Trading Networks, Monopoly and Economic Development in Medieval Northern Europe: an Agent-Based Simulation of Early Hanseatic Trade

*Ulf Christian Ewert**
Helmut Schmidt University, Hamburg

Marco Sunder
University of Leipzig

Paper prepared for the 9th European Historical Economics Society Conference,
Dublin, Ireland, September 2–3, 2011

Abstract

That Hanseatic merchants of the late Middle Ages relied on multiple kinship and friendship networks to handle their business is well established. The majority of these merchants had settled down and operated their trade from their hometowns. They committed to reciprocal exchange with relatives and friends at distant markets, often without formal contracts, and their trading networks were based on reputation, trust and culture. Little is known, however, on the emergence of this Hanseatic trading system in the high Middle Ages, a period characterised by a significant migration into the Baltic region and the foundation of numerous towns alongside the Baltic sea's southern shore. Against the backdrop of severe data limitations, we develop – and analyse the predictions of – a simple agent-based simulation model of Hanseatic trade. We ask how the network pattern of Hanseatic trade could have emerged and developed before the turn of the 13th century, in which way the unfolding of network-based trade might have contributed to the economic development of the Baltic region in this period and whether development paths other than that of an emerging network organisation would have been viable solutions as well.

Keywords: network organisation, multi-agent model, Hanse, medieval trade
JEL classification: N73, C63

I. Introduction

Hanseatic network trade and the rise of the Hanse

Concerning the history of medieval trade in general, the institutional arrangement observed in late medieval Northern European trade is to some extent a special case. This trade was dominated, if not to say monopolised, by the merchants of the Hanse, and the persistence of their network-based trading pattern until

* Corresponding author. Address: Ulf Christian Ewert, Helmut-Schmidt-Universität / Universität der Bundeswehr Hamburg, Fakultät für Geistes- und Sozialwissenschaften, Holstenhofweg 85, 22043 Hamburg, Germany; e-mail: *uce@hsu-hh.de*.

the end of the Middle Ages and beyond is quite astonishing. Avner Greif analysed a similarly structured trading system of the so-called "Maghribi Traders" who operated in the 11th century at the southern shore of the Mediterranean (Greif 1992, 1993), but in the late Middle Ages a setting like this appears unusual. While elsewhere in Europe during the so-called "Commercial Revolution of the Middle Ages" merchants had already invented sophisticated techniques, formal contractual schemes and organisation patterns to handle risk capital, to operate cashless payments and to transmit market information quickly via huge distances (Lopez 1976; Epstein 2009), many of these elements were only poorly developed or even missing in the Hanseatic world. In 14th and 15th centuries, but even still so in the early 16th century, German-speaking merchants from the Baltic and the North Sea area (the Hanseatics) traded with each other on the basis of mostly informal, only implicitly defined contracts, and usually they had only a small amount of capital at hand (Selzer and Ewert 2001; Ewert and Selzer 2007, 2010). Hanseatic trade was based upon the privileges these merchants had obtained in London, Novgorod, Bruges and Bergen. The Hanse, like the entire merchant community was named, founded *Kontore* in these important markets (von Brandt 1963; Bracker 1989). The Hanseatic trading system was instrumental in bringing the "Commercial Revolution of the Middle Ages" to the North of Europe (Hammel-Kiesow 2000, pp. 52–53; Selzer 2010, pp. 30–40). Hanseatic merchants delivered all sorts of goods to the consumers in the towns that had begun to flourish in the entire Baltic area (Selzer and Ewert 2001; Selzer 2010, pp. 95–97). During the late Middle Ages, Hanseatic merchants defended their major trade privileges successfully, and even though they had neither formed large firms nor adopted the, by that time, state-of-the-art trading techniques, they enjoyed a nearly perfect trade monopoly in the Baltic, at least until the turn of the 15th century.

How did this rather simple trading system – which enabled Hanseatic merchants to dominate Northern European trade so extensively – evolve, and why did it survive for such a long time? An often told explanation of the rise of the Hanse is fairly straightforward. Starting with the foundation of Lübeck in 1143 by count Adolf II of Holsatia, and again in 1159 by the Saxon duke Henry the Lion (Hammel-Kiesow 2000, pp. 27–30), merchants from Lower Germany attempted to get the already existing trade in the Baltic region under control, and then connected it with the trade routes in north-Western Europe, excluding in the process potential competitors by obtaining trade privileges in London, Novgorod, Bruges and later on also in Bergen.

As a matter of fact, the pronounced teleological character of this standard explanation was recently questioned, stating that for instance the foundation of Lübeck cannot be taken as the one and only initial point of the Hanse's commercial conquest of the Baltic Sea, since the town was originally founded for objectives in regional trade only (Jahnke 2008, 2009).

Moreover, apart from observing demographic and economic development as well as some fundamental structural changes before the turn of the 13th century there is only scant evidence on the period of the early Hanse. By 1300, immigration from the West into the Baltic region was almost completed, and all the towns at the southern Baltic coastline which later on belonged to the Hanseatic League had been founded. The economic expansion of these newly founded towns and their hinterland was already under way. Hanseatic merchants had ousted competitors from long-distance trade in the North Sea and the Baltic, and by and by monopolised commercial exchange. In the process, the majority of them changed their trading practice from active trade, where they travelled around and carried their goods to the markets, to a kind of passive trade, where they now operated their business as residents of the Hanseatic towns with the help of commercial agents. Exactly in this early stage of Hanse history, and maybe also because of these developments, Northern Europe saw an unprecedented economic take-off.

Agent-based simulation approach

As only little information on specific merchants from the period before the turn of the 13th century has survived, it is neither clear how the closed family-based commercial networks – which are so typical for Hanseatic trade after 1300 – were built nor why they had been formed at all, and whether or not they contributed to the economic development of the Baltic area. The objective of the paper is to illustrate possible paths of the emergence of a network structure in long-distance trade that in the Hanseatic case can only be traced in the surviving historical records after it had already been formed (c. 1300).

In order to compensate the almost missing data for the period before this date, we pursue an agent-based simulation approach. This technique has previously been applied in demographical research, sociology and economics, but rarely in historical research (Doran 1996; Epstein and Axtell 1996; Epstein 1999;

LeBaron 2000; Billari and Prskawetz 2003).[1] Resorting to simulation methods in historical research may be justified for the simple reason that a key characteristic of observed historical cases and facts usually is its singularity, meaning that history happened only once and can thus not be repeated. This notwithstanding, simulation allows us to construct alternative scenarios which could have happened in the past as well, and these kind of "what-if-scenarios" are useful to put the known historical facts into a well-defined context (Ewert 2007). Simulation is thus not an alternative means to historical interpretation. It is, in contrast, a method to foster interpretation, especially if empirical data are rare or almost missing, as it is the case with early Hanseatic trade.

An agent-based simulation approach is chosen here for two further reasons: firstly, trade in general needs more than one merchant to happen, and single merchants only had limited access to the commercial information on which to base their decision-making. As a consequence, it is necessary to allow for individual decisions, so that in the end an observable complex macro-structure like the pattern of commercial exchange emerges from the various individual activities of agents (merchants) at the micro-level (Doran 1996; Epstein and Axtell 1996). Secondly, geography and geographical differences in the disposal of resources and in economic specialisation are important factors for the emergence of a trading system, so that different agents (merchants) need to represent this kind of economic variety.

Structure of the paper

The remainder of the paper is organised as follows: section II describes the structure of Hanseatic trade networks and how they functioned. Section III provides a short overview of the determinants of the rise of the Hanse that are discussed in the literature. Section IV describes our simulation model and Section V analyses its predictions in different scenarios of trade privileges and transportation costs. Section VI provides a discussion of results and concludes.

---

[1] Cf. Ewert 2007 for some general considerations concerning the issue and Ewert, Roehl and Uhrmacher (2001, 2003, 2007) for an application to long-term demographic and economic consequences of mortality crises in pre-modern urban communities and the assessment of strategies and devices to manage such crises.

II. Structure and functioning of late medieval Hanseatic trading networks

Structure of trading networks

To get along with heterogeneous commercial environments in Northern Europe, late medieval resident Hanseatic merchants relied on trading networks of different size, varying density and endurance (Selzer and Ewert 2001, 2005, 2010; Ewert and Selzer 2009, 2007, 2011a). These networks were medium-term or long-term co-operations of legally independent merchants, who were often related to each other or were attached to each other through friendship relations (Sprandel 1984; Stark 1993). The core structure typically consisted of mutual transactions between two partners at distant locations, each partner selling the other partner's goods. These co-operations neither needed formal contracting nor have they been exclusive, and a selling merchant was usually not paid for taking the commercial risk entailed with the sale. Numerically, reciprocal trade was by far the most important pattern of commercial transaction between Hanseatic merchants (Mickwitz 1937, 1938; Sprandel 1984; Stark 1993; Cordes 1998, 2000).[2]

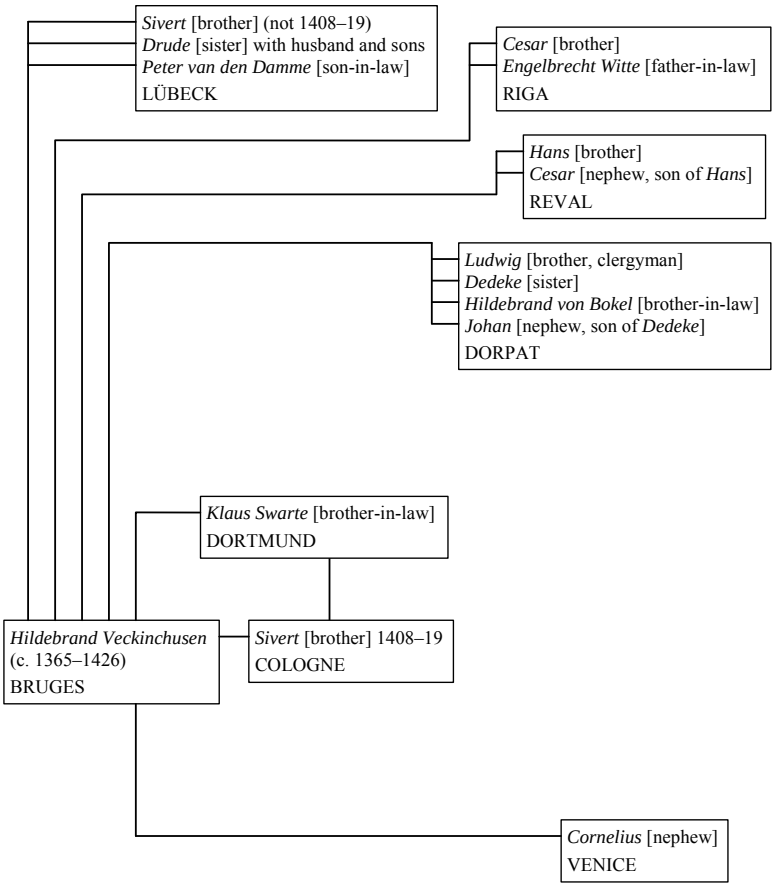
Information on the structure of trading networks can be drawn from different types of sources: a series of wills reveals the commercial relationships of a group of merchants from Lübeck and Stockholm in 1350, the year of Black Death (Koppe 1933; Cordes 1998). Account-books are preserved for the merchants *Johann Pisz* from Danzig, *Vicko von Geldersen* from Hamburg and *Hermann* and *Johann Wittenborg* from Lübeck, that of *Johann Pisz* covering a period of about 32 years (Sprandel 1984, Stark 1985). These sources show that a merchant could have up to c. 40 trading partners in a period of about 30 years, and the cooperation with a single partner could last up to 22 years. Trading partners can be classified into family members, friends and occasional partners. Core partnerships – i.e. stable and persistent exchange relationships with a high frequency of mutual exchange – are thought to coincide significantly with family ties (Li 1998). The existing Hanseatic sources support this notion.

