

Ito-Bayesian Employee Output Modelling for Corporate Financial Performance-driven motivation in Kenyan Credit Unions: Introducing the Entropy Motivation Model

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Abstract

In Kenya, human resource office normally reports to the finance office. The finance manager allocates resources to horn the human resource asset; but has no way of measuring the expected output from his/her own end. This paper attempts to provide a metric for setting expectations for the human resource officer by the finance office; first by demonstrating that extrinsic motivation plays a more important role than intrinsic motivation, secondly, to show that corporate financial performance stimulus can be used to measure extrinsic motivation; and lastly, to show that activity based staffing maximizes employee output to optimally take care of high decision volume positions. Key motivation theories are revised and their components fitted around the concept of entropy from the second law of thermodynamics; information theory version. Entropy motivation theory that derives from binomial Bayesian decision model driven by geometric Brownian motion model is introduced. Subjective probability data were transformed into objective probability through cumulative prospect theory decision weights function. Two time-point longitudinal data were analysed. The results show that where low intrinsic motivation exists, strong corporate financial performance can stimulate extrinsic motivation. Total motivation obtains as a sum of intrinsic and extrinsic motivation.

Keywords: Intrinsic motivation; Activity based staffing; High decision volume; Ito-Bayesian process

Introduction

Staffing in organizations remains daunting. Lots of theories have been put forward over the years to guide recruitment, selection, placement, engagement and retention of employees. The private sector controls over 75% of the global gross domestic products [1]. Private sector, for purposes of economic activities includes for-profit enterprises, sole traders, partnerships, corporations, non-profit-making organizations, charities, and nongovernmental organizations (NGOs). Like the public sector, the private sector is manned by natural persons with human characteristics. All these organizations seek to achieve one super-ordinate goal; to maximize wealth, or social welfare, all of which are monetarily quantifiable. Since other factors of production like machines, money, materials and technology cannot drive themselves; entry of human resource becomes indispensable. I argue that it is this human resource that should seek to achieve the said goal by relentlessly focusing on overall wealth maximization goal of the firm part of which is expected to trickle down to them. Unfortunately, the individual does possess own goals which may be incongruent with the firm's. This confines the functions of the human resource manager to carrying out all necessary undertakings likely to result to synchrony of the employee and the firm's goals in terms of recruitment, safety, employee relations, compliance with the law and training and development; in favour of the firm both in the short and long runs [2].

For employees to deliver required services, they need to be motivated. After employee on boarding contractually on the basis of pay, actual working will still depend on the much motivated they are. An employee may decide to give the minimum output that maintains pay or give the maximum output possible. In most cases, employee output is usually between the minimum and the maximum. I posit that this output level (job performance) is determined by their motivation level which in the long run brings about job satisfaction [3].

Statement of the Problem and Objectives

Human beings are endowed with different abilities with regard

job performance. Again, Job performance is directly influenced by job satisfaction, alluding to the affective domain. Job satisfaction depends on the how motivated an employee is [4]. The challenge is that there exists no mathematical relation between job performance and employee motivation. Noting that motivation is influenced by other observable variables like reputation and corporate image, these need to be incorporated into the relation to make it as comprehensive as possible, and one that aggregates as many motivation theories as possible. Most human resource departments operate under finance departments in Kenya. The finance manager needs to predict financial performance as a function of employee motivation. The manager also needs to set quantitative targets for the human resource officer for purposes of evaluation at the end of the year, a tool that can proactively be used. Besides, a lot of human resource managers get frustrated when they hire employees only to realize that the employees cannot match the job targets immediately after contractually engaging; irreversibly in the near future as shown in Figure 1. An attempt to arrest this situation prompted examination of the following: first, to show that extrinsic motivation plays a bigger role in employee job satisfaction than intrinsic motivation; secondly, to show that a financial performance reward sensitivity can be used as an indicator of extrinsic motivation; lastly, to show that activity based staffing might be preferable for high decision-volume positions in the firm.

