



Networks and History's Generalizations: Comparing the Financial Systems of Germany, Japan, Great Britain, and the United States of America.

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If it is correct to generalize that, historically, Germany and Japan have had bank-oriented or bank-dominated financial systems, while Great Britain and the United States have had more market-oriented financial systems, then different network structures may have characterized these pairs' financial systems. We explore that possibility, along with a few possible reasons that might account for such differing network characteristics. We also consider if viewing modern financial systems as networks and examining their network externalities might support some scholars' contentions that economic growth, both historically and in recent decades, was somewhat dependent on well-functioning financial systems and may even have been finance led.

One of the more durable generalizations of economic, business, and financial historians, is that during the nineteenth and twentieth centuries there were similarities between the German and Japanese financial systems, which differed substantially from the British and American financial systems. The alternatives to this generalization include, at one extreme, the assertion that each of these four national financial systems had unique characteristics. At the other extreme is the contention that all four systems were essentially similar, at least some points in time.

The origins of the generalization can be traced to the influential writings of Alexander Gerschenkron.¹ Germany in the nineteenth century, according to Gerschenkron, was a latecomer to industrialization and financial capital was scarcer there than it was for earlier industrializers such as Great Britain. To overcome this disadvantage, Germans perfected the universal bank, which combined commercial and investment banking,

¹ Alexander Gerschenkron, *Economic Backwardness in Historical Perspective* (Cambridge, Mass., 1962).

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channeled finance into industrial investment, and nurtured German companies from the cradle to the grave. In contrast, earlier industrialization in Great Britain was characterized by more abundant capital, fairly refined securities, and money markets that provided alternatives to banks for companies seeking external finance. Therefore, Britain's banking system developed a functional specialization absent in Germany, with commercial banks specializing in short-term commercial lending and merchant/investment banks specializing in floating company securities and other forms of long-term company finance.

Gerschenkron's insights into the differing characteristics of German and British banking became a paradigmatic model for scholars to extend to the banking and financial histories of many other countries. Japan, for example, seemed to be more like Germany, with banks dominating the external financing of companies, whereas the United States, where securities markets and banking developed in tandem, was more like Britain. The initial distinction Gerschenkron made between German and British banking practices was generalized. Financial systems as a rule are either bank-dominated or have a market orientation in which banks compete with each other and with securities markets to finance businesses. Historians and financial economists continue to debate the generalization, search for explanations for it, and consider the economic and other effects of what some call "the battle of the systems."²

Accepting the generalization without necessarily endorsing it, we examine it in the context of modern network concepts. Such concepts are just beginning to be applied to historical questions. Because modern financial systems are complex networks, network concepts may illuminate financial history in new ways. If different types of networks do in fact capture important differences among historical financial systems, then we may have added confidence in our generalizations. If not, then perhaps we need to rethink these generalizations. If this exploratory essay offers useful insights, we invite other scholars to explore the network and moral hazard characteristics of the German, Japanese, U.K, and other countries' financial systems and their possible implications for financial-system differences.

Financial Systems in International Comparison

Business historians tend to agree that Anglo-American financial systems differed from their counterparts in Germany and Japan. In Germany and Japan, external financing traditionally came from banks with which borrowers had long-standing and deep relationships. In both Germany and Japan, banks held significant equity stakes in non-financial firms and often exerted some degree of managerial control over borrowers. Although banks were also an important source of external business

² Douglas J. Forsyth and Daniel Verdier, *The Origins of National Financial Systems: Alexander Gerschenkron Reconsidered* (London, 2003).

financing in Great Britain, British bankers traditionally did not attempt to own equity stakes in or attempt to exert managerial control over their business borrowers, preferring to maintain “arms-length” or market-based relationships. The same held true for most U.S. banks, although there have been documented cases of “insider lending” in some regions of the country³ Moreover, many British and U.S. firms obtained a good deal of their external financing directly from the capital and money markets via stock and bond issues. We accept those stylized differences between bank-oriented (German and Japanese) and market-oriented (British and U.S.) financial systems as having some validity, or at least adherents. However, the nature of the differences and why they emerged require further explication and explanation.

Japan. After Japan’s Meiji Restoration, a handful of *zaibatsu*, family-owned and family-controlled conglomerate-like organizations composed of multiple firms spread over a variety of disparate industries, came to dominate the upper echelons of the rapidly developing Japanese economy. Each *zaibatsu* established a bank or banks that eventually formed close relationships with both member and external firms. Interestingly, depositors forced the *zaibatsu* banks to diversify by withdrawing their funds from banks known to lend to too few borrowers. In fact, in 1904, Mitsui Bank, the lead bank of the Mitsui *zaibatsu*, was forced to publicly declare, “[I]t’s extremely unsound and improper for Mitsui to invest in its own enterprises funds received on deposits from others.”⁴ Already accustomed to forming “relational” contracts with intra-*zaibatsu* borrowers, *zaibatsu* banks proceeded to extend the practice to their extra-*zaibatsu* borrowers as well.

Briefly, relational contracts are characterized by “contact, not contract.”⁵ Considerably less expensive than formal, attorney-created, court-mediated “classical” contracts, relational contracts arise in any society when the parties to a contract feel that they can “trust” each other.⁶ Trust arises from three main sources. The first is incentive alignment, as

³ Naomi Lamoreaux, *Insider Lending: Banks, Personal Connections, and Economic Development in Industrial New England* (New York, 1994).

⁴ Frank Packer, “Before Main Banks: A Selective Overview of Japan’s Prewar Financial System,” Policy Research Working Paper No. 1537, The World Bank (1995), 3-6.

⁵ D. Eleanor Westney, “Japanese Enterprise Faces the Twenty-First Century,” in *The Twenty-First-Century Firm: Changing Economic Organization in International Perspective*, ed. Paul DiMaggio (Princeton, N.J., 2001), 105-44, quotation at 122.

⁶ Erik Berglof and Enrico Perrotti, “The Governance Structure of the Japanese Financial *Keiretsu*,” *Journal of Financial Economics* 36 (1994): 259-284; Jeffrey H. Dyer, “To Sue or *Keiretsu*: A Comparison of Partnering in the United States and Japan,” in *Networks, Markets, and the Pacific Rim: Studies in Strategy*, ed. W. Mark Fruin (New York, 1998).

in a repeated, profitable “game.” Examples include extensive cross shareholdings and other forms of taking “financial hostages.”⁷ The trillions of dollars of foreign exchange contracts traded on oral contracts each day are a modern example of such a repeated, profitable game.⁸

Second, are reputation effects, the long-term dealings that have reduced information asymmetry over time. *Zaibatsu*, *keiretsu*, and other forms of business networks are some obvious examples.⁹

The third source is low societal rates of default. Some societies exhibit lower levels of moral hazard than others; that is, *ceteris paribus*, in some countries it is less likely than in others that a party to a contract will engage in opportunistic behavior. Where systemic moral hazard is low, as in Japan, the chance of a firm being “held up” by, say, a supplier is low, and hence, at the margin, purchasing from a supplier with which a firm has a long-standing relationship becomes more attractive than owning the supplier.¹⁰ Where moral hazard (opportunistic behavior, for example) is greater, as it perhaps is in the United States, the attraction of owning suppliers, and hence the attraction of large, vertically-integrated corporations is greater.

