The Political Economy of Global Finance: A Complex Network Model

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Abstract

Although the subprime crisis regenerated interest in and stimulated debate about how to study the politics of global finance, it has not sparked the development of new approaches to IPE: IPE remains firmly rooted in actor-centered models. This paper develops an alternative network-based approach that shifts the analytical focus to the relations between actors. We first depict the contemporary global financial system as a network, with a particularly focus on its hierarchical structure. We then explore key characteristics of this global financial network, including how the hierarchic network structure shapes the dynamics of financial contagion and the source and persistence of power. Throughout, we strive to relate existing research to our network approach in order to highlight exactly where this approach accommodates, where it extends, and where it challenges existing knowledge generated by actor-centered models. We conclude by suggesting that a network approach enables us to construct a systemic IPE that is theoretically and empirically pluralist.

The international financial crisis of 2007-08 has sparked a resurgence of research on the politics of global finance and become a bit of a focal point in an ongoing debate between the American and British schools about the future of international political economy (see e.g., Helleiner 2011; Helleiner and Pagliari 2011; Deeg 2009). Benjamin Cohen, already critical of the American school prior to the crisis, asserted that the field's failure to anticipate the crisis is an embarrassment equivalent to the failure to predict the collapse of the Soviet Union twenty years earlier (Cohen 2009). He attributes this failure to the reigning epistemology. Particularly problematic in his view is the commitment to "mid-level theory building, focused on key relationships isolated within a broader structure whose characteristics are assumed, normally, to be given and stable… An epistemology that takes the stability of underlying structures for granted is hardly likely to encourage serious theorizing about broad changes in the global political economy" (Cohen 2009, 440-442). Eric Helleiner (2011) sharpens the point, claiming the failure to predict the crisis was a failure of the American school rather than of IPE generally; the British School, he argues, anticipated many aspects of the crisis (Helleiner 2011, 83).

The American school's response to this critique seems to be succinctly summarized by the assertion that because IPE scholars are "not in the business of predicting financial crises", the failure to anticipate the recent crisis hardly constitutes a failure of scholarship (Mosley and Singer 2009, 420). Mosley and Singer neither propose modifications to nor engage in an extended defense of the epistemology of the American school. Instead, they suggest that the crisis highlights the need to apply this epistemology to substantive issues that received too little attention prior to the crisis. The topics in need of closer scrutiny include cross-national variation in financial regulation, the politics of global financial governance, and the role of private actors in the politics of regulation.

Lacking in this conversation to date is any novel approach to politics of international finance. Helleiner asserts that the chief lesson scholars should draw from the crisis is to engage in more research in the tradition of the British school (Helleiner 2011, 83). Mosley and Singer call for more work in the tradition of the American school. Thus, in spite of calls to use the crisis as an opportunity "to rethink the analytical toolkits…developed prior to the crisis," little actual adjustment of established models has occurred (Helleiner and Pagliari 2011, 185). The absence of an alternative to these two established traditions is particularly troubling for scholars who may agree with Cohen that the failure to anticipate the crisis is a bit embarrassing for the American school of IPE, but are reluctant to embrace fully the British school's historical-interpretive orientation. The need for an alternative is particularly urgent given that research on the politics of global finance is likely to grow exponentially

during the next decade.

We develop an alternative approach to the political economy of global finance based on complex networks. We develop a complex networks approach for two reasons. First, the approach allows us to begin to address a large conceptual gap in current literature. Although the American and British schools differ along many dimensions, on one central dimension they are similar: both focus heavily on actors and devote little explicit attention to how these actors are connected or to the structure within which they act. A complex network model provides a unified empirical structure that we can use to examine how the connections between actors shape individual behavior as well as the performance of the international financial system as a whole. Second, we argue that a network approach can bridge existing epistemological and methodological divides rather than create a new chasm. It encourages scholars from all traditions to focus on a common set of empirical patterns and puzzles, it can support multiple theoretical perspectives as explanations for these patterns and solutions to these puzzles, and it enables multi-method empirical research. In short, we argue that a network approach promises to move research on the political economy of global finance in new and productive directions in a structure that accommodates many existing traditions rather than forcing scholars to choose between them. Throughout, therefore, our goal is to lay out a research agenda based on this network model, to highlight how existing research fits into this approach, and highlight areas of disagreement between our network model and established research when they arise.

We are not the first to apply network analysis to international relations (see, e.g., Kahler 2009; Hafner-Burton et al. 2009; Hafner-Burton and Montgomery 2009; Carpenter 2011). However, there are few applications to politics in the global economy. Most network research focuses on such issues as transnational advocacy networks (Murdie et al. 2010; Carpenter 2011), alliance affiliations (Cranmer et al. forthcoming), weapons proliferation (Montgomery 2008), and conflict patterns (Cranmer and Desmarais 2011; Maoz 2006). The model we elaborate thus seems to be the first effort to conceptualize the global financial system in network terms as well as one of the first applications to international political economy more broadly.

Moreover, our approach to network analysis differs somewhat from other network research in IR. Extant research draws upon sociology's long tradition of social network analysis (SNA). Such analysis characteristically focuses on describing a network structure — who is connected to whom — and evaluating the impact of such connections on node characteristics or node behavior. Carpenter (2011), in a fascinating study of transnational advocacy networks, for example, focuses on how an international organization's position within a network — its "centrality" in network terminology — affects the organization's ability to shape the agenda. Bach and Newman (2010), in their innovative

examination of the transgovernmental network focused on international regulation of insider trading, offer compelling evidence that a state's participation in transgovernmental network has a measurable impact on the regulatory policies it adopts at home.

Without questioning the utility of such social network analysis, and indeed drawing expressly from this tradition at times, we focus our attention more heavily on insights generated by "complex network science" (see Newman 2003). The emerging science of complex networks focuses on three characteristics of networks that together distinguish it from traditional SNA (Newman 2003, 2). First, whereas traditional SNA has focused on relatively small networks that are readily visualized but not easily characterized statistically, complex network theory works with large networks that it characterizes in terms of their statistical properties such as the distribution of links. Second, whereas traditional SNA focuses on how the network shapes node behavior and attributes, complex network theory strives to explain network performance as a function of network structure. Third, whereas traditional SNA has tended to treat network structures statically, complex network theory strives to explain the evolution of network structure why does the network take a particular structure and what shapes the evolution of this structure over time? Thus, while we are reluctant to draw sharp distinctions between traditions that have considerable and important areas of overlap, traditional SNA places relatively greater emphasis on how social relationships shape individual behavior or individual attributes, whereas complex network theory places relatively greater emphasis on how network structure affects network performance, and modeling how the network structure evolves across time.

