Connected

The Surprising Power of Our Social Networks and How They Shape Our Lives— How Your Friends' Friends' Friends Affect Everything You Feel, Think, and Do

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problem, namely, how best to conduct surveillance for a new behavior or a new pathogen (or bioterror attack): do we monitor people randomly or choose them according to their network position? A choice informed by network science could be seven hundred times more effective and efficient.[47]

Finally, network interventions increase the cost-effectiveness of interventions. For every dollar we spend on improving the health of an employee, we also improve the health of that employee's relatives, coworkers, friends, and even their friends of friends. This substantially increases the return on the investment. And, in the case of employers or insurers, this can be especially important since roughly two-thirds of workplace health costs are related to health problems in spouses and other dependents of workers. Targeting a worker and improving the health of the worker's family in the bargain is thus good business. As we will see in the next chapter, there are many ways networks can magnify economic benefits besides health care, and our understanding of economic behavior requires us to come to terms with the idea that no man or woman is an island. People are connected, and their health and well-being are connected.

CHAPTER 5

The Buck Starts Here

Not since 1866 had England seen such a crisis. In the summer of 2007, the worldwide real-estate bubble was bursting, the mortgage markets were grinding to a halt, and British banks were finding it harder and harder to raise funds in the money markets. Mortgage lenders were particularly hard-hit, and some were running out of options. On Wednesday, September 12, the Northern Rock bank shut its doors and asked the state-run Bank of England for money to cover its deposits. The news spread rapidly over the airwaves and by word of mouth. The government issued a statement saying customers should not be worried about their current accounts or mortgages, but to no avail. By Friday, September 14, when the bank's doors reopened, a real bank run was in progress for the first time in more than 140 years.

Long lines started forming outside Northern Rock branches throughout Britain as early as 6:00 a.m. Some customers came because everything they had was in a bank that appeared to be failing. "I have been saving for years, and I don't want to lose it," said

Jacqueline Porte, who had advanced just twenty-five feet toward the entrance of the Golders Green branch in three hours when she spoke to reporters.[1]

Others had less information about the bank's situation, but they came anyway because they saw the long lines on the television news or as they passed local branches. One customer who called herself Marilyn claimed she was reassured by the statements made by the government, but she could not resist the urge to join the run when she saw everyone else withdrawing their money: "I thought if I didn't come down here, I'd regret it."[2] A man in his fifties who preferred to remain anonymous said: "I'm an accountant, I should know better.... I shouldn't be here.... My head tells me it's all right, but my heart says otherwise."[3] Customer Anne Burke, fifty, waited with her ninety-year-old father in a line of 130 people outside the Brighton branch. "It's not that I disbelieve Northern Rock.... But everyone is worried, and I don't want to be the last one in the queue. If everyone else does it, it becomes the right thing to do."[4]

The run on Northern Rock also attracted people who did not have deposits at the bank. Tim Price, a portfolio manager, made a special trip to see the long lines of middle-class people waiting to withdraw their money. "It was a very British bank run," he said. "The queues were orderly, but the emotional impact will scar people for generations."[5] Others agreed with him. A mobile billboard advertising a suicide-prevention counseling service was parked in front of the Edinburgh branch. And not to be outdone, staff from other banks hovered outside several branches like vultures, with flyers that specifically targeted the fears of Northern Rock depositors, urging customers to switch accounts.

Meanwhile, Northern Rock management summoned extra staff and extended bank hours to deal with the continuing long lines and disgruntled customers. At one branch in Newcastle, customers burst into laughter when a staff member asked, "Does anyone want to pay

money in?"[6] But at other locations things were becoming more tense. The Strathclyde police had to shut down one branch as a way to deal with "boisterous" customers. And in Cheltenham, police were called in to deal with a couple that barricaded a bank manager in her office, demanding that she let them withdraw one million pounds they had in their account.

These interventions did not stop the panic. The run continued for three days, and as it progressed, it was clear that social networks were playing a role. For example, retiree Terry Mays at first believed the Bank of England's guarantee was enough, but by Monday he had traveled to the London branch where he said, "I took some financial advice over the weekend, and I'm taking the money out to get peace of mind. We're relying on this money for our pension."[7]

This kind of person-to-person contact caused many people who would otherwise ignore the run to join in the frenzy. And the anxiety that spread was similar to the anxiety that spreads in mass psychogenic illness, which we discussed in chapter 2. Like MPI, bank runs take on a life of their own. Under the right conditions, what starts as aberrant behavior in just a few people can spread like wildfire in social networks.

These sentiments can spread not just among depositors but also among investors, creating a "banking contagion." As news of the Northern Rock run dominated the financial press, people wondered who was next, and panic soon started to spread to other firms. The bank Alliance & Leicester lost a third of its market value (1.2 billion pounds) shortly after the run on Northern Rock, and shares of other banks fell too. Soon there was a generalized fear that these other banks were in a similar situation and might need to make the same kind of announcement, which would set off a whole wave of bank runs. Fortunately, before things spiraled out of control, Alistair Darling, the Chancellor of the Exchequer, made an official statement that the British government and the Bank of England would guarantee

Northern Rock's deposits. The bank run came to an end, and the financial markets stabilized.

Of course, the story did not end there. The subprime crisis continued to unfold, and later in 2008, financial contagion swept through international markets. First, it hit institutions like Bear Stearns that were directly involved with the mortgage market (on the verge of bankruptcy, Bear Stearns was purchased by JPMorgan Chase for a paltry $2 per share). Then IndyMac Bank failed (the fourth largest bank failure in U.S. history), and soon the federal government had no choice but to take over Fannie Mae and Freddie Mac, two formerly private mortgage companies that guaranteed about half of the $12 trillion dollars in U.S. mortgages. A week later, the crisis spread to investment banks as cash-starved Merrill Lynch acquiesced to a buyout by Bank of America, and Lehman Brothers collapsed. Two days later, the crisis spread to insurance giant AIG, forcing the U.S. government to step in and lend the company $85 billion. As two other banks (Washington Mutual and Wachovia) failed, markets froze and banks stopped lending money. One investor joked darkly that the only safe investments were bottled water, bomb shelters, and a nice cubbyhole in his mattress. By October 2008, the U.S. government had agreed to fund a $700 billion bank rescue plan, but it was too little too late. The Dow Jones and S&P 500 stock market indices had fallen over 40 percent from their highs a year earlier, representing a stunning loss of $8.4 trillion.

The meltdown of 2008 shows how easy it is for panic to spread in financial networks. When one big company fails, others that are connected to it are also at risk. In fact, famed investor Warren Buffet, in his annual shareholder letter of 2009, characterized the cascading nature of the business failures as follows: "[Market] participants seeking to dodge troubles face the same problem as someone seeking to avoid venereal disease.... It's not just whom you sleep with, but also whom they are sleeping with."[8] Hyperdyadic spread indeed.

