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Motivation for Occupational Fraud: An Analysis of the “Fraud Triangle” Using Economic Logic

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Abstract: The “fraud triangle” constitutes a very popular criminological model of occupational fraud that explains the dynamics underlying occupational fraud. However, given that occupational fraud is essentially an economic crime, there is little evidence in the extant literature that provides an explanation of the “fraud triangle” in purely economic terms. In this paper, we separately consider each of the three vertices of the “fraud triangle” and establish an underlying economic linkage that coherently connects each of the vertices. We first consider the “incentive” vertex and hypothesize and prove that in equilibrium, the “net valence” (i.e., net incentive to an employee from an act of occupational fraud) is zero. It is when the equilibrium is disturbed that a positive “net valence” for fraud arises, identified in our framework by an increase in the probability of an employee not being caught after committing fraud. We then move to the second vertex i.e., “opportunity” and derive, using a finite-state Markov chain, a separate, closed-form expression for the equilibrium probability measure identified in our analysis of the first vertex. Finally, we show that the last vertex—“rationalisation”—represented in our framework via an equilibrium penalty-to-reward ratio for an act of occupational fraud from an employee’s viewpoint is very sensitive dependent on the likelihood of the organisational culture towards fraud continuing to remain in a slack state in the future given that it is currently in a slack state. We also provide a hypothetical numerical illustration of our framework for a specific setting of the Markov state transition matrix. We believe that our analysis is a first step in providing a rigorous mathematical ratification of the criminological theory of “fraud triangle” and therefore helps to open up the field for more meaningful empirical inquiry in future.

Keywords: Occupational Fraud, Organisational Culture, Finite-State Markov Chain

Brief Background

“Occupational fraud” is formally defined by the Association of Certified Fraud Examiners (ACFE) as “the use of one’s occupation for personal enrichment through the deliberate misuse or misapplication of the employing organization’s resources or assets” (www.osc.state.ny.us/localgov/pubs/red_flags_fraud.pdf, last retrieved 5th April 2012). To commit an act of occupational fraud, an employee must have a definite ‘motivation’ that simulates him/her to act in such a way (Ajzen 1991). If an employee knows that he/she can enjoy a net positive economic gain by committing fraud and not getting caught then that knowledge can motivate the employee to commit the act. Of course, not every employee will commit an act of fraud against the employer just because there is potential for an economic gain and an opportunity to do so and not get caught. Many (likely a vast majority) of employees will successfully resist any ulterior temptations to commit fraud – however a few may fall prey to such temptations if both the incentive and the opportunity are seen to be present in the organization over a sustained period of time (Beck and Ajzen 1991; Ajzen 1991).

If, over time, the employer fails to remove the incentive and opportunity to commit fraud, a few employees may take this as a signal of ‘slack organizational culture’ towards acts of occupational fraud and cause them to rationalize their actions by developing a “no one would care to bother” position. “Incentive”, “opportunity” and “rationalization” are in fact the three vertices of the “fraud triangle” – a cornerstone in the criminological theory of occupational fraud (Wilk and Zimbelman 2004). These three elements were first recognized by Sutherland (1949).
and later developed by Cressey (1953). Cramer (1977) subsequently analysed and further expanded on Cressey's initial theory. In the following decade, Albrecht et al. (1982) further honed the underlying criminological concept in identifying effective strategies for fraud detection. There are recent applications of the "fraud triangle" model in determining the efficacy of internal controls (Rae and Subramanian 2008).

Given that an occupational fraud is fundamentally an economic crime, a deep exploration of the "fraud triangle" theory in terms of economic logic has a rich potential via both theoretical and empirical examinations. Here we have analytically explored and ratified the fundamental underpinnings of the "fraud triangle" theory by employing economic formalism. We consider each of the three vertices of the "fraud triangle" separately and develop an underlying framework of mathematical reasoning which highlights their individual roles in determining the net potential, in economic terms, for an employee to commit an act of fraud against his/her employer. It is perhaps useful at this stage to stress that our analysis intends to unearth the latent logical interconnectivity of the three vertices of the classical fraud triangle without necessarily delving deep into the constituents of the vertexes themselves, which we believe needs to be a separate endeavor because of the inherent analytical complexities. For example, there is a strand of recent literature on the relevance of ethical and equity considerations in determining the cause of employee frauds (Özkul and Pamukçu 2012). For our analysis, we assume that such individual behavioral factors have all been effectively 'aggregated' under the single vertex of "rationalization" as per the classical model.

