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Determinants of trust in banking networks☆

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ABSTRACT

This paper investigates the determinants of trust in banking networks and, thus, identifies several forces determining the stabilizing effect of networks. Using a unique dataset of 249 German savings banks, the empirical results show that intense interaction with central coordinators supports trust-building within the network. Larger banks and banks with strong competitive standing and high income invest less in a deeper relationship with the network. Moreover, bank's own trustworthiness is a relevant component in building trust. The banks are more willing to trust if they believe that they can influence the banking group's decisions. These findings may help to explain how banking networks can function well even in periods of financial crisis.

1. Introduction

The financial crisis has revealed a strong need for understanding the role of trust in complex and interlinked networks. Market participants, politicians and researchers have once more realized that the level of trust within a system or a network of financial institutions is important for the stability of the network. This paper is an empirical investigation of the circumstances under which trust in network mechanisms is created and maintained and of how banking networks can function well even in periods of financial crisis.

Bank crises have been studied extensively, and various sources of systemic risk have been identified. The most important source of systemic risk is contagion. The common perception is that interlinkages may create a risk of financial contagion (see e.g. Brusco and Castiglionesi, 2007; Dasgupta, 2004). However, economic theory shows that the risk of contagion is dependent on the precise pattern of interbank linkages.

The seminal paper by Allen and Gale (2000) assesses the impact of the network connectivity on the stability of the banking system. They find that the more connected a banking network is, the more resilient the system is to contagion. The theoretical work of Leitner (2005) addresses the issue of optimal network design as he builds on the framework of Allen and Gale (2000) and integrates a central planner that coordinates voluntary transfers within the network. He argues that a necessary condition for linkages is the presence of some coordinating mechanism that prevents the spreading of a crisis.

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Empirical evidence on contagion risk in the interbank markets supports these theoretical findings for a number of European countries and the US. For the German interbank market Upper and Worms (2004) show that the existing safety nets of savings banks and cooperative banks reduce the danger of contagion.

The network structure of the German Savings Banks Finance Group closely corresponds to the theoretical models of Allen and Gale (2000) and Leitner (2005). The high degree of connectivity between the member institutions and the existence of coordinating agents are important organizational characteristics of this banking group. The Savings Banks Finance Group remained stable throughout the financial crisis despite the fact that several Landesbanks were severely affected by the crisis and caused the banking group to suffer large losses (DBRS, 2010). All stabilizing actions taken by the group were coordinated by the regional savings banks associations and the German Savings Banks Association (henceforth, DSGV[1]).

The amount of trust in interbank relations must be addressed along with the precise pattern of interbank linkages as important factors in the context of contagion risk. Trust is important because it can mitigate undesirable effects induced by uncertainty. While Allen et al. (2009) show that the problem of asymmetry of information can lead to a break-down of the interbank market, Cocco et al. (2009) provide evidence that the level of cooperation between banks plays an important role in liquidity provision in the interbank market.[2]

To develop explicit strategies for maintaining or enhancing trust within a system or network that foster stability and efficiency, it is crucial to first understand the determinants of trust. As Sako and Helper (1998) rightly argue, before strategies of trust can be considered feasible, the determinants of trust must first be identified. In this study, a specific dimension of trust is considered. Consistent with Mayer et al. (1995), the "ability" of the trustee as an essential element of trust is used as a central concept. Following Sako and Helper (1998), among others, I use the term "competence trust". In this study, competence trust emphasizes the trust of a bank in the ability of network mechanisms to accomplish a task of importance to the bank, which is the management of concentration risk. Concentration risk of loan portfolios in individual savings banks is a key concern for the Savings Banks Finance Group and a potential source of contagion risk.

The measure of competence trust is derived from a survey conducted among all banks of the German Savings Banks Finance Group during the financial crisis of 2009. Given the events that were taking place, this was an appropriate time to examine trust. In total, 279 completed questionnaires were returned, representing a response rate of over 60 percent. The questionnaire data are combined with a unique dataset of balance-sheet and income-statement data and regional economic data. The resulting dataset allows to uncover a variety of patterns that explain the factors contributing to trust-building in banking networks.

The findings provide strong empirical evidence that intense interaction with central coordinators of the banking group is associated with increasing trust in the coordinating mechanisms of the network. This result is consistent with that of Leitner (2005), who also highlight the importance of a central coordinator in a banking network. More generally, this empirical result supports the theoretical findings of Allen et al. (2010) that network structure matters for containing systemic risk.

Investigating the effects of environmental uncertainty proxied by sector concentration and bank competition provides additional interesting insight. It shows that sector concentration in the region of their operation leads banks to distrust the banking network, with high levels of competition have the opposite effect. Banks facing stronger competition trust network mechanisms more and, thereby, tend to place a higher value on the potential safety net of the banking group. This result is consistent with findings reported by Babus (2006) that a network serves as an insurance mechanism. Furthermore, I find that a bank's income has a negative effect on trust building. This result follows predictions on the general effects of competition on bank behavior, which posit that banks that face less competition have higher charter value (Keeley, 1990). Such banks may be strong economically and therefore less dependent on the network.

Higher capital ratios have a positive effect on a bank's trust in the network to which it belongs. Banks with higher capital ratios are more stable (Diamond and Rajan, 2000) and, therefore, are more trustworthy themselves. This result is particularly remarkable as it indicates that a bank's own trustworthiness determines its level of trust. This confirms the prediction of Butler et al. (2009) that one's own level of trustworthiness is the basis for the decision to trust others. Furthermore, I find evidence that larger banks tend to trust less in network mechanisms. Larger banks can benefit more from the effects of diversification and may be more resilient to contagion risk in this respect.

The empirical findings are robust regarding different model specifications. The main results are similarly significant when controlling for bank-level and network-level effects, bank mergers and the size of the sub-network.

