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NETWORKS, INFORMATION AND PREVENTION OF
IDIOSYNCRATIC RISKS IN MEXICAN BANKS. 1945-1980

Resumen

Entre 1945 y 1982 el sistema bancario mexican privado formó en su interior una red de interconecciones entre los consejos de administración de los bancos. Sin embargo, no se han estudiado las implicaciones de esta red. Este artículo argumenta que la red entre los consejos de administración de los bancos servía para transmitir información a lo largo del sistema bancario y por lo tanto, para reducir riesgos idiosincráticos. Con el empleo de análisis de redes sociales y una base de datos de los consejos de administración de los bancos este artículo presenta cálculos de la centralidad de la red. Centralidad de grado y centralidad de eigenvalor se usan para medir las interconecciones entre los bancos; estas medidas se contrastan con indicadores de desempeño financiero de los bancos usando una regresión de panel, con la que se demuestra el argumento.

Abstract

Between 1945 and 1982 a network of interlocking directorates formed at the interior of the Mexican banking system. However, little work has been done to explore its implications. This paper proves that the network among bankers served to transfer information within the financial system and hence to reduce idiosyncratic risks. Using social network analysis with a database of the banks' boards, this paper presents computations of the centrality of the network. Degree and Eigenvalue centrality, used as measures for interconnection among banks, are then contrasted with indicators of financial performance for individual banks using a panel regression technique.

1. Introduction

From the early 1940s to 1982, the Mexican banking system contained an intricate network of interlocking directorates. Although the existence of this network is consistently mentioned in the literature on the Mexican financial system, no work has explored the economic implications of its configuration of interlocking directorates. In this paper, I analyze the structure of the network and will show that the inter-relations among the board members of the commercial banks served to transmit information and thus prevent idiosyncratic risk.

In the Mexican context of 1940-1980, information for financial transactions was scarce and highly asymmetrical. I will demonstrate, in the light of historical evidence, social network theory and econometric analysis: the hypothesis that banks better interconnected at the interior of the network had greater access to information and therefore had lower levels of non-performing loans. In addition, I will show that although better-interconnected banks had greater access to information, they were not necessarily more profitable than their counterparts, thus rejecting the possibility that the network was used to exercise coordination and discipline for oligopolic practices.

While the exposure that banks had to idiosyncratic risks depended on many factors, information availability was the most important variable of the soundness of a bank's portfolio. Management of the lending process as a whole depended on the information that banks had concerning borrowers. Although there were no endemic problems of moral hazard in the banking sector, there was a generalized concern about the lack of information in the general economy. In the case of business groups, banks had solved the problem of information through relationship banking lending. There were borrowers, nonetheless, who were not so closely linked to banks. For this reason, other means to secure information were necessary.

This paper has two goals: one historical and the other methodological. First, I aim to make a contribution to the understanding of the financial development of Mexico, and in particular to show some economic effects of the historical structure of the ownership of banks at large. And second, I aim to show that the organizational configuration of ownership linkages—i.e., the network—had a substantive effect on economic performance. This effect derived from the melding of common interests through interlocking directorates and from creating a network that permitted transmission of information across the banking industry. From the standpoint of theoretical research, this paper provides historical and quantitative evidence for the development of theoretical models that can explain not only this case but also similar ones. This paper will also demonstrate how the combination of composition analysis (social network theory) and parametric analysis (panel regression) may prove useful in explaining historical problems. In these ways, I will demonstrate that a historical perspective is the best way to answer the questions addressed in this paper.

One of the main implications of this paper for this study is that the Mexican banking industry faced an environment that was not optimal for financial transactions. Information was scarce and institutional enforcement was uncertain; thus, private

mechanisms became a means for solving institutional imperfections. This could be considered a sub-optimal outcome.

The hypotheses put forth here are proven in the following manner: first, I will show the configuration of the network of interlocking directorates and how the literature has dealt with it. Part of the analysis of the network is based on historical qualitative evidence, but it is also based on analysis of measures of how banks were interconnected at the interior of the network, specifically computations of centrality. In order to do this, I use an extensive database of the interlocking directorates based on the boards of the entire Mexican commercial banking industry for the years 1952, 1957, 1962, 1968, and 1980[1].

One way to analyze how the network served to transmit information across banks is to compare its structural characteristics with indicators of financial performance susceptible to the information that a bank might receive. The level of non-performing loans is an indicator of how a bank manages its loan portfolio, but this depends on the information available to the bank. The next step is to contrast these measures with the structure of the network. Since the causes that explain the performance of the bank portfolio are complex and, needless to say, the risks that a bank faces are varied, it is preferable to find patterns rather than focusing on particular cases. In order to do this, a regression test is necessary. Another reason is to obtain the statistical significance of the relationships. Panel regressions will demonstrate patterns across time and across the industry to sustain the hypotheses advanced in this paper.

The rationale of this work encompasses various approaches. Originally, it departs from the classic conceptualization of the relevance of information in financial transactions[2]. However, it also seeks to understand the notions of how firms interact, particularly in the way Aoki, Gustafsson, and Williamson (1990) and Casson (1997) have analyzed the relevance of transmission of information within the firm and among different firms[3]. More specifically, it seeks to understand how coordination and information transmission among firms stands as a form of cooperative behavior. This becomes important in an environment in which information about transactions is highly incomplete and scarce. Especially relevant to this understanding is the conceptualization of Granovetter (1992, 1983), which points out the role of social structures such as networks and kinship ties in economic activity.

