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System Exploitation by Family Business
Part 4 of 4
of
Entrepreneur & Entrepreneurship
Louangrath, P.I. ★

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ABSTRACT

This paper is part 4 of 4 parts series called Entrepreneur and Entrepreneurship. The scope of part 4 is to discuss “how does family business operate within the larger system: economy.” As a larger system, the economy provides a fully functional super-infrastructure within which the family business submerges itself and exploits the system. This perspective stands at a contrast to the common argument that the market exploits the individual; here, the successful individual entrepreneur, who transformed the enterprise into a family business, exploits the system. In so doing, the entrepreneurial enterprise continues to develop and transform itself by moving from the informal sector into the formal economy. In doing so, the family business becomes more organized and structured. Internally, as a formal organization, the newly transformed family business undergoes continued restructuring in operations, finance, and management. The family operational and management boundaries also are redefined. We end the paper with the reflection on does a family transform itself into SME in order to continued search for value creation.

Keyword: entrepreneur, entrepreneurship, family business, Business Model Canvass, restructuring, change Management

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1.0 INTRODUCTION

The objective of this paper is to explore the nature of the family business as a system exploiter. Recall that the entrepreneur is a system explorer. He has no focus; he explores the system and seeks to exploit all opportunities that presented themselves to him. However, a family business is more organized. With more stakeholders in the enterprise, a family business cannot afford to roam the market. It has to stay focus on a particular line of business. In family business, the owner has the final say in which

direction the business should head (De Massis *et al.*, 2014); this is different from the firm where the interests of shareholders dictates the policy direction. This concentration allows the family business to be innovative in what it does through cost reduction and increase productivity. Cost reduction is made possible through the learning curve. In addition, another driver of cost reduction comes from the fact that family business always faces limited operating fund. Therefore, it must learn to optimize its resource utilization.

In this paper we will also see that the formal structure of the family business makes the business more conservative. It learns to be risk averse. It engages in the business that is has determined to be within its core competence and would avoid engaging in the line of business that lies outside of its expertise. This risk aversion forces the family business to specialize in a particular product line. More specialization means the introduction of a formal structure. The formality of organizational structure restricts the family owner's ability to act freely. The assets and capital accumulated by the family business begins to be recorded. Little by little, the family business grows into a formal SMS. As such the value creation slowly transforms into wealth accumulation. As the result, the formalization of the family business helps it to lift itself out of the informal sector of the economy and gain a better credit standing in the eyes of lending institutions. This transformation is part of the natural development of the family business.

Table 1: List of well-known family businesses

| | | |
|------------------------|----------------------------|-------------------------|
| Aditya Birla Group | Jolly Time | Solaris Bus & Coach |
| Avantha Group | Koch Industries | Swinkels Family Brewers |
| Bombardier Inc. | Lundberg Family Farms | Tata Group |
| Cargill | Mango | Toyota |
| Chic Fil A | Mittal Steel | Trump Organization |
| Country-Wide Insurance | Nordstrom | Utz Quality Foods |
| Company | Panda Energy International | Wal-Mart |
| Dillard's | Raymond Group | Wawa |
| Ford | Red Bull | Wegmans |
| Glencore | Simon Property Group | WWE |
| Heineken | | Kingfisher Airlines |

Source: https://en.wikipedia.org/wiki/Family_business#cite_ref-EMJ1_18-0

2.0 THEORY OF FIRM AND FAMILY BUSINESS

A family business is an entity in the making; it comes in small, medium and large sizes (Carlock *et al.*, 2007). It is a business that is owned and operated by the family (Chakrabarty, 2009). As such people tend to look at it as a non-firm entity. However, this classification is misplaced. An entrepreneur is one engaging the market as a one-man operation. An entrepreneur answers to no one but himself. "Being your own boss" truly describes the entrepreneur. Answering to the shareholders describes the firm or corporation. However, in the family business, that is not the case. A family business owner must answer to the stakeholders in the enterprise. These stakeholders may be someone who contribute capital to the enterprise, a co-worker family

members, or someone who has a vested interest in the enterprise. There is a structural constraint in a family business (McGoldrick *et al.*, 1999). However, this structural constraint is not restrictive enough to make the family business quite the highly structured organization as the corporation or firm.

To gain a better understanding of the family business, it is necessary to reexamine the theory of firm. Since the family business retains some structure and organization, the theory of firm may shed light to how a family business may behave and what role it plays in the economy. This is not to say that the theory of firm explains the existence of family business. The theory of firm may provide some guidance to our understanding of family business by the mere fact that the family business has evolved into something more structured and took a form of an organization, albeit weak one. Like a firm it is structured. Unlike a firm, it is owned and run by a single head or a close knit of family circle. As such the issue of transparency and recordation sets it apart from the firm. As the result, its access to the capital market and lending institutions are also limited.

2.1 Property Rights

The firm is governed by contractual relationships among people within the firm. In particular, the relationship between the managers and owners of the firm determines the inner working of the firm (Jensen and Meckling, 1976). This relationship may be divided into two groups of people: (i) employer-employee, and (ii) company and shareholders.

Among the managers and owners of the firm, the relationship between managers and owners of the firm is defined contractually. There is no such a thing as a volunteer manager. All managers in the firm work for the firm in exchange for a compensation, i.e. salary, benefits, etc. This compensation is obtained through a bargaining process. The exchange of the bargain is memorialized into a written contract. The contract governs the relationship of the parties. Under such a setting, the managers work for the firm so long as they confer benefits to the firm. How does property rights theory come into play in the theory of firm?

The benefits secured through the contract relationship are considered private benefits to both parties. There are two level of analysis here. Firstly, the power to contract by the individuals: managers and owners of the firm, is considered a private property right. The power to contract is considered a fundamental right of the individual in a free society. Once the parties exchange their bargains and memorialize these bargains in a written contract and agree to govern their contract by the terms of the contract, these bargains are considered property rights. For the firms, the benefits expected to be conferred through the work of managers in exchange for salary and other forms of compensation is considered as a property right to the firm. Secondly, the right to the position, title, treatment and the compensation package in exchange for the work contribution by the manager are considered property rights to the managers of employees of the firm. The function of the firm is the manifestation of the relationships between the managers and owners of the firm.

It is interesting to note that under this approach to firm theory, both managers and owners of firms hold opposing interest. Each party would want to maximize its

interest. In so doing, a gain in one comes at the expense of the other. This opposing interests are held together only by the mere fact that each party agree to the term of the exchange. This term of the exchange is made possible by the belief of each party that the disadvantage it bears is compensated by the benefits conferred by the other party. Under this circumstance, the contractual relationship between employer-employee defines the functions of the firm. Lacking mutual interest, this theory of firm tells us that the relationship between employer-employee is one characterized by continued conflict of interests. This type of posture or relationship characteristic is lacking in the family business. All stakeholders in the family business adopts perspective of share sacrifice and share benefits. *Shared sacrifice* is inculcated into each stakeholder because the enterprise is family owned and operated. The gain from the enterprise is commonly share; therefore, each stakeholder holds no opposing interests to the enterprise. Despite the fact that the family business owner may hold the controlling interests or dictate the terms of the business operations, each stakeholder agree to be bound by the terms of the family business. This agreement is secured through mutual consent by means of voluntary assent, not through a bargaining process.

A second group of actors under the property rights perspective of the theory of firm are the company and the shareholders. Unlike the contractual relationship between managers and owners of firm, the relationship between the firm and the shareholder is mutually inclusive. The relationship is bounded by a contractual stipulation. The firm holds a fiduciary duty to maximize the wealth of the firm and indirectly the shareholder's wealth. The shareholder's right in the firm, i.e. the ownership of the share interests in the firm, is a property right. That right is the right to receive benefits. As a condition of enjoying that right, the shareholder also bears the risk of loss. If the firm sustains an operating loss, the shareholders also bear the loss in accordance with its ownership of shared interests in the firm.

The characteristic of the relationship thus described among share holders in a firm is also lacking in a family business. The stakeholders in the family business generally are not shareholders of the family enterprise. For this reason, there is no such a thing as the 'family council' making decision through a democratic forum as some writers wanting the world to belief. A family business has a limited room for discussion in the decision making process; the decision is made in a semi-dictatorial fashion. Generally, the head of the family business or the owner makes all the decision. He/she calls the shot. Everyone else in the family has little input and must go along with the flow. Due to its small size and limited resources, and thus risk exposure to market competition is keen, a family business cannot afford being indecisive through 'forum discussion.'

2.2 Agency Cost

The theory of agency relating to firm was best described by Adam Smith who wrote that:

"The directors of such [joint-stock] companies, however, being the managers rather of other people's money than of their own, it cannot well

be expected, that they should watch over it with the same anxious vigilance with which the partners in a private copartnery frequently watch over their own. Like the stewards of a rich man, they are apt to consider attention to small matters as not for their master's honour, and very easily give themselves a dispensation from having it. Negligence and profusion, therefore, must always prevail, more or less, in the management of the affairs of such a company." (Smith, 1776[1973]).

The issue of agency relationship is closely related to the contractual relationship discussed under *property rights* as a theory of firm. Under the agency cost theory of firm, the firm's function is defined by the relationship between principal and agent. The firm is the principal and the employee or managers are agents. The interests between these parties are not mutually inclusive. The agents want to maximize their benefits. Maximizing agents' benefits means reducing the principal's benefits and *vice versa*. Under the agency cost theory of firm, in order to maintain the principal-agent relationship, the firm incurs certain costs. These costs include: (1) Monitoring expenditures by principal; (2) Bonding expenditures by agents; and (3) Residual loss by principal.

Monitoring expenditures are expenses involved in making certain that the agent or employees work according to the terms of the contract. Since the interests of employees are not the same as that of the employers, employers must monitor employees to make sure that the employees work for their money. The use of clock-in and clock-out to monitor work hours is a good example of how the principal monitor the work or hours used by agent. This monitoring system, i.e. time card machine, costs money. All expenses involved in the monitoring of the agent's work is called monitoring expenditures.

Bonding expenditures by the agent is the opportunity cost borne by the agent for attaching himself/herself to one employer. The agent is some times required to make certain expenditure to assure that the agent will not harm the principal. For instance, in a the agent is require is give a 30-days notice prior to quitting a job with the principal in order to allow principal an adequate time to look for a replacement; if the agent fails to given such a notice, a certain cost may be imposed on the agent. Another example may be a case involving the requirement of the agent to make a security deposit for the issuance of certain tools related to the job, i.e. equipment, uniform, vehicle, etc. For the agent, these costs are considered bonding costs. These costs are not bond by the principal. They come out of the pock of the agent.

Residual loss occurs that the agent is engages in a divergence. It is a mistake to think that an employee works every minute of the hours in the 8-hour shift. The employee's divergence from the work reduces productivity. The loss productivity in the job has a cost. This cost is called residue cost. It is not tabulated by any one, but the loss is there to be sustained by the employee (principal). For example, the work day ends at five o'clock. However, the agent may take fifteen minutes to prepare to leave. The loss of fifteen minutes in a lot of 20 working days per months means $20 \times 15 = 300$ minutes or 5 hours per person per month of work hours lost. For a company with 100 employees, the residue loss is $5 \times 100 = 500$ hours per month.

Can *agency cost* theory be used to explain family business? Most employees of the family business are close relative. If the family business does not use relatives, because of the generally small size of the enterprise, there is an ease of control of all employees; therefore, the issue of monitoring cost is a minor issue. As for bonding cost by agent, this cost may exist. Certain small enterprise forces their employees to buy uniform whereas larger firm would provide free uniform. Therefore, *bonding expenditures* by the agent may exist in family business. Lastly, *residue loss* may not be a significant issue. Most family enterprises are small. The small size of the business allows the employee to be closely supervised and, therefore, have less chance to engage in divergent activities. Under this circumstance, the cost would be borne by the principal as monitoring cost. However, as a small enterprise, this cost may be eliminated altogether through acculturation of the employee to internalize the family business as a mutually beneficial enterprise for both agent and principal.

2.3 Behavioral Theory Approach to Firm

The behavioral theory of firm outlines four overarching themes which influence and govern the firm's function: (i) information, (ii) efficiency, (iii) implementation, and (iv) design. These four factors are bounded by cognitive constraints. There are four cognitive limitations: (a) constraint, (b) authority, (c) routines, and (d) bounded rationality. Each of these terms will be explained in the context of a firm and how they are related to the family business.

Information is defined as interpretive data or data that meaningful significance had been attached. The function of the firm depends on the collection, storing, retrieving and use of information. Information that helps the managers and the firm make decision are called useful information. In order to be useful, the information must be relevant, up-to-date, and accurate. Today's firms are inundated with information. Information overflow slows down the decision making process because the decision makers have to spend time to sift through the pile of information and select ones that are relevant, accurate and current. In the family business, information does not play an important role as it is in the firm. A family business is considered a routine business. Its small size makes it dependent on the market movement. The information about price of competitors and the cost of input are the micro-level information which is relevant to the family business. Macro-level information, such as interest rate, monetary policy of the government or the growth of the GDP would have little use to a family business.

Efficiency is the second factor that drives the firm's function. Efficiency is defined as the use of any given level of resource or input to achieve the optimal level of output. Note that the term "optimal" is used instead of the term "maximum." Maximum connotes an absolute term. One cannot speak in absolute term when dealing with production output of productivity because the firm's operators or the firm is constantly faced with constraints. These constraints prevent the firm from achieving its objective in absolute term. Moreover, every production process sustains a certain level of loss or inefficiency. Therefore, the more appropriate term to use when discussing efficiency is *optimum level of output*.

Despite its size and availability of resources, a firm is also faced with the issue of limited resources. The corporate objective of all firms is to reduce cost and drives the increase in productivity. The effectiveness of the firm's management capacity is measured by its ability to manage its resources efficiently. The constraint of the firm is defined by its annual budget. The use of an annual budget by the firm signifies the reality that resources are finite. However, since the interests of the firm and the managers, under the contractual relationship arrangement, is divergent, the firm always face an uphill battle to drive down cost and increase productivity since employees would always engage in divergence.

In family business, efficiency is a key driver for achieving success in the business. Family business generally operates with its own capital. With little to no access to the conventional lending or capital market, the family business is left to fend for itself. Faced with limited resources, the family business always strives to reduce cost or increase productivity for each dollar spent. Wasteful spending is generally nonexistent in family business. Success leads to increase in saving, and the accumulation of savings leads to business expansion. This model of the family business seems to be an unalterable reality.

Design and implementation generally go hand-in-hand. Design refers to the planning and implementation refers to the putting the plan into practice. In the firm setting, design and implementation generally is formalized. There are four functions of management: planning, organizing, staffing and controlling. Design fulfills the planning function of management. Implementation fulfills the remaining three functions. Implementation is a broad term that includes organizing. Organizing is to prepare the resources for use according to the corporate plan. Staffing involves the organizing and assigning of people within the organization to undertake tasks for purposes of carrying out the firm's objective. Controlling involves the overall management of the activities so tat all firm's activities are within the prescribed plan.

In the family business design and implementation are not as formal as in the corporate setting; it has a specific purpose in serving the creator's interest (De Massis *et al.*, 2012). A corporation (firm) may have a written business plan by which the firm's management team follows. Such a formal guiding document may be lacking in a family business. This informality is part of the weak structure of the family business. This weak structure is an inheritance from the previous developmental stage of the business: entrepreneurship. Although the formal business plan may be lacking, a family business may follow an unwritten and less formal plan for its operation. For instance, a family business generally confined itself to a certain line of business and stays focused on that particular line of products. This limitation of business scope is not written any where, but it is understood that the family business would do only a certain business and will not blindly follow any opportunities that may present themselves. This is the difference between a family business and an entrepreneurship.

The above four factors governing firm's behavior are circumscribed by the cognitive constrains. These constraints include (a) constraint, (b) authority, (c) routines, and (d) bounded rationality. Both firm and family business are faced with constraints. These **constraints** come in many form. External to the business, the constraint may exist in a form of regulations, legal prohibition or requirement that

draws the boundary beyond which the business may not cross. Within the organization the firm may face the limitation of resources. These constraints are faced by the firm and family business.

Authority is defined as the use of power. Power can be used only by people who have the mandate to wheel it. In the firm, power is defined by the hierarchy of the organization. Each level of management is granted a certain degree of power or level of authority. In a family business, the authority generally rests in one hand or few individuals. The existence of authority allows members of the organization to restrain its free will and to conform its conduct to a certain standard. The creation of standard and maintaining compliance to that standard allows the organization to function smoothly. To this end, both the firm and family business do not differ.

However, on the issue of authority the firm may differ from family business through the curse of size. As the firm grows so grows the complexity of its bureaucracy. As the firm becomes more bureaucratic, inefficiency sets in. As the result, one of the four factors that permit the firm to function smoothly is hindered. This curse of size does not present itself as a threat in the family business because of its small size, the tendency of a family business to become bureaucratic is almost none. The small size of the family business blesses it with the efficiency of size.

Routines are the habitual ways of doing things in the organization. It is considered as a potential hindrance to efficiency because routines lead to stagnation and organizational lethargy. Routine is the enemy of inventiveness. Without inventiveness, innovation cannot exist. Without innovation, competitive advantage is lost. For the firm, routines may lead to inefficiency because members of the organization tend to accept routines and become resistant to change. When that happens it is difficult for the firm to implement new policy because changes or new policy threatens the existing order within the organization. For the family business routines may work wonder. Since the organization is small, routines allows the organization to operate more efficiently through close monitoring and adjusting processes to achieve optimal productivity. Can routines lead to stagnation in family business? No, stagnation is not a likely outcome in family business because routines allow the family business to reduce cost through the learning curve. The hands-on decision making of the family business prevents routines from hindering efficiency.

Bounded rationality is a cognitive limitation for both the firm and family business. Bounded rationality is defined as the use of limited knowledge in making decision. No organization may have access to perfect information or every element of information needed to make a decision. This limited is true for both the firm and family business. However, the adverse effect of bounded rationality may be keener in family business than in a firm. A firm has access to information at a greater breadth than a family business due to its formal structure and availability of greater level of resources. Inside the firm, there is an army of individuals, such as executives, managers and workers who contribute to the knowledge base of the firm. In addition, the resources of the firm allow it greater access to information available in the market. By comparison, the family business has limited resources and its access to information is likewise limited.

2.4 William's Approach: Asset Specificity

According to William's approach to explain firm, firms produces certain products because it owns a certain type of assets (William, 1981, 1981, 1983). The production of products by firm is asset specific. Firms cannot easily change assets and change production. On the contrary, firm tends to become fixed with its assets and produce whatever the assets can produce. For that reason, the asset specificity leads to specialization. Specialization leads to efficiency through the learning curve effect. As more firms specializes in certain production according to its assets ownership, economies of scale is possible to achieve. Economies of scale is defined as the reduction of per unit cost with an increase in quantity produced. This scale economies allows producers to produce more at lower cost; as the result, firms becomes more competitive. For this reason, competition drives down price and benefits both the firm and consumers.

The family business also has asset specificity (Walczak and Voss, 2013). The family business is endowed with a certain assets; these assets can produce only a certain product. For that reason, the family business is also compelled to specialize in certain product. However, this specialization, unlike on found in the firm, does not lead to economies of scale. In order to achieve economies of scale the production must reach and go beyond a certain critical quantity. The family business can never reach that production level. Instead specialization in the family business leads to the development of *high-end quality product* or *customer made* products because the family business cannot in engage in mass production. This niche effect is a development of asset specificity of the family business.

3.0 SUCCESS FACTORS IN FAMILY BUSINESS

3.1 Necessity and Opportunity for Family Business

This section explores the relationship between necessity and opportunity as the drivers for the success and failure of the family business. Recall that family business is not as formal and not as structured by the firm or corporation. Being semi-structured, the transparency of its operations and hence profitability is not completely verifiable. The difference between self-sustaining and profiting is blurred in family business. There is no pressure for the family business owner to pay dividends to shareholders. Therefore, the family business owner is under less pressure to success unless forced by the competition in the market. If being coerced by market competition, the family business owner will react instinctively by springing to action. All its energy and entrepreneurial spirit seem to have come back to life again and work towards a single purpose of survivorship.

The necessity to maintain the family business afloat in the market is one factor that drives the family business to success. Success at one level comes from not being eliminated from the market. Survivorship or breaking event is a form of success. Breaking even may not be seen as success in the corporate world. However, for the family business surviving the market by meeting all one's fixed costs and expenses is the first level of success. Profit is considered as a form of excess rent derived from performance that had been outstanding in comparison to market forces.

Necessity in the family business comes from its capital structure. The capital of the family business is constrained by its limited access to the capital market or formal lending institutions, such as bank. This limitation stems from the fact that the family business is the outgrowth of the entrepreneur. An entrepreneur is defined as someone who takes risks in exchange of uncertain income. This characteristic of the entrepreneur still remains as a stigma for the family business even though it is a successor in interest of the entrepreneur. Lending institutions, therefore, sees family business as a risky enterprise. Being conservative and risk averse, banks and other lending institutions may recoil from family business. However, this may later be proven that it is a misperception of family business.

Despite the fact that family business is an outgrowth of the success of an entrepreneur, the family business is quite different from the risk taking entrepreneur. A family business is more structure and is confined to a particular enterprise or business line. This focused operation of business makes the family business risk averse and conservative. At the same, the entrepreneurial spirit and inventiveness of the entrepreneur remains alive in the family business. These two characteristics of the family business make it resilient in times of economic crisis. In time of normal growth, the family business seeks and exploits market opportunities.

3.2 Survival as a Recondition for Success

Like the entrepreneur who looks for short-term gain, most family businesses also have shorter horizon. Family business has limited resources; therefore, its operations are also confined to a particular geography and product line. It cannot afford to over stretch its resources. Therefore, long-term planning that requires the use of resources seem impracticable for family business. The focus is on short-term gain. The strength of short-term gain focus allows the family business to stay focused on transforming its resources into value. It can produce more and better products by not spreading itself thin in the market. Family business, therefore, has very thin portfolio. Its success depends on the performance of each portfolio element.

The weakness of a short-term outlook does not allow the family business to meet the challenges of the changing market. The introduction of new technology, for instance, may pose a threat to the family business. Technology allows mass production and a reduction of price. Being handicapped by resources, family business would not stand a chance competing against giant corporations. As the result, in order to survive in the market, family business has to turn more inward by becoming niche producer. The family business turned into value creation through specialization that differentiates it from mass production. Specialty and boutique stores are this type of response to mass marketing by larger corporation. To some degree, this response mechanism has worked well for family business.

3.3 Innovation by Necessity Not Creativeness

Innovation means originality or making existing products more effective (Frankelius, 2009). Innovation has long been relegated to inventiveness. However, in family business, innovation may have another source of inspiration: necessity. Family business always engages in a fight for its survival. A family business does not plan to

unseat the competitor because it does not have unused assets or underutilized capital. All its assets and capitals are always deployed at full capacity. Success of the family business depends on its ability to turn idled assets to value creators. Family business is at the pulse of the market and knows what are the needs of consumers, and, thus, could serve the market more readily, albeit in smaller scale than efforts exerted by more organized firms (Maraville, 1992).