Interestingly, I find that the size of sub-networks has a significant impact on the evolution of competence trust. Using the size of sub-networks to measure the power of an individual bank within the banking group, the findings reveal that banks belonging to a larger regional savings banks association are more willing to trust in network mechanisms. One potential explanation for this finding could be that these banks "feel" that they have more influence on group decisions if they belong to these associations.

The contribution of this study to the existing literature is twofold. First, it provides a new measure of competence trust, and second, it is the first empirical study to identify the main determinants of competence trust in banking networks.

[1] Deutsche Sparkassen- und Giroverband

[2] A review of the literature on trust issues in banking is provided by Hoepner and Wilson (2012).

The remainder of the paper is structured as follows. Section 2 describes the network architecture of the banking group and provides background information about the network of the German Savings Banks Finance Group. Section 3 provides the conceptual framework and derives the hypotheses that will be tested. Section 4 introduces the methodology and variables used for the empirical analyses. Data and tables of descriptive statistics are presented in Section 5, while empirical results are presented and discussed in Section 6. Section 7 concludes this paper.

2. The German Savings Banks Finance Group

The German Savings Banks Finance Group (*Sparkassen-Finanzgruppe*) is one of the largest groups of credit institutions in the world, and as such, it constitutes one pillar within the German "three-pillar" banking system.[3] Historically, the establishment of the group began approximately 200 years ago with the formation of the first savings banks in Germany. Over the years, the number of savings banks continuously increased and, with the introduction of giro transactions, the Landesbanks were established in the early twentieth century. Later, additional institutions were founded and added to the network. However, the savings banks remain the heart of this banking group.

The savings banks are legally universal banks that provide a full range of financial services for retail customers, small- and medium-sized enterprises and municipaities. As legally and economically independent institutions, all savings banks operate under the common brand "Sparkasse".

At the end of 2010, the German Savings Banks Finance Group consisted of approximately 620 legally independent institutions, including 429 savings banks, 8 Landesbanks (regional banks), 10 central building societies, DekaBank, Deutsche Leasing, and a number of service providers and other financial and non-financial institutions.[4]

Most of the institutions, including almost all of the savings banks that belong to the German Savings Banks Finance Group, are governed by public law. In the case of savings banks, their respective municipalities can be regarded as a dominant force in their governance. However, the municipalities are not "owners" of the savings banks in a strict legal sense. Therefore, their property rights structure is better described as a "municipal trusteeship held by local governments". In economic terms, the institutions of the group are profit-oriented because they need to be profitable to survive and grow. However, they are not profit-maximizers as their statutory objective is the promotion of social welfare and economic development in their operating region.

The "regional principle" is a characteristic of the savings bank network and an important institutional basis for the decentralized structure of the network. This principle implies that individual savings banks are expected to do business only within the defined region in which they operate. The prime motivation behind the regional principle is risk mitigation.[5] The regional principle also fosters regional economic development as shown by Hakenes and Schnabel (2010). A further effect of the principle is the restriction of competition between different savings banks, thus encouraging cooperation. According to Schmidt (2009), the regional principle implies that savings banks act "more as colleagues than as rivals". This function is a precondition for close cooperation within the group.

The savings banks and other institutions in the group are organized and connected by a multi-level network. The network consists of three levels: savings banks, which operate at the regional level (primary level); institutions such as Landesbanks, central building societies and insurance companies, which operate at the state level (second level); and other institutions, such as DekaBank and Deutsche Leasing, which operate at the national level (third level). However, it is important to note that the structure of the German Savings Banks Group is not a hierarchical system with central power at the top. Thus, the Landesbanks are not superior to the savings banks and DekaBank does not have authority over the Landesbanks.

In addition to the multi-level network of financial institutions, there also exists a parallel structure of associations at the second and third level. This structure consists of 11 regional associations that act as central coordinators at the state level and the DSGV at the third level that functions as the central coordinator at the national level. These regional associations comprise all independent savings banks in their respective regions as their members. The DSGV is the umbrella organization of the German Savings Banks Group.

The structure of the Savings Bank Financial Group is based on the principle of cooperation. This principle allows savings banks to provide a full range of services to their customers without being forced to produce all of these services themselves in those cases where it would either be too costly or, because of the size of the local institutions, simply not be feasible. One important linkage, and thus also a form of cooperation, is the network of joint liability schemes. The financial institutions in the group are connected through a safety net that is designed to prevent the failure of an institution.

[3] For detailed descriptions and analyses of the German banking sector, see Krahnen and Schmidt (2004). A detailed discussion of the German Savings Banks Finance Group is provided by Schmidt (2009).

[4] The present network of savings banks and affiliated institutions has been shaped by a process of group-wide consolidation that took decades. Further information on the network structure of the banking group can be obtained from the German Savings Banks Association (DSGV, 2011).

[5] As savings banks are local players, they also have a profound knowledge of their local customers. This intimate knowledge allows them to gain a much clearer understanding of the risks involved in their business (DSGV, 2011).

3. Conceptual framework and hypotheses

3.1. The concept of competence trust

In the academic research the notion of trust has been approached from a variety of fields with different perspectives. Therefore, it is not surprising that trust has been defined in various ways in the literature. Remarkably, there is no consensus on the definition of trust and no consensus on the proper measurement of trust (Fehr, 2009). What determines trust is a subject of even greater controversy. However, to a certain extent, a common understanding has been developed about what constitutes trust. Thus, Kee and Knox (1970) define trust as "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party".

Although trust has its basis in individuals, Zaheer (1998) show that individuals in an organization may share an orientation toward another organization and, as such, inter-organizational trust is a collectively held trust orientation by the organizational members toward a partner organization. Therefore, in this study, the notion of trust is applied at the bank level, showing the trust level of an individual bank toward other institutions or mechanisms of the banking network.