---

[2] There also existed the *sendeve*, a kind of commission business. In this well defined contractual scheme the commission agent sold the goods he had received from another merchant by order and for account of the partner who had formally instructed the sale and had sent the goods to the commission agent, with profits and risk remaining with the sender (Cordes 1998; 1999).

An instructive example for such a reliance of Hanseatic merchants on kinship networks and the different business operations that coexisted among the Hanseatics is the family network of *Hildebrand Veckinchusen*, which can be reconstructed from surviving account-books and letters of his family (Figure 1). From Bruges, where he lived in the beginning of the 15th century, he traded regularly (on the basis of reciprocal relationships) with his brothers, his cousins, his father-in-law, his nephews and some of his friends in Lübeck, Danzig, Riga, Reval and Dorpat (Irsigler 1985; Stark 1993; Cordes 1998; Greve 2002; Selzer 2010, pp. 122–124; Ewert and Selzer 2011b). In addition, he was part of a formal society through which he operated his trade with Cologne (Schweichel 2001). Burkhardt (2009) documents many other networks of Hanseatic merchants in the late Middle Ages.

Figure 1: The family network of *Hildebrand Veckinchusen*



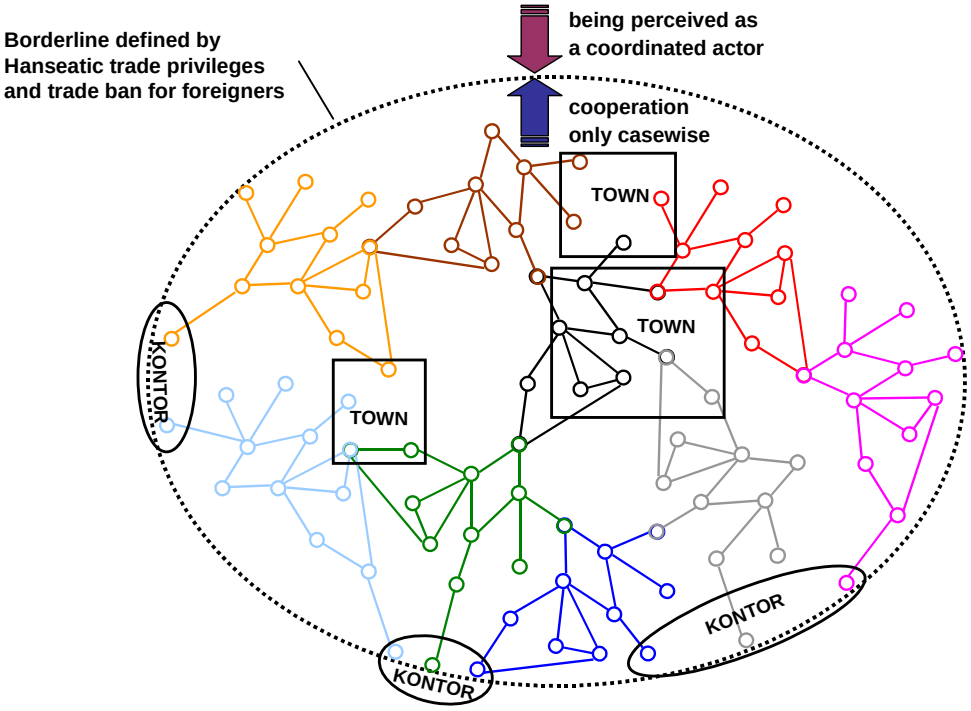
Remarks: Graph of the ego-centered family network of *Hildebrand Veckinhusen* showing trading relationships and the geographical diffusion of the *Veckinhusen* family.
Source: Ewert and Selzer (2011b), based on Irsigler (1985, pp. 75–99) and Stark (1993, pp. 191–201).

Yet, the Hanseatic network organisation of trade was more than only a simple overlap of family and business circles. Mutual relationships between Hanseatic merchants and their social proximity to each other can be grasped from their joint memberships in town councils, in merchant societies and merchant associations (Dünnebeil 1996; Selzer 1996; Asmussen 2002; Burkhardt 2009), from their nearby lodging in Hanseatic towns (Hammel 1985; Igel 2005) and from their mutual choice of one another as future executors of their wills (Meyer 2002, 2003; Ewert and Selzer 2011b).

Kinship-based trading networks and network organisation

The organisational pattern that had evolved through the trading activities of Hanseatic merchants is quite typical for a network organisation (Selzer and Ewert 2001, 2005, 2010; Ewert and Selzer 2006, 2007, 2009). Such an organisation is defined as a loose cooperation of legally and economically independent entities. Through "networking" a "new" structure evolves which constitutes the framework for potential co-operations between the members of a network. In theory, this "new" structure, the inter-organisational network, possesses no hierarchical levels and is not controlled by headquarters. Rather, co-operations between network members may be thought of as voluntary and flexible couplings (Powell 1990; Illinitch et al. 1996; Osborn and Hagedoorn 1997; Windeler 2001). Small-scale businesses of self-employed merchants with little financial power formed such networks by mutually cooperating in reciprocal trade. The entire Hanseatic League, an alliance of towns under the leadership of Lübeck that in the late Middle Ages became prominent as a kind of superstructure to the Hanseatic network organisation, could never really fulfil the function of a headquarter, despite several attempts of Lübeck to do so (Wernicke 1983, Henn 1984, Pitz 2001). As a result – and also because merchants fiercely defended the Hanseatic trade privileges they enjoyed at the *Kontore* – contemporary foreign traders recognised their Hanseatic competitors as belonging to a seemingly well-defined and also well-coordinated group, which in reality was rarely the case. Figure 2 sketches the network organisation of the late medieval Hanse and its somehow distorted perception by non-Hanseatics.

Figure 2: Structure and perception (by non-Hanseatics) of the late medieval Hanse



Network coordination and cost efficiency

From a theoretical perspective, Hanseatic trading networks are quite interesting. Bilateral exchange between the members of these networks was based on an informal consensus, in most cases without headquarters that would have been capable of coordinating and controlling the activities of the numerous network participants. Moreover, as network members were allowed to trade with many partners all over the Baltic area, the network structure was characterised by both cooperation of its members and a time-wise and case-wise competition between them.

As a result of hierarchies not being clearly defined within traders' networks, coordination of the activities of merchants was not possible by hierarchical means in general. Instead, these activities were coordinated by culture, trust and reputation. Such means of coordination are often assumed to compensate for a missing hierarchy (Powell 1990; Galaskiewicz 1996; Staber 2000).

Belonging to a broader family, sharing common values and speaking the same language facilitated exchange between Hanseatic merchants considerably. Outside families cultural correspondence between network members was established and maintained by institutions and social events that allowed network

members to socialise with each other. The "Artus courts" in the Baltic area (Selzer 1996) and the *Zirkel-Gesellschaft* of Lübeck (Dünnebeil 1996) are good examples of institutions where rich merchants and political leaders of the local town met guests from other towns and celebrated festivities.

These institutions were also important for the enforcement of fairness within commercial networks, since they allowed information on the reputation of individual network members to be distributed across the entire network (Selzer 2003, pp. 84, 96–97). Having a high reputation was essential to all members of in these networks, and not to lose it was the primary incentive for acting fairly, as cheating not only defected the relationship with the betrayed partner but it also resulted in a loss of access to the whole network and thus undermined other possible partnerships in the future. While commercial information had to be transmitted quickly to control particular trade operations, slower transmission channels were sufficient in the case of information on reputation for preventing fraud among merchants. The multilateral reputation mechanism – which was similar to the one Hanseatic merchants used for interactions with foreign rulers at the *Kontore* – was able to solve problems of free-riding, so that reciprocal trade without entering into formal contracts and without assuming speedy communication lines was a viable and self-enforcing mode of commercial exchange (Greif et al. 1994; Streb 2004).

Moreover, mutual trust between partners allowed Hanseatic merchants to leave with their respective partner the collection and processing of information relevant for sales operations on foreign markets. Due to the employment of partners as commercial agents (and thereby making use of the their commercial expertise), Hanseatic merchants were not specialised in trading only a particular commodity. As a result of both networking strategy and coordination of merchant activities by culture, reputation and trust, the Hanseatic network organisation of trade had a fairly lean governance structure. It provided its network members with a certain degree of flexibility at only moderate costs of transaction, information and organisation (Ewert and Selzer 2009, 2011a). The kinship- and friendship-based network always offered opportunities to establish commercial contacts inside the broader Hanse, and it allowed all Hanseatic merchants to profit from the supply of goods at the markets of Bruges, London, Bergen and Novgorod, since the commodities traded on these markets could easily be reached by almost all members via relatives or friends that lived and traded there.

III. The rise of Hanseatic trade: when, where, and why?

Merchant groups, trading voyages and privileges in the early period of the Hanse

How did this simple structured, but nonetheless highly efficient trading system evolve? There is only little archival evidence for the rise of Hanseatic trade, so knowledge concerning the early period of the Hanse is fairly easy to overview. Long-distance trade in Northern Europe existed long before the appearance of Hanseatic merchants and was organised similar to long-distance trade in other regions of the continent. It was an active form of trade in the sense that merchants brought their commodities to the markets in person. Due to the geographical characteristics of Northern Europe with many open waters and extended fluvial systems, this commercial exchange was conducted by sea or river trade. Both in the North Sea region and in the Baltic region markets were held at numerous emporia, e.g. Hedeby, Ribe, Birka, Old-Lübeck, Daugmale, Reric and Starajo Ladoga. These trading posts were located at rivers nearby the sea and functioned as interfaces between sea trade and river trade, allowing for a further distribution of goods into the hinterland. Most of these emporia were only seasonally frequented (Sawyer and Sawyer 1993, pp. 144–149).

In connection with this long-distance trade the term "Hanse" was used well before the high Middle Ages, and it had different meanings. In particular, three of them can be distinguished. Firstly, the term describes the participants or, more precisely, the comrades of a trading voyage abroad, who for this purpose usually travelled in convoys. The Latin equivalent to this meaning is *cohors*. Secondly, the right to take part in such a voyage was also termed "Hanse". And thirdly, the term encompassed the duty or fee that had to be paid by the comrades of a trading voyage.