The capital structure of the family business constrains its ability to act freely. By not being able to access the conventional lending institution, it relies of its own savings. This type of limitation forces the family business to be resourceful. Resourcefulness drives the family business to seek optimum productivity to ensure its survival in the market. The stakeholders in the enterprise further impose pressure on family business owner to be more vigilant in value creation. The family business becomes innovative in its value creation through cost reduction and better business process or methods in order to increase productivity under the condition of limited capital.

Necessity is the driver for success in family business. Success comes from value creation. Value creation results from innovation. Innovation is the fruit of being resourceful in the limited “source” possessed by the family business. This condition keeps alive the entrepreneurial spirit in the family business owner. However, unlike the untamed spirit of the entrepreneur who takes any opportunities that come his way, the family business owner is more selective in choosing the opportunity. It wants to survive the competition. However, in surviving that competition, the family business would engage an opportunity only if it falls within its core competence. There is no element of inventiveness in a sense of a free spirit of the entrepreneur. In place of inventiveness, innovation in the family business is replaced with a sense of necessity; the necessity to succeed. Success is defined as surviving the competition and living on to fight another day in order to claim its place under the sun among other enterprises in the market.

3.4 From Value Creation to Capital Accumulation

The striving for survivorship of the family business exceeds expectation when it survives and shows a profit. In fact, many family businesses, given the right opportunities and economic condition, survive the competition and succeed. Success requires more organization in the family business. Specialization in certain skills may be required. What it lacks inside the organization, the family business may look to outsourcing. In time, the family business may develop its organization into a more formal structure to meet its current needs.

If the organizational management is successful, the family business is further assured with further success in the over all operations. As the organization growth, its operations create value and accumulate capital. The earliest form of asset accumulation may come in a form of cash savings in the bank. As its cash account grows in the bank, the family business takes its first steps towards transforming itself from being a member of the informal sector to a formalized business with verifiable accounts and positive cash flow. The perception of the banks and lending institution about family business at this point changes.

With capital accumulation in the bank, the value creation process continues. However, the family business begins to create intangible value. Its products and services bought and sold in the market are considered tangible. The new credit worthiness that lending institutions conferred upon the family business as the result of the accumulated capital is a new form of value creation: *intangible asset*. As the business expands and the family business creates more alliances with other businesses, hire more people, and expand its customer list, the growth of its intangible assets begins to take shape. The consequence of this success puts a greater pressure for the family business to create more structure and tighten the loose ends of the organization. The growth of such bureaucracy threatens and suffocates the entrepreneurial spirit inside the family business owner. A successful family business owner must know how to keep alive its innovative and inventive spirit of the entrepreneur, and knows how to release it when it is needed.

Family business aims to create value more than adopting the conventional firm's aim of maximizing profit. The idea of maximizing profit comes from the fact that the firm's management, especially publicly trade firms, holds the fiduciary to maximize the wealth of the shareholders. However, a family business owner does not face such requirement. The objective of the firm is to create value. This objective comes from the fact that the family business is small in nature. As a small player in the market, the family business always faces competition. The threat of failure imposes upon the family business owner a constant pressure to survive. One means to survive comes from value maximization.

Value maximization has its origin in value creation. Value creation comes from the creative spirit left as a residue in inventiveness from the time when the family business started out with an entrepreneur. If the behavior and character of family business is traced back to the source of its value creation, one would find that value creation comes from the inventiveness thinking of the entrepreneur. This character survives through the structural transformation from the entrepreneurship into a more formal structured of family business. Faced with limited resources and the limitation of scope of the business, the family business must rely on its ability to be creative. *Creativity* is defined as the expression of idea into concrete business model or products that differentiate the enterprise in the market as being unique. This uniqueness, achieved through creative spirit of the entrepreneur embedded in the family business owner, helps the family business grow. This growth comes from the creation of value. Creation of value is achieved through the inventive spirit of the entrepreneur-family business owner. This inventiveness is driven by the urge to remain afloat in the market. The need to survive in the market and the pressure to maintain at least the same level of benefits to all stakeholders in the family enterprise are the key drivers that push for value creation in the family business. The success of the family business through value creation differs significantly from the firm's drive towards profit maximization.

3.5 From Family Business to SME

The continue growth of the family business will ultimately transforms the business into SME. The formalization of the organization is one structure. Decision makers in

the organization are readily identifiable. The decision making power is less concentrated and the decision making process is more systematic and less arbitrary. Many successful SMEs are family owned because SMEs evolved from family businesses.

What happens to a failed family business? There are two possible outcomes for a failed family business: either it reverts to an entrepreneurial enterprise in a scaled down form or it goes out of business altogether. Since the family business evolves from an entrepreneurial enterprise, the natural course of development in case the family business fails, the owner would divest from the failed enterprise and go into an entrepreneurial mode. In the entrepreneurial mode, the formal family business owner could no longer afford to have staff on payroll. For that reason, the failed family business leads to the dissolution of the unit and is reduced to a one man operation. For the former stakeholders in the family business, they have the choice of waiting for the entrepreneurial enterprise to pick up speed and grow again or look for other source of income. Generally, people do not put any hope of a failed enterprise to be revived. The family business owner is left alone. The entrepreneur emerges again.

Another option is for the family business to divest completely from further activity. All stakeholders including the family business owners may divest themselves from the failed activities and seek other source of sustenance. Under this option, the family business no longer exists and the entrepreneur is also terminated. It is far too familiar to see cases where the owner of the failed family business closes the enterprise and decide to work for a salary from someone else. The decision is as equally wise as if he had decided to pursue the business alone as an entrepreneur.

3.6 Survival and Success for Family Business

Success of the family business depends on its ability to survive the competition in the market. There is nothing that a family business can do a firm cannot do. There might be some differentiation characteristics in the delivery and packaging of the product that the family business may differentiate itself from the firm. Being small, the family business can afford to give attention to details when interacting with the customers.

In order for the family business to be successful, it must first survive the competition. This is different from a large firm. A large firm can sustain loss for several operating period. Its access capital allows it to ride through the roller coaster of the business cycle and market down turn. For the family business, lacking such a capital endowment, it cannot survive a market down turn for long. A family business is vulnerable to market shift and changes.

Assume that the family business survives the competition it is on its way to become successful. For family business, success is defined as the ability to sustain itself. Growth comes from production product that allows it to meet its current obligations. These obligations include salary payment and other operating costs in the enterprise. Since the family business does not have access to the conventional form of lending, it is not burden with debt. Since its operation is small and retains smaller asset, its asset turn over is generally higher than that found in larger firm in similar business. The key to survival is innovation. By being innovative in its production and

sales, family business can some times outmaneuver the competition. Its limitation in size and resources are used as asset through innovative thinking.

4.0 STRUCURAL CHANGES AND CAPITALIZATION

4.1 Capitalization for Family Business in SMEs

The success of the family business would lead to the accumulation of capital. Generally, capital accumulation in family business is in a form of current asset, i.e. cash not the bank. However, before coming to that point, at the start family business starts with its own capital.

The capitalization of family business comes from personal savings and excess profits of the previous stage of development, i.e. successful entrepreneurial enterprise. Since the entrepreneur is one person and the excess profit from the activity of one person is generally small in comparison to that of the corporation. For that reason, the start of the family business is generally small.

In time, the family business would growth. The successful family business would grow into SME. At that stage, the success of the family business may show as recordable and verifiable source of capital kept in the bank; thus, the family business may change its nature of capitalization. For further expansion of the business, the family business may now access the conventional lending market. One distinguishing feature between a family business and the SME is that the SME is more formalize in structure and has easier access to capital; therefore, capitalization by the SME may be relatively easier than that found in the family business. Secondly, SME is not considered as part of the informal section. Although it is true that SME evolved from as successful family business, the formality of SME generally makes its claim of success, asset ownership and profitable operations verifiable. Moreover, the formality pf the structure of the SME makes it more credible than a family business which is still a one-man show except with more stake holders in comparison to an entrepreneurial enterprise.

4.2 Formality and Structure of Family Business

The stricture of the family business is informal and less bureaucratic. This structural informality is both a blessing and a curse. It is a blessing because less structured in the family business allows decisions to be made efficiently; as the result, the business can respond to the market more quickly. The informality in the family business may be seen as a curse because it may not be predictable and nonsystematic.

In a corporation, policies are clearly written. However, in the family business policies are generally made as events unfold. The arbitrary nature of the family business makes it unable to attract talents. Without attracting talents, the business has a limitation for innovation and future growth. The creative energy in the family business is limited to its inner circle. This small circle reinforces the culture of family business for being less formal and less structured; therefore, it is generally seen by outsiders as unpredictable.

The characteristic of the entrepreneur still surfaces in the family business. As an organization, the family business is autonomous. It makes its own plan and operates according to its own needs and objective. The stakeholders must accept this

arrangement in the family business. Employees, for instance, must be able to deal with the arbitrary conduct and unwritten policy or *ad hoc* policy of the family business. Although decision may be made quickly, since there is no rule or restrictions, this quickness in decision making may lead to arbitrary action and abuses by the family business owners. In fact, most labor abuses in the developing countries, i.e. contract manufacturers in the garment industry, is the result of the arbitrary and non-systematic decision and conduct of the family business owners. The arbitrariness of the decision making process by the family business owners sometimes breaks the norm of decency in the case of labor abuse.

4.3 Access to Capital

The weakness of a family business is its limited access to capital. As the name suggests: family business, it derives its capital for the business from its own savings and that of its family members. Generally, family business does not have access to the conventional capital market, such as bank loans or the stock market. It does not have the luxury to ponder the question of whether to pursue its operation by debt or equity.

Family business is generally financed through sweat equity of the owner. Ownership is generally kept in few hands among family members. In addition, the mainstream economy generally sees family business as part of the informal sector because of its structure is not well defined. For this reason, conventional lenders are not attracted to family businesses. However, this person is changing.

The effect of limited access to conventional capital has kept family business generally small in size. Although there are successful family businesses that are large, those large family businesses are not the majority. Limited access to capital has put a limitation on the growth and expansion of the family business.

4.4 Risk Taker & Risky Enterprise Unattractive to Lending Banks

Family business is an outgrowth of a successful entrepreneur. As such, it is seen as a risk taker. Risk taking is deemed unattractive for lending banks because risky activities represent potential default or non-performing loan (NPL). However, family business may be misinterpreted because being a small enterprise with limited fund it curtails its risk exposure through business concentration. Although the family business grew from the success of an entrepreneur, it curtails its risk as the business involves addition stakeholders in the enterprise.

Every business is a risky enterprise. The family business is not a particularly risky enterprise. The risk of a family business is not the same as that found among entrepreneurs. An entrepreneur has no sense of direction. The objective of the entrepreneur is to make money by whatever activities. To that end, an entrepreneur is a risk taker. Banks generally do not lend to an entrepreneur without collateral.

As an enterprise, the family business is also classified as a risky enterprise. However, generally a family business cultivates a working relationship with its bank and is considered a loyal customer by the bank. The bank also monitors the financial transactions of the family business and can readily assess the risk of this customer. Traditionally, family business is not attractive to lending banks. However, that

perception is changing in today's economy with more and more family business playing a significant role in the economy. This changing perception is particularly true among the developing economies.

4.5 Collateralization of Wealth and Value

Lending institutions shirk from lending to family businesses because they lack the formal structure of the corporation and tend to lack operational record. However, as the family businesses become sophisticated, they change the place for safe keeping their money from under the pillow to bank accounts. The money in the bank may be used as collateral for future capital need.

Banks are ready lenders to family businesses. The safekeeping of the wealth that the family business accumulated from its operation has now created *value* never before though possible: potential borrower with good credit standing. This new status is an intangible asset possessed by a successful family business that uses the banking system.

The valuation of the family business is not confined to its excess profit alone. The location of where the money is kept also contributes to its further success. For the family business whose success is constrained by its limited fund, the money in the bank can now serve as collateral for bank loans needed for expansion. Profit leads to growth and growth leads to success. Profits come from the operation of the business. The excess profit is kept at the bank. The funded account may be used as collateral for loans when the business needs to be expanded.

4.6 Changing Perception by Banks towards Family Business

There are many factors and development that had made banks seeing family business in different light in recent years. Successful family businesses begin to accumulate wealth. This new wealth is kept in banks. Banks could notice the movement and growth of assets of family businesses. The perception that family businesses are part of the informal sector begins to change since the money of these businesses are kept at the bank and could be verified.

As banks change perception towards family businesses and extend credit to these businesses, they could now have access to conventional loans. However, accessing conventional banking products does not mean that the chance of success among family businesses would increase. In fact, access to the new capital market means that the family business is exposed to a new form of risk: *debt management*. With new capital it wants to expand. As long as the family business expands within its field of core competence, it would do well. However, as soon as it ventures out of its field of expertise, it spreads itself thin and is subject to market risk. Such a risk may have a negative impact on its overall operation. Meanwhile the recent access to new money in the bank becomes a burden. When this burden becomes overbearing, the risk of default sets in. This risk exposure is the curse of success.

4.7 Value Creation vs. Wealth Creation

Value creation and wealth creation are not the same. Value creation defined as products and activities that lead to the increase the successful operations of the

enterprise. Innovation is a value creation. Value creation is the cause for the success of a business. Profit is the effect of value creation. Wealth creation is defined as the maximization of profit. This is the tangible assets of the firm. Family business is preoccupied with value creation. Wealth creation is indicative of the firm where profit maximization is driven by the fiduciary obligation by the owners and managers to maximize the wealth of the stockholders.

In family business, value creation is important because it assures the family business owner that value is an investment in the business. If the value comes from innovation, it is an investment in the business because the innovative activities differentiates the family business from competitors and helps it to secure good will in the market. This good will is long lasting and it helps create an identity and positioning for the family business in the market. For instance, a family business may achieve this innovation through customer service or product delivery. These features of the business produce a certain image for the business. The positive image is valuable to the family business. In time of keen competition, this good will may help retain customers through loyalty as a recompense for past services. The family business seeks profit; every business seeks profit. However, profit is the effect of value creation. Value creation is the primary causation for the success of the family business.

4.8 Value Creation in Family Business

Value is defined as the causation of wealth. Value is created by the combination of tangible and intangible assets in the firm. These assets are put into the productive process to create products and services. However, unlike firms that tend to be impersonal, family business tends to be more personalized in their delivery of products and services. For instance, family business may put greater emphasis on customer service with the aim of creating good will in customers. This good will is a value created in the transaction, but the effect of this good will is long lasting. As the result of the good customer service in one transaction, the customer may return for future transaction. This is an example of value creation.

This is not to say that all family business has good customer service. Due to its small size and lacking the expertise to train its staff, in fact a family business may fail in customer service. However, that type of family business would tend not to create addition value in the transaction and would most likely fail in the business. In general, value creation in family business creates a lasting intangible asset for the organization.

4.9 Wealth Creation in Firms

Wealth is defined as the realization of profitable sales. It is not enough that the organization makes the sales, but the sales must be profitable. Wealth creation in the family business is achieved through sales transaction just like wealth creation found in firms. In firms, wealth creation also comes from other sources, such as accumulation of assets and human resources in a form of human capital.

Physical wealth is defined as the tangible assets owned by the organization. The firm generally has larger quantity of physical wealth in a form of machines and

land. The physical wealth may be transformed into cash after their productive life. During their time in service, these assets may be put into the productive process to produce goods and services that could be sold and make profit for the firm. After they are retired from service, they may be resold in the secondary market. Family business also possesses physical wealth but not in great quantity because physical wealth depends on the capacity of the organization to acquire them. This capacity is limited in the family business since the family business has limited amount of cash.

Human capital accumulation refers to the combined knowledge and experience of people within the organization. These combined knowledge and experience of the people can contribute to the creation of wealth within the firm. Human capitalization is a common phenomenon in firms. Within its formal structure, well defined policy and predictable earnings, firms generally attract talent from the labor pool. Family businesses, on the other hand, generally do not have the advantage of human capitalization. Due to its informal structure and lack of resources, family business seldom attracts talents from outside. The family business owes its value creation and success to its innovation. The innovative capacity of the family business depends almost exclusively on its owner. The stakeholders in the family business, such as employees and staff, generally do not contribute to the innovation of the organization because they do not participate in the decision making process, i.e. how may resources be utilized.

4.10 Transforming Value into Wealth

As defined in 4.41, value is the causation for the production of wealth. Value is the independent variable that produces wealth. As such value is the potential for the creation of wealth. Wealth is the actual sales and profit. Value is transformed into wealth by the combination of the tangible and intangible assets in the organization to produce sales. Tangible assets include labor and materials. Intangible assets include the good will of the organization, such as innovative process, brand, and reputation of the firm. Value is transformed into wealth by turning the existing assets in the organization into consumable products and delivering that product to consumers through a sales transaction.

All businesses have stored value. Both firms and family business rely in value to create sales and profit. However, firms put greater emphasis on wealth creation more than family business. This intense emphasis on wealth creation comes from the fact that owners and managers in firms, particularly those that are publicly traded, are under fiduciary duty to maximize wealth. This requirement of wealth maximization forces firms to become more systematic and highly specialized in whatever they produce. The drive to maximize profits forces firm to look for production efficiency; for example, specialized firms attempt to realize economies of scale. Economies of scale allow firms to reduce price per unit and, thus, firms are able to compete on the basis of price. With price reduction and with the intensity of wealth maximization requirement, owners and managers in firms are more interested in short-term gain. Family business, on the other hand, puts greater emphasis on value creation.

4.11 The Role of Accounting and Finance in Family Business

Accounting is the recordation of financial transaction in the organization. Finance is the management of the money, investment and assets in the organization. In a firm, these two functions are important for the firm's resource management. The performance of the firm is evaluated on the basis of its financial management. The finance of the firm is derived from the management of the firm's accounting. These two functions are interconnected. Without accounting, financial manager would not have the data it needed to analyze and make recommendation to the management. Without finance, accounting would not have the urge to produce sensible data. Accounting is the supplier of data, and the finance department is the down stream user of the data. These two functions do have the same significance in the family business.

What is the role of accounting in family business? The management of income and expense in the family business is generally left to the owner of the business. This practice is one of the distinguishing characteristic of the family business. All monetary issues: income and expense, is managed by the owner. While the firm's accounting is subject to audit. In particular, publicly traded companies are required to have transparency in accounting practices. However, in family business due to its small size and informal structure, accounting practice is generally unstructured and not transparent. There is not periodic audit not is there internal control procedure for accounting practices within the organization. This is one of the reasons why lending institutions traditionally see family business as unattractive because the accounting practice of family business lacks standard and independent evaluation.

What is the role of finance in family business? Finance management depends on accounting practice. Since accounting practice in family business is non-transparent and generally lacks systematic management, the finance of the family business is equally inept. Among the successful family business, there might be a semblance of structure and system in the accounting and financial management in the organization.

4.12 Valuation of Firm vs. Valuation of Family Business

Valuation is the estimation of the monetary value of the subject being evaluated. In this case, it is a business. How is a business valued? The valuation of the firm is a straight forward matter. It is sufficient to long through the financial statements of the firm and make a fair assessment of how much the firm is worth. In fact, for publicly traded companies, firm valuation is made all the time through stock price calculation, particularly the use of price-to-earning (PE) ratio to assess the value of the firm whether it is worth the price per share being offered in the market by comparing the price per share to the among of dividends paid per share of stock.

In family business, it is not so simple because there is not formal stock or share for the assessor to determine. Secondly, a significant level of success of the family business comes from its good will in the market and customer loyalty or innovative process in its business. These success factors of the family business are all valuable; however, it is not easy to affix a numerical value to them. For that reason, the valuation of the family business is not the same as the conventional method used for formally structured firms. One must look at the past performance and future potential

of the family business in light of its current standing in the industry and customer base.

5.0 BOUNDARY OF THE FORMAL AND INFORMAL SECTORS

5.1 Shared Sector Boundary: Formal & Informal Sectors

Family business has share boundary between the formal and informal economies. There might be extreme cases where the boundary between the formal and informal sectors is clearly defined. For instance, the level of organizational complexity is clearer among members of the formal sector. Large corporations and banks, for instance, have clear policy, and members have easily identifiable positions and responsibilities. However, these organizational features are not clearly defined or identifiable among members of the informal structure. In the most extreme case, an entrepreneur in the informal sector who “hustles the street” may not carry a business card clearly identifying himself and his business. This is not to say that he engages in illegal activities nor does it say anything about his professional competence. In fact, such an entrepreneur may know more than a well educated and trained manager in some large firms.

Despite their differences, there are some shared boundaries between the formal and informal sectors. In the manufacturing industry, established manufacturers may depend on family business or entrepreneur to supply raw materials or serve as intermediary for the finished product in the market. This symbiotic relationship between members of the two sectors cohabitate in the business environment and mutually benefits one another. Trade brokers, for instance, play a significant role in linking the manufacturer and its final consumers via the brokering by an entrepreneur. This distribution channel symbiosis is but one of many examples.

Not all contacts between the formal and informal sectors lead to mutually beneficial outcome. For example, local merchants always resent the coming of hypermarkets. Both local merchants and hypermarkets are competing against the same customer base. Being large in size and endowed with financial resources, hypermarkets always crowd out local merchants in the local market. These hypermarkets are generally large and are global in nature. Their operations span the continents. Local merchants are no match for their offerings. These hypermarkets can offer everything from A-to-Z to consumers. Since they are large in size and through the effect of economies of scale, hypermarkets can offer competitive price to consumers. On the other hand, being small and have little to offer, local merchants generally lose in the competition. Family business is not an exception when it comes to vulnerability to the effect of competition with larger firms. The share boundaries between the formal and informal sectors sometimes generate conflict.

5.2 Family Business and the Informal Sector

Family business plays a role both in the formal and informal economies. As a small firm, the family business is less formal and its operations generally go unnoticed by the larger players in the market. This curse of anonymity makes the family business escaped public notice. However, according to the World Bank, the informal sector accounts for significant contribution to the overall economies of the world. Being part

of the informal economy, family business thus plays a significant role in the health of the national economy in every country.

Successful family businesses are responsible for innovation and growth in the economy. Since family business is generally small in size and has limited resources. By its nature, family business is forced to be innovative, i.e. find ways to be efficient in its resource utilization. Innovation in family business leads to success; success leads to growth and the growth leads to employment. By tracing these chains of value in the operation and success of family business allows us to say that family business is also a “major player” in the economy.

Most family businesses are formally registered and pay their taxes. Having been accounted for through the tax system, family businesses are part of the formal sector.

5.3 Family Business and SMEs in Shared Boundaries

Family business and SME have shared boundaries in many aspects. SME is the natural outgrowth of successful family business. As the family business becomes successful and expanded; it becomes more structured. The decision making process and resource utilization becomes more formalized. The increased complexity and formalization of structure help transform the family business into SME.