Consistent with Mayer et al. (1995), I apply the "ability" of the trustee (party to be trusted) as an essential element of trust in this research. Other authors phrase this element as "competence" or "expertise" and emphasize it as a critical characteristic of the trustee. Following Sako and Helper (1998), among others, I utilize the term "competence trust". In this study, competence trust emphasizes the trust in the ability of the network mechanisms to accomplish a task of importance to the bank.

The task of importance to the savings banks analyzed in this research is the management of concentration risk. Concentration risk of loan portfolios of individual savings banks is a key concern for the Savings Banks Finance Group and a source for contagion risk.[6] Banks that specialize in certain industries and, in the case of the savings banks, certain regions, face concentration risk in their loan portfolios. On the other hand, they may benefit from their superior screening and monitoring capabilities as they build up industry expertise. A recent paper by Böve et al. (2010) investigates this issue and finds that the results are mixed for savings banks. Thus, credit concentration remains an important issue for the savings banks.

The measurement of competence trust is derived from the following survey item, which examines a bank's level of trust in the abilities of the network's coordination mechanisms.[7]

- *Competence trust*: Credit risk concentration is an important issue for the group as concentration risk is only managed efficiently at the group level.

The survey was conducted in 2009 during the financial crisis. Given the events that were taking place, this was an appropriate time to examine trust. Acknowledging that trust is a dynamic construct, Rempel et al. (1985) claims that "the most opportune time to examine trust may occur when stress or conflict has created a situation where confidence in the other is an issue".

In this paper, the concept of competence trust is also understood as the "decision to trust", thereby taking a rational choice approach to trust (Williamson, 1993). This proposed concept of trust induces banks to make rational and efficient choices through either trusting or distrusting behavior. Thus, the banks tend to trust if the benefits of that trust outweigh the risks or costs associated with that trust. The advantage of this concept is that decisions constitute observable behavior (Kramer, 1999).

3.2. Determinants of competence trust in networks

Through identifying the determinants of competence trust, the drivers contributing to the stability of a highly connected network can be understood. I propose the following determinants that can be divided into four categories, all of which have been derived from the existing literature.

Cooperation: When considering issues of cooperation and trust, the following questions must be addressed. First, is there an incentive for cooperation? If there is an incentive for cooperation, where does the incentive for cooperation come from? Moreover, what effect does cooperation have on competence trust?

Due to the specific organizational structure and the tight linkages described in Section 2, institutions have strong incentives to cooperate with each other. A further incentive for cooperation comes from the outside reputation of the network (see e.g. Kreps et al., 1982). Understanding that banks have strong incentives to cooperate, the next step is to investigate whether cooperation builds competence trust in network mechanisms. La Porta et al. (1997) find a positive relationship between trust and cooperation, especially in large organizations. The regular exchange of information between institutions during a cooperative exercise can enhance trust (Anderson et al., 1987).

[6] Credit risk concentration has played a critical role in past bank failures in mature economies (Basel Committee on Banking Supervision, 2004).
[7] For the German origin of the survey item please refer to Appendix.

Every individual savings bank determines independently if and how intensively it wants to cooperate with other institutions within the banking group. Cooperating on different levels (vertical vs horizontal) and with different types of institutions on each level (savings banks, Landesbanks and central building societies) may have different effects on the evolution of trust. Thus, the following hypotheses are generated:

Hypothesis 1a. Higher competence trust in the banking network mechanisms is associated with higher horizontal cooperation with neighboring savings banks.

Hypothesis 1b. Higher competence trust in the banking network mechanisms is associated with higher vertical cooperation with Landesbanks.

Hypothesis 1c. Higher competence trust in the banking network mechanisms is associated with higher vertical cooperation with central building societies (Landesbausparkassen).

Interactions with central coordinators: Following Leitner (2005), the regional associations of savings banks and the DSGV act as central coordinators for the group. The banks interact with the associations on different occasions and for different reasons. I argue that the more a bank interacts with the regional savings banks associations and the DSGV, the more the bank will develop confidence and trust in that relationship. According to Driscoll et al. (1972), trust evolves through mutually satisfying interactions and increasing confidence in the relationship.

Hypothesis 2a. Higher competence trust in the banking network mechanisms is associated with intense interactions with central coordinators.

Ring and Van de Ven (1992) finds that trust is based on experience and interaction. I argue that the longer the bank manager has been part of the banking network, the more chances he has had to interact with the regional savings bank associations and the DSGV and the more opportunities he has had to build trust in the network and its mechanisms. Because trust needs time to evolve, the following hypothesis is proposed:

Hypothesis 2b. Higher competence trust in the banking network mechanisms is associated with past experience and prior interactions within the group.

Uncertain environments: Uncertain environments offer potential for contagion risks. If the bank acts in a particularly uncertain environment, it may have greater incentives for opportunistic behavior, leading the bank to act against the interests of the group. Anticipating this, other banks would then behave opportunistically and exploit network mechanisms, thereby reducing the power of the network by lowering the level of trust in those network mechanisms. On the other hand, the more the bank is exposed to uncertainty in its region, the more incentive the bank has to trust the network mechanisms. Thus, the network serves as a type of safety net for the bank, and the trust relationship is viewed as valuable because of potential unforeseen future developments. Babus (2006) notes that the network serves as an insurance mechanism. The bank is more dependent on the network and should invest more in a deeper relationship with the network. Hence, uncertain environments can both induce and inhibit trust.