As the losses continued, they led to a dramatic global slowdown in the economy that was the worst we have seen since the Great Depression. Thousands of people lost their homes, and millions more lost their jobs. Amid such a breakdown in trust between people and institutions, the only solution was government intervention. Once the government made it clear that it would intervene to prevent further failures, banks started to lend money again, and the markets began to stabilize. This has caused some experts to wonder if we could have prevented the problem by acting earlier.

Although many ties in financial networks are formal (for example, many affected firms had legal contracts with other firms that had failed), we should not underestimate the power of informal and personal ties. Wall Street has developed a vast culture that promotes social relationships between bankers and CEOs, salespeople and clients, and even between competing traders. These titans of industry and masters of the universe come into frequent contact on the phone, at business meetings, and during after-hours social events. And when they quit their jobs to move to new firms, they become connectors, linking everyone at their previous offices with everyone at their new ones. As a result, markets that move vast sums of money through the international financial system are run by tight-knit networks of traders where the major players often know one another so well that they can tell who they are trading with just by watching the pattern of bids and offers that appear on their computer screens. Traders could ignore this information, but they probably do not. When people they trust start selling, they may want to sell too. Although some company failures are to be expected during economic downturns, social networks can exacerbate the problem by spreading fear among the very people and institutions who must take risks to turn things around.

It might seem like the modern technological age has made us much more interdependent and therefore more susceptible to panics like

these. However, the role of social networks in financial contagion is nothing new. Economists Morgan Kelly and Cormac O'Grada studied Irish depositors at a New York bank (Emigrant Industrial Savings Bank) during two panics in the 1850s.[9] They had an extraordinary amount of information about these depositors, including which parish in Ireland the depositors came from. Arguing plausibly that individuals from the same parish were likely to have known each other during this time, they used this information to construct social networks and to see whether socially close individuals corresponded in their decision to withdraw money during the panic. Kelly and O'Grada found that social networks were the single most important factor in explaining the closure of accounts during both panics, even more so than the size of the accounts or the length of time they had been opened. Thus, financial panics may result from the spread of emotions or information from person to person.

It is interesting that such economic phenomena are usually seen as aberrations. Traditional economists would say this behavior is not rational. After all, many people who stood in lines at Northern Rock to withdraw their money did not really think the bank would fail. Some even explicitly said so. But, spurred on by the motion of the herd, they blindly followed. In this way, social networks generate behavior that is not consistent with the simplified, idealized image of a rational buyer and seller picking a price to transact the sale of goods. And for many years, economists reacted to this inconsistency by ignoring the behavior altogether.

Bank runs are a classic example of how individually rational behavior can lead to communally irrational behavior. We are all capable of thinking with our heads, but our hearts keep in touch with the crowd, and sometimes this leads us to disaster. Social networks can make a problem worse because they make it possible for the first people who panic to influence many others (like the couple who decided to withdraw their money once they discovered their friends had). The wisdom of crowds can quickly turn to folly.

Where's George?

Social networks clearly play a big role in financial crises, but they also have an effect on everyday transactions. Have you ever wondered where the dollar bills you get from the cashier at the grocery store come from? Some are dog-eared and look like they have been through the washing machine at least a dozen times in forgotten pockets, the kind of bills that a soda machine just won't take no matter how many times you try to flatten them and feed them in just right. Bills like that have a history. They have passed from hand to hand in all kinds of transactions, from buying soda to paying the kid who mows the lawn to giving the grandchildren a present to buying drugs or sex. The dollars in your wallet have had a secret and varied life.

This life actually represents one path through the enormous social network we inhabit. If there were some way to see such paths, these endless exchanges in the whole human economy, then we might be able to better understand the ties that connect us. The flow of money depends on social-network ties but also defines them.

Lots of people are curious about where their money has been and where it is heading. Some people write their names on bills in the vain hope of receiving the bill back in the future. But in 1998, a database consultant from Brookline, Massachusetts, named Hank Eskin figured out a way to satisfy this curiosity. He started a website called Where's George? (WheresGeorge.com). The George he was looking for was George Washington, whose face first appeared on American dollar bills in 1869. Prior to the Internet, tracing the movement of currency in the fashion Eskin had in mind would have been impossible.

Eskin's website allows people to track a particular dollar bill by entering its unique serial number and the ZIP code where the bill was acquired into an online database. Anyone can record a bill to the database, and if that same bill has been previously entered, the

website will show where the bill has been. These records are known as "hits." Visitors to the website can also leave notes about where they received the bill. And so it is possible see the specific paths that the dollars take from one person to another.

As of 2008, more than 133 million bills had been tracked, with a total value of over $729 million (the site accepts all denominations). One user, Gary Wattsburg, has entered almost a million of those bills himself, but the majority of the bills are reported by newcomers to the website.

Most bills are not reported more than once. But 11 percent reach two or more people. In fact, one of these bills was reported by fifteen different Where's George? users. This particular bill had a colorful life. It was first reported in 2002 in Dayton, Ohio, and soon traveled to Scottsville, Kentucky, where a user received it as a tip in his job at a drive-in restaurant. The bill crossed the border into Tennessee, where it was given as change at the Shell Food Mart in Chapel Hill, North Carolina, and at a country store in Halls Mill near Unionville. The bill found its way to Texas, where one person received it as change in a McDonald's in the town of Keller. It then passed through an adult-entertainment part of the social network. The bill was given as change at a racetrack betting window at Lone Star Park in Grapevine, and later it was found on the floor at the Penthouse Key Club in Dallas, a "sexually oriented business" that has been shut down a few times by the Dallas City Council for prostitution.[10] After a brief stint in Shreveport, Louisiana, the dollar returned to Texas in change at the Jack in the Box restaurant in Rockwall and later at Mr. K Food Mart in Irving. It apparently ended its spree in 2005 after passing through Panguitch, Utah, and later to Kincheloe and Rudyard, Michigan, where the last person to report on the bill wrote, "This bill is getting pretty old looking."

All told, the bill traveled at least four thousand miles in a little more than three years, averaging about 3.8 miles a day. No other bill has been so well tracked. But the entries at this website contain information about the "jumps" that countless bills have made, including the distance between origin and destination and the time it took for the bill to get from one place to another. These jumps can skip over people who did not report the bill. So, for example, the bill we just described was probably exchanged between many more than fifteen people. But never before had we known so much about where, when, and how money travels.

The flow of dollar bills through financial-contact networks resembles the flow of sexually transmitted diseases through sexual-contact networks. In these examples, the network can be deduced simply by what flows across it. This is good news for researchers, because both germs and money can be used to trace connections that might not otherwise be apparent. But inferred networks differ from fully observed networks. In an observed network (like a regular friendship network), we know all the connections, and we know who has the potential to transmit something to someone else, even if nothing is transmitted. For example, you might still be good friends with a friend from high school even though you have not had contact in years. In an inferred network, however, we only observe the realized interactions. Inferred networks are therefore incomplete pictures of social networks. So, for example, two people may have a sexual relationship but might never transmit a disease. The science of social networks often depends on the art of figuring out what kind of network to study and how to discern it.