Only successful family business can become SME. Failed family business or a family business that is struggling to survive does not maintain a shared boundary with SME. SME is the next stage of development for the family business. What is the shared boundary between family business and SME? The shared boundary between the family business and SME is the management composition and characteristic. The management team of SME may be family members or managers recruited from the outside. As for family business, the management lies in few hands or a single person who owns and runs the business. In both family business and SME, the management team is clearly identifiable and easily accessible within the organization. This characteristic of the management is different from that found in the firm. A larger corporation would have longer social distance between the management and employees. For instance, the President or Chief Executive Officer (CEO) of the corporation would have little opportunity to interact with employees due to the many layers of mid-management between the top and bottom rung of the organization.

There are some SMEs which do not grow from the family business. Nevertheless, these organizations still share certain characteristics with the family business, i.e. smaller organization size and less complicated organizational structure. In addition, decisions made in these types of organization, like their family business counterpart, tend to be efficient due to less bureaucracy commonly found in larger firms.

5.4 The Role of the Family Business in the Informal Sector

Family business dominates the informal sector of the economy because it is the first form of organization that naturally grows out of the success of the unorganized entrepreneurial enterprise. A successful family business grows into SME. SMEs play

significant role in the economy. For that reason, family business is important to the economy.

What is an informal sector of the economy? Organizations and transactions whose value are difficult to record or cannot be recorded is considered informal. An entrepreneurial enterprise is part of the informal economy because the work of the entrepreneur is unseen and unrecorded by the macro-economy. A family business may be considered as part of the informal economy because its structure is not well defined and not all of its transactions are recorded. Family business is considered self-employed in a sense that it depends on its own capital to operate. In addition, the family business ownership structure is generally concentrated in one hand. As such the structure of the organization is simple and some times undefined.

As an active participant in the informal economy, family business help sustain life at the lower rung of the economy. It provides jobs among low-paid workers. It also serves as the outlet for products of firms. In short, the family business serves as a link between the formal and informal sectors. It is unfair to say that family business is completely “informal.” There is a semblance of formality in the family business. For example, family business uses the banking institutions for their transactions, such as maintaining an account, depositing money and transfer money. Thus, the value of these transactions is recorded. To that extent, family business is part of the formal sector. However, things like small cash sales and payment of cash for compensation of employee in order to avoid payroll tax and underreporting sales receipt in order to avoid sales tax---had made family business a member of the informal sector.

5.5 The Role of the Informal Sector in the Economy

No one can deny that the informal sector of the economy has a critical role to play in the life of the country's economy. According to the World Bank Report, the informal sector accounts for 17% of the general economy in 162 countries surveyed. Generally, the term “informal sector” conjures the image of illegal activity or is synonymous with illicit business. However, this is a misconception. Even if one defines the informal sector to include activities that are not recorded in tax records, it does not mean that non-recording of tax collection means tax evasion or illegal activities. In fact, honest living people who earn their living from legal activities may not have their activities recorded in the tax system. For instance, in the developing countries, food vendors on the street are considered parts of the informal sector of the economy. In fact, most entrepreneurial activities are in the informal sector because most entrepreneurial activities are not recorded. Therefore, informality does not mean illegality. Informality means activities that are unrecorded or unregistered in the formal registration system. Tax registration is but one component of the registry of the formal economy. By not showing up in the tax registry does not automatically mean the activity is illegal. Activities that generate income less than the minimum reporting amount, for instance, is not recorded. Entrepreneurs or family business that ear below the reporting requirement falls into this category. They are active member of the informal economy.

This Paper explores several theories to explain the function and behavior of firms. Many elements of these theories also found application to family business. It

can be said that family business is akin to a firm. Although lacking the formal structure of a fully developed corporation, a family business is qualified to be classified as a firm. There are some differences such as the firm is compelled by fiduciary duty to maximize wealth or profit, the firm is occupied in value creation. This marked distinction between the two types of organization helps to set it apart.

Family business is an organization in transition. As a family business, the organization is generally small and informal. Most family businesses are small. This size limitation comes from the fact that the family business has limited assets and has not access to the capital market. Although there are many family businesses which are large, the majority of family businesses are small. Successful family business grows; with that growth, the family business will transform itself through the increase of structural complexity and multi-layers of organizational structure. This development leads to the transformation of the family business into a Small and Medium Size Enterprise (SME).

All theories of firm may be used to explain the function of the family business. Although there are certain elements of the firm theories which are not applicable to the family business, family business should be treated as a firm: 'family firm.' There is no need to create a separate discipline of family business requiring the introduction of a new set of theory. Family business is a family firm, an organization in transition. As part of the SME in transformation, family business behaves more like a firm than an entrepreneurial enterprise. Firm theories should be applied and modified to explain family business.

6.0 CONCLUSION

In this paper, we learned that family business is the outgrowth of the successful entrepreneur. The family business grew from an entrepreneurial enterprise and is also in a transition to the next stage of development. A successful family business generally transforms itself into SME. An SME may still retain the characteristic of family business. In fact, some large and successful corporations are still family own. It has also been explained that family business tends to seek value creation. The creation of wealth is the effect of value creation. In non-family corporations, the emphasis is put on wealth creation. Thus difference between corporation and family business defines the boundaries between the formal and informal sectors of the economy that family business and large corporations belong. Generally, family businesses are part of the informal sector. This Paper makes clear that the term "informal sector" of the economy does not have derogatory meaning. Informality means small in size and the activities are generally overlooked by the real economy.

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Correlation Coefficient for Continuous and Discrete Data

Part 4 of 4

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ABSTRACT

The purpose of this paper is to introduce researchers to correlation coefficient calculation. The Pearson Product Moment Correlation Coefficient is the most common type of correlation; however, the Pearson correlation coefficient may not be applicable in all cases. The Pearson r is used only when the data of the dependent and independent variables are quantitative. There are many types of correlation coefficient. The correct choice of correlation coefficient depends on the classification of the independent variable (X) and dependent variable (Y). Data are classified into one of three types: quantitative, nominal and ordinal. This writing explains various types of correlations on the basis of X-by-Y data type combination. Using the wrong type of correlation coefficient would lead to faulty inference; as the result, the researcher would commit Type 2 error.

Keywords: correlation coefficient, data type, Type 2 error

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1.0 INTRODUCTION

Correlation coefficient is commonly used to measure the level of association between variables: independent (Y) and dependent (X) (Boddy and Smith, 2009). Incorrect type of correlation coefficient would lead to Type 2 error. Type 2 error is defined as a wrongful acceptance of the null hypothesis (Sherman, 2002). The objective of this paper is to provide a clear guidance on how to use correct type of correlation coefficient. We begin with a simple set up of linear equation in a form of $Y = a + bX + c$ where a is the Y-intercept, b is the slope of the linear regression line, and c is the forecast error. In basic statistics, the linear regression line equation is obtained through the following three statements:

$$I_{XY} = N \sum XY - (\sum X)(\sum Y)$$

$$II_X = N \sum X^2 - (\sum X)^2$$

$$III_Y = N \sum Y^2 - (\sum Y)^2$$

$$a = \bar{Y} - b\bar{X}$$

$$b = \frac{I_{XY}}{II_X}$$

$$c = \sqrt{\left[\frac{1}{N(N-2)} \right] \left[(III_Y) - \left(\frac{(I_{XY})^2}{II_X} \right) \right]}$$

The argument in $Y = a + bX + c$ asserts that there is a relationship between X and Y. This relationship is embodied in the slope b . The level of this association or relationship is measured by the ratio of the deviation in Y with respect to the change in X adjusted by b . This simple procedure may become erroneous if we use the Pearson correlation coefficient for all cases. The Pearson r is appropriate only when both X and Y are quantitative. However, in cases dealing with non-quantitative data, such as demographic information or preferential ranking, the Pearson r would not be applicable. This paper intends to address these non-Pearson r cases.

2.0 TYPES OF CORRELATION COEFFICIENT

Reliability test uses correlation coefficient as one of the means to test the degree of association. In reliability context, correlation coefficient is interpreted as the ability to replicate the data of a prior study as the current experiment represents one array and the prior study represents the second array. The function of correlation coefficient is to give an index of association between two data arrays. The researcher must be aware of various types of correlation coefficient calculations and which one to use in a given situation. The situation is defined by the type of data available. The variable may be defined as X and Y. The objective of correlation coefficient calculation is to determine the relationship between X and Y through the measurement of association between X and Y. The table below illustrates the type of data crossing according to data types.

Table 1. Types of correlation coefficient classified by data types

| Variable (X,Y) | Quantitative X | Ordinal X | Nominal X | <i>Nota Bene</i> |
|-----------------------|----------------------------|------------------------------------------------|----------------------------|---------------------------------------------------------------------------------|
| Quantitative Y | Pearson r | Biserial r_b | Point Biserial r_{pb} | Determine the type of data for X and Y then select the appropriate correlation. |
| Ordinal Y | Biserial r_b | Spearman ρ Tetrachoric & Polychoric | Rank Biserial r_{rb} | |
| Nominal Y | Point Biserial r_{pb} | Rank Biserial r_{rb} | Phi, L, C, Lambda | |

This section of the writing includes ten types of correlation coefficients; each type of the correlation coefficient is used according to the characteristic of the data arrays: quantitative, ordinal, or nominal for the variables X and Y. There are nine common correlation coefficient types; one additional type is a variance of the tetrachoric correlation (2×2) made to accommodate $K \times L$ contingency data for ordinal-x-ordinal data. This extension of Pearson's 2×2 contingency is called

polychoric correlation. Before examining each type of correlation, it is important to be familiar with data classification.

2.1 Pearson correlation coefficient

The Pearson correlation coefficient is the most commonly used form of correlation. The Pearson r is used when both X and Y are quantitative data. Quantitative data is the numerical measurement produced by the instrument without any intermediary interpretation, translation, or transformation. The raw data from the response itself may be read as a numerical data. This type of data may be accommodated by the Pearson correlation coefficient. The Pearson correlation coefficient is given by:

$$r = \frac{1}{n-1} \left(\frac{X_i - \bar{X}}{s_X} \right) \left(\frac{Y_i - \bar{Y}}{s_Y} \right) \quad (1)$$

where ...

$Z = \frac{X_i - \bar{X}}{s_X}$ is the standard score measuring how far the individual data point is located away from the mean;

$$\bar{X} = \frac{1}{n-1} \sum_{i=1}^n X_i \quad \text{is the mean of } X_i, \text{ and}$$

$$\bar{Y} = \frac{1}{n-1} \sum_{i=1}^n Y_i \text{ is the mean of } Y_i.$$

Another means to define r is to use the slope of the linear equation $Y = a + bX + c$ as the parameter and multiply the slope by the quotient of the standard deviation of X divided by the standard deviation of Y , thus:

$$r = b \left(\frac{s_X}{s_Y} \right) \quad (2)$$

where ...

$$b = \frac{n \sum XY - (\sum X)(\sum Y)}{n \sum X^2 - (\sum X)^2} \quad \text{where } X : (x_1, x_2, \dots, x_n) \text{ and } Y : (y_1, y_2, \dots, y_n) \quad (3)$$

and the standard deviation is generally given by:

$$s_X = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2} \quad \text{and} \quad s_Y = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (y_i - \bar{y})^2} \quad (4)$$

The value of the correlation coefficient ranges between -1 and +1. A value of zero means that there is no association between the two arrays. Negative coefficient means that there is an obverse association. If there is an increase in X , there is a corresponding decrease in Y and *vice*

versa. A positive coefficient means that there is a perfect association. If there is an increase in X, there is also an increase in Y.

2.2 Biserial correlation coefficient

Biserial correlation is used when the X array is quantitative and the Y array is ordinal data. For example, X may represent the raw score of test performance of n number of students and Y represents the ranking placement of students according to their test scores, i.e. 100 = 1st place, 90 = 2nd, 80 = 3rd, and so on. The biserial correlation is given by:

$$r_b = \frac{(Y_1 - Y_0) \left(\frac{pq}{Y} \right)}{\sigma_Y} \quad (5)$$

where ...

Y = Y score means for data pairs with $x : (1, 0)$:

$$Y_1 = \frac{1}{n_1} \sum_{i=1}^{n_1} y_i \quad \text{and} \quad Y_0 = \frac{1}{n_0} \sum_{i=1}^{n_0} y_i$$

$q = 1 - p$;

p = proportion of data pairs with scores $x : (1, 0)$; and

σ_Y = population standard deviation for the y data and Y is the height of the standardized normal distribution at point z where $P(z' < z) = q$ and $P(z' > z) = p$.

Note that the probability for p and q may be given by the Laplace Rule of Succession (Laplace, 1814):

$$p = \frac{s+1}{n+2} \quad \text{where } s = \text{number of success and } n = \text{total observations.} \quad (6)$$

$$q = 1 - p \quad (7)$$

The population standard deviation (σ) may not be known; however, it may be determined indirectly through two-steps process: (i) t-equation and (ii) Z-equation.

$$t = \frac{\bar{x} - \mu}{S / \sqrt{n}} \quad (8)$$

From the t-equation, determine the population mean (μ), thus:

$$\mu = t \left(\frac{S}{\sqrt{n}} \right) - \bar{x} \quad (9)$$

With known μ , the population standard deviation may be determined through the Z-equation. The Z-equation is given by:

$$Z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}} \quad (10)$$

Now solve for the population standard deviation (σ), thus:

$$\sigma = \left(\frac{\bar{x} - \mu}{Z} \right) \sqrt{n} \quad (11)$$

Note that p and q are used when discrete probability is involved. In point biserial correlation, discrete probability is used because Y (response variable) exists as a ranked or ordinal variable. The response $Y : (y_1, y_2, \dots, y_n)$ either falls with a rank placement: $[1^{st}, 2^{nd}, \dots, i^{th}]$ or it does not. This “either or” argument dichotomizes the ordinal variable into {Yes | No} identifier which could be score as Yes = 1 and No = 0. Therefore, p and q of the discrete binomial probability is used. The test statistic for the binomial probability is given by:

$$Z_{bin} = \frac{\frac{X}{n} - p}{\sqrt{\frac{pq}{n}}} \quad \text{See infra.}$$

2.3 Point biserial correlation coefficient

There are two cases where point-biserial correlation is used: (i) X is nominal and Y is quantitative data, and (ii) X is quantitative data and Y is nominal. In addition, if one variable, such as Y in the series of X and Y is dichotomous, point-biserial correlation is also used. Dichotomous data are categorical data that gives a binomial distribution. This type of distribution is produced by {Yes | No} answer category. Although the point biserial correlation is equivalent to the Pearson correlation, the formula is different from the Pearson product moment correlation. The mathematical equivalence is: $r_{XY} = r_{pb}$. The point-biserial correlation (r_{pb}) is given by:

$$r_{pb} = \left(\frac{M_1 - M_0}{s_n} \right) \sqrt{\frac{n_1 n_0}{n^2}} \quad (12)$$

where s_n is the standard deviation of the combined population or pooled standard deviation, thus:

$$s_n = \sqrt{\frac{1}{n} \sum_{i=1}^n (X_i - \bar{X})^2} \quad (13)$$

In order to obtain S_n , both arrays must be combined: $n_1 + n_2 = n$, and the standard deviation of the combined string n is calculated to obtain s_n . This pooled standard deviation is presented as S_n .

The term M_1 is the mean value for the continuous $X : x_1, x_2, \dots, x_n$; therefore: $M_1 = \frac{1}{n_1} \sum_{i=1}^{n_1} X_i$

for all data points in group 1 with size n_1 and $M_0 = \frac{1}{n_2} \sum_{i=1}^{n_2} X_i$. The combined sample size is given

by: $n = n_1 + n_2$. If a data comes from only one *sample* of the population, s_{n-1} is used for the standard deviation. Thus r_{pb} is written as:

$$r_{pb} = \left(\frac{M_1 - M_0}{s_{n-1}} \right) \sqrt{\frac{n_1 n_0}{n(n-1)}} \quad (14)$$

The standard deviation for the “sample only” data set is given by:

$$s_{n-1} = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2} \quad (15)$$

The two equations using s_n and s_{n-1} are equivalent, thus;

$$r_{pb} = \left(\frac{M_1 - M_0}{s_n} \right) \sqrt{\frac{n_1 n_0}{n^2}} = \left(\frac{M_1 - M_0}{s_{n-1}} \right) \sqrt{\frac{n_1 n_0}{n(n-1)}}$$

The test statistic is the t-test which is given by:

$$t_{pb} = r_{pb} \sqrt{\frac{n_1 + n_0 - 2}{1 - r_{pb}^2}} \quad (16)$$

The degrees of freedom is $v = n_1 + n_0 - 2$. If the data array of X is normally distributed, a more accurate biserial coefficient is given by:

$$r_b = \left(\frac{M_1 - M_0}{s_n} \right) \left(\frac{n_1 n_0}{n^2 u} \right) \quad (17)$$

where u is the *abscissa* or Y of the normal distribution $N(0,1)$. Normal distribution may be verified by the Anderson-Darling test (Stephen, 1974, 1986).

There are three types of point-biserial correlation, namely (i) the Pearson correlation between item scores and total test scores including the item scores, (ii) the Pearson correlation between item scores and total test score excluding the item scores, and (iii) correlation adjusted for the bias resulted from the inclusion of the items scores. The correlation adjusted for the bias resulted from the inclusion of the items scores is given by:

$$r_{upb} = \frac{M_1 - M_0 - 1}{\sqrt{\left(\frac{n^2 s_n^2}{n_1 n_0} \right) - 2(M_1 - M_0) + 1}} \quad (18)$$

Note that for point-wise or specific probability of X value, the binomial distribution for the categorical data is given by:

$$P(X) = \frac{n!}{(n-X)!n!} p^X q^{X-n} \quad (19)$$

where n is the total number of observations, X is the specified value to be predicted, p is the probability of success of the observed value over the total number of events, and q is $1 - p$ or the probability of failure. The test statistic for the binomial distribution is:

$$Z_{bin} = \frac{\frac{X}{n} - p}{\sqrt{\frac{pq}{n}}} \quad (20)$$

Recall that the term a in the 2×2 contingency table is the frequency of for perfect match of {Yes: observed} and {Yes: forecast}. The frequency a is equal to X in $P(X)$ as illustrated in the table below.

Table 2. Contingency Table 2 x 2

| | Y | | | |
|---|-------------|----------------|------------|-----------------|
| | | YES | NO | |
| X | YES | a | b | $P(F) = a + b$ |
| | NO | c | d | $1 - P(F)$ |
| | Observation | $P(O) = a + c$ | $1 - P(O)$ | $a + b + c + d$ |

The term $a + b + c + d$ is the combined joint probability of all events in the set.

2.4 Spearman rho

The Spearman correlation coefficient is used when both the independent variable (X) and dependent variable (Y) are ordinal. Ordinal data is defined as a ranked order type of a well order set (Dauben, 1990; Moore, 1982; Suppes, 1972): {first, second, third, ..., n^{th} }. However, there is a claim made by Lehman that the Spearman coefficient can be used for both continuous and discrete variable (Lehman, 2005). This section focuses on the ordinal data of both dependent and independent variables.

Assume that there are two arrays of data called independent variable: X_i and dependent variable: Y_i . The ordinal data of these variable are x_i and y_i respectively. The correlation coefficient of x_i and y_i is given by:

$$\rho = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i (x_i - \bar{x})^2 \sum_i (y_i - \bar{y})^2}} \quad (21)$$

There is an alternative calculation of ρ through the use of the difference of two ranked arrays (Myers and Well, 2003; Maritz, 1981) x_i and y_i , thus:

$$\rho = \frac{1 - 6 \sum d_i^2}{n(n^2 - 1)} \quad (22)$$

where $d_i = x_i - y_i$ and n is the number of elements in the paired set: i in d . This method is not used if the researcher is looking for top X . Generally, equation (21) is used.

The test statistic used for the Spearman rank correlation is given by the Z-test or t-test. In order to use the Z-score test, it is necessary to find the Fisher's transformation of r . The Fisher's transformation for the correlation is given by:

$$F(r) = \frac{1}{2} \ln \left(\frac{1+r}{1-r} \right) \quad (23)$$

where $r = b \left(\frac{S_x}{S_y} \right)$ and \ln is the natural log of base $e = 2.718...$ The test statistic under the Z-equation is given by:

$$z = \left(\sqrt{\frac{n-3}{1.06}} \right) F(r) \quad (24)$$

The null hypothesis is that $r = 0$ which means that there is a statistical independence (Choi, 1977; Feiller *et al.*, 2003) or no dependent association. In the alternative, the test statistic may also be determined by the t-test thus:

$$t_r = r \sqrt{\frac{n-2}{1-r^2}} \quad (25)$$

The degree of freedom (Press *et al.*, 1992) is given by $df = n - 2$. The argument in support of t_r approach rests on the idea of permutation (Kendall and Stuart, 1973). The equivalence of the above determination is the Kendall's *tau* (Kowalczyk, *et al.*, 2004). Kendall's *tau* is beyond the scope of the present topic.

2.5 Tetrachoric correlation coefficient

The tetrachoric correlation coefficient is used when both the independent (X) and dependent (Y) variables are dichotomous or binary data and both are ordinal. Generally, there are two correlation tests used for binary data, namely phi-coefficient and tetrachoric correlation coefficient. The data is commonly presented in 2×2 contingency table. Below is an example of the 2×2 contingency table and its scoring.

Table 3. Contingency table for frequency counts

| | | Y | | |
|---|-----|-------|-----------|-----------|
| | | Yes | No | |
| X | Yes | a | b | p_F |
| | No | c | d | $1 - p_F$ |
| | | p_o | $1 - p_o$ | |

A series of definition for the terms used in tetrachoric correlation coefficient must be provided in order to gain a clearer understanding. The definitions are based on the 2×2 contingency table below:

p_o and p_F = marginal frequencies;

p_o = probability of the observed and

p_F = probability of the forecast;

a = joint frequency of the contingency table

O = observations which is comprised of $O \rightarrow X_O : (x_{O1} + x_{O2} +, \dots, x_{On})$

F = forecast which is comprised of $F \rightarrow X_F : (x_{F1} + x_{F2} +, \dots, x_{Fn})$

The three frequencies: a , p_O and p_F determine the values in the table. The bias of this determination is given by:

$$Bias = \frac{P_F}{P_O} \quad \text{or} \quad Bias = \frac{a+b}{a+c} \quad (26)$$

Juras and Pasarić (2006) formally explained tetrachoric correlation coefficient as:

“Let $z_O = \Phi^{-1}(P_O)$ and $z_F = \Phi^{-1}(P_F)$ be the standard normal deviates (SND) corresponding to marginal probabilities P_O and P_F , respectively. The tetrachoric correlation coefficient (TCC), introduced by Pearson (1900), is the correlation coefficient r that satisfies

$$a = \int_{z_O}^{\infty} \int_{z_F}^{\infty} \phi(x_1, x_2, r) dx_1 / dx_2, \quad (2)$$

Where $\phi(x_1, x_2, r)$ is the bivariate normal p.d.f.

$$\phi(x_1, x_2, r) = \frac{1}{2\pi\sqrt{1-r^2}} \exp \left[-\frac{1}{2(1-r^2)} (x_1^2 - 2rx_1x_2 + x_2^2) \right]. \quad (3)$$

The line $x_1 = z_O$ and $x_2 = z_F$ divide the bivariate normal into four quadrants whose probabilities correspond to relative frequencies in the 2×2 table.