For banks, environmental uncertainty results from bank competition and sector concentration, both of which create uncertainty. Given that savings banks conduct business in a defined regional area, sector concentration in that region should be reflected in the lending portfolios of those banks. A bank with a highly concentrated loan portfolio can be considered to be more risky (see e.g. Düllmann and Masschelein, 2007). Banking competition in the region affects the competitive stance of the bank and, ultimately, affects the potential risk of contagion. The effects of competition on a bank's risk-taking behavior are broadly discussed in the literature (see e.g. Keeley, 1990; Boyd and De Nicolò, 2005). Indeed, the relationship of the bank to its network could be essential to its competitive position (see e.g. for Japanese firms Lincoln et al., 1996).

Hypothesis 3a. Higher competence trust in banking network mechanisms is associated with high environmental uncertainty through higher sector concentration in the region.

Hypothesis 3b. Higher competence trust in banking network mechanisms is associated with low environmental uncertainty through lower sector concentration in the region.

Hypothesis 4a. Higher competence trust in banking network mechanisms is associated with high environmental uncertainty through higher bank competition.

Hypothesis 4b. Higher competence trust in the banking network mechanisms is associated with low environmental uncertainty through lower bank competition.

Trustworthiness: The financial soundness of the bank plays an important role in trusting its counterpart but also in being trusted by its counterpart. If a bank behaves in a way that is objectively viewed as trustworthy, then the bank will have more confidence in the trustworthiness of its counterparts. Thus, their own trustworthiness is the basis for their decision to trust their business partners (Butler et al., 2009). In this way, trust can be self-reinforcing (Falk and Kosfeld, 2006).

Hypothesis 5. Higher competence trust in banking network mechanisms is associated with a bank's own trustworthiness.

To summarize, the main determinants of competence trust in network mechanisms are cooperation, interaction with central coordinators, uncertain environments and a bank's trustworthiness.

4. Model specification and variable estimation

4.1. Empirical methodology

Empirical analyses utilize an ordered logit model for ordinal dependent variables applied to cross-sectional data, accounting for robust standard errors. To analyze the determinants of competence trust in network mechanisms, the following empirical model is estimated:

$$\begin{aligned}\text{Competence trust}_i = {} & \beta_0 + \beta_1 \text{Horizontal}_i + \beta_2 \text{Vertical-LB}_i + \beta_3 \text{Vertical-CBS}_i + \beta_4 \text{Interaction}_i + \beta_5 \text{Tenure}_i \\ & + \beta_6 \text{Lerner}_i + \beta_7 \text{HHI}_i + \beta_8 \text{East}_i + \beta_9 \text{logTA}_i + \beta_{10} \text{LLP}_i + \beta_{11} \text{NII}_i + +\beta_{12} \text{Equity}_i + \epsilon_i \end{aligned} \quad (1)$$

where Horizontal_i is the horizontal cooperation with the neighbor savings banks, Vertical-LB_i is the vertical cooperation with the Landesbanks, Vertical-CBS_i is the vertical cooperation with the central building societies, Interaction_i represents the intensity of interaction with the regional savings banks associations and the DSGV, Tenure_i is the number of years of employment within the banking network, LERNER_i proxies bank competition and HHI_i is sector concentration in the region. EAST is a dummy for East Germany and logTA_i represents the logarithm of total assets. NII_i is the net interest income ratio, LLP_i is the loan loss provision ratio and Equity_i stands for the equity ratio of the bank.

4.2. Variables

Competence Trust. The dependent variable of interest, competence trust, is derived from a survey item. The measurement of competence trust is described in detail in Section 3.1. Respondents were asked to provide information on their level of trust on a 6-point Likert scale. Based on the respones, the dependent variable was constructed as an ordered variable taking values ranging from 1 for "strongly disagree" to 6 for "strongly agree". Respondents answering "no statement" were removed from the sample.

The choice of explanatory variables reflects both the theory of the determinants of competence trust and data availability. To test the hypotheses, the following explanatory variables are defined.

Cooperation: The cooperation between the institutions of the group is differentiated between horizontal and vertical cooperation.

Horizontal: For horizontal cooperation, which is the cooperation of the individual savings banks with their neighbor savings banks, the syndicated loan business is selected as it is both typical and integral to business cooperation among savings banks. *Vertical-LB*: For vertical cooperation, which is the cooperation of the individual savings banks with the Landesbanks, the syndicated loan business is chosen to allow comparison to data collected for horizontal cooperation. Moreover, the syndicated loan business is a typical type of cooperation between savings banks and Landesbanks. Information on the intensity of cooperation is obtained from the survey. Participating banks indicate the intensity of cooperation between the savings banks and the Landesbanks in the syndicated loan business as "no cooperation", "occasional cooperation" or "intensive cooperation". These variables take values of 0, 1, and 2, respectively. *Vertical-CBS*: To account for different types of vertical cooperation, which is the cooperation of the individual savings banks with the central building societies, the own-home-savings business is chosen. The own-home-savings business is a typical fee-based business activity for the central building societies. This information is obtained from banks' balance sheets, and the intensity of cooperation is proxied by the number of contracts of the own-home-savings business standardized by the number of employees per bank.

Interaction with central coordinators. A typical interaction with the central coordinators occurs during the development, implementation and maintenance of new instruments for risk management provided by the regional savings bank associations and the DSGV. Each implementation phase for instruments requires close communication with the central coordinators because problems or difficulties inevitably occur and must be resolved during this process. If banks use that instrument, they must interact with the central coordinators even after the implementation phase, e.g., when systems are updated or new features are designed and incorporated.

Interaction: The use of instruments for risk management, in particular for credit portfolio modeling and loan pooling, is proxied for the interaction with the central coordinators. The variable is constructed as a dummy variable taking the value 1 for intense interaction with the central coordinators, and 0 otherwise.

Tenure: The duration of the bank manager's work experience in the group is used to proxy the maturity of the relationship. This variable is obtained from the survey question asking for duration of employment. Participants declared their number of years of employment within the group.

