BANKING CRIME ANALYSIS AND THE EFFECTIVENESS OF BANKING SUPERVISION: COMBINING GAME THEORY AND THE ANALYTICAL NETWORK PROCESS APPROACH

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ABSTRACT

A failed bank can spark a deep financial crisis throughout the whole country when ironically it may simply have been triggered by a banking crime perpetrated by an insider, i.e. the banker. Although banking crimes may pose a significant threat to financial sector stability, the potential risk of internal fraud has, hitherto, not beentaken into account in banking supervision processes. This paper analyzes the effectiveness of banking supervision to uncover potential risks of banking crimes by combining game theory and the analytical network process approach. In this paper, the author conducts two games with three players; the banker, the bank supervisor and the police. The banker has two strategies: to offend or not to offend. The bank supervisor has two choices: to supervise or not to supervise. The police can choose toenforce or not to enforce. Inthe first part, the effectiveness of bank supervision is analyzed theoretically using game theory. The effectiveness of banking supervision will depend on the behavior of each player as reflected intheir decisions. Further analysis will confirm the previous result using an analytical network process. At this stage, the analytical network process is used to calculate the probability of each strategy being chosen by considering all criteria or sub criteria. Any decision made by one player will influence the other players in choosing their alternative strategies and vice versa.

Keywords: Analytical Network Process, banking crimes, game theory.

1. Introduction

Duringthe last decade a number ofcountries experienced severe crises detrimental not only to theirfinancial systems but also the regional economy as a whole. From 2008 until now, the global economy has survived extremeturbulence. Gauging the recent global crisis against all others in recorded history, the current turmoil probably ranks as the most significant. Nevertheless, the magnitude may vary depending critically on the government's policy response, particularly through recapitalizing the banking system to restore stability and confidence.

In most cases of financial crisis, the banking sector has always played a prominent role. Often the dominating sector in aneconomy, the banking sector either triggersacrisis or exacerbatesthe situation. Considering its staggering effect, banking resilience is thepivotalfirst line of defense to protect the economy. Based on that same logic, bank recovery is the most determining step in anyfinancial crisis resolution. For instance, in the current global financial crisis almost all developed countries are relying on bank recovery to bring the crisis to an end.

Many scholars and bankers are acutely aware of the problem with banking sector fragility. After the 1997 Asian Crisis, risk-based banking supervision was introduced and implemented. Despite stricter

regulations, the problems with banking overthe last decade indicated that not enough safeguards were put in place to avoid a banking crisis.

The current banking supervision mechanism does not sufficiently take into account the actions of individual bank employees as a risk factor when ironically some cases of troubled banks were attributable to a banking crime perpetrated by an insider, i.e. the banker. Barings Bank for instance – one of the oldest and leading banks in England – collapsed simply as a result of speculative activities by its manager. In Japan, Daiwa Bank, one of the largest banks in the country, was bancrupted because of a single internal fraudulent act. If the banker adopts risk-seeking or even greedy behavior, the banking sector therefore contains a potentially high risk of internal fraud. As a consequence, despite thecontinued strengthening ofbanking supervision, the probability of a banking crisis caused by a single banking crime remains high.

2. Literature Review

2.1 Crime Economics: Becker Vs Tsebelis

To anticipate or lessen the likelihood of bank failure, we need analysis tools to identify banking problems from a different perspective. Most available analysis tools used todeterminethe factors of a banking crisis, and subsequently compileresolution programs, overlook internal fraud as a cause for concern. Those analyses primarilyfocus on external factors such as market and credit risks. The lessons learned from numerouscases of banking problems showus that internal factors like risk-seeking or greedy behaviorat certain levels should not be tolerated. Risk-seeking or greedy behavior by bankers should be taken into account as a factor that may increase the probability of banking crime and, furthermore, may cause bank failure or even worse, a banking crisis.

Banking crime is a criminal act and to analyze the banking crime phenomena we can adopt the economic model pioneered by Gary S. Becker[1]. By using a decision-making approach Becker models the economics of a crime as follows (Becker, 1968):

$$EU_j = p_j U_j (Y_j - f_j) + (1 - p_j)U_j(Y_j) \qquad (1)$$

Where:
EU_j = expected utility from the crime
p_j = probability of conviction
f_j = monetary equivalent of punishment from given offense
Y_j = offenders income including monetary and "psychic"
U_j = individuals utility function

From equation (1), we see that the total expected utility comprises of two parts. The first part is the probability of getting caught multiplied bythe utility that will be received if caught. It includes the monetary and non-monetary income from the activity minus the cost of the punishment from the activity. The second part is the probability of not getting caught multiplied bythe utility from the income from the activity. Through this equationBecker argues that a person commits an offense if the expected utility exceeds the utility available by using the time and other resources forother activities.