Clearly, the SDN_{-S} z_O and z_F are uniquely determined by P_O and P_F , respectively. The double integral in (2) can be expressed as (National Bureau of Standards, 1959):

$$a = \frac{1}{2\pi} \int_{\arccos r}^{\pi} \exp \left[-\frac{1}{2} (z_O^2 + z_F^2 - 2z_O z_F \cos \omega) \operatorname{cosec}^2 \omega \right] d\omega \quad (4)$$

Showing that the joint frequency a is a monotone function of r is well defined by (2).” See Josip Juras and Zoran Pasarić (2006). “Application of tetrachoric and polychoric correlation coefficients to forecast verification.” GEOFIZIKA, Vol. 23, No. 1, p. 64.

Another version, the tetrachoric correlation coefficient is defined as the solution given by r_{tc} to the integral equation:

$$p_a = \int_{\Phi=1(1-p_X)}^{\infty} \int_{\Phi=1(1-p_Y)}^{\infty} \phi_2(x_1, x_2, r_{tc}) dx_2 dx_1 \quad (27)$$

where $\Phi(x)$ is the standard normal distribution and $\phi_2(x_1, x_2, \rho)$ is the bivariate standard normal density function. The term p_a may be written as:

$$p_a = \bar{\Phi} \left(\Phi^{-1}(1 - p_X), \Phi^{-1}(1 - p_Y), r_{tc} \right) \quad (28)$$

These formal definitions are not helpful for the actual calculation of the tetrachoric correlation coefficient. For practical purpose, assume that the 2×2 contingency table below as the basis for further discussion of the tetrachoric correlation coefficient: r_{tc} .

Table 4. Contingency table for joint probabilities

| | | Y | | |
|---|------|-------|-----------|-----------|
| | | Pos. | Neg. | |
| X | Pos. | p_a | p_b | p_X |
| | Neg. | p_c | p_d | $1 - p_X$ |
| | | p_Y | $1 - p_Y$ | |

Juras and Pasaric gave an extensive treatment of the tetrachoric correlation coefficient when they provided the Peirce measure (s_P), Heidke measure (s_H) and the Doolittle measure (s_D) as the estimate of r_{tc} . All these measures are comparable calculation for the tetrachoric correlation coefficient. These measures are provided as:

$$s_P = \frac{a - P_O P_F}{P_O(1 - P_O)} \quad (29)$$

$$s_H = \frac{2(a - P_O P_F)}{P_O + P_F - 2P_O P_F} \quad (30)$$

$$s_D = \frac{a - P_O P_F}{\sqrt{P_O(1 - P_O)P_F(1 - P_F)}} \quad (31)$$

In addition, the Yule's odd ratio skill score is said to also give the approximation of the tetrachoric correlation coefficient:

$$S_Y = \frac{a - P_O P_F}{a[1 - 2(P_O + P_F) + 2a] + P_O P_F} \quad (32)$$

Finally, the actually tetrachoric correlation coefficient is given by (Juras, 1998; Johnson and Kots, 1972):

$$S_r = \sin \left(\frac{\pi}{2} (4a - 1) \right) \quad (33)$$

Note that S with subscripts is equivalent to r_{tc} . One alternative to calculating tetrachoric correlation coefficient is given by the alpha ratio:

$$r_{tc} = \frac{\alpha - 1}{\alpha + 1} \quad (34)$$

where $\alpha = \left(\frac{AD}{BC}\right)^{\pi/4}$ and the equivalence of ABCD are $A = P_a$; $B = P_b$; $C = P_c$ and $D = P_d$. This short-hand version is less complicated than the Pearson's original version (Pearson, 1904). Yet another shorthand formula for tetrachoric correlation coefficient is given by:

$$r_{tc} = \cos\left(\frac{180}{1 + \sqrt{(BC/AD)}}\right) \quad (35)$$

where the contingency table is given by:

| | | Y | | |
|---|---|-------|-------|-------|
| | | 0 | 1 | |
| X | 1 | A | B | A + B |
| | 0 | C | D | C + D |
| | | A + C | B + D | |

Assume that Table 8.4.0 has the following data set:

| | | Y | | |
|---|---|------------|------------|------------|
| | | 0 | 1 | |
| X | 1 | A = 10 | B = 5 | A + B = 15 |
| | 0 | C = 5 | D = 10 | C + D = 15 |
| | | A + C = 15 | B + D = 15 | 30 |

The calculation for r_{tc} follows:

$$r_{tc} = \cos\left(\frac{180}{1 + \sqrt{(BC/AD)}}\right)$$

$$r_{tc} = \cos\left(\frac{180}{1 + \sqrt{(5)(5)/(10)(10)}}\right) = \cos\left(\frac{180}{1 + \sqrt{25/100}}\right)$$

$$r_{tc} = \cos\left(\frac{180}{1 + \sqrt{25/100}}\right) = \cos\left(\frac{180}{1 + \sqrt{0.25}}\right) = \cos\left(\frac{180}{1 + 0.50}\right)$$

$$r_{tc} = \cos\left(\frac{180}{1.50}\right) = \cos(120) = 0.81$$

Using equation (34), the calculation for alpha follows:

$$\alpha = \left(\frac{AD}{BC}\right)^{\pi/4} = \left(\frac{10(10)}{5(5)}\right)^{3.14/4} = \left(\frac{100}{25}\right)^{3.14/4} = 4^{3.14/4}, \text{ then ...}$$

$$\alpha = 4^{0.79} = 2.97$$

$$r_{tc} = \frac{\alpha - 1}{\alpha + 1} = \frac{2.97 - 1}{2.97 + 1} = \frac{1.97}{3.97} = 0.50$$

Another means of determining the tetrachoric correlation coefficient is given by:

$$r_{tc} = \sin \left(\frac{\pi}{2} \left(\frac{\sqrt{ad} - \sqrt{bc}}{\sqrt{ad} + \sqrt{bc}} \right) \right) \quad (36)$$

According to this method, the calculation follows:

$$r_{tc} = \sin \left(\frac{\pi}{2} \left(\frac{\sqrt{ad} - \sqrt{bc}}{\sqrt{ad} + \sqrt{bc}} \right) \right) = \sin \left(\frac{\pi}{2} \left(\frac{\sqrt{10(10)} - \sqrt{5(5)}}{\sqrt{10(10)} + \sqrt{5(5)}} \right) \right)$$

$$r_{tc} = \sin \left(\frac{\pi}{2} \left(\frac{\sqrt{100} - \sqrt{25}}{\sqrt{100} + \sqrt{25}} \right) \right) = \sin \left(\frac{\pi}{2} \left(\frac{10 - 5}{10 + 5} \right) \right)$$

$$r_{tc} = \sin \left(\frac{\pi}{2} \left(\frac{5}{15} \right) \right) = \sin(1.57(0.33)) = \sin(0.52)$$

$$r_{tc} = 0.50$$

The result of the calculation shows that equations (10.34) and (10.36):

$$r_{tc} = \frac{\alpha - 1}{\alpha + 1} \quad \text{and} \quad r_{tc} = \sin \left(\frac{\pi}{2} \left(\frac{\sqrt{ad} - \sqrt{bc}}{\sqrt{ad} + \sqrt{bc}} \right) \right) \quad \text{produce the same result and equation}$$

$r_{tc} = \cos \left(\frac{180}{1 + \sqrt{(BC/AD)}} \right)$ produces a higher coefficient. In comparison, equation (8.33) yields the following computation:

$$S_r = \sin \left(\frac{\pi}{2} (4a - 1) \right)$$

$$S_r = \sin \left(\frac{\pi}{2} (4(10) - 1) \right) = \sin \left(\frac{\pi}{2} (40 - 1) \right) = \sin \left(\frac{\pi}{2} (39) \right)$$

$$S_r = \sin \left(\frac{3.14}{2} (39) \right) = \sin(1.57(39)) = \sin(61.23)$$

$$S_r = -1$$

The results of the computation are from various claims of method are not in agreement. Below are the computation of the Peirce's measure, Heike, Doolittle and Yule. For convenience the following definition and value are given:

$$P_O = a + c = 10 + 5 = 15$$

$$P_F = a + b = 10 + 5 = 15$$

The calculation for the Peirce measure follows:

$$s_P = \frac{a - P_O P_F}{P_O(1 - P_O)} = \frac{10 - (15)(15)}{15(1 - 15)} = \frac{10 - 225}{15(-14)} = \frac{-215}{-210}$$

$$s_P = 1.02$$

The result does not seem to be accurate because the range of a correlation coefficient is between -1 and +1. The calculation under the Heidke measure follows:

$$s_H = \frac{2(a - P_O P_F)}{P_O + P_F - 2P_O P_F} = \frac{2(10 - 15(15))}{15 + 15 - 2(15(15))} = \frac{2(10 - 225)}{15 + 15 - 2(225)}$$

$$s_H = \frac{2(10 - 225)}{30 - 450} = \frac{2(-215)}{-420} = \frac{-430}{-420}$$

$$s_H = 1.02$$

Again a different number is obtained. The calculation under the Doolittle measure follows:

$$s_D = \frac{a - P_O P_F}{\sqrt{P_O(1 - P_O)P_F(1 - P_F)}} = \frac{10 - 15(15)}{\sqrt{15(1 - 15)15(1 - 15)}} = \frac{215}{\sqrt{15(14)15(14)}}$$

$$s_D = \frac{215}{\sqrt{15(14)15(14)}} = \frac{215}{\sqrt{15(14)210}} = \frac{215}{\sqrt{210(210)}} = \frac{215}{\sqrt{4410}} = \frac{215}{210}$$

$$s_D = 1.02$$

This result coincides with the Peirce measure. Lastly, under the Yule's method the calculation follows:

$$S_Y = \frac{a - P_O P_F}{a[1 - 2(P_O + P_F) + 2a] + P_O P_F}$$

$$S_Y = \frac{10 - (15)(15)}{10[1 - 2(15 + 15) + 2(10)] + 15(15)} = \frac{10 - 225}{10[1 - 2(30) + 20] + 225}$$

$$S_Y = \frac{-215}{10[1 - 60 + 20] + 225} = \frac{-215}{10(-39) + 225} = \frac{-215}{-390 + 225} = \frac{-215}{-165}$$

$$S_Y = 1.30$$

The result under the Yule's measure also exceeds 1.00. Bias in each case is determined by: $Bias = P_F / P_O = 15 / 15 = 1.00$. The results of the various measures may be summarized thus:

$$s_P = 1.02$$

$$s_H = 1.02$$

$$s_D = 1.02$$

$$s_Y = 1.30$$

$$S_r = -1.00$$

The values appear to be consistent, except the sign for S_r . With the exception of the negative sign of S_r , the interpretation of the correlation coefficient would otherwise be consistent. However, with the negative S_r , the S_r value would point to an opposite meaning in interpretation.

Table 5. Estimating level of significance using standard score: Z

| X_i | \bar{X} | $(X_i - \bar{X})$ | S | $Z_i = (X_i - \bar{X}) / S$ | \hat{Z}_i |
|-------|-----------|-------------------|--------|-----------------------------|-------------|
| 1.02 | 0.672 | 0.348 | 0.9425 | 0.369 | 1.65 |
| 1.02 | 0.672 | 0.348 | 0.9425 | 0.369 | 1.65 |
| 1.02 | 0.672 | 0.348 | 0.9425 | 0.369 | 1.65 |
| 1.30 | 0.672 | 0.628 | 0.9425 | 0.666 | 1.65 |
| -1.00 | 0.672 | -1.672 | 0.9425 | -1.774 | 1.65 |

Table 5 shows the determining of the level of significance of the for the variance estimates for the tetrachoric correlation. All estimates are consistent except S_r showing significant difference: $|-1.774| > 1.65$. The above analysis deals with correlation coefficient called tetrachoric for 2×2 contingency table. There is also a case where the categories of the contingency table is expanded to $K \times L$. The corresponding correlation coefficient of multiple categorical data is polychoric correlation coefficient.

2.6 Polychoric correlation coefficient

When both X and Y are ordinal data, i.e. $X = 1^{\text{st}}, 2^{\text{nd}}, \dots, n^{\text{th}}$ and $Y = 1^{\text{st}}, 2^{\text{nd}}, \dots, n^{\text{th}}$, and the categories of the data exceeds two, the use of polychoric correlation is suggested (Holgado-Tello *et al.*, 2010). Polychoric correlation is an estimate of the correlation between two unobserved variables X and Y where both X and Y are continuous by using the observed variables X^* and Y^* as the basis. The variables X^* and Y^* are ordinal variables that are assumed to follow bivariate normal distribution.

First, collect the observations of X^* and Y^* . These are ordinal data. The values of X^* and Y^* are known as the *underlying* or *latent variables*. These variables cannot be measured by direct observations. For instance, IQ test is a score obtained from a test battery intended to measure the level of intelligence. IQ test scores are the observed data X^* and Y^* ; intelligence is the unobservable X and Y. In this case, IQ is the score from an indirect test used to determine intelligence; however, the purpose of the illustration here is to give an example of a latent variable. These observations may be given as:

$$X^* = \begin{bmatrix} x_1^* \\ x_2^* \\ \vdots \\ x_n^* \end{bmatrix} \quad \text{and} \quad Y^* = \begin{bmatrix} y_1^* \\ y_2^* \\ \vdots \\ y_n^* \end{bmatrix}$$

Thus, $X^* = \{x_1^*, x_2^*, \dots, x_n^*\}$ and $Y^* = \{y_1^*, y_2^*, \dots, y_n^*\}$. These are observed data. Assume that there are discrete and random variables X and Y (note that there is no asterisk marking this “unobserved” set) which relates to X^* and Y^* where

$$x_{i=k} \quad \text{if} \quad \xi_{k-1} < x_i^* \leq \xi_k \quad \text{and} \quad (37)$$

$$y_{i=l} \quad \text{if} \quad \eta_{l-1} < y_i^* \leq \eta_l \quad (38)$$

For x_i the threshold ξ_k comes from $\xi_1, \xi_2, \dots, \xi_k$ and $\xi_0 = -\infty$ and $\xi_k = +\infty$. Similarly, the threshold for y_i is given by η_l which comes from $\eta_1 + \eta_2 + \dots + \eta_l$ and $\eta_0 = -\infty$ and $\eta_l = +\infty$. The corresponding values of the observed X^* and Y^* and the unobserved X and Y may be represented as:

$$X^* \rightarrow X = \begin{bmatrix} x_1^* \rightarrow x_1 \\ x_2^* \rightarrow x_2 \\ \vdots \\ x_n^* \rightarrow x_k \end{bmatrix} \quad \text{and} \quad Y^* \rightarrow Y = \begin{bmatrix} y_1^* \rightarrow y_1 \\ y_2^* \rightarrow y_2 \\ \vdots \\ y_l^* \rightarrow y_\eta \end{bmatrix}$$

The joint distribution of the unobserved X and Y is given by:

$$P[x = k] = p_k \quad \text{for } X \quad \text{and} \quad (39)$$

$$P[y = l] = q_l \quad \text{for } Y \quad (40)$$

The cloud of the unobserved variables X^* and Y^* as defined by x_i^* and y_i^* may be projected onto a space, thus:

$$\begin{bmatrix} \pi_{11} & \pi_{12} & \cdots & \pi_{1L} \\ \pi_{12} & \pi_{22} & \cdots & \pi_{2L} \\ \vdots & \vdots & \vdots & \vdots \\ \pi_{K1} & \pi_{K2} & \cdots & \pi_{KL} \end{bmatrix} \quad (41)$$

The term π_{KL} is called the *discrete cell proportion*. The objective of polychoric correlation is to find the value for π_{KL} . Recall that π is the joint probability of X and Y pair that is not observed.

With the above set up, polychoric correlation can now be discussed. Polychoric correlation is developed as the result of the inadequacy of the tetrachoric correlation to handle a $K \times L$ contingency table;¹ recall that the tetrachoric correlation is confined to a 2×2 contingency table. In

¹ Ritchie-Scott used the notation as $r \times s$ in labeling the contingency matrix. Zoran Pasoric and Josip Juras uses $K \times L$. Common statistics designated the multivariable contingency table as $K \times K$. In general, the $K \times K$ or $K \times L$ contingency table is provided as:

| OBSERVATIONS | | | |
|--------------|-------|----------|-------|
| C_1 | C_2 | \cdots | C_K |

1900, Pearson (Pearson, 1900) introduced tetrachoric correlation calculation as an attempt to obtain a quantitative measurement of a continuous variable. However, Pearson's earlier attempt was confined to 2×2 scenario. The work was further expanded by Ritchie-Scott (Ritchie, 1918) to cover a $K \times L$ scenario which became known as polychoric correlation today. Where as Pearson's 2×2 tetrachoric handles dichotomous data, Ritchie-Scott's $K \times L$ handles polytomous tests.

The observed array X^* and Y^* are assumed to be bivariate normal, and the correlation between X^* and Y^* is given by ρ (rho) given series of unobserved data set of x_i^* and y_i^* . The objective of polychoric correlation is to obtained the correlation of the unobserved arrays X and Y from the product-moment or correlation of the observed arrays X^* and Y^* where x_i^* and y_i^* is jointly normally distributed. The polychoric correlation is estimated from the discrete cell proportion π_{KL} ; thus, this estimated value is designated as $\hat{\pi}_{KL}$ from the $K \times L$ contingency table (8.5.0).

The *probability density function* (PDF) of the bivariate normal X^* and Y^* is given by:

$$\phi(x^*, y^*; \rho) = \frac{1}{2\pi\sqrt{1-\rho^2}} \exp \left[-\frac{x^{*2} - 2\rho x^* y^* + y^{*2}}{2(1-\rho^2)} \right] \quad (42)$$

The *cumulative distribution function* (CDF) for the bivariate normal X^* and Y^* is given by:

$$\Phi_2(\xi_i, \eta_i; \rho) = \int_{-\infty}^{\xi_i} \int_{-\infty}^{\eta_i} \phi(x^*, y^*; \rho) dy^* dx^* \quad (43)$$

for $x_i = 1$ and $y_i = 1$, the probability is:

| | | | | | | |
|----------|-------|-------------|-------------|-----|-------------|------------------------------------|
| FORECAST | C_1 | P_{11} | P_{12} | ... | P_{1K} | P_{F1} |
| | C_2 | P_{21} | P_{22} | ... | P_{2K} | P_{F2} |
| | ... | ... | ... | ... | P_{KK} | ... |
| | C_K | P_{K1} | P_{K2} | ... | P_{KK} | P_{FK} |
| | | $P_{obs,1}$ | $P_{obs,2}$ | ... | $P_{obs,K}$ | Polychoric Joint Probability |

Bias = $(P_{F,1} / P_{1\cdot}, \dots, P_{F,K-1} / P_{0,K-1})$ and $P_{obs} = (P_{obs,1}, \dots, P_{obs,k-1})$. The notation above uses:

$P_{row,column}$. Note that there is switching of observation and forecast above. This alternation does not change the number of interpretation of the result.

$$\pi_{11} = \phi(\xi_1, \eta_1; \rho) \quad (44)$$

The probability of $x_i = 1$ and $y_i = 1$ is a function of ρ . Recall that ρ is the correlation of the observed X^* and Y^* where the threshold is (ξ_1, η_1) . From the cumulative distribution function Φ_2 , the following generalization may be made:

$$h_{kl}(\theta) = \Phi_2(\xi_k, \eta_l) - \Phi_2(\xi_{k-1}, \eta_l) - \Phi_2(\xi_k, \eta_{l-1}) + \Phi_2(\xi_{k-1}, \eta_{l-1}) \quad (45)$$

The term h_{kl} stands for the *likelihood* of event k and l occurring and this likelihood is a function of theta θ and θ is given by:

$$\theta = [\rho, \theta_1] = [\rho, \xi_1, \dots, \xi_{K-1}, \eta_1, \dots, \eta'_{L-1}] \quad (46)$$

The *likelihood for the discrete cell proportion* is written as:

$$\pi_{kl} = h_{kl}(\theta) \quad (47)$$

A general statement may now be made about π ; now let $\pi = [\pi_{11}, \dots, \pi_{KL}]'$ and the likelihood of θ may be generally stated as $h[\theta] = [h_{11}(\theta), \dots, h_{KL}(\theta)]'$. Now, the polychoric equation may be written as:

$$\pi = h(\theta) \quad (48)$$

Olsson (Olsson, 1979) provides a close estimate of π as the maximum log likelihood which is equivalent to the estimated theta $\hat{\theta}$. Olsson's maximum log likelihood is given by:

$$\ln L = \sum_{k=1}^K \sum_{l=1}^L \pi_{kl} \log h_{kl}(\theta) \quad (49)$$

Recall that theta θ is the likelihood function. There are three kinds of maximum likelihood functions used according to the type of data distribution: (i) Bernoulli distribution, (ii) normal distribution, and (iii) Poisson distribution. Polychoric correlation deals with ordinal data. Ordinal data is ranked data set. The appropriate form of maximum likelihood function type is one that is used for normal distribution. The maximum likelihood function for normal distribution is provided thus:

$$f(x_1, x_2, \dots, x_n | \mu, \sigma) = \prod \frac{1}{\sigma \sqrt{2\pi}} \exp \left[-\frac{(x_i - \mu)^2}{2\sigma^2} \right] \quad (50)$$

which may be make into a general statement as:

$$f(x_1, x_2, \dots, x_n | \mu, \sigma) = \frac{(2\pi)^{-n/2}}{\sigma^n} \exp \left[-\frac{\sum (x_i - \mu)^2}{2\sigma^2} \right] \quad (51)$$

The maximum likelihood is express as the natural log of the function; therefore,

$$\ln f = -\frac{1}{2}n \ln(2\pi) - n \ln \sigma - \frac{\sum (x_i - \mu)^2}{2\sigma^2} \quad (52)$$

To find the expected mean of the function, the derivative of the maximum likelihood function is taken by:

$$\frac{\partial(\ln f)}{\partial \mu} = \frac{\sum (x_i - \mu)}{\sigma^2} = 0 \quad \text{which gives the expected mean as:} \quad (53)$$

$$\hat{\mu} = \frac{\sum x_i}{n} \quad (54)$$

Using the same rationale, the expected standard deviation follows:

$$\frac{\partial(\ln f)}{\partial \sigma} = -\frac{n}{\sigma} + \frac{\sum (x_i - \mu)^2}{\sigma^3} = 0 \quad (55)$$

$$\hat{\sigma} = \sqrt{\frac{\sum (x_i - \hat{\mu})^2}{n}} \quad (56)$$

The above steps obtained the maximum likelihood of mean and standard deviation as the mean and standard deviation of the sample. This may be a biased estimate; nevertheless, for purposes of demonstrating how the maximum likelihood is calculated in the context of the maximum likelihood of $\hat{\pi}_{KL}$, it is an adequate explanation.