Uncertain environment: An uncertain environment is proxied by bank competition in the region, sector concentration in the region and whether the bank is located in East or West Germany.

Lerner: Bank competition in the region is estimated by the Lerner index, which is constructed following Berger et al. (2009). The Lerner index measures the extent to which banks can set prices above their marginal costs, and it is calculated as

$$\text{LERNER}_{it} = \frac{(P_{it} - \text{MC}_{it})}{P_{it}}. \quad (2)$$

where P_{it} is the price proxied by the ratio of total revenues (interest and non-interest income) to total assets and MC_{it} is the marginal cost. Marginal cost is derived from a translag cost function[8] where banking output is proxied by total assets TA_{it} and the three input prices $W_{k,it}$ are defined as the ratio of personnel expenses to total asset (price of labor), the ratio of interest expenses to total deposits (price of funding) and the ratio of operating and administrative expenses to total assets (price of capital). The equation is estimated by introducing year fixed and bank specific effects with robust standard errors using panel data covering all banks between 1996 and 2006. The Lerner index is averaged for the observation period to capture the competitive stance of the bank and it takes values between 0 and 1.

HHI: The uncertain environment is further proxied by sector concentration in the region, which also reflects the loan portfolio concentration of the savings bank. The Herfindahl–Hirschman index is used to estimate the sector concentration in region *i* for the savings banks *i* and is calculated as

$$\mathrm{HHI}(x)_i = \sum_{n=j}^{N} x_j^2 \tag{3}$$

where x_j is the share of the number of firms conducting business by sectors *j* over all firms in the region *i* as of 2005.[9] The variable takes values between 0 and 1.

East: To account for regional economic, structural and infrastructural differences between East and West Germany, as well as for the different experiences of the savings banks in the two regions after re-unification, a dummy variable is included. The East dummy indicates whether the bank is located in East Germany.

Trustworthiness: In order to measure bank's own trustworthiness, typical bank characteristics are used as indicators for bank's own trustworthiness. The bank characteristics are best described by bank's size, its risk-return profile and amount of capital the bank holds. These information are obtained from the bank's balance sheets and income statements.

logTA: The logarithm of total assets of the bank is a proxy for its size and organizational complexity. Memmel et al. (2007) finds that the number of relationships within a bank declines with its size. The increasing opacity of clients may well contribute to a higher complexity. Furthermore, a bank that is less risky and has high earnings should be more trustworthy. Thus, both the loan loss provision and the income of the bank display its risk-return profile and provides information on bank's financial soundness. *LLP*: The loan loss provision of the bank, proxy for the riskiness of the bank, is the ratio of a bank's loan loss provision over total assets. *NII*: The net interest income of the bank is a proxy for the bank's performance in the lending business and is calculated as the ratio of the bank's net interest income over total income. *Equity*: A bank with a higher capital ratio is more stable (Diamond and Rajan, 2000), and therefore, it is more trustworthy. The capital of the bank, used as a proxy for the stability of the bank, is the ratio of a bank's equity over total assets.

5. Data and summary statistics

5.1. Data

For the analyses, three datasets are merged: banks' balance-sheet and income-statement data, regional economic data and survey data. This unique panel dataset is provided by the German Savings Banks Association and includes balance-sheet and income-statement data observed annually. For the analyses, regional economic data are used that were provided by the Statistical State Offices for the 439 administrative districts in Germany.[10]

Additionally, a paper questionnaire was distributed to elicit the information needed on trust in network mechanisms. Out of the 431 questionnaires sent out to all savings banks in 2009, a total of 279 completed questionnaires were returned. This equals a response rate of above 60 percent. Because some banks returned the questionnaire without the front page containing the name of the bank, these banks are excluded from the sample. The banks that have been involved in a merger since 2006 are not included in the sample, as no historical data for the new entities are available. After eliminating these banks, the sample size was reduced to 249 responses. With a response rate of above 50 percent, the sample is highly representative of all regions and asset classes. Because the survey was sent to the whole population of savings banks of the German Savings Banks Group the analyses are robust in terms of response bias with a response rate of 57 (63) percent.

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$$\ln \mathrm{Cost}_{it} = \beta_0 + \beta_1 \ln \mathrm{TA}_{it} + \frac{\beta_2}{2} \ln \mathrm{TA}_{it}{}^2 + \sum_{k=1}^{3} \gamma_{kt} \ln W_{k,it} + \sum_{k=1}^{3} \phi_k \ln \mathrm{TA}_{it} \ln W_{k,it} + \sum_{k=1}^{3}\sum_{j=1}^{3} \ln W_{k,it} \ln W_{j,it} + \epsilon_{it}$$

[9] According to the Statistical Classification of Economic Activities in the European Community twelve sectors are specified: (i) Mining and Quarrying, (ii) Manufacturing, (iii) Electricity, Gas, Steam and Air Conditioning Supply, (iv) Construction, (v) Wholesale and Retail Trade, Repair of Motor Vehicles and Motorcycles Transportation and Storage, (vi) Accommodation and Food Service Activities, (vii) Transportation and Storage, (viii) Financial and Insurance Activities, (ix) Real Estate Activities, (x) Education, (xi) Human Health and Social Work Activities and (xii) Other Service Activities.

[10] These administrative districts are classified as level 3 according to the *Nomenclature of Territorial Units for Statistics* (NUTS). This definition allows for the investigation of region-specific variables, such as sector concentration.

Table 1
Summary statistics.