First Vertex of the Fraud Triangle: Incentive

According to the "expectancy theory of motivation", (Vroom 1964; Porter and Lawler 1968), workplace motivation is driven by *valence*; defined as the product of the magnitude of the reward at stake and the probability of actually reaping the reward as deemed by the individual employee. Thus "net valence" may be defined as the difference between valence and "counter valence" which represents the forces that negate or counteract valence.

The net incentive for fraud can logically be interpreted as the "net valence" from the viewpoint of an employee that instigates fraudulent behavior. Let \( w \) be the net incentive for an employee in an organization to commit fraud. Therefore, represented formally as "net valence" as per our above definition of that term, \( w \) can be expressed as:

\[
w = pr - (1 - p)c = p(r + c) - c
\]  \hspace{1cm} \text{(i)}

Here \( pr \) is the valence for committing an act of fraud and \( (1 - p)c \) is the "counter valence" where \( p \) stands for the probability that an employee will commit an act of fraud and not get caught and \( r \) is the immediate 'reward' that the employee acquires. Obviously, \( (1 - p) \) is the probability that the employee will be caught either during or following the act and \( c \) is the associated 'penalty' if caught. It can be readily observed that \( w = w_{\text{max}} = r \) when \( p = 1 \) and \( w = w_{\text{min}} = -c \) when \( p = 0 \).

*Lemma:* In equilibrium, the net valence for committing an act of occupational fraud is zero.

*Proof:* Let us hypothesize two continuous, univariate cost functions as follows; both of them being differentiable with one having a positive slope and the other having a negative slope:

Cost of occupational fraud = \( f(p) \), such that \( f'(p) > 0 \); and

Cost of defending against occupational fraud = \( h(p) \), such that \( h'(p) < 0 \)
The total cost function is then expressible as \( t(p) = f(p) + h(p) \) \( \ldots (ii) \)

The first derivative of (ii) with respect to \( p \) would yield:

\[
t'(p) = f'(p) + h'(p)
\]

\( \ldots (iii) \)

As the total cost changes, this change will be exactly offset in terms of the "net valence" for fraud - so the total-cost slope function \( t'(p) \) may be intuitively interpreted to have a one-to-one mapping with \( w \). This is because if the net valence for fraud is positive in the long-run, the cost to the organization from occupational fraud would increase thereby forcing the organization to invest more resources to reduce fraud valence (e.g. by upgrading internal controls). If the net valence for fraud is negative, it would mean that excessive resources were being spent to defend against occupational fraud. In that case, the organization is better off by diverting the excess resources elsewhere.

At the point of minimum total cost, according to the necessary condition for minimization, \( t'(p) = 0 \).

\[ t(p) = h(p) + f(p) \]

\[ p^* \]

Figure 1: Hypothesized total cost curve as a sum of the cost of occupational fraud \( h(p) \) and defending against occupational fraud \( f(p) \), both expressed as functions of the probability of an occupational fraud.

For \( t'(p) \) to be a true minimum point, the sufficient condition for minimization requires \( t''(p) > 0 \).

\[
t''(p) = w'(p) = r + c > 0
\]

\( \ldots (iv) \)

Hence \( t(p) \) is truly minimized at \( t'(p) = 0 \). Therefore, in equilibrium "net valence" for fraud is zero.

\( Q. \; E. \; D. \)

One may also derive the relevant total cost function from the organization's point of view using the above lemma. The "valence" and "counter valence" terms in equation (i) may be
intuitively interpreted as the change in the cost of occupational fraud and change in cost to
defend against occupational fraud respectively; if we adhere to a Vroom-type valence-expectancy
model as stated.

Then the total cost function from the organization’s point of view (which it has to minimize
in order to get to the zero net valence condition) can be mathematically derived as follows:

\[ t(p) = \int \left( \frac{1}{2} \right) \left[ rp^2 + c(1 - p)^2 \right] + m \]

... (v)

All the terms have their previously introduced connotations in (v) and m is the integration
constant.