Bank-borrower relationships in Japan grew even closer when borrowers ran into financial difficulties.¹¹ The strict Japanese bankruptcy system was the prime reason. Japanese bankruptcy courts often refused to hear cases, and when they did, managers often lost their jobs and stockholders received no compensation. Faced with such bleak prospects, troubled Japanese firms clung to their bankers for aid and succor.¹² Interestingly, strict bankruptcy rules may have induced Japanese companies to form *zaibatsu* in the first place, and later vertical and horizontal *keiretsu*.¹³ Because bankruptcy costs and economic uncertainty were so high, Japanese companies found it necessary to have access to a bank likely to help them through difficult times.¹⁴ They also found it

⁷ Dyer, “To Sue or *Keiretsu*,” 247, 250.

⁸ Amitai Aviram, “Regulation by Networks.” Chicago Working Paper Series, <http://www.law.uchicago.edu/Lawecon/index.html> (2003): 8-9; accessed 7 Oct. 2004.

⁹ Aviram, “Regulation by Networks,” 9; Dyer, “To Sue or *Keiretsu*,” 246-47; Toshio Yamagishi and Midori Yamagishi, “Trust and Commitment as Alternative Responses to Social Uncertainty,” in *Networks, Markets, and the Pacific Rim: Studies in Strategy*, ed. W. Mark Fruin (New York, 1998), 111.

¹⁰ Westney, “Japanese Enterprise Faces the Twenty-First Century,” 112.

¹¹ Berglof and Perotti, “The Governance Structure of the Japanese Financial *Keiretsu*,” 260-63.

¹² Packer, “Before Main Banks,” 6-7.

¹³ Westney, “Japanese Enterprise Faces the Twenty-First Century,” 117-21.

¹⁴ Huei-Huang Wang, *Technology, Economic Security, State, and the Political Economy of Economic Networks: A Historical and Comparative Research on the Evolution of Economic Networks in Taiwan and Japan* (New York, 1998), 273-74.

advantageous to keep their firms relatively small, at least in legal terms. That way, unprofitable portions of their operations would not threaten to drag down a larger organization. In terms of Ronald Coase's insight into what firms do for themselves and what they rely on markets to do, Japanese managers, cognizant of the high costs of bankruptcy, found it optimal to limit their firms' size. In contrast to Coase's modeling of the firm's decision, however, managers did not see the market as the only alternative to outright ownership. A third way, forming close relationships with other firms and banks, was open to them thanks to the relatively low level of systemic moral hazard inherent in Japanese society.¹⁵

Until the 1920s, Japan was home to a few relatively large *zaibatsu* banks and numerous smaller banking institutions. Structural and legal changes following the Great Kanto Earthquake spurred a wave of exits of smaller banks in the 1920s and 1930s. Most of the surviving deposits shifted to Japan's postal savings system, but some ended up in the *zaibatsu* banks. By 1940, only 357 banks remained, down from about 1,400 in 1927. The shift to fewer, larger banks before Pearl Harbor set the stage for Japan's postwar banking system.¹⁶

After the war and occupation, Japan developed a system in which "main banks" supplied most external business finance. Of particular interest is the network of firms or *keiretsu* of which the main bank itself may have been a component. A *keiretsu* is a non-familial but nonetheless *zaibatsu*-like conglomeration characterized by "extensive intra-group trade and a capital structure with elaborate cross-holdings of debt and equity, a strong domination for the group's main bank in corporate borrowing, and historically high levels of gearing in member firms." According to one study, up to 84 percent of the firms listed on the 1981 Tokyo stock exchange were *keiretsu* members.¹⁷

Postwar Japanese main banks possessed three main characteristics. First, they were major lenders to their main-bank clients (who received more than 25 percent of total loans). Second, they held fairly substantial blocks of shares (5 -10 percent) of their clients' equity. Third, main banks were represented in their clients' management, particularly during times of distress.¹⁸ According to Paul Sheard, "the flow of executives is almost entirely from banks to corporate clients; there is almost no flow in the

¹⁵ Dyer, "To Sue or *Keiretsu*."

¹⁶ Packer, "Before Main Banks," 9-10.

¹⁷ Berglof and Perotti, "The Governance Structure of the Japanese Financial *Keiretsu*," 259-60.

¹⁸ Paul Sheard, "Japanese Corporate Boards and the Role of Bank Directors," in *Networks, Markets, and the Pacific Rim: Studies in Strategy*, ed. W. Mark Fruin, (New York, 1998), 201, 212-13.

reverse direction.”¹⁹ Most major Japanese firms, and many small ones, still partner with a main bank.²⁰

Germany. In German history, scholars find a pattern similar to Japan’s, although with different terminologies and somewhat different causal mechanisms. Low systemic moral hazard, harsh bankruptcy rules, and informal bank-led restructurings also characterize the German system.²¹ These factors may also explain the German predilection for government-sponsored cartels, “congeries of firms,”²² and more formally-integrated *konzerne*.²³ After all, we can view cartels of smaller German firms as an alternative way to gain the greater market power that large, integrated firms possessed in the United States, which we posit as having higher moral hazard than Germany and Japan.

In addition, as in Japan, German businesses were often subject to the strong influence of “universal” or “great” banks that made loans to them, arranged securities sales for them, and played major roles in corporate control and governance. The main institutional force in the German case was that owners of corporate shares traditionally deposited their shares in the banks and ceded their voting rights by proxy to the great banks.²⁴ As in Japan, German businesses often clustered into groups. Unlike in Japan, however, German banks took direct, if partial, control of their clients and borrowers, overseeing firms (as was sometimes said) from the cradle to the grave. In Japan, banks were generally considered part of broader, consensual *keiretsu* decision-making processes, whereas in Germany the banks were often viewed as the primary decision makers.²⁵

¹⁹ Sheard, “Japanese Corporate Boards,” 204.

²⁰ Packer, “Before Main Banks,” 2; Sheard, “Japanese Corporate Boards,” 200.

²¹ Allen B. Frankel and John D. Montgomery, “Financial Structure: An International Perspective,” *Brookings Papers on Economic Activity* 1 (1991): 257-97.

²² Paul DiMaggio, “Introduction: Making Sense of the Contemporary Firm and Prefiguring Its Future,” in *The Twenty-First-Century Firm: Changing Economic Organization in International Perspective*, ed. Paul DiMaggio (Princeton, N.J., 2001), 3-30.

²³ Jeffrey Fear, “August Thyssen and German Steel,” in *Creating Modern Capitalism: How Entrepreneurs, Companies, and Countries Triumphed in Three Industrial Revolutions*, ed. Thomas McCraw (Cambridge, Mass. 1995), 183-226; Jeffrey Fear, “German Capitalism,” in *Creating Modern Capitalism: How Entrepreneurs, Companies, and Countries Triumphed in Three Industrial Revolutions*, ed. Thomas McCraw (Cambridge, Mass., 1995), 133-82.

²⁴ Frankel and Montgomery, “Financial Structure,” 285-86.

²⁵ DiMaggio, “Introduction,” 24; Frankel and Montgomery, “Financial Structure,” 286; Sheard, “Japanese Corporate Boards,” 224-25.