	Mean	sd	Min	Max
Tenure	17.7426	11.3625	1.0000	47.0000
Horizontal	1.0000	0.4117	0.0000	2.0000
Vertical-LB	1.0549	0.5686	0.0000	2.0000
Vertical-CBS	5.9817	1.8795	1.4966	12.4378
Interaction	0.2068	0.4058	0.0000	1.0000
logTA	14.2157	0.9337	12.0229	17.1608
Lerner	0.2882	0.0706	0.0887	0.4517
HHI	0.1580	0.0131	0.1312	0.2155
LLP	0.0208	0.0096	0.0011	0.0544
NII	0.4261	0.0346	0.3293	0.5146
Equity	0.0468	0.0089	0.0256	0.0761
Observations	237			

The table shows mean values for the years from 2002 to 2006. Loan loss provision (LLP) is the ratio of loan loss provision over total assets. Net interest income (NNI) is the ratio of net interest income to total income. Equity is the ratio of equity over total assets. Total assets are the logarithm of total assets (logTA). HHI is the Herfindahl–Hirschman index for sector concentration in each region. The LERNER index measures the competitive stance of the bank. Horizontal is the horizontal cooperation link between savings banks, Vertical-LB is the vertical cooperation link with Landesbanks and Vertical-CBS is the vertical cooperation link with central building societies. Tenure is the number of years of employment of the bank manager with the banking group, and Interaction indicates the intensity of interaction with central coordinators.

In the analyses, data on banks' characteristics, regional and market conditions from 2002 to 2006 are used. In 2002, the banks in the sample adopted a group-wide strategy, including widespread reorganizational activities and the introduction of standardized approaches to different business areas. The analyses are conducted beginning in 2002, thereby accounting for these structural changes. To gain a clear idea of bank characteristics under "normal" conditions, the years after 2006 are not considered. For the empirical analyses, the panel structure of the banking and the regional variables are reduced to a pure cross-sectional data structure by averaging for each bank over the period between 2002 and 2006. It is useful to refer to a longer time period to capture the characteristics of the banks and to assess the regional economic situation under "normal" conditions.

5.2. Descriptive statistics

The mean values of the variables used throughout the analyses are presented in Table 1. The mean values of the variables are calculated for the period from 2002 to 2006. Descriptive statistics for banks' net interest income ratio and loan loss provision ratio are reported. Other bank-specific variables, such as banks' equity ratios and logarithms of total assets, are shown. Descriptive statistics for regional economic indicators, the Herfindahl–Hirschman index for sector concentration per region, and the Lerner index to capture the competitive stance of each bank in the region in which it operates are reported. Furthermore, the number of years of employment of the bank managers is shown, and the intensities of cooperation with neighbor savings banks, Landesbanks and central building societies are presented in Table 1. The intensity of interaction with central coordinators is also measured. The descriptive statistics in Table 1 show that differences exist across banks in the sample despite the fact that the savings banks are rather homogeneous relative to their business model, focusing primarily on deposit and loan business.

Table 2 depicts the heterogeneity of competence trust within the banking group. A considerable number of banks do not trust the network mechanisms or trust them very little. "Strongly disagree" means that the level of competence trust is very low or nonexistent, whereas "strongly agree" indicates a high level of competence trust in the network mechanisms.

Table 2
Heterogeneity of competence trust.

Statement	Competence trust
Strongly disagree	8
Disagree	23
Slightly disagree	37
Slightly agree	68
Agree	64
Strongly agree	41
No statement	8
Total	249

The table shows the level of competence trust on a 6-point Likert scale. "Strongly disagree" indicates that the level of competence trust is very low or nonexistent, whereas "strongly agree" indicates a high level of competence trust in the network mechanisms. The number of banks per category is shown.

Table 3
Competence trust in banking networks.

Variable	(1) Competence trust	(2) Competence trust	(3) Competence trust	(4) Competence trust
Horizontal	0.3167	0.3783	0.4085	0.3618
	(0.3318)	(0.3341)	(0.3468)	(0.3191)
Vertical-LB	0.2805	0.1527	0.1738	0.1747
	(0.2384)	(0.2533)	(0.2580)	(0.2627)
Vertical-CBS	−0.0375	−0.0038	−0.0683	−0.0698
	(0.0580)	(0.0603)	(0.0662)	(0.0669)
Interaction		0.7709***	0.9161***	1.0174***
		(0.2757)	(0.3019)	(0.3014)
Tenure		0.0067	0.0042	0.0119
		(0.0104)	(0.0109)	(0.0118)
Lerner			1.2784	−7.7397*
			(1.7818)	(4.1330)
HHI			−25.5314***	−15.1334
			(9.2887)	(10.0953)
East			−0.1655	0.9105
			(0.5187)	(0.7064)
logTA				−0.8392**
				(0.3308)
LLP				16.0996
				(14.3383)
NII				−7.4634*
				(4.2902)
Equity				43.5843**
				(20.1361)
cut1	−3.0082***	−2.7323***	−6.8306***	−20.3913***
cut2	−1.5435***	−1.2300**	−5.3107***	−18.8518***
cut3	−0.5545	−0.2008	−4.2545**	−17.7525***
cut4	0.6556	1.0678*	−2.9528	−16.3817***
cut5	1.9942***	2.4513***	−1.5485	−14.9349***
log pseudolikelihood	−392.3316	−368.0068	−364.0944	−358.1430
Wald	3.1299	11.8714	20.8259	32.6518
N	241	230	230	230

The table shows the results of the ordered logit regressions investigating the determinants of competence trust in coordinating mechanisms of the banking network. The dependent variable is an ordered variable taking values ranging from 1 for "strongly disagree" to 6 for "strongly agree". The coefficients indicate the directions of the effects.

* Significance at the 10 percent level.
** Significance at the 5 percent level.
*** Significance at the 1 percent level.

6. Empirical results

This section presents the empirical results. The relationships of competence trust with cooperation linkages, interactions with central coordinators, banks' characteristics and regional and market conditions are examined. The result table reports the relationship between competence trust and the determinants of competence trust. Estimating cross-sectional ordered logit regressions and controlling for robust standard errors, the coefficients express the directions of the effects.