Following the above lemma, an employing organization would continue to re-direct the
quantum of resources directed towards occupational fraud defense to the point where the
marginal benefit from such re-direction exactly offsets the marginal cost of occupational fraud.
So, in equilibrium, the net valence is neither strictly positive nor strictly negative but exactly
zero, which yields the following:

\[ w^* = 0 \text{ i.e. } p^* = c/(r + c); \quad (1 - p^*) = r/(r + c) \]

... (vi)

As long as w = 0, the net incentive, in strictly economic terms, for an employee to commit
an act of fraud against his/her employer is zero. In Figure 2 below we present a graphical plot of
\( p^* \) values corresponding to the different levels of “reward” to an employee from occupational
fraud against the “penalty” if caught (we varied \( r \) in equal increments from 10% to 200% of c and
plotted the results):

Figure 2: Graphical plot of \( p^* \) i.e. equilibrium probability of occupational fraud for different
levels of “r” (reward if successful) expressed as a percentage of “c” (penalty if caught).
From the graphical plot shown in Figure 2 it becomes visually apparent that a logarithmic relationship exists between p* and the level of reward to be gained from an act of occupational fraud. This is consistent with the expectancy theory of motivation (Vroom 1964; Porter and Lawler 1968). Large rewards are intuitively associated with small probabilities of reaping them while small rewards are intuitively seen as easier to reap and so have large associated probabilities. However, no matter how large a reward, to a ‘determined’ aspirant it will always have a finite probability of being successfully attained irrespective of the associated risk. So the value of p* is expected to level out rather than fall sharply for high perceived reward values as can be seen in Figure 2.

However, expected reward can be an economic incentive for an employee to commit an act of occupational fraud but such an act will be executed only if there is an adequate scope for the perpetrator to get away without being caught. So we now move to the second vertex — opportunity.

Second Vertex of the Fraud Triangle: Opportunity

The probability of an employee committing an act of fraud and not getting caught can change over time depending on the organization’s appetite to combat and control fraud. If the organization is very strict then it will ‘plug’ loopholes in its current internal control systems so that in future, employees will have fewer opportunities to exploit loopholes. This means that the probability of an employee not getting caught will decrease but comes with additional costs of improving/upgrading the existing internal controls and remove/reduce existing loopholes. If on the other hand, the organization chooses not to plug the existing loopholes then employees will have more opportunities to exploit these and get away with a fraud in the future. This will mean that the probability of an employee not getting caught will increase. This is consistent with intuitive logic that it is the presence of opportunities along with incentive that provide a fertile back-drop for employee fraud.

For the sake of analytical simplicity let us consider two internal control regimes “slack” and “strict”. Under a regime-switching process following a Markov chain, the state vector [p₀, q₀] at time point t₀ would change to [p₁, q₁] at time t₁ (where q₁ = 1 – p₁) via a transition probability matrix M (Rabiner & Juang, January 1986). The entries aᵢⱼ of M stand for individual regime switching/retention probabilities as shown in Figure 3 (i is a row number and j is a column number).

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1 Victor H. Vroom developed the theory from his study on the motivation behind decision-making. The result was his creation of the VIE Theory (Valence, Instrumentality, Expectancy) or “expectancy theory” as published in Work and Motivation in 1964. Porter and Lawler provided a further extension to Vroom’s model in 1968.
Figure 3: Switching between "slack" and "strict" organizational cultures modeled as a Markov chain. The probability of remaining in the current state given current state is "Slack" is $a_{11}$, and the probability of switching to a "Strict" state in the next period is $a_{12}$. Similarly, the probability of remaining in the current state given current state is "Strict" is $a_{22}$, while the probability of switching over to a "Slack" state is $a_{21}$.

\[
M = \begin{bmatrix}
a_{11} & a_{12} \\
a_{21} & a_{22}
\end{bmatrix} \quad \text{(vii)}
\]

Within the transition probability matrix, $a_{11}$ stands for the probability that the current regime ("Slack") will remain in the organization at the next point in time while $a_{12}$ stands for the probability that the organization will switch over to the other regime ("Strict") at the next time point. Similarly, $a_{22}$ stands for the probability that the current regime ("Strict") will remain in the organization at the next time point while $a_{21}$ stands for the probability that the organization will switch over to the other regime ("Slack") at the next point in time. Following the Markov chain rule:

\[
[p_0, q_0] \times M = [p_{11}, q_{11}] \quad \text{(viii)}
\]