Recent research on European banking history has emphasized, in a way analogous with the present study, the historical significance of networks in financial transactions. Godley and Ross (1996) explain that due to the particularities of financial contracts, intermediaries have relied on diverse mechanisms to obtain information, in particular social and business networks. For instance, the work of Carnevali (1996) explains the operation of the network of regional banks in Italy. During the twentieth century Italian regional banks used both formal and informal connections between them to overcome information asymmetries in loan contracts and to reduce the costs of screening,

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[1] Although the period studied here covers 1952-1968, the year 1980 is included to contrast the behavior of the network after the consolidation of the banking industry into multi-banks.

[2] See Stiglitz and Weiss, 1981; Arrow, K., 1984 [1971 and 1978].

[3] Cfr. Aoki, M., Gustafsson, B., Williamson, O., 1990; Casson, M., 1997.

monitoring, and enforcing[4]. The case of Italian regional banks is comparable to the Mexican case.

Commercial banks perhaps present the best example of interlocking directorate networks in the context of twentieth-century Mexico. Nevertheless, many studies show that the interlocking directorates in the Mexican banking are beyond the financial sector. The studies of Camp (1989), Basave, Morera and Strassburger (1994, 1995) and Lomnitz (1994) are especially useful for showing specific cases of Mexican business networks. In fact, the network formed at the interior of the banking system belongs to a larger network that extended to the remainder of the financial system as well as to industrial and commercial activities. Directorates of banks could also belong to the boards of companies producing steel, cement, manufacturing or tourist services, and many of these companies had interlocking directorates. Despite this, the banking system offers a more solid case to study interconnections across the economy. First, because in terms of the different sectors of the Mexican economy, the network formed at the interior of the banking system was much more consolidated and notorious than any other structure of socioeconomic interconnections in any other economic sector. Second, the interlocks among banks exist in a sector that, in terms of its form and activity, is more homogeneous than the non-financial sectors. In addition, the different interconnections that firms had—for example, a mining firm and a cement producer—could respond to the formation of business groups and conglomerates. Third, commercial banks were the largest sector and the leader of the financial system. Indeed, the most influential decision-makers of *financieras* also belonged to the network of commercial banks; in many cases this occurred because commercial banks were the main financial units of financial conglomerates.

This paper is organized in the following manner: the subsequent section offers an overview of the literature on the interlocking directorates in the Mexican economy. The third section explains the emergence and evolution of the network, attempting to explain the reasons why banks interlocked directorates. Section four sets forth a rationale for the operation of the network and its structure, and introduces the measures of centrality. Section five presents quantitative analysis to test the hypotheses that the network permitted the resolution of information problems. The final section provides concluding remarks.

2. The Network and its Place in Literature

Nearly every work of the Mexican financial system, or of topics in which the financial system is an important component (for instance, relationships between politics and the private sector, investment and financial policies, and entrepreneurial history), makes reference to the network of interlocking directorates during the period under study[5]. However, there has been very little in-depth research of the network and its implications.

After the work of sociologists who, during the 1970s, explored kinship relationships in Mexican business groups (see, for example, DeRossi [1971] and Cordero

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[4] Carnevalli, F., 1996; Godley, A. and Ross, D., 1996.

[5] See, for example, the classic works of Moore, E., 1963; Brothers and Solis, 1966; Eckaus, R., 1974.

and Santin [1977]), further works highlighted the interlocking directorates in the leading entrepreneurial groups. For instance, the work of Camp (1989) offers a detailed analysis of the configuration of the firms' boards in the Mexican *cúpula empresarial* (business elite). Camp describes links among entrepreneurs as well as among entrepreneurs and politicians. But rather than structuring networks, he emphasizes in his work the existence of groups—or perhaps cliques—that join different business partners, some with preexisting kinship ties[6]. Camp's work focused more on the political implications of inter-relations, in particular among government officials and private businesspersons, rather than their economic implications.

Works exploring the consolidation of business groups and conglomerates during the 1970s emphasize interlocking directorates as early evidence of the formation of common business interests in Mexico. In particular, the work of Basave, Morera and Strassburger (1994, 1995) provides an extensive view of business groups during the 1970s and 80s. An anthropological analysis of social networks by Lomnitz and Lizaur (1993) explores social and kinship inter-relations in business. However, with few exceptions, the spirit of most of the works that study business networks in Mexico focuses on how capital accumulates among groups with kinship ties[7]. Needless to say, the origins of the early works exploring kinship ties not only reflected a scholarly concern, but also the growing attention of policy makers and analysts of the 1960s and 70s to the increasing concentration of wealth in Mexico[8].

What can we learn from the existing literature? Many of these works implicitly and explicitly claim that the networks and interconnections in Mexico had one of two different consequences. First, those firms could exchange information; second, they could coordinate and exercise discipline for oligopolic behavior. In order to prove both, I need to find not only historical evidence, but also the rationale behind it.

To examine the implications of the network, I can make generic interpretations departing from historical narratives. For instance, although the existence of a network implies to some extent the transmission of information, it is not necessarily true that

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[6] See Camp, R., 1989. Hamilton, N., 1982, may also be considered a pioneering work. In one of its chapters illustrates interlocking directorates among different types of business in industry that emerged during the Cárdenas regime. See also Marichal, C. and Cerruti, M., 1997; Haber, S., 1989.