SARS, Seagulls, and Sailors

In 2003, the world faced an epidemic of a new disease called SARS (severe acute respiratory syndrome). In the months following the appearance of the epidemic, many scientists became interested in the impact of social networks on the spread of disease. As we will discuss in chapter 8, over the centuries there has been a dramatic

increase in how far people can travel, and the wider physical range of modern social networks has greatly increased the speed at which pathogens can spread. In fourteenth-century Europe, the plague (the Black Death) did not spread very quickly from town to town because people typically did not travel more than a few miles a day, and the people they interacted with usually lived nearby. Back then, it took more than three years for the plague to move from the southern part of Europe to its northern reaches, with an average speed of movement of two or three miles a day.[11] In comparison, one of the people involved in the 2003 SARS outbreak carried the infection eight thousand miles (from China to Canada) in a single day!

The urgency of the SARS epidemic prompted researchers to meet in Montreal to discuss the impact of social networks and human travel on disease. One problem in particular was the question of measurement: how is it possible to follow the movements and interactions of enough specific people in order to be able to build a statistical model to predict the spread of a pathogen? The answer to this question came soon after the conference. Dirk Brockmann, a researcher at the Max Planck Institute for Dynamics and Self-Organization, stopped in Vermont to visit a friend on his way back to Germany. Brockmann's friend, a carpenter by trade, was a fan of the Where's George? website, and he showed him how money could be traced from person to person and from place to place. Brockmann was intrigued. People carry dollar bills and then exchange them person-to-person in close contact, just like they carry and exchange viruses and bacteria. If the researchers could understand the movement of money, they just might be able to learn something about the spread of SARS, flu pandemics, and other deadly diseases.

Brockmann and his fellow researchers Lars Hufnagel and Theo Geisel soon contacted Hank Eskin at WheresGeorge.com to ask for the data. Eskin obliged, and soon the researchers were awash in the very data they were saying they so badly needed just weeks before.

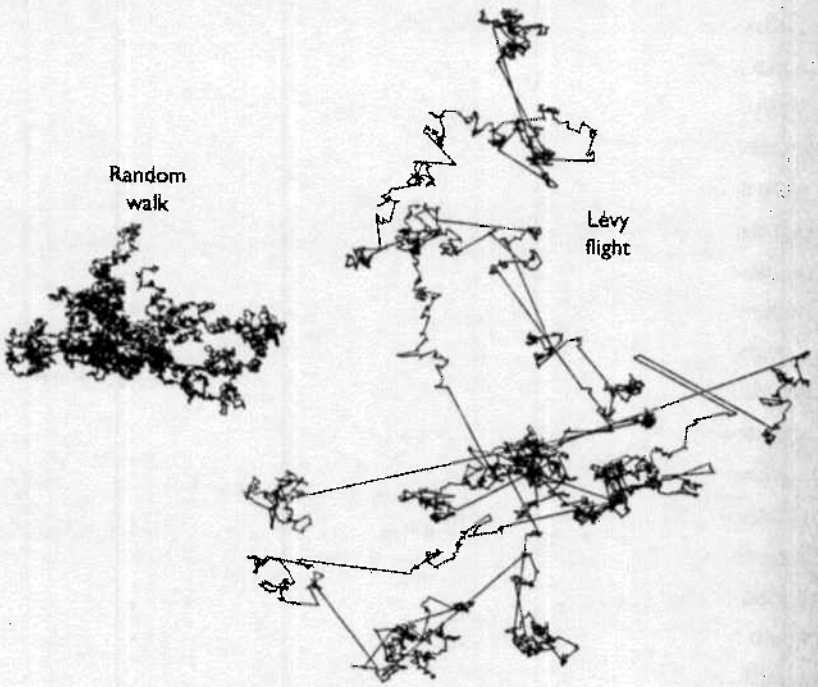
As Hufnagel put it: "Since we can't track people with tracking devices, like we do animals, we needed to get data that provided us with millions of movements of individuals."[12] They would not have a record of every single transaction, but the sheer quantity of information they did have meant that they could describe general rules that apply even to the transactions they did not observe. The researchers reported their results in the prestigious journal *Nature* in early 2006.[13] Since then, scientists have begun to harvest still other sources of movement data, such as the traces left by cell phones, which we will discuss in chapter 8. Cell phone data allows researchers to study who people are connected to and where they are minute by minute for months at a time.

Brockmann and his colleagues discovered that the jumps bills make from one place to another obey a simple mathematical rule. A typical dollar bill is traded locally several times, moving only a few feet or a few miles between exchanges; but occasionally you take your wallet with you on a trip to a friend's wedding, a family gathering, or a business meeting halfway across the continent. And most of the time, money does not stay with you for long; it leaves your pocket shortly after it gets there. But sometimes, you lose track of money, and it stays with you for a very long time; you might forget about that twenty-dollar bill in your parka until you are happily reunited with it the following winter.

The overall pattern indicates two important features of human interaction. First, bills stay much closer to home for a much longer time than previous models of human movement had predicted. Our regular routine involves straying little and spending cash locally. Yet, when bills do jump from one place to another, the distance they jump is typically much longer than previous models of human behavior had predicted.

In fact, the jumps follow a mathematical pattern poetically called a *Lévy flight*, after the French mathematician Paul Pierre Lévy.

Imagine a seagull that is searching for food. It might find a nice spot by the seashore where it can catch crabs, and it will stay there for several hours chasing them in and out of the waves. But when the tide changes, it might then fly a long distance to reach its next feeding location. Lévy flights, with their pattern of many short jumps interspersed with a small number of very long jumps, are quite different from what are called *random walks*, where each jump is roughly the same size and in a random direction. For a typical random walk, instead of a foraging seagull, imagine a very drunk sailor. He starts by holding on to a lamppost. When he lets go, which way will he



The random walk (left) shows five thousand steps of equal length in a random pattern of movement. In contrast, the Lévy flight (right) shows five thousand steps of varying length, sometimes with a "flight," in a random pattern of movement.

stumble? Left or right? Will he lunge forward or stagger backward? And if we leave him for a while and come back, where will he be?

Just like the bird, the sailor will appear to move randomly. But if we drew their paths, they would look very different, as shown in the illustration. Both would look like a tangle of spaghetti at first, criss-crossing more and more as time goes on. But at a certain point, the bird gives up on its current feeding ground and flies miles away to start a new search in a different location. The sailor, taking the same-sized step each time, can't do this (though if he is drunk enough, he might imagine that he can). As a result, we have very different predictions about how far the seagull and the sailor can travel in a certain amount of time. In the end, the sailor cannot really stray too far from the lamppost. Not so for the bird in Lévy flight. Because it can make the occasional long trip, it will be able to travel away from its starting point at a much faster pace over time.