We organize the paper around these three focal points of complex network science. We focus first on characterizing the network structure of the international financial system in terms of its degree distribution. Employing data on cross-border financial assets, we illustrate the extent to which the contemporary global financial system is a hierarchical network with a clear delineation between international financial centers and peripheral countries. Second, we develop hypotheses about how this hierarchical network structure shapes global financial stability. We suggest that financial crises in global financial centers almost always spark global crises, while financial crises in peripheral systems almost never do. Third, we derive hypotheses about the evolution of the network structure. We focus particular attention on making power endogenous to the dynamics of the hierarchical network. We conceptualize power as network centrality, we highlight how preferential attachment reinforces a state's position in the network long after initial advantages may have dissipated, and we consider whether endogenous crisis are necessary to spark the network restructuring that transfers power from an

established to a rising hegemon. We return to broader themes in the conclusion.

The International Financial System as a Complex Network

Although scholars recognize that the international financial system is a system, existing research has yet to articulate the structure of financial relationships that constitute this system. Current research in American IPE measures the integration of national economies into global capital markets using indices of capital account openness (Quinn 1997; Quinn 2003; Quinn and Toyoda 2007; Chinn and Ito 2008). British school scholarship focuses on how specific financial instruments (such derivatives) financial institutions (hedge funds) and regulatory arrangements (private versus public) affect aspects of financial system performance, but pays little explicit attention to the structure of international financial relationships (see, e.g., Blyth 2003; Bryan and Rafferty 2006; Strange 1998; Porter 2005; Tsingou 2010; Underhill and Zhang 2008). Research in both traditions thus devotes substantial attention to the characteristics of the actors at the center of global finance, but relatively little attention to the connections between them.

Although we do not know why IPE scholars have devoted little attention to the structure of international financial integration, we suspect it is because until quite recently there was no reason to believe that network structure could be an important consideration. Until the end of the 20th century, random network theory dominated research on large complex networks.[1] Random network theory assumes that every large complex network has a similar structure. In statistical terms, random network theory assumes that node degree — the number of ties or links per node — is Poisson distributed. Average and modal degree are identical, and the distribution has steep shoulders. Hence, all nodes are connected to approximately the same degree. Applied to the global financial system, random network theory implied that every country would have approximately the same number of cross-border financial relationships. The most important variation would occur over time and reflect change in average node degree as national financial systems became more and more tightly connected. In this context, it is reasonable to measure the evolution of financial interdependence with indices of capital account openness.

Recent empirical work has made it increasingly apparent that most real world networks fail to conform to the expectations of random network theory. Node degree is rarely Poisson distributed. Instead, most real world networks exhibit hierarchical structures. The prototypical hierarchical structure, a scale-free network, is one in which a few nodes have a very large number of links

[1]For popular accounts of the evolution of research on complex networks see Barabasi (2003) and Watts (2003).

while the vast majority of nodes have very few. Consider links to online blogs (Drezner and Farrell 2008). Although millions of blogs exist, most receive no links from other websites at all. Some attract a few links, and a very small number of blogs attract an extremely large number of links. In true scale-free networks, node degree is power-law distributed — the frequency of node-degree is inversely proportional to degree magnitude (Cederman 2003, 135; see also Bak 1996, 21-24; Jensen 1998, 5). Complex network science has also discovered that network structure affects network performance. As we explore below, how a shock in one node is transmitted throughout the network is powerfully influenced by the network's degree distribution; random networks behave differently than hierarchical networks.

Hence, recent developments in complex network science suggest that how national financial systems are connected may be an important determinant of how the global financial system behaves. That means that we need to model the global financial network structure explicitly. We take an initial step in that direction by using existing data to model the global financial network. We conceptualize the global financial system as a network in which national financial systems constitute the nodes and ties between nodes arise from cross-border financial transactions. Two national financial systems are tied if residents in one system place financial assets in the other. The global financial system is a directed network because residents in each national financial system can direct their domestic assets into foreign financial systems (out-degree) and each national financial system can accept assets from residents in foreign financial systems (in-degree). For example, when a Japanese bank transfers assets to a bank in the United States, the in-degree of the United States increases as it receives the deposits and the out-degree of Japan increases as it moves savings abroad. Decisions by agents based in each node to establish new ties to other nodes, or to strengthen existing ties, create a structure of cross-border financial relationships.

We constructed financial networks from two separate financial data sources.[2] We constructed one network from Bank for International Settlements (BIS) consolidated banking statistics. These data are somewhat narrow in substantive scope — they include only interbank deposits — and in geographic scope — comprehensive data cover only twenty-four countries. Because of the limited coverage of BIS data, we constructed a second network using data on total cross-border portfolio assets made available by the International Monetary Fund's Coordinated Portfolio Investment Survey (CPIS).[3] These data cover all

[2] We analyzed the BIS data using the "tnet" and "igraph" packages in R. For details on "tnet" see Opsahl (2010). For "igraph" see Csardi and Nepusz (2006).

[3] The International Monetary Fund's Consolidated Portfolio Investment Survey and are holdings of equity securities and long- and short-term debt securities that are not part of the

foreign portfolio assets for 68 countries. Although the content of the two data sets varies, both make clear the extent to which the contemporary global financial system exhibits the hierarchical structure characteristic of scale-free networks.

We look first at the network constructed from banking statistics. Figure 1 depicts this network in the second quarter of 1999 and the first quarter of 2010. Countries are arranged alphabetically counter-clockwise. Ties are weighted and directed.[4] If country *i* holds bank assets in country *j*, a black line connects the two nodes. In this way, the out-degree of *i* is the in-degree of *j*. If *j* holds bank assets in *i*, a gray line marks that tie, and the out-degree of *j* is the in-degree of *i*.[5] Tie thickness represents the size of the bank holdings. Node size is the sum of the country's total in-degree. A white node indicates that total in-degree is greater than total out-degree for that country, meaning that they are net recipients of bank assets. A gray node indicates that the opposite holds. A comparison of the two panels in figure 1 reveals two stark facts: the strength of the international banking relationships grew dramatically over time, as represented by the thickening of ties and increased node size. However, the distribution of the increase in cross-national bank holdings has been highly skewed toward the U.S. and U.K. In other words, the international banking network exhibits a hierarchical structure.

(Figure 1 about here)

The hierarchical structure of the banking network is clearly evident in plots of the network's degree distribution. Figure 2a plots weighted in-degree the number of ties and the average weight of each for each country against each country's rank in the system. Even in this small sample of large economies, large inequalities in the distribution of bank-centered finance are clearly evident: the U.S. and to a lesser extent, the U.K. is strongly connected to more countries than any other country in the sample, and the degree distribution decays exponentially. Figure 2b plots the same data in log-log scale and shows a distribution characteristic of scale-free networks. We stress that our ability to determine whether this distribution conforms to a

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balance of payments data categories of direct investment, reserve assets, or financial derivatives." (IMF 2010).