6.1. Baseline analyses

In Table 3, the results of the baseline regressions investigating the determinants of competence trust in network coordination mechanisms are presented.

In the first column of Table 3, competence trust in the network coordinating mechanism is related to banks' horizontal and vertical cooperation linkages on the right-hand side. The estimates show no significant results in the first column. The cooperation between the financial institutions within the banking group has no significant effect on the level of competence trust. This result is surprising because the literature predicts a positive relationship between trust and cooperation. One explanation for this finding could be that banks belonging to the banking group have cooperated with other institutions within the group for decades. Over the years, they have developed a level of competence trust that remains constant over time. Therefore, further horizontal cooperation with neighbor savings banks and vertical cooperation with Landesbanks and central building societies seems not to alter trust levels.

In the second column, the interaction with the central coordinators and the duration of tenure of the bank managers within the banking network is added to the regression. The ordered logit estimations show highly significant results for interaction with the central coordinators, suggesting that banks that interact closely with the regional savings bank associations and the DSGV are more prone to trust the coordinating mechanisms of the group. This result holds true when adding the regional

and market conditions to the equation in the third column. The effect of the intensive interaction with central coordinators is robust throughout all model specifications.

This finding is consistent with that of Leitner (2005), who note the importance of a central coordinator in banking networks. Increased voluntary interaction of the bank with the central coordinators builds trust in coordinating mechanisms. Banks interacting closely with the central coordinators are more trusting in the abilities of the group, to the degree that concentration risks are most efficiently tackled at the group level.

The results in the third column suggest that banks operating in regions with concentrated industrial sectors trust the coordinating mechanism of the network less. Banks operating in regions with concentrated sectors face a potentially higher concentration risk to their portfolios and are more vulnerable to contagion risk. In the full model, the effect disappears but still shows the same direction of the relationship. This result indicates that banks may have greater incentives for opportunistic behavior and therefore trust the network mechanisms less.

In the full model, I find that banking competition has a significant effect on competence trust, suggesting that banks enjoying more market power (facing low bank competition) trust less in the coordination mechanisms of the network. Banks with high market power may invest less in a deeper relationship with the network. Consequently, their strong competitive standing would make them less dependent on the network because they are more resilient to contagion risk.

The investigation of the environmental uncertainty proxied by sector concentration and bank competition provides an interesting insight. It shows that uncertainty caused by sector concentration leads banks to distrust the banking network, while high competition has the opposite effect and is significant in the full model. Bank competition may be a stronger determinant of competence trust considering that competition between banks is more threatening to a bank's business. The potential safety net of the banking network is valued in this way, and therefore, banks facing high competition decide to trust network coordinating mechanisms more. This result is consistent with the findings of Babus (2006), who notes that the network serves as an insurance mechanism.

Furthermore, banks with higher profits from net interest income trust coordinating mechanisms less. This result does not support the derived hypothesis on banks' own trustworthiness proxied by net interest income, however, it coincides with the above findings on the effect of competition on competence trust. Following Keeley (1990), banks facing less competition have higher charter value. As these banks may perceive themselves as very strong economically and thus less dependent on the network, the issue of concentration risk may not be as threatening to them as it is to other banks. As such, trusting less in coordinating mechanisms constitutes a rational decision for profitable banks.

Further empirical results show that banks with higher equity ratios trust more in network coordinating mechanisms. Because banks with higher equity ratios are more stable (Diamond and Rajan, 2000), they are considered more trustworthy. This result is revealing in that it indicates that a bank's own trustworthiness, displayed by the amount of equity it holds, determines its level of trust toward others and supports the prediction of Butler et al. (2009) that one's own trustworthiness is the basis for the decision to trust.

I also find that larger banks trust less in the coordinating mechanisms of the network, suggesting that larger banks doubt whether concentration risk can be handled more efficiently at the group level. Apparently, they trust more in their own abilities to efficiently manage concentration risk at the bank level. Larger banks may benefit more from diversification effects and be more resilient to contagion risk. Emmons et al. (2004) argue that the greatest diversification benefits are achieved by increasing the size of the banks.

6.2. Sensitivity analyses: bank level effects and capital market engagement

In the following subsections, the analyses are repeated and tested for robustness of the results.[11] To begin with, it is important to consider the possibility that banks in the sample may trust their own capabilities more than they trust the mechanisms of the banking group. The following statement allows for the examination of such bank-level effects.

- *Competence Trust-Bank level*: Credit risk concentration is NOT an important issue for the group as concentration risk is only managed efficiently at the bank level.

Expecting opposite signs for the variables of interest, I find consistent results for interaction with central coordinators, equity and net interest income. In addition, vertical cooperation with central building societies has a significant positive effect on competence trust. However, this effect disappears when adding regional and market conditions to the model. Additionally, in the full model, no effect can be reported for cooperation. The main results remain robust.

Furthermore, the individual bank is not only a member of the banking group, but it also acts independently in the banking market. Therefore, the business relationships of the bank with other market participants in the industry must be considered in the analyses as the capital market is a place where banks interact and engage in business with other market participants.

[11] Result tables for all sensitivity analyses are reported in Appendix.

The following statement accounts for the possibility that the banks of the banking group manage concentration risk through the way they engage in transactions within the capital markets.[12]

- *Competence Trust-Capital markets*: Credit risk concentration is NOT an important issue for the group as concentration risk is only managed efficiently through capital markets.

The results show that 95 percent of the banks disagree with the above statement. Thus, the management of concentration risk outside of the banking group does not seem to be a relevant option for the majority of the savings banks.