2.7 Rank biserial correlation coefficient

In a case where Y is dichotomous and X is rank data, rank biserial correlation coefficient is used. The formula for the rank biserial correlation is given by (Glass and Hopkins, 1995):

$$r_{rb} = 2 \left(\frac{M_1 - M_0}{n_1 + n_0} \right) \quad (57)$$

where the subscripts 1 and 0 refers to the score of 1 and 0 in the 2×2 contingency table; M is the mean of the frequency of the scores, and n is the sample size. The null hypothesis is that $r_{rb} = 0$, meaning there is no correlation. If the null hypothesis is true, the data is distributed as Mann-Whitney U.

The objective of the Mann-Whitney U Test is to verify the claim that the standard deviation of population A is the same as the standard deviation of population B; if so, then the two populations are identical, except for their locations, i.e. the populations in two cities have the same income. The case involves two population located at a different place; this is a case that could be termed *parallel group*. The claim by the alternative hypothesis (H_A) is that the two populations are the same and have the same population standard deviation. The logic follows that “if the two standard deviations are the same, there difference, i.e. $\sigma_1 - \sigma_2 = 0$, must equal to zero.” The null

hypothesis (H_0) states the obverse: “the two populations are different; their means are different. Therefore, $\sigma_1 - \sigma_2 \neq 0$.”

The procedure for conducting the Mann-Whitney U test involves five steps. Each step is explained below thus:

1. Collect a sample from each population. The sample size of the two samples may be equal or unequal. Mark one sample as n_1 and the second sample n_2 . It does not matter which one is designated as the *first* or the *second* sample. However, conventional practice dictates that treat the largest sample as n_1 and the smaller sample as n_2 .
2. Combine the two samples into one array, i.e. one set as shown below:

$$n = n_1 + n_2 \quad (58)$$

3. Rank the combined sample (n) in an ascending order, i.e. from low to high so that the elements of the set is arranged as: $n_1 < n_2, \dots < n_N$.
4. calculate the test statistic for the Mann-Whitney U test according to the formula below:

$$Z = W_1 - \left(\frac{\frac{n_1(n_1 + n_2 + 1)}{2}}{S_w} \right) + C \quad (59)$$

where ...

$$W_1 = \sum_{k=1}^{n_1} \text{Rank}(X_{lk}) \quad (60)$$

This (W_1) is called the rank sum. The standard deviation of the ranked set is given by:

$$S_w = \frac{n_1 n_2 (n_1 + n_2 + 1)}{12} - \left(\frac{n_1 n_2 \left(\sum_{i=1}^3 t_i^3 - t_i \right)}{12(n_1 + n_2)(n_1 + n_2 - 1)} \right) \quad (61)$$

where t_1 = number of observations tied at value one;

t_2 = number of observations tied at value two, and so on.

C = correction factor. This number is fixed at 0.50 if the numerator if Z is *negative* and -0.50 if the numerator of Z is *positive*.

5. Use the following decision rule to determine whether to accept or reject the null hypothesis:

$H_A : \sigma = 0$, the decision rule is governed by $Z < Z_{\alpha/2}$ or $Z > Z_{1-\alpha/2}$.

$H_A : \sigma > 0$, the decision rule is governed by $Z > Z_{1-\alpha/2}$; and

$H_A : \sigma < 0$, the decision rule is governed by $Z < Z_{\alpha}$.

The Mann-Whitney U test is used in the following cases: (i) the test involves the comparison of two populations; (ii) the values of the data is non-parametric; therefore, it is an alternative test to the conventional t-test; (iii) the data is classified as *ordinal* and NOT interval scale. “Ordinal”

means that the data score, i.e. answer choice, has the spacing between each score unit is unequal or non-constant. For example, a scale of 1 (lowest) to 5 (highest) would not be able to use the Mann-Whitney U test. Whereas, 1st place, 2nd place, and 3rd place type of answer choice, where the distance between the first, second, and third are not equal, may be appropriate for this test; and (iv) it is said that the Mann-Whitney test is more *robust* and *efficient* than the conventional t-test.

“Robustness” (Portnoy and He, 2000) means that the final result is not unduly affected by the outliers. *Outliers* are extreme value. If the system is robust, it will not be affected by extreme value. Generally, extreme value tends to create bias estimate by the estimator because outliers or extreme values creates greater variance and thus larger standard deviation. This problem is eliminated through the use of *ranking* the data by arranging the combined sets of $n = n_1 + n_2$ into one set ranking from lowest value to highest value.

“Efficiency” is the measure of the desirability of the estimator. The estimator is desirable if it yields an optimal result. It yields the optimal result if the observed data meets or comes closest to the expected value (Everitt, 2002).

Recall that the conventional t-test is given by:

$$t = \frac{\bar{x} - \mu}{S / \sqrt{n}} \quad (62)$$

The Mann-Whitney U Test requires the comparison of the population standard deviations $\sigma_1 - \sigma_2 = 0$. Recall further that in order to determine the population standard deviation one must use the Z-equation. The Z equation is given by:

$$Z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}} \quad (63)$$

From equation (43), the population standard deviation may be written as:

$$\sigma = \left(\frac{\bar{x} - \mu}{Z} \right) \sqrt{n} \quad (64)$$

Note that the population standard deviation in equation (64) may not be determined unless the conventional t-equation (62) is used to determine the population mean (μ). The value of μ is derived from equation (62) as:

$$\mu = t \left(\frac{S}{\sqrt{n}} \right) - \bar{x} \quad (65)$$

Therefore, even the Mann-Whitney U test statistic, equation (59), shows no use of the t-equation and Z-equation, the researcher must understand the underlying functions and steps to illustrate the logic of the Mann-Whitney U Test.

2.8 Phi correlation coefficient

In case where the data of X and Y are both nominal, the *phi* correlation coefficient is used. The *phi* equation is given by:

$$r_{phi} = \phi = \frac{P_a - P_X P_Y}{\sqrt{(P_X P_Y (1 - P_X)(1 - P_Y))}} \quad (66)$$

There is an equivalence of equation (66) by contingency coding method of blocks ABCD in the table:

$$r_{phi} = \frac{(BC - AD)}{\sqrt{(A + B)(C + D)(A + C)(B + D)}} \quad (67)$$

The calculation according to equation (10.67) follows:

$$\begin{aligned} r_{phi} &= \frac{(BC - AD)}{\sqrt{(A + B)(C + D)(A + C)(B + D)}} \\ r_{phi} &= \frac{(25 - 100)}{\sqrt{(15)(15)(15)(15)}} = \frac{-75}{\sqrt{50,625}} = \frac{-75}{225} \\ r_{phi} &= -0.33 \end{aligned}$$

Note that equations (66) and (67) is equivalent to:

$$\phi = \sqrt{\frac{\chi^2}{n}} \quad (68)$$

$$\text{where } \chi^2 = \frac{(n-1)S^2}{\sigma^2} \text{ or } \chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}.$$

2.9 Pearson contingency C

Another case where both X and Y are nominal data, the Pearson contingency coefficient is used. This is known as Pearson's C which is given by:

$$C = \sqrt{\frac{\chi^2}{N + \chi^2}} \quad (69)$$

where χ^2 is chi square and N is the grand total of observations. Generally, the range for correlation coefficient is -1 and +1; however, C does not reach this range (Pearson, 1904; p. 16). For a 2×2 table, it can reach 0.707 and 0.870 for 4×4 table. In order to reach the interval maximum, more categories has to be added (Smith and Albaum, 2004).

2.10 Goodman and Kruskal lambda

The Goodman and Kruskal's lambda is a measurement of reduction in error ratio. This type of correlation measurement is used for the measurement of association. To the extent that it is applicable to "reliability," GK's lambda is usable only if reliability is defined in terms of association of polytomies, i.e. the answer to the survey question contains more than 2 choices. The lambda equation is given by:

$$\lambda = \frac{\varepsilon_1 - \varepsilon_2}{\varepsilon_1} \quad (70)$$

where ε_1 is the overall non-modal frequency; and ε_2 is the sum of the non-modal frequencies for each value of independent variable. The range of lambda is $0 \leq \lambda \leq 1$. Zero means there is no association between the independent and dependent variables, and one means there is a perfect association between the two variables.

Goodman and Kruskal deals with optimal prediction of two polytomies (multiples) which are asymmetrical where there is no underlying continua and no ordering of interest (Goodman and Kruskal, 1954). The Goodman and Kruskal (GK) polytomy is described by $A \times B$ crossing in the table below:

Table 6. Measure of association under Goodman-Kruskal method

| A | B | | | | |
|------------|--------------------|--------------------|----------|------------------------|-------------------------|
| | B_1 | B_2 | ... | B_β | Total |
| A_1 | ρ_{11} | ρ_{12} | ... | $\rho_{1\beta}$ | $\rho_{1\bullet}$ |
| A_2 | ρ_{21} | ρ_{22} | ... | $\rho_{2\beta}$ | $\rho_{2\bullet}$ |
| \vdots | \vdots | \vdots | \vdots | \vdots | \vdots |
| A_α | $\rho_{\alpha 1}$ | $\rho_{\alpha 2}$ | ... | $\rho_{\alpha \beta}$ | $\rho_{\alpha \bullet}$ |
| Total | $\rho_{\bullet 1}$ | $\rho_{\bullet 2}$ | ... | $\rho_{\bullet \beta}$ | 1 |

In Table 6, A divides the population into *alpha* (α) classes where $\alpha : (A_1, A_2, \dots, A_\alpha)$. Similarly, B divides the population into *beta* (β) classes where $\beta : (B_1, B_2, \dots, B_\beta)$. The proportion that classified as both A_α and B_β is $\rho_{\alpha\beta}$. The marginal proportion $\rho_{\alpha\bullet}$ is the proportion of the population classified as A_α and $\rho_{\bullet\beta}$ is the proportion of the population classified as B_β . See Goodman & Kruskal (1954), p. 734.

Goodman and Kruskal originally proposed the measure of association as:

$$\lambda_b = \frac{P(e_1) - P(e_2)}{P(e_1)} \quad (71)$$

which can be written as:

$$\lambda_b = \frac{\sum \rho_{am} - \rho_{\bullet m}}{1 - \rho_{\bullet m}} \quad (72)$$

The expression above is the relative decrease in probability of error from B_b as between A_a unknown and A_a known. The value λ_b gives the error proportion which can be eliminated when A is known. Goodman and Kruskal defined λ_α as:

$$\lambda_a = \frac{\sum_b \rho_{mb} - \rho_{m\bullet}}{1 - \rho_{m\bullet}} \quad (73)$$

where: $\rho_m = \text{Max}_a \rho_{a\bullet}$ and $\rho_{mb} = \text{Max}_a \rho_{ab}$

The interpretation of the meaning of λ_a is opposite of λ_b . The meaning of λ_a is “the relative decrease in probability of error in guessing A_a as between B_b unknown and known” (Goodman and Kruskal, p. 742). Goodman and Kruskal stated that the value of λ_a and λ_b were given by Guttman (Guttman, 1941) from which they derived the following lambda:

$$\lambda = \frac{0.5 \left[\sum_a \rho_{am} + \sum_b \rho_{mb} - \rho_{\bullet m} - \rho_{m\bullet} \right]}{1 - 0.5(\rho_{\bullet m} + \rho_{m\bullet})} \quad (74)$$

The lambda proposed by Goodman and Kruskal lies between λ_a and λ_b described by Guttman. The range of GK’s lambda is $0 \leq \lambda \leq 1$. Goodman and Kruskal alternatively the terms in lambda by “[l]et v be the total number of individuals in the population, $v_{ab} = v\rho_{ab}$, $v_{am} = v\rho_{am}$, $v_{mb} = v\rho_{mb}$, and so on” (Goodman and Kruskal, p. 743). Under this general definition, the Guttman λ_a and λ_b becomes:

$$\lambda_b = \frac{\sum_a v_{am} - v_{\bullet m}}{v - v_{\bullet m}} \quad \text{and} \quad (75)$$

$$\lambda_a = \frac{\sum_b v_{mb} - v_{m\bullet}}{v - v_{m\bullet}} \quad (76)$$

The general GK’s lambda then is given by:

$$\lambda = \frac{\sum_a v_{am} + \sum_b v_{mb} - v_{\bullet m} - v_{m\bullet}}{2v - (v_{\bullet m} + v_{m\bullet})} \quad (77)$$

The following table demonstrates GK’s new definition of the population and its components.

Table 7. Example of Goodman-Kruskal measure of association

| A | B | | | | |
|---------------|-------|-------|-------|-------|--------------|
| | B_1 | B_2 | B_3 | B_4 | $v_{a\cdot}$ |
| A_1 | 1768 | 807 | 189 | 47 | 2811 |
| A_2 | 946 | 1387 | 746 | 53 | 3132 |
| A_3 | 115 | 438 | 288 | 16 | 857 |
| $v_{\cdot b}$ | 2829 | 2632 | 1223 | 116 | $v = 6800$ |

The numerical examples in Table 7 are taken from Kendall's work and also was reproduced in Goodman and Kruskal's article (p. 744). See Kendall, Maurice G. (1948). *The Advanced Theory of Statistics*, London, Charles Griffin and Co., Ltd. 1948; p. 300.

Goodman and Kruskal provided the calculation as:

$$\begin{array}{ll} v_{1m} = 1768 & v_{m1} = 1768 \\ v_{2m} = 1387 & v_{m2} = 1387 \\ v_{3m} = 438 & v_{m3} = 746 \\ & v_{m4} = 53 \\ v_{\square m} = 2829 & v_{m\square} = 3132 \end{array}$$

The calculation for Guttman's λ_a and λ_b follows:

$$\lambda_a = \frac{3954 - 3132}{6800 - 3132} = \frac{822}{3668} = 0.2241$$

$$\lambda_b = \frac{3593 - 2829}{6800 - 2829} = \frac{764}{3971} = 0.1924$$

The calculation for GK's lambda follows:

$$\lambda = \frac{822 + 764}{3668 + 3971} = \frac{1586}{7639} = 0.2076$$

It is tempted to treat GK's lambda λ as the average of Guttman's λ_a and λ_b ; however, the following calculation shows:

$$\lambda = \frac{\lambda_a + \lambda_b}{2} = \frac{0.2241 + 0.1924}{2} = \frac{0.4165}{2} = 0.2083$$

There is a minor difference of $0.2083 - 0.2076 = 0.0006$ or 0.065%. It is a good approximation. For that reason, GK's lambda may be preferential to Guttman's λ_a and λ_b which requires a two-step process.

In reliability test, the GK's lambda is a tool to measure the degree of reliability through the interpretation of the reduction of the error ratio. If the error ratio is reduced, it is said that the study is reliable. Is this reliability test relevant to the instrument itself or the entire score set produced by the survey? It is worth noting that the issue of reliability, when it relates to the survey, fulfills the requirement of replication. For instrument assessment, the issue of reliability attests to the efficacy of the instrument, i.e. does it give predictable result or scores? GK's lambda, as well as Guttman's λ_a and λ_b , measures association between two polytomies: A_a and B_b . On the issue of instrumentation, GK's lambda is not a tool for instrument calibration. On the issue of survey reliability, GK's is not a tool for testing the reliability of the survey. GK's lambda is a tool to measure association of two random variables. Only if reliability is measured as the degree of association would GK's lambda be a usable tool for reliability analysis.

3.0 CONCLUSION

This paper underscores the importance of the use of correct type of correlation coefficient. Correlation coefficient measures the level of association between variables. If the type of correlation is not correct, the inference made from it would also be faulty: a case of Type 2 error. The correct type of correlation coefficient depends on the type of data of the variables. Assume that the relationship is captured by the dependent (Y) and independent (X) variables, the correct correlation coefficient to use depends on two questions: what type of data is Y? and what type of data is X? Data are classified into three types: quantitative, ordinal and nominal. The crossing of X-by-Y determines the type of correlation coefficient. Although this is not a new knowledge, this paper has put all three possible pairs of QON into context and explained how each type of correlation coefficient is calculated. This attempt helps facilitate correct calculation of association among variables.

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Stock Price Analysis under Extreme Value Theory

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ABSTRACT

The objective of this paper is to provide a practical tool for stock price evaluation and forecasting under Extreme Value Theory (EVT). We reviewed three existing models: Modern Portfolio Theory, Black-Scholes, and Jarrow-Rudd models. It was found that these models may not be effective tools where option contract is not part of the investment regime. The data used in this research consist of the daily close price from a period of 30 days from 100 companies in the SET100 index. From the sample distribution $F(X)$, extreme values were separated into a group $G(X)$. A tail index ξ was calculated from $G(X)$ and the distribution for each security was identified. Using EVT, the threshold value was estimated and used as a tool for risk assessment for each stock. It was found that Thailand's SET100 consists of two groups of stocks according to price distribution. The majority of the stocks are Weibull distributed and the remaining stocks are Fréchet distributed. Using Fisher-Tippett-Gnedenko's Generalized Extreme Value calculation for the indication of price volatility, the Weibull group shows the mean value of $H(\xi, \mu, \sigma) = 0.57$, and the Fréchet group shows $H(\xi, \mu, \sigma) = 0.05$. The findings may be used as a tool for risk assessment in stock investment. This finding rejects the general assertion that most financial data are fat-tailed distribution. The finding of this paper implies that investors face two categories of stocks: low and high price volatility. The idea of sector diversity becomes secondary. Empirical evidence shows that stocks from different sectors may have the same distribution and stocks of the same sector may have different distributions. Therefore, price volatility index is a better indicator for risk management.

Keywords: Extreme Value Theory, risk management, stock price analysis

JEL CODE: C10, C13, C14, C46, E27, G11, G17

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1.0 INTRODUCTION

Investors in the stock market face the challenge of stock price analysis and forecasting. Investors may use software package to analyze and forecast stock price movement. These programs are confined to basic statistical tests which may not be applicable to every scenario faced by investors. Many methods for stock price forecasting had been developed (Olaniyi, 2011). These methods include random walk theory, regime switching theory, cointegration and chaos techniques (Granger, 1992). However, these methods are too technical to be accessible by investors (Larsen, 2007). For that reason, there is a gap between investor's needs and analytical tools available in the market. This paper proposes a new perspective in stock price analysis and forecasting through the use of Extreme Value Theory.

EVT may be used as a tool for investment risk management. Risk has been broadly defined as the effect of uncertainty on objectives (ISO 31000: 2009). However, some writers attempt to differentiate risk and uncertainty. For instance, one writer asserts that risk is quantifiable and uncertainty is not measurable (Knight, 1921). Other writers claim that both risk and uncertainty are measurable. This line of literature asserts that risk is measured by percentage possibility; uncertainty is measured by percentage probabilities (Hubbard, 2007). In finance, risk refers to the outcome of the return on investment which differs from the expected value. (Holton, 2004). If the return is higher than what has been expected, it is called an upside risk (Horcher, 2005). If the return is lower than what has been expected, it is called a downside risk (McNeil et al., 2005). One method of minimizing the effect of downside risk is the use of portfolio (Markowitz, 1952). Markowitz' modern portfolio theory suggests that a portfolio comprising of debt and equity may minimize the effect of return's deviation. However, Markowitz approach minimizes both downside and upside risk. Where downside risk represents a loss and upside risk represents a gain, an effective risk management tool should minimize the loss and optimize the gain. Markowitz could not meet these requisites. This paper proposes that EVT may fill this gap.

EVT is an effective tool for risk management because it could quantify risk into percentage probability through the use of threshold p-quantile analysis. Generally, a threshold is defined by the predetermined upper and lower bound of the confidence interval called $1-\alpha$ with a critical value of $Z_{1-\alpha}$. For example, if the confidence interval is 95%, the threshold is $Z_{1-\alpha} \leq 1.65$ for two-tailed test. However, this approach assumes that the data is normally distributed. In real life, not all data is normally distributed. This is particularly true in stock price data. S&P500, for instance has 500 stocks as its components. The general method thus described would assume that all components of S&P500 are distributed normally. This assumption is faulty because it does not reflect reality. Empirical tests of SET100 also confirm that the assumption of normality of erroneous. EVT avoids making such an assumption by verifying each stock price series for its distribution through the use of tail index. By using empirical data to justify the modeling, EVT stands out as a more scientific method in risk analysis.

2.0 LITERATURE REVIEW

Three models are reviewed as the foundational materials of the current literature for investing in the stock market. These models include: Modern Portfolio Theory (MPT), (ii) Black-Scholes Model (BSM), and (iii) Jarrow-Rudd Model (JRM). This paper asserts that these three models are not adequate tool for risk management for stock investing, especially in emerging markets. This paper proposes EVT as a supplemental tool. All models presented in this paper rely on statistics as the building block for stock price and market analyses.

2.1 Modern Portfolio Theory

Markowitz introduced Modern Portfolio Theory (MPT) as a means to reduce risk in investment (Markowitz, 1952 & 1959). MPT is a mathematical formulation for risk reduction by many assets in an investment holding. Under MPT risk is defined as total portfolio variance. MPT assumes that investors are rational; the market is efficient; and the data is normally distributed (Elton & Gruber, 1997). The theory begins with the definition of expected return:

$$E(R_p) = \sum_i w_i E(R_i) \quad (1)$$

where R_p = return of the portfolio; R_i = return of asset i , and w_i = weight of the asset, i.e. proportion of asset in the portfolio. Since the return of the asset may fluctuate, the portfolio has a variance:

$$\sigma_p^2 = \sum_i \sum_j w_i w_j \sigma_i \sigma_j \rho_{ij} \quad (2)$$

Under this approach, the volatility of the portfolio return is simply the standard deviation. The standard deviation of the portfolio is given by:

$$\sigma_p = \sqrt{\sigma_p^2} \quad (3)$$

MPT argues that risk or the effect of volatility of the portfolio return may be reduced by holding a combination of assets that are not perfectly correlated: $-1 \leq \rho_{ij} \leq 1$. This rationale lays the foundation for the concept of risk reduction through assets diversification in hope of maximizing μ and minimizing σ^2 (Marling & Emanuelsson, 2012).