[4] For the BIS data we plot a circle graph rather than a graph that emphasizes centrality, such as a Fruchterman-Reingold or Kamada-Kawai, because graphs that emphasize centrality are not well suited for networks with weighted and directed ties.

[5] Outflows from countries with alphabetic priority are therefore indicated in black. In Figure 1, for example, the black line between Japan and the United States indicates Japanese bank deposits in the U.S. because Japan 'J' precedes 'U' in the alphabet. Conversely, the black line between Germany and Japan indicates German deposits in Japan. Because the US is last, all black lines connected to the US indicate deposits in the US. Similarly, because Australia is first alphabetically, all gray lines indicate deposits in Australia.

power-law is limited by the small number of nodes (24) in our network.[6] Not withstanding this limitation, however, the global banking network is heavily skewed and has fat tails. This type of distribution is characteristic of hierarchical networks.

(Figure 2 about here)

An almost identical pattern is evident in the global financial network constructed from the IMF CPIS data (figure 3). As a contrast to the weighted ties analysis presented above, we transformed this data in two ways. First, we constructed portfolio shares for each country so that each tie is the percent of economy *i*'s total overseas portfolio assets that it has placed in economy *j*. Second, we created a directed link from economy *i* to economy *j* for any portfolio share greater than 7.5 percent.[7] For example, Argentina places more than 80 percent of its overseas portfolio assets in the United States. Argentina is thus linked to the United States. Argentina places less than 1 percent of its overseas portfolio assets in Australia. Argentina is thus not linked to Australia.

(Figure 3 about here)

The network visualization clearly illustrates the center-periphery structure of the international financial relationships. The U.S. and the U.K. are major global financial hubs. Germany and Luxembourg emerge as important hubs within Europe but are less central to the global financial system. Perhaps surprising is the absence of a regional system in East Asia similar to the regional center-periphery system apparent in Europe. The remaining national financial systems are connected to one or more of the major financial centers and only rarely to other peripheral nodes. Like the network constructed from BIS banking data, therefore, these data highlight the hierarchical center-periphery structure of contemporary global finance.

The skewed degree distribution is powerfully evident when we plot normalized in-degree for all countries (Figure 4). The median and modal in-degree in the sample is zero: half of the national economies in the sample are not important hosts of overseas assets for even a single foreign economy. Some national economies, however, are important hosts of overseas investments for many national economies. The most important center, the U.S., is an important host for the overseas portfolio assets of 72 percent of the economies in the sample. The U.K. is an important host for the overseas assets of 35 percent of these economies. Thus, when we look at a broader category of cross-border financial assets and reduce the importance of country size as a determinant of

[6] We agree with Clauset et al (2009, 30): "For some measured quantities, the answers to questions of scientific interest may not rest upon the distribution following a power law perfectly. It may be enough, for example, that a quantity merely have a heavy-tailed distribution."

[7] We replicated the analysis reported here for a 5 percent threshold. The conclusions do not change markedly.

in-degree, we still observe a highly skewed network structure that clearly delineates between global financial centers and the periphery.[8] Although the small number of nodes in the network again limits our ability to draw definitive conclusions about degree distribution, what is clear is the extent to which the global financial system displays a hierarchical center-periphery structure. The distribution is skewed and exhibits fat tails.

(Figure 4 about here)

Simply as an empirical matter, therefore, the complex network model offers refinements of and extensions to current research. We recognize that its central insight — the Anglo-centric character of the global financial system — is hardly novel. Yet, as far as we are aware, no one has offered an empirical measure of this defining characteristic of contemporary global finance. The network approach also enables us to measure changes in network centrality from one year to the next as a step toward measuring shifts in structural power (Strange 1986; Kirshner 2008; Strange 1998; Schwartz 2009). Such measures might be very useful in research on hegemonic transitions. For instance, we might extend the global financial network back in time to add empirical and historical depth to the current discussion of the dollar's rise as the central reserve currency prior to World War II (Eichengreen and Flandreau 2009). Historical research of this sort would surely advance our understanding of the dynamics at work in the evolving systemic roles of the dollar, the euro, and perhaps even the renminbi.

The approach also offers a measure of country-level financial integration that complements standard capital account openness indices. And while we have focused our discussion here on in-degree, out-degree seems a potentially more useful measure of integration in this context. A measure of how and to whom countries are connected adds a dimension to our measures of financial interdependence lacking from indices of capital account openness. Such measures might allow us, for instance, to build on existing research in the second-image reversed tradition to consider whether countries that are tightly connected to the U.S.-U.K. are subject to different constraints than countries that are more deeply integrated into the Luxo-Germanic hub. We might consider, for example, whether the countries that fared better in the recent global financial crisis did so because of country characteristics such as domestic financial regulation, as existing literature suggests, or because of the structure

[8] The same network topology is evident in a smaller financial network constructed by researchers at the Bank of England (Kubelec and Sa 2008). Kubelec and Sa (2008) analyze financial relationships among 18 economies which together account for as much as 80 percent of cross-border assets in 1985, 1995, and 2005. They find evidence of a scale-free network structure at each point in time. "The distribution of financial links exhibits a long tail…characterized by a large number of small links and a small number of large links."

of their international financial relationships. We might consider whether the structure of connectedness affects the likelihood that current sovereign debt problems in Europe will spread throughout the European Union or whether they are likely to remain contained. While we might expect crises in peripheral nodes such as Greece to remain relatively localized, if larger regional or global nodes are tightly connected to Greece the effects of a local crises may spread. A complex network approach allows us to analyze this question in a systematic way.

We might also strive to explain the pattern of financial relationships as a function of network structure and node characteristics. For instance, why are French financial ties to Germany stronger than French ties to the United States? Does this reflect node characteristics — perhaps something about the structure of French politics that pushes assets to Germany rather than the United States? Perhaps ties reflect adherence to a common model of capitalism, as the varieties of capitalism literature might suggest (see, e.g., Gourevitch and Shinn 2005). Alternatively, does this pattern reflect network characteristics? Perhaps France links to Germany because France links to Italy and Italy links to Germany? Perhaps the pattern reflects homophily — the tendency of individuals to associate with others who are similar — related to the increased institutionalization of politics and economics in continental Europe stemming from the adoption of the euro. If this were the case, then tight European financial integration may be a relatively recent phenomenon.

The network structure also generates some empirical puzzles. For example, why has East Asia not evolved a center-periphery regional structure like that seen in the E.U.? Is the absence of such a regional system a consequence of the Bretton Woods II system that emerged in the late 1990s (Dooley et al. 2004)? Is it because of lower levels of overall economic development in East Asia than in Europe, or because East Asia does not have the same common market and political integration as Europe? Why does Japan remain under-connected (at least in terms of in-degree) to an extent that seems inconsistent with its level of economic and financial development?