Since the jumps of dollar bills look like a Lévy flight, the average speed of a dollar bill should be much faster than it would be if it were taking a random walk. However, Brockmann and his colleagues discovered that the movement of dollar bills from person to person followed a pattern that was somewhere between sailors and seagulls, traveling faster than a random walk but slower than a Lévy flight. To see why, they also studied the lengths of time between jumps, not just the distance. They found that, as with the pattern of distances, the pattern of times between dollar exchanges was dominated by many short intervals, but occasionally the intervals would be really long. Some dollars were traded frequently, while a rare few got stuck in the hands of an infrequent trader, in a bank vault, or with the socks lost in the laundry. This could help explain why the dollars would spread more slowly than expected in a social network where the movements of people followed a Lévy flight. And modeling both time and distance in the network of financial transactions helped researchers to better understand how often people come into physical contact and how fast a disease like SARS might spread.

Moody Markets

The famous mathematician Benoît Mandelbrot developed much of the mathematics used to describe Lévy flights. He used these new techniques to study price changes he had first observed in the early 1960s in the cotton market and other financial markets. Scholars had previously thought that price changes in these markets followed a normal bell-curve distribution, with many average-sized jumps and just a few jumps of moderate size occurring every now and then. But Mandelbrot showed that both small changes and large changes were much more common than expected. Like the foraging seagulls, markets tend to oscillate near a given price for a while and then jump to a new one.

There are lots of reasons why markets might make a long jump from one price to another, and our interconnection is one of them. Some pieces of information are so important that markets respond to them in seconds. For example, the government routinely releases statistics about economic growth, unemployment, the housing market, and inflation that can have a big effect on bond and stock prices. But another reason is that prices are not just an impartial estimate of the objective value of an item: prices also include expectations about how much other people value an item. The more people who think gold is a good investment, the higher the price will go. We do not simply decide for ourselves how much gold is worth; we also look at what others think gold is worth in order to decide. Our judgment about the value and desirability of goods is thus similar to our judgment about the value and desirability of sexual partners: it depends on how others perceive the object of affection in question. Social pressures can drive demand.

This makes markets much different from foraging seagulls. When a seagull eats a crab, it gets the same nutritional value from it no matter how many other seagulls wanted to eat it; a crab is just a crab. In

contrast, when a person buys gold, the profit he makes depends critically on the number of other people who also want to buy gold.

So what determines the number of people interested in buying gold? Economists say markets are driven by supply and demand, but where does the demand come from? In part, it comes from the inherent value of an object. Gold can be used to make wedding rings, royal crowns, foil for space capsules, and teeth. But demand is also influenced by needs and expectations, and these can be strongly influenced by the needs and expectations of others to whom a person is connected. Moreover, people may need to have confidence that they are investing in something that others will want to buy in the future. This gives markets an inherently subjective quality.

For example, you might be able to make $500 worth of stuff with a one-ounce gold coin, but if you think that someone else in the market is willing to buy it for $1,000, then you will probably try to sell it for that price. And once you ask for $1,000, you send a signal to everyone who sees your shiny gold coin for sale that you think it is worth much more than $500. You might not get your asking price, but you might get more than $500. If you do, then the increase in the price of gold sends a signal to other market participants. Increasing prices may convince some people that demand for gold is on the rise, which could increase their confidence that others would be willing to buy it at a higher price in the future. Like people doing *La Ola* at sporting events, market investors take cues from one another in synchrony, driving prices away from reality. It is just this situation that results in "irrational exuberance" in stock markets, housing markets, even tulip markets (in seventeenth-century Netherlands).[14]

Human social networks thus have economic moods. Nothing makes the collective nature of these moods more obvious than the language we use to describe changes in the economy. The economic boom in the 1890s in Boston and New York gave rise to the decade's moniker "the gay nineties," and we use equally evocative expressions

when we speak of economic downturns as "panics" and "depressions." As discussed in chapter 2, moods can spread from person to person to person, making the situation even worse than the objective situation in the economy warrants.

At this point, traditional economists may cry foul. After all, from Adam Smith on, the conventional perspective has been that markets are efficient: an "invisible hand" leads to the "correct" price for the good being traded. If too many people think the price is too high, it will fall because people will buy less. If too many people think the price is too low, it will rise because people will buy more. The most recent price reflects the best guess about where these expectations are in balance.

And, in fact, we have lots of examples where the market does a pretty good job of getting it right. One of the most prosaic comes from "Vox Populi" (Latin for "voice of the people"), a 1907 article in *Nature* by polymath statistician Francis Galton.[15] Galton visited the West of England Fat Stock and Poultry Exhibition, a county fair where there was a contest to guess the weight of a fattened ox. Participants had to pay six cents to guess, and the closest guesses won prizes. Galton managed to acquire the cards on which people had made their guesses, and he showed that most guesses were quite bad. However, when he ordered them from the lowest guess to the highest guess, he found that the median guess (1207 pounds) was extremely close to the actual weight of the ox (1198 pounds). Galton concluded, to his own surprise, that democratic decision making might not be as bad as previously thought. When faced with the challenge of identifying the correct weight of the ox, most individuals would get it wrong, but the group as a whole could get it right. If the ox had been for sale, the same thing would have happened with respect to its price, and the ox's true value could be determined.

More examples come from modern-day election-prediction markets, like the Iowa Electronic Markets and Intrade. In these markets, using real money, you can buy an outcome, and if that outcome

occurs, you get paid. For example, for the 2008 election, you could buy contracts for Barack Obama, John McCain, and all the other candidates for the presidency. If you bought an Obama contract, you got paid the day after the election, but if you bought any of the others you did not, since Obama won. The price in these markets reflects the probability that people think the outcome will occur. So if an Obama contract that pays one dollar is priced at sixty cents, it means that the market expectation is that Obama has a 60 percent chance of winning. Scholars have compared market predictions with what actually happens, and they have shown that election markets predict outcomes better than other available methods, such as polling.[16] In fact, they are so successful that prediction markets are now commonly used inside large companies like Siemens, Google, General Electric, France Telecom, Yahoo, Hewlett-Packard, IBM, Intel, and Microsoft to aggregate information about production schedules and competitors. The employees make bets on what is going to happen. Such markets can even be used to predict the risk of terrorist attacks.[17]

While economists will point to markets like these to emphasize the triumph of the invisible hand, it is important to note that they are, in fact, special cases of group activities. In the fattened ox example, individual guesses were made independently. No doubt, some people discussed their guesses with friends at the fair, but the guesses were not made public like prices on the stock market. Moreover, the payoff was explicitly tied to an objectively verifiable event. The ox got on the scale, and a winner was determined. Similarly, in the prediction markets, an outcome occurred, and people got paid.

In contrast, stocks and houses are continuously traded until a company goes bankrupt or the house burns down. It is true that companies report profits at regular intervals, and these reports have an effect on perceptions of value. It is also true that the price of building a new home constrains how much someone is willing to pay for an existing home. However, the overall value of stocks and homes is

highly dependent on what other people think they are worth. Competitive markets may operate via the invisible hand, but social networks can distort these markets, sometimes yielding an invisible slap in the face.