In its meaning of describing distinct groups of merchants who jointly undertook trading voyages on a regular basis, the term "Hanse" can sporadically be found in the surviving sources prior to 1200, e.g. for merchants of the town of Soest in Westphalia who regularly went to the market of Schleswig (1161), but more often in the 13th century, as for instance for the merchants from Cologne who frequented markets in Denmark (*fraternitas Danica*, 1246) or for merchants from Riga, Visby, Lübeck, Soest, Münster, Dortmund and Bremen who traded in Visby on the isle of Gotland (*universitas mercatorum Romani imperii Gotlandium frequentatium*, 1229) (Hammel-Kiesow 2000, p. 47). The dates refer to the oldest surviving source,

respectively, so a longer existence of these *cohortes* can be assumed. It was only in 1282 when the English king Edward I renewed and improved a trade privilege for German merchants, that the term "Hanse" (or "Hansa") was used to name all of the German-speaking merchants trading in the North Sea and in the Baltic Sea as *mercatores de hansa Alemania* ("merchants of the German Hanse") (Hammel-Kiesow 2000, p. 27). Before that time, only a few Hanseatic merchants are known in person and can provide a spotlight on the situation in the 12th and 13th centuries (Hammel-Kiesow 2000, pp. 38–44). However, most of the archival evidence points to the political influence of these merchants and does not describe their commercial business. E.g., a group of rich Cologne merchants seem to have influenced the election of Otto IV to roman kingship in 1198. In the second half of the 12th century, *Gerhard Unmaze* was a minister of the archbishop of Cologne and also worked as lay assessor, customs officer and officer of the so-called *Richerzeche*, a prominent and very important contemporary merchant guild of Cologne. Another Cologne merchant, *Terricus Teotonicus*, was an officer of the English king Henry III and administered the fairs at Stamford. There is some evidence that he also became the first *aldermann* ("oldest man") of the German merchants living in London, a position that was created to oversee this group of traders. From 1251 onwards, *Arnold Fitz Thetmar*, who had origins in both Bremen and Cologne, served in this position as *alderman*. He was a strong supporter of Richard of Cornwall in his election to roman king, a tactic that earned both merchants of Bremen and Cologne improved trade privileges for their trade in England.

Environmental and structural changes in the high Middle Ages

The main result of economic development in Northern Europe up to the 14th century was the emergence of a trading system that linked the originally less developed, agricultural regions in the North and in the East to Western Europe, which was already densely populated and quite well advanced in commercial terms. Trade was based on the exchange of raw materials and food stuffs of the northern and eastern regions for western finished products and consumables. A plausible explanation for the rise of the early Hanseatic trading system builds on three factors: the integration of the Baltic area into European trade after the Christianisation of Scandinavia and parts of the north-eastern Baltic area, an increase in consumption due to accelerating

population growth after 1100, and finally the foundations of most of the towns in the Baltic area after c. 1150 (Hammel-Kiesow 2000, pp. 21–26).

Prerequisites for the integration of Northern European trade into the existing trading system in Western Europe after the turn of the first millennium were on the one hand the Christianisation of Scandinavia (Sawyer and Sawyer 1993, pp. 100–128), which created cultural similarities between northern and Western Europe, and on the other hand the breakdown of Scandinavian trade with eastern Europe and Asia after 1030 due to political shifts in the East (Noonan 2001, pp. 160–165). Scandinavian traders were therefore keen to exploit new markets for their goods, e.g. furs, copper, iron or the ivory of walruses. The new customers for these Scandinavian goods lived in the quite densely populated areas in the Northwest of Europe: Flanders, Northern France and southern England. By the 12th century, merchants from all across the Baltic region – including people from the isle of Gotland and from Prussia as well as Russian, Slavonic and Swedish people – were actively involved in Northern European trade (Sawyer and Sawyer 1993, pp. 154–155; Hammel-Kiesow 2000, p. 28).

A vital point in the process of integration of Scandinavian trade into a broader European trading system was the fact that merchants from Westphalia, Friesland and the Lower Rhine region, who reached the southernmost Scandinavian market of Schleswig (which after 1000 had succeeded the older nearby trading post of Hedeby) either by land or across the North Sea, obviously obtained control over the trade with northern and eastern goods on their way into the hands of Flemish merchants and their respective western customers. Over the course of time, Flemish traders lost their right to trade in person the goods from the West (mainly metal goods and cloth) into the Baltic area. Likewise, Gotlanders were not able to travel from the Baltic to the North Sea (Sawyer and Sawyer 1993, p. 161). In this respect, Lower German merchants became the element that linked Northern with Western European trade.

Medieval population growth presumably played a key role for the changes that trade and the trading system underwent in Northern Europe in the 12th and 13th centuries. Rising population in the already developed and commercialised western regions resulted in tremendous increase in demand for foodstuffs and raw materials in these regions. Then, with a significant migration to the developing regions in the East and a melioration of land there, both capacities of agricultural production and consumption levels in the East

increased. Both factors likely contributed to both the emergence of a new trading system and to the further economic development of the northern and north-eastern regions of Europe (Hammel-Kiesow 2000, pp. 23–24).

A vehicle for the establishment of trading relationships and for the economic development of Northern Europe was the foundation of numerous towns, mainly along the southern shore of the Baltic sea. Before the turn of the 13th century, all the towns at the southern Baltic coastline – which later on became more or less formal members of the Hanseatic League – had been founded and given written community law by local rulers, princes or other authorities such as the Teutonic Order. Beginning with the foundation of Lübeck in 1143/59, the series of foundations and town law assignments – of which the most prominent examples are Rostock in 1218, Danzig in 1224, Wismar in 1229, Stralsund in 1234, Elbing in 1237, Stettin in 1243 and Königsberg in 1255 – continued for roughly a whole century. These towns were permanent markets and obviously offered better business opportunities to merchants than the older emporia (Hammel-Kiesow 2000, p. 24).

With the appearance of the Hanseatic League in the middle of the 14th century, the rise of the Hanse and of the Hanseatic network-based trading system were completed. This appearance also stands for the political meaning of Hanse, which it obtained in the late Middle Ages. This becomes obvious when in 1358–60, following a controversy over trade privileges in Bruges, Hanseatic merchants moved their *Kontor* from Bruges in Flanders to Dordrecht in Holland in order to force the count of Flanders to improve the trade privilege of Hanseatics in Bruges. This episode marks an important turnaround in the history of the Hanse, because the conflict and the merchants' reaction to it are indicators of a significant change of the Hanse's organisation. For the first time, *Kontore* and towns cooperated under the leadership of Lübeck in a coordinated manner to enforce their commercial interests. The previously loosely linked group of merchants now possessed a kind of superstructure (Selzer 2010, pp. 45–52), although this superstructure could never fully control individual merchants' commercial activities. However, Hanseatic merchants as well as Hanseatic towns used this structural element to enforce their commercial interests and their quasi-monopoly in Northern European trade.

Were rise of trade and monopolisation strategic attempts?

From hindsight, the rise of Hanseatic merchant networks and the monopolisation of Baltic trade by this group of traders may appear to be the proper and logical result of a carefully prepared and executed master plan. The outward appearance of the late medieval Hanse as a kind of commercial super-trust or a state of cities, and the further misjudgement that it had been like this already in 12th and 13th centuries, might support the (implausible) idea that both the establishment of the Hanseatic trading system and the success of Hanseatic merchants could be explained by a single rationale.

Yet, a more plausible explanation would recall the many individual short-term rationales of early Hanseatic merchants, by which first steps towards the establishment of a network-based trading system could be realised. These early developments in turn opened up new opportunities for ensuing generations. With this more realistic approach to Hanse history, which is taken in the newer strand of literature (Hammel-Kiesow 2000; Jahnke 2008, 2009; Selzer 2010), even the key elements of the master plan explanation of Hanseatic rise and success – the assignment of trade privileges and the foundation of Lübeck – are now judged differently. The town of Lübeck was not founded as the future gateway for merchants from Lower Germany to the Baltic area that it would become later, but rather as a competitor to the market of Schleswig and for controlling the salt and herring trade in the region. Similarly, the trade privileges in London, Novgorod and Bruges that were so important for Hanseatic trade, had originally been assigned to merchants of single towns, who only later on extended these privileges to a much wider group which then included merchants from other towns. Agent-based modelling takes such individual rationals into consideration.

IV. A simulation model of medieval sea trade

The world and its population

We set up a simulation model for the analysis of the rise of Hanseatic trade and its network characteristics. The simulation model considers a square world with 64 towns arranged akin to the fields of a chess board. Each town has an initial population of n = 1 000, and there are two goods: food (F) and cloth (C). We assume equal distribution among the citizens of each town and define a town's welfare as $W = \sqrt{F \cdot C}/n$. A limited amount of both goods is produced and consumed autonomously in each town, irrespective of population size.

We set this amount to 30 for both types of goods. Larger amounts may become available if there is a merchant in the town. While the world population is fixed in the model, towns with higher welfare attract population from neighbouring towns. However, only a small fraction (c. 5%) of the entire welfare-equalising migration occurs within a period to ensure that larger towns may persist even through short periods of lower welfare. Migration takes place only at the end of each period of the simulation, after production and trade have taken place (Figure 3).

The role of merchants

Merchants are the agents in our model. We assume that no more than one merchant can settle in a town. This position requires the payment of a lump sum tax, which is subtracted from the merchant's wealth in each period. Our simulations set this tax to 500 units. Wealth can be increased by selling goods to the local population and/or by engaging in long distance trade with other merchant towns. Each merchant produces one of the two goods, according to the specialisation of the town. The amount of production is a function of the local population size:

$$X_i^{prod.} = S_i \cdot n^{\beta} \text{, with } X_i \in \{F^{prod.}, C^{prod.}\}$$

The dichotomous variable S_i takes on the value 1 in the case of food (cloth) production in a town with specialisation in food (cloth), and 0 otherwise. In all simulations below we set $\beta = 0.6$, i.e. there are diminishing returns to town size. After production, the merchant may sell the produce locally and/or engage in long-distance trade with merchants in distant towns. For the latter purpose, each merchant possesses one ship which can carry a limited amount of the good in which the town of origin is specialised. The capacity limit is set to 30 units of one of the two goods in the simulations below. Selling the produce locally encompasses both selling it to the local population and to other merchants whose ships may have arrived in the local port. No trade is possible with towns that do not have a merchant.

A merchant's decision whether and whither to send his ship away – and whether cargo should be loaded on the way to the distant town and/or the way back – depends on the expected profit of the round-trip, considering opportunity costs in the sense that the produce could also be sold at home. Every second stint of a trading voyage has to have the home town as destination, i.e. the merchant does not solve more complex

travelling salesman problems. Profit expectations depend on the beliefs about prices in all merchant towns, including the merchant's home town. Each merchant has his own set of price beliefs for each town. They depend both on his own experiences and on rumour he heard in the past. While price signals from distant towns are received with noise, those from his home town or the town where his ship is currently located are received without noise once all transactions of a period have been settled. He also uses the price belief for the home town when deciding upon his trade strategy. This implies that his strategy does not account for the cargo of ships sailing towards his home town. The (expected and actual) net-returns of a trading voyage furthermore depend on distance-based travelling costs and a fee that merchants of distant towns charge from the ships entering their harbours. Having completed a round-trip, the owner of a ship also updates his belief about the net-returns for the respective destination town by calculating the difference between actually realised and originally expected returns. Such deviations from the original plan may arise, e.g., from supply limitations in the destination town.

