BROKER ZERO: THE SOCIAL AND GEOGRAPHIC SPREAD OF PONZI SCHEME INVESTOR NETWORKS

Aili Malm, Ph.D. Simon Fraser University 2006
Assistant Professor, California State University, Long Beach

Andrea Schoepfer, Ph.D. Florida State University 2007
Assistant Professor, California State University, San Bernardino

Gisela Bichler, Ph.D. Rutgers University 2000
Professor, California State University, San Bernardino

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ABSTRACT

This study offers a rare glimpse into the spatial and social network dynamics of a Ponzi scheme. Drawing on survey data from over 500 investors, we apply diffusion theory to understand the social and geographic spread of the Eron mortgage fraud . This study provides evidence that financial frauds spread socially and spatially through the mechanism of contagious diffusion. Together, social network and spatial analysis offer a viable hybrid methodology offering direct insight into financial fraud.

KEY WORDS: Diffusion, Investor Fraud, Network Analysis, Ponzi Scheme, Spatial Analysis, White-Collar Crime.

INTRODUCTION

In 1920, Charles Ponzi was the talk of Boston. His business, The Security Exchange Company, was taking in more than a million dollars a week from investors. He had guaranteed them an astonishing rate of return—50 per cent interest on their principal in 45 days. The wealth was generated through an international reply postal coupon, a device for facilitating international business. Ponzi told his investors that he could buy a postal coupon in Spain for one cent and cash it in America for six one cent stamps. It was all legal and lauded by many as a brilliant plan.

Ponzi's scheme seemed to work. Early investors achieved the promised rate of return on their money and, as a result, investments grew exponentially. However, Ponzi was simply using the money from new investors to pay himself and pay off earlier obligations; he had simply adapted the longstanding pyramid scheme – a variation that is now termed a "Ponzi" scheme. The Boston Post questioned Ponzi's business after a few months – who, after all, would buy the millions of dollars of stamps that Ponzi was said to be collecting? In response to increasing media criticism, Ponzi allowed an auditor to

examine his books, and his abrupt decline began. The newspaper learned that Ponzi had previous convictions for forgery and smuggling and had spent time in prison in both Canada and the United States; his books quickly revealed his latest deception. He was convicted of fraud, and sent to jail for 14 years, leaving thousands of Americans in financial ruin (Zuckoff, 2005).

Since 1920, there have been several "Ponzi schemes" in the United States and Canada. The most notorious of recent cases involves Bernard Madoff, who was convicted in the U.S. of the largest investor fraud ever committed by a single person. Over 23 years, he managed to defraud investors of between 10 and 17 billion dollars. While not all Ponzi schemes have the notoriety of Ponzi's or the scope of Madoff's, each scheme leaves a trail of victimized investors behind.

Research on fraud victimization largely focuses on victim characteristics (see for example: Anderson, 2004; Schoepfer and Piquero, 2009; Shichor et al. 2000; Titus et al., 1995; Van Wyk and Benson, 1993; Van Wyk and Mason, 2001), neglecting how the fraud spreads (Baker and Faulkner, 2003, 2004, Comet, 2011). Clearly, social networks play an integral role in the growth of the fraud—many early investors become unwitting brokers and spokespersons for the frauds by drawing in friends, family and co-workers with news about their initial returns (Fairfax, 2002). However, while every victimization network is spatially distributed, it is unclear how fraud victimization networks spread geographically and what nourishes or constrains this spread.

Applying concepts from related research fields it is likely that a contagious diffusion process is at work. As more individuals become victimized by the fraud, it becomes more likely that the fraud spread outside of the general area where it originated .

And while social networks are key to the growth of financial frauds, such as a ponzi scheme, the actual infection process, mechanisms, rate of spread, and geographic diffusion have not been previously examined in a multivariate model. Drawing on a hybrid methodology integrating social network analysis and spatial analysis this paper uses a unique case study – the Eron mortgage fraud—that will contribute significantly to the financial fraud literature..

ERON MORTGAGE FRAUD

The Eron mortgage fraud operated from January, 1993 through October, 1997 in British Columbia, Canada. This fraud, like that of Charles Ponzi and Bernard Madoff, was a Ponzi scheme based on a pyramid structure where early investors buy into the scheme based on the promise of high returns, and the influx of new investor capital is used to pay off early investors with false profit (Baker and Faulkner, 2003, 2004; Comet, 2011). It is unclear whether this fraud started off as a legitimate business, what Clinard would term an intermediate fraud, or whether it was a pre-planned fraud from the beginning (Baker and Faulkner, 2003, 2004; Clinard, 1984).[1] What is clear is that investors were defrauded out of $240 million.

The two Eron principles, and several employees, brokered syndicated mortgages where funds for single mortgages (for properties in Canada and the United States) were raised from many investors. Investors were supposed to receive interest, but instead received promissory notes or had their money moved to another mortgage without their

[1] Either way, the executives of this company knew it was going to fail, and the principals were intent on maximizing their profits before the scheme collapsed. Within the financial crime literature this behavior falls under the realm of control fraud. For more information about control fraud see Black, 2005.

consent or knowledge (British Columbia Securities Commission, 2004). In fact, much of the principal raised from new investors was going to pay existing investors.