6.3. Sensitivity analyses: structure of the sub-network

One can argue that the structure of the sub-networks (11 regional savings bank associations) may affect the level of trust of individual banks and, therefore, may alter the results thus far presented. Therefore, the analyses are repeated controlling for this effect. The 11 regional savings bank associations are of different sizes. The size of the sub-network is estimated by the number of branches of all savings banks that provide customer services within each regional association. Savings banks operating in larger sub-networks, both in terms of number of institutions and in terms of geographical spread, may have significantly different levels of trust than savings banks belonging to smaller sub-networks. In this study, an interpretation of the size of the sub-networks is related to the relative power of each individual savings bank within the banking group. One could argue that savings banks belonging to larger sub-networks may believe that they have relatively more power within the banking group. This argument is based on the assumption that the greater the proportion of resources, the greater the (voting) power (Brams and Affuso, 1976). In this case, it can be assumed that savings banks belonging to larger sub-networks have greater incentives to trust in the network mechanisms as they may "feel" that they have more influence on the group's decisions. To test this hypothesis, the size of the sub-network measures the perceived relative power of individual savings banks.

I find that the size of the associations has a significant positive impact on the level of competence trust. This result indicates that banks belonging to larger associations trust more in the network coordinating mechanisms. The more an individual bank "feels" that it can influence the group's decision, the more the bank may want to trust the network mechanisms. Furthermore, I find robust results for the interaction with the central coordinator. The results also remain robust for Lerner, the size of the bank and the bank's income and equity.

6.4. Further sensitivity analyses

The risk management instruments – credit portfolio modeling and loan pooling – have been applied to measure the interaction with the central coordinators. However, these instruments are used explicitly for the management of concentration risk, and therefore, may bias the results. To account for this potential bias, the analyses are repeated with an alternative measure for interaction with the central coordinators. The construction of the alternative measure is based on the following instruments that are not explicitly used for the management of concentration risk but instead are related to the measurement of credit risk: a rating system for the smallest enterprises, a risk-adjusted pricing system and a system for calculating default recovery rates. Repeating the analyses with the alternative measure for interaction with central coordinators, the main findings remain robust. The effect of the central coordinator remains significant and positive. Furthermore, I find robust results for Lerner, the size of the bank and the bank's income and equity.

The most critical time for trusting in the network mechanisms of the group is when a bank is in distress. Banks that were involved in a merger may have faced such a situation. I address the question of whether such banks differ significantly in their level of trust toward the mechanisms of the group. Controlling for that in the analyses, I find that bank mergers have no significant impact on the level of competence trust. The results do not alter the main findings.

6.5. Limitations of the analyses

I recognize that establishing causality between trust and the independent variables is not straightforward and that determining the direction of causality is certainly not trivial. For instance, instead of cooperation affecting trust, it is possible that high trust increases cooperation. Empirical studies of trust commonly face the problem of reverse causality. Therefore, a number of studies instrument trust as a dependent variable on the left-hand side (see e.g. Sako and Helper, 1998), whereas other studies use trust as a right-hand variable (see e.g. Knack and Keefer, 1997).

Trust is endogenous in its very nature as it is based on beliefs that are, according to Fehr (2009), "malleable so that they change [...] quickly in response variations in the prevailing conditions". Few studies have tried to address empirically the endogeneity problems by applying instrumental variables (Guisio et al., 2009; Knack and Keefer, 1997). Indeed, finding a

[12] The variables "Competence Trust-Bank level" and "Competence Trust-Capital markets" are negatively and significantly correlated with "Competence trust", for more information see Appendix.

good instrument is difficult in general. However, finding a good instrument for trust seems to be an even greater challenge as noted by Fehr (2009), who expresses his doubts concerning the choice of instrumental variables in these empirical studies.

I acknowledge the fact that building trust is certainly an interactive process. Therefore, not being able to control for the dynamic nature of trust is a shortcoming of this study. Nevertheless, knowing that levels of trust can change over time, it is as plausible that levels of trust can accumulate over time. In this study, the bank manager (the average bank manager in the sample has been employed with the banking group for at least 17 years) had sufficient time to evaluate and confirm his beliefs. Moreover, the point in time at which trust is investigated is highly relevant because trust is particularly important in times of high uncertainty. Therefore, examining trust during the financial crisis, as this study does, seems to be the most relevant and appropriate time to do so.

While I have provided arguments to explain why the particular choice of independent variables may build competence trust, I still might expect a certain degree of reciprocal causality. Fehr (2009) concludes that trust measures are endogenous, irrespective of the method used to measure trust.

7. Conclusion

In this paper, I investigated the determinants of trust in banking networks and argued that the level of trust is important for the stability of a system, drawing guidance from the recent financial crisis. The collapse in trust played a crucial role in the recent crisis. Therefore, understanding the determinants of trust in banking networks is the first step toward gaining a better understanding of modern financial systems.

Using the German Savings Banks Finance Group as a concrete case to investigate the determinants of competence trust in banking networks I have identified several forces determining the stabilizing effect of banking networks.

An important implication of the results is that intense interaction with central coordinators supports trust-building within the network and helps to stabilize the network. The group as a whole can benefit if interactions with central coordinators are intensified. Further, it stabilizes a banking network if banks belonging to the network hold more equity, thereby influencing their perception toward others. A bank's own trustworthiness is relevant for trust-building within the banking network.

The banking group must ensure that smaller banks and smaller sub-networks are assured of having the same power within the banking group. This sense of equality among the institutions that belong to a banking group, irrespective of size or type, is essential for the stability of a network. Moreover, it is also apparent that banks with strong competitive standing and high income seem to invest less in a deeper relationship with the network.

I am convinced that the results of this study are relevant beyond the scope of the specific banking group I have studied. Indeed, the analyses uncover a variety of patterns that explain why banking networks seem to function well even in periods of financial crises. This paper contributes to the understanding of the working of banking networks. While more research must be conducted unraveling parts of the puzzle promises to be beneficial.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jebo.2012.02.022.

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