Although there is often wisdom in crowds, they also can go horribly awry when making a decision. The difference between these two extremes (say, an orderly election and a violent riot) has a lot to do with the path-specific motion of information through networks. Whether groups of people are able to reach a correct decision about something (the value of a product, the number of jelly beans in a jar, the weight of an ox) depends on whether decisions are made at the same time or sequentially. If a group of people is deciding on the price of an item and bid on it independently, then their average guess is probably a good indicator of its market value. However, if people make decisions in sequence and are aware of prior decisions, if information moves from one person to the next (as in the game of telephone), we can end up with the blind leading the blind. Once a critical mass of people make a decision, the rest of the group goes along, reasoning that others cannot all be wrong. Like the people in chapter 1 looking up at the window in New York City, they fall in line. So whether the wisdom of crowds can be trusted may depend on whether the members interact concurrently and independently or sequentially and interdependently.

Sociologists and physicists Matthew Salganik, Peter Dodds, and Duncan Watts studied this problem using an online music market.[16] They designed an experiment involving an online site they created that gave away downloadable songs. A total of 14,341 people came to a website featuring forty-eight songs. There were different "worlds," however, that visitors to the website could experience, and these worlds were created by the actions of previous users. Visitors could download songs from bands they had never heard before and evaluate their quality after listening to them. In one "world," subjects were

able to see what previous participants thought of a song's quality, while in the other "world" they could not. The scientists found that in the world where song ratings were visible, the first person's rating influenced the whole trajectory of ratings for particular songs, keeping them high for a very long time. In other words, musical tastes are contagious. A tiny tweak in the sequence of social interactions when people make cultural choices can turn an average tune or a mediocre singer into a sensation.

This experiment documents the path dependency that can arise when people make decisions in sequence. There is no correct or true value of the songs in question. The value and the quality of each song depends on an idiosyncratic and essentially random process that gives rise to a particular sequence of people making choices. Because of our tendency to want what others want, and because of our inclination to see the choices of others as an efficient way to understand the world, our social networks can magnify what starts as essentially random variation. And these small variations can sometimes cause big differences in whether or not we can work together to solve problems.

Three Degrees of Information Flow

Residents in the high Andean community of Tigua Loma had beautiful latrines. As a Peace Corps volunteer in Ecuador, James visited Tigua Loma and worked in many communities where basic sanitation was a challenge and where preventable diseases like cholera were epidemic. Time after time, economic development agencies poured money into latrine projects. Each family spent hours digging pits, moving materials, and building walls. When the latrines were finally completed, the community celebrated with the engineers who had helped them through the entire process. However, in Tigua Loma,

the latrines would often fall into disuse. Why? And why did some communities succeed in changing their behavior when others failed?

New technologies frequently offer enhanced quality of life. Even basic inventions like water pumps and latrines can dramatically improve the health and economic well-being of people in remote parts of the nonindustrialized world. Yet all too often, even when resources for these new technologies are available, they fail to catch on. Figuring out how and why people adopt new ideas and how they can spread from person to person to improve underdeveloped economies has been a driving force in the science of social networks since its inception. In fact, some of the earliest concerns had to do with how new ideas spread in a population. Development experts wanted to know how they could spread more efficient agricultural techniques from farmer to farmer. Public health officials wanted to know how new medical practices spread from doctor to doctor or from family to family. And for-profit firms wanted to know how recommendations to buy their products spread from consumer to consumer.

One feature of this early work was that it rarely included information about specific social ties between individuals. For example, sociologist Everett Rogers's seminal book, *Diffusion of Innovations*, treated technology in a population like a drop of blue dye in a glass of water.[19] He theorized that technology would diffuse slowly at first, then quickly, and then slowly again as it reached the entire population. However, recent research that takes social-network structure into account shows that it is not so simple. In particular, many ideas never take off at all, and the influence of any one decision in the network may be limited.

Something was in fact different about the structure of the social network in Tigua Loma. The people there were more suspicious of each other, there were fewer "*mingas*" (shared labor between households during the harvest), and there were fewer connections between

the people. Local institutions that might have given people opportunities to form ties were less present in this community than in others nearby. The people in Tigua Loma had a problem. They didn't talk to one another.

Scholars have started to focus on network structure and how it affects information flow. In one study, researchers carefully examined the word-of-mouth network of recommendations for three piano teachers in Tempe, Arizona. The teachers did not advertise and therefore relied on their social networks to keep them in business. Most of the recommendations occurred between close friends who were directly connected, but the positive references would spread, often to people the original recommender did not know. In fact, fully 38 percent of the recommendations came from people who were three degrees removed from the piano teacher they were recommending (the teacher's friend's friend's friend). However, the paths tended to fizzle out after that, with less than 1 percent of the recommendations reaching people who were six degrees removed.[20] The great majority of pupils came from within three degrees of the teachers.

The next example hails from a completely different corner. The spread of information is obviously crucial to the process of invention. And while information does spread between inventors, here too the spread is limited. When inventors submit patent applications, they nearly always connect their ideas to the work of other innovators by citing other patents. Although there are several reasons for this, the principal one is that the inventors acquired information from another invention that was useful in their own.[21] In addition, many patents are filed by two or more people, so the patent filings can be used to establish the social network of inventors—who collaborates with whom. There are thus two crucial sets of information in the patent data: the network of ideas and the network of collaborations.

An examination of more than two million citations from one patent to another used these citations to identify the effect of social

networks on the spread of ideas among inventors.[22] It showed that there was a strong probability that inventors with a direct collaboration tie would cite each other; in fact, they do so about four times more often than would be expected due to chance. But the effect extended further into the network. At two degrees of separation (two people did not collaborate directly but instead shared a common collaborator), they would be about 3.2 times more likely to cite each other, and at three degrees (a collaborator's collaborator's collaborator), they would be 2.7 times more likely. Beyond three degrees, the effect virtually disappears. Additional analysis showed that these relationships did not exist just because two inventors happened to work on similar designs. Instead, they were a direct result of the spread of information through the social network.

The Strength of Weak Ties

The principal idea underlying the diffusion of innovation is that information and influence tend to spread through close, deep connections. If we have an effect on people we do not know, it is because we take advantage of a series of strong ties. Like dominoes falling one by one, we can spread information to, or influence the behavior of, the next person, and that person does so in turn.

However, this idea neglects an important feature of human social networks. As we discussed in chapter 1, we tend to be clustered in tightly knit groups. Take any two of your friends at random, and the chance they are friends with each other is higher than 50 percent. As a result, the series of strong ties through which we might influence others is not like dominoes. Ties do not extend outward in straight lines like spokes on a wheel. Instead, these paths double back on themselves and spiral around like a tangled pile of spaghetti, weaving in and out of other paths that rarely ever leave the plate.

While this structure is good for reaching everyone in your group, and even for reinforcing your own behavior via feedback loops, it is very bad for reaching people outside the group. Stanford sociologist Mark Granovetter was one of the first people to recognize this difference. Others had dismissed "weak ties" and casual acquaintances as irrelevant to the spread of information. But Granovetter argued that these weaker connections frequently act as bridges from one group to another and therefore play a critical role. Strong ties may bind individuals together into groups, but weak ties bind groups together into the larger society and are crucial for the spread of information about the benefits of using latrines, the availability of good piano teachers, the existence of valuable information in other inventions, and much else besides.