We assume that the price a merchant believes to realise in his home town is also the price he charges other merchants when they purchase goods from him to load on their ship. The other party will always accept this price, without second thoughts. Ships that unload cargo sell their goods to the local population – as does the local merchant if he sells his own produce at home. In this type of transaction, the price is a function of the entire quantity supplied in period *t* by autonomous production, incoming ships and the local merchant. To avoid abrupt jumps in price volatility, we introduce an autoregressive component and set

$$p_{X_i,t} = \alpha \cdot m/(2X_i) + (1-\alpha) \cdot p_{X_i,t-1},$$

where $X_i \in \{F,C\}$. The parameter *m* reflects the town's long-run budget, which depends on the size of the population. We set $m = n$ and $\alpha = 0.5$ in all simulations.

Merchant demography and trade dynasties

Due to the lump sum tax or due to misconception about the net-returns from long-distance trade, a merchant's wealth may become negative. In such a case he disappears from the world, thereby providing an "empty" town for a new merchant. Ships arriving at a town whose merchant has just disappeared will return to their home town and sell their cargo there.

New merchants may come into being either by instantaneous creation or as an offshoot of an existing merchant. In both cases, the new merchant is equipped with an initial wealth of 1 000 units. Each period of the simulation in which there is at least one empty town with a specialisation in cloth production sees the instantaneous creation of exactly one merchant in one of these empty towns (chosen randomly). Such a merchant forms a new trade dynasty. His beliefs about the prices of goods in the various towns are vague: simply median prices plus some noise. Offshoots, in contrast, belong to the dynasty of their parent merchant, from whom they are furnished with their initial wealth (also 1 000 units) and also with initial beliefs about goods prices. Offshoots occur in an empty town nearby the parent, irrespective of the town's specialisation. This sort of birth of new merchants forms the basis of trading networks in our model. Irrespective of wealth, a merchant disappears after his 50th period of existence. In this case, a nearby merchant of the same trade dynasty (if there is any) inherits his wealth.

Apart from the possibility to inherit wealth, we assume further potential advantages of belonging to a network of merchants of the same dynasty: price signals from same-dynasty towns are received with a lower noise component, no fees are levied from ships sailing to a town whose merchant belongs to the same dynasty as the ship owner, and ships from the same dynasty as the local merchant are granted preferential access to buying cargo for their trip back home.

Implementation

We implement our model with the software NetLogo, version 4.1.3 (Wilensky 1999).[3] The steps laid out in Figure 3 form the basis of one period of the model. One round-trip of a ship takes two periods in the model.[4] Given medieval trading patterns, two periods roughly correspond to a year. In the following analysis of the model we always start with a town grid of equal population size and with no merchants. Half of the towns are specialised in cloth, the other half in foodstuffs. One "replication" consists of running 600 periods of the model, which should provide enough time for networks to emerge and evolve. We then run 250 replications

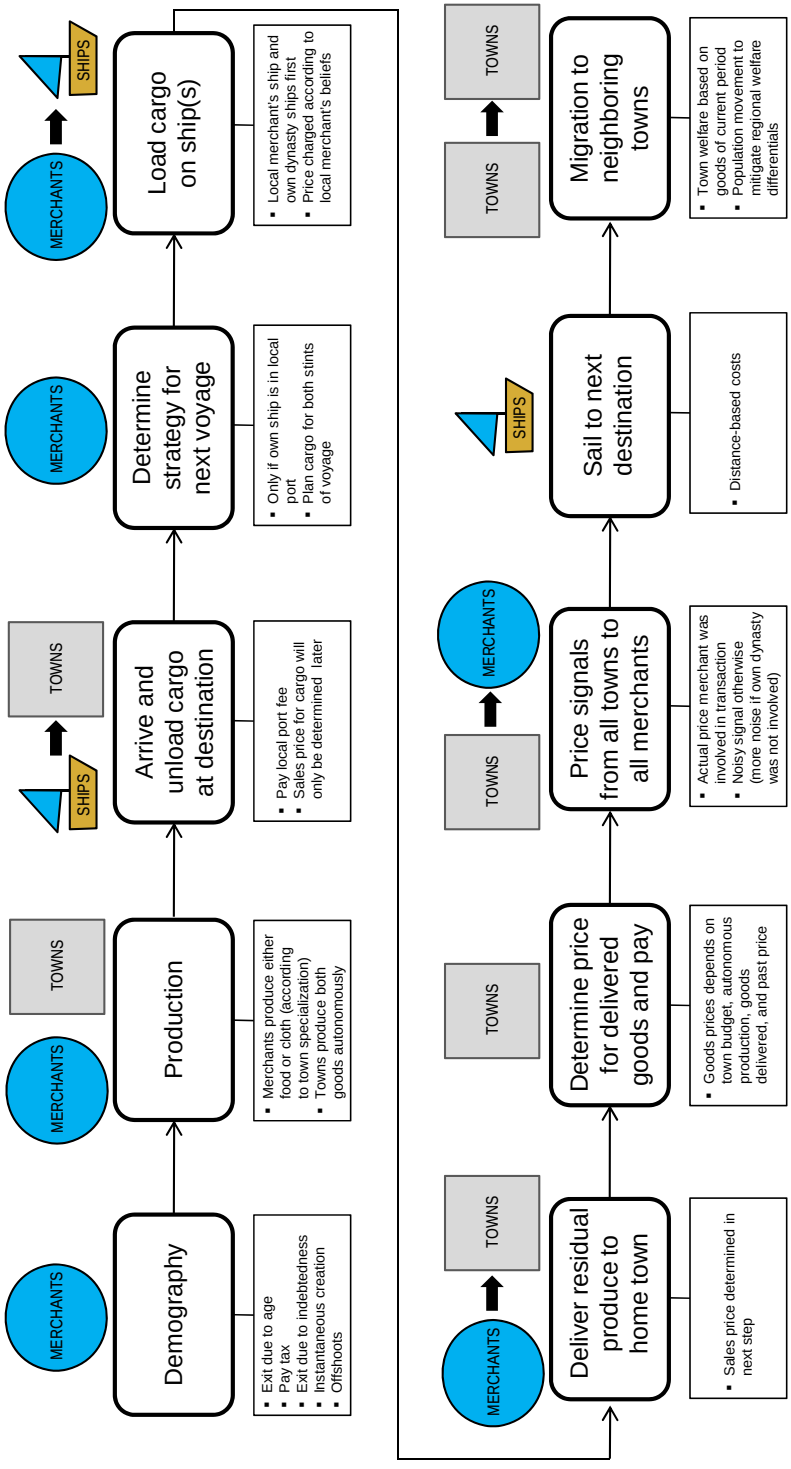
---

[3] The reader is invited to run the model with a JAVA-equipped browser or download it at *http://www.wifa.uni-leipzig.de/fileadmin/user_upload/iew-vwl/Docs/Sunder/seatrade.html*

[4] When a ship sails back home with cargo, this cargo will only be unloaded in the third period. However, it can already load new cargo in the third period, which thus marks the beginning of the next round-trip.

of these histories to obtain an understanding of the "typical" course of events and their distribution. Furthermore, we repeat this process with different parameter settings and compare the outcomes of these different scenarios.

Figure 3: Flow-chart of one period of the simulation model



V. Simulation results

Baseline scenario

The presentation of simulation results first covers a scenario which we refer to as "baseline scenario". It is calibrated in such a way as to reflect some conditions of the region at stake in the 11th to 13th centuries. The specialisation of towns follows an east-west pattern in the baseline scenario: cloth specialisation is available in the western half of the map, food in the East. We specify a very high fee (of 350 money units) to trade in towns that do not belong to a merchant's own family network. This basically curtails trade across dynasty boundaries. Furthermore, transportation costs is set to 40 money units per unit of distance, which is high enough for location to be a relevant factor in trading strategies. We discuss the outcomes of the simulation in terms of a set of indicator measures that reflect the structure of the trading system, economic development and welfare effects.

(a) The structure of the emerging trading system is measured in terms of

- the *network density*, defined as the ratio of all family ties to all ties possible,
- the *dominance of the largest network*, defined as the ratio of ties within the leading family network to the aggregate number of ties occurring in all other families,[5]
- the *population share* associated with towns of the leading family network,
- the *persistence of leadership,* defined as the propensity of the largest network in period $t = 400$ to hold this position also in period $t = 600$
- and the median period of the *first occurrence of a family network* consisting of at least five merchants, a proxy for the speed of network formation.

(b) Economic development of the simulated world is captured in terms of

- the *number of merchants*, a proxy for commercial development,
- the *share of ships sailing*, a measure of the importance of long-distance trade,

---

[5] The "leading" family network is defined as the largest (in terms of head-count) group of merchants of the same dynasty.

- the *number of merchants in food towns*, indicating the expansion of trade into the agricultural regions,
- and the *concentration of population*, calculated as the concentration ratio of the population shares for all towns, which indicates how unevenly population is eventually distributed across the grid. If the entire population lived in a single town, the concentration ratio would assume the value 1, and it is 0 in the case of a perfectly even distribution across towns.

(c) Measures for welfare are

- the per period *population-weighted welfare* (of all towns),
- the *wealth of the leading network*, which indicates the economic success of this family network and can be taken as a proxy for the monopoly rent that can be earned,
- the (cumulative) *profit due to long-distance trade*, indicating economic gains of sea trade since the very first period.

Unless specified otherwise, the measures refer to the final period of each run ($t = 600$). As the model contains stochastic components – such as the initial placement of merchants or the noise in their price beliefs – outcomes of the simulation may not be deterministic. Table 1 presents means of the indicators along with the respective 95% confidence interval on the basis of 250 replications (Table 1).[6]

The baseline scenario predicts the emergence of a network-based trading pattern with a dominant leading family in the majority of cases. With an average of 0.58 the network density is quite high and mostly due to the single leading network (99%), which indicates a high degree of network organisation among merchants. On average, the towns belonging to the leading family network hold almost 58% of the entire population. Furthermore, this leading role of one family network remains quite unchallenged over the course of time: the leading merchant dynasty of period 400 will be in this position in 89% of the cases in period 600 as well. Networks are formed considerably early: in the median case, a family network of (at least) five

[6] To be sure, the mean may not necessarily reflect the "typical" outcome if the underlying distribution is not unimodal.

merchants can be observed for the first time in period 72. The map shown in Figure 4 represents a typical outcome of the simulation model after 600 periods.

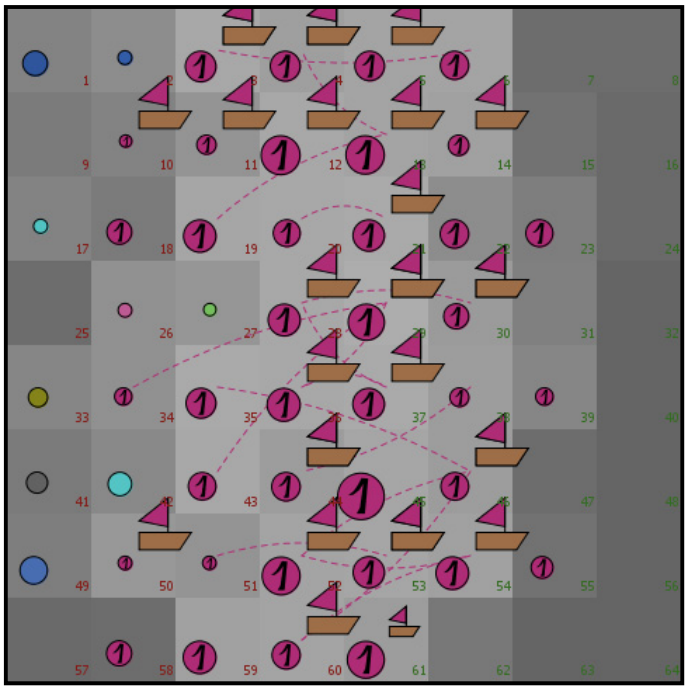
How does this network structure affect economic development and welfare? In the final period of the simulation there are 42 merchants on average, i.e. two thirds of all towns have a merchant. Since, on average, 17 of them occupy food towns on the grid (i.e. about half of the 32 possible towns), expansion to the agricultural regions does occur to a considerable degree in the baseline scenario. On average, 60% of all ships actually sail in period $t = 600$ (most of which belong to the leading family network). Thus, long-distance trade is quite important in the baseline scenario. The welfare measures of the model can hardly be interpreted in absolute terms, but what can be seen is an increase in the early stages of a simulation run and a persistence of this level thereafter (Figure 5).