The contemporary global financial system is thus characterized by a hierarchical structure similar to that found in many real world networks. This structure suggests three broad avenues for research. First, as we have briefly developed in this section, rendering the network structure explicitly yields new measures to incorporate into existing models and reveals new patterns and puzzles — at the node level, regional level, and global level — that require explanation. The second and third avenues occupy our attention for the rest of this paper: How does network structure affect network performance? Why does the network exhibit this hierarchical structure, and how does the structure evolve over time?

Network Structure and Network Performance: Local Financial Crises and Global Financial Stability

Complex network science posits that network topology shapes network performance. In the case of the global financial system, a particularly important question is the stability of the global financial system in the face of local disturbances. In other words, what determines the likelihood that a banking crisis in one country will spread through cross-border financial ties and generate a major global financial crisis. Indeed, one is hard-pressed to identify anything more central to current discussion about the global financial system than such "financial contagion."

Most discussion about global financial contagion assumes that the risk of global contagion rises continuously as global financial integration deepens (see e.g., Summers 2000; Rogoff 1999; Fischer 1999; Stiglitz 2010b, 2010a; Claessens et al. 2010; Mosley and Singer 2009, 421). Thus, as countries become more tightly integrated, the stability of the global financial system becomes vulnerable to instability anywhere within the system. This hypothesis is consistent with the processes we expect to observe in a highly connected random network characterized by a poisson distribution. In such networks, a banking crisis in any node can spread quickly through the entire network and affect most nodes. In hierarchical networks, in contrast, whether a local disturbance has network-wide consequences depends upon where within the network the disturbance originates. Disturbances in some nodes are very destabilizing, while identical disturbances in other nodes are not. In short, the systemic consequence of a local shock is a function of network structure.

We can elaborate this logic by drawing on the concept of "robust but fragile" property of scale-free networks (Albert et al. 2000; Newman 2003, 16). Scale-free networks are robust because they remain tightly connected in the face of the random removal of nodes. This is not surprising; because most nodes have very few ties, removing a node at random is most likely to remove a low-degree node. Removing a low-degree node has little impact on network connectivity. Scale-free networks are fragile, however, because they fragment into unconnected components when one removes a central node. Hence, the topology of hierarchical networks makes them stable in the face of disruptions in low-degree nodes but highly vulnerable to disturbances in high-degree nodes. Consider the impact that two thunderstorms of equal strength, one in Atlanta, Georgia and one in Wilmington, North Carolina have on national air traffic. Because Atlanta is a central node, a thunderstorm in Atlanta that disrupts takeoffs and landings can affect air traffic nationwide. Because Wilmington is a peripheral node, the same magnitude storm with identical local consequences has little effect on national air traffic. The impact of an identical local disturbance (a thunderstorm) on network performance (national

air traffic) depends upon whether it occurs in a high-degree node (Atlanta) or a low-degree node (Wilmington, NC).

Applied to the hierarchical structure that characterizes the contemporary international financial system, the robust but fragile property of hierarchical networks suggests that whether a local banking crisis will spark a global financial crisis depends upon whether the crisis originates in the center or the periphery.[9] Peripheral crises will rarely generate global crises because peripheral nodes are weakly connected. Because peripheral nodes are connected to few other nodes, a banking crisis in one peripheral system has an impact on balance sheets in a very limited number of other peripheral systems. Although peripheral systems host some assets from the financial center, a peripheral system's holdings of center assets will be a small fraction of the center's bank capital. Consequently, a peripheral crisis rarely imposes losses on the center sufficient to precipitate a banking crisis in the center. The structure of financial relationships between the center and periphery may thus render the global financial system stable in the face of peripheral crises.

In contrast, a banking crisis in a global financial center is highly likely to spark a global crisis. By definition, financial centers are strongly connected. When a financial center experiences a banking crisis, therefore, the assets that peripheral countries have placed there lose substantial value. Because the center attracts such a large share of peripheral assets, the probability that the center crisis imposes losses greater than peripheral bank capital is likely to be quite high. Moreover, banks in financial centers tend to call foreign assets home to shore up their balance sheets, thereby imposing additional strain on peripheral financial systems. And because the vast majority of peripheral countries are connected to the center, the crisis at the center radiates throughout the system. The structure of international financial interdependence may thus render the global financial system highly vulnerable to crises emanating in financial centers.

The asymmetric impact of central and peripheral crises can be illustrated by comparing the ego neighborhoods of a central and a peripheral node (see figure 5). An ego neighborhood contains all nodes linked to the node in

[9]A large literature examines the spread of viruses (human and computer) through network structures (See, e.g., Pastor-Satorras and Vespignani 2001; Dezső and Barabási 2002). It seems natural, therefore, to treat financial contagion — the spread of financial instability from one system to another — as analogous to viral contagion and draw inferences about financial contagion from network models of viral contagion. We think this analogy misleads rather than informs. The spread of viruses is dependent on neither direction nor strength of ties while financial contagion is dependent upon both. In viral contagion, a peripheral node can infect the central node, which can then infect other nodes. We argue that peripheral financial crises don't spread to financial centers because the strength of the directed tie (center assets held in periphery systems) is too weak. For this reason, we do not draw on the network literature on viral contagion in scale-free networks.

question, as well as the links between these nodes. South Korea's neighborhood contains only four other countries. Thus, a banking crisis in South Korea threatens assets of only a few countries. Moreover, each of these four countries in turn has a small ego neighborhood and hence there is little likelihood that a crisis in South Korea will spread far as a second-generation event. And notice finally that South Korea is one of the more strongly connected peripheral nodes. More than half of the peripheral nodes have ego neighborhoods of zero countries. In contrast, the United States' ego neighborhood contains almost three quarters of the countries in the system. In addition, the U.K. and Germany have relatively strong ties to the U.S., allowing a crisis in the U.S. to spread to countries that may not be directly connected to the United States through these secondary financial centers. As a consequence, a banking crisis in a financial center is likely to destabilize the entire global financial system, while a banking crisis in a peripheral system will have largely local consequences that dampen relatively quickly.