Eron attracted investors through marketing that incorporated seminars, television and newspaper advertisements, and bulk mailings (British Columbia Securities Commission, 2004). As will be explained later in the paper, social networks of investors and the staff of Eron also funded the Ponzi scheme. Despite the fact that annual market returns in the mid-1990s for guaranteed investments were around six percent, Eron guaranteed a return of 18 to 24 percent on its mortgages. Therefore, while the returns were guaranteed, they were certainly out of step with the prevailing market. This incongruous return raised the risk and uncertainty of investing in Eron and most likely impelled investors to use their social networks to inform their decision to invest (Baker and Faulkner, 2003, 2004; Comet, 2011).

CONTAGIOUS DIFFUSION

Contagious diffusion of information and innovation occurs through members of a social system over time (Rogers, 2003; Valente, 1995). This process is not strictly social, but includes a geographic or spatial component; a phenomenon will spread and recede over space (Cohen and Tita, 1999). The contagious spread of a Ponzi scheme is not likely to rely on a single person, or small group of people, infecting a large number of people over time and space, but rather on a large number of infectors and impersonal methods (Baker and Faulkner, 2003).

Social Diffusion

A fraud could be considered a new idea, or innovation, and since the "newness" of the idea is what separates diffusion from other forms of communication (Rogers, 2003), diffusion theory is applicable to the study of fraud. Inherent in this newness is a certain degree of risk or uncertainty about the innovation, which is especially relevant in the current study regarding investment fraud. An important stage in the diffusion process is the critical mass tipping point (inflection point) that occurs around the 20 per cent level of adoption (Rogers, 2003). After this point, the diffusion becomes self-sustaining and little promotion of the innovation is needed.

Diffusion is typically carried out through two mediums, mass media and personal contact. According to Bass (1969), the influence of mass media on the adoption of an innovation is concentrated in the early stages but remains relatively constant throughout the diffusion process. In their study on stock purchasers, Shiller and Pound (1989) found that most bought stock on the recommendation of their trusted friends. Personal influence among investors is equivalent to the diffusion mechanism of *contagion* (Rogers, 2003; Valente, 1995). Such personal messages, while increasing in the first half of the process then declining as time goes on, are more influential than mass media throughout the entire process (Rogers, 2003). Thus, the adoption of the innovation over time creates a logistic (S-shaped curve) which, combined with the critical mass tipping point, are the key components of diffusion theory (Rogers, 2003). If adopters are dissatisfied with the innovation, the logistic curve will show a much slower rate of adoption or it will reach a plateau and then decline with more widespread dissatisfaction (Rogers, 2003).

Interestingly, Baker and Faulkner (2003) did not find a logistic curve in their analysis of fraudulent oil investments; rather, they found that their case of fraud followed a linear growth pattern. From interviews, they discovered that the principals of the company encouraged victims to tell their social network about the investment opportunity. However, the authors found that only 29 per cent of investors learned about the investment opportunities from other investors. When the investor-based recruitment proved inadequate (many investors kept the opportunity secret), they relied on impersonal methods of recruitment which proved just as successful. This reluctance of investors to spread the word did not lead to the emergence of a contagious diffusion effect driven by social networks (Baker and Faulkner, 2003). In order to test whether the findings of Baker and Faulkner (2003) are indicative of fraud, innovation adoption rates should be plotted in future investment fraud cases.

Diffusion research usually recognizes five types of adopters – innovators, those who start the diffusion process, early adopters, early majority, late majority, and laggards. (Rogers, 2003). Early adopters are individuals who have a higher potential for early adoption based on their access to communication media or status. These individuals are among the first to adopt a new innovation and place pressure on non-adopters to adopt the new innovation, who then become late adopters in the diffusion process. Early adopters have been shown to be involved in trusted social relations, such as friends and family members, with the opinion leaders who influenced them to adopt the innovation (Rogers, 1993; Valente, 1995; & Nooy et al., 2005).

Spatial Diffusion

Studies of financial fraud tend to include spatial factors as descriptive variables. Simply describing the spatial clustering of fraud in a cross-sectional study does not provide insight into the social and behavioral factors that drive the diffusion of fraud (Cohen and Tita, 1999). For example, Baker and Faulkner (2003) reported that 95 per cent of investors resided in the state where the crime occurred. Martin (2009) examined the geography of funds victimized by Madoff and found that most were geographically concentrated in the countries where the funds are managed and offered in portfolios by private banks—United States (23.3%), Switzerland (22.7%), and the United Kingdom (15.3%) Little can be surmised from these findings; a more precise analysis is required to determine whether spatial patterning exists.