In stark contrast to Gary S. Becker, another pioneer ofcrime economics, George Tsebelis (1986), argues that the occurrence probability of a crime is affected by the interactions of rational players, i.e. the public and police. Based on this argument, Tsebelis analyzed the economics of crimeusing game theory. In his

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[1] Becker's seminal paper (1968), "*Crime and Punishment: An Economic Approach*", has inspired the development of crime economics. Studies in this area have been conducted by several authors including Garoupa (1997), Bowles (2000), and Polinsky and Shavell (2000, 2007).

model, the interaction between the public and the police or between firms and the authorities is represented by a one-shot 2×2 inspection game that is played simultaneously. The payoff matrix of the game is as follows:

		THE POLICE	
		Enforce	Not Enforce
PUBLIC	Offend	a_1, a_2	b_1, b_2
	Not Offend	c_1, c_2	d_1, d_2

Figure 1. Tsebelis Inspection Games

where: $c_1 > a_1$, $b_1 > d_1$, $a_2 > b_2$, and $d_2 > c_2$.

The game does not have a pure strategy equilibrium; instead it has a unique mixed strategy equilibrium, which implies that punishment is not effective in influencing the tendency of individuals fromcommittingillegal activities. Let p be the probability of the public to offend and $q$be the probability of the police to enforce the law. The mixed strategy equilibrium of the game is as follows (theorem 1 of Tsebelis, 1989):

$$p^* = \frac{d_2 - c_2}{a_2 - b_2 + d_2 - c_2} \tag{2}$$

$$q^* = \frac{b_1 - d_1}{b_1 - d_1 + c_1 - a_1} \tag{3}$$

Through equations (2) and (3), Tsebelis argues that any attempt to increase the severity of punishment will only alter the payoffs for individuals, namely $a'_1 < a_1$ and $c_1 > a'_1$. This policy leaves unchanged the frequency of violation at equilibrium (p^*). On the other hand, it decreases the likelihood of enforcing the law(q^*). Hirshleifer and Rasmusen (1992) labeled these results as the payoff irrelevance proposition (PIP).

Tsebelis's proposition on the ineffectiveness of punishment is controversial. It has attracted many critics. The critics primarilyfocus on proving that the ineffectiveness applies only in certain conditions - for instance, if the game is played by no more than two players, if the game with discrete payoffs is played simultaneously, or if the game is played sequentially with the public's move being first.

2.1 Inspection Game Refinement: Pradiptyo's Model
Pradiptyo (2006) modeled the phenomena in criminal justice as a 2-player 2×2 one-shot game played by representative agents, namely public and enforcer. In his model, Pradiptyo modified Tsebelis' model by replacing the police with the enforcer. Pradiptyo assumes that the enforcer is a broader institution than the police, yet the enforcer is part of a higher organization, namely the Criminal Justice Authority (CJA). The CJA finances the enforcer and it has the authority to set the level of punishment. Given the punishment regime, the enforcer has the duty of enforcing the law and delivering criminal justice intervention, including sentencing.

Furthermore, Pradiptyo modified Tsebelis' model by describing the specification of the payoffs. In Tsebelis' model, each element of the payoffs (i.e., a, b, c and d) represents the net benefits of choosing a strategy, given the strategy taken by the opponent. In his model, Pradiptyo provide the identity of each element in the payoff matrix and the game is given as follows:

<div align="center">THE ENFORCER</div>

PUBLIK		Enforce	Not Enforce
	Offend	U_O-U_D, B_E-C_E-C_S	U_O+U_R, 0
	Not Offend	U_R, B_R-C_E	U_R, B_R

<div align="center">Figure 2. Pradityo's Inspection Games</div>

Where:

U_O = immediate utility arising from committing an offence.

U_D = disutility of serving direct punishment (e.g., imprisonment, fine, community service).

U_R = positive reputation effects for individuals of not being convicted.

B_E = benefits of enforcing the law, including the detection of incidents and any deterrence effects thatarise due to enforcement of the law.

B_R = reputation benefits in achieving objectives set by the CJA.

C_E = cost of law enforcement, including, for instance, costs of investigation and of dispatching police officers to certain areas.

C_S = cost of delivering court sentences, including direct and indirect punishments (e.g., the list of posts that cannot be taken by ex-offenders, the length of probation and the period offenders have to report their whereabouts to thepolice).

In his model, Pradityo argues that an individual will commit an offence if the utility to conduct such activity dominates the expected disutility of serving direct punishment and the expected loss of reputation. While the law will be enforced if the expected benefits of enforcing it dominate the costs of enforcement and the expected cost of delivering sentence. These arguments are in line with Becker's proposition.

In addition, Pradiptyo proves in his study that both increasing the severity of the punishment and initiating crime prevention programs may influence the offending behavior of individuals. The impact of the latter on reducing the probability of offending is more certain than the former, *ceteris paribus*. These findings are not in line withTsebelis' theorem.