(Figure 5 about here)

This robust-but-fragile mechanism offers an alternative explanation for established empirical facts. Most analysts of the global financial system agree that a crisis in the US is more likely to generate a global crisis than a crisis in a peripheral node. Yet, existing literature provides no theoretical model to explain why this is so. Indeed, the standard open economy politics model of financial crises posits that the threat posed by countries is likely to be normally distributed. A crisis in the US shouldn't pose a fundamentally larger threat to global stability than crises in other countries. Moreover, when analysts are pushed to explain why an American crisis is more destabilizing, most IPE scholars would point to market size: the US is large. The complex network model questions both assumptions: the threat to global stability posed by a local banking crisis isn't a linear function of country size. Instead, rhe risk is non-linear: central countries pose risks; peripheral countries do not. There is no intermediate category. Moreover, the factor that determines the threat to stability is network centrality rather than country size. And although the distinction between size and centrality may be one without meaningful difference for the contemporary US (which is large and central), the distinction may matter a lot if we are trying to estimate the relative threat posed by a banking crisis in China (large but not central) and Luxembourg (central but not large). Thus, even though scholars may agree that American crises are more destabilizing than others, the complex network model offers an explanation for this fact that differs sharply from current thinking.

The robust-but-fragile hypothesis also predicts "novel facts." The most important such novel fact is that crises in peripheral countries pose no threat to global financial stability. This cuts against the conventional understanding that in a highly integrated global financial system, most crises in most countries

pose a threat to global stability. We think that the evidence suggests that the robust in the face of peripheral shocks hypothesis is eminently plausible. Consider first that 98 percent of all banking crisis to occur since 1975 failed to escalate into global banking crises or even pose a threat to global stability. According to Laeven and Valencia (2008), the world experienced 144 local banking crises between 1975 and 2009. Of these, exactly three struck a central node: the United States in 1988 and 2008, and the United Kingdom in 2008. The remaining 141 banking crises occurred in peripheral nodes. Of the 141 peripheral banking crises, zero escalated into global banking crises.[10]

Moreover, it has proven extremely difficult to find systematic evidence that peripheral crises have any large impact on global financial stability. Bartram et al. (2007) evaluate the global effect of the largest peripheral crises to occur since 1990 (see also Baele and Inghelbrecht 2010; Karolyi 2003; Kho et al. 2000). They explore the impact of the Mexican Peso Crisis, the Asian Financial Crisis, the Russian Crisis and LTCM Crisis, and the 1999 Brazilian Crisis on the probability of default for 334 banks in 28 countries. This sample represents 80% of global bank equity and includes banks in Latin America and Asia as well as North America and Europe. They find that even the largest banking crises in peripheral countries have minor global consequences. Foreign banks with assets in the crisis country experienced a moderate increase in the probability of failure, with the largest increase (3.2%) arising in the 1997 Asian crisis. Banks that had no assets directly at risk in the crisis country experienced an increase in the probability of failure of less than 1%. In other words, peripheral crises had a negative impact only on those banks directly exposed, and even this impact was very small. This evidence reinforces the central message of a network model generally financial crises spread as a result of assets at risk and thus through existing relationships. And this evidence is consistent with the specific hypothesis that peripheral crises are unlikely to generate global crises because peripheral countries are low-degree nodes.

The 1997 Asian crisis is the only peripheral crisis that is potentially disconfirming. It is not surprising that this crisis would be a potentially disconfirming event, for it is the largest peripheral crisis to occur and the Asian countries are the most highly connected of the peripheral countries. There is no question about the local severity of the Asian crisis. The magnitude of banking sector weakness in the East Asian crisis countries is evident in the restructuring that followed (see Table 1). Governments closed, merged, and intervened directly in a major proportion of the banks and non-bank financial institutions (Lindgren et al. 1999). The Indonesian government merged half of the state-owned commercial banks and closed another 18 percent of private commercial banks. In South Korea, 15 percent of the commercial banks were

[10] We recognize that it is probably inaccurate to treat the 2008 U.S. crisis and the 2008 U.K. crisis as independent events. We inherit this assumption of independence from the data.

closed, and an additional 15 percent of the commercial and merchant banks were merged. Closures, mergers, and acquisitions in Thailand were of a similar magnitude. This restructuring cost between 15 and 50 percent of GDP (Lindgren et al. 1999, 40).

(Table 1 about here)

Yet, in spite of its local severity, one struggles to find compelling evidence that the Asian crisis threatened the stability of the global financial system. The Asian crisis did not threaten widespread insolvencies in banks outside the region. Japan is the only industrialized country that experienced a major episode of bank insolvency within the six months following the Asian crisis (Laeven and Valencia (2008). Yet, this insolvency was limited to two institutions, and it is unclear whether either failure reflected Japanese bank exposure to the Asian crisis, ongoing bank weakness specific to the Japanese financial difficulties, or to a combination. Moreover, these insolvencies had no broader consequences, either for Japan's financial system or for the global financial system.

The Asian crisis had no discernible impact on the stability of the American banking system. According to the Federal Deposit Insurance Corporation, four small banks closed between November 1997 and December 1998. The largest of these (and by an order of magnitude), was Best Bank of Boulder, Colorado. Its losses totaled $218 million, an indication that the bank was probably not highly exposed to Asia and posed little risk of a broader systemic crisis in the U.S.[11] Four bank failures in a year is not atypical; six small banks failed in 1996. Thus, one sees no evidence that the Asian financial crisis threatened major bank solvencies outside the region, much less threatened to generate a global systemic crisis.

The regional rather than global impact of the crisis is also evident in equity market indices. Figure 6 plots the twelve-month change of the U.S. S&P 500, the U.K. FTSE, and the Hong Kong Hang Seng, from January 1996 through the end of 1999. Notice that the Hang Seng collapses as the crisis strikes Thailand in the middle of 1997 and substantial losses continue through the middle of 1998. In contrast, the S&P 500 and the FTSE both lose a bit of ground as the Asian crisis breaks, but they both maintain a positive 12-month return and both stabilize relatively quickly. While a major emerging Asian equity market was strongly negatively affected by the regional crisis, equity markets in the U.S. and U.K. were largely unaffected. This suggests that the Asian crisis had a large regional impact, but little impact on the global financial stability.

(Figure 6 about here)

[11]Data from the FDIC website "Failures and Assistance Transactions" (http://www2.fdic.gov/hsob/selectrpt.asp?entrytyp=30. Accessed January 17, 2011.

Consider in contrast the evolution of these same indicators in the wake of the 2007-08 subprime crisis. The impact of the collapse of American financial institutions spread quickly and directly to Europe. Major real estate lenders in Germany, Belgium, the Netherlands, and Italy all required government bailouts as they suffered from their exposure to collapsing values of American real estate. The credit crunch sparked by the bankruptcy of Lehman Brothers pushed the major banks in Ireland and Iceland into illiquidity and ultimately insolvency. The Irish government nationalized the entire domestic banking sector. In all, some twenty-three European countries experienced a significant bank crisis in the wake of the emergence of problems in the American financial system (Laeven and Valencia 2008). The subprime crisis had clear negative consequences for global equity markets too (see figure 7). The collapse of the S&P 500 and the FTSE pulled down the Hang Seng and Nikkei in spite of the fact that neither country experienced a property bubble nor was highly exposed to American subprime assets.