Great Britain and the United States. Anglo-American financial systems are often viewed as distinctly different from German and Japanese systems. In Anglo-American capital markets, investors typically are either equity holders or debt holders, not both. For instance, suppliers might extend credit to their customers, but rarely own those customers' stock. In Continental Europe and Asia, by contrast, "enterprises are part of complex customer and supplier networks where financing patterns and trade are interlinked; financial institutions hold both corporate debt and equity."²⁶

British and U.S. financial networks and their supporting legal structures differ from one another, but share certain core features.²⁷ For example, "in the United States and the United Kingdom, it has been a basic tenet that a bank with an equity interest in another firm should be presumed incapable of dispassionate analysis of that firm's creditworthiness."²⁸ The potential for conflicts of interest between the lending and the equity investing functions led in the United States to their legal separation under the Glass-Steagall Act from the 1930s to the 1990s. In Britain, the same division of financing between commercial and merchant bankers emerged without legislation. However, "in countries with universal banking traditions, the presumption [against combining commercial and investment banking] is reversed."²⁹ In these countries, what the Anglo-American systems perceive to be a threatening conflict of interest was actually encouraged in the interest of supporting strong bank-firm relationships.

Britain and the United States did differ in some ways. U.S. firms tapped securities markets much more extensively than U.K. firms did. From 1969 to 1979, for instance, U.S. firms actually borrowed more dollars directly in the markets than from banks. Over that same period, U.K. firms raised only a small percentage of their funds from financial markets, interestingly enough about the same percentage as Japanese and German firms did.³⁰ There is evidence that the Americans' greater use of securities markets extended far back into history.³¹ When it comes to banking regulations, as opposed to lending practices, U.S. banks resembled those

²⁶ Berglof and Perotti, "The Governance Structure of the Japanese Financial *Keiretsu*," 259-60.

²⁷ L. C. B. Gower, "Some Contrasts Between British and American Corporation Law," *Harvard Law Review* 69 (June 1956): 1,369-1,402; Robert E. Wright, ed., *The History of Corporate Finance: Development of Anglo-American Securities Markets, Financial Practices, Theories and Laws* 6 vols. (London, 2003).

²⁸ Frankel and Montgomery, "Financial Structure," 258.

²⁹ *Ibid.*

³⁰ *Ibid.*, 257.

³¹ Richard Sylla, "U.S. Securities Markets and the Banking System, 1790-1840," *Federal Reserve Bank of St. Louis Review* 80 (May/June 1998): 83-104; Peter L. Rousseau and Richard Sylla, "Emerging Financial Markets and Early U.S. Growth," *Explorations in Economic History*, forthcoming.

of Japan more closely than those of Britain. British banks were more like, or at least freer to be more like, German universal banks than British and German banks were like U.S. or Japanese banks, especially regarding branching and the overall level of formal regulatory oversight.³² Banking restrictions and regulations probably account for these differences, with American and Japanese banks being subject to stricter regulatory regimes than British and German banks.

The practices of U.S. and U.K. banks, however, were similar. Unlike German banks, which in 1988 held 12 percent of the outstanding stock of German firms, and Japanese banks, which that same year held 21 percent of the outstanding stock of Japanese companies, Anglo-American banks, generally eschewed equity ownership or managerial influence, even when and where it was allowed, at least since the decline of U.S. “financial capitalism” in the early twentieth century.³³

This is not to say that Anglo-American banks disdained long-term relationships with borrowers. Such relationships were economically rational in the face of asymmetric information, as admirers of German and Japanese bank-firm relationships have long noted. Rather, the connection between Anglo-American banks and their borrowers was dominated by formal rather than relational contracts.³⁴ A likely reason for this is that Anglo-American bankruptcy law contrasted sharply with bankruptcy law and practice in Germany and Japan. In general, Anglo-American courts penalized banks that formed close relationships with customers while in Germany and Japan the courts shielded banks, even at the expense of other creditors.³⁵ Therefore, Anglo-American banks had incentives to avoid close relationships with borrowers. Moreover, in the face of relatively low bankruptcy costs, Anglo-American firms did not have major incentives to create or maintain captive banks or to cloister their core businesses behind thick corporate walls.

Financial Systems as Networks

Networks are systems of interconnected components known as nodes. The nature of the interconnections (for example, their direction, quality, intensity, and frequency) varies over different network types.³⁶ In

³² Frankel and Montgomery, “Financial Structure,” 278.

³³ Ibid., 285; George D. Smith and Richard Sylla, *The Transformation of Financial Capitalism: An Essay on the History of American Capital Markets* (New York, 1993).

³⁴ Frankel and Montgomery, “Financial Structure,” 286-87.

³⁵ Ibid., 288-91.

³⁶ David F. Batten, “The Evolutionary Network Economy: Historical Parallels from Europe and Japan,” in *Patterns of a Network Economy*, ed. Borje Johansson, Charlie Karlsson, and Lars Westin (New York, 1994), 91; Anna Nagurney and Stavros Siokos, *Financial Networks: Statics and Dynamics* (New York, 1997), 3.

hierarchical parts of networks, for instance, nodular power is asymmetric and information flows are largely unidirectional.³⁷ The phrase “hierarchical parts of networks” may strike some readers as a strange construction because in some scholarly traditions—business history, for example—hierarchies, markets, and networks are different things.³⁸ Mark Fruin, for example, states, “the three most common models and ideal types of organization are hierarchies (as bureaucracies and firms are often called), markets, and networks.”³⁹ Discerning the difference between hierarchies, markets, and networks, however, turns out to be difficult.⁴⁰ We argue that “hierarchy” and “market” are best used to describe the nature of nodal interconnections, and not organizations, institutions, or other things.

A node may contain within itself one or more networks, so if a given entity or system is called a network or a node depends on nothing more than the level of aggregation under study.⁴¹ Therefore, New York City’s subway system can be studied as a network in and of itself, or it can be viewed as just one of many nodes in national or international transportation systems. Similarly, a company intranet can be considered a network or simply as a node on the Internet. On the other hand, some nodes, called “basal nodes” here, are not networks but rather the fundamental elements or building blocks from which all networks are ultimately formed. In the digital world, computing devices called microchips are the primary type of basal node. Microchips are embedded in a variety of shells, such as personal computers (PCs), handhelds, and even mobile phones. In the social world, individual human beings are the most common basal nodes. Firms, the usual level of analysis of business historians, are networks, often ones with porous or ill-defined boundaries, rather than basal nodes.⁴² Nations, tribes, and clans are also networks. (Families or households represent a gray area that need not concern us here.)

Once one begins to think of the world as increasingly complex, layered interconnections of basal nodes, seemingly everything becomes a

³⁷ Charlie Karlsson and Lars Westin, “Patterns of a Network Economy—An Introduction,” in *Patterns of a Network Economy*, ed. Borje Johansson, Charlie Karlsson, and Lars Westin (New York, 1994), 5.

³⁸ Roberta Capello and Tomaso Pompili, “From Trade Flows to Corporate Networks,” in *Patterns of a Network Economy*, ed. Borje Johansson, Charlie Karlsson, and Lars Westin (New York, 1994), 160.

³⁹ W. Mark Fruin, “Analyzing Pacific Rim Networks and Markets: An Introduction,” in *Networks, Markets, and the Pacific Rim: Studies in Strategy*, ed. W. Mark Fruin (New York, 1998), 3.