To capture the existence of a spatial pattern it is critical to measure the geographic distance adaptors are from the origin of a fraud scheme. Though many methods exist to capture distance, the distance from home to a particular location is generally considered amongst criminologists to be preferred over other polygon based methods (e.g., measuring for the center of a census tract to the center of another census tract). Though debate continues as the choice of measuring process, Euclidean distance—straight line distance between two points—is commonly used to capture distance from or two crime sites when micro-level precision is not at issue. With the distances captured, classification of spatial patterning is possible.

There are three main types of spatial diffusion of interest to this study: relocation diffusion, expansion diffusion, and hierarchical diffusion (Cliff, Haggett, Ord & Versey, 1981; Cohen and Tita, 1999). Relocation diffusion occurs when the object or information being diffused leaves an origin point and spreads outward, similar to a wildfire. Like a

wildfire, spatial clustering and incident frequency around the origin point will decrease over time as fuel (in this case, investors) is depleted. Expansion diffusion occurs when information or events spread outward from the center, but the center remains high in event concentration. Expansion diffusion is indicative of phenomena with a strong attachment to a central place (Cliff, et al., 1981; Cohen and Tita, 1999). Relocation and expansion diffusion are indicative of contagious diffusion. The third form of diffusion, hierarchical diffusion, happens when the spread of a phenomenon does not require direct personal contact. The event or information spread through this type of diffusion tends to be less clustered and spreads fairly evenly to physically disjoint areas (Cliff, et al., 1981; Cohen and Tita, 1999). This process is typified by the spread of innovations through cultural influences such as mass media.

In the context of fraud, it follows that the spatial diffusion of investors would depend upon the patterns of social diffusion of the fraud. For instance, if a fraud relied upon personal methods of diffusion (indicative of s-curve growth), then the fraud is likely to spread outward from the center contagiously; this patterning would be indicative of either relocation or expansion diffusion. If investors were informed primarily through impersonal methods (mass media), then hierarchical spatial diffusion would be more likely.

AIMS OF THE CURRENT STUDY

The intent of this study is to incrementally advance our understanding of financial frauds by investigating the diffusion of investment activity. Using data from a survey of over 500 investors in the Eron mortgage fraud, this study seeks to answer two research questions: 1) Did the Eron mortgage fraud spread through the mechanism of contagious

diffusion?, and 2) do social network variables, such as mode of infection (personal or impersonal), and relationship to the infector, influence spatial diffusion. Policy implications for financial fraud and limitations of combining social network and spatial analysis are also discussed.

METHOD

Data Source

The data used in this study are from a survey administered to investors following the public collapse of the Eron Mortgage scheme. The list of investors was originally drawn from a database of approximately 2,800 names obtained from the Eron Lender's Committee and the British Columbia Securities Commission (BCSC). Duplicate names, incomplete addresses and corporate addresses which did not refer to an identifiable individual were removed, leaving 2,285 unique names and addresses of Eron investors.

Investor surveys are likely to have generated credible data. To help develop questions for the survey and clarify potential recall issues (since seven years had passed since the end of the fraud), three focus groups were held with Eron investors who held substantial knowledge of the fraud.[2] These individuals were identified from the list with the help of the Eron Lender's Group and the BCSC. Participants in the focus groups stated that since the majority of the investors lost a substantial amount of money, and they were interviewed by the BCSC and police several times over the past seven years, their memories regarding the fraud were clear. Through an examination of archival and interview data, Baker and Faulkner also show that age, salience, and stress do not appear

[2] Cohen and Faulkner (1989) suggest that several factors might impede the ability of a respondent to accurately recall events of victimization--stress, age, and other factors.

significantly associated with the accuracy of recalling fraud events (2004). Thus, this group of victims should provide reasonably accurate information.

The survey was administered in two waves. The pilot survey was mailed to 520 randomly selected Eron investors in December of 2004. During the 2nd phase of the survey, 1,765 surveys were mailed out between February and March, 2005. Of the 2,285 surveys mailed, 438 (19%) were returned undeliverable and 559 investors responded. The total pool of survey respondents represents 30 per cent of the investors. The survey questions were designed to obtain from respondents, a summary of their age, education, gender, income, net worth, process of involvement in Eron (including personal and impersonal methods of introduction), extent of loss, perceptions of responsibility for the fraud, personal consequences from the fraud, and possibilities for future prevention of securities fraud.

Variables

Independent Variables

Infection Mechanisms. To measure the method of initial infection, the survey asked investors, "How did you first hear of Eron Mortgage?" Respondents could choose among twelve categories (multiple choices were allowed). The two measures were recoded from this question for the multivariate model. The first set measured whether the investor was infected through personal methods, impersonal methods, or both, as defined in Baker and Faulkner (2003). The second measured whether the investor was infected through an Eron Mortgage employee or principal. Table 1 presents the percentages for each of these variables. In order to use these variables in the multivariate analysis, they were dummy coded (1=yes; 0=no).