(Figure 7 about here)

Although this evidence is suggestive, it underscores the plausibility of the robust-but-fragile hypothesis. Given the hierarchical structure of global financial relationships, the impact of a banking crisis on global financial stability depends upon where within the system the crisis originates. A banking crisis that originates in a financial center is quite likely to escalate into a global crisis. A banking crisis in a peripheral node — even in relatively highly-connected peripheral nodes — has little observable impact on global financial activity. The structure of global financial relationships, therefore, stabilizes the system in the face of peripheral crises but renders the system highly vulnerable to crises in the center. This is obviously not the final word about system stability, but the causal dynamics are sufficiently distinctive from conventional wisdom and sufficiently plausible to warrant further empirical investigation.

The Evolution of Financial Power in Hierarchical Networks

Complex network science strives to model the evolution of network structure. Of particular relevance to the politics of global finance is how financial power, conceptualized as network centrality, evolves. A sizeable literature maintains that the sub-prime crisis has accelerated the dissipation of American hegemony (National Intelligence Council 2008; Burrows and Harris 2009; Drezner 2009; Chin and Helleiner 2008; Drezner 2007; Helleiner and Pagliari 2011). As Helleiner and Pagliari (2011, 175) note succinctly, "the crisis has coincided with, and reinforced, a diffusion of power in global finance." *Financial Times* columnist Martin Wolf (2008) summarized the logic: "the ability of the west in general and the U.S. in particular to influence the course of events will also be damaged. The collapse of the western financial system, while China's flourishes, marks a humiliating end to the 'unipolar moment." Even

scholars who question the shift of power to China do suggest that American financial hegemony has given way to a US-EU condominium (Drezner 2007, 35-9; Kirshner 2008; Helleiner and Kirshner 2009).

These expectations are derived from variations of standard power-based models of IPE. Such models have two characteristics. First, the standard power-based model conceptualizes power in terms of national attributes. In the IPE literature on global financial regulation, this attribute-based conceptualization of power often invokes market size or national income (see, e.g., Simmons 2001; Oatley and Nabors 1998; Drezner 2007; Singer 2007). Such models draw on a long tradition of theorizing that conceptualizes power in terms of the material resources states possess. As Waltz summarizes, "power is estimated by comparing the capabilities of a number of units" (Waltz 1979, p. 98). Second, standard power-based models assume a relatively continuous relationship between the dissipation of hegemonic power measured in terms of national attributes and influence in the international financial system.

A network approach conceptualizes power in relational terms (Hafner-Burton and Montgomery 2010). As Hanneman and Riddle (2005) note, "network analysts often describe the way that an actor is embedded in a relational network as imposing constraints on the actor, and offering the actor opportunities. Actors that face fewer constraints and have more opportunities than others are in favorable structural positions. Having a favored position means that an actor may extract better bargains in exchanges, have greater influence, and that the actor will be a focus for deference and attention from those in less favored positions." Others, including Carpenter (2011), have emphasized the role of network centrality in conveying power. In informational networks, such as the transnational advocacy network that Carpenter analyzes, this is often referred to as "gatekeeper" power, whereby central nodes have the ability to restrict access of peripheral nodes to other peripheral nodes. More simply stated, a state's power is a function of its network centrality.

Consider first how network centrality reduces constraints on American behavior and thus confers what Cohen (2006, 32) has called "power as autonomy": the ability "to exercise policy independence to act freely, insulated from outside pressure in policy formulation and implementation." In the midst of the worst financial crisis to hit the United States since 1930, the U.S. experienced net capital inflows. As Helleiner (2011, 81) points out, this is puzzling when considered in the context of other crises. "In most emerging-market countries…bursting of domestic financial bubbles was accompanied by capital flight, which only exacerbated these countries' financial crises by generating exchange rate depreciation and higher interest rates. But foreign funding of the United States both public and private continued during the crisis, even as the United States lowered interest rates dramatically. Indeed, the dollar even strengthened as the crisis became more severe after mid-2008." And

what was true in the depth of the 2008 crisis is true generally: the United States is much less constrained by bond markets than other countries. Thus, whereas sharply rising government debt in Ireland and Greece triggered bond market selloffs that pushed governments in both countries into international "rescue packages," sharply rising government debt in the United States has been financed at historically low interest rates. And borrowing costs for the United States remained low in the summer of 2011 even in the face of a political war of attrition that constrained deficit reduction and a credit risk downgrade by one of the major global credit ratings agencies. The ability to borrow more heavily at lower rates than other countries (an ability the French labeled an "exorbitant privilege") reduces the cost of extending American economic and military power.

A network model suggests that reduced constraints are a consequence of positive feedback generated by the network externalities present in financial systems.[12] In private financial markets, the attractiveness of any national financial system is a function of its liquidity, which we can characterize in terms of market depth and breadth. Secondary markets for financial instruments are attractive when one can quickly liquidate one position and acquire another. In order to move quickly from one position to another one needs to find agents that will offer the desired trades at a reasonable price. The likelihood of finding willing trading partners rises in line with the number of participants in the market. The more agents that are active in any national financial system, therefore, the more appealing is that market for the marginal trade. A national financial system will thus attract new business because it already attracts a lot of business. What applies to national financial markets applies also to individual financial instruments; low risk bonds attract purchasers because they are low (default) risk, and they are low risk in part because they attract lots of purchasers (low liquidity risk).

The same logic applies to reserve currencies (Eichengreen and Flandreau 2009; Chinn and Frankel 2008; Aliber 1966; Meissner 2005). The attractiveness of a currency as a reserve asset is partly a function of its utility as a store of value, an attribute linked to characteristics of its issuing authorities. Also important, however, is the number of other governments who hold the

[12] On the role of positive feedback in politics more generally, see Jervis (1997) and Pierson (2004). Network externalities are gains (or losses) that accrue to agents as a consequence of the number of other individuals that adhere to a particular standard or employ a particular product. "[G]oods exhibit a network externality wherever the consumer enjoys benefits or suffers costs from changes in the size of an associated network" (Liebowitz and Margolis 1994, 134; see also Katz and Shapiro 1985). For example, the value to an individual of a particular computer operating system is a function of the characteristics of the system itself and a function of the number of other people who employ the same operating system. Similarly, the value of a telephone to an individual is largely a function of the number of people that have telephones.

currency as reserve and the frequency with which the currency is used as a vehicle currency. The more governments that hold a given currency as a reserve asset, the more appealing that currency becomes as a reserve asset. And the more that a given currency serves as vehicle currency in international transactions, the more likely it will serve as a vehicle currency. Moreover, serving as a vehicle currency strengthens the appeal of the currency as a reserve asset. Such positive feedback is preferential attachment at work.