Table 1: Simulation results for the baseline scenario, based on 250 replications

	mean ($t = 600$)	95% confidence interval lower bound	upper bound
STRUCTURE OF TRADING SYSTEM			
network density	0.58	0.56	0.61
dominance of largest network	0.99	0.99	1.00
population share associated with the leading network	0.58	0.56	0.60
persistence of leadership	0.89	0.85	0.93
period of first occurrence of a family network with ≥5 merchants	72*		
ECONOMIC DEVELOPMENT			
number of merchants	42.5	41.9	43.1
share of ships sailing	0.60	0.57	0.62
number of merchants in food towns	17.02	16.32	17.72
concentration of population	0.00098	0.00097	0.00100
WELFARE			
population-weighted welfare	0.0481	0.0479	0.0484
wealth of the leading network	50 412	48 380	52 444
profit due to long-distance trade	763 948	732 920	794 976

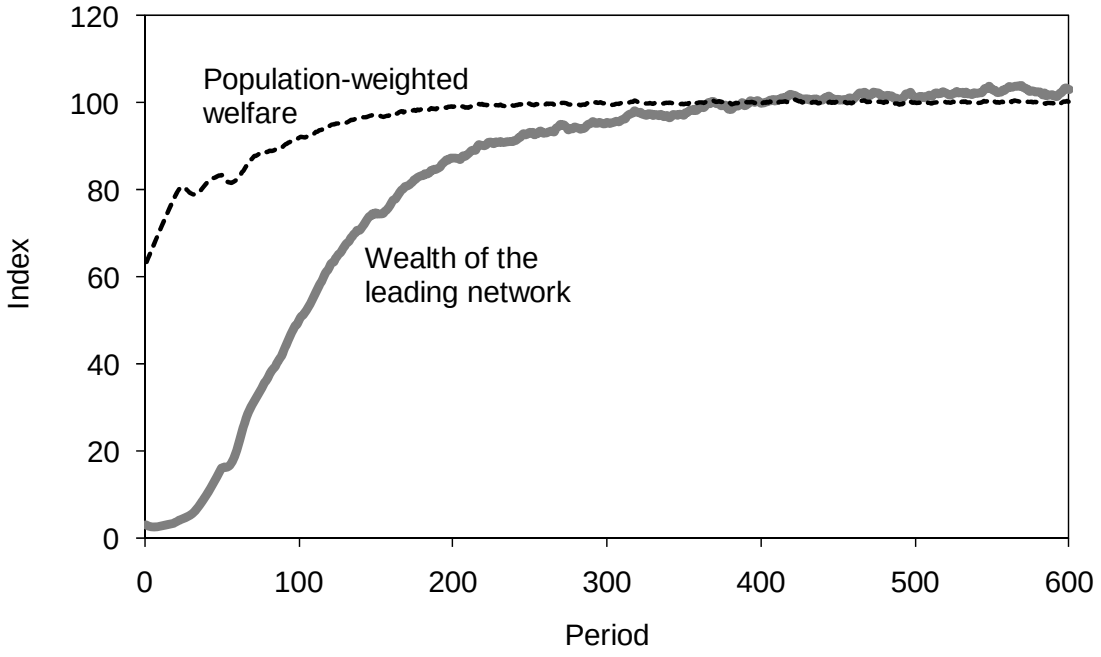
* This value is the median period and does not correspond to $t = 600$.

Figure 4: Final structure of a trading system in the baseline scenario



Plot of grid occupation by merchants in the final period ($t = 600$) for the baseline scenario. Merchants (circles) labeled with a 1 belong to the leading family network. Brighter fields correspond to larger population size of the respective town.

Figure 5: Trajectories of welfare measures in the baseline scenario



Remark: Period-specific mean values for welfare measures, calculated from 250 replications and converted to indices with reference period $t = 400$.

Parameter variations

Against the background of historical Northern Europe and the rise of the Hanse along with the commercialisation of agricultural regions in the Baltic and economic take-off, one might ask how important some economic factors were for the genesis of such a trade network. We evaluate the role of such conditions within the framework of our model by means of varying several parameters. The different scenarios result from a change in the spatial distribution of specialisation of towns ("random mapping"), from the absence of trade privileges or information asymmetries and from a decrease in transportation costs. Again, the indicator measures of the structure of trading system, economic development and welfare are used to assess these alternative scenarios. Table 2 presents percentage deviations of these indicators relative to the baseline scenario.

Random spatial distribution of production specialisation

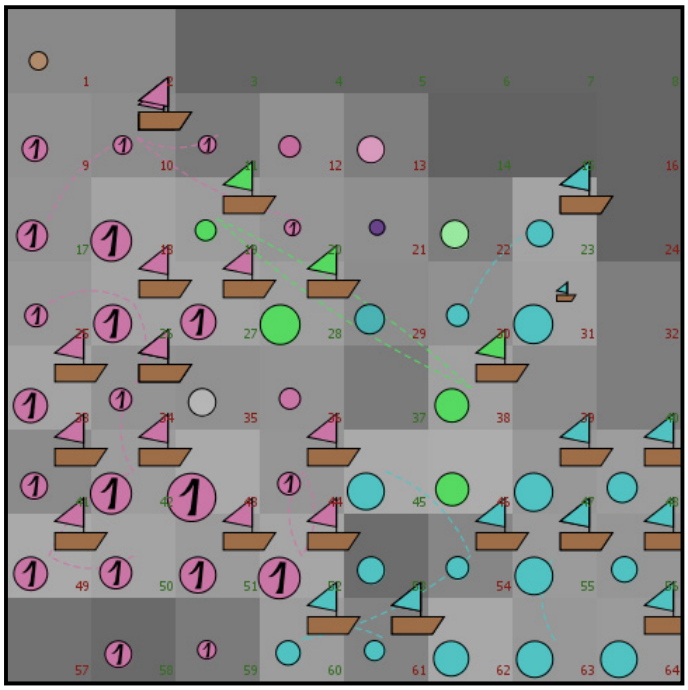
To measure the impact of the clear-cut division of the grid into western commercialised and eastern agricultural regions on simulation results, we test a variant of the baseline scenario with a differing distribution of resources and production opportunities. In this alternative scenario the economic specialisations of spots are randomly distributed over the grid at the outset of each replication. Concerning the structure of the emerging network of trade, the simulation runs of this alternative scenario lead again to a network-based trading system on average, but in this system the evolving family network is more densely structured, more persistent, it attracts more population to its towns and it is also formed considerably earlier than in the baseline scenario: the formation of a first network of five merchants occurs on average as early as in period $t = 30$. This notwithstanding, a situation of two (or more) distinct groups of merchants having divided the market proves to be more likely now, as on average the dominance of the largest network is by about 4% lower than in the baseline scenario. Figure 6 depicts an outcome of the market division of two merchant families.

Table 2: Simulation results for alternative scenarios (based on 250 replications of each scenario)

	Scenario					
	Random mapping	Absence of trade privileges	Absence of information asymmetry	Baseline scenario, lower transportation costs	Baseline scenario, lower transportation costs for newcomers after $t = 400$	Absence of trade privileges, lower transportation costs for newcomers after $t = 400$
	- percentage deviation from the mean of the baseline scenario in period $t = 600$ -					
STRUCTURE OF TRADING SYSTEM						
network density	+10	–60	–2	–7	–4	–67
dominance of leading network	–4	–29	–1	–5	–1	–36
population share associated with the leading network	+15	–44	–2	–4	–4	–50
persistence of leadership	+5	–59	–2	–8	–5	–73
median period of first occurrence of a family network with ≥5 merchants	30*	113*	69*	64*	75*	112*
ECONOMIC DEVELOPMENT						
number of merchants	+15	+2	–1	+6	–1	+11
share of ships sailing	+28	+17	–1	+19	–1	+42
number of merchants in food towns	+28	+11	–3	+5	–3	+24
concentration of population	–27	–2	0	–15	+1	–16
WELFARE						
population-weighted welfare	+6	+1	0	+2	0	+4
wealth of leading network	+22	–44	–2	+1	–4	–42
profit due to long-distance trade	+113	–11	–1	+63	–3	+5

* This value is the median period (rather than a percentage change) and does not correspond to $t = 600$.

Figure 6: Final structure of a trading system with the "random mapping" scenario



Remarks: Plot of grid occupation by merchants in the last period (t = 600) with an initial random spatial distribution of production specialisation, showing a balanced trading system with two family networks.

The economic performance with a random spatial distribution of production specialisation is much better than in the baseline scenario. Overall trade is more developed, long-distance trade becomes more important and there is a more pronounced expansion of merchants to the agricultural spots on the grid. Due to the randomised distribution, regions with different production specialisation are more likely to be located next to each other. This renders the emergence of dominant trading centres less likely, to the effect that the population is more evenly distributed across towns. This in turn is an indication for a more balanced spread of commercial activities and economic development. Global welfare is considerably higher in this scenario, and so is the income of merchants as a result of (on average) shorter distance to market and hence lower transportation costs. The stark difference between this scenario and the baseline case highlights the importance of geography not only in our simulation model but probably also in the historical course of events, as regional specialisation did differ. To be sure, short distances to markets would even have allowed market integration through other means of transportation than the sea-based trade considered in our model.