[7] Basave, J., Morera, C., Strassburger, 1994; Basave, J., Morera, C., Reyes, R., Strassburger, C., 1995.

[8] Beyond scholarly investigation, less academic literature has provided impressions of the Mexican banking industry and other economic sectors in the period under investigation. Particularly influential have been the chronicle of Salvador Novo, *Life in Mexico during the presidential period of ...*, which offers much evidence concerning the social interactions at the interior of the entrepreneurial elite in Mexico. Novo provided valuable anecdotal references for the study of the interactions of the Mexican economic elite, references that were important toward understanding the social aspects of business relations in Mexico. *Life in Mexico during the presidential period of ...* (title, which usually concluded with the president in turn during the period Novo was narrating), was a series of books compiled between 1964 and 1967 ranging from Lázaro Cárdenas in the 1930s, to Díaz Ordaz in the 1960s. Novo, a distinguished playwright, had personal contact with some bankers when he held an official position at the government's Department of Fine Arts. However, it also appears that he enjoyed personal connections with certain business barons. He focused his chronicles on the social life of the well to do, employing a rather superficial, but ironic writing style.

directorates exchanged information. However, being a plausible conjecture, I can assume that directorates participating in the boards of different banks used the information they collected in the best interests of the banks with which they were involved. The belief that interlocking directorates facilitated collusive behavior is more difficult to prove because historical sources show that there was a fierce competition among banks. An example of this competition is the case of Banco de Comercio and Banco Nacional de México following each other in the hunt for new branch locations. Not only the largest banks competed among themselves, but also small local banks followed a regional, market-niche strategy in an attempt to outmaneuver the competition from large national banks. The existing competition might contradict the conjecture that interlocks facilitated collusive behavior (and, by extension, oligopolic practices). Although this idea is based on the notion that interconnections among firms facilitate coordination and discipline in the exercise of market power, more evidence concerning the interests leading to collusive behavior needs to be obtained.

3. Emergence and Evolution of the Network

A network is a conceptual device used to analyze existing interactions within a particular context. Strictly speaking, the current analysis of the Mexican banks' network is a phenomenological view to a historic outcome. This outcome is formed by gradual, cumulative incidents that occur in a complex fashion. This is important to point out for the following reason: although interlocking directorates were the result of purposeful decisions of actors, formation of the network itself (in its entirety) was unintentional and decentralized, its operation unplanned and implicit in the business practices of the actors belonging to it[9]. However, the apparent chaos from which the network emerged had some order to it, and there were patterns in which banks interlocked their directorates. This section seeks to explain why banks had interlocking directorates. I will show historic patterns in the composition of banks' boards and how this composition led to interlocking directorates and to the formation of a network throughout the banking industry.

During the 1930s and 40s, the creation of new business firms led many entrepreneurs to participate on the boards of several firms, including banks. But this story is not limited to the ownership of firms; also, there were specific reasons why banks had interlocked directorates. Research for this study has identified three principal ones. The first was that professional financiers were involved on the boards of many banks, intending to use their expertise in bank decision-making and operation. A second reason was that businessmen invested more than in one bank, in order to diversify and extend their businesses. The third reason was that many banks had associations among themselves in the form of strategic alliances and subsidiaries. Associations among banks required them to share directorates. Now I will show examples of these types of

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[9] Here I refer to the network of interlocking directorates as the entire phenomenon, in an extensive way. Interlocks themselves were the result of purposive actions; the network itself was not. In specific cases, such as the formation of networks or *sistemas* of banks at the interior of the sector, such as Banco de Comercio and Banco Internacional, networks were constructed intentionally with the purpose of strategic collaboration and to enjoy network externalities.

interlocking directorates analyzing the patterns that I observed in the Boards of commercial banks[10].

Professional Financiers

Emerging banks needed professional financiers to administer, monitor, and advise them on their operations. Some of these financiers were individuals associated to business interests through family and kinship linkages and who had professional experience in financial firms. Others were former government officials who worked in the financial areas of the government. Examples of the first type include Aníbal de Iturbide, Eloy Vallina, Adolfo Riveroll, and Raúl Bailleres.

Aníbal de Iturbide was a dynamic financier in the banking community. He began his career at Banco Nacional de México and moved to Banco de Comercio when this bank initiated operations and later on became the CEO of this bank. Thus, de Iturbide was involved on all Boards of all banks associated with the Banco de Comercio system as well as on other provincial banks until the 1950s, when he moved to Banco Comercial Mexicano. A case of a financier and entrepreneur from regional business interests was Eloy Vallina. Like many skilled and well-connected bankers, Vallina moved up fast on the financial ladder, beginning his banking career at a local bank in Ciudad Juárez and then moving to Banco Mercantíl de Chihuahua. In 1933, he founded Banco Comercial Mexicano in Chihuahua, which became one of the largest Mexican banks. In 1957, Vallina was also involved in Banco Comercial de la República and Banco de la Laguna in addition to his own bank. However, not all the financiers came from the banking sector; Adolfo Riveroll, for instance, was a professional entrepreneur in the insurance industry that became involved in banking. Riveroll participated on the Boards of Banco Comercial Mexicano, Banco Continental, and Banco de Londres y México.

Raúl Bailleres was a businessman with diversified interests but with the background of a financier. He initiated his financial career in the 1920s, opening a silver exchange business, and afterward becoming the Mexican representative of Equitable Trust and Chase Manhattan. He contributed to the start up of several financial firms, for instance Banco de Comercio and Banco General de Capitalización. Bailleres, however, focused his business activity in the firms of his own business group. In 1934, he opened the *financieras* Crédito Minero, Crédito Hipotecario, and Crédito Afianzador.