Granovetter used a simple economic study to prove his point. He surveyed several technical, managerial, and professional workers in a Boston suburb who had recently relied on a personal contact to get a new job, and he asked them a simple question: "Prior to switching employers, how often did you see the person who helped you get the new job?" He found that only 17 percent responded "often," while 55 percent said "occasionally"; the remaining 28 percent said "rarely." Most workers found jobs via old college friends, past workmates, or previous employers. Contact with the person was sporadic, and very few had ever spent time with the contact outside the workplace. According to Granovetter: "Usually, such ties had not even been very strong when first forged.... Chance meetings or mutual friends operated to reactivate such ties. It is remarkable that people receive crucial information from individuals whose very existence they have forgotten."[23] In other words, most of his subjects had acquired their jobs by (nearly) relying on the kindness of strangers. These were distant friends or friends of friends who passed their names to an employer or who passed information about jobs to the prospective employee. People find jobs, in other words, in much the same way

that they find sexual partners (as we saw in chapter 3)—by searching their social network beyond their immediate ties.

Weak ties are thus a rich source of new information that we tap when we are trying to improve our lot. And we seem to do this intuitively, even though we do not know the structure of our own network or consciously think about the problem in the way Granovetter proposed. In fact, people frequently rely on weak ties to search large networks for useful information, as the study of global e-mail forwarding outlined in chapter 1 showed. People frequently relied on socially distant friends to accomplish this task. Since information flows freely within a close circle of friends, it is likely that people know more or less everything that their close friends know. Therefore, your immediate relatives and friends, for instance, would be unlikely to know something you do not about how to reach a person in Indonesia. But move socially farther away, and there is less overlap in experience and information. We might trust socially distant people less, but the information and contacts they have may be intrinsically more valuable because we cannot access them ourselves.

One implication of this is that people who have many weak ties will be frequently sought out for advice or offered opportunities in exchange for their information or access. In other words, people who act as bridges between groups can become central to the overall network and so are more likely to be rewarded financially and otherwise.

The other implication is that we sometimes leapfrog over the natural boundaries of the network when we are intentionally trying to search it for information and opportunities. The flow of influence may stop at three degrees, but it appears that we often start our search for information two or three degrees away in order to make sure we are learning something new. We do this in everyday life, whether searching for a job, an idea, or a new piano teacher, and it is this region in the network, just beyond our social horizon, that has a critical impact on our own economic fortunes.

Good Ol' Boys Through the Ages

To make it easier to think about how networks affect economic outcomes, it is often convenient to assume that our ties to others are fixed. But, as in the case of sexual networks (whose structure unfolds over time because people usually acquire partners sequentially) and loneliness networks (where connections can form and break depending on a person's characteristics), networks are not static; they are dynamic. The flow of money, information, and influence means that we affect our friends and our friends' friends, and in the process the network takes on a life of its own, changing shape as time goes by. If money makes the world go round, it does so not because it passively accepts the network. Wealthy individuals and big businesses shape their networks according to their financial and economic goals, and in turn, the shape of their networks has a big impact on whether they can achieve those goals. The good ol' boys circle together and take care of their own.

Some of the earliest evidence of attempts to mold networks comes from the Renaissance. Cosimo de' Medici rose to power in fifteenth-century Florence and headed up a coalition of families and partisans that consolidated the emerging banking system of Europe and then ruled northern Italy for three centuries. John Padgett, a political scientist at the Santa Fe Institute and the University of Chicago, has collected an enormous amount of information about the Medicis and other Florentine families during this time period and shown that dramatic changes in social networks deeply influenced our modern capitalist and democratic societies.

The growth of trade with Asia caused some families to suddenly become wealthy, upsetting a feudal social network that was extremely hierarchical and disconnected between groups. New-money families started competing with old-money families for social control, and to do so, they intermarried with, and gave power to, tradesmen and guilds (who were increasingly important with the rise of commerce)

and vied for their alliance. At the center of this new social network was the Medici party, which spanned many of the previously disconnected groups. As a result, the Medicis were able to conquer once and for all the oligarchs who previously ruled Florence. In the last battle between the two sides on September 26, 1433, Rinaldo Albizzi, the leader of the oligarchs, tried to organize his supporters to attack city hall. But only a few showed up at a time, and their lack of enthusiasm caused them to drift away before they ever reached a critical mass. In contrast, the Medicis organized a massive preemptive response that gathered all their supporters at the Palazzo Vecchio. As a result, no military battle took place—the outcome was obvious, and the oligarchs quietly drifted into exile. The result of this change in the social-network structure (away from oligarchy) was reduced social control, and with it came new institutions that would democratize Florence and later other parts of Italy and the world. This convergence of money and open political systems created a big bang in the arts and sciences that has had an enduring impact to the present day.[24]

Similar processes are at work in modern corporations. Although today corporations rarely seal deals through intermarriage, they do share executives on their boards of directors. Some of these are celebrities—Bill Clinton sat on at least twelve boards at one point—but most are genuine businessmen who have typically served the same industry for a number of years.[25] Directors create network links between the multiple firms they serve, and they can easily pass information among them. This increases the chances for collusion and market manipulation and has been a source of congressional investigations for over a century.

One classic study of the eight hundred firms with the largest market capitalization (i.e., the highest total value of all their stock) found that bank boards were particularly well connected to the largest businesses, and these businesses were themselves strongly connected to other businesses in the economy, making banks the most central

actors in the network.[26] This is exactly the pattern we might expect to find if we thought banks were trying to use the social network of board directorships to exert control over the most powerful players in the economy or to tap the flow of information about industries. However, since board meetings and discussions between directors are private, it has been very difficult to verify whether the network actually influences a firm's decisions.

One way to tackle this would be to examine a behavior that all boards engage in that is public and trackable, namely, political contributions. One would expect two firms with similar interests or located in the same part of the country to donate to the same political candidates. Yet, even accounting for this, increasing the number of mutual directors between two firms tends to increase the similarity in the profile of campaign contributions.[27] This suggests that increasing the social ties between large corporations helps them to synchronize their behavior.

Social networks also affect the way businesses exchange goods with one another. Overly simplistic economic theories of markets typically assume that firms will sell to the highest bidder and buy from the cheapest seller, regardless of the personal histories of those involved. However, real-world interactions are often based on personal relationships between businesses that are embedded (strongly connected) in stable networks of trust and reciprocity.

Sociologist Brian Uzzi, a professor at Northwestern whose mother worked as a dressmaker in New York, had personally observed how some businesses in the apparel industry were embedded while others were not. He conducted interviews at several of these firms and found that embedded firms were more likely to survive than those that did not rely on their personal networks to decide with whom to trade.[28] But he also found that too much embeddedness can be a bad thing. An unconditional commitment to a particular business partner (a strong tie) can be disastrous if it causes a firm to completely ignore opportunities with other firms (weak ties). Thus, there is a trade-off

between building stable relationships with a certain group of partners and being willing to leave those relationships when changes in the market cause them to lose viability. It is important to have a mix of strong and weak ties, and hitting the sweet spot is key.