⁴⁰ DiMaggio, “Introduction,” 4-5; Fruin, “Analyzing Pacific Rim Networks,” 4-7.

⁴¹ Batten, “The Evolutionary Network Economy,” 91; Fruin, “Analyzing Pacific Rim Networks,” 7; Karlsson and Westin, “Patterns of a Network Economy,” 3.

⁴² DiMaggio, “Introduction,” 3-4.

network: cities, states, and their governments;⁴³ business firms and other organizations; webs of socioeconomic relationships in early Maine;⁴⁴ electricity grids; each component of the natural environment, the ecosystem, including Northwest Coast salmon fisheries and the Argentine Pampas; Stanford University graduates living in Tokyo; roads and other means of transportation; trading systems;⁴⁵ and even property rights.⁴⁶

A whole world of networks is even more complex. Multiple basal nodes (for example, PCs) are needed to create a first-level network (for example, a departmental LAN), and multiples of those are needed to create a second-level network (for example, a campus intranet), and so forth. More confusingly still, different types of networks interact at multiple levels.⁴⁷ Individual humans own and operate PCs, for instance, which they use to access high-level computer networks, such as the Internet, to make reservations on transportation networks, such as the European rail system, by transferring funds via a financial network, possibly via a credit or debit card.⁴⁸

Scholars have increasingly come to see financial systems as networks.⁴⁹ We concur, insofar as the term “financial system” implies the existence of links between nodes. Many writers are looser in the use of the term “financial system,” however. They treat financial “system” and financial “sector” as synonymous, implying the existence of a system no matter how segmented or disjointed a given financial sector might be in a given country. In contrast, we contend, and will try to show, that the financial sectors of the early United States, Great Britain, Germany, and Japan were truly “systems,” and hence networks.

This issue is far from semantic. According to “Metcalf’s law” (after Robert Metcalfe, founder of 3Com Corporation and inventor of the Ethernet), the social value of a network is roughly proportional to the number of users squared. A single post office, train station, telegraph, telephone, or computer is essentially useless. Add a second office, station, and so forth each additional connection increases the value of the network exponentially.⁵⁰ Networks, in other words, are characterized by increasing returns to scale, not the constant or diminishing returns to scale that led

⁴³ Batten, “The Evolutionary Network Economy.”

⁴⁴ Laurel Thatcher Ulrich, *A Midwife’s Tale: The Life of Martha Ballard, Based on Her Diary, 1785-1812* (New York, 1990).

⁴⁵ Batten, “The Evolutionary Network Economy.”

⁴⁶ Nagurney and Siokos, *Financial Networks*, 3; Fruin, “Analyzing Pacific Rim Networks,” 4, 7; Karlsson and Westin, “Patterns of a Network Economy,” 6-8.

⁴⁷ Karlsson and Westin, “Patterns of a Network Economy,” 5.

⁴⁸ Batten, “The Evolutionary Network Economy,” 91.

⁴⁹ Nagurney and Siokos, *Financial Networks*, 4-11; Aviram, “Regulation by Networks.”

⁵⁰ Aviram, “Regulation by Networks,” 11-13; Hernando De Soto, *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else* (New York, 2000), 72.

many classical economists to conclude that the economy would eventually reach a steady state or non-growth stage.⁵¹ To the extent that financial systems are networks and Metcalfe's Law applies to them, the financial sector is characterized by increasing returns to scale. This is not to say that each firm or network segment will enjoy scale economies, however; it is the scale of the network that matters.

The policy implication of the insight that financial systems are networks is far-reaching. To the extent that Metcalfe's Law holds, policies ought to encourage the growth of the financial system because as the number of nodes or users that become part of the system increases, the financial network becomes more valuable to everyone. An obvious rebuttal is that financial systems are fundamentally different from, and less stable than, say, electronic and transportation networks. Financial systems provide economies with essential goods, like transaction media, intermediation services, liquidity, and price discovery that must not be interrupted. Quality of the network components in this view trumps quantity, so the appropriate policy regime is restrictive or regulated.⁵²

Our view is more nuanced. We believe that the underlying network structure of financial systems will evolve to match the demands of the respective external environments.⁵³ In other words, as they grow (the number of nodes increases) networks spontaneously form in a way that mitigates potential quality problems.⁵⁴ Given the high opportunity costs of trying to anticipate and stymie all potential threats, financial systems develop to meet the exigencies of their respective environments. Therefore, like biological species, financial-system networks can reduce the damage stemming from cyclical or otherwise expected shocks, but unexpected shocks, or new types of shocks, may cause considerable pain.⁵⁵ Financial systems, like biological species, face a positive probability of severe damage or even outright extinction. Hence, we should not expect financial networks, even highly regulated ones, to be immune to "panics," "contagion" (note the unconscious use of biological terms), or other disruptions. The good news is that the probability of a catastrophic shock is low, and financial-system networks can adapt to avoid or limit the damage of many shocks.

⁵¹ William Easterly, *The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics* (Cambridge, Mass., 2002), 145-69.

⁵² Batten, "The Evolutionary Network Economy," 91.

⁵³ Fruin, "Analyzing Pacific Rim Networks," 11.

⁵⁴ Aviram, "Regulation by Networks," 39-47; Morris Teubal and Ehud Zuscovitch, "Demand Revealing and Knowledge Differentiation Through Network Evolution," in *Patterns of a Network Economy*, ed. Borje Johansson, Charlie Karlsson, and Lars Westin (New York, 1994), 28-29.

⁵⁵ David J. Bryce and Jitendra V. Singh, "The Future of the Firm from an Evolutionary Perspective," in *The Twenty-First-Century Firm: Changing Economic Organization in International Perspective*, ed. Paul DiMaggio (Princeton, N.J., 2001), 161-85.

Endowed with relatively low levels of systemic moral hazard, in our view the Japanese and German financial networks are analogous to computer networks. Their financial systems may have evolved into hierarchical networks: networks where connections between nodes follow pre-figured, relatively rigid pathways, and where some nodes serve as network managers or “servers.” Such hierarchical networks are efficient because they limit transaction costs. Simple rules or heuristics quickly complete routine transactions and even solve simple or well-understood problems.⁵⁶

The purported relative dominance of German banks over the firms that borrowed from them suggests that the analogy can be pushed even further. German banks function like a mainframe computer; their borrowers are like terminals. In this respect, the German financial system is a “master-slave”⁵⁷ network, like the mainframe-terminal configurations common on many college and corporate campuses during the 1960s and 1970s. Terminals can send or request information from the mainframe, but all data manipulation is done in the mainframe’s processors and the mainframe controls all outputs (for example, e-mail and printing). Terminals communicate with other networks only through the mainframe; they are usually physically wired to the mainframe and only to the mainframe. Like mainframe computers, German banks (“masters”) control their client firms (“slaves”) by owning and controlling them through formal contracts (physical connections) like share ownership, proxy voting, and board memberships.

The relative autonomy of Japanese firms (clients) vis-à-vis their banks (servers) suggests that the proper analogy for the Japanese financial system might be a client-server network, such as an Ethernet LAN (local area network), a corporate intranet, or the Internet. In such networks, servers hold an informationally superior position. Servers do not control network nodes, which have their own powerful, independent storage and information processing capabilities. However, they do regulate the ability of nodes to access other nodes and output peripherals (for example, shared printers) on the same network. They may or may not also regulate nodes’ access to other networks. (For instance, on campus a professor’s office computer can connect to the Internet, but only through an institutional server. A home computer, by contrast, may connect to the Internet through a choice of several different Internet Service Providers (ISPs.) Servers may allow nodes to access (may lend to nodes) their computer programs and/or storage space. Finally, connection type can vary in intensity, from hard-wired LANs (that is, formal contracts), to

⁵⁶ DiMaggio, “Introduction,” 8.