Absence of trade privileges

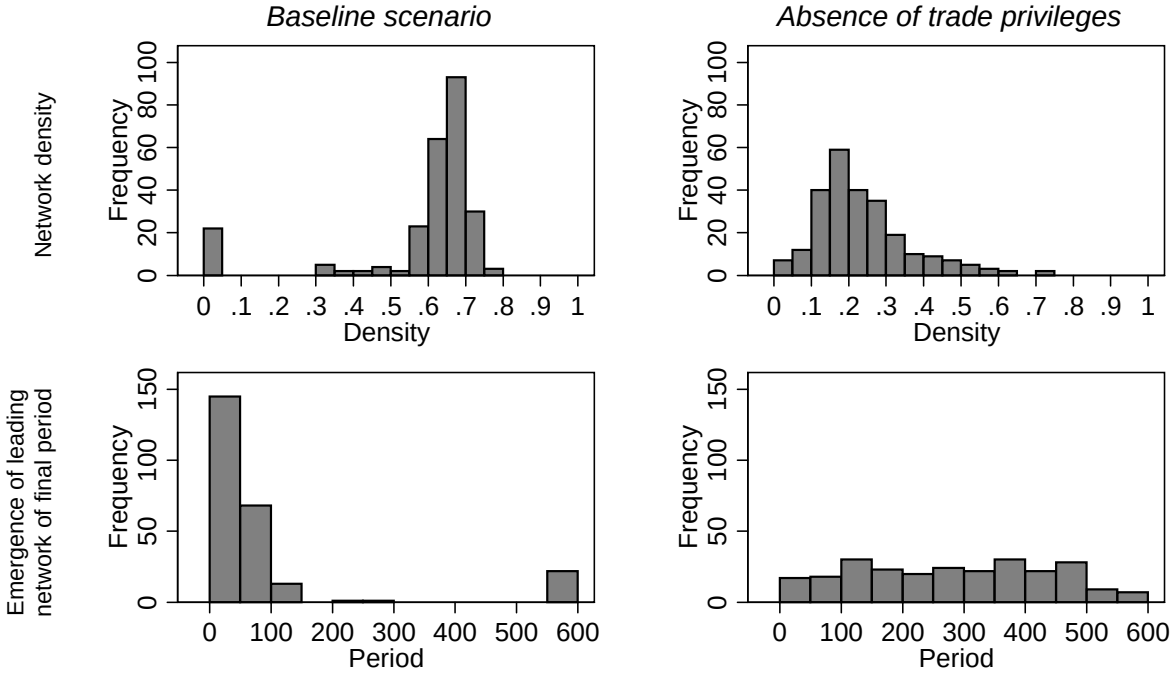
Following Douglass C. North (1981, 1991), institutions as formal and informal rules of a society are important to economic growth – in fostering or even hampering it. Medieval trade privileges may be regarded as such institutions. On the one hand they provided incentives for local merchants to trade, but on the other hand they could also have growth-inhibiting effects by restricting free trade. Trade privileges could encompass the exclusive rights to trade specific products and commodities, to pay a lower market tax or a lower toll for shipping goods. Rulers assigned this kind of rights to single merchants or to groups of traders in order to attract trade to their realm. Merchants, as the bearers of such privileges, then usually formed groups, because they sought to prevent the rulers from cancelling or abusing these rights (Greif et al. 1994; Streb 2004). An obvious question is thus, how trade would have developed if a certain group of merchants had not been granted the competitive advantage of extensive trade privileges.

In our model, the institution of trade privileges is represented by a port fee that traders have to pay at markets that do not belong to their own family network. The results of a scenario without port fees (for any merchant) underscore what economic reasoning would suggest. Network formation is much less pronounced than in the presence of such privileges. The networks formed under these free trade conditions are, on average, less densely structured, less dominant, less persistent, and their formation occurs significantly later: on average in period $t = 112$. This can be seen in Figure 7 from histograms of the distribution of network density in the final period ($t = 600$) across the 250 replications for both the baseline case and the scenario without trade privileges. Quite similarly, the distributions of the periods in which the eventually leading family network emerged show the marked differences that result from the absence of trade privileges. While in the baseline scenario the leading family of period $t = 600$ was "born" within the first 100 periods (in the majority of cases), later-born families did have a fair chance to dominate in the final period under the free trade regime.

The lack of trade privileges can also be beneficial for the development of trade. Although overall trade increases only slightly above the baseline level, long-distance trade becomes much more important, and more of the agricultural towns become integrated into commercial exchange. Even though this free trade setting provides strong incentives to both development and expansion of commercial exchange, it has only a

marginal effect on the overall welfare of the population. That profits of merchants are lower under free trade may be rationalised by a now more competitive environment.

Figure 7: Distributions of network density and the period of emergence of the leading family network



Remarks: Network density (upper panel) in the final period $t = 600$, and period of emergence of the leading family network of the final period (lower panel) for the baseline case (left) and in the scenario without trade privileges (right). Histograms are based on 250 replications of each scenario.

Absence of information asymmetries

In the Middle Ages any kind of information could be transmitted only slowly when compared to the technology of our time. We analyse, within the framework of the model, whether the reliance on kinship-based trading networks could have helped medieval merchants to handle the information that was relevant to their commercial purposes.

In the model, being part of a family network would give an advantage with respect to price information over those not belonging to that family. We compare the baseline scenario with a scenario in which such information asymmetries between members of a network and non-members do not exist. Results of simulating the latter scenario show that a quite similar network structure of trade is formed, with network density, dominance and persistence being only slightly lower. Concerning economic development and welfare, no significant differences to the results of the baseline scenario are observed. This paradoxical

outcome may be attributable to the extensive trade privileges under which processing information on towns not belonging to one's own family network may have seemed pointless to the agents in our model. Although network formation is usually considered an efficient method to deal with costly information, this advantage will not turn out in this particular setting, where higher gains can always be made from commercial exchange with family members.

Transportation costs

One of the most prominent conclusions of Douglass C. North (1981, 1985) concerning the "Commercial Revolution of the Middle Ages" is that the commercial rise of medieval Europe was mainly caused by a significant decrease in transaction costs, whereas the so-called "Industrial Revolution" became reality as a consequence of rapidly decreasing production costs. The costs of transportation are a vital part of transaction costs, if one considers medieval transportation technology and the distances that merchants of the Hanse negotiated.

To measure the impact of transportation costs we run 250 replications of the model with transportation costs reduced to the half of their original value. A comparison of the results of this scenario with those obtained from the baseline scenario confirms how important costs of transportation were for the emergence of trade, its pattern, its development and for welfare. Again, a network-based exchange structure emerges, but this trading network is less densely structured, less persistent and less dominant. What is more important, is that a reduction of transportation costs would significantly promote trade development and also increase profit opportunities for merchants. However, due to a higher degree of competition in such a setting the monopoly rent that could be extracted from consumers would not be much higher than in conditions of higher transportation costs. The overall welfare level of the population would be higher indeed, but only by about 2%.

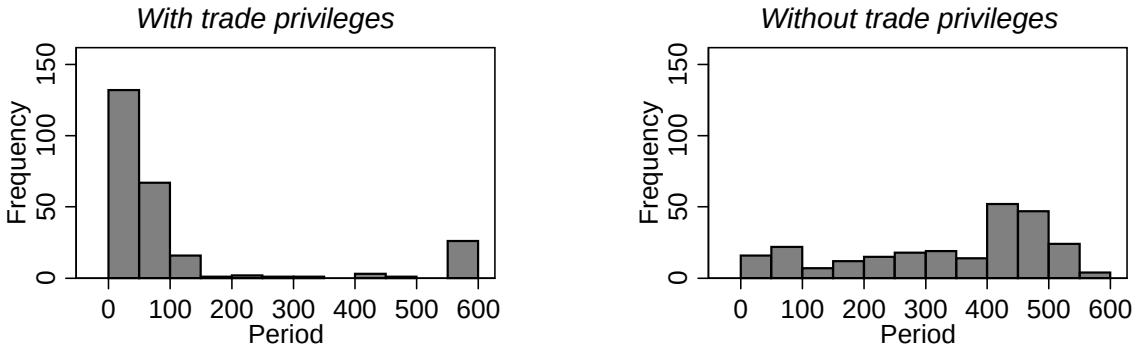
We also tested what would happen if only the new merchant dynasties ("newcomers") would profit from lower transportation costs. This scenario models a technological shift that is only available to those entering the market after a certain time period ($t = 400$). The emerging structure of trade in this scenario would also be less network-based, but with smaller deviations from the baseline scenario than before.

Furthermore, trade would be improved by a lesser amount, and both merchant profits and global welfare would be more or less equal to the baseline scenario outcome. This is again an indication for the competition-preventing effect of a kinship-based trading structure in the presence of trade privileges. As such a pattern usually emerges quite early after the initialisation of the model (Figure 8), it cannot be broken up by a later decrease of transportation costs. The persistence of the technologically backward leading network thus points to a lock-in situation.

Another indication of path-dependency is provided by a scenario without any trade privileges. In this case a decrease of transportation costs for later newcomers yields a much less pronounced network-based trading system, with network density decreasing by about 67% on average. More importantly, the persistence of the leading family network would be much lower in comparison to the baseline case or the previous scenario in which trade privileges existed. The finally leading family network often belongs to the newcomer group, i.e. it emerged after the technological shift in period $t = 400$ (Figure 8).

Economic development would improve substantially, with an increase in the number of merchants by 11%, in particular an increase in the number of merchants in "the East" by 24%. Long-distance trade would gain in importance, and welfare would be slightly higher. In addition, long-distance traders could make larger profits in this setting, whereas – due to stronger competition – the opportunity to earn a monopoly rent would be lower. These results foster the aforementioned interpretation that trade privileges were the key vehicle to form closed networks, which cannot easily be broken up once established.

Figure 8: Distribution of the period of emergence of the leading family network in scenarios of lower transportation costs for newcomers after period $t = 400$



Remarks: Histograms of period of emergence of the leading family network of the final period, according to the existence of trade privileges. Transportation costs are reduced by 50% for newcomer families only. Calculations are based on 250 replications of each scenario.

Directions for possible extensions

A simulation model cannot (and probably should not) cover all aspects and details of a historical phenomenon. It should be restricted to key parameters, in order to obtain general insights into structure and dynamics, but choosing what is relevant and what can be ignored is a difficult task. And to be sure, although basic features of medieval trade are incorporated, some relevant details concerning the Hanseatic case are missing from our model. One direction for model improvement could consist in allowing merchants to operate more than just one ship. With a larger number, it would be possible to model more precisely the process of economic concentration that could occur within a specific family network. Another way of tailoring the model better to the Hanseatic experience would be to implement a certain number of trading centres as key markets, which then play an important role in long-distance trade from the very beginning, instead of letting such "hot spots" of trade emerge by the simulation itself. Such a setting would model the Hanseatic case more accurately, as the leading markets of medieval Northern Europe were the places where Hanseatic merchants could obtain extended trade privileges, which in turn became the basis of their kinship-based trading system.

Moreover, several technical aspects of the model could be improved upon. It would be interesting to test, for instance, if the simulation results are different for a town grid that offers considerably more than the 64 locations of the present version, thus providing space for more merchants. Efficient cooperation in closed and dense networks is usually limited to a certain number of members. Once this critical mass is exceeded, a network's properties of both efficient coordination and enforcement of fairness among members will disappear, because costs for coordination will rise exponentially and a fraud will be less likely detected (Greif 2000; Ewert and Selzer 2007). One hypothesis is thus that with a wider grid (i.e. in a larger world) it is more likely to observe the emergence of network-based trading patterns that consist of different family groups of merchants. Other extensions could include a smaller share of towns with cloth specialisation, as this would fit better to the historical record.