Networking Creativity

Uzzi extended his insight from dressmakers to a little-studied corner of the corporate world.[29] From *Cats* to *Spamalot,* Broadway musicals have been big business for decades, but investors usually have to follow their gut when they decide to back one show or another. *Bye Bye Birdie* starring Dick Van Dyke ran for 607 nights on Broadway and was a smashing success, but *Bring Back Birdie* was a flop and closed after just four. What was the difference? Why do some shows succeed and others fail?

Uzzi believed the social networks formed by the musical production companies played an important role, so he and Janet Spiro studied collaborations between the producers of 321 musicals that premiered on Broadway between 1945 and 1989. In particular, they were interested in whether collaborators formed "small-world" networks like those identified by Duncan Watts and Steven Strogatz in their seminal 1998 *Nature* article.[30] The idea underlying small-world networks is that they exhibit two important features: low average path length (people can easily reach others in the network through a small number of intermediaries, as Stanley Milgram's Nebraska mail experiment illustrated) and high transitivity (most of a person's friends are friends with one another). Watts and Strogatz showed that you could put everyone on a highly structured network (like a ring or a grid where neighbors are only connected to each other) and then just add a few random connections to turn it into a small-world network with low average path length. The result was a highly ordered network with lots of cliques (groups in which everyone is connected

to everyone else) but also with many ways that information can pass between these cliques from person to person to person.

Uzzi found that teams made up of individuals who had never before worked together fared poorly, greatly increasing the chance of a flop. These networks were not well connected and contained mostly weak ties. At the other extreme, groups made up of individuals who had all worked together previously also tended to create musicals that were unsuccessful. Because these groups lacked creative input from the outside, they tended to rehash the same ideas that they used the first time they worked together. In between, however, Uzzi once again found a sweet spot that combines the diversity of new team members with the stability of previously formed relationships. The networks that best exhibited the small-world property were those that had the greatest success.

Production company networks with a mix of weak and strong ties allowed easy communication but also fostered greater creativity because of the ideas of new members of the group and the synergies they created. Thus, the structure of the network appears to have a strong effect on both financial and critical success.

Making better musicals might not be at the top of your list of world problems, but knowing how to spur creativity in teams has much broader applications. Uzzi has also studied human achievement and how it relates to social networks. Previous perspectives on scientific discovery, for instance, have stressed individual genius as the explanation for outstanding achievement, but over the course of the twentieth century, discovery and innovation increasingly came to be properties of groups rather than of individuals. Of course, innovation rarely, if ever, arises without input from others, as we saw with the inventor networks. Breakthroughs are created in collaborative circles, and networks can amplify talent (we have certainly seen this in our own experience, finding that complementary skills and knowledge enrich our joint work, making the whole greater than the sum of the parts). The empirical question is how to show whether

individuals do better when they are part of teams than they would do if they acted alone.

To study this problem, Uzzi used citations as a marker for the "best" scientific work. In the scientific world, citation is a form of praise or at least attention. Uzzi collected data on 21 million scientific papers published worldwide between 1945 and 2005 and also 1.9 million patent filings from a fifteen-year period. He then compared the papers written by individuals to the papers written by teams. Using citation as a measure of quality, Uzzi found that, on average, team efforts were judged to be better and more important science than efforts by individuals.

Uzzi also evaluated whether there was any truth to what many academics know informally as the "thirty-foot rule." This rule states that people collaborate only with others within thirty feet of them. But as we saw in the case of sexual partners, where people shift from finding partners "in the neighborhood" to finding them through their network, and as we saw in the case of obesity where social-network connections were more important than geographic connections, physical distance is becoming less of a constraint on scientific collaboration. Studying 4.2 million papers published from 1975 to 2005, Uzzi found that collaborative teams involving researchers at different universities are increasing relative to teams that are all from the same university. This trend has to do with a greater focus on specialization, and it surely has been spurred in part by globalization. But what is increasingly clear is that scientific collaboration works best in small-world forms of organization that make it easy to work with a mix of people from different places.

Color Coordinated

Although Uzzi's studies show an association between certain network shapes or structures and collaboration, it is hard to know if networks are causing people to collaborate differently or if people

who are more likely to collaborate just happen to form certain kinds of networks. For this reason, computer scientist Michael Kearns and his fellow investigators at the University of Pennsylvania decided to create an experiment to see how social networks constructed in a laboratory influenced collaboration. They took students and arrayed them into networks of thirty-eight people that had different structures, such as those shown in plate 5.[31] The investigators gave students at each position in the network a single choice: what color do you want to be? And they were also given a single goal: choose a color that is different from the colors chosen by the people you are connected to.

Students were seated at computer terminals showing the colors chosen by their neighbors (they could not see the whole network), given a menu of colors, and told to pick a color different from their immediate network neighbors. They could change their color at any moment. And they were timed. If the group reached a solution in the time allotted so that every individual had a color different from his neighbors, then they earned some money.

So how did they do? It turns out that the structure of the network indeed had a big effect on their ability to solve the problem. Ring networks (like A–D in plate 5) were easier to solve than the more jumbled networks. And, counterintuitively, the more neighbors the average person had in the network, the faster the group as a whole arrived at a solution. The average time it took for the thirty-eight individuals to finish declined from 144 seconds (network A) to 121 (network B) to 66 (network C) to 41 (network D). The more complicated networks took still longer for people to solve (network E took 220 seconds and network F, 155).

The contrast between networks D and E is especially telling. The people in these two networks faced very similar circumstances, with about the same average number of neighbors and about the same average degree of separation between any two people in the network. Crucially, students in these experiments could not tell what kind of

network they were in; all they could see was their immediate neighbors. Yet, network E took more than five times as long to solve as network D. So small differences in the overall patterns of connection in the network can matter a great deal to the performance of the group.

The lesson for people trying to coordinate efforts to solve economic problems is that it may be valuable to create explicit links in networks or to organize them in a way consistent with the task at hand. For example, the $787 billion economic stimulus legislation enacted in 2009 provided funds for thousands of local, state, and federal agencies that were all supposed to spend the money as quickly as possible. And to avoid wasteful duplication, they were all supposed to spend the money on different projects. The Kearns experiment suggests that, for projects like these, the government should create structured channels of communication between agencies in addition to whatever informal channels may already exist. In other words, the government should foster small-world connections.

But sometimes actors do not always agree on the goals they are trying to achieve. Consider the debacle in the federal effort to get aid to victims of Hurricane Katrina. Federal authorities wanted to evacuate people from New Orleans, but local police in Gretna (a town near New Orleans) feared being overrun and prevented evacuees from leaving the city.

Kearns and his fellow investigators wanted to know how networks affected decision making in exactly these kinds of situations, when people have different incentives but still must work together. They conducted another set of laboratory experiments in which people embedded in networks of varying structure attempted to reach a global consensus (everyone must be the same color).[32] And this time, the researchers created tension in the group's goals. Half of the subjects were told that they would earn an extra 50¢ if everyone was colored red and the other half were told they would earn an extra 50¢ if everyone was colored blue. As in the previous coloring experiments, if consensus was not reached by a certain time, no one would get paid. If people were stubborn, holding out for the extra reward, then no one would get anything. So some people had to yield.