Literature Review

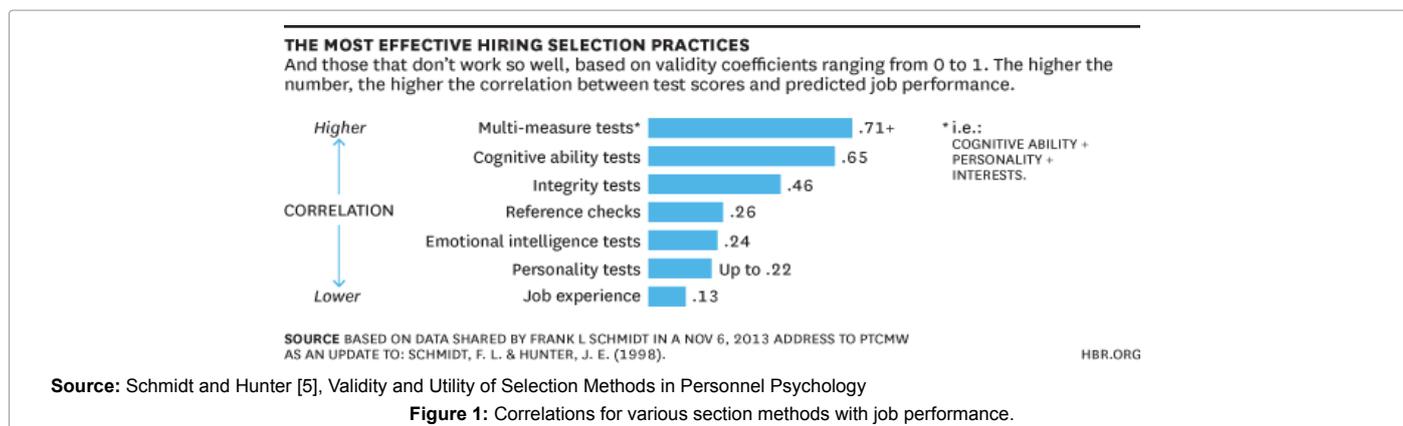
This section examines two things; a summary of major motivation

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theories as they relate to the Bayesian decision theory framework and Bayesian decision theory in a binomial setting to aid construction of an appropriate conceptual framework. Key aspects deriving from the arguments are then fitted into the conceptual framework and accompanying interpretation given.

Summary Review of Selected Motivation Theories

Theories reviewed include: Hertzberg two-factor theory (1964), Maslow's hierarchy of needs (1943), Elton Mayo's Hawthorne effect (1984), Vroom's expectancy theory (1964), three dimensional theory of attribution (1974) and cognitive evaluation theory (1975). Hertzberg summarizes the two factor theory to comprise motivator factors (like recognition and praise) whose presence increases motivation, and hygiene factors (like salary and company policy) whose absence decreases motivation. Surprisingly, he associates motivator factors to work done but does not associate hygiene factors to work done. Reward for working the bare minimum for self-preservation (just to receive salary) may be regarded as reward for working at the minimum potential (output) alluding to hygiene factors; salary, company policy among others. That is, there exists a bare minimum productivity level that preserves the salary. Any extra benefit at this productivity level is the reward contemplated for purposes of this paper. On the other hand, Motivator factors allude to the employee operating at their maximum potential, which also attracts a reward. Maslow's concluding statement in his hierarchy of needs motivation theory states that to get the most out of a team, ensure to avail support to them in their aspects outside the work engagement. This means that management should be ready to reward employees for minimum work done. Note that this is over and above the salary.

The Hawthorne effect (1984) can be fitted into this framework. By changing the environment, employees recorded better performance. Again, it is noteworthy that employees were rewarded with attention not because of performing better. This attention reward caused better performance, the same argument of Maslow. If management is concerned with employees outside the norm duty, this is likely to raise their motivation and hence output. A statement made by Vroom (1964) in his expectancy theory fits pretty well in the above argument. He reckoned that people behave depending on the outcomes they expect as a result of their behaviour. In a work setting, benefits are supposed to derive from positive behaviour like working hard, while losses are expected to derive from negative behaviour like that of truancy. But, in reality it is not a must that benefits accrue from positive behaviour. Management may be in lack at the time. For instance an employee may not be praised for saving firm's costs in the production department.