3. Banking Crime Analysis: How Effective Banking Supervision Could Be?

Quite different from the crime economic analyses proposed by Tsebelis and Pradiptyo, banking crime analysis involves three players, i.e., the banker, the police and the bank supervisor. Bank supervision and law enforcement on banking crime can be described by the following process:
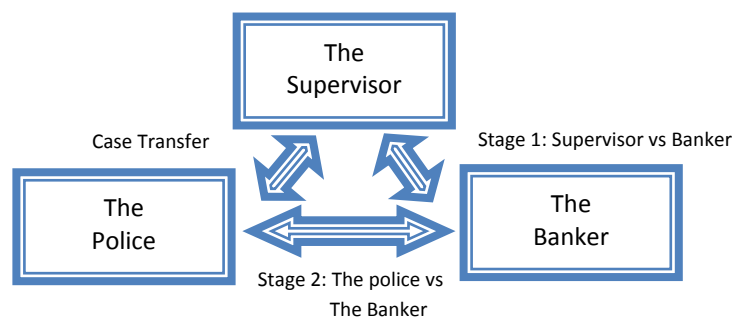
Figure3. Banking Crime Analysis Process

As seen in Figure 3, banking crime analysis includesthree players and two stages. In the first stage we can analyze how the supervisor has to decide whether to supervise or not supervise, while concomitantly the banker will choose between offend or not offend. If the supervisor decided to supervise, and he/she found that the banker committed an offence, he/she would not be able to bring the case to the court. The supervisor has to referthe case to the police, who then (stage 2) have two alternative decisions, enforce the law or not enforce the law. Atthis stage, the banker who has been arrestedwill have two options, try to bribe the police, or just let the court decide whether he/she is really guilty or not and acceptthe consequences.

3.1 Inspection Game Approach
3.1.1 Setting the Game
3.1.1.1 Stage 1: The Banker Vs The Supervisor

We model banking crime analysis stage one as a 2-player 2×2 one-shot game played by representative agents, namely the banker and supervisor. It is assumed that the supervisor and banker are individual persons. Under this assumption the supervisor has no authority to set the level of punishment. Given the punishment regime, the supervisor has aduty tosupervise and referthe case - if any banking crime is discovered – to the police. This is consistent with Tsebelis' model, which assumes that the level of punishment is exogenous, and simultaneously accommodates Becker's model by incorporating the allocation of resources by the supervisor in tackling crime.

Referring to Pradiptyo (2006), the disutility of being convicted is not limited only to serving direct punishment (e.g., paying a fine or a custodial sentence) but, more importantly, there is a substantial reduction in potential future wealth owing to loss of reputation (we define this as areputation cost). In a one-shot game analysis, thesereputation effects should be taken into consideration in the model.

To set the game we adopt both Tsebelis' and Pradiptyo's specifications. In Tsebelis'original model, each element of the payoff (i.e., a, b, c and d) represents the net benefits of choosing a particular strategy, given the strategy taken by the opponent. Pradiptyo refined Tsebelis' model by providing the identity of each element in the payoff matrix. We combine Tsebelis' andPradiptyo's specification and the game is given as follows:

		SUPERVISOR	
		Supervise	Not Supervise
BANKER	Offend	a_1, a_2	b_1, b_2
	Not Offend	c_1, c_2	d_1, d_2

Figure 4. Inspection Games in Bank Supervision, stage 1

Where:

a_1 = $UO_B - CO_B - DO_B - RC_B$
a_2 = $DB_S - CS_S + RB_S$
b_1 = $UO_B - CO_B + RB_B$
b_2 = $-RC_S$
c_1 = RB_B
c_2 = $DB_S - CS_S + RB_S$
d_1 = RB_B
d_2 = RB_S
UO_B = immediate utility arising from committing a fraud/banking crime.
DO_B = disutility of serving direct punishment (e.g., imprisonment or fine).

CO_B = cost of offense arising from committing a fraud/banking crime.
RB_B = positive reputation effects for bankernot convicted.
RC_B = reputation cost for convicted banker.
DB_S = direct benefits of supervision, including satisfaction due to enforcement of the regulationsand bank soundness.
CS_S = cost of supervising the bank, including, for instance, cost of investigation and of dispatching police officers to certain areas.
RB_S = reputation benefits in achieving the objective ofbank soundness.
RC_S = reputation cost for supervisors not achieving their objective.

From abanker's perspective, committing a banking crime or fraud produces immediate benefits (UO_B), either in terms of material well-being or psychological rewards. Differing slightly from Pradiptyo (2006), committing abanking crime is not a free-of-charge activity. To do so, a banker has to sacrifice some of his resources including money and time as costs (CO_B). On the other hand, crime produces disutility to the banker (DO_B) if convicted and incarcerated. The longer (higher) the imprisonment term (fines), the greaterthe disutility of serving direct punishment (DO_B). The disutility of serving direct punishment ranges from aloss of earnings to aloss of liberty due to incarceration (Pradiptyo, 2006).

If a banker decides to offend, andthe supervisors do not supervise, the banker will enjoy the immediate utility of offending (UO_B) minus its cost (CO_B), while keeping intact his or her positive reputation (RB_B). However, ifabanker commits an offence and the supervisors supervise, the banker will receive theimmediate utility of offending (UO_B) minus the cost (CO_B), but at the same time, he/she will have to bear the disutility of facingdirect punishment (DO_B). If the banker decides not to offend, irrespective of whether the supervisors supervise or not, he/she will be able to maintainpositive reputation effects (RB_B).