Financiers also exchanged careers between the public sector and the private sector. The expertise of financiers made them able to hold public positions and to work for private financial intermediaries. Two examples of public finance professionals who became involved in the private financial system are Manuel Gómez Morín and Ernesto Espinosa Porset. Gómez Morín, an architect of the Mexican financial system, became involved in the group of Banco de Londres y México. Espinosa Porset began his career in private banks and then moved to the *Comisión Nacional Bancaria*, embarking on a public career and becoming deputy director of *Banco de México* in 1938. Espinosa Porset,

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[10] Although the analysis is fundamentally based on the sociomatrices of my database, I complemented it with the profiles of entrepreneurs described in Silva, L.M., 1998; Musacchio, H., 1999, and Camp, R., 1989.

however, moved back to the private sector in the 1950s and appeared in the Boards of Banco del Ahorro Nacional and Banco Internacional.

Over a period of time, the role of these financiers as financial experts and bank organizers disappeared. Apparently, financial knowledge was no longer monopolized by a few because the increasing financial activity served as a training ground for new professional bankers and financiers. For example, many branch managers and executives of Banco Nacional de México were offered positions in emerging banks. Apparently, the migration of Banco Nacional de México's employees to positions at other entities was common during that period[11]. After the 1950s professional bankers were numerous in the financial sector. Indeed, the boards of banks also reflected the incorporation of new professionals since many executives who climbed career ladders became bank directorates.

Business Extension and Diversification

The second type of interlock—entrepreneurs participating in banks—was common in the banking industry because for many businesspeople, being directly involved with banks was an important strategy to obtain external financing. They participated in different banks and other financial intermediaries to obtain direct access to funding from more than one intermediary. This was particularly important for local entrepreneurs, who considered it more convenient to have their own funding entity than to be subject to large banks or to banks owned by their competitors. In addition, they possessed the advantage of being better informed about potential borrowers from the banks in their region. As a result, there were patterns of local entrepreneurs participating on the boards of different local banks in their own area.

For instance, entrepreneurs from the Northern region of La Laguna formed their own banks to finance cotton production, cattle raising, and other agro-industrial activities. During the 1950s some of these entrepreneurs included Alberto E. Rodriguez and Ignacio M. Martínez. Rodriguez was a member of the boards of Banco Algodonero Refaccionario, Banco de la Laguna, and Banco Lagunero. Martínez was involved with the boards of Banco de Comercio de Torreón, Banco General de Durango, and Banco Lagunero.

During the same decade, Agustín Vales, a native of Yucatán and partner of an international trade company, was involved in two banks on the Yucatán peninsula, Banco de Yucatán and Banco del Sur. Examples in the area of Puebla state were Guillermo Pérez Salazar and Domingo Taboada Roldán. Pérez Salazar participated on the board of Banco de Oriente and Banco de Puebla, while Taboada Roldán was involved with the board of Banco Comercial de Puebla, Banco de Oriente, and Banco de Puebla.

The interests of some local entrepreneurs displayed a scope beyond the region of their businesses. For instance, Pedro Maus was an entrepreneur in the tobacco industry based in Veracruz and Mexico City. During the 1950s Maus was involved with the boards of Banco de Londres y México, Banco Internacional, and Banco Mexicano. Another example of this is Joaquín Zorrilla Gutierrez, who in 1968 participated with the

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[11] Interview 1a; Banco Nacional de México. Libro de Personal. 1935.

Boards of Banco de Oriente, Banco del Noroeste de México, Banco del Sureste, Banco Ganadero y Agrícola, and Banco Provincial del Norte.

The involvement of these entrepreneurs in several banks contrasts with the fact that some important Mexican business figures participated on the board of only one bank. The cases of Pablo Diez and Carlos Prieto at Banco Nacional de México, Eugenio Garza Sada at Banco de Nuevo León, and Rómulo O'Farril at Banco de Puebla represent this type of entrepreneur. However, there was no precise relationship between the size of the entrepreneur's businesses and the number of financial firms to which the entrepreneur belonged. In the case of the top business figures, what mattered was the capital and financial services to which they could have access, whether they were members of the boards of several banks, of a only a single large bank, or in a financial conglomerate composed of different types of firms. The fact is that the predominant capitalists in Mexico usually had influential positions at the largest financial entities, such as Banco Nacional de México, Banco de Comercio, and Banco Comercial Mexicano.

Corporate Alliances

The third type of interlock came about as the result of certain large banks forming strategic alliances and associations with smaller entities. These strategies included sharing directorates as a way to advise on and monitor the operations of smaller banks. The case of Banco de Comercio and its network of associated regional banks are the classic example. Banco de Comercio system was a network of associated entities through a vertical relationship of a mother firm (Banco de Comercio) and its relatively independent subsidiaries (regional Bancos de Comercio).

Banco Nacional de México shared directorates with the troubled banks that it intervened, as well as with group associated banks with which it developed strategic alliances. Perhaps Banco Nacional de México provided a benchmark of strategic alliances in Mexican banking. Banco Internacional also had interlocking directorates with banks for the purpose of forming strategic alliances. However, Banco Internacional apparently maintained weak ownership ties with these banks[12].