Likewise, it is not a must that an employee be punished for operating at minimum output. It all is probabilistic, which is well captured by the instrumentality aspect of expectancy theory, where Vroom talks about the level of belief. The three dimensional theory of attribution can also be fitted such that stability and locus of control dimensions relates to intrinsic motivation the one held by the individual independent of external factors. Controllability relates to both intrinsic and extrinsic aspects. Finally comes the cognitive evaluation theory which separates intrinsic from extrinsic motivation and which produces three times employee engagement level compared to extrinsic motivation [5,6]. On this background, a Bayesian probabilistic conceptual model has been crafted.

Bayesian Decision Theory

Deriving from Bayes theorem, this theory is used to forecast discrete dependent variable values especially when multiple time periods are involved. The theory is premised on the argument that at the beginning of a process, an individual holds a subjective opinion about the likelihood of a phenomenon taking place, and then based on the data observed; the individual revises their opinion and keeps on doing so as emerging data provides evidence progressively to improve decision quality. Bayesian statistics deals with two dimensions: one is the observable variable dimension (OVD) and the other is unobservable variable dimension (UVD) [7]. Increase/decrease in wealth is observable while job output is unobservable. Yet, the decision maker cannot for a specific instance, tell whether it is operating higher output caused the wealth increase or operating at the lower output or the increase just happened (say out of previous decisions or was just a windfall). Quantities for these dimensions were solved using Bayes theorem followed by a calculation of expected values of job satisfaction.

There is a wealth level from which an employee makes observations on the changes occurring. These changes will be communicated to them through financial disclosures in terms of higher earnings prospects, cost savings which occasionally elicits praise from management to particular employees or groups of employees. These stimuli will prompt upward or downward output revision.

Methodology

Stima, Mwalimu National and Unitas credit unions staff, 14, 16 and 16, respectively, filled questionnaires about themselves as employees, of the three unions. This research was designed longitudinally such that responses relating to year 2005 and 2015 were solicited. The employees perceived job output probabilities in 2005 and 2015 were obtained; denoted by prior probabilities and a calculated expected value of

current job output respectively. Prospects of being rewarded for minimum output by an employee [Pr(rew|Out=0)] and prospects for being rewarded for maximum output by an employee [Pr(rew|Out=1)] for 2005 and 2015 were obtained. These probabilities were passed through cumulative prospect theory decision weights function for transformation into objective probabilities [8] as shown by equation 1.

$$p_s = \frac{p_o^\delta}{\{p_o^\delta + (1-p_o)^\delta\}^{1/\delta}} \quad (1)$$

The value δ (delta) for the equation was 0.63 for the three credit unions. The mean return on assets (drift), return's volatility (standard deviation) and the initial asset value (W_o) were also collected. This data were summarized in Table 1.

The drift, volatility and initial assets value were input into R-statistical software simulation algorithm to produce the effective and actual wealth increases and decreases. These increases (i's) and decreases (d's) updating process (Figure 2) together with the objective probabilities are fitted into a multi period Bayesian decision model as shown by equation 2 for the probability of job satisfaction being unity (equation 3), and job satisfaction expected value (equation 4).

$$P(Out = 1 | i, d) = \frac{rp^i(1-p)^d}{rp^i(1-p)^d + (1-r)q^i(1-q)^d} \quad (2)$$

$$E(O) = P(Out = 1 | i, d)(1) + P(Out = 0 | i, d)(0) = P(Out = 1 | i, d) \quad (3)$$

$$E(O) = \Gamma(O) = \frac{rp^i(1-p)^d}{rp^i(1-p)^d + (1-r)q^i(1-q)^d} \quad (4)$$