In short, because the United States is at the center of the international financial system, it attracts capital from the far corners of the globe. Because the majority of participants in global finance participate in U.S. markets and trade in U.S. instruments, the majority of participants find it useful to hold dollars and dollar-denominated assets. And because the majority of market participants want to hold dollar-denominated assets, the United States is less constrained when funding its expenditures than other countries facing similar borrowing requirements. Recent studies have quantified this centrality advantage as a .5 to .6 basis point reduction in borrowing costs and suggested that most of these gains are realized by the U.S. government in the form of lower borrowing costs and seignorage (Dobbs et al. 2009; see also Gourinchas and Rey 2007). The United States can use (and many argue has used) this advantage to extend economic and military power abroad (Schwartz 2009).

The second advantage the United States enjoys as a consequence of its central position in the network is what Susan Strange characterized as structural power or Lloyd Gruber as "go it alone power" (Strange 1986; 1988; Gruber 2000). Because the global financial system is centered upon the American financial system, the U.S. government gains an implicit veto over global rules. Regulating global finance requires regulation of the American financial system, and regulating the American financial system through international agreements requires global rules that the United States government is willing to embrace. No other state enjoys this status. As Susan Strange noted long ago; "no change in collective management takes place [in the international financial system] that is not initiated by the United States. No one else shares this over-riding power to block change or to initiate change" (Strange 1986, 30). Network centrality thus confers power. And although the two forms of power discussed here — power as autonomy and a variant of structural or go it alone power — spring from existing literature, embedding them both in a network frame is useful.

Conceptualizing financial power in terms of network centrality is particularly useful because it enables us to endogenize power to network dynamics. As we noted above, most literature conceptualizes power in terms of national attributes. The US is powerful because its financial system is large. The network model conceptualizes power in relational terms. The US is powerful because it is central. The two dimensions of power are inextricably

connected is the US large because it is central? Is the US central because it is large? Indeed, over the long run we would expect a strong positive correlation between national capabilities and network centrality. Yet, what is true for the long run average obviously need not apply to every period. Instead, we might observe large and persistent gaps between national capabilities and network centrality as a consequence of positive feedback within the network.

Positive feedback might keep a prior hegemon at the center of the global financial network even as its initial advantage in terms of capabilities diminishes. This same positive feedback might slow a rising hegemon's movement from the network's periphery to its center even as its national capabilities increase. Rather than a continuous transition between a declining and rising hegemon posited by standard power transition models, therefore, a complex network model posits abrupt discontinuities. An established hegemon remains central until a major financial crisis disrupts existing relationships. If the shock is large enough, and if another financial center exists, the global financial network may get rewired; established relationships weaken while new relationships emerge and existing weak ties strengthen.[13]

Consider, for example, New York's challenge to London's centrality in global finance prior to World War I. As Broz (1999) notes, pressure by American investment bankers on the US government to construct a central bank in order to support a large and liquid market for bankers acceptances was a key factor in the creation of the Federal Reserve System. There is no question but that the construction of this financial infrastructure was a necessary condition of the United States' emergence as an international financial center. Yet, positive feedback ensured that the construction of this infrastructure was insufficient to displace London. It took at least one World War, and the associated government-imposed restrictions on financial market activity in London, as well as the forced liquidation of overseas assets by the British government, to shift the center of global finance from London to New York (Germain 1997). Arguably, these wartime restrictions and the collapse of global finance during the Great Depression destroyed many existing relationships and forced international market participants to establish new relationships in their place. This rewiring of the international financial network in turn allowed the U.S. to supplant the U.K. at the center of the system during the war, and positive feedback reinforced the U.S. in this position once the war ended.

[13]Our emphasis on major discontinuities between changes in the distribution of national capabilities and changes in network centrality is similar to Krasner's (1976) tectonic plate metaphor in his explanation of the gap between changes in the distribution of power and changes in global trade openness. Yet, whereas Krasner explained this gap as a function of domestic politics, the complex network model explains the gap as a function of positive feedback in the global financial system.

Was the subprime crisis significant enough to cause such a reorganization of the international financial network? There are reasons to believe that this could be the case. The initial shock is "likely to be judged the most virulent global financial crisis ever" (Greenspan 2010, 202). The international community responded to the crisis by increasing the status of the G-20 over the G-7 as a multilateral decision-making body, establishing the Financial Stability Board with more inclusive membership than the Financial Stability Forum, and negotiating a new Basel accord. Many have interpreted these moves as signaling a shift from a U.S.-centric to multilateral financial governance system, and noted parallels between this crisis and previous periods of systemic change. Some prominent scholars have argued that the relative decline of American economic power will translate into a declining global role for the dollar (see, e.g., Eichengreen 2011; Calleo 2009). Helleiner (2010) has compared present circumstances to those that preceded the establishment of the Bretton Woods institutions governing international finance, and speculated that we may presently be in an "interregnum" phase preceding a shift in the global financial architecture.

But a complex network approach suggests that these expectations may be premature. In contrast to the 20th century shift from the London to New York, there is no country positioned to displace the United States from the center of global finance. European Union markets suffered from the direct effects of the subprime crisis, and are now embroiled in a sovereign debt crisis that threatens major banks across the continent. Japan has yet recover fully from the weaknesses in its banking sector that emerged in the 1990s, and is surprisingly peripheral to the global financial system. China has a closed capital account, lack of currency convertibility, and a small presence in international banking markets. In terms of financial centrality, the United States appears to have no serious competitors at this time.

Additionally, in contrast to the interwar period, American policymakers have sought to preserve the structure of the financial system. The Federal Reserve coordinated with other major central banks to inject liquidity into financial markets beginning in the December, 2007.[14] The Fed also extended trillions of dollars in liquidity financing to financial institutions, including dozens of foreign firms as well as domestic.[15] As a result of this cooperation, the

[14] From 2007-2010 the Federal Reserve opened swap lines with the central banks of Australia, Brazil, Canada, Denmark, England, Japan, South Korea, Mexico, New Zealand, Norway, Singapore, Sweden, Switzerland, as well as the European Central Bank. http://www.federalreserve.gov/monetarypolicy/bst_swapfaqs.htm#5619, accessed October 4, 2011.

[15] The Government Accountability Office audit of the Federal Reserve's actions during the financial crisis, released in July, 2011, details the extent of the central bank's emergency actions. http://sanders.senate.gov/imo/media/doc/GAO%20Fed%20Investigation.pdf, accessed October 6, 2011.

international financial network weakened following the initial 2008-2009 shock, but did not suffer a complete collapse and began reinforcing itself fairly quickly. The U.S. maintained its position as the most central node in the system. A complex network approach — which argues that stabilizing the central node will usually keep the network structure intact — offers an explanation for this outcome lacking in existing literature.