4. The Network and Its Structure: Implications

In this section, I will explain the rationale of how and why the network served to transmit information. I will also explain that linkages among banks can be measured in terms of the extent of connection between the different entities, these connections were intended to enhance the access to information of each entity. In this regard, I will introduce the use of measures of centrality in the network.

The basic function of a network is the exchange of information[13]. But a network of the type analyzed here might imply different forms of cooperative behavior among

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[12] See Bátiz, B. and Del Angel, G., 2002, for an explanation on strategic alliances among Mexican commercial banks.

[13] Casson, M., 1997; Chapter 4.

banks[14]. Although some links among banks were part of strategies of collaboration, explicit collaboration did not exist among the majority banks. However, interlocking directorates can lead to an implicit form of cooperation. Each bank can have its own strategic priorities and even compete; however, in the final analysis, sharing board members implies sharing common interests. The transmission of information to evaluate risks can represent a type of collaborative behavior that might take the form of either unintentional or purposeful actions.

There are two levels of transmission of information among banks with interlocking directorates: a level of transmission that is unintentional and unavoidable, and another that is intentional and contingent. The first level of transmission of information is inevitable because it does not depend on the voluntary exchange of information among individuals. Strictly speaking, interlocking directorates imply the transmission of information from one bank to another (at least among banks with interlocks with each other), because each directorate will carry the information collected on the different boards to which they belong.

A second level of information transmission occurs if directorates exchange information among themselves. At this level of transmission, the board of a bank receives information not only from banks with which it has interlocks, but also from banks were its interlocking boards are also interconnected. The value of a board's interconnection is not only the number of interlocks it has with other banks, but the extent to which the boards of the interlocking banks are interconnected. Transmission at this level is contingent on whether or not the directorates are willing to share information.

Under this system, the number of interconnections a firm has at the interior of the network will affect its access to information. It is trivial to say that banks with more interlocks will have access to more information. However, the number of interlocks is not the only variable affecting information availability; the extent to which the linked banks are interconnected is also highly significant. For example, bank A might have interlocks with four banks that have no interconnections with other banks but bank A. Bank B might have interlocks with only two banks, but one of these banks has interlocks with two additional banks. Consequently, although bank B is only related to two banks, it potentially has access to the information of four banks.

In the case under study, linkages of interlocking directorates form a network in which actors are tied to each other through their participation in multiple memberships. In the terminology of network theory this is an affiliation network or a membership network. The variables of analysis of this network are the actors (the directorates of the banks) and the events to which they are affiliated (the boards of the banks). Because an actor or a bank might have more or fewer relationships to other actors (or banks), we need to assess their position in terms of direct and indirect interconnections at the interior of the network. Sociologists call this positioning the centrality of the network agents[15]. Figure 1 shows an example of these interconnections. This figure is a graphic construct of

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[14] Collaboration presupposes that actors pursued mutually beneficial agreements and acted to maximize value for the banks to which they belonged. In this context this is a reasonable assumption. However, not all networks might show strictly collaborative behavior.

[15] Wasserman and Faust, K., 1994, Chapters. 5; 8; Faust, K., 1997.

a segment of the network: Banco de Londres y México and all its direct linkages in 1952. Indirect linkages are also indicated.

Figure 1
Cross Sectional Sample of the NetworkBanco de Londres y México in 1952.
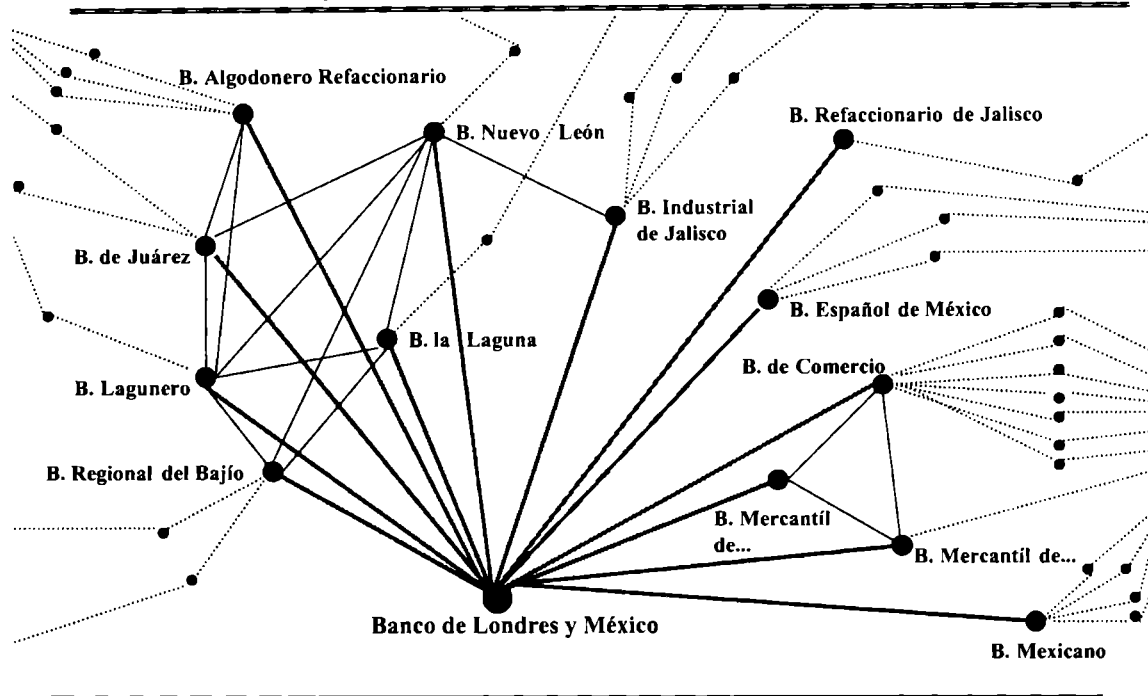
Two applications to measure centrality are: a) degree centrality and b) Eigenvector centrality. Faust (1997) explains that in an affiliation network, motivations for degree centrality consist of events being important because of the size of their memberships. A standardized degree centrality index measures the number of interconnections normalized by the size of the network. However, a limitation of degree centrality is that it does not consider the centrality of events to which an event is adjacent. Eigenvector centrality corrects this by incorporating into the centrality index the centrality of the actors to which a given actor is adjacent[16]. Degree centrality approximates the potential access information to which the bank has direct access from its interlocks. Eigenvalue centrality approximates the potential access information from the broader interconnections that a bank possesses from its interlocks in the network.