Contagious Diffusion of Initial Investment Activity. The cumulative percent of infections per year was calculated to determine whether the fraud was spread through contagious diffusion. Investors were asked, "In which year did you first become involved in a project or property of Eron Mortgage?" Then, this temporal component of investment activity was reclassified into four categories presented by Rogers and Nooy et al. (2005); innovators, early adopters, early majority, and late adopters. Laggards are not represented in this study due to the arrest and indictment of Eron principals, prematurely ending the diffusion process. The year of first investment was also used as independent variable in the multivariate model (See Table 1 for variable descriptions).

Diffusion of Skepticism. One of the initial reactions victims display is a reluctance to advertise their victimization; people tend to be embarrassed that they were defrauded and this might be exacerbated if they are responsible for spreading the victimization to their family and friends. To develop a sense of the shift in network structure as investors began to grow suspicious of the legitimacy of the corporation, information was solicited about when each investor first attempted to withdraw their investments. The question posed to investors was, "Approximately how long before the collapse did you first try to pull your money out?" From this information it was possible to determine which quarter the investors began to grow wary about Eron. This information was integrated into the network visualization (described below) to explore the diffusion of negative sentiment—skepticism—that often seeds the collapse of fraud schemes.

Among all investors surveyed, 132 tried to pull money out before the collapse of ERON. The length of time was about 4 months (median 3 months) with a standard deviation of 3.1 months, where initial withdrawal attempts ranged from a low of less than

a month to a maximum of 24 months. Among the network sample, 81 people tried to withdraw about 4 months prior to the collapse with a standard deviation of 3.5 months (the minimum and maximum were the same).

Table 1. Description Variables Measuring Eron Fraud Infection and Contagious Diffusion.

VARIABLES	***PER CENT***
Infection Mechanisms	
Original Method of Initial Infection (n=540)*	
Personal	
Eron Broker	28
Independent Broker	5
Family or Friends	56
Business Associates	13
Financial Advisor	6
Impersonal	
Eron Seminar	20
Newspaper Ad	16
Newspaper Article or Column	4
Mail Solicitation	1
TV ad	0
Public Events (Impersonal)	3
Reclassified Mode of Infection (n=540)*	
Personal	89
Impersonal	28
Eron Employee Infector (n=540)	
Yes	28
No	62
Contagious Diffusion	
Year Adopted (n=507)	
1992	3
1993	3
1994	10
1995	13
1996	32
1997	40
Types of Adopters (n=507)	
Innovators (1992)	3
Early Adopters (1993)	3
Early Majority (1994-1996)	55
Late adopters (1997)	40

*Will not add to 100% due to multiple responses

Control Variables

A number of control variables were included in order to check the influence of other correlates. One control variables describing investment activity was used. This variable measured the investor's net loss in dollars. Two demographic variables were used as controls: gender and age at time of first investment, measured in years. Table 2 describes these variables.

Table 2. Control Variables used in the Multivariate Analysis of the Spread of the Eron Mortgage Fraud

VARIABLES	
Investment Variable	
Average Net Loss (n=529)	$67,659 (sd=$111,854)
Socio-demographic Variables	
Gender (n=554)	
Male	61%
Female	39%
*Age at time of initial investment (n=497)	
Less than 45	28%
45-54	28%
55-64	28%
65+	16%

*Categorized for clarity of description

Dependent Variable

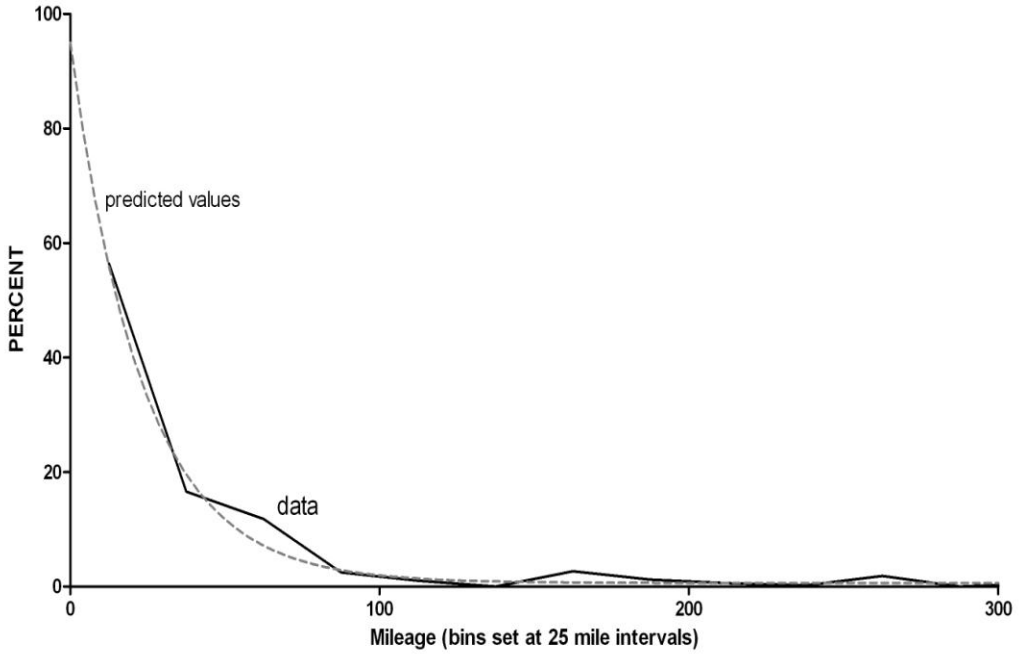
Distance from the epicentre of the fraud was used as dependent variable for the multivariate model. The Euclidean distance from the geographic centre of the fraud was calculated for each investor. The geographic centre of the fraud was deemed to be the former location of the Eron mortgage offices. We obtained each investor's home address at the time of the collapse in 1997 from the Securities Commission investigation files. The spatial data were generated using ArcGIS 10.0 (ESRI, 2011) and CrimeStat III (Levine, 2010) software packages. Out of the 559 survey respondents, 469 (84%) had last known home addresses that were geocodable. Figure 1 displays a map of the