⁵⁷ The master-slave terminology adopted from the network literature should not be interpreted as a negative comment on the German financial system. It is only an analogy, and mainframe-terminal configurations still play a major role in the computer world.

remote Wide Area Networks or WANs (that is, relational contracts), or to temporary dial-in connections such as America Online (that is, market exchanges). In short, servers partially own and control nodes over a variety of connection types, much as Japanese banks partially own and control their client-borrowers with a variety of relationship-contract types.

If the computer network analogies hold, the Japanese financial system suffered in the 1990s after the collapse of the 1980s bubble, while the German system, which absorbed a huge shock after the fall of the Berlin Wall, did not suffer because of its different network structure. Specifically, Japanese servers expended too much network capacity attempting to keep some of their nodes from failing. Diversion of network bandwidth degraded network quality, leading to difficulties with additional nodes. Many of the network's looser connections, like relational contracts, were severed or transformed. In short, the Japanese financial system caught the equivalent of a computer virus. That virus used the network's hierarchical connections to spread quickly, and it used the network's relatively decentralized structure to hide, replicate, and retransmit itself. More than a decade later, Japan's financial Information Technology specialists are still trying to repair the damage.

In the German or master-slave system, banks (mainframes) could more effectively discover and root out trouble spots (viruses) because of the relatively stronger control they exerted over their clients (nodes). Moreover, terminal-nodes communicate only with the mainframe, so virus transmission channels are fewer and hence more easily monitored.⁵⁸

Computer-network analogies do not work as well with Anglo-American style financial systems because the connections between nodes are rarely rigid. Today, node A may interact with nodes B, C, and D. Tomorrow, however, node A may interact with nodes E, F, and G, and the day after that with B, F, H, Q, and T. In other words, the physical cables that connect mainframes to terminals or servers to nodes simply do not characterize such financial systems. Anglo-American financial systems are therefore more akin to neural networks, like mammalian brains, that do not rely on rigid, hierarchical connections.⁵⁹

Endowed (we think) with relatively higher levels of systemic moral hazard than faced German and Japanese financial systems, Anglo-American financial systems evolved to be smart (good at reducing information asymmetry) rather than bureaucratically efficient. Instead of following predetermined pathways from nodes to servers (and vice versa), information suffuses neural networks in seemingly random or chaotic ways. The result is a flexible and adaptable web of (seemingly) constantly

⁵⁸ This is not an argument that the German (master-slave) system is superior; merely that it can handle node-level viruses more efficiently than the Japanese (client-server) system.

⁵⁹ Joseph S. Zirilli, *Financial Prediction Using Neural Networks* (Boston, 1997), ix.

changing nodal connections.⁶⁰ Somehow, through all the apparent confusion, the neural network itself makes decisions regarding the value of nodes (assets, projects, and firms).⁶¹ In the words of Scott McNealy, former Chief Executive Officer of Sun Microsystems, the network in this case *is* the computer.⁶²

We can extend the analogy a step further. The U.S. financial system (and perhaps the British system as well), like a mammalian brain, has two well-developed specialized hemispheres. In a healthy person, the two hemispheres cooperate almost seamlessly, while at the same time competing for sensory input and other resources.⁶³ Similarly, the U.S. financial system has two specialized parts—intermediaries and markets—that cooperate and compete at the same time. Firms (nodes or neurons) opt for lower-cost, but the observation of firms' decisions provides valuable information. For instance, financial intermediaries such as banks and insurance companies can observe the price of a company's bonds over time in the bond market to help them make their lending and investing decisions; at the same time, bond-market investors can observe the company's level of bank debt on its balance sheet.

Neural networks are extremely powerful and flexible-computing devices capable of creative or insightful leaps of logic as formerly unconnected nodes (neurons) make new connections. An example might be the innovation of so-called junk-bond markets, which are markets for high-yield debt that allow firms previously able to access only banks for loans an alternative market-based source of external financing. Given enough time and information, "neural" financial networks can make highly specific, nuanced judgments, even predictions.⁶⁴ The tradeoff is loss of efficiency. Some insights and predictions may turn out after the fact to have been ill-advised, even idiotic, such as a lender lending to a firm about to enter bankruptcy, or an investor purchasing its stock. Neural networks can sometimes make mistakes, even on very simple problems. Moreover, they can unlearn (forget) information or skills that are not repeated or practiced often enough—which of us human neural networks has not had that experience?

Both competition and cooperation among intermediaries and markets can offset some of these efficiency losses. Competition increases the efficiency of the system by providing borrowers with a viable alternative source of external finance. Cooperation also increases efficiency by creating and disseminating information about borrowers (credit bureaus, bond rating agencies), and by allowing each hemisphere to leverage its absolute advantage in making certain types of decisions.

⁶⁰ DiMaggio, "Introduction," 14.

⁶¹ Zirilli, *Financial Prediction*, ix, 3.

⁶² Fruin, "Analyzing Pacific Rim Networks," 11.

⁶³ Zirilli, *Financial Prediction*, 3.

⁶⁴ *Ibid.*, 18.

The degree of cooperation in financial networks is not always appreciated, but it is fairly intense.⁶⁵ For example, securities serve as collateral for commercial bank loans, financial intermediaries raise capital by issuing securities, bankers' balances increase stock market liquidity by being put out as call loans, bank loans and home mortgages are bundled into tranches and sold in the markets (that is, securitized), and so on.

Again, the argument here is not that one type of network structure is superior to another. Rather it is that networks evolved—à la Armen Alchian—to match the challenges posed by their respective environments.⁶⁶ We have explained how one aspect of the external environment, the stringency of bankruptcy laws, may have influenced managers' decisions about the optimal size of the firm and the optimal type of network connection to create with other nodes such as banks. Next, we address the role of another environmental characteristic, systemic moral hazard, and its possible role in the evolution of different financial network structures.

Systemic Moral Hazard and Optimal Network Structure

We do not hold the view, demolished by Kozo Yamamura, that the Japanese are somehow more nationalistic or community-oriented than Westerners.⁶⁷ Nor do we hold the view, similarly demolished by Toshio and Midori Yamagishi, that the Japanese are naturally more trusting than Westerners.⁶⁸ We nonetheless think it is possible to contend that Japanese society is endowed with a lower level of systemic moral hazard than U.S. society. We also think it likely that British society is probably closer on a moral-hazard scale to U.S. society, while Germany is closer to Japan.

With no one clear indicator of moral hazard, we can offer no compelling quantitative evidence that the degree of moral hazard varies over time and place. Historical evidence of such differences is rife, however. Perhaps due to a fear of strangers or strangeness, some societies are “stricter” than others.⁶⁹ In strict societies, people closely monitor each other's behavior and are quick to punish—via the state, the church, the market, or the woodshed—any deviant behavior. In lax societies, by contrast, people tend to ignore others' behavior unless it negatively impinges on them personally. They often neglect to report suspicious or even clearly criminal activity.