Where, $P(Out=1|i,d)$ =Probability of operating at the maximum potential of an employee

$P(Out=0|i,d)$ =Probability of operating at the maximum potential of an employee

$E(O)=\Gamma_{(o)}$ =Expected value of output of an employee

r =prior output level of an employee

q =Probability of employee receiving a reward for for operating at minimum potential

p =Probability of employee receiving a reward for for operating at maximum potential

An output level of 0.3570 was the initial arbitrary employee's output level. If increase in financial performance is observed, then a reward is given to the employee. Note that the reward need not be money. However, even if the employee was just praised, the key point is that the praise emerged from increased corporate performance. This raises the output level to 0.4374. Thereafter, if a drop in financial performance is observed, the spirit of the employee slackens to post an output of 0.3768. These are working results of equation 4. The value 0.3768 should be interpreted as the percentage potential difference between the maximum and the minimum potential of the employee. For example, an employee may be employed at an output level of 20 units, below which the employee's services must be terminated. But the employee can stretch to 28 units depending on the motivation level available. An output of 0.3768 means an actual employee output of $20 + 0.3768 \times (28 - 20) = 23.0144$. Recall that the minimum potential (20 in this case) is the performance level that just maintains the salary. However, management can only set the standard of 20 units but not 28!

Credit Union Employees	n (1)	Avg Age (2)	δ (3)	Prior Output (4)	Current Output	Pr(rew Out=0) 2005 (6)	Pr(rew Out=0) 2015 (7)	Pr(rew Out=1) 2005 (8)	Pr(Rew Out=1) 2015 (9)	Drift (10)	Std Dev (11)	Wo (Sh'000) Avg (12)
Mwalimu Employees	16	38.7	0.63	0.8173	0.8769	0.807	0.4681	0.9424	0.8891	0.154	0.1646	80,73,526
Stima Employees	14	30.5	0.63	0.6866	0.9361	0.5021	0.6205	0.9319	0.9411	0.321	0.2304	23,209
Unitas Employees	16	30	0.63	0.5592	0.8934	0.7171	0.6637	0.8582	0.8835	0.274	0.0903	8,27,386

n=number of observations; δ =optimism coefficient determined from Life Orientation Test - Revised

Table 1: Job output observations over the period 2005-2015 and the initial wealth for credit unions.