To measure centrality for the network of Mexican banks, I used a database containing the members of the Boards of the commercial banking industry for the years 1952, 1957, 1962, 1968, and 1980. I constructed this database from information published in the *Anuario Financiero de México*. This database contains more than 11,000

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[16] Faust, K., 1997.

name entries per year[17]. Centrality was computed with *Ucinet-5*, software developed for these measures [18]. The expressions for the computations are at the end of this paper. Table 1, Table 2, and Table 3 show a sample of the results.

Table 1
Degree Centrality (normalized values)

Year	Mean	Standard Deviation	Maximum
1952	20.679	29.207	82.5
1957	47.712	64.846	166.667
1962	58.033	67.406	175.641
1968	62.334	71.004	198.864
1980	19.238	16.503	65.957

Table 2
Eigenvalue Centrality (normalized values)

Year	Mean	Standard Deviation	Maximum
1952	7.552	13.780	40.596
1957	8.451	13.482	32.318
1962	8.941	13.162	31.927
1968	8.261	12.509	32.986
1980	4.791	19.842	139.720

Table 3
Degree Centrality (normalized values) of the two largest banks

Year	Banco Nacional de Mexico	Banco de Comercio	Maximum
1952	3.75	56.25	B. de Chihuahua: 82.5
1957	5.128	93.58	B. Comercio. De Torreon: 166.667
1962	5.128	101.28	B. Com. de Yucatan: 175.64
1968	4.54	62.5	B. Com. de Guadalajara.: 198.864
1980	27.65	57.44	B. Serfin: 65.957

Table 1 and Table 2 show the computation of average, standard deviation and maximum value for standardized degree centrality and Eigenvalue centrality. Table 3 shows the value of the two largest banks compared with the maximum value and its respective bank. It is noteworthy that the average degree centrality increased along time, and some increase can be also observed in the Eigenvalue centrality. Maximum values

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[17] The information of some banks is missing for each year; however, these are minor cases of the entire population (approx. 10-15% missing and these tended to be the smaller banks).

[18] Bogarti, Everett and Freeman, 1999.

also increased. Variance is high because many banks had no interlocks (hence, values are equal to 0). Banks belonging to the Banco de Comercio system tended to have a higher centrality than the majority of the other entities. This occurred because banks of that system had both interconnections among themselves and with outsider banks.

Additionally it is well known that between 1952 and 1968, the largest banks were not necessarily the most interconnected. In 1980, after the consolidation of the banking system into multi-banks, the best-connected banks tended to be large entities. This took place because large banks merged smaller banks during the multi-bank consolidation of 1975; in many cases, this implied incorporation of board members of the merged banks into the new entity. This process demonstrates the profound effect of the consolidation process on the structure of the network.

5. Implications. Calibrating the Effect of Networks at the Interior of the Banking Industry

The main hypothesis of this paper is that the network—i.e., links across the boards of the banking industry—permitted banks to avoid idiosyncratic risks by means of an enhanced transmission of information. At the same time, an extension of the argument is that if the network permitted transmission of information among banks, there was an open window for the coordination and discipline for oligopolic practices; thus, well-interconnected banks benefitted economically. In this section, I will first prove that we cannot reject the former hypothesis; second I will show that we cannot confirm the latter. Both tests will be done using panel regression estimates.

The first step was to estimate measures for interconnections among banks, previously shown in Section 4 of this paper. I will now prove the hypotheses using panel regression analysis to contrast indicators of performance against the interconnections among firms. An indicator of performance is the ratio of non-performing loans over total loans. This ratio permits us to approximate quality in the administration of credit, which principally depends on the information a bank possesses concerning borrowers and the way in which the loan process is carried out (allocation and monitoring included). Systemic risks will also affect this measure, but considering that regressions are based on all industry data, relative effects on every single bank might be neutralized. When contrasted with accessibility to information, non-performing loans would render an idea of how banks were able to prevent adverse selection. Another indicator of performance used here is return on equity, the classic measure of a bank's profitability.

Implications: Information Exchange and Prevention of Adverse Selection

By making information more available, the flow of information through networks helps to avoid adverse selection in the lending process. In this section I will test the hypothesis that networks of interlocking directorates facilitated the flow of information within the banking sector, thus helping to prevent adverse selection.