Suppose an individual banker commits an offence and supervision is in place, there will be benefits of supervising (DB_S). The benefits include the ability of Supervisors to detect the crime and, subsequently, to refer theoffenders to the police, the possible recovery of some of the victims' materials from the perpetrators, and the benefits arising from the sentences following conviction.

In general, the objectives of bank supervision are to provide a signal to potential offenders not to commit an offence. In the case where these objectives are met, the supervisor will earn positive reputation benefits (RB_S), which are obtained if, irrespective of the strategies chosen by the supervisor, the banker decides not to offend. If the banker commits an offence and the supervisor decides not to supervise, then the crimes may be undetected. However, the banking system itself may unveil the crime, and in this case, the supervisor will bear negative reputation (RC_S).

3.1.1.2 Stage 2: The Banker Vs The Police

If abanker commits an offence and the supervisors decide to supervise,assuming the supervisors can detect the crime, they are unable to bring the bankers to courtdirectly. The supervisors have to referthe case to the police and let the police enforce the law. This will be the stage 2 of the game in which the banker will meet the police. The game is given as follows:

		POLICE	
		Enforce	Not Enforce
BANKER	Bribe	e_1, e_2	f_1, f_2
	Not Bribe	g_1, g_2	h_1, h_2

Figure 5. Inspection Games in Bank Supervision, stage 2

where:

e_1 = UO_B-CO_B-DO_B-RC_B-CB_B
e_2 = DB_P-CE_p+RB_p
f_1 = UO_B-CO_B-CB_B+RB_B
f_2 = FI_P-RC_p
g_1 = UO_B-CO_B-DO_B-RC_B
g_2 = DB_P-CE_P+RB_P
h_1 = UO_B-CO_B+RB_B
h_2 = -RC_P
CB_B = cost of bribery for banker to avoid punishment.
DB_P = direct benefits of enforcing the law, including satisfaction due to enforcement of the law and bank soundness.
CE_P = cost of law enforcement , including, for instance, cost of investigation and of dispatching police officers to certain areas.
RB_P = reputation benefits in achieving objective to enforce the law.
RC_P = reputation cost for the police of not achieving their objective.

In this game, the bankers who have been convicted by the supervisor in stage one have two strategies: try to avoid punishment by bribing the police, or go to court. On the other hand, the police have two options: enforce the law (bring the banker to court) or not enforce the law. The game is assumed to be sequential in which the banker will move first followed by the police.

3.1.2 Game Analysis
Consider q is the probability that the supervisor will supervise the banker. From the banker's perspective, he/she will commit an offence if :

$$UO_B - CO_B \geq (DO_B + RC_B + RB_B)q \qquad (4)$$

In line with Pradiptyo's proposition, equation (4) shows that the banker will commit an offence if the net utility to conduct such activity exceedsthe expected disutility of direct punishment and the expected reputation loss.

A similar method is used by the supervisor to decide whether to supervise the banker or not. Consider p to be the probability of the banker to offend, thus the supervisor will supervise if:

$$DB_S - CS_S \geq (-RC_S - RB_S)p \qquad (5)$$

According to equation (5), the supervisor will supervise if the net benefit of supervision exceedsthe expected reputation loss.

The game above does not have a pure strategy equilibrium. The mixed strategy equilibrium is as follows:

$$p^* = \frac{CS_S - DB_S}{RB_S + RC_S} \qquad (6)$$

$$q^* = \frac{UO_B - CO_B}{RB_B + DO_B + RC_B} \qquad (7)$$

Since $p^*, q^* \in (0,1)$it can be inferred that the underlying assumptions of the model are as follows:

$$RB_S > CS_S - RC_S - DB_S \qquad (8)$$

$$RB_B > UO_B - CO_B - DO_B - RC_B \qquad (9)$$

Equations (6) and (8) imply that in equilibrium, given the net cost of supervision (i.e., CS_S-DB_S), the probability of a banker committing an offence increases (decreases) as the net benefits of supervision (i.e., RB_S+RC_S) decrease (increase). To minimize a banker's chance of offending we have to improve our appreciation ofthe supervisor for their supervision of thebank.The higher our appreciation, the higher the benefits of supervision (i.e., RB_S+RC_S), thus the higher the probability that the supervisor will supervise the bank.

Equations (7) and (9), on the other hand, imply that if the supervisor observes that an increase in severity of punishment increases either DO_B or RC_B or both, there is no incentive for the supervisor to increase or to maintain the level of supervision. The increasing severity of punishment (DOB + RCB) will reduce the probability that the banker will commit an offence, in additionit will discourage supervisorsfromincreasing or maintaining the level of supervision. This finding is in line with Tsebelis' and Pradiptyo's propositions.

Atstage two, the banker who has been convicted will play a game with the police. From the banker's perspective, the only way to avoid disutility of serving direct punishment (DO_B) is to stopthe police from enforcing the law. The banker will move first. Since h_1>f_1>g_1>e_1, the best choice for the banker is to try and bribe the police. If the police accept the bribe, the banker will evade punishment and retain his/her reputation (f_1>e_1). However, if the police reject the bribe and decide to enforce the law, there will be an additional cost of the bribe (CB_B) for the banker (e_1<a_1). If the banker decides not to bribe the police but,fortunately, the police choose not to enforce the law, the banker will enjoy all the spoilsofhis/her offence (h_1>a_1, h_1=b_1).