Given that $M$ satisfies the necessary mathematical properties of ergodicity and regularity (Solow 1956); a steady-state equilibrium exists such that the following relationship is necessarily satisfied:

\[
[p_*, q_*] \times M = [p_*, q_*] \lambda \quad \text{(ix)}
\]

In equation (ix), $\lambda$ is an eigenvalue of $M$ such that the steady-state vector is an eigenvector of $M$ (Kemény and Snell 1960). To check whether $\lambda$ is in fact the dominant eigenvalue of $M$, we solve the relevant characteristic equation as follows:

\[
det(M - \lambda I) = 0
\]

i.e. $(a_{11} - \lambda)(a_{22} - \lambda) - (1 - a_{22})(1 - a_{11}) = 0$

i.e. $\lambda^2 - \lambda(a_{11} + a_{22}) - (1 - a_{11} - a_{22}) = 0$

i.e. either $\lambda = 1$ or $\lambda = (a_{11} + a_{22}) - 1$ \quad \text{(x)}

In (vii), $I$ of course stands for a 2x2 identity matrix. So, given that $0 < \lambda = (a_{11} + a_{22}) - 1 < 1$, the dominant eigenvalue of $M$ is 1. Thus, solving for $p_*$ and $q_*$ using standard linear algebra, we obtain:

\[
p_* = a_{22}/\{1 - (a_{11} - a_{22})\} \quad \text{and} \quad q_* = 1 - p_* = (1 - a_{11})/\{1 - (a_{11} - a_{22})\} \quad \text{(xi)}
\]

When modeled as a Markov chain, the steady-state probabilities of an employee getting away with an act of fraud can be obtained from the switching/retention probabilities of the
current organizational regime from strict to slack, the latter being the state where opportunities to
get away with fraud are allowed to exist within the organization. It reflects an organizational
culture that’s conducive to not only allow an employee to get away with an act of fraud if he/she
was to commit one but also rationalize his/her action by aiding the development of a “no one
would care to bother” attitude. This takes us now to the third and final vertex of the “fraud
triangle” — rationalization.

Third Vertex of the Fraud Triangle: Rationalization

The scope for rationalizing an act of occupational fraud would intuitively depend on both the net
valence of the act as well as the existence of an organizational culture that is interpreted as being
slack towards occupational fraud. Combining the two expressions for equilibrium probability of
an employee to commit an act of occupational fraud that we obtained in our analysis
expressing the first two vertices of the “fraud triangle”, we now move to the fundamental
equilibrium relationship that exists between r and c in terms of the switching/retention
probabilities of the current organizational culture from a strict one to a slack one. Therefore:

\[ \frac{c}{r + c} = \frac{a_{21}}{\{1 - (a_{11} - a_{21})\}} \]

i.e. \( (r + c)a_{21} = c\{1 - (a_{11} - a_{21})\} \)

i.e. \( ra_{21} + ca_{21} = c - ca_{11} + ca_{21} \)

i.e. \( \frac{c}{r} = \frac{a_{21}}{1 - a_{11}} \) \( \ldots \) (xii)

The equilibrium \( \frac{c}{r} \), value as per (xii) then effectively represents a quantified ground for
rationalizing an act of occupational fraud by an employee against his/her employing
organization. As long as the equilibrium is maintained, there’s zero net valence for fraud and also
the opportunities are limited. However this equilibrium penalty-to-reward level can shift (either
higher or lower) depending on \( M \).

Equilibrium \( \frac{c}{r} \) values for different settings of \( M \) are computationally obtained and shown in
Figure 4.
Figure 4: Equilibrium $\gamma_i$ values plotted separately against $a_{11}$ and $a_{21}$ (keeping the other constant at 0.05)

It is apparent from Figure 4 that the equilibrium $\gamma_i$, is linear in $a_{11}$ (i.e. the probability that the organizational culture will switch from “strict” in the current state to “slack” in the future state) but is exponential in $a_{21}$ (i.e. the probability that the organizational culture will continue to remain in a “slack” state in the future given that the current state is “slack”). In terms of the rationalization vertex of the “fraud triangle” this result implies that the scope for rationalizing an act of occupational fraud by an employee against the employing organization would be most sensitive to whether he/she perceives the current organizational culture to be slack towards occupational fraud and his/her perceived likelihood that this will continue to be so in the foreseeable future.