geographic spread of investors over the province of British Columbia for the entirety of the fraud (1992-1997) and the former location of the Eron mortgage office (the map excludes 17 investors who were located outside of the province). The geocoded addresses were then imported into CrimeStat III software and a point-to-point distance matrix was created between each address and the former Eron mortgage office.

Insert Figure 1: Map of investor home locations

Distance was used in several ways throughout this study. To examine the distance distribution, distances were binned into 25 mile groups and truncated at 625 miles (18 extreme distances set to 625 miles). The distribution exhibits a one phase decay model (Figure 2). To test for spatial diffusion, the distance variable was truncated at 150 miles (every distance over 150 miles was transformed into the maximum distance of 150 miles). Distance was transformed into a dichotomous variable of above or below 25 miles for the multivariate model. And finally, average distance per year was used to provide some indication of the spatial diffusion of the Eron fraud.

Figure 2: Distance distribution



Network Visualization

A directional network was generated using information gleaned from responses to the following question, ―How did you first hear of ERON Mortgage?" As noted above, the respondents were able to list multiple sources: on average, each investor named 1.6 sources (with a standard deviation of 0.8, a minimum 1 source and a maximum 4). The first fraud network (personal) includes investors and employees of the corporation, where each investor (considered the ego) is linked to the person that first introduced them to the scheme (classed as alters). Investor nodes were anchored to the sociogram by geographic distance from Eron headquarters (as described above). The network includes 14 components with 330 nodes (investors and sources) contained in the main or principal component. The main component includes 285 links.

RESULTS

Contagious Diffusion

One of the primary objectives of this paper is to examine whether Eron spread spatially through contagious diffusion. However, prior to presenting the spatial results, it is important to look at overall growth of the fraud among investors. Contagious diffusion follows a logistic curve, spreading slowly from innovators to early adopters and then spreading progressively more quickly through the early and late majority. Figure 3 displays a diffusion curve describing first involvement of investors. It is readily apparent that the fraud spread through contagious diffusion, growing slowly and speeding up once it hits the 20 per cent tipping point. The last part of the diffusion is missing due to the fact that the fraud was interrupted before it could reach the flattened out final portion of the logistic curve. These results are more thoroughly investigated in a companion paper (Nash, Bouchard, & Malm, 2011)

Figure 3. Cumulative Distribution of Investors by Year of Initial Investment, Eron Mortgage Fraud