From apolice perspective, when the supervisor has caughtthe banker and referredthe case, the police can choose whether to prosecutethe banker and benefit from enforcing the law (DB_P). The benefits include satisfaction from prosecuting theoffender, the possible recovery of some of the victims' materials from the perpetrator, and the benefits arising from the sentences following conviction. Enforcing the law, however, is costly and so is delivering sentences. Supposing that the law has been enforced, regardless of the actions of the bankers, the police incur the costs of law enforcement (CE_P).

Referring to Bowles and Pradiptyo (2004), the objectives of sentences (law enforcement) are: a) general deterrence–providing a signal to potential offenders not to commit an offence; b) specific deterrence–deterring re-offending in the future; c) punishment; d) rehabilitation; e) incapacitation–isolating offenders from the rest of society during their incarceration; and f) restitution–restoring the losses incurred by the victims (Bowles and Pradiptyo, 2004). The police will achieve these objectives only if they enforce the law. If so, the police will earn positive reputation benefits (RB_P). Otherwise, they will bear the negative reputation cost (RC_P).

From apoliceperspective, consider r is the probability that the banker will attempt to bribe, he/she will enforce the law if :

$$DB_P - CE_P + RB_P \geq (FI_P)r - RC_P \qquad (10)$$

Equation (10) implies that the police will enforce the law if the total net benefit earned from enforcing the law (DB_P-CE_P+RB_P) exceeds the total expected value of financial incentives from the bribe (Fi_P) minus negative reputation (RC_P). Through this equation we can see that if the net benefit earned from enforcing the law (DB_P-CE_P+RB_P) is small, due to - for instance –less reputation benefit, the convicted banker will be encouraged to bribe the police. The banker will try to bribe the police if he or she knows that the net

benefit earned by the police by enforcing the law is limited. Reputation benefit (RB_P) is predictable. The lower the reputation benefit, the smaller the net benefit earned from enforcing the law. Thus, the higher probability the banker will try to bribe the police.

3.1.3 The Effectiveness of Bank Supervision

Bank supervision will be considered effective if it meets its objective, namely deterring banking crimes. Thus, to measure the effectiveness of bank supervision we need to know the impact of bank supervision on the possibility of banking crime occurrence (p). From equation (4) we can see that given the net utility of committing an offence, the higher the probability q the lower the probability p. This implies that bank supervision effectively discouraged the banker from committing an offence (banking crime). It is noteworthy, however, that if society istoo tolerant and, thus, there is no value for reputation, the increasing probability q will not affect the probability p. Consequently, bank supervision will not be effective in reducing the likelihood of banking crime. Equation (4) also implies that increasing the severity of punishment will lower the probability p.

Equation (5), on the other hand, reveals that the supervisor will supervise only if the net benefit of supervision dominates the potential reputation loss. Thismeans that the higher the reputation values (the bigger the potential reputation loss), the bigger the probability q.

Suchassumptionsare also supported by equation (6) and (7), implying that in equilibrium, given the net cost of supervision (i.e., CS_S-DB_S), the probability of a banker committing an offence increases (decreases) as the net benefits of supervision (i.e., RB_S+RC_S) decrease (increase). To minimize a banker's chance of offending we have to improve our appreciation forthe supervisor inachieving adequate bank supervision.The greaterour appreciation, the bigger the benefits of supervision (i.e., RB_S+RC_S), thus ahigher probability that the supervisor will supervise the bank.

Atstage 2, we know that if the net benefits earned from enforcing the law aresmall, there is a tendency that the police will accept abribe from the convicted banker. Since the banker can predict this result, the banker atstage 1 will consider f_1 rather than a_1 as his or her payoff, and it changesequation (4) to equation (11) as follows:

$$UO_B - CO_B \geq (RB_B)q \tag{11}$$

Equation (11) strengthens our previous finding that without reputation value anincreasing probability of q will not affect probability p. Consequently, bank supervision will not be effective in reducing the likelihood of banking crime. Equation (11) also implies that increasing the severity of punishment will not lower the probability p.

3.2 Analytical Network Process Approach
3.2.1 Setting the Network

Using the logic of those games we can build a framework utilizing theanalytical network process approach. Here the story is quite the same. Each player (i.e., the supervisor, the banker and the police) has their own goal, and for that goal each player will have payoffs as their criteria and alternatives decisions. Thus, the criteria for the supervisor will be: direct benefits of supervision (DB_S), cost of supervision (CS_S), reputation benefits (RB_S), and reputation cost (RC_S). Criteria for bankers are: immediate utility from crime (UO_B), disutility of direct punishment (DO_B), cost of offense (CO_B), positive reputation (RB_B), reputation cost (RC_B), and cost of bribe (CB_B). While, the police criteriaincludedirect benefits of enforcing the law (DB_P), cost of enforcing the law (CE_P), reputation benefits (RB_P) and reputation costs (RC_P).