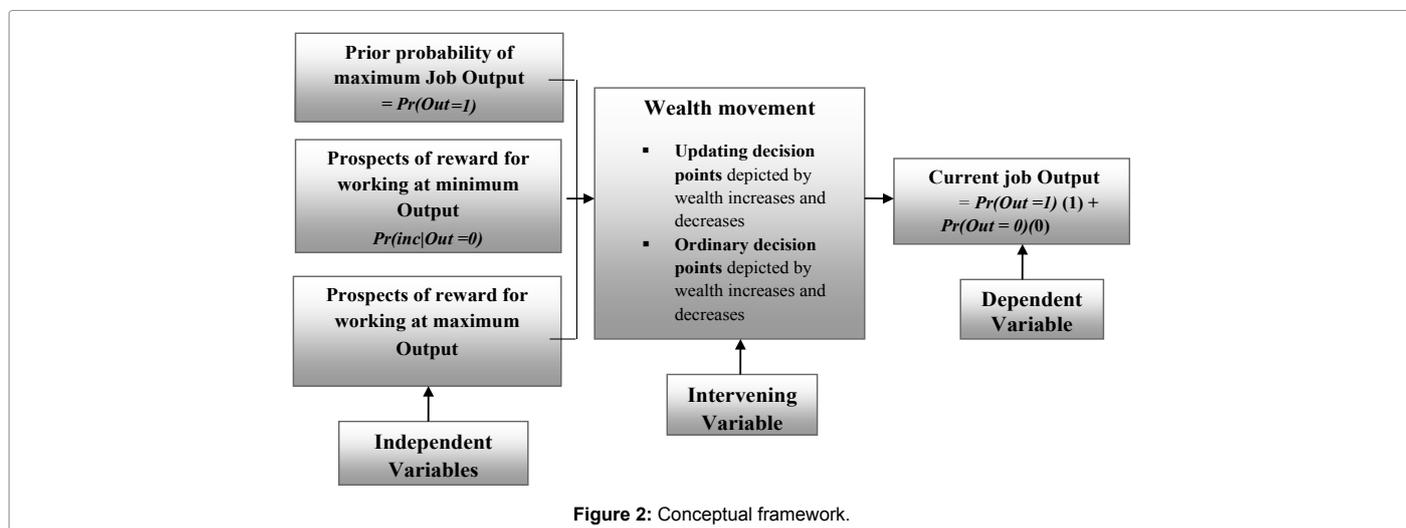


Figure 2: Conceptual framework.

No one can determine the highest potential but by another arbitrary value; in this case, 28 units. This example derives from a piece rate wage scenario but can be extended to a time rate wage structure as well.

The unions use a cash reward system almost exclusively as depicted by assets values at the end of every financial year. Five key assumptions apply; first, that there exists no agency conflict, secondly, that employee satisfaction is only driven by corporate financial performance for which there is sufficient disclosure. Any employee reward, cash or non-cash (including praise) derives from corporate financial performance. Thirdly, employees anticipate better working conditions as a positive correlate of financial corporate performance to meet both the written and psychological contracts expectations. Fourth, the arbitrary upper limit of 28 was set in 2005 and has never been achieved; and fifth, an assumption is made that job output is bounded at unity.

Using excel iterations to find the minimum number of wealth increases and decreases that equate prior output in 2005 with current output in 2015, Table 2 obtains. An R-algorithm is then formulated with parameters drift (average return on assets), standard deviation (volatility of expected returns) and initial wealth level (Wo) fitted into an Ito process shown in equation 5.

$$\Delta W = \mu W \Delta t + \sigma W \epsilon \sqrt{\Delta t} \quad (5)$$

W=wealth level

ΔW =change in wealth

μ =drift (average return on assets)

σ =standard deviation (volatility of return on assets)

ϵ =a normal random variable of mean zero and standard deviation unity

Δt =change in time

Ordinarily, excel iterated increases and decreases should equal simulation algorithm generated increases and decreases. This would mean that all wealth changes affect employee output; which in reality is not true. This suggests that there are some wealth changes that will not affect output, for output can be affected by other exogenous factors. When the increases and decreases are plugged into equation 2, an Ito-Bayesian process is produced. Expected and actual wealth changes have been summarized in Table 3.

From the column of increases and decreases, over a period of ten years, Unitas employees with a much less entropy (0.1105) compared

to Mwalimu employees' entropy of 0.2974 affected their output 13 times compared to Mwalimu employees' 11 times. This shows that Unitas employees are more active than Mwalimu employees; for which reason they achieved an output level of 89.57% compared to 86.30% for Mwalimu employees. If a firm selected an employee from a number of candidates on the basis of the number of times output changes due to change of an external stimulus, this is known as activity based staffing. This kind of staffing need not be exercised only when recruiting. The human resource officer may discern that a particular employee is more responsive than another and conveniently place them in a position of high decision volume.

Discussion

Prospects of receiving a reward after offering the bare minimum services from an employee should ideally be naught [$q=P(\text{rew}|\text{Out}=0)=0$]. This is an ethical expectation. But demotivated or sick employees may get away with it and still receive rewards. If employees fill there is potential reward for giving the minimum it means their motivation is low. On the other hand, prospects of receiving a reward after offering maximum services from an employee should be unity [$p=P(\text{rew}|\text{Out}=1)=1$]. However, many reasons abound for employees not receiving rewards even after performing at their maximum potential. So this expectation is only probabilistic. The higher this prospect is the better motivated employees get. All these are prospects held by an employee as an individual; they are intrinsic. These prospects have not so far been influenced by corporate financial performance. Since the two prospects form two probability distributions, the distance between the two distributions is known as entropy (shown in Table 1), which has been used to measure intrinsic motivation which cannot surpass unity [9].