Conclusion: Summarizing the Importance of Our Analysis

In our analysis, we have developed a logical framework based on economic formalism to rationally examine the elemental foundations of the “fraud triangle” theory. We have considered the three vertexes of the fraud triangle viz., “incentive”, “opportunity” and “rationalization” (Sutherland 1949; Cressey 1953) individually and have attempted to establish an underlying framework of mathematical reasoning to explore and ratify their respective roles in determining the net potential, in rational economic terms, for an employee to commit an act of occupational fraud against his/her employing organization. We acknowledge that there may very well be other variables or catalysts which may play a role in motivating an employee to commit fraud e.g. if he/she feels that the outcomes/rewards do not justify their current input/efforts especially in comparison to others resulting in a general feeling of inequity. We assumed all such factors are clubbed under the single vertex of “rationalization” as per the classical fraud triangle model which we have tried to explore and explain in this paper using economic logic. Our aim here has been to identify and model an intrinsic interconnectivity between the three vertexes of the fraud
triangle without delving deep into the exact constituents of each. This may be seen as a limitation of our present work which can be the focus of future research. We acknowledge that this work is purely of a theoretical nature. Nevertheless it makes a significant contribution to the fraud literature because in any scientific endeavour, it is commonly accepted that a theoretical model should necessarily precede empirical verification/validation. What we have attempted to do is seminal in nature in that, we believe we have created enough of a theoretical groundwork which other researchers can test empirically.

To examine the potential of the first vertex, i.e., incentive, we have hypothesized two univariate cost functions, viz., the cost of occupational fraud with a positive slope and the cost of defending against occupational fraud with a negative slope. We have defined “net valence” as the difference between “valence” and “counter valence” and in equilibrium, the net valence for committing an act of fraud will be equal to zero. We find that an employing organization would continue to expend resources to deter occupational fraud to the point where the marginal benefit from such re-direction exactly offsets the marginal cost of occupational fraud. So, in equilibrium, the net valence should equal zero, in other words, and as long as equilibrium exists, in strict economic terms, the net valence for an employee to commit an act of occupational fraud against his/her employing organization is zero.

The second vertex, i.e., opportunity, can be explained as the probability of an employee committing a fraud against his/her employer and not get caught. We have considered two types of organizational culture (corresponding to two different internal control regimes) – “slack” and “strict”, the former being one where a fraudulent employee has more opportunities to commit an act of fraud and not get caught. Using a Markov chain, we have computed the steady-state probabilities of an employee not getting caught, and have obtained those probabilities from the switching/retention probabilities of the existing organizational culture from “strict” to “slack”.

Rationalization, which forms the third vertex of the fraud triangle, is instinctively dependent on both the net valence of the fraudulent act and the existence of a slack organization culture. Hence, to examine the potential of the third vertex of the fraud triangle, we have combined the two expressions for equilibrium probability of an employee to commit an act of occupational fraud against his/her employing organization that we developed in our analysis corresponding to the first two vertices of the “fraud triangle”; and obtained a quantified ground for rationalization in the form of an equilibrium penalty-to-reward ratio. Our analysis also reveals that the probability that the organizational culture will switch from “strict” in the current state to “slack” in the future state is linear while the probability that the organizational culture towards fraud will continue to remain “slack” in the future given that it is currently “slack” is exponential. We infer that an employee’s perception regarding the existing and future organizational culture towards occupational fraud is what determines the scope for rationalizing an act of fraud against the employer. Therefore, while presence of economic motivation and opportunity (first two vertices of the “fraud triangle”) are necessary for fraud to occur, a sufficient driver appears to be the individual employee’s perception of the organization’s culture towards internal fraud (i.e. how slack or strict it is towards fraud). We believe that our theoretical framework now provides an interesting and fertile “testing ground” for future researchers to further explore and empirically test the model inferences with field data.

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