MPT assumes that investors are rational. However, in practice, it has been shown that investors are not rational (Koponen, 2003). Empirical evidence shows that investors are generally overconfidence and often cause asset price to be inflated (Kent et al., 2001). Other assumptions of MPT also had been challenged. For instance, MPT's assumption of normal distribution of returns had been criticized (Doganoglu et al., 2007). It was shown that asset returns are non-elliptical (Chicheportiche & Bouchaud, 2012). One writer has rejects MPT as unworkable (Taleb, 2007). Witt and Dobbins (1979) wrote that in real life, no one uses MPT. The problem with MPT stems from the fact that it makes assumptions that do not reflect price behavior in the stock market. As a risk management tool, the concept of asset diversification seems to work for downside risk; however, when it comes to upside risk, MPT is not helpful. MPT allows investors to reduce the effect of the fluctuation of prices or return rates. As such, it does not serve as a forecasting tool. Investors in the stock market need a tool that could provide price analysis, as well as forecasting. MPT provides a management tool for the *end*; investors need a tool to manage the *means*. To that end, MPT left a gap in the literature.

2.2 Black-Scholes Model

Twenty years after MPT, a new model called the Black-Scholes equation was introduced (Black & Scholes, 1973). The Black-Schole model allows the investor to reduce risk through hedging. Hedging is the taking of position in one market in order to reduce risk incurred in another market. Hedging is used when the firm is faced with financial constraint. Effective hedging minimizes the variability of the firm's cash balance (Mello & Parsons, 2000).

The Black-Scholes model assumes that the portfolio consists of two types of assets: risky asset called stock and riskless asset called bond (Sircar & Papanicolaou, 1998). The stock price fluctuates in a random walk with drift. The random walk of the stock price manifests geometric Brownian motion. It is assumed that the stock does not pay any dividends. The model also makes certain assumptions about the market. It assumes that the market does not have arbitrage. It is possible to borrow money at riskless rate. The buying and selling may occur for any amount without cost, i.e. no market friction.

The model assumes that the stock price is normally distributed with cumulative ($N(x)$) and probability density functions ($N'(x)$) as:

$$N(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^x \exp\left(-\frac{z^2}{2}\right) dz \quad (4)$$

$$N'(x) = \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{x^2}{2}\right) \quad (5)$$

Black-Scholes argues that the call price is given by:

$$C(S, t) = N(d_1)S - N(d_2)K \exp(-r(T-t)) \quad (6)$$

where C = call price; S = price of stock; $C(S, t)$ = call option of S stock at time t ; K = spot price; r = risk free rate; and d = cumulative probability of a standard normal point or implied volatility. A “call option” is the right to buy. The “put option” is the right to sell. According to (6) the stock price is a function of the difference between the distribution of the stock price general movement and the spot price accounted for volatility (d_i) where:

$$d_1 = \frac{1}{\sigma\sqrt{T-t}} \left[\ln\left(\frac{S}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)(T-t) \right] \quad (7)$$

$$d_2 = d_1 - \sigma\sqrt{T-t} \quad (8)$$

The put price is given by:

$$P(S, t) = K \exp(-r(T-t)) - S + C(S, t) \quad (9)$$

To express (9) in terms of d_i , the formula may be written as:

$$P(S, t) = M(-d_2)K \exp(-r(T-t)) - N(-d_1)S \quad (10)$$

Black-Scholes model is an improvement over the oversimplified argument of MPT. The improvement comes from the introduction of the distribution of the past and spot price movements. However, Black-Scholes could not accommodate future price volatility (Gencay & Salih, 2003). Black-Scholes also share a weakness with MPT in assuming normality of price without verifying the actual distribution of the price.

The weakness from the assumption in Black-Scholes may best summarized by two economists who wrote that: “Essentially, all models are wrong but some are useful” (Box and Draper, 1987, p. 424) and “... all models are wrong; the practical question is how wrong do they have to be to not be useful” (*ibid*, p. 74). Writers admit that normal distribution is not always found in practical context (Geary, 1947). Nevertheless, we continue to make such an assumption. This paper attempts to lessen that tendency and proposes a more robust approach to data analysis by verifying the type of distribution through empirical tests. Such an attempt in the context of stock price analysis has been witnessed in the Jarrow-Rudd Model.

2.3 Jarrow-Rudd Model

In 1983, the Jarrow-Rudd Model (JRM) was introduced as a new tool for stock price analysis. This new method also employs price distribution as the building block of the model. The call price is distributed as F which is a function of a second distribution called A . By analyzing the central moments of these two distributions, a price forecasting may be obtained. The JRM method is given by:

$$C(F) = C(A) - \exp \left[-rt \left(\frac{K_3(F) - K_3(A)}{3!} \right) \frac{da(K)}{dS_t} \right] + \exp \left[-rt \left(\frac{K_4(F) - K_4(A)}{4!} \right) \frac{d^2a(K)}{dS_t^2} \right] + \varepsilon(K) \quad (11)$$

where $C(F)$ = call option based on stock price with distribution F ; $C(A)$ = price based on known distribution A ; $K_j(F)$ = cumulant of F ; $K_j(A)$ = cumulant of A , such that: $K_2(F) = \mu_2(F)$; $K_3(F) = \mu_3(F)$; and $K_4(F) = \mu_4(F) - 3\mu_2^2(F)$; μ_i = central moment; aS_t = density of A ; S_t = random price of option A expired; K = strike price; and $\varepsilon(K)$ = Edgewood series with terms based on higher order cumulants and derivatives.

If the above equation (11) drops the last term $\varepsilon(K)$, then a shorter version of the formula is given by:

$$C(F) = C(A) + \lambda_1 Q_3 + \lambda_2 Q_4 \quad (12)$$

$$\text{where: } \lambda_1 = \gamma_1(F) - \gamma_1(A) \quad (12.1)$$

$$\lambda_2 = \gamma_2(F) - \gamma_2(A) \quad (12.2)$$

$$Q_3 = - \left(S_0 e^{rt} \right)^4 \left(e^{\sigma^2 t} \right)^2 \left(\frac{e^{-rt}}{3!} \right)^{3/2} \frac{d^2a(K)}{dS_t^2} \quad (12.3)$$

$$Q_4 = - \left(S_0 e^{rt} \right)^4 \left(e^{\sigma^2 t} \right)^2 \left(\frac{e^{-rt}}{4!} \right)^2 \frac{d^2a(K)}{dS_t^2} \quad (12.4)$$

JRM does not make any assumptions about distributions F and A . These two distributions are verified by empirical data. This approach is an improvement over MPT and BSM. However, JRM and BSM are employed in markets where option or future contracts are available. In the emerging markets or for day-traders where spot price is the overriding issue, JRM and BSM have limited use.

2.4 Extreme Value Theory

According to the National Institute of Technology and Science: “Extreme Value Distribution usually refers to the distribution of the minimum of a large number of unbounded random observations” (NIST, 2013). Under this definition, the maximum of minimum values of the series are separated from the original observation and re-analyzed separately. A threshold value is used for removing the minimum or maximum values. These removed items are then re-examined for their distribution and characteristics. The distribution of the second group may be estimated through the tail index. The tail index can provide information about the underlying distribution (Kostov & McErlean, 2002, p. 5).

There are two approaches to extreme value analysis. The first method uses the maxima block of points. This is called annual maxima series (AMS) approach (Hosking et al., 1985, and Madsen et al., 1997). The second method uses a specified points as the threshold beyond which points of

values are considered extreme (Leadbetter, 1991). This is known as Peak Over Threshold (POT) approach. Although AMS and POT had been used in analysis natural disaster events, for market behavior they must be adapted to the nature of the event. For example, AMS may not be appropriate for financial risk management due to its requirement of longer period of observation. The POT method may be more appropriate for financial risk management due to its use of threshold value which could be defined by investors. The POT method is also known as Partial Duration Series (PDS) approach. Under PDS, the data set is assumed to take a particular distribution (Madsen et al., 1997). The question of “which distribution should PDS assume” remains unsettled. For instance, Shane and Lynn (1964) assume that PDS is Poisson distributed. Zelenhasic (1970) proposed that the exceedance is gamma distributed. Another group of writers, such as Miquel (1984) and Ekanayake and Cruise (1993), proposed that the exceedance is Weibull distributed. In Rosbjerg et al. (1991), it was suggested that lognormal distribution characterizes the exceedance. Lastly, there are researchers who suggests that the exceedance set is distributed generalized Pareto (Van Monfort and Witter, 1986; Hosking and Wallis, 1987; Fitzgerald, 1989; Davidson and Smith, 1990; Wang, 1991; Rosbjerg et al., 1992; and Madsen et al., 1995). This paper makes no assumption of data distribution. The distribution is verified by empirical evidence under the tail index.

The reason why writers cannot agree of a definite distribution of extreme series may come from the fact that both AMS and POT methods removed exceedance points from the original set $X_i : (x_1, x_2, \dots, x_n)$ distributed as $F(X)$ and treat the removed set independently as $Y_i : (y_1, y_2, \dots, y_n)$ distributed as $G(Y)$. This has an inherent problem with sample size requirement. The size of Y_i varies from one study to another depending on the size of the original X_i ; thus, the resulting distribution of $G(Y)$ is not definitive. If Y_i is small, it may approximate chi-square distribution. If Y_i is large enough, under the law of large number, the series may approximate a normal distribution. However, if Y_i is volatile it may be Gumbel, Fréchet, Weibull or any one of the continuous distributions; there is no definite answer as to the type of data distribution of Y_i .

In order to reconcile these differences and uncertainty, for smaller sample this paper suggests a two step process: (i) employing the standard score equation to verify the existence of outlier points; and (ii) if the outliers are found, use the entire original observation as the basis for EVA. This approach overcomes the issue of inadequate sample size for verifying the distribution of the points in excess of the threshold and allows research to work with smaller sample size, i.e. weekly or monthly stock price movement. In so doing, we do not “assume” any type of distribution, but empirically verify the distribution type through the tail index and p-quartile percentage probability.

Under EVT, no assumption about the data distribution is made. Prices of stocks are tested and verified for their distribution. Whereas MPT focuses on investors and sanctifies them as rational, EVT does not look at investors. In EVT, the stock price itself becomes the unit of analysis. As a tool for univariate and nonparametric testing, EVT allows investors to determine the threshold level for price level and the scale of price volatility as indicators of risk. Thus, EVT becomes increasingly relevant in risk management (Embrechts et al., 1999, p. 32).

3.0 METHODOLOGY

Probability distribution under GEV is used to propose a tool for stock price analysis for purposes of risk management. GEV distribution is the generalized form of three extreme value distributions: Fréchet, Weibull and Gumbel (Gilli & Kaellezi, 2006; p. 5). One hundred companies in the SET100 Index were used as the main sample F . From this main sample a group of exceedance G were separated for tail index analysis. From the tail index ξ , the correct type of distribution is assigned to each company's price data.

3.1 Data

The data used in this paper comes from SET100. SET100 is an index of stock prices traded at the Stock Exchange of Thailand (SET). SET100 is an index comprised of 100 companies. The close price of the individual index components for 30 trading days was used as the data set. One company in the index has no data information. The remaining 99 companies were used as the final sample. Additional data consists of the SET100 index values for the same period.

3.2 Sampling and Sample Size

During this study period, the Stock Exchange of Thailand has 686 listed companies. SET classifies these companies into 9 industries and 16 sectors. It maintains three active indices: SET Index for the entire market; SET100 Index for 100 leading companies and SET Index for leading 50 companies. The data from SET and SET100 were used in this study. SET50 was not included because companies in SET50 are also listed in SET100.

The effective sample size after the removal of defective data is comprised of close price of 30 consecutive trading days for 99 companies. Individual stock price was collected from April 16, 2015 to June 2, 2015. The monthly market index SET was collected from January 2012 to May 2015. The rationale for using a longer period for market data collection is to assure the stability of data distribution at a market level. The individual stock data was confined to 30 trading days due to the time frame of information needed for short-term risk assessment. A longer period would not be practical due to potential price volatility and the aging of the data.

Since this study involves multiple stocks with diverse price level, the adequacy of sample size was calculated by best-fit method under Chi square equation where $\chi^2 = ((n-1)S^2 / \sigma^2)$, by solving for n , the expected sample size is given by:

$$n = 1 + \left(\frac{\chi_1^2(\sigma^2)}{S^2} \right) \quad (13)$$

where n = minimum sample size to be determined; χ_1^2 = chi square's critical value at 99.5% CI and one degree of freedom which is 7.90; σ^2 = estimated variance deviation; and S^2 = sample variance of the close price for 30 trading days in the study period. Under this method, the minimum sample size is $n = 10.25$ or 10 trading sessions; 30 sessions has been used in the present study.

3.3. Generalized Extreme Value (GEV)

Rosbjerg and Madsen (1992) recommended that the threshold level (q_0) should be obtained by the sum of the expected mean plus the product of the k count and the sample's standard deviation, thus:

$$q_0 = E[Q] + kS[Q] \quad (14)$$

where $E[Q]$ = observed mean of the sample; $S[Q]$ = sample standard deviation; and k = predefined frequency factor. This method of identifying exceedance level q_0 has been used in flood studies (Rasmussen & Rosbjerg, 1991) and precipitation research (Madsen et al., 1994). However, in financial data analysis where the time period is short and sample size is small, this method is not practical. For instance, if we deal with a sample of five items: $X_i : (1, 2, 3, 4, 10)$. The mean is 4.00 and the standard deviation is 3.54. The k count is 1 since one value (10) in the series stands out as an "apparent extreme." Using equation (14): $q_0 = E[Q] + kS[Q] = 4 + 1(3.54) = 7.54$. It is determined that the extreme point (u) is 7.54. However, if $X_i : (1, 2, 3, 4, 10)$ is distributed as $F(X)$ in space Ω_1 and the exceedance is expected to distribute as $G(X)$ in space Ω_2 , it is not possible to

determine the distribution type for $G(X)$ because the k count is 1 or a mere point in space Ω_2 . This is the inherent limitation of the q_0 approach.

This paper proposes that extreme values should be determined by the use of standard score equation:

$$Z = \frac{X_i - \bar{X}}{S} \quad (15)$$

where X_i = daily close price of individual stock; \bar{X} = mean close price of individual stock; and S = standard deviation of the daily close price. The array $X_i : (x_1, x_2, \dots, x_{30})$ for 30 trading days called sample $F(X)$ was subjected to equation (13) under 0.95 confidence interval: $Z(0.95) = \pm 1.65$. Prices that exceeds 1.65 or less than -1.65 are separated into a group called $G(X)$. The elements of $G(X)$ are used to calculate the tail index. For small sample size as in $X_i : (1, 2, 3, 4, 10)$, once an extreme point is identified, the entire set is used for the tail index calculation, i.e. $F(X) \cong G(X)$.

Extreme values may be analyzed under the generalized extreme value (GEV) distribution proposed by Fisher-Tippett-Gnedenko:

$$H(x; \mu, \sigma, \xi) = \exp \left\{ - \left[1 + \xi \left(\frac{x - \mu}{\sigma} \right) \right]^{-1/\xi} \right\} \quad (16)$$

where μ = location; σ = scale; and ξ = shape. If $\xi > 0$, H becomes a cumulative distribution function (CDF); if $\xi < 0$, it is valid for $x < \mu + \sigma / (-\xi)$; and if $\xi = 0$, H is undefined. (Bensalah, 2000). However, if $\xi \rightarrow 0$, then (36) is reduced to:

$$H(x; \mu, \sigma, 0) = \exp \left\{ - \left(\frac{x - \mu}{\sigma} \right) \right\} \quad (17)$$

The parameter ξ is the tail index of the distribution. This index may be used to classify the type of extreme value distribution. If $\xi = 0$, the H distribution is Gumbel distribution, also known as Type I where $x \in \Re$ and $\xi = 0$. The Gumbel distribution is given by:

$$H(x; \mu, \sigma, 0) = \exp \left\{ - \exp \left(\frac{x - \mu}{\sigma} \right) \right\} \quad (18)$$

If $\xi > 0$, the H distribution is a Fréchet distribution or Type II. The Fréchet distribution is given by:

$$H(x; \mu, \sigma, \xi) = \begin{cases} 0 & \text{for } x < \mu \\ \exp \left\{ \left(\frac{x - \mu}{\sigma} \right)^{-\alpha} \right\} & \text{for } x > \mu \end{cases} \quad (19)$$

In Frechet distribution with sample size n and parameters: α and β (Abbas & Yincai, 2012). The maximum likelihood estimation of β is:

$$\hat{\beta}_{ML} = \left(\frac{n}{t}\right)^{1/\alpha} \quad (20)$$

If $\xi < 0$, the H distribution is Weibull distribution or Type III. The Weibull distribution is given by:

$$H(x; \mu, \sigma, \xi) = \begin{cases} \exp \left\{ - \left(- \left(\frac{x - \mu}{\sigma} \right) \right) \right\}^{-\alpha} & \text{for } x < \mu \\ 1 & \text{for } x \geq \mu \end{cases} \quad (21)$$

The next step was to classify the type of extreme value distribution of the series through the use of the tail index. There are two methods for the tail index estimation: the Pickands method (Pickands, 1975), and the Hill method. (Wagner and Marsh, 2000). Firstly, the Pickands method is given by:

$$\hat{\xi}_{k,m} = \frac{1}{m} \sum_{i=1}^k (\ln X_{n-i+1} - \ln X_{n-m}) \quad (22)$$

where m = number of observations whose tail is to be observed and k = sample size. Secondly, the Hill method is given by:

$$\hat{\xi}_{k,T} = \frac{1}{k} \sum_{i=1}^k (\ln R_{i,T} - \ln R_{k,T}) \quad (23)$$

where $R = \sigma Z$; recall that σ is the estimated population standard deviation and Z is the standard score of the series. Both methods follows the same conditions in providing the decision rule for classifying the type of extreme value distribution: *Frechet* = $\xi > 0$, *Weibull* = $\xi < 0$ and *Gumbel* = $\xi = 0$.

4.0 FINDINGS

Contrary to the general assertions found in the current literature that financial data, specifically stock price data, is a fat-tailed (Fréchet) distribution, empirical test of data from Thailand's Stock Exchange show that the stock market price distribution contains no extreme values under the standard score formula approach for verifying exceedance. Nevertheless, the tail index of the market data shows that SET is a mixed of Fréchet and Weibull distributions. This empirical evidence also contradicts Markowitz' and Black-Scholes' assumptions of normality in stock price distribution. This finding has significant implication on how market analysts and investors should approach risk management in stock investment.

4.1 Extreme Value Identification

Using the Z-score method under 0.95 CI, the market data shows that there are no extreme values. The market index over a period of two years for the Thai Stock Exchange is stable. Nevertheless, it is still necessary to verify the distribution for SET, SET50 and SET100 indices. Since the standard score calculation shows that there is no extreme values, the entire series for 14 months were used to verify distribution. All three indices were Weibull distributed with the tail indices of $\xi = -1.05, -1.02$ & -1.11 respectively.

Individual stocks were tested for extreme values over a period of 30 trading days. Out of 100 companies in the SET100 index, 97 companies show extreme values in 30 consecutive trading days between April 16 – June 2, 2015. Three companies were removed for incomplete or defective data.

4.2 Tail Index and Distribution Verification

Three sets of calculations were made for the tail index at the macro-level; these indices include the tail index for SET, SET50 and SET100. Under the Hill method, it was found that the tail indices were -1.05 for SET, -1.02 for SET50 and -1.11 for SET100. The stock market in Thailand is Weibull distributed.

A second set of tail index calculation was used to identify the tail for component stocks of SET100. Among these 100 companies, 26 companies were confirmed Fréchet distributed; 71 were Weibull distributed; one was distributed Gumbel and two companies were removed for data incompleteness or defect.

Table 1. Tail Index Identification for Market Indices and Individual Stocks

| Data Source Thailand | Fréchet $\xi > 0$ | Weibull $\xi < 0$ | Gumbel $\xi \neq 0$ | Tail Index ξ |
|-------------------------|----------------------|----------------------|------------------------|---------------------|
| SET | - | ✓ | - | -1.05 |
| SET50 | - | ✓ | - | -1.02 |
| SET100 | - | ✓ | - | -1.11 |
| Individual Stocks | 26 companies | 71 companies | 1 company | $\xi \neq 0$ |

4.3 Fisher-Tipett-Gnedenko's GEV's Scale and Risk Indicator

Using GEV parameters, the scale of the exceedance is determined by:

$$\beta = \sigma + \xi(u - \mu) \quad (24)$$

where σ = estimated standard deviation of the exceedance; μ = mean of exceedance; ξ = tail index; and u = threshold value. (Moscadelli, 2004). The threshold value used in this case is the critical score at CI(0.95) or 1.65. From the scale β , the upper bound of the estimated price is determined by $U = \bar{X} + \beta$ and the lower bound $L = \bar{X} - \beta$. The range is simply $R = U - L$. This range is the bound within which price may fluctuate without being classified as risk: upside or downside. Thus, the risk indicator Z_k is obtained by: $Z_k = (R_i - \bar{R}) / S$ which is a reformulation of equation (13). An upside and downside risks are defined by value outside of the boundary $-1.65 \leq Z_k \leq 1.65$.

Table 2. Price Volatility of Individual Stocks by Distribution Type

| Distribution | $\bar{H}(\xi, \mu, \sigma)$ | P | Up/Downside Risk: * CI: 0.95, 0.90 & 0.80 | | | Volatility |
|--------------|-----------------------------|------|----------------------------------------------|-------|-------|------------|
| Fréchet | 0.05 | 0.53 | +1/-0 | +2/-3 | +5/-6 | Low |
| Weibull | 0.57 | 0.57 | +4/-0 | +6/-0 | +7/-0 | High |
| Gumbel | - | - | - | - | - | - |

*A plus sign (+) denotes upside risk; (-) downside risk frequency counts.

The results in Table 2 are used to verify statistical significance of the upside and downside risk for the two groups of stocks: Fréchet and Weibull distributed. Firstly, the discrete probability of upside risk for the Fréchet group is calculated with the determination of the Laplace Rule of Succession (Durrett, 2013):

$$p = \frac{s+1}{n+2} \quad (25)$$

where s = combined number of upside risk at 0.95, 0.90 and 0.80 CI; n = number of stocks showing exceedance distributed Fréchet. The probability of upside risk is $p = 0.64$ and the probability of non-upside risk is $q = 0.36$. The test statistic follows the De Moivre-Laplace Theorem (Balazs and Balint, 2014):

$$Z = \frac{|S_n| - np}{\sqrt{npq}} \quad (26)$$

From Table 2, $s = 5$; thus, $p = (5+1)/(26+2) = 6/28 = 0.21$ and $q = 0.79$. The result of the calculations: $Z_u = (11 - 26(0.21)) / \sqrt{26(0.21)(0.79)}$; thus, $Z_u = 2.61$. Using 0.95 confidence interval where $-1.65 \leq X \leq 1.65$, the finding of $Z_u = 2.61$ is statistically significant. Similarly, for the downside risk among the Fréchet group is also statistically significant: $Z_d = 6.97$. Among the 26 stocks that are distributed Fréchet, the following stocks manifest statistically significant risk: BH, BIGC, KBANK, KTC, PTT, SCB and SCCC. The summary of their price statistics and risk indicator Z_k are summarized in the Table 3.