The alternative decisions for each player are the same asthose used in the game theory approach. The supervisor will have two alternatives: supervise or not supervise, while the police will have to choose between enforcingor not enforcing the law. The banker, in the first stage will have two alternatives, offend or not offend, and atthe next stage will have to choose, bribe or not bribe.
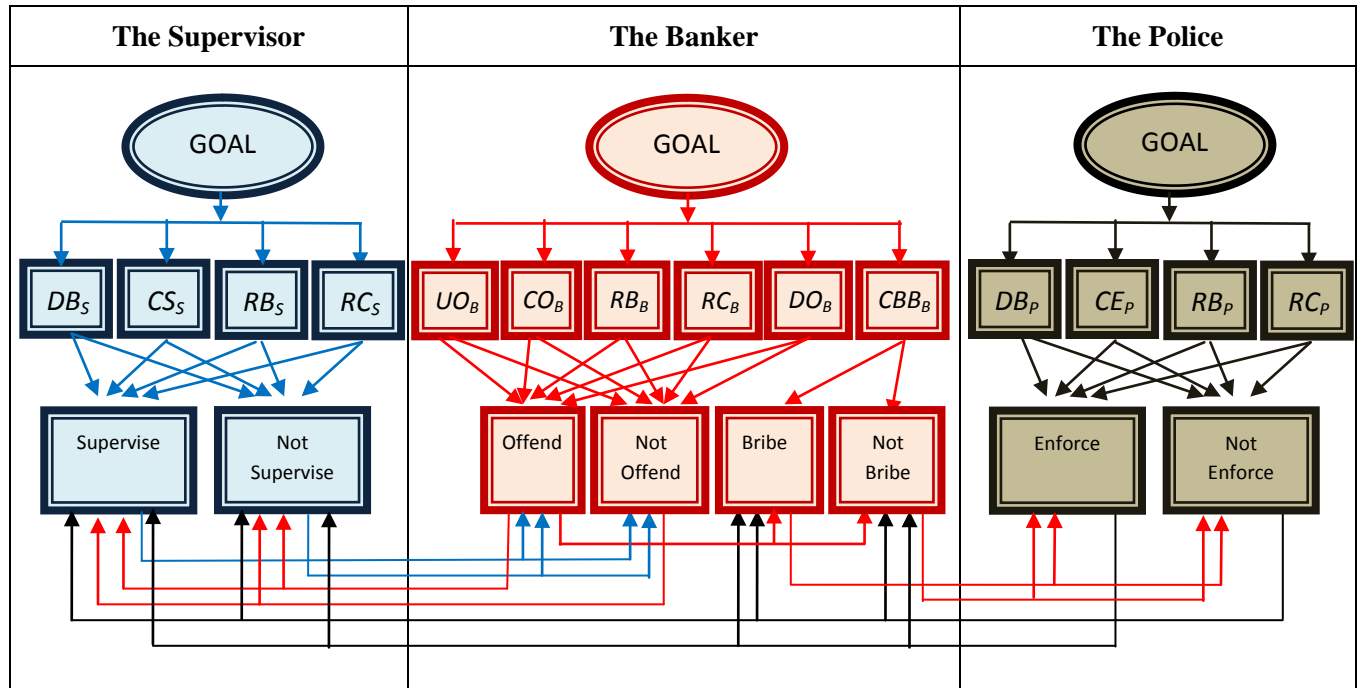
The network can be illustratedas follows:

Figure 6. Analytic Network Process of Banking Crime

Referring to the results of the game theory approach, the decisions of one player will affect and be affected by the other players' decisions. Equation (4), for instance, implies that the decision of a supervisor represented by q will affect the decision of the banker to offend or not to offend. While equation (5) implies the opposite. Equation (10) on the other hand describes how the police will choose to enforce or not enforce based on the decision of the banker.

3.2.2TheImpact of Bank Supervision

To analyze the effectiveness of bank supervision we need a baseline condition. This condition can be estimated using Superdecision software based on the network in Figure 6. In the baseline condition, each player will balance all the criteria, and for each criterion the player will follow their tendency that is derived in the previous game theory analysis. From abanker's point of view, for instance, with respect to the utility ofoffend (UO_B) the banker is likely to choose offend.Thismeans that offend is equally to moderately (scale 2) more important than not offend. While, with respect to disutility of offend (DO_B), the banker is likely to choose not to offend, meaning that not to offend is equally to moderately (scale 2) more important than offend.

Employing all tendencies derived from the game theory analysis to all criteria for all players, including the relationship between decisions, we will have baseline conditions as shown in Table 1.

Table 1. Baseline Condition Priorities

Alternative Decisions	Limiting	Normalized
Bribe	0.072029	0.66667
not bribe	0.036014	0.33333
not offend	0.202881	0.48424
Offend	0.216086	0.51576
Enforce	0.048019	0.44444
not enforce	0.060024	0.55556
not supervise	0.199280	0.54605
Supervise	0.165666	0.45395

Source: Super Decision's output

It is shown in Table 1 that under thebaseline scenario the supervisor is likely to choose not to supervise, the police may decide not to enforce the law and,accordingly, the banker will tend to offend. It should be noted, however, that this result is because thedecision-making processes of all players are linked. Adifferent outcome may occur if the processes are separated. In that case, the supervisor will choose to supervise, the police may decide to enforce and the banker is likely not to offend. The interesting finding here is that the preference of one player changes after they consider the decisions of theother players.