When intrinsic motivation is impacted by corporate financial performance from which rewards for employees emerge, output levels are affected. A rise in the firm's wealth prompts increase in employee output and vice versa. But human beings output may not necessarily be influenced by corporate wealth fluctuations. Table 3 shows increases (*inc) that do not affect motivation. In this case, the remaining 13%, 25% and 27% ineffective output changes for Unitas, Stima and Mwalimu credit unions relate to factors other than corporate financial performance. These could be corporate culture, work place interpersonal relationships or even factors outside work. The proportion of actual increases and decreases affecting output out of actual total increases and decreases depicts the much sensitive output is to changes in corporate financial performance. Again, it can clearly be seen that the

C.U Group	Out05(r)	q	p	entropy	i	d	Out15(Γ)	Drift	Sd	Wo Sh'000
Unitas Mgt	0.5592	0.6904	0.8709	0.1105	12	1	0.8957	0.2735	0.0903	8,27,386
Stima Mgt	0.6866	0.5613	0.9365	0.5606	15	3	0.9349	0.3208	0.2304	23,209
M. N.Mgt	0.8173	0.6376	0.9156	0.2974	9	2	0.863	0.154	0.1646	80,73,526

Out05=output for year 2005; Out15=output for year 2015; Sd=standard deviation; Wo=Wealth in 2005

Table 2: Update rate, drift, volatility and initial job satisfaction with credit union group properties.

SACCO group	Expected updating decision points (Predicted update points)			Simulated Actual decision points				Error rate	%Effective output changes	
	Inc	Dec	Total	Actual update pts		Ineffective pts				Total
				Inc	Dec	*Inc	*Dec			
U. Emp	12	1	13	12	1	2	0	15	0.0769	0.8667
S. Emp	15	3	18	15	3	6	0	24	0.1667	0.75
M. Emp	9	2	11	9	2	4	0	15	0.1818	0.7333

*Inc and *Dec are wealth increases and decreases respectively never affected job output. That is, job output remained same level; though there had been wealth increases.

Table 3: A summary of expected and actual job output decision points.

C.U. Group	Intrinsic Motivation (Entropy)	Extrinsic Motivation	Total Motivation	Overall Percentage Motivation
Unitas employees	0.1105	0.8667	0.9772	48.86%
Stima employees	0.5606	0.75	1.3106	65.53%
M. N. employees	0.2974	0.7333	1.0307	51.54%

Table 4: Intrinsic, extrinsic, total and overall percentage motivation.