⁶⁵ Karlsson and Westin, “Patterns of a Network Economy,” 3.

⁶⁶ Armen Alchian, “Uncertainty, Evolution, and Economic Theory,” *Journal of Political Economy* 58 (June 1950): 211-21.

⁶⁷ Kozo Yamamura, “A Re-examination of Entrepreneurship in Meiji Japan (1868-1912),” *Economic History Review* 21 (April 1968): 144-58.

⁶⁸ Yamagishi and Yamagishi, “Trust and Commitment as Alternative Responses.”

⁶⁹ *Ibid.*, 114.

More traditional, more authoritarian societies tend to be stricter (less lax) than more dynamic, more democratic societies. People in strict societies were socialized to behave as agents of the state, the aristocracy, or the church.⁷⁰ Criminal or untoward activity was still possible, but it was relatively more easily detected than in lax societies, essentially because a large segment of the population felt obligated to monitor the activities of others. With God, the priests, the governors, and their minions seemingly everywhere, the expected cost of breaking laws or mores increased. For starters, misbehavers were likely to be caught. Perhaps worse, they were likely to face long-term consequences as their neighbors, business associates, and co-religionists discovered, remembered, and only slowly forgave their transgressions. A result of the high costs of misbehaving was, of course a lower systemic level of moral hazard. Japan's low crime levels could be one manifestation of the relatively strict nature of Japanese society. Germany's rules, regulations (for example, store opening and closing hours), labor-market rigidities, and respect for police forces could similarly be a manifestation of social strictness.

In laxer, Anglo-American societies, by contrast, crime rates were generally much higher than in Japan and Germany. Britain once had so many convicts in its jails that it was deemed prudent to stash them in old ships and export them to the Georgia colony in America and to Australia. American jails also brimmed, and still do. Anglo-Americans generally displayed less respect for the law, social mores, or business ethics. Other factors equal, they were less likely to be caught than in stricter societies, and if they were caught, they received relatively light punishment. If the punishment was still too hard, they could reduce it by skipping town, state, region, or even the entire nation. Their new neighbors, after all, were not likely to make serious inquiries into their past. Hernando De Soto describes the alacrity with which seventeenth and eighteenth century Anglo-Americans created wealth by ignoring statutes that would otherwise have impeded economic growth.⁷¹ Essentially, they created regulatory arbitrage opportunities by establishing extralegal property rights systems. They were not a people easily cowed by tradition or authority.

In the 1830s, Canadian Alfred Domett nicely summarized the difference between lax Anglo Canada and strict Franco Canada:

The Upper-Canadians [Ontario], who are mostly Yankee-bred, are the very Antipodes of the Lower [Quebec], mostly French-bred. The Upper is stiff and boorish, if not impertinent, sturdy and shows little respect of persons. The Lower is smooth, obsequious, lively, polite. Both will

⁷⁰ Alexis de Tocqueville, "Democracy in America," in *The Character of Americans: A Book of Readings*, ed. Michael McGiffert (Homewood, Ill., 1970), 49.

⁷¹ De Soto, *The Mystery of Capital*, 105-52.

probably cheat you, *but the Upper to a greater extent and far more audaciously.*⁷²

Domett further explained, “the security and confidence with respect to property arises in the Lower country from their honest and primitive character.” Ontario, however, was a different story because its Yankee-bred inhabitants were constantly “bustling, changing, money-getting [and] improving.”⁷³ A few years later, Charles Buller too referred to the “lawless and wild race that peopled the frontiers, especially the shores of the Great Lakes.”⁷⁴

Especially in the United States, laxity was the order of the day. One early observer of American-ness, J. Hector St. John de Crevecoeur, noted that “religion demands but little” of Americans and government even less.⁷⁵ According to nineteenth-century British scholar of U.S. institutions, James Bryce, “Americans are good-natured people...disposed to take a charitable view even of wrong-doers.” “Nowhere,” he noted, “is cruelty more abhorred.” “As everybody knows,” Bryce continued, “juries are more lenient to offences of all kinds but one, offences against women, than they are anywhere in Europe.”⁷⁶ Late nineteenth-century U.S. historian Henry Adams also identified laxity as an American trait. “The increasing cheerfulness of religion” was one sign. “Mild” punishments and the ability of “every offender [to] cast off his past, and create a new career,” was another.⁷⁷

Indeed, Americans were extremely mobile geographically. In the late 1820s, Captain Basil Hall of the Royal Navy noted that one of America’s peculiarities was the “unbounded room in which her population may rove about.”⁷⁸ “In a society composed of such loose materials, as the active, roving population of America,” Hall contended, “it is almost impossible, except at the great cities, to find men of education and high

⁷² Emphasis added. E. A. Horsman and Lillian Benson, eds., *The Canadian Journal of Alfred Domett: Being an Extract from a Journal of a Tour in Canada, the United States and Jamaica, 1833-1835* (London, 1955), 47.

⁷³ Horsman and Benson, *The Canadian Journal of Alfred Domett*, 47.

⁷⁴ Charles Lucas, ed. *Lord Durham’s Report on the Affairs of British North America* 3 vols. (New York, 1970), 3: 348.

⁷⁵ J. Hector St. John de Crevecoeur, “What Is an American?” in *The Character of Americans: A Book of Readings*, ed. Michael McGiffert (Homewood, Ill., 1970), 43.

⁷⁶ James Bryce, “The American Character in the 1880s,” *The Character of Americans: A Book of Readings*, ed. Michael McGiffert (Homewood, Ill., 1970), 71.

⁷⁷ Henry Adams, “The Shaping of National Character,” in *The Character of Americans: A Book of Readings*, ed. Michael McGiffert (Homewood, Ill., 1970), 93-94.

⁷⁸ Basil Hall, *Travels in North America in the Years 1827 and 1828* (Edinburgh, Scotland, 1829), 108.

character to fill...judicial situations.”⁷⁹ It was a rare foreign traveler indeed who did not comment on the American predisposition to move frequently, and often over great distances.⁸⁰

Adding to the high level of moral hazard was what Lord Selkirk, among many others, called Americans’ “sordid attention to money.” Lacking both an aristocracy and widespread poverty, almost all Americans were middle class, at least by contemporary British, German and Japanese standards. Moreover, that broad equality meant that competition in all walks of economic life was keen. To get ahead one had to engage in “speculation,” “sharp practices,” or worse. According to Selkirk, “every Gentleman who is acquainted with the back settlers speaks with disgust of their moral character.”⁸¹ Aristocratic prejudice? Perhaps. Selkirk readily added, “all admit of [the back settlers’] activity & sagacity.”⁸²

The “general equality of conditions” also struck Alexis de Tocqueville as problematic. In fact, he proclaimed such equality “the fundamental fact from which all others seem to be derived.”⁸³ In the land of meritocracy, he argued, people were “constantly haunted by the apprehension” of losing whatever wealth and status they had built for themselves.⁸⁴ A grasping sort of materialism, “a love of physical prosperity,” was the result.⁸⁵

Another French traveler, Michael Chevalier, extolled the benefits of American economic freedom:

Every one is at liberty to work, to choose his profession, and to change it twenty times; every one has the right to go and come on his business, at pleasure, and to transport his person and his industry from the centre to the circumference, and from the circumference to the centre.⁸⁶

Chevalier noted, however, that such “liberty...is abused by some individuals.”⁸⁷ That is the essence of a higher level of moral hazard.