A regression analysis of this type needs to cover all the firms of the commercial banking industry during the years under study; therefore, it is necessary to pool cross-

sectional with time series information. The years measured are 1952, 1957, 1962, 1968, and 1980. The information is tested in a linear functional form. A function expressing a relationship between measurement for interconnections (measures of centrality) and levels of idiosyncratic risks (non-performing loans) is the following:

(1)   Non-performing loans over total loans $_{t,i}$ = α + β (centrality)$_{t,i}$ +
    + χ (time trend)$_{t,i}$ + δ ((time trend) (centrality))$_{t,i}$ + $\varepsilon_{t,i}$

The previous expression represents the linear relationship between centrality measurements on the network of each bank (i = bank), with respect to the ratio of non-performing loans over total loans along the entire period. A time trend and an interaction variable are added to the regression to detect the effect of time on the relationship. The regression will be estimated as a least squares panel regression: i.e., a linear estimation of the relationship that covers cross-sectional and time series information. Because the dependent variable are non-performing loans over total loans ratio, the hypothesis to test is if a larger degree of centrality (more interconnections) permitted banks to have (proportionally) fewer bad credits ($\beta<0$).

Results are shown in Table 4 and Table 5. In Table 4, the regression is estimated with the degree centrality of the network. Degree centrality captures the level of direct interconnections of a bank. The overall regression is statistically significant. The coefficient of degree centrality is statistically significant and negative, as expected, which does not permit the rejection of the hypothesis that banks with more interlocks had more access to information (and as a result were able to better prevent adverse selection).

Table 4
Panel Regression 1. All Commercial Banks; 1952, 1957, 1962, 1968, 1980.
Dependent variable: Non-performing loans over total loans

Variable	Coefficient	Error	t-statistic
Centrality Degree	-0.643864E-03	0.183011E-03	-3.51818
Time trend	-0.177271E-02	0.432481E-03	-4.09893
(time trend)(Centrality Degree)	0.222252E-04	0.925358E-05	2.40179
Constant	0.093446	0.914185E-02	10.2218

R-squared = 0.100053
Adjusted R-squared = 0.091563
Durbin-Watson = 1.84605 [0.060, 0.112]

Table 5
Panel Regression 2. All Commercial Banks; 1952, 1957, 1962, 1968, 1980.
Dependent variable: Non-performing loans over total loans

Variable	Coefficient	Error	t-statistic
Eigen Centrality	-0.216614E-02	0.490068E-03	-4.42008
Time trend	-0.165998E-02	0.379501E-03	-4.37410
(time trend)(eigen centrality)	0.784575E-02	0.291677E-02	2.68988
Constant	0.090784	0.840740E-02	10.7981

R-squared = 0.110348
Adjusted R-squared = 0.101955
Durbin-Watson = 1.89624 [0.135, 0.223]

In Table 5, the regression is estimated using eigenvalue centrality of the network. Eigenvalue centrality gauges the level of interconnection of a bank and weights it with the centrality of banks with which the measured bank has interlocks. The overall regression is statistically significant. As expected, the coefficient of Eigenvalue centrality is statistically significant and negative; this does not permit us to reject the hypothesis that information flowed at the interior of the network. It is clear that banks with more interlocks—and especially banks interlocked with others better positioned in the network—will have more access to information and therefore be able to better prevent adverse selection.

Both regressions indicate that the two levels of transmission of information at the interior of the network helped banks to prevent risks. The coefficients show that Eigenvalue centrality had more impact in access to information; this means that not only did the number of interconnections matter, but also their quality—or to put it more precisely, the positioning of each bank in the network. In addition, this relationship increased over time, which perhaps reflects the increasing importance of informal transmission of information; it may also reflect a learning process among banks that exchanged more information among their directorates, or both.

Extensions for the Transfer of Information: Coordination of Oligopolic Practices

In this section, I will show that we cannot conclude that banks profited by using the network as facilitator of coordination for oligopoly practices. I will show that banks better interconnected in the network were not necessarily more profitable than the remainder of the industry. In order to do this, I estimated a regression analysis that covers all firms of the commercial banking industry during the years under study, pooling cross sectional with time series information. The years measured are also 1952, 1957, 1962, 1968, and 1980. The information will be tested in a linear functional form. A function expressing a measurement for interconnections (centrality) and levels of profitability (return on equity) is the following:

(2) Return on equity $_{t,i}$ = α + β (Eigenvalue centrality) $_{t,i}$ +
+ χ (time trend) $_{t,i}$ + δ ((time trend) (centrality)) $_{t,i}$ + $\varepsilon_{t,i}$

The previous expression represents the linear relationship between eigenvalue centrality measures on the network each single bank (i = bank) with respect to return on equity along all the period. A time trend and an interaction variable are added to the regression to know the effect of time on the relationship. The regression will be estimated as a least squares panel regression: i.e., a linear estimation of the relationship that covers cross-sectional and time series information. Since the dependent variable is return on equity, the hypothesis to test is if a larger degree of eigenvalue centrality (more interconnections along the entire network) permitted banks to have (proportionally) more profitability or rents than the remainder of the industry ($\beta > 0$).

The results are shown on Table 6. The regression is estimated with the eigenvalue centrality of the network. The coefficient of degree centrality is not statistically significant, which allows us to reject the hypothesis that banks with more interlocks were more profitable than their counterparts in the industry.

Table 6
Panel Regression 3. All Commercial Banks, 1952, 1957, 1962, 1968, 1980.
Dependent variable: Return on Equity.