VI. Discussion

Insights from simulation

Our model reflects some of the important factors of medieval sea trade, such as the geographical spread of resources, trade privileges, transportation costs and limited facilities of information transmission. A central question was whether the persistence of a kinship-based trading pattern of late medieval Hanseatic merchants could be explained by these factors. Simulation results underline that the assignment of extensive trade privileges to a group of merchants was indeed beneficial to this group, insofar as such privileges restricted trade by outsiders. As a consequence, the group could act as a cartel and develop a strong market position. This result strengthens a common explanation of the rise of Hanseatic trade during the high Middle Ages as being first of all the effect of valuable trade privileges which merchants of the Hanse obtained at important markets in Northern Europe (Sprandel 1984, Hammel-Kiesow 2000, p. 28). A new insight from the model is that trade privileges also fostered the establishment of kinship networks for trade. Close kinship bonds were viable means to solve the obvious information and coordination problem that cartels usually face. Cost efficiency of a kinship-based network organisation was thus not the only reason for Hanseatic merchants to stick to this kind of trading pattern in the late Middle Ages (Ewert and Selzer 2007, 2010). It rather seems likely that forming an effective cartel was a crucial motif for the choice of a kinship organisation very early on.[7]

Under a random spatial distribution of production specialisation the model produces an even more densely structured and more persistent network-based trading structure. Moreover, this structure emerges earlier than in the baseline scenario, and both economic development and welfare are much more advanced. This divergence of results highlights that geography certainly played a fundamental role for the formation of the Hanseatic trading network. Given the vast spatial extent of Northern Europe, one may better understand why it took more than one generation to build a kinship network for purposes of trade. Huge distances had to be bridged, which would have been a much more difficult task without a network. The finding of our

---

[7] It may also explain why early Hanseatic merchants soon abandoned their co-operations with other groups of merchants, e.g. with traders from the Isle of Gotland (Hammel-Kiesow 2000, pp. 32–34).

simulation that increased distance slowed down the formation of kinship networks corresponds with the fact that Hanseatic merchants, before they attempted to obtain exclusive trade privileges, cooperated with other merchants to benefit from the trade privileges of these merchants. This was a strategy necessary to enter the market at first.

Costs of transportation, too, turned out to be important to foster network formation, at least in the context of negligible trade privileges. Much of the literature sees transportation costs at the core of the commercial success of early Hanseatic merchants. Very early on, they used larger ships (*Kogge*), which reduced unit costs of transportation. There is also historical evidence that shows that both trade privileges and transportation costs were linked to a certain degree. This way Hanseatic merchants were able to oust Flemish traders from the emerging Baltic markets (Hammel-Kiesow 2000). For the Flemish the profitable opportunity to take eastern goods back to the West when they traded on these eastern markets was deterred by the merchants of the Hanse. As the bearers of the exclusive right to ship and trade goods from the East, Hanseatic merchants profited from decreasing costs per voyage in comparison to their competitors when trading on western markets, because their ships could be loaded with cargo on both trips of a voyage. The various scenarios in which we reduce transportation costs show that this kind of technological shift can yield results quite different from those of the baseline scenario, but only in the absence of trade privileges. This corroborates the above interpretation that trading privileges were the key vehicle to form closed networks. Once established, these networks could not easily be broken up. It was for this reason that Hanseatic merchants – even in the late Middle Ages – were so keen on keeping their extensive trade privileges, e.g. in Bruges, even though other markets, especially Antwerp, had developed in the meantime and in the second half of the 15th century began to seriously compete with the economic leadership of the Bruges market (Selzer 2010, p. 113–114). Until the late 15th century, Hanseatic merchants also did not have to worry about new technologies opening up to potential competitors inasmuch as their established trading network was stable enough for the Hanse to dominate trade even if they may have faced higher transportation costs than some competitors.

Network-based trade and the medieval Northern European take-off

While our model is not tailored to explain economic growth and the development of the standard of living in Northern Europe in the high Middle Ages at large, it may allow us to draw tentative conclusions on the contribution of a trade cartel like the Hanse to the economic development in the Baltic in the late 12th and the 13th century. Was the monopoly of the Hanseatic cartel a necessary prerequisite for triggering the "Commercial Revolution" in this region? This is an important question, even more so, because the persistence of this cartel that restricted competition was partly guaranteed by its kinship-based internal structure. Might Northern Europe have experienced its commercial expansion and economic boom of the high Middle Ages also on the grounds of a different and perhaps more competitive trading system?

In our baseline scenario the economy develops to an advanced degree, in the sense that long-distance trade becomes important and expands significantly into the agricultural regions. Welfare increases considerably at the time the network is established, though it does not increase further over the course of time. This matches quite well the qualitative historical record. As described above, trade did improve significantly in this region and many towns were founded. It stands to reason that towns must have been rich if large cathedrals could be built in these towns.

What cannot be proven with archival evidence is how rapid the economic take-off was in the Baltic and to which degree the economy of Northern Europe had actually grown. Comparing the baseline scenario of our simulation with the scenario of randomly assigned specialisation of towns – in which network formation occurred much faster – it may become clearer why the process of economic development of the Baltic region in 12th and 13th centuries took a centuries time, and why this economic take-off, even though being quite impressive, presumably did not match the economic development of Western Europe or the Mediterranean regions. A clear-cut division of resources and production facilities combined with long distances, as it was the case for medieval Northern Europe, was obviously a severe obstacle to the development of a trading system. In our simulation, network-based trade tends to be more pronounced in the vicinity of the border between commercialised and agricultural regions as a result from distance-based transportation costs. This in turn highlights once more why Northern Germany was so important for the emergence of the Hanse.

Our results are at variance with the common interpretation of the role of the Hanse for economic development and welfare in medieval Northern Europe. In scenarios without trade privileges and with reduced transportation costs simulations indicate that the closed and stable kinship network of the Hanse would not have been crucial for the development of an extended and powerful system of commercial exchange in the region, though the consequence for welfare turns out to be negligible in our simulation. This is not meant to dwarf the historical significance of Hanseatic merchants for the commercial development of Northern Europe, since their achievements were more or less a logical and necessary result of the environmental conditions of medieval trade. We rather suggest to add simulation-based thought experiments to the toolkit of historical inquiry in order to tease out the significance of economic and institutional circumstances.

References

Georg ASMUSSEN, Die Älterleute der Lübecker Bergenfahrer (1401–1854). Eine Führungsposition in Lübeck im Vergleich über mehrere Jahrhunderte, in: Stephan SELZER, Ulf Christian EWERT (eds.), Menschenbilder – Menschenbildner. Individuum und Gruppe im Blick des Historikers (*Hallische Beiträge zur Geschichte des Mittelalters und der Frühen Neuzeit* **2**), Berlin 2002, pp. 121-152.

Francesco BILLARI, Alexia PRSKAWETZ (eds.), Agent-based Computational Demography. Using Simulation to Improve Our Understanding of Demographic Behaviour, Berlin, Heidelberg 2003.

Jörg Bracker, Die Hanse. Lebenswirklichkeit und Mythos. Katolog der Ausstellung im Museum für Hamburgische Geschichte 1989, 2 vols., Lübeck 1989.

Ahasver VON BRANDT, Die Hanse als mittelalterliche Wirtschaftsorganisation. Entstehen, Daseinsformen, Aufgaben, in: ID. et al. (eds.), Die Deutsche Hanse als Mittler zwischen Ost und West, Cologne, Opladen 1963, pp. 9–38.

Mike BURKHARDT, Der Bergenhandel im Spätmittelalter: Handel, Kaufleute, Netzwerke (*Quellen und Darstellungen zur Hansischen Geschichte* **60**), Cologne, Weimar 2009.

Albrecht CORDES, Spätmittelalterlicher Gesellschaftshandel im Hanseraum (*Quellen und Darstellungen zur hansischen Geschichte* **N.F. 45**), Cologne 1998.

Albrecht CORDES, Einheimische und gemeinrechtliche Elemente im hansischen Gesellschaftsrecht des 15.–17. Jahrhunderts. Eine Projektskizze, in: Niels JÖRN, Detlef KATTINGER, Horst WERNICKE (eds.), "*kopet uns werk by tyden*". Beiträge zur hansischen und preußischen Geschichte. Festschrift für Walter Stark zum 75. Geburtstag, Schwerin 1999, pp. 67–71.

Albrecht CORDES, Wie verdiente der Kaufmann sein Geld? Hansische Handelsgesellschaften im Spätmittelalter (*Handel, Geld und Politik* **2**), Lübeck 2000.

Jim E. DORAN, From Computer Simulation to Artificial Societies, in: *Transactions of the Society for Computer Simulation International* **14/2** (1996), pp. 69–77

Sonja DÜNNEBEIL, Die Lübecker Zirkel-Gesellschaft. Formen der Selbstdarstellung einer städtischen Oberschicht (*Veröffentlichungen zur Geschichte der Hansestadt Lübeck*, **B27**), Lübeck 1996.

Joshua M. EPSTEIN, Agent-Based Computational Models and Generative Social Science, in: *Complexity* **4/5** (1999), pp. 41–60.

Joshua M. EPSTEIN, Robert AXTELL, Growing Artificial Societies. Social Science from the Bottom Up, Cambridge (MA) 1996.

Steven A. EPSTEIN, An Economic and Social History of Later Medieval Europe, 1000–1500, Cambridge 2009.

Ulf Christian EWERT, Wirtschaftsgeschichte im Experiment: Modellierung und Simulation als Methode zur Erforschung ökonomischer Folgen vormoderner Sterblichkeitskrisen, Working Paper *Irseer Arbeitskreises für vorindustrielle Wirtschafts- und Sozialgeschichte* 2007.

Ulf Christian EWERT, Mathias ROEHL, Adelinde M. UHRMACHER, The Role of Deliberative Agents in Analyzing Crisis Management in Pre-modern Towns, in: *Sozionik aktuell* **3**/2001, pp. 43–57.

Ulf Christian EWERT, Mathias ROEHL, Adelinde M. UHRMACHER, Consequences of Mortality Crises in Pre-modern European Towns: A Multiagent-based Simulation Approach, in: Francesco BILLARI, Alexia PRSKAWETZ (eds.), Agent-based Computational Demography. Using Simulation to Improve Our Understanding of Demographic Behaviour, Berlin, Heidelberg 2003, pp. 175–196.

Ulf Christian EWERT, Mathias ROEHL, Adelinde M. UHRMACHER, Hunger and Market Dynamics in Pre-modern Communities: Insights into the Effects of Market Intervention from a Multi-agent Model, in: *Historical Social Research* **32/4** (2007), pp. 122–150 (Special Issue "New Political Economy in History", ed. by Johannes MARX, Andreas FRINGS).

Ulf Christian EWERT, Stephan SELZER, The Hansa as a Virtual Organisation: Some Historical Remarks on the Network Paradigm, Working Paper ESSHC Amsterdam 2006.

Ulf Christian EWERT, Stephan SELZER, Netzwerkorganisation im Fernhandel des Mittelalters: Wettbewerbsvorteil oder Wachstumshemmnis?, in: Hartmut BERGHOFF, Jörg SYDOW (eds.), Unternehmerische Netzwerke. Eine historische Organisationsform mit Zukunft?, Stuttgart 2007, pp. 45–70.

Ulf Christian EWERT, Stephan SELZER, Commercial Super Trust or Virtual Organisation? An Institutional Economics Interpretation of the Late Medieval Hanse., Working Paper EHES Geneva 2009.

Ulf Christian EWERT, Stephan SELZER, Wirtschaftliche Stärke durch Vernetzung. Zu den Erfolgsfaktoren des hansischen Handels, in: Mark HÄBERLEIN, Christof JEGGLE (eds.), Praktiken des Handels. Geschäfte und soziale Beziehungen europäischer Kaufleute in Mittelalter und früher Neuzeit (*Irseer Schriften* **N.F. 6**), Konstanz 2010, pp. 39–69.