Earlier we noted that Japan and Germany historically have had stricter (more anti-debtor) bankruptcy laws than Britain and the United States. This difference, we suggested, may have encouraged closer bank-

⁷⁹ Hall, *Travels in North America*, 428.

⁸⁰ Michael Chevalier, *Society, Manners and Politics in the United States, Being a Series of Letters on North America* (Boston, 1839), 330; Joseph Gurney, *A Journey in North America, Described in Familiar Letters to Amelia Opie* (Norwich, 1841), 88; Crèvecoeur, “What Is an American?,” 45.

⁸¹ Patrick White, ed., *Lord Selkirk’s Diary, 1803-1804: A Journal of His Travels in British North America and the Northeastern United States* (Toronto, 1958), 130.

⁸² White, *Lord Selkirk’s Diary*, 131.

⁸³ Tocqueville, “Democracy in America,” 47.

⁸⁴ *Ibid.*, 54.

⁸⁵ *Ibid.*, 66-67.

⁸⁶ Chevalier, *Society, Manners and Politics in the United States*, 330.

⁸⁷ *Ibid.*, 330.

firm relationships in Japan and Germany than the typical arms-length relations of the Anglo-Americans. In fact, these bankruptcy-law differences may well reflect a higher tolerance of moral hazard as well as a higher value attached to entrepreneurial risk-taking among the Anglo-Americans. These characteristics were not always present in Anglo-American societies. More likely they appeared in the eighteenth century, at the time both Britain and the United States first saw the emergence of modern financial systems. According to legal historian Bruce Mann, writing of the United States in that century:

...the rapid spread of written credit instruments in the increasingly commercialized economies before the Revolution marked the intrusion of impersonal market relations into lives that until then had been governed more communally. The assignability of notes and bonds severed the connection between debts and their underlying social relations, thereby making possible a transformation in the relations between debtors and creditors. At the same time, paper money permitted more people to participate more freely in the economy, while the sudden emergence of a consumer marketplace created both wants and the promise of satisfying them.... Large-scale speculation in land and government securities transformed the interdependency between debtor and creditor and far-reaching social, economic, political, and legal consequences. The rise of speculation as the investment of choice helped redefine insolvency from a moral delict to an economic one....⁸⁸

Mann says that this “redefinition of insolvency from sin to risk, from moral failure to economic failure,” prompted the enactment of more liberal, pro-debtor bankruptcy laws.⁸⁹ Germany and Japan with their later-developing financial systems may not have traveled quite so far down this road. If so, it could help account for differing, and possibly persisting, network characteristics among the financial systems of these developed economies.

Positive and Negative Externalities Inherent in Networks: The U.S. Case

By comparing the German and Japanese systems with the Anglo-American systems relative bank and securities-market orientations with respect to the provision of external finance for business firms, we have only hinted at the network structures of modern financial systems. Modern financial systems are more complex. Their key components do include banks (banking systems), securities markets, and corporations, the increasingly

⁸⁸ Bruce H. Mann, *Republic of Debtors: Bankruptcy in the Age of American Independence* (Cambridge, Mass., 2002), 4.

⁸⁹ *Ibid.*, 5.

dominant organization form of business enterprise chartered by governments and distinguished by limited liability and by issuing corporate securities.

The other key components of modern financial systems include government finance, central banks, and money itself. Governments have always taxed and spent, but modern governments also borrow on a large scale, creating securitized national debts in the process. Indeed, the historical origins of securities markets appear to lie in the creation of such public debts, not in the issue of corporate securities, which were established only after markets for government securities were already in existence.

Central banks are entities created by governments and charged with serving as government banks and with supervising, regulating, and stabilizing other banks, monetary and payments systems, and the financial system as a whole. Initially, central banks were just the banks of governments, often called for that reason “public banks.” Along with public treasuries, they served as governments’ fiscal agents. Because of their large size relative to other banks as well as their special relationship with governments, public banks in varying degrees and at varying rates discovered that they could have impacts—for good or ill—on their countries’ overall financial systems. They thus evolved into modern central banks with additional functions.

Money, a key feature of any financial system that is so basic that we often take it for granted, is also defined and often created by governments. Among history’s first moneys were precious metals and coins made from them. When fractional-reserve banking developed, precious metals became the monetary base, into which bank-created moneys (bank notes and deposits transferable by check) were convertible. In recent history, although there were precedents in earlier centuries, fiat paper money has replaced the precious metals as the monetary base. Central banks typically create the fiat monetary base, and fractional-reserve banks multiply it into the total money stock by creating bank moneys that are convertible back into it.

We can visualize these key components as key nodes of a large and interconnected network that is the financial system itself. There may be gains for historians in such visualization. After all, one of the greatest questions addressed by economic historians is why nations such as Great Britain, the United States, Germany, and Japan, for example, have become vastly richer than the great majority of other nations. There are many possible answers. One that we as financial historians deem promising is that the rich countries became rich because they developed all of the key nodes of a modern financial system before others did and quickly networked them to form the system. We think that many historical studies support this contention because “financial revolutions,” that is, bursts of financial innovation resulting in the creation of modern financial systems, as well as less revolutionary financial developments that tend in the same

direction, appear to precede the economic development that made the rich countries so rich. In short, modern economic growth was finance led.

Happily, the work of financial economists analyzing the rich, multi-country datasets covering recent decades appears to confirm the evidence from centuries past. In recent decades, more developed banking systems and securities markets are associated with higher rates of economic growth across nations in ways that appear to be causal, that is, economic growth continues to be finance led. Interestingly, the evidence is strongest for less developed countries and weaker as an explanation of growth differences among rich countries. Perhaps this is because rich countries all have highly-developed financial systems, so that growth differences are mainly due to other than financial-systemic differences.

This leads us toward a conclusion that financial development is particularly important, both historically and in the contemporary world, for making the transition from relative poverty to relative affluence. Why might that be? What characteristics of modern financial systems make them crucial in bringing about the transition from poverty to affluence?

Network concepts may help to provide answers to such questions, for modern financial systems are surely sophisticated networks. Perhaps they are even the first complex, articulated networks to emerge in modern history, because they antedate telegraphic, telephonic and other modern communication networks, rail and other modern transportation networks, electrical networks, and the Internet.

How can network concepts help us toward an understanding of why economic growth in history might have been finance led, and why today among the less developed countries it still appears to be finance led? We can apply Metcalfe's law that the social value of a network is roughly proportional to the number of users squared to our thinking about the social value of the financial nodes and networks that emerged in the U.S. financial revolution of the early 1790s. This is a particularly interesting case because the United States began that decade with none of the components of a modern financial system, but during the decade acquired all of them.⁹⁰

Government finance was the first key node of the financial network/system. A network of Treasury agents efficiently collected the taxes Congress levied on imports and a few articles of domestic production and forwarded the proceeds to the Treasury and the three banks it initially used in Boston, New York, and Philadelphia. This became the basis for Treasury Secretary Alexander Hamilton's plan, enacted by Congress, to restructure the national debt into three new securities issues. Suddenly there was a network of thousands of bondholders receiving quarterly interest payments from the Treasury node. Active securities markets, another node or nodes, grew up in the three cities where the new bonds,

⁹⁰ Richard Sylla, "Financial Systems and Economic Modernization," *Journal of Economic History* 62 (June 2002): 277-92.

along with an initially small but growing number of corporate equities, were bought and sold. The securities-market node(s) attracted buyers and sellers by providing the network externalities of liquidity and price discovery.⁹¹ As more buyers and sellers participated in these markets, liquidity increased and price discovery became more efficient, making participation even more attractive. The securities markets of the three cities became linked into a larger network, a national market of sorts for national securities.