Again, the speed at which consensus was reached varied according to the network structure. In networks where some people had many more neighbors than others, those with the most neighbors were able to drive the entire network to their preferred color. The investigators called this the *minority-power effect*. A small group of influentially positioned individuals can consistently get their way. On the other hand, such a group can also facilitate global unity and prevent the outcome where no one gets anything. So although social networks may help us do what we could not do on our own, they also often give more power to people who are well connected. And as a result, those with the most connections often reap the highest rewards.

Your Friends Are Worth Something

While elites like corporate directors clearly benefit from shaping social networks to suit their needs, it is less clear whether these benefits reach other levels of society. If anything, social networks might be seen as an explanation for why the rich are getting richer, and why economic inequality continues to rise. The logic is simple: if you are rich, you can attract more friends, and if you have more friends, you can find more ways to become rich. And recent changes in technology might make the problem worse. When it is easier to search and navigate social networks, the positive-feedback loop between social connections and success could create a social magnifier that concentrates even more power and wealth in the hands of those who already had it.

Fortunately, the millions of poor around the world are not completely out of luck. Over the past thirty years, there has been an

important movement to use social networks to fight inequality and improve the lot of the worse-off by giving them access to something they never had before: credit. Although it may be hard to believe in the United States, where we get sent unsolicited credit cards in the mail nearly every day, many people in the rest of the world cannot borrow even a dollar. And the main reason they cannot is that they have no collateral; they do not own land or property, and what few things they possess have such limited value that traditional lenders do not consider using them as a guarantee.

Traditional banks around the world overlooked, however, a source of collateral that even the most destitute have: their friends and family. Social networks are ubiquitous, and, as it turns out, they can be used to successfully guarantee a loan. Bangladeshi economist Muhammad Yunus is credited for having this insight, which he originally developed when visiting poor villages near Chittagong University where he worked. When Yunus learned that women in the village of Jobra were being gouged by local moneylenders to pay for the bamboo they turned into furniture, he agreed to lend them money himself. What was the staggering sum these forty-two women asked for? About twenty-seven U.S. dollars. Less than a dollar each. The new microcredit market was born.

Sensing the need for this kind of loan throughout the country, Yunus approached a bank and became a guarantor for loans the bank would make to the villages, since it did not loan money to people without assets. Amazingly, the repayment rate for the loans he made actually exceeded the repayment rate the bank typically enjoyed. Yunus would go on to found the Grameen Bank in Bangladesh, which pioneered the microfinance loan.

One of the most important features of these very small loans is that they are given to groups, rather than to individuals, to help them start small businesses or make other investments that will help them escape poverty (like paying for their children's school or paying off high-interest loans from local moneylenders). In essence, individuals use their friends and family as social collateral to assure the bank that they will repay the loan. This makes these high-risk loans feasible because it dramatically reduces the probability of default. Social networks help distribute risk and help groups cope more effectively with unexpected events like a drought or a death in the family. But, most generally, this is a way to monetize social-network ties. The bank typically requires five people to form a group, and if each of the five successfully passes a test after a week of training in business skills, then individuals in the group are eligible to apply for loans. Loans are made to two people first, and if those are repaid, then the next two people can apply, and finally if those are repaid, then the fifth group member can apply.

Yunus attributes the success of the Grameen Bank model to features of the social network: "Subtle and at times not-so-subtle peer pressure keeps each group member in line." The bank also refrains from creating groups artificially since "solidarity [will] be stronger if the groups [come] into being by themselves." Up to eight groups are tied together and administered in centers where initial loan applications are screened by an elected member. This small-world design is exactly what Brian Uzzi found among dressmakers, on Broadway, and in academia. The Grameen Bank fosters strong ties within groups that optimize trust and then connects them via weaker ties to members of other groups to optimize their ability to find creative solutions when problems arise. According to Yunus: "A sense of intergroup and intragroup competition also encourages each member to be an achiever."[33]

Another important network feature is the bank's almost exclusive focus on lending to women. On the one hand, this makes sense since women may have more social collateral than men. But lending to women has the added bonus of multiplying the benefits of the loan since women are much more likely than men to invest in improving the lives of children via schooling and improved health services. Women are also more likely to invest in their husbands than men are in their wives.

Since the founding of the Grameen Bank, microloans have been shown to reduce poverty, even among the poorest of the poor, and their success at grass-roots development has spawned similar programs in more than a hundred other nations. Even the industrialized world is starting to use programs like these for college students and other low-income individuals. It is interesting to see how an innovation from Bangladesh that was built on a deep understanding of the natural advantages of social networks has itself spread. The microfinance movement has generated so much interest worldwide that Wall Street now packages the loans and sells them as bonds just like mortgages or other common securities. The Nobel Foundation recognized the efforts of the Grameen Bank and Muhammad Yunus "for their efforts to create economic and social development from below" by awarding Yunus the Nobel Peace Prize for 2006.

Similar institutions that capitalize on social ties have emerged throughout history. For example, rotating credit associations, also known as solidarity groups or money-go-rounds, are composed of people who voluntarily assemble into a group that meets periodically to contribute to a fund that is then given in whole or in part to one of the contributors in rotation. These associations are typically self-organizing; they do not rely on formal institutions and typically lack a leader. These types of associations are found all over the world, from Korea to China to Japan to Pakistan to India to Nigeria to Cameroon, and they are often used by immigrant groups in the United States to pool capital for entrepreneurial activities (especially since immigrants are often cut off from the formal banking sector). Similar groups were found among working girls in England in the nineteenth century. And traditions of barn raising among nineteenth-century frontier farmers in the United States were a variant: people would band together to take turns, perhaps on the first Sunday of each month, to build a barn for each person.

Anthropologist Clifford Geertz outlined in 1962 what may have been the first academic description of these institutions, noting that

their origins may be related to the tradition of "rotating feasts" in which each person in a small group agrees to host a feast in turn. In the Indonesian setting where Geertz did his original fieldwork, and in most other settings where rotating credit associations were found in traditional cultures, the local people often saw these associations as less about serving economic objectives and more as serving social and symbolic functions. "This association strengthens our village solidarity and our communal harmony," they might say.[34] A bewildering array of such traditional institutions can exist, and some may even involve complicated procedures for charging interest or determining the order of receipt of the funds.[35] But what they all have in common is that social connections function to prevent defection after a person has received the pot. The dollars move from person to person, across established social ties, and everyone knows where George is.

It remains to be seen whether we can harness the power of social networks to improve the lives of the poor as fast as we are improving the lives of the rich. However, we feel optimistic that networks can be used to reduce inequality, both directly via loans and sound economic policies that cope with moody markets, and indirectly via improved physical health and mental well-being. The main unresolved question is not about whether we have the ability to use social networks this way, but whether we will. In other words, how do networks affect our capacity to govern ourselves and to achieve our goals of spreading well-being?