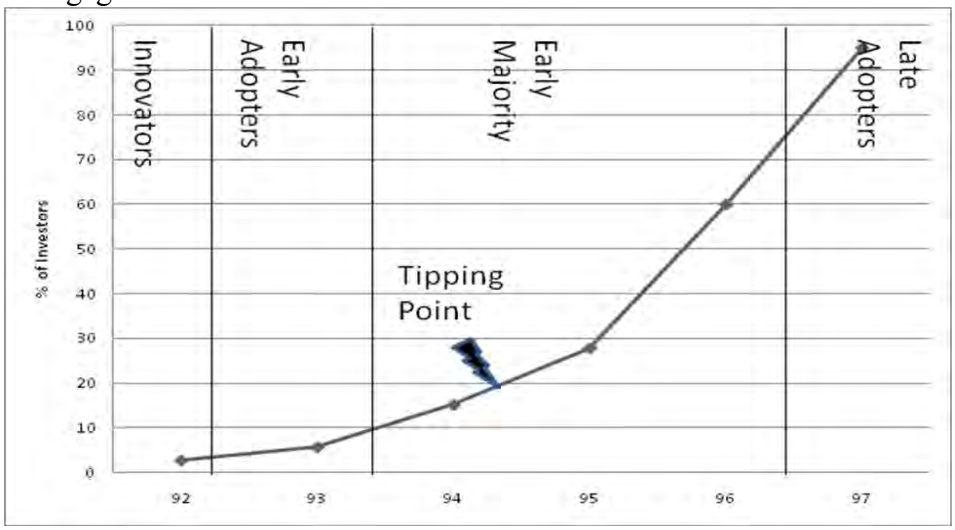
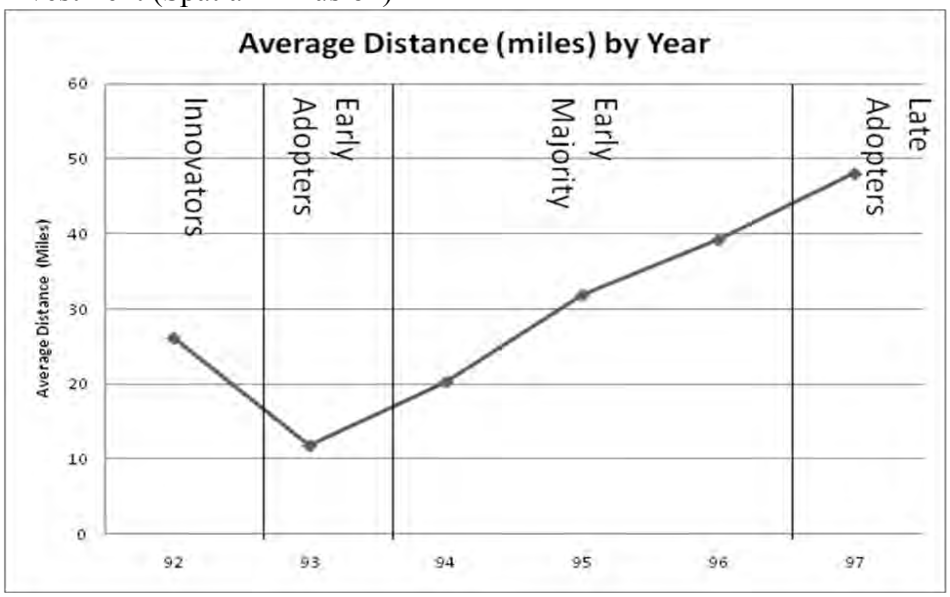


Figure 4 presents the spatial spread over the five years of the fraud. The curve shows that the fraud starts out with innovators who are moderately distanced from the

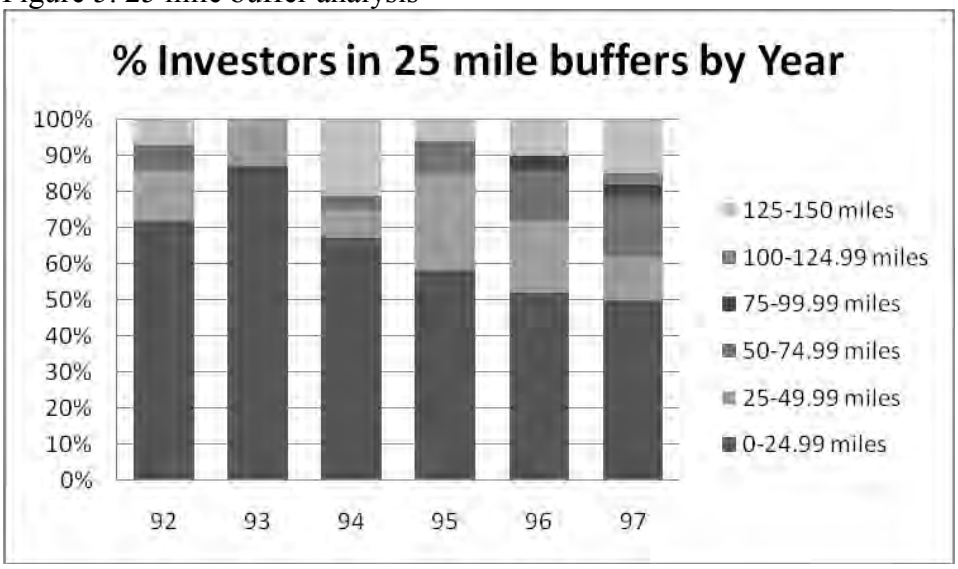
core. As the fraud spreads to early adopters, the distance rapidly decreases. The distance then increases in a linear fashion through the early and late majority of investors.

Figure 4. Average Distance From Home Address to Eron Offices by Year of Initial Investment (Spatial Diffusion)



In order to determine whether the mechanism of contagion is relocation or expansion diffusion, investor distances were grouped in 25 mile intervals for the five years of the fraud (see Figure 5). While the concentration of investors within 25 miles of the core does decrease, over 50% of the investors are consistently located within this buffer. This is indicative of expansion diffusion where information or events spread outward from the center, but the center remains high in event concentration.

Figure 5. 25 mile buffer analysis



Visualization of the Diffusion Process

To visualize the diffusion of investment and skepticism a series of sociograms were created with UCInet (Borgatti, Everett & Freeman, 2006). All nodes are included in the network and then as time passes, the color of nodes will shift. As investors were drawn into the fraud the color of their node changes from white to grey. Then, as investors grow wary of their involvement, their node darkens to black. Since the network is weighted by geographic distance from the Eron offices (central node), the geodesic arrangement of the network reflects social and spatial distance. Node size is scaled by in-degree centrality. In a directed network, this statistic looks at pairs of actors and counts the number of times someone is named; in network analysis terms, this means the number of ties flowing toward a selected actor (Freeman, 1979). The general form of in-degree centrality is:

$$C_{in} = \sum_{i=1}^{n} x_{ij} \Big/ \sum_{i=1}^{n}\sum_{j=1}^{n} x_{ij} \qquad (1)$$

Where x is the degree of node i and j. The denominator in this equation represents the sum of all possible ties in the network.