- *Scenario 1: Strengthen bank supervision*

To strengthen bank supervision we need to improve the value of criteriaassumedtoencourage supervisors to act. These criteria are the Direct Benefits of Supervision (DB_S) and Reputation Benefit (RB_S). Therefore, with respect to the supervisor's objective, the Direct Benefit of Supervision (DB_S) and Reputation Benefit (RB_S) are more significantthan other criteria. Furthermore, with respect to these criteria, we improve the supervisor's tendency to supervise. The results are presented in Table 2.

Table 2. Priorities of Scenario 1

Alternative Decisions	Limiting	Normalized
Bribe	0.073859	0.66667
not bribe	0.036929	0.33333
not offend	0.195334	0.46853
Offend	0.221576	0.53147
Enforce	0.049239	0.44444
not enforce	0.061549	0.55556
not supervise	0.195874	0.54181
Supervise	0.165641	0.45819

Source: Super Decision's output

The result of this scenario is surprising. There areno fundamental changes regarding the priorities; the supervisor is still likely to choose not to supervise, the police still decide not to enforce the law and the banker tends to offend. This implies that strengthening bank supervision will not be effective in deterring banking crimes. This result provides a counterintuitive outcome tothe game theory approach. Any changes in the supervisor's utility to supervise (DB_S and RB_S) do not effect the equilibrium of probability of offending. More intensive banking supervision doesnot lower the probability of banking crime.

- *Scenario 2: Strengthen bank supervision and increase the severity of punishment*

In this scenario, besides strengthening bank supervision we also increase the severity of punishment. We combine two policies: 1) increasing the disutility of punishment(DO_B), and 2) increasing the loss of offenders' reputation benefits (RC_B). In the model we improve the value of these criteria to become more significant than the other criteria, and in additionwe enhance the banker's tendency not to offend. The results of this scenario are presentedin Table 3.

Table 3. Priorities of Scenario 2

Alternative Decisions	Limiting	Normalized
Bribe	0.069914	0.66667
not bribe	0.034957	0.33333
not offend	0.211606	0.50221
Offend	0.209741	0.49779
Enforce	0.046609	0.44445
not enforce	0.058261	0.55555
not supervise	0.178745	0.48452
Supervise	0.190166	0.51548

Source: Super Decision's output

The results of scenario 2 areinteresting. Table 3 shows that there are criticalimprovements regardingthe priorities. The probability that asupervisor will supervise increases and the banker may decide not to offend. The police, however, arestill likely to choose not to enforce the law. This finding implies that strengthening bank supervision coupledwith increasing the severity of punishment will be effective in deterring banking crimes.

- *Scenario 3: Strengthen bank supervision and law enforcement, increase severity of punishment*

In this scenario, we improve not only banking supervision and the severity of punishment but also law enforcement. There are two waysto enhance law enforcement, namely: 1) increase the Direct Benefits of law enforcement (DB_P), and 2) increase the police Reputation Benefits (RC_P). In the model we improved the value of these criteria to become more significant than the other criteria and, in addition, we improvedthe tendency of the policeto enforce the law.

Table 4Priorities of Scenario 3

Alternative Decisions	Limiting	Normalized
Bribe	0.069045	0.66667
not bribe	0.034522	0.33333
not offend	0.21519	0.50954
Offend	0.207135	0.49046
Enforce	0.057537	0.55555
not enforce	0.04603	0.44445
not supervise	0.196202	0.5295
Supervise	0.174339	0.4705

Source: Super Decision's output

The results of Scenario 3 as shown in Table 4 arevery interesting. Increasing law enforcement indeed reduces the probability a banker will offend. This policy, however, not only influences the banker's decision but also the supervisor's. It may discourage the supervisor fromsupervising the bank and also reduce the effectiveness of the policy in deterring banking crimes. This finding implies that to make law enforcement policy effective, supervisorsmust continue to focus on their objective and not be affected by the banker's decision.

4. Closing Remarks

It has been shown in this study using both the game theory and Analytical Network Process (ANP) approach that eachplayer in decision-making process is influenced by the other players. A player will make adecision not only based on its payoffs or criteria but also on the alternative decisions taken by the other players. This finding supports Tsebelis' argument that the interaction of agents in criminal justice is better analyzed using game theory.

In the analysis of banking crime there are three players and at least two stages of analysis. The players are the banker, the supervisor and the police – or criminal justice authority. The two stages of analysis are: 1) the banker versus the supervisor, and 2) the banker versus the police. Since there are two stages, predicting the results of the second stage will affect the decision-making process in stage one. If the banker is certain that the police will accept the bribe offered in stage two, the banker will consider different payoffs in stage one. Consequently, theresults of the analysis will change considerably.