Table 3. List of Upside Risk Stocks in the Fréchet Group

| Stock Symbol | 30-days Mean | Mean: μ | Deviation: σ | Z_{upside} |
|--------------|--------------|-------------|---------------------|--------------|
| BH | 166.51 | 159.79 | 15.76 | 3.26 |
| BIGC | 218.04 | 211.07 | 15.80 | 3.52 |
| KBANK | 216.73 | 208.03 | 17.45 | 4.04 |
| KTC | 99.00 | 96.03 | 6.73 | 0.87 |
| PTT | 354.00 | 349.20 | 9.66 | 1.63 |
| SCB | 168.25 | 163.96 | 8.23 | 1.30 |
| SCCC | 384.08 | 376.54 | 16.47 | 3.67 |

There are 11 stocks in the Weibull group that shows upside risk. There is now downside risk indication in this group. The Z value under the De Moivre-Laplace Theorem for the Weibull group is $Z = ((1 - 71(0.125)) / \sqrt{71(0.125)(0.875)})$ or $Z = -2.82$; compared to -1.65, the upside risk in the Weibull group is statistically significant.

Table 4. List of Upside Risk Stocks in the Weibull Group

| Stock Symbol | 30-days Mean | Mean: μ | Deviation: σ | Z_{upside} |
|--------------|--------------|-------------|---------------------|--------------|
| AMATA | 17.53 | 17.12 | 0.75 | 1.39 |
| AP | 7.38 | 7.20 | 0.40 | -1.40 |
| BCH | 7.94 | 7.64 | 0.74 | 1.00 |
| BLAND | 1.51 | 1.36 | 0.20 | -0.96 |
| MBCL | 1.90 | 1.87 | 0.08 | 2.66 |
| BTS | 9.26 | 9.15 | 0.22 | -1.53 |
| EARTH | 4.85 | 4.78 | 0.13 | 1.27 |
| TRIPL | 2.78 | 2.71 | 0.17 | 0.94 |
| TUF | 20.63 | 20.44 | 0.46 | -1.12 |
| UV | 8.04 | 7.88 | 0.39 | -1.28 |
| VGI | 4.55 | 4.42 | 0.24 | -1.14 |

The upside risk shows that $Z_u = ((57 - 71(0.11)) / \sqrt{71(0.11)(0.89)})$; thus, $Z_u = 18.63$ which is higher than the standard reference value of 1.65. The upside risk for the Weibull group is statistically significant. No stocks in the Weibull group manifest downside risk. Among the Fréchet group of stocks show a total of 9 downside risk at CI 0.95, 0.90 and 0.80.

5.0 DISCUSSION

Two additional observations are made. First, EVT is an effective tool for risk assessment. This efficacy is evidenced through distribution analysis under EVT. The parameters of the distribution functions allow investors to gauge the threshold of risk level or volatility level and manage risk accordingly. These parameters include distribution location, shape, and scale. Second, the result of empirical test from SET100 data shows that MPT's and BSM's assumptions of normal distribution is refuted.

If both the upside and down risks are statistically significant, then the stock is volatile. Volatility in this context is defined as $1.65 \leq Z_k \leq -1.65$. Thus, in this study, the Fréchet group of stocks shows both significant upside and downside risk. Stocks in this group are considered volatile. They are more appropriate for investors who are risk affine or have higher tolerance for risk. Stocks in the Weibull group shows significant upside risk but has no down side risk. These stocks are considered non-volatile. They are more appropriate for investors with lower tolerance for risk. The method used to arrive at these conclusions is a contribution to stock investment practice.

The reading of individual stocks must be read with the market's movement. In the present case, SET100 as a whole is distributed Weibull. Uner Fisher-Tippett-Gnedenko's GEV equation both Fréchet and Weibull distributed data may be generalized under one general equation $H(\xi, \mu, \sigma)$. Therefore, if the upside and downside risk indicators for SET100 are determined, a 2×2 table could be constructed for comparing the individual stock price to the market index.

Table 5. Chi Square Analysis under 2×2 Table

| | Upside Risk Z_u | Downside Risk Z_d | Total Counts |
|-------------------------|----------------------|------------------------|-----------------|
| Individual Stock: X_i | a | b | $a + b$ |
| | 11 | 0 | 11 |
| Market: SET100 | c | d | $c + d$ |
| | 9 | 10 | 19 |
| Total Counts | $a + c$ | $b + d$ | $a + b + c + d$ |
| | 20 | 10 | 30 |

The test statistic is the chi square test with one degree of freedom or $\chi^2_{1(0.95)} = 3.80$. The chi square test is given by:

$$\chi^2_1 = \frac{(n-1)(ad+bc)^2}{(a+b)(a+c)(b+d)(c+d)} \quad (27)$$

The test under (24) indicates whether the individual stock's upside and downside risks are significantly different from that found in SET100's distribution. The result under equation (24) is $\chi^2 = 8.39$. Compared to the standard reference value of $\chi^2_{1(0.95)} = 3.80$, it is concluded that individual stock's exceedance and SET100 are significantly different. Therefore, SET100 could not serve as an indicator or guide for stock price movement. This finding provides an important implication because the index and its components do not reflect one another. This is antithetical to the idea of stock market index: a reference against which individual stock prices are compared. The

experience of Thailand's stock market shows that the individual stocks identified by EVT are significantly different from that of the index of which they are components.

5.1 Risk Assessment Tool

EVT verifies data distribution type through empirical testing. There is no need for making an assumption about data distribution. The investor could verify the type of data distribution through the use of tail index ξ . Conventionally, risk has been defined as the variance of the returns from the asset. However, in stock price movement analysis, risk is defined as the volatility of the price itself. For this reason, the shape, location and scale of the stock price distribution are key indicators for risk assessment. The location of the mean on the distribution curve indicated expected price level. The shape of the curve indicates the characteristic behavior of the stock price. The scale of the curve indicates the level of volatility of the price. These three parameters may be used as risk assessment tools. EVT provides these tools a practical and accessible to investors at large. No complicated computer software or cumbersome mathematical formulae are necessary. By following series of simple calculations outlined in this paper, investors could assess risk and make investment decision according to the value of Z_u for upside risk and Z_d for downside risk.

5.2 Implications on Modern Portfolio Theory

Thailand's Stock Exchange is comprised of 9 industries and 16 sectors. It is tempted to accept MPT's concept of portfolio diversification by holding assets drawn from various industries and sectors. However, empirical testing shows that the entire SET100 index components have two types of distribution: Fréchet and Weibull. The type of distribution does not depend on sector or industry. This finding implies that MPT's concept of equity-only portfolio diversification has no merit for the stock market in Thailand unless the portfolio mixes stocks and non-stock assets. This assessment does not apply to the case where MPT advocates a combined holding of stock and bonds. Whether this conclusion could be made about other markets, further research and testing are required.

5.3 Sample Size of Exceedance

The application of EVT is a two-steps process: (i) taking the main sample distributed as $F(X)$ within which a threshold point u is designated; and (ii) collecting all points that exceeds u which distributed as $G(X)$. The problem arises when $G(X)$ is too small to provide meaningful extraction of the tail index in order to verify the distribution of $G(X)$. For instance, if $G(X)$ comprises of two points no distribution could be stipulated. To solve this problem, it is suggested that if the original sample $F(X)$ is small and the finding of extreme point for $G(X)$ is also unreasonably small, the entire $F(X)$ should be used for the tail index calculation. This approach would be more appropriate in stock price analysis since investors trading on spot market would often deal with small sample size. This approach is akin to using the finding of exceedance, no matter how small, as a diagnosis. Once exceedance values are found, the application of EVT on the entire sample is applied. This approach is practical for day-traders and short-term investors in the equity market.

This paper urges that no assumption of distribution should be made and that data distribution should be verified through the tail index; yet the identification of the exceedance is obtained through the Z score equation. The underlying assumption of the Z equation is normal distribution. This apparent contradiction may be explained.

Recall that sample n distributed as $F(X)$ was taken from population N distributed as $\Phi(Z)$. By definition for adequately large i.i.d. N , $\Phi(Z)$ is distributed normally. This logic was offered by the deMoivre-Laplace theorem (MLT) (Balazs & Toth, 2014). Under MLT, discrete data would approximate normal distribution as the sample size n approaches infinity, thus:

$$\lim_{n \rightarrow \infty} P \left[a < \frac{X - np}{\sqrt{npq}} < b \right] \cong \frac{1}{\sqrt{2\pi\sigma^2}} \exp \left(-\frac{(x - \mu)^2}{2\sigma^2} \right) \quad (28)$$

In our case N is non-finite or $N \rightarrow \infty$, thus if the original distribution of N from which sample n is taken was $N(0,1)$ then $F(X) \Leftrightarrow \Phi(Z)$. Therefore, the use of the standard score: $Z = (X - \bar{X})/S$ to identify exceedance in set n reflects $\Phi(Z)$ distribution type of N from which n was drawn. The distribution of n is verified in subsequent calculation under tail index method.

6.0 CONCLUSION

This paper reviews three existing risk management tools in stock investment, namely Markowitz's Modern Portfolio Theory (MPT), Black-Scholes Model (BSM), and Jarrow-Rudd Model (JRM). Using SET100 index and its components from Thailand's Stock Exchange as a case study, evidence shows that MPT has a weakness for intra- and inter-sector diversification due to the lack of diversity when the data distribution is the unit of analysis. If the portfolio is mix of debt and equity, MPT might perform differently; however, such an issue is beyond the scope of this paper. BSM assumes that the market is normally distributed. However, in practice the market is not normally distributed. In this study, price data of the SET contains stocks that are distributed Fréchet and Weibull. BSM has been criticized in the literature and empirical evidence in this study also echoes those criticisms over the model's assumption of normality. Finally, a review of JRM saw an improvement over MPT and BSM by using empirical distribution. However, like BSM, JRM is more applicable to markets where hedging and future contracts are available. Such a requisite is more applicable for advanced and developed markets, such as NYSE, NASDAQ, FTSE, CAC40 or NIKKEI. In emerging markets, such as SET or other markets in the ASEAN region where option contracts may not available, JRM may still be out of reach as an investment management tool. This paper proposes a fourth alternative under extreme Value Theory (EVT). Under EVT, this paper advocates four-steps process in investment risk management for stock traders: (i) use 30 trading daily sessions as the references sample $F(X)$ from which extreme values are identified; (ii) with predefined risk tolerance level under percentage confidence interval, fix a threshold value beyond which the event is classified as extreme; (iii) collect all extreme events into a separate group called $G(X)$; use the tail index calculation to verify the distribution of $G(X)$ and impute such distribution onto $F(X)$; and (iv) use the shape, location, and scale parameters under Fisher-Tippett-Gnedenko's General Extreme Value (GEV) to assess risk level or investment decision, i.e. buy or sell orders. This four-steps process may be a practical risk management tool in stock investment in emerging markets where option contracts are not available.

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Mobile Communication Devices and their Impact on Social Communication in Thailand

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ABSTRACT

This paper studies the impact of mobile communication devices on social communication. The paper focuses on the availability and use of mobile phone and tablet as tools to access the mass media, and how they impact contemporary culture in Thailand. The objective of this research is to provide quantitative tools to determine changing trend in mass communication moving from the traditional print media to electronic information transfer through mobile devices. The research intends to prove how this new means of information exchange impact both contemporary culture and social communication in Thailand. Structural data for telecommunication subscriptions and market trend was obtained through the ICT Ministry's data base. Primary data comes from a field survey. The survey is comprised of 60 randomly selected mobile device users. The methodology employed in this research consists of impact analysis modeling (IAM). Series of statistical tests were used to analyze the data. A confidence interval of 0.95 was used in all statistical tests. Laplace Trend Test (LTT). The findings show that there is an increasing trend among users to accessing the mass media through mobile devices. The Z-score LTT exceeds 1.65. The prospective impact of mobile devices on social communication was identified through Kahneman-Tversky Prospect Theory equation. Under the prospect theory, the impact of mobile communication devices on social communication exceeds 0.80. The intended contribution of this research is to introduce quantitative method in communication research through impact analysis. The impact of mobile communication device on social communication is used as a case study.

Key words:

Continuous probability, discrete probability, impact analysis, mass communication, randomness test, prospect theory, trend test

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1.0 INTRODUCTION

The *rationale* of this research is the need to verify the assertion that mobile device may be part of the mass media. The *question* addressed by this research is whether mobile device as a tool for communication impacts contemporary Thai society? If so, in what aspect has such an impact been found? This research proves that mobile device positively impacts contemporary culture in two

aspects; on the one hand, it contributes to the acquisition of knowledge through accessing information base via Internet connection and, on the other, mobile device allows more freedom of expression. The intended *contribution* of this research comes from its new findings

This research was accomplished through the use of two types of data. Primary data was obtained through field survey. The field survey was accomplished through written questionnaires. The secondary data came from the ICT Ministry's database. The database is comprised of subscription records of mobile and fixed line users from the year 2002 to 2013. The two types of subscription are summarized in Table 1.

Table 1. Mobile and Fixed Line Subscription from 2003 – 2014

| No | Year | Mobile | Fixed Line | Gap | % Δ Gap |
|----|------|---------------|--------------|---------------|---------|
| 1 | 2002 | 17,449,890.00 | - | - | - |
| 2 | 2003 | 21,616,910.00 | 6,997,401.00 | 14,619,509.00 | |
| 3 | 2004 | 26,965,548.00 | 6,979,484.00 | 19,986,064.00 | 37% |
| 4 | 2005 | 30,460,238.00 | 7,293,467.00 | 23,166,771.00 | 16% |
| 5 | 2006 | 40,125,470.00 | 7,219,893.00 | 32,905,577.00 | 42% |
| 6 | 2007 | 52,973,994.00 | 7,563,352.00 | 45,410,642.00 | 38% |
| 7 | 2008 | 61,837,164.00 | 7,394,349.00 | 54,442,815.00 | 20% |
| 8 | 2009 | 65,952,313.00 | 7,204,936.00 | 58,747,377.00 | 8% |
| 9 | 2010 | 71,726,300.00 | 6,924,844.00 | 64,801,456.00 | 10% |
| 10 | 2011 | 77,449,466.00 | 6,661,174.00 | 70,788,292.00 | 9% |
| 11 | 2012 | 85,012,411.00 | 6,377,256.00 | 78,635,155.00 | 11% |
| 12 | 2013 | 93,848,536.00 | 6,056,207.00 | 87,792,329.00 | 12% |

Source: <http://www2.nbt.go.th/TTID/>

The first objective is to determine whether is a significant increasing trend for mobile subscription in the period from 2002 to 2013. There are three general methods of proving trends. The first method is the Reverse Arrangement Trend Test (RAT). The Reverse Arrangement test (RAT) is given by:

$$Z_{RAT} = \frac{R - \left(\frac{r(r-1)}{4} \right) + 0.50}{\sqrt{\frac{(2r+5)(r-1)r}{72}}} \quad (1)$$

where r = arrival time or $r = df = n - 1$, R = reversal counts. The approach of Z_{RAT} is to use the first arrival of the event as the reference point. In subsequent observations, determine whether larger value occurs. If there is a larger event occurring, count such an event as 1. If there is a smaller event, count it as 0. Mark each count of value larger than the initial event as R_i . This method was not used because it is cumbersome to determine series of R counts.

The second method is called the Military Hand Book Trend Test (MHT). The MHT trend test method is given by:

$$\chi^2_{2r} = 2 \sum_{i=1}^r \ln \left(\frac{T_{end}}{T_i} \right) \quad (2)$$

The MHT method is based on chi-square distribution. Use the chi-square table to determine the critical value as the standard value against which the observed trend is compared. The degree of freedom (df) is defined as $df = 2r$. Recall that r is the arrival time.

$$\chi^2_{2r} = 2 \sum_{i=1}^r \ln \left(\frac{T_{end}}{T_i} \right) \quad (3)$$

The MHT method was not used in this research because it does not match the type of data distribution: $A^2 = 11.82$ and $A^{*2} = 12.85$. The data is normally distributed; therefore, MHT may not be used.

The third method is called the Laplace Trend test (LTT). The LTT method is based on normal distribution of the data. This research selects LTT as to test the trends of mobile subscription data for the period 2002-2013 because the Anderson-Darling test confirms that the data is normally distributed. The first test of the trend is to examine the year-to-year gap between mobile and fixed line subscription by using LTT. The Laplace trend test is given by:

$$Z_{Laplace} = \frac{\sqrt{12r} \left(\sum_{i=1}^r \left(T_i - \frac{T_{end}}{2} \right) \right)}{rT_{end}} \quad (4)$$

where r = degree of freedom or $df = n - 1$, T_i = arrival time of event, i.e. T_1, T_2, \dots, T_r . The result of LLT shows that $Z_{LTT} = 13.76$ compared to the null hypothesis: $H_0 : Z_{obs} < 1.65$, there is a significant increase of the gap trend in the mobile device subscription relative to fixed line subscription. This finding is also confirmed by the significant decreasing trend in fixed line users by subscription count year-by-year from 2003 to 2013: $Z_{LTT} = 32.71$ and there is a corresponding increasing trend among mobile users in the same period: $Z_{LTT} = 2.58$. In both cases, the null hypothesis was $H_0 : Z_{obs} < 1.65$ using 0.95 confidence interval.

The significant growth of mobile service subscription underscores the perceived utility of the technology and its influence on contemporary Thai citizens. There are two types of mobile device users: pre-paid and post-paid. The mobile market composition and changes over the years is given in Table 2.

Table 2. Mobile Market in Thailand for 2002-2013

| Year | Minute Usage | | Revenue Per Month | | Mobile Penetration | | Market Growth | |
|------|--------------|----------|-------------------|----------|--------------------|----------|---------------|----------|
| | Post-Paid | Pre-Paid | Post-Paid | Pre-Paid | Post-Paid | Pre-Paid | Post-Paid | Pre-Paid |
| 2002 | 447.00 | 127.00 | 1,057.00 | 209.00 | 6.67% | 20.84% | -7.12 | 18.15 |
| 2003 | 468.00 | 111.00 | 1,191.00 | 258.00 | 5.58% | 28.21% | -1.30 | 5.92 |
| 2004 | 462.00 | 105.00 | 1,140.00 | 286.00 | 6.53% | 35.26% | 2.84 | 4.94 |
| 2005 | 460.00 | 206.00 | 941.00 | 331.00 | 6.79% | 40.00% | -0.53 | 4.23 |
| 2006 | 606.00 | 221.00 | 754.00 | 245.00 | 7.94% | 53.25% | 8.02 | 9.32 |
| 2007 | 648.00 | 277.00 | 746.00 | 254.00 | 8.30% | 71.91% | -3.48 | 6.55 |
| 2008 | 539.00 | 217.00 | 643.00 | 214.00 | 9.75% | 83.26% | 6.02 | 3.15 |
| 2009 | 486.00 | 226.00 | 639.00 | 210.00 | 10.54% | 88.26% | 1.24 | 2.07 |
| 2010 | 477.00 | 233.00 | 648.00 | 210.00 | 10.78% | 88.04% | 2.01 | 3.03 |
| 2011 | 400.00 | 217.00 | 484.00 | 157.00 | 11.74% | 95.78% | 3.70 | 1.42 |
| 2012 | 375.00 | 220.00 | 454.00 | 161.00 | 14.71% | 102.83% | 6.60 | 3.07 |
| 2013 | 461.00 | 240.00 | 459.00 | 151.00 | 17.36% | 123.22% | 5.50 | 2.38 |

Source: http://www2.nbt.go.th/TTID/mobile_market/minutes_of_use/.

Using the Laplace trend test, various components of the mobile market in Thailand shows significant increasing trend from 2002 to 2013. The test result is summarized in Table 3.

Table 3. Trend Test of Mobile Market in Thailand for 2002-2013.

| | Minute Usage | | Revenue Per Month | | Mobile Penetration | | Market Growth | |
|----------------|--------------|----------|-------------------|----------|--------------------|----------|---------------|----------|
| α Level | Post-Paid | Pre-Paid | Post-Paid | Pre-Paid | Post-Paid | Pre-Paid | Post-Paid | Pre-Paid |
| Z(obs) | 6.94 | 4.18 | 33.58 | 5.42 | 6.26 | 6.23 | 6.16 | 5.99 |
| Z(0.95) | 1.65 | 1.65 | 1.65 | 1.65 | 1.65 | 1.65 | 1.65 | 1.65 |
| Conclude | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. |

Against this back ground information of the mobile market in Thailand, this research attempts to prove whether mobile device usage has any effects on contemporary culture of Thailand. If so, whether such effects (i) positively influence the increase of knowledge inventory by accessing information-base, (ii) brings positive change to contemporary Thai culture and (iii) increases the ability of people to express opinion through online posting via mobile device. These effects will be quantified into a perceived utility measurement under Kahneman-Tversky's Prospect Theory of utility. The Kahneman-Tversky equation for the prospect theory is given by:

$$U = \sum_{i=1}^n w(p_i)v(x_i) \quad (5)$$

where w = weight assigned to each variable, p_i = probability for each event, v = function that produce each event, and x_i = event outcome.

2.0 LITERATURE REVIEW

The first form of mass communication was made possible by the printing press. (Splichal, 2006, p. 41, Ramey, 2007, pp. 1-2, Galician, 2004, p. 69). Large circulation of printed materials made it unfeasible to receive feedback from readers. Newspapers, for instance, became a one-way communication medium. (Newman, 1999, Nerone, 2006, and Pace, 1997). Thompson defined mass media as '[I]nformation distribution' - a "one to many" form of communication, whereby products are mass-produced and disseminated to a great quantity of audiences. (Thompson, 1995, 26-8). The purpose of mass media may be classified into three types: (i) advocacy, (ii) entertainment, and (iii) public service announcement.

Three theories explain the influence of mass media: limited-effects theory, class-dominant theory, and culturalist theory. Limited-effects theory the media exerts limited effect on people because people select to interact with the media based on pre-existing belief or knowledge. (Chaffee *et al.*, 1985, pp. 267-96). The class-dominant theory asserts that the media projects the views of the ruling minority in society. Bennet, 1982, pp. 30-55. Lastly, the culturalist theory argues that people create new their own meanings and, thus, their own new culture, as the result of interacting with the media. (Hutchby, 2006, p. 5; Hodge and Tripp, 1986, and Palmer, 1986). The first question presented in this research is *whether mobile device has any impact on the Thai society?*

Media is the tool used to communicate with the public. Mass media consists of seven channels: prints, audio recording, cinema, radio, television, Internet, and mobile phones. The second question present in this research is *whether the Thai public considers mobile phone as part of the mass media?*

Mobile phone usage is widespread in all parts of the world. (Oksman and Rautiainen, 2003, pp. 293-308). Mobile phone is part of our daily life. (Addo, A., 2013, p. 47). In some instances, mobile phone may be used as a tool to strengthen social ties. (Johnsen, 2003, p. 161-69). In Thailand, at the end of 2013, there were 93,848,536 mobile subscribers compared with 6,056,207

fixed line subscriptions. Thailand is a country with a population of 66,720,153 people. The person-to-mobile phone subscription ratio is 1.4 mobile subscriptions per person. In contrast, the ratio for the fixed line usage is 11.02 persons per fixed line. Mobile phone technology is accessible and affordable in Thailand. The pervasive use of mobile phone in Thailand motivates this research to raise the question of whether mobile has become the 7th media in Thailand. In an attempt to determine the influence of the mobile device, this research attempts to document three impacts of mobile phone in Thailand: acquisition of new knowledge, cultural change, and freedom of expression.