Figure 6: Diffusion process 1992-1997

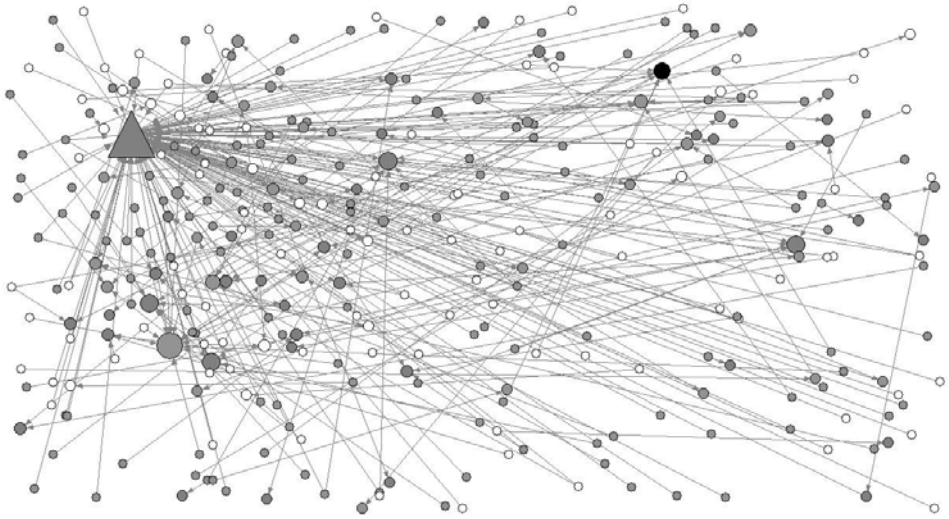
1992

1993

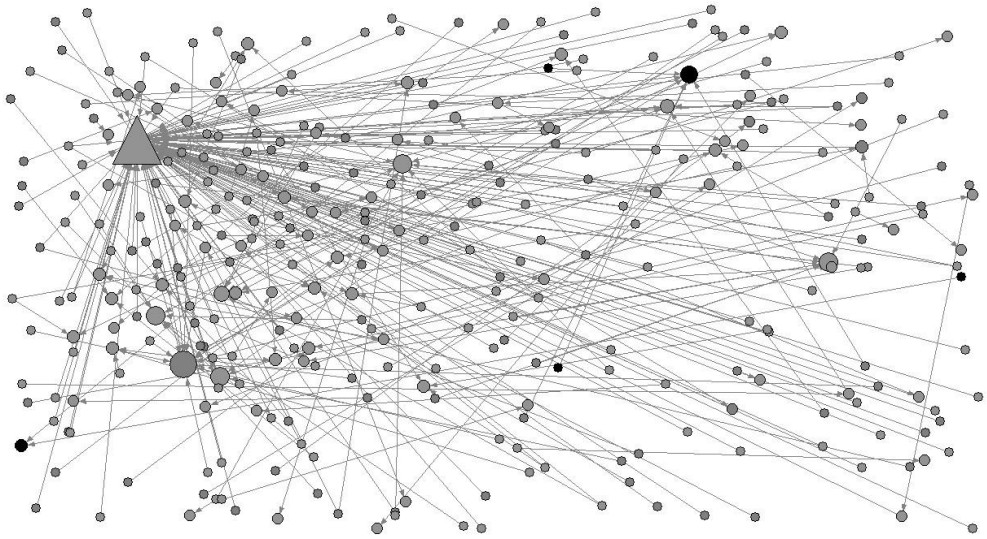
1994

1995

1996



1997



Multivariate Model

The second objective of this paper is to examine how social contact impacts the spatial diffusion of fraud. Specifically, the second research questions asks whether a specific mode of infection (personal or impersonal), and/or relationship to infector, is more common for those living closest to the fraud (within 25 miles). Since the dependent variable is dichotomous (1= living 25 miles or less from the fraud epicentre, 0=not living within 25 miles of the fraud), a binary logistic model was used to answer this question. No substantial problems of multicollinearity were revealed; the highest intercorrelation was -0.573 (dummy variables for personal mode of infection and impersonal mode of infection), which is well below the standard 0.700 benchmark for exclusion set by Tabachnik and Fidell (1989).

The model was weak, but did find two significant variables (See Table 3). None of the demographic or investment control variables showed any effect. The model shows that investors infected by an employee of the fraud and those investing early in the scheme have a significantly higher probability of living close to the core (within 25 miles) than other investors.