Although game theory and the analytical network process approach reach the same conclusion on the interaction of agents in banking crime analysis, the two approaches, however, actually revealed differing results. With regard the effectiveness of banking supervision, game theory approach concludesthatbank supervision will effectively discourage abanker from committing an offence. Conversely, the Analytical Network Process shows that bank supervision alone isineffective in influencing abanker's decision. If society are overly tolerant and, thus, there is no real value for reputation and no value for punishment, enhancing bank supervision will not be effective in discouraging a banker from committing an offence.

REFERENCES

Becker, G.S. (1968). *Crime and Punishment: an Economic Approach*, Journalof Political Economy 70: 1-13.

Becker, G.S. and Murphy, K.M. (1988). *A Theory of Rational Addiction*,Journal of Political Economy , 96:675-700.

Bianco, W.T., Ordeshook, P.C. and Tsebelis, G. (1990). *Crime and Punishment:Are One-Shot, Two-Person Games Enough?* American PoliticalScience Review, 84: 569-586.

Bowles, R. (2000), *Corruption*, in Boudewijn, B., and De Greest, G. (2000),Encyclopedia of Law and Economics, Vol. 5, The Economics of Crime andLitigation 460-491.

Bowles, R. and Garoupa, N. (1997). *Casual Police Corruption and the Economicsof Crime*, International Review of Law and Economics 17: 75-87.

Bowles, R., Gordon, F., Pradiptyo, R., McDougall, C., Perry, A. andSwaray, R. (2004). *Costs and Benefits of Sentencing Options*, Report tothe Home Office, unpublished manuscript, Centre for Criminal Justice Economicsand Psychology, University of York.

Bowles, R., and Pradiptyo, R. (2004). *An Economic Approach to Offending,Sentencing and Criminal Justice Interventions*, Report to Esmee FairbairnFoundation, unpublished manuscript, Centre for Criminal JusticeEconomics and Psychology, University of York .

De Mesquita, B. and Cohen, L.E. (1995). *Self Interest, Equity, and Crime Control:A Game-Theoretic Analysis of Criminal Decision Making*, Criminology, 33: 483-518.

Funk, P. (2004). *On the Effective Use of Stigma as a Crime-Deterrent*,European Economic Review 48:715-728.

Garoupa, N. and Klerman, D. (2004), *Corruption and the Optimal Use ofNonmonetary Sanctions*, International Review of Law and Economics 24:219-225.

Garoupa, N. (1997), *The Theory of Optimal Law Enforcement*, Journal ofEconomic Surveys 11:267-295.

Kilgour, D.M. (1994). *The Use of Costless Inspection in Enforcement*, Theoryand Decision, 36, 207-232.

Levitt. S.D., and Miles.T.J, (2007). *Empirical Study of Criminal Punishment.*,in A.M. Polinsky and S. Shavell, eds.(2007) Handbook of Law and Economics 1,North Holland.

Polinsky, A.M. and Shavell, S. (1997), *On the Disutility and Discounting of Imprisonmentand the Theory of Deterrence*, Working Paper 6259, NBER

Polinsky, A.M. and Shavell, S. (2000), *Economic Theory of Public Enforcementof Law*, Journal of Economic Literature 38:45-76.

Polinsky, A.M. and Shavell, S (2001), *Corruption and Optimal Law Enforcement*,Journal of Public Economics 81:1-24.

Polinsky, A.M. and Shavell, S. (2005), *The Theory of Public Enforcement of Law*,NBER Working Paper no. 11780, NBER.

Polinsky, A.M. and Shavell, S.(2007). *The Theory of Public Enforcement of Law*,in A.M. Polinsky and S. Shavell, eds.(2007) Handbook of Law and Economics 1,North Holland.

Pradiptyo, Rimawan. (2006).*On the Inspection Games; The Applications of Game Theoretical and Learning Process Analyses in the Area of Criminal Justice,* Dissertation, University of York, UK.

Tonry, M. (1997). *Intermediate Sanctions in Sentencing Guidelines*, National Instituteof Justice, US Department of Justice.

Tsebelis, G. (1989). *The Abuse of Probability in Political Analysis: The RobinsonCrusoe Fallacy*, The American Political Science Review, 83:77-91

Tsebelis, G. (1990). *Penalty Has No Impact on Crime? A Game TheoreticalAnalysis*,.Rationality and Society 2: 255-286.

Tsebelis, G. (1991). *The Effects of Fines on Regulated Industries: Game Theoryvs. Decision Theory*, Journal of Theoretical Politics 3:81-101.

Tsebelis, G. (1992). *Are Sanctions Effective? A Game-Theoretic Analysis*, Journalof Conflic Resolution, 34: 3-28

Tsebelis, G. (1993). *Penalty and Crime: Further Theoretical Considerations andEmpirical Evidence*, Journal of Theoretical Politics, 5:349-374.

Wittman, D. (1985). *Counter-Intuitive Results in Game Theory*, European Journalof Political Economy, 1:77-89.

Wittman, D. (1993). *Nash Equilibrium vs Maximin: A Comparative Game StaticsAnalysis*, European Journal of Political Economy, 9: 559-565.