Ulf Christian EWERT, Stephan SELZER, Art. "Social Networks", in: Don HARRELD (ed.), A Companion to the Hanseatic League, Leiden 2011. [forthcoming] [= Ewert and Selzer 2011a]

Ulf Christian EWERT, Stephan SELZER, Building Bridges, Closing Gaps: The Variable Strategies of Hanseatic Merchants in Heterogeneous Mercantile Environments, in: James M. MURRAY, Peter STABEL (eds.), Bridging the Gap: Problems of Coordination and the Organization of International Commerce in Late Medieval European Cities (*Urban History*), Turnhout 2011 [= Ewert and Selzer 2011b]

Joseph GALASKIEWICZ, The "New Network Analysis" and its Application to Organizational Theory and Behavior, in: Dawn IACOBUCCI (ed.), Networks in Marketing, Thousand Oakes, London, New Delhi 1996, pp. 19–31.

Avner GREIF, Institutions and International Trade: Lessons from the Commercial Revolution, in: *American Economic Review, Papers and Proceedings* **82** (1992), pp. 128–133.

Avner GREIF, Contract Enforceability and Economic Institutions in Early Trade: The Magribi Traders' Coalition, in: *American Economic Review* **83** (1993), pp. 525-548.

Avner GREIF, The Fundamental Problem of Exchange. A Research Agenda in Historical Institutional Analysis, in: *European Review of Economic History* **4** (2000), pp. 251–284.

Anke GREVE, Fremde unter Freunden – Freunde unter Fremden? Hansische Kaufleute im spätmittelalterlichen Brügger Handelsalltag, in: Stephan SELZER, Ulf Christian EWERT (eds.), Menschenbilder – Menschenbildner. Individuum und Gruppe im Blick des Historikers (*Hallische Beiträge zur Geschichte des Mittelalters und der Frühen Neuzeit* **2**), Berlin 2002, pp. 177-188.

Rolf HAMMEL, Hauseigentum im spätmittelalterlichen Lübeck. Methoden zur sozial- und wirtschaftsgeschichtlichen Auswertung der Oberstadtbuchregesten, in: *Lübecker Schriften zur Archäologie und Kulturgeschichte* **10** (1987), pp. 85–300.

Rolf HAMMEL-KIESOW, Die Hanse, Munich 2000.

Volker HENN, Die Hanse: Interessengemeinschaft oder Städtebund? Anmerkungen zu einem neuen Buch, in: *Hansische Geschichtsblätter* **102** (1984), pp. 119-126.

Karsten IGEL, Zur Sozialtopographie Greifswalds um 1400. Der Greifswalder *liber herediatum* (1351–1452), in: Matthias MEINHARDT and Andreas RANFT (eds.), Die Sozialstruktur und Sozialtopographie vorindustrieller Städte (*Hallische Beiträge zur Geschichte des Mittelalters und der Frühen Neuzeit* **1**) Berlin 2005, pp. 227–245.

Anne ILLINITCH et al., New Organisational Forms and Strategies for Managing in Hypercompetitive Environment, in: *Organization Science* **7** (1996), pp. 211–220.

Franz IRSIGLER, Der Alltag einer hansischen Kaufmannsfamilie im Spiegel der Veckinchusen-Briefe, in: *Hansische Geschichtsblätter* **103** (1985), pp. 75-99.

Carsten JAHNKE, Handelsstrukturen im Ostseeraum im 12. und beginnenden 13. Jahrhundert. Ansätze einer Neubewertung, in: *Hansische Geschichtsblätter* **126** (2008), pp. 145–185.

Carsten JAHNKE, The City of Lübeck and the Internationality of Early Hanseatic Trade [Working Paper WEHC Utrecht 2009. [forthcoming in: Justyna WUBS-MROZEWICZ (ed.), The Hanse: A Typical and an Atypical Medieval Mercantile Phenomenon, Leiden (et al.) 2010].

Wilhelm KOPPE, Lübeck-Stockholmer Handelsgeschichte im 14. Jahrhundert (*Abhandlungen zur Handels- und Seegeschichte* **2**), Neumünster 1933.

Blake LEBARON, Agent-based Computational Finance: Suggested Readings and Early Research, in: *Journal of Economic Dynamics & Control* **24** (2000), pp. 679–702.

Peter Ping LI, Towards a Geocentric Framework of Organizational Form: A Holistic, Dynamic and Paradoxical Approach, in: *Organization Studies* **19** (1998), pp. 829–861.

Robert S. LOPEZ, The Commercial Revolution of the Middle Ages, 950–1350, Cambridge 1976.

Gunnar MEYER, *... up dat se mynen lesten wyllen truweliken vorvullen.* Die Werkmeister der Lübecker Pfarrkirchen als Vormünder in Testamenten, in: Stephan SELZER, Ulf Christian EWERT (eds.), Menschenbilder – Menschenbildner. Individuum und Gruppe im Blick des Historikers (*Hallische Beiträge zur Geschichte des Mittelalters und der Frühen Neuzeit* **2**), Berlin 2002, pp. 277–294

Gunnar MEYER, Solidarität in der Genossenschaft: Die Lübecker Bergenfahrer des frühen 15. Jahrhunderts im Spiegel ihrer Testamente, in: Antjekathrin GRAßMANN (ed.), Das hansische Kontor zu Bergen und die Lübecker Bergenfahrer: International Workshop Lübeck 2003, Lübeck 2005, pp. 187–204.

Gunnar MICKWITZ, Neues zur Funktion hansischer Handelsgesellschaften, in: *Hansische Geschichtsblätter* **62** (1937), pp. 191-201.

Gunnar MICKWITZ, Aus Revaler Handelsbüchern. Zur Technik des Ostseehandels in der ersten Hälfte des 16. Jahrhunderts (*Societas Scientiarum Fennica. Commentationes Humanarum Litterarum* **IX/5**), Helsingfors 1938.

Thomas S. NOONAN, Skandinavier im europäischen Teil Russlands, in: Peter Sawyer (ed.), Die Wikinger. Geschichte und Kultur eines Seefahrervolkes, Stuttgart 2001, pp. 144–166.

Douglass C. NORTH, Structure and Change in Economic History, New York 1981.

Douglass C. NORTH, Transaction Costs in History, in: *Journal of European Economic History* **14** (1985), pp. 557–576.

Douglass C. NORTH, Institutions, in: *Journal of Economic Perspectives* **5** (1991), pp. 97–112.

Richard N. OSBORN and John HAGEDOORN, The Institutionalisation and Evolutionary Dynamics of Inter-organisational Alliances and Networks, in: *Academy of Management Journal* **40** (1997), pp. 261–278.

Ernst PITZ, Bürgereinung und Städteeinung. Studien zur Verfassungsgeschichte der Hansestädte und der deutschen Hanse (*Quellen und Darstellungen zur hansischen Geschichte* **52**), Cologne et al. 2001.

Walter W. POWELL, Neither Market nor Hierarchy: Network Forms of Organization, in: *Research in Organisational Behaviour* **10** (eds. L. L. CUMMINGS and B. M. STAW), Greenwich 1990, pp. 295–336.

Birgit SAWYER, Peter SAWYER, Medieval Scandinavia. From Conversion to Reformation, circa 800–1500 (*The Nordic Series* **17**), Minneapolis, London 1993.

Roswitha SCHWEICHEL, Kaufmännische Kontakte und Warenaustausch zwischen Köln und Brügge. Die Handelsgesellschaft von Hildebrand Veckinchusen, Werner Scherer und Reinhard Noiltgin, in: Dick E. H. DE BOER et al. (eds.), "*... in guete freuntlichen nachbarlichen verwantnus und hantierung ...* ". Wanderung von Personen, Verbreitung von Ideen, Austausch von Waren in den niederländischen und deutschen Küstenregionen vom 13. bis 18. Jahrhundert (*Oldenburger Schriften zur Geschichtswissenschaft* **6**), Oldenburg 2001, pp. 341–358.

Stephan SELZER, Artushöfe im Ostseeraum. Ritterlich-höfische Kultur in den Städten des Preußenlandes im 14. Jahrhundert (*Kieler Werkstücke*, **D8**), Frankfurt/Main et al. 1996.

Stephan SELZER, Trinkstuben als Orte der Kommunikation. Das Beispiel der Artushöfe im Preußenland (ca. 1350–1550), in: Gerhard FOUQUET, Matthias STEINBRINK and Gabriel ZEILINGER (eds.), Geschlechtergesellschaften, Zunft-Trinkstuben und Bruderschaften in spätmittelalterlichen und frühneuzeitlichen Städten (Stadt in der Geschichte, 30), Stuttgart 2003, pp. 73–98.

Stephan SELZER, Die mittelalterliche Hanse, Darmstadt 2010.

Stephan SELZER, Ulf Christian EWERT, Verhandeln und Verkaufen, Vernetzen und Vertrauen. Über die Netzwerkstruktur des hansischen Handels, in: *Hansische Geschichtsblätter* **119** (2001), pp. 135–161.

Stephan SELZER, Ulf Christian EWERT, Die Neue Institutionenökonomik als Herausforderung an die Hanseforschung, in: *Hansische Geschichtsblätter* **123** (2005), pp. 7–29.

Stephan SELZER, Ulf Christian EWERT, Netzwerke im europäischen Handel des Mittelalters: Konzepte – Anwendungen – Fragestellungen, in: Gerhard FOUQUET, Hans-Jörg GILOMEN (eds.), Netzwerke im europäischen Handel des Mittelalters (*Vorträge und Forschungen* **LXXII**), Ostfildern 2010, pp. 21–47.

Rolf SPRANDEL, Die Konkurrenzfähigkeit der Hanse im Spätmittelalter, in: *Hansische Geschichtsblätter* **102** (1984), pp. 21–38.

Udo STABER, Steuerung von Unternehmensnetzwerken: Organisationstheoretische Perspektiven und soziale Mechanismen, in: Jörg SYDOW, Arnold WINDELER (eds.), Steuerung von Netzwerken. Konzepte und Praktiken, Wiesbaden 2000, pp. 58-87.

Walter STARK, Untersuchungen zum Profit beim hansischen Handelskapital in der ersten Hälfte des 15. Jahrhunderts (*Abhandlungen zur Handels- und Sozialgeschichte* **24**), Weimar 1985.

Walter STARK, Über Techniken und Organisationsformen des hansischen Handels im Spätmittelalter, in: Stuart JENKS, Michael NORTH (eds.), Der hansische Sonderweg? Beiträge zur Sozial- und Wirtschaftsgeschichte der Hanse, Cologne, Weimar, Vienna 1993, pp. 191–201.

Jochen STREB, Die politische Glaubwürdigkeit von Regierungen im institutionellen Wandel. Warum ausländische Fürsten das Eigentum der Fernhandelskaufleute der Hanse schützten, in: *Jahrbuch für Wirtschaftsgeschichte* 2004/**1**, pp. 141–156.

Horst WERNICKE, Die Städtehanse, 1280–1418. Genesis – Strukturen – Funktionen (*Abhandlungen zur Handels-* und *Sozialgeschichte* **22**), Weimar 1983.

Arnold WINDELER, Unternehmensnetzwerke. Konstitution und Strukturation. Wiesbaden 2001.

Uri WILENSKY, NetLogo. http://ccl.northwestern.edu/netlogo/. Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston (IL) 1999.