Table 3. Binary Logit Coefficients

Independent Variables	Live within 25 miles of Fraud Epicenter
Infection Mechanisms	
Personal Infection	-.397
Impersonal Infection	- .122
Eron Employee Infector	1.131*
Contagious Diffusion	
Year Adopted	-.271*
Controls	
Investment Variables	
Net Loss	.122
Socio-demographic Variables	
Gender	-.019
Age at time of initial investment	.046
Constant	.949
Nagelkerke R^2	.126
n	378

*p<.01

DISCUSSION AND CONCLUSION

Back in 2000, Frank Biller and Brian Slobogian were convicted of Canada's largest Ponzi scheme, the Eron Mortgage fraud. Similar to Ponzi's postal reply coupon, the high returns on investments promoted by Eron Mortgage – real estate developments in Canada and the United States – seemed plausible to investors at the time. Like Charles Ponzi and Bernard Madoff, the principals of Eron Mortgage did not actually carry out much of the plans that they enthusiastically described to their willing contributors, though their businesses were widely praised by media commentators. In all three cases, after questions were raised about their businesses, their books were examined and frauds discovered. But in all three cases, it was too late for the victims; the businesses had crashed, their money was gone, and little could be done to retrieve it. Since these frauds

have devastating effects on their victims, this research sought to advance our understanding by investigating the social and spatial diffusion of investment activity.

The first research question asked whether the Eron mortgage fraud spread socially and spatially through the mechanism of contagious diffusion. The results show that contagious diffusion was, in fact, present. The question of why this fraud spread through contagious diffusion, contrary to Baker and Faulkner's case study (2003; 2004), is fully discussed in Nash, Bouchard, and Malm (2011). This study is more concerned with the spatial diffusion of fraud and the effect of social network variables on spatial diffusion.

The spatial analysis indicated the presence of contagious expansion diffusion over relocation diffusion in the case study. Remember that relocation diffusion occurs when information is spread from an origin outward and clustering around the origin decreases over time. Expansion diffusion occurs when information spreads out from a core, but the center remains high in event concentration. Expansion diffusion is common with phenomena that have a strong attachment to a central place (Cliff et al, 1983; Cohen and Tita, 1999). In the Eron case, brokers and principals operated out of the Eron Mortgage office, which acted as a central meeting place, much like a drug market (Cohen, Cork, Enberg, & Tita, 1998; Cohen & Tita, 1999, Papachristos, 2009). Several interview and focus group participants indicated that Slobogian, more than anyone else was the initiator of the fraud – broker zero [see Nash, Bouchard, and Malm (2011) for a more complete discussion of Slobogian's role in the fraud]. Slobogian worked almost exclusively out of the Eron office, and lived nearby. When asked, "Before putting your money into Eron, what steps did you take?", 40 percent of the respondents reported that they had visited Eron offices. Interestingly, this was very similar to the amount of people who reported

that they spoke to trusted friends and family members (41%), and other investors (40%). When asked about how he was introduced to Eron, one of the interview respondents recalled,

> *A friend told me about Eron, I mean I trusted this guy. I made an appointment to talk to Slobogian at the offices. I went down there and he showed me pictures of the property and showed me the prospectus. It all seemed legitimate, I mean the offices were nice and they had a secretary and a bunch of people milling around. It all looked very professional. So I invested all my savings – about $90,000.*

It follows that individuals who are geographically close to the offices would be more likely to visit and be positively influenced by the seemingly professional appearance.

Based on the finding that most investors were infected via personal modes (89%), and that the diffusion did not spread evenly over time (seen through network visualization) but clustered around the Eron offices, contagious diffusion (specifically expansion diffusion) was favored over hierarchical diffusion. Hierarchical diffusion does not require direct personal contact and tends to be less clustered. While this conclusion may be valid, there are admittedly more sophisticated analytic techniques that could be used to test this assumption. Future research should focus on applying spatial clustering analysis such as LISA statistics to study diffusion processes in more depth.

The multivariate model also supports the above interpretation. The results showed that being introduced to the scheme by an Eron broker increases the probability that the investor lives close to the Eron offices. Personal vs. impersonal mode of introduction did not significantly influence living closely to the Eron offices. The fact that none of the demographic or investment control variables showed any effect is also interesting. However, the multivariate portion of this research also had limitations. Once again, introducing a clustering variable instead of a simple distance as the dependent

variable might have produced more valid results. Also, the introduction of a spatial lag term to account for any possible spatial dependence would also increase the robustness of the model. This research also demonstrates the utility of combining social network and spatial analysis.

Geographers and social researchers have repeatedly shown that space influences social relations and crime (Brantingham & Brantingham, 1984; Eck & Weisburd, 1995; Simmel, 1997; Papachristos, 2009). This paper highlights the utility of using spatial arrangement in social network visualizations over time (McGrath et al. 1997). The series of sociograms allows the reader to visualize how closely tied actors are also located in close spatial proximity, and how time effects that spatial and social arrangement. However, the technique used did not position the sociograms on GIS maps, which limited explanatory capabilities. Future research should utilize new software capable of combining GIS and social network analysis [i.e. SONOMA (Nag, 2010)].

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