The banking node existed in 1790, but it was not yet a banking system. There were just three banks but they were merely local banks in Boston, New York, and Philadelphia that were not linked into a network. That rapidly changed beginning in 1791 when Congress erected another of the pillars of Secretary Hamilton's financial-system plan by chartering the Bank of the United States (BUS) as a central bank with branching privileges. Its appearance stimulated the states to charter more banks; by 1795, there were 20 state-chartered banks and five branches of the BUS. The BUS with five branches itself formed a banking network. However, it was also linked to the state banks and the Treasury. All the banks issued convertible bank notes denominated in U.S. dollars, the currency defined in 1791 by gold and silver (the money node), and all received—and sometimes created in the process of lending—deposits subject to check. The banks received, paid out, and exchanged with one another, bank notes and checks. The United States had a banking system and a central bank, two more nodes of a modern financial network. As more people used the banking system for loans and making payments, its network value—its network externalities—increased rapidly, as Metcalfe's law predicts. Perhaps for that reason the banking network itself rapidly grew. By 1805, there were 71 state-chartered banks and 9 branches of the BUS ranging from Boston to Savannah to New Orleans.

These banks were corporations that represented the banking, the central banking, and the corporation nodes of a modern financial network. They raised their capitals by selling corporate stock to investors, an activity greatly facilitated by the rapid development of the securities-markets node that gave securities liquidity and accurately priced them. In return, banks aided the securities markets by accepting securities as collateral for bank loans, thus adding to the liquidity of securities and to the banks' business.

Banks, however, were far from the only corporate beneficiaries of securities markets. The new financial system in the 1790s encouraged the formation of other categories of corporations: insurance, navigation, bridge, turnpike, water supply, manufacturing, and mining companies. There was a ready market for the stock of these initial public offerings

⁹¹ Robert B. Ahdieh, "Making Markets: Network Effects and the Role of Law in the Creation of Strong Securities Markets," *Southern California Law Review* 76 (Jan. 2003): 277.

(IPOs), in part because there were trading markets to give equity shares liquidity. In the two years 1791-1792, more corporations were chartered than had been chartered in all previous years of American history, beginning with colonial times. In the decade of the 1790s, more than 300 business corporations received state charters, compared with 26 during the 1780s. As with the other nodes, this was just the start of a financial network expansion that has continued in the United States to this day.

In addition to these positive externalities, financial networks also create negative externalities. The most obvious example of a negative externality is a financial “panic,” a period of perceived crisis when most nodes seek to change less liquid assets into cash or base money as quickly as possible. As the term implies, a financial panic is not entirely rational. In most cases, the mad dash for liquidity arising from the fear of an impending panic or collapse becomes a self-fulfilling prophecy. Due to some shock, perhaps an unexpected piece of bad news, basal nodes (individual stock and bond owners, bank depositors and note holders) question the quality or value of their assets or of their links to other nodes. Fearing the worst, many seek to divest simultaneously. Others simply stop buying new assets. Many sellers and few buyers create big price decreases that cause yet more uncertainty and selling. A vicious, downward spiral quickly develops. Eager for information, nodes bombard the network with information requests, most of which go unanswered. Uncertainty skyrockets. With information flows stymied, basal and other nodes continue selling. Prices continue to drop until exhausted nodes cease sending frantic network requests or a few nodes discover that prices have fallen to irrationally low levels. They begin to buy enough to stop the slide but it will be weeks, months, even years before asset prices return to their pre-Panic prices.

Panics also afflict hierarchical networks but they are more easily contained if the network administrator (central banker) quickly shuts down or shores up the servers linked to the original trouble spot. In a neural network, where linkages are both numerous and largely unknown, the best response to panic may be to inundate the system with cash, the financial equivalent of brain endorphins, in what has come to be known as acting as a “lender of last resort.” Alexander Hamilton in 1792, and Alan Greenspan in 1987, each injected liquidity into crashing securities markets. The plethora of cash suffuses the “brain,” calming the “neurons” by reducing the uncertainty caused by the initial shock, subsequent selling, and dearth of information.

In addition to creating both positive and negative externalities, networks also can be good regulators. First, they can reduce the damage caused by defaults by quickly “covering,” them, for example, by finding an alternative counterparty. Besides reducing risks, such activity deters the types of opportunism based on renegotiating agreements with captive

customers.⁹² Second, networks wield a powerful sanction that serves to limit opportunistic behavior: exile or exclusion from the network. Recall that the value of a network is roughly equal to the number of nodes squared. By excluding a troublemaker, the network's value decreases a little [from n^2 to $(n-1)^2$], but the exile's loss is total or nearly so. Therefore, networks have incentives to identify and expel rogue nodes and have the leverage to do so.⁹³ As noted, computer network servers (and Japanese and German banks) can shut down node access to the network and its benefits, such as printers and e-mail (loans and discounts, payments processing), as can British and U.S. banks in more arms-length situations.⁹⁴

Conclusions

Financial systems can be viewed as networks that enjoy Metcalfean (increasing) scale economies. We characterize financial network structures here by the types of interconnections that link their nodes: strong (ownership, hierarchy), medium (relational contracting), and weak (market). Those structures evolve to meet the exigencies of their external environments, including bankruptcy laws and the degree of systemic moral hazard. In the United States, where systemic moral hazard was high and bankruptcy laws were pro-company, the financial system evolved into a neural network (brain), a sophisticated learning entity characterized by numerous, shifting market connections. In Germany and Japan, where systemic moral hazard was low but bankruptcy laws were anti-company, the financial system evolved into a hierarchical network, similar to a computer network, characterized by relational or ownership ties. Neither network structure is superior to the other in any absolute sense. The optimal tradeoff between efficiency (computer) and predictive capability (neural) varies depending on the external environment. The positive network externalities created by modern financial systems, which appear to have been large in various historical contexts, may contain the seeds of an explanation of why economic growth and development, and the transition from relative poverty to relative affluence, appears in many cases to have been finance led.

Our paper is exploratory. We have examined "stylized" differences among financial systems described by previous financial historians within the new framework of networks. Although we are unsure of the fruitfulness of this approach, some analogies arising in the exploration are intriguing. We are more convinced that thinking about financial systems as complex, sophisticated networks, and exploring the positive and negative network externalities of such systems, is more productive than the sort of reductionism that made financial history little more than the

⁹² Aviram, "Regulation by Networks," 18-20.

⁹³ Aviram, "Regulation by Networks," 21-22.

⁹⁴ *Ibid.*, 22-23.

history of banks and banking systems.⁹⁵ Such an approach may well help us to discover just why historical economic development in a wide range of settings, from Europe to America to Asia, appears to have been finance led.

⁹⁵ Albert-Laslo Barabasi, *Linked: The New Science of Networks* (Cambridge, Mass., 2002).