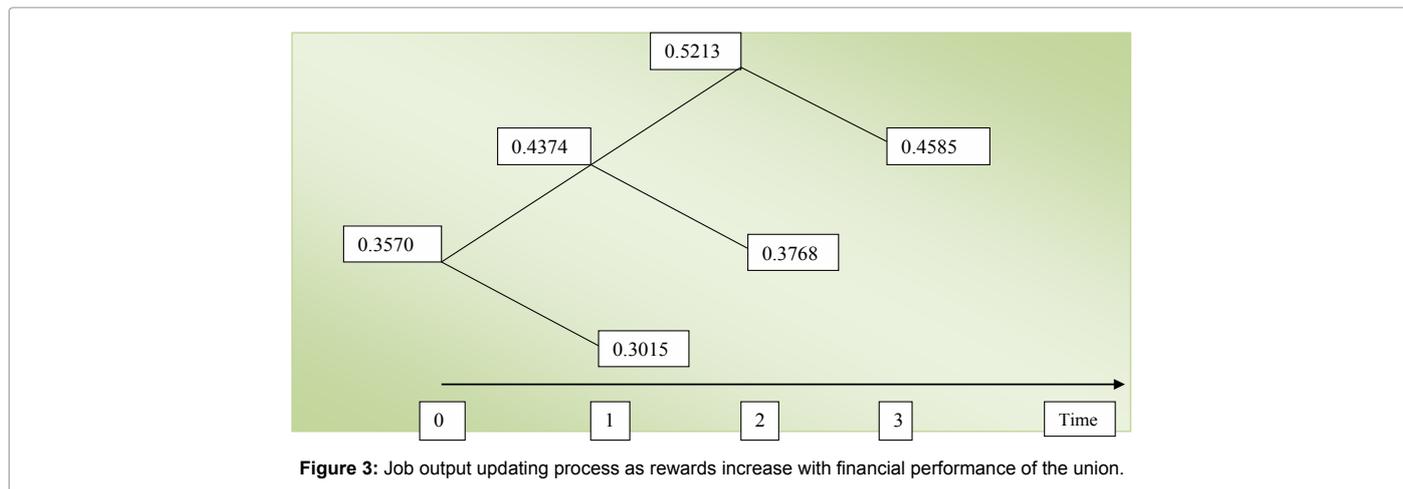


Figure 3: Job output updating process as rewards increase with financial performance of the union.

maximum value of this proportion can only be unity. This is extrinsic motivation. The sum of intrinsic and extrinsic motivation equals total motivation. The maximum value of total motivation can only be 2. The last column of Table 3 shows percentage of output sensitivity to wealth changes. This means that output sometimes may not be influenced by corporate wealth changes. This derives the Entropy Motivation Model. The model comprises two motivation types; intrinsic (measured by entropy) and extrinsic (measured by stimulus sensitivity). The sum of the two gives total motivation. Table 4 shows a summary of intrinsic, extrinsic and total motivation out of a total of 2. Clearly, on average an employer should select a Stima credit union employee given three candidates each from the three unions. But these are union aggregates. Specific tests may be necessary to determine candidates' motivation levels other factors held constant. However, going by activity based staffing; an employee from Unitas would be preferred to an employee from Mwalimu credit union though Mwalimu possesses a higher total motivation level than Unitas credit union.

Entropy motivation model is only interpreted from an Ito-Bayesian process. One cardinal assumption of financial disclosure to generate stimuli that guides output changes is rather too often out of place. Many employers do not peg pay to performance so that the employee is only propelled by intrinsic motivation. From Table 4, intrinsic motivation is lower for all employee groups than extrinsic motivation. So, when no financial performance disclosures are made, $i=0$ and $d=0$. This means that output remains the same as prior job output r .

Conclusion

Personality, cognitive ability and interests have the highest correlation (0.71) to job performance (output) according to Figure 3. In the entropy rationality model, intrinsic motivation represents personality and engagement while extrinsic represents a combination of cognitive ability and interests. More specifically, employee activity relates to interests as depicted in activity based staffing. An employer who prefers a more engaged employee would look for a higher intrinsically motivated employee as measured by entropy. Such an employee is unlikely to disengage in times of low economic

performance. Such employees are usually contracted on permanent terms. Alternatively, where the employer needs a skillful employee to turn things round by stimulus of pay, a highly extrinsically motivated person may be favourable; to be contracted on a fixed period term. The importance of financial performance generated extrinsic motivation is that the employer will regulate the performance desired from the employer by altering cash-based remuneration.

The discussed results show that if no corporate finance-based extrinsic motivation is exercised by management, output would greatly suffer for all the three credit unions. As measured by financial reward sensitivity as the stimulus sensitivity, the measures are rather high. Normally, high intrinsic motivation features early in employment when not much responsibility weighs on the employee. Table 1 attests to this when entropy values are high in 2005; they diminish towards 2015 as more responsibility and need for money, children school fees, building for settlement among others set in. Progressively, employees feel the need to match output with reward. Depending on self efficacy and locus of control, employees take responsibility of their jobs by updating regularly. This reflects their activity levels which the employer may use to effectively place them in positions depending on positional decision volumes. Activity level also denotes employee learning orientation. These and other firm specific factors can be used for succession planning.

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