Endogenizing power to positive feedback thus allows us to connect global financial power to broader dynamics in the international financial system. A state's power in global finance emerges to the extent that dynamics of preferential attachment place its national financial system at the center of the global financial network. Once emerging as a global financial center, a state's power is reinforced by positive feedback generated by the dynamics of tie formation and tie strengthening in the complex network. Finally, the dynamics of positive feedback may generate financial crises in the center that almost necessarily have system-wide destabilizing consequences. These systemic crises may in turn bring about a reconfiguration of network structure that allows rising peripheral states to move abruptly to the center and pushes declining hegemons out of the center. Such displacement depends not just on the occurrence of a crisis, but also on the existence of a rising power with the infrastructure necessary to assume a central position in the global financial system, and an inability of the central node to reestablish stability in the face of a shock.

Conclusion

In the wake of the 2008 subprime crisis, and amid continuing turmoil in European financial systems, IPE scholarship has taken renewed interest in the politics of global finance. Most calls for research have focused on aspects of the financial system viewed to have been at the center of the subprime crisis: complex financial instruments, large financial institutions, and inadequate financial regulation. We agree that scholars should pay more attention to the politics of global finance, but we also believe that we should also take advantage of this crisis to rethink some of the foundations upon which we base research on the politics of global finance. Specifically, we think that the international character of the crisis should cause us to think systematically about the structure of the international system. We have argued that recent developments in the science of complex networks suggest that it might be important and extremely useful to model the global financial system as a complex network.

We have demonstrated that the contemporary international financial system exhibits characteristics typical of a hierarchical network. Networks constructed from two quite different data sets sharply distinguish between global financial centers — the United States and, to a lesser extent, the United Kingdom — and the periphery. Moreover, in both network structures the

periphery was a highly inclusive category. It included not just developing countries, as most analysts would expect, but almost all of the advanced industrialized countries as well. Although it seems clear that the contemporary international financial system is hierarchical, we know little about and provided no evidence on other periods or other scales. An important question for future research is whether a hierarchical structure also characterized prior eras of global finance. Equally important is to examine whether the hierarchical structure evident in the global financial network constructed from country-level data is evident in networks constructed from firm-level data.

According to complex network science, knowing network structure is important because network structure shapes network performance. Another way to say this is that hierarchical networks perform in ways that models of financial integration that ignore network structure cannot anticipate. In particular, such networks often are "robust but fragile" systems. They are robust in the face of peripheral shocks, but fragile when shocks strike central nodes. We have suggested that when applied to global finance, this implies that the contemporary global financial system is vulnerable to crises in the United States but relatively stable in the face of crises everywhere else. Most IPE scholars agree with one side of this hypothesis; the global financial system is highly vulnerable to shocks that originate in the United States, although most probably offer a causal mechanism that focuses on size rather than network centrality. An equal number of scholars likely disagree with the hypothesis that crises in peripheral nodes pose little threat to global stability. We don't pretend to have resolved this issue here; instead we pose it as a central question for empirical research. Understanding how network structure shapes financial contagion is important in its own right, but also it matters critically for the design of effective financial regulation. Just as domestic policymakers have paid increased attention to "systemically important financial institutions" in the wake of the crisis, so too might global regulators consider whether it makes sense to differentiate "systemically important countries" from others.

Finally, complex network science suggests that positive feedback reinforces the hierarchical structure of contemporary global finance. This suggests that the United States will remain at the center of global finance, and benefit from the opportunities that such a position confers, in spite of an apparent decline of its economic dominance. It also suggests that China is likely to remain a peripheral actor in global finance in spite of its status as a global creditor. Moreover, the model encourages us to explore whether major systemic change — the shift of the center of global finance from London to New York in the early 20th century or from New York to Shanghai if this occurs in the 21st century — follows the logic of punctuated equilibrium or self organizing criticality. One might hypothesize that positive feedback mechanisms create extreme asymmetry and thus precipitate asset bubbles. The popping of bubbles

in turn sparks a global crisis that can, if severe enough, result in the restructuring of the global financial network.

A focus on the complex network approach to the politics of international finance isn't intended to substitute for a focus on actors and institutions, but is intended instead to provide a context within which to examine the role actors and institutions play. Articulating this context explicitly may be important. If, as we have argued, network structure does influence network performance, if positive feedback mechanisms shape the evolution of actor centrality, then models that focus exclusively on actors and institutions omit relevant and important causal mechanisms. Equally important, however, is the recognition that network structure is produced by individual behavior, and behavior in many instances will reflect incentives generated by existing institutions. Thus, understanding politics of global finance require us to explore actors and institutions within the broader context of the network structure.

A complex network approach does not require scholars to embrace a single set of theoretical assumptions, and is thus potentially useful for scholars conducting research in a variety of epistemological traditions. Conceptualizing the politics of global finance in network terms encourages research that focuses on common empirical puzzles and patterns. Yet the network approach implies nothing about the theoretical assumptions one employs to analyze, interpret, and explain these patterns and puzzles. A network model can accommodate an emphasis on the cross-border diffusion of ideas about the proper ordering of financial markets and financial regulation as well as a power-based model of global regulatory change. Indeed, a network approach provides the common empirical structure that might allow scholars to evaluate the purchase each of these perspectives provides to our understanding of the deregulatory changes that shaped global capital markets since the late 1990s. Network analysis thus offers a platform that can orient multiple theoretical perspectives around a common set of problems and puzzles.

Nor does a network approach privilege any particular empirical strategy. One can apply statistical techniques, such as latent space or exponential random graph (ERGM) models, to test hypotheses in network contexts. One can conduct qualitative case studies to evaluate hypotheses about non-linear dynamics, such as positive feedback, against a limited number of observations (we have had only two global financial crises in the last 100 years). One can employ computer simulations in instances where a small *n* reduces confidence in observed empirical relationships, such as in the study of network stability and network evolution. A network approach thus encourages scholarship that selects the methodology best suited to the question under investigation and recognizes the validity of findings generated by a variety of methods.

The potential benefits of a complex network approach are not limited to the politics of global finance. Instead, the approach holds promise for the study

of IPE more generally. This orientation allows us to conceptualize the global political economy as a complex social system. It enables us to explore how states, firms, financial institutions and intergovernmental organizations establish relationships that give structure to the global political economy. It encourages us to explore how this structure of relationships in turn shapes the behavior of the actors we study. A network approach thus provides the opportunity to construct a systemic approach to international political economy without returning to grand theory.

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