Variable	Coefficient	Error	t-statistic
Eigen Centrality	-.155371E-02	0.169810E-02	-0.914968
Time trend	0.736464E-02	0.131498E-02	5.60056
(time trend)(eigen centrality)	0.015129	0.010107	1.49691
Constant	0.085072	0.029132	2.92024

R-squared = 0.127669
Adjusted R-squared = 0.119440
Durbin-Watson = 1.98897 [.394, 0.528]

The previous regression, together with the last two regressions, show a pattern in which banks with more interconnections in the network prevented risks better but are not necessarily more profitable. This means that privileged information on highly profitable business was not transmitted through the network. This also means that we cannot assert that banks were exercising oligopolic coordination and discipline via interlocking directorates. However, the main reason why this did not occur is because profitability depended on other factors much more related to the nature of the investments they financed. Indeed, it is plausible to say that the choice of "good" investments for banks depended on strategic variables such as positioning in the market, involvement with a successful business group, and selection of highly profitable projects to finance.

I carried out econometric tests changing the samples. More specifically, I excluded all affiliates of *sistema* Banco de Comercio in one case, and excluded the year 1980 in another. Results were similar to the previous regressions in terms of signs and statistical significance of coefficients. Nevertheless, the effect of *sistema* Banco de

Comercio in the tests is noteworthy in that they affect the statistical significance in the test with degree centrality (to a t-value=1.22). This means that important flows of information were carried out in the Banco de Comercio network. Considering this, further econometric tests must be done, responding to questions different from those addressed in this paper.

6. Concluding Remarks

The quantitative analysis in this paper permitted to make an inferential argument concerning the nature of information transmission across the network of Mexican commercial banks. Although the argument is inferential and the fact that there could be many reasons why particular cases behaved in one way or another, results showed existing patterns in the behavior and performance of banks. The patterns observed when connecting quantitative and qualitative information—namely, social interconnections captured in the sociomatrices of the network, variables of financial performance, and historical evidence—demonstrate the manner in which the historical organization of economic institutions and actors affects economic outcomes.

This analysis has three important implications. One is that the Mexican banking industry operated in an environment in which information availability and institutional enforcement was not optimal for financial transactions; thus, private mechanisms were permitted to overcome such market imperfections. Another implication is that as a consequence of better informational flow at the interior of the network, information originally privileged becomes "more public", at least within that environment. A third implication is that the organizational composition of an industry, in particular the position of firms at the interior of networks, can affect the economic performance of certain firms.

There are, however, some caveats to the analysis presented in this paper. In particular, there are limitations on information that the measures of centrality can accurately detect. In this sense, measures of centrality are a lower bound to approximate access to the information that bankers possessed. I would like to point out three of these limitations. One factor that the measures of centrality presented here do not capture is access to information that many board members had outside the banking system. In this regard, this does not account the linkages that a bank might have outside the banking system. For instance, large banks, such as Banco Nacional de Mexico, often incorporated in their board several important capitalists who certainly had access to more information about the Mexican economy than the average directorate had. Another factor that measures of centrality do not detect is diversity in the ability to collect and process information that each member of the boards possessed. This is also an important factor that depends on the cognitive abilities of the actors, their professional skills, and their training. However, the principal intention of this paper is to detect patterns across the banking system, rather than particular observations beyond the mainstream lines. Moreover, the panel regression would cancel the possible weight these observations had over the financial outcome of some banks, and detect the dominant patterns.

A third factor that measures of centrality do not detect is the weight that each member of the board had at its interior. Decision making at board meetings might vary according to the legal position of the members. Nevertheless, this does not present a

problem for the argument in this paper because the main concern here is the distribution of and access to information.

Most contemporary problems of economic growth and development have their roots in the past. However, these problems have complex origins because they evolve historically with cumulative events; in this fashion, the economic, social, and political systems overlap. Formal explorations on the interaction of economic activities and social composition must be undertaken to better understand the historical roots of economic development. This paper intended to emphasize the historical significance of the problem and its implications for economic performance. Some important new investigations might spring from the historical analysis presented in this paper. One such investigation would be to model the incentive mechanisms that motivated different forms of informational exchange in the network, as well as the formation of the network itself. Another is to analyze the evolution of the network and the external factors that affected it. The first represents a future task for economists; the second for sociologists.

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Appendix.

Measuring degree centrality and the eigenvalue centrality

Expressions for the measures of degree centrality and the eigenvalue centrality according to Faust, K., 1997 and Wasserman, S. and Faust, K., 1994 are the following:

Degree centrality for a bank, an event k:

$$C_D^M (m_k) = \sum_{l=1}^{h} (x_{kl}^M)$$

where x is the value of the tie among bank k and bank l;

and degree centrality standardized by the size of the sample of banks, the number of events h:

$$C_D^{M*} (m_k) = \frac{C_D^M (m_k)}{h - 1}$$

Eigen value centrality of a bank (event) k:

$$C_E^M (m_k) = \frac{1}{\lambda} \sum_{i=1}^{h} c_E^M (n_i) \cdot a_{ik}$$

λ is the largest eigenvalue of A, the matrix of association of directorates (actors) and banks (events);
c is the centrality of the actor i,
a is the affiliation of actor i to event k;

and degree centrality standardized by the size of the sample of banks:

$$C_E^{M*} (m_k) = \frac{C_E^M (m_k)}{h - 1}$$