3.0 DATA

There are two types of data used in this research: primary and secondary data. The primary data was generated by field survey. The instrument used to collect the data is a written questionnaire consisted of five sections: (i) demographic information, (ii) perception of mobile device as a source of information, (iii) influence of mobile device on interpersonal relationship, (iv) access to mobile device technology, and (v) impact of mobile device on contemporary culture. The secondary data came from the ICT Ministry's website where mobile and fixed line subscriptions information are opened for public access at: www2.nbtc.go.th.

3.1 Research Instrument

The response format of the questionnaire is comprised of four answer choices arranged in successive integers from 0 (lowest) to 3 (highest). The rationale for equidistance scale of four choices is motivated by (a) flexibility of data set to be classified as dichotomous and polytomous in order to engage binomial and polynomial distribution testing, and (b) pointwise (per survey question) reliability of the instrument.

The scale flexibility is obtained through the used of zero as the lowest value. This use of zero allows the data to be dichotomized into categorical data set of zero and non-zero. This scale type allows binomial distribution and polynomial distribution testing. Binomial distribution testing consists of two elements: (1) predictive probability, and (2) significance test under the Z-equation. The binomial predictive probability is given by:

$$P(X) = \frac{n!}{(n-X)!n!} p^n q^{(X-n)} \quad (6)$$

where n = sample size, and X = targeted number to be forecasted. The variable p is the probability of success (Yes = 1) which is given by the Laplace Rule of Success:

$$p = \frac{s+1}{n+2} \quad (7)$$

where s = success, and n = number of total observations. The non-zero of the scale (0,1,2,3) is 3. Therefore, $p = (3+1)/(4+2) = 4/6 = 0.6667$ and the probability of zero is $q = 1 - p = 1 - 0.6667 = 0.3333$. The expected value is $E(X) = \bar{X} = 1.50$ and the expected variance is $E(\text{var}) = 1.66$ and $S = 1.29$.

The significance test for binomial distribution of discrete data is given by the Z-equation for binary data:

$$Z_{bin} = \frac{\frac{X}{n} - p}{\sqrt{\frac{pq}{n}}} \quad (8)$$

If the threshold is 1.50 and the value of p and q are known, the test statistics for the {0-3} scale can be determined thus:

$$Z_{bin} = \frac{\frac{X}{n} - p}{\sqrt{\frac{pq}{n}}} = \frac{\frac{1.50}{60} - 0.6667}{\sqrt{\frac{0.6667(0.3333)}{60}}} = \frac{0.025 - 0.6667}{\sqrt{\frac{0.2222}{60}}} = \frac{-0.6417}{\sqrt{0.3703}} = \frac{-0.6417}{0.6086} = -1.0545$$

From the Unit Normal Distribution Table, a score of $Z = -1.0545$ has a p-value of 0.1251 or 12.51% which is well within the 95% confidence interval. The Z_{bin} test confirms that the expected threshold value of the 0-3 scale is within 0.95 confidence interval.

3.2 Instrument Reliability

The 0-3 scale consists of four answer choices. Using the 0.95 confidence interval, the reliability of each question in the instrument is determined by the expected reliability equation

$$R = \sqrt{1 - \hat{e}} \quad (9)$$

where \hat{e} (e-hat) is the expected error of an individual questionnaire which is given by:

$$\hat{e} = (df - 1)\alpha \quad (10)$$

The reliability of the *zero-embedded successive integers of four answer choice* may be determined: $\hat{e} = (df - 1)0.05 = (3 - 1)0.05 = 2(0.05)$ or $\hat{e} = 0.10$ because $df = n - 1$. With known \hat{e} , the reliability of the question may be calculated: $R = \sqrt{1 - \hat{e}} = \sqrt{1 - 0.10} = \sqrt{0.90} = 0.94867$ or approximately 0.95. The confidence interval used throughout this research is 0.95. The individual question reliability of a *zero-embedded successive integers of four answer choice* meets this 95% CI threshold.

3.3 Data Classification

There are three types of data where the dependent and independent variables may be classified: (i) quantitative, (ii) ordinal, and (iii) nominal data. The data used in this research is classified as quantitative data. Quantitative data are data which may be subject to mathematical operations. For purposes of proving the intensity of the relationship in bivariate data set: X (independent) and Y (dependent variable), the appropriate determinant is the Pearson Product Moment or Correlation Coefficient. The applicable test for significance is generally given by the t-test:

3.4 Independent Variable (X) and Independent Variable (Y)

The independent variables used in this research are comprised of three factors: (i) perception of mobile device as a source of information, (ii) influence of mobile device on interpersonal relationship, (iii) access to mobile device technology. These three factors are incorporated into the questions with the answer scale ranging from 0 (lowest) to 3 (highest).

The dependent variable Y is the impact of mobile device. The impact is comprised of the following components: (i) increase inventory of knowledge, (ii) positive change on contemporary culture, and (iii) increase personal freedom of expression. In this research, both X and Y are quantitative data.

3.5 Data Distribution Test

The data was first tested for distribution. Distribution test was achieved through the Anderson-Darling test. The Anderson-Darling test verifies whether the data is normally distributed. The AD test is given by:

$$A^2 = -n - S \quad (11)$$

where n = ample size. The required sample size for the AD test is $n > 5$, and S is the logarithm sum in the following form:

$$A^2 = \sum_{i=1}^n \frac{2i-1}{n} [\ln(\Phi(Y_i)) + \ln(1 - \Phi(Y_{n+1-i}))] \quad (12)$$

The test statistic for the AD test is given by:

$$A^{*2} = A^2 \left(1 + \frac{0.752}{n} + \frac{2.25}{n^2} \right) \quad (13)$$

The result of the AD test is summarized in Table 4.

Table 4. Summary of Anderson-Darling Test for Data Distribution

| | X_1 | X_2 | X_3 | Y_i |
|---------------------|--------|--------|--------|--------|
| A^2 (observed) | 52.24 | 53.83 | 39.38 | 54.40 |
| A^{*2} (standard) | 52.93 | 54.54 | 39.90 | 55.11 |
| Conclusion | Normal | Normal | Normal | Normal |

Legend: X_1 = Perception of mobile device as part of mass media; X_2 = Effect of mobile phone on interpersonal relationships; X_3 = Access to mobile device technology; and Y_i = impact of mobile device on (i) knowledge acquisition; (ii) contemporary culture; and (iii) freedom of expression.

A second examination of the data was the verification of randomness in the field survey. Randomness is defined as a stochastic process in which no significant trend may exist to allow predictable pattern. Most commonly used statistical test, such as the t-test requires that the data be random. For this reason, testing for randomness was accomplished in this research. The test for randomness was accomplished by the adjacent test. The adjacent test for $n > 25$ is given by:

$$L_{n>25} = 1 - \frac{\sum_{i=1}^{n-1} (x_{i+1} - x_i)^2}{2 \sum_{i=1}^n (x_i - \bar{x})^2} \quad (14)$$

For $n > 25$, equation (13) approximately follows a normal distribution with mean zero: $\bar{x} = 0$ and the variance is given by:

$$S_x^2 = \sqrt{\frac{(n-2)}{(n-1)(n+1)}} \quad (15)$$

The result of the adjacent test is summarized in Table 5.

Table 5. Summary of Adjacent Test to Verify Random Process

| $n = 60$ | X_1 | X_2 | X_3 | Y_i |
|------------------|-------------------|-------------------|-------------------|-------------------|
| L (observed) | 0.074 | 0.072 | 0.073 | 0.074 |
| L^* (standard) | $1.37 < L < 2.63$ | $1.37 < L < 2.63$ | $1.37 < L < 2.63$ | $1.37 < L < 2.63$ |
| Conclusion | Non-random | Non-random | Non-random | Non-random |

Since the data is not random, Student t-test is not the appropriate tool to use for the test of significance. With questions in the dependent variables and 9 questions, the F-test for multiple regressions is used for significance test.

The last data treatment is to verify whether there is any extreme value in the data set that would create bias by using the Grubbs test. The Grubbs test allows the detection of outlier data points within a set. (Grubbs, 1969, p. 1-21, and Stefansky, 1972, pp. 469-479). The test is also known as the *maximum normed residual test* or *extreme studentized deviate test*. This test is used only in univariate data set. The assumption is that the data comes from a normally distributed population. The hypothesis statement follows: $H_0 : G_{obs} < G_{0.95,n}$ and $H_A : G_{obs} > G_{0.95,n}$. The test statistic is given by:

$$G = \frac{N-1}{\sqrt{N}} \sqrt{\frac{t_{\alpha/(2N), N-2}^2}{N-2 + t_{\alpha/(2N), N-2}^2}} \quad (16)$$

The null hypothesis is rejected if $G_{obs} > \frac{N-1}{\sqrt{N}} \sqrt{\frac{t_{\alpha/(2N), N-2}^2}{N-2 + t_{\alpha/(2N), N-2}^2}}$. The critical for G is provided by the G-table. The general argument is stated as:

$$G = \max_{i=1, \dots, n} |Y_i - \bar{Y}| \quad (17)$$

where Y_i = individual observations, \bar{Y} = sample mean, and s = sample standard deviation.

The value of G is the largest value of the data point that deviates from the sample mean. The unit of measurement is a unit of standard deviation. The general statement is used for two-sided test. The one-sided Grubbs test for a low value is given by:

$$G = \frac{\bar{Y} - Y_{\min}}{s} \quad (18)$$

where Y_{\min} = minimum value in the sample; \bar{Y} = sample mean, and s = sample standard deviation. The one-sided Grubbs test for the high value is given by:

$$G = \frac{\bar{Y} - Y_{\max}}{s} \quad (19)$$

where Y_{\min} = minimum value in the sample, \bar{Y} = sample mean, and s = sample standard deviation. The results of the data analysis for the Grubbs test for the Y and X are summarized in Table 6.

Table 6. Summary of Grubbs Test to Verify Random Process

| $n = 60$ | X_1 | X_2 | X_3 | Y_i |
|------------------|-------------|-------------|--------------------|-------------|
| G (observed) | 1.0 – 2.91 | 1.58 – 2.99 | 0.61 – 3.69 | 1.48 – 1.73 |
| G^* (standard) | 3.19 | 3.19 | 3.19 | 3.19 |
| Conclusion | No outliers | No outliers | Outlier on min | No outliers |

This preliminary examination of the data confirms that X_i and Y_i in this survey, the public opinions were not randomized. This non-random process is came from a random process ma be explained by the fact that the population was homogeneous, i.e. everyone was mobile device or mobile phone user. Under the Grubbs test, there was no significant outliers found in the data from the field survey; thus, there was not extreme value to render the data biased. There was one survey returned with an outlier value of 0.50 in a [0-3] scale. This extreme value showed in $G(X_3)$ where the observed value is 3.69 compared to 3.19. In total there were 60 survey; each survey has 12 questions or a total of 720 questions were answer. Out of 720 counts, one count shows an extreme value. Therefore, it is dismissed as insignificant aberration.

There are 3 questions in the X variable that received a score of zero. These were Q4, Q6 and Q11. The survey contains 12 questions. The summary of this apparent extreme values are summarized in Table 7.

Table 7. Questions with Response Score of Zero

| No. | Description | Q4 | Q6 | Q11 |
|-----|-----------------------|------|------|------|
| 1 | Score = 0 | 3 | 3 | 2 |
| 2 | Score > 1 | 57 | 57 | 58 |
| 3 | s counts | 57 | 57 | 58 |
| 4 | $s + 1$ | 58 | 58 | 59 |
| 5 | $n + 2$ | 62 | 62 | 62 |
| 6 | $p = (s + 1) / n + 2$ | 0.94 | 0.94 | 0.95 |
| 7 | $q = 1 - p$ | 0.06 | 0.06 | 0.05 |

Code: Q(4): Mobile phones improves communication with others; Q(6): Mobile phone increases number of acquaintances; and Q11: mobile phone brings positive change to contemporary culture.

The probability of zero score is about 5-6% while non-zero probability is about 94-95%. This occurrence is no cause for concern about data biasness or extreme values contamination.

4.0 METHODOLOGY

The quantitative method employed in this research is based on conventional statistical tests. These test include: (i) Anderson-Darling Test to verify data distribution, (ii) Adjacency Test to verify random process in data sets, (iii) Grubbs Test for Outliers, and (iv) Laplace Trend Test. Two modeling methods are employed in this research, namely simple and multiple regression models.

Simple and multiple regression models were used to verify the relationship between the dependent and independent variables. The simple linear regression is given by:

$$Y = \beta_0 + \beta_1 X + \varepsilon \quad (20)$$

where β_0 is the Y-intercept, β_1 is the slope of the linear regression line, and ε is the forecast error. In the present case, simple linear regression was used to verify the relationship between the impact of mobile device (Y) and the public's perception of mobile device as a source of mass media (X). The decision for the hypothesis test is accept the null hypothesis if $H_0 : \beta_0 = 0$, otherwise reject if $H_A : \beta_0 \neq 0$ is true. If $H_A : \beta_0 \neq 0$ is true, the significance test follows the t_r test.

The multiple regressions were used to analyze multiple factors for the interaction between the impact of mobile device on contemporary culture (Y) and the explanatory factors: X1 = interpersonal relationship and X2 = access to mobile device technology. The multiple regression model is given by:

$$Y = \beta_0 + \beta_1 X + \beta_2 X_2 + \varepsilon \quad (21)$$

The decision rule governs the acceptance or rejection of the null hypothesis is given by $H_0 : \beta_0 + \beta_1 = 0$ and $H_0 : \beta_0 + \beta_1 = 0$. If $H_0 : \beta_0 + \beta_1 = 0$ is true and the null hypothesis is rejected, the test for significance follows:

$$F(k, N - k - 1) = \frac{R^2 / k}{1 - R^2 / N - k - 1} \quad (22)$$

where the N = number of observations; $R^2 = r(r)$; k = number of predictors and $N - k - 1$ is the degree of freedom for the F-test in multiple regression. In the present case $N = 60$ and $k = 2$; thus, $df = N - k - 1 = 60 - 2 - 1 = 57$. The F-critical value for $F(60,57)$ is 1.3952.

4.1 Sampling Method

The sampling method used in this research is *unequal probability sampling* of the Midzuno scheme (Midzuno, 1952, pp. 99-107). The Mizuno scheme for unequal probability sampling is given by:

$$P(s) = \begin{cases} \frac{\hat{X}}{X} \frac{1}{\binom{N}{n}} & \text{if } n(s) = n \\ 0 & \text{otherwise} \end{cases} \quad (23)$$

where \hat{X} is the unbiased estimation of the population total X of the size variable x , i.e. $\hat{X} = \frac{N}{n} \sum_{i \in s} X_i$ under simple random sampling. It is under this approach that the sampling for this research was undertaken. A total of 60 counts were taken from the field survey.

4.2 Sample Size

A literature review of minimum sample size requirement for field survey is 30 counts. Agresti and Franklin suggest that the minimum sample size should be 30 counts. Agresti and Franklin (2012, p. 312). The rationale is that with 30 counts, the researcher could optimize the benefits offered by the Central Limit Theorem. In subsequent studies this call for $n = 30$ was confirmed in Louangrath's n -hat method (Louangrath and Rewtrakunpaiboon, 2013, pp. 127-139) and Louangrath's n -omega method (Louangrath, 2014). This research uses 60 counts of survey. This number of sample satisfies the requirement of minimum sample size under at least three methods: n -hat, n -omega, and nonfinite population methods.

Under the n -hat method, minimum sample size is determined by

$$\hat{n} = \sqrt{n_r^M} \quad (24)$$

where $n_r^M = n_r / 2$ and $n_r = n_i^{0.99} - n_j^{0.01}$. The following terms are defined: $n_i^{0.99} = n_i / 0.99$ and $n_j^{0.01} = n_j / 0.01$. The quotient of $(n_i^{0.99} / n_j^{0.01}) = n^*$ and the initial sampling n^* is given by: $n^* = (\sigma^2 n / S^2) / E^2$ where expected error is $\hat{E} = [n - n(1 - df(\alpha))] / n$ calculated from the initial or pilot sample. Under equation (23), the minimum sample size is a constant: $\hat{n} \approx 32$.

Under n -omega method, minimum sample size is determined by:

$$n_\omega = \sqrt{\frac{\left(\frac{|n_1 - n_2|}{2}\right)^{-0.01} - \left(\frac{|n_1 - n_2|}{2}\right)^{-0.99}}{2}} \quad (25)$$

where $n_1 = Z\sigma / E$, and $n_2 = Z^2\sigma^2 / E^2$; the value of Z and E are defined as $Z = 1.65$ and $E = 0.05$ for 0.95 confidence interval.

Under the n -omega method, the minimum sample size for 0.95 confidence interval is between 30 – 40 counts. In the present case, 60 counts of had been collected. This sample size satisfies the requisite under n -hat and n -mega methods; it is also consistent with Agresti's suggestion and other writers, such as Roscoe (Roscoe, 1975, p. 163) and Abranovic (Abranovic, 1997, pp. 307-8).

The n -hat and n -omega method is consistent with the conventional minimum sample size determination in nonfinite population cases. (Montgomery, Runger and Hubele, 2001, p. 172). The non-finite population sample size is given by:

$$n = \frac{Z^2\sigma^2}{E^2} \quad (26)$$

The minimum sample size under equation (26) is 161 counts. In the present case, the population is nonfinite because the population of mobile devise is dynamic. In any given day, there may be additional subscribers and some subscribers may also drop out from the population. Under this circumstance, the population proportion method proposed by Yamane is inappropriate. (Yamane, 1967, p. 886). The Yamane method is given by:

$$n_Y = \frac{N}{1 + Ne^2} \quad (27)$$

where N = population, and $e = \alpha$ or the error level. This method for calculating minimum sample size was not used because (i) the population size is not known and (ii) the method assumes that the population is normally distributed; such an assumption is improper without conducting an initial population study to verify population distribution type. Minimum sample size determination by various methods is summarized in Table 8.

Table 8. Minimum Sample Size Determination by Various Methods

| Method | Population | Initial Sample | Bootstrap | Sample Size |
|--------------------------------|------------|----------------|-----------|-------------|
| $\hat{n} = \sqrt{n_r^M}$ | Non-finite | Yes | Yes | 30 |
| $n_\omega = \sqrt{\omega / 2}$ | Non-finite | Yes | Yes | 30 |
| $n = Z^2\sigma^2 / E^2$ | Non-finite | Yes | Yes | 161 |

| | | | | |
|------------------------|--------|----|----|-----|
| $n_Y = N / (1 + Ne^2)$ | Finite | No | No | 400 |
|------------------------|--------|----|----|-----|

5.0 FINDINGS AND DISCUSSION

The general finding shows that the public does not see mobile device as part of the mass media. This finding comes from the simple regression analysis between the impact of mobile device on contemporary culture (Y) and the public perception of mobile device as part of the mass media.

An additional finding verifies that mobile positively impact contemporary culture. This impact was brought about by the change in interpersonal relationship and the availability of mobile device technology. This relationship was revealed through multiple regression analysis between the impact of mobile device on contemporary culture (Y) and two explanatory factors: (i) interpersonal relations (X1) and (ii) accessibility to mobile device technology (X2). The finding of simple regression for each Y element and X element is summarized in Table 7.

Table 9. Impact of Mobile Phone on Contemporary Thai Society

| <i>Dependent Variable (Y)</i> | | <i>Indication of T-test Significance Level: CI = 0.95</i> | | | | | | | | |
|-------------------------------|----------------|-----------------------------------------------------------|----|-----|----|-----|-----|----|-----|-----|
| Questions | Y _i | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 |
| Q10 | Knowledge | - | - | - | - | 2.5 | - | - | 4.1 | |
| Q11 | Culture | - | - | 1.9 | - | 3.3 | - | - | 2.6 | 2.6 |
| Q12 | Freedom | - | - | 2.5 | - | 2.2 | 2.4 | - | 2.9 | |
| | | <i>Independent variable (X)</i> | | | | | | | | |

Code key:

- Q1:** Mobile device will soon replace printed materials
- Q2:** Mobile device is part of mass media
- Q3:** Communication via mobile device is better than face-to-face
- Q4:** Mobile phone improves communication
- Q5:** Mobile phone is important to daily life
- Q6:** Mobile device increase number of acquaintances
- Q7:** All my acquaintances have mobile phones
- Q8:** Mobile phone must have many functions
- Q9:** Use mobile device to access the Internet

Dependent variables: Q1, Q2, Q4 and Q7 have no significant bearing on the impact of mobile device usage, i.e. acquisition of knowledge, impact in culture and increase personal freedom of expression. The general perception towards mobile device as a potential replacement or rival to printed media (Q1) is perceptively insignificant. Secondly, the public does not see that mobile device is part of the mass media. Thirdly, there is no significant finding that mobile phone improves communication skills. Finally, the access to mobile technology, i.e. mobile phone, is considered a common place and does not have any significant impact on knowledge acquisition, change contemporary culture of increase personal freedom of expression. Although these three independent variables: Q1, Q2, Q4 and Q7 do not show significant impact on the dependent variables: Q10, Q11 and Q12, this finding also provides important lesson about the public perception on mobile phone in Thailand.

5.1 Simple Regression Analysis

There are eight questions in the survey acting as independent variable (X). These eight questions are grouped into three groups: (i) perception of mobile device as an element of the mass media, (ii) mobile device as a tool to improve interpersonal relationships, and (iii) access to mobile device technology. These independent variables are regress on one category of Y called impact. The

impact of the use of mobile device is comprised of (a) increase knowledge acquisition, (b) positively impacting contemporary culture and (c) increase in person freedom of expression.

5.1.1 Mobile Device Impact on Knowledge Acquisition

There is a general perception that the use of mobile device contributes to the acquisition of new knowledge. This perception is explained by two factors: (i) the belief that mobile device is important in a person's daily life, and (ii) the mobile device must have many features. The two simple regression equations produced through this single factor analysis are: $Y_{(5)} = 1.33 + 0.40X$ with a t-score of 2.47 and $Y_{(8)} = -0.009 + 0.84X$. People considered mobile device important in their daily life and they believe that mobile phone should have many features.

5.1.2 Mobile Device Impact on Contemporary Culture

There are four instances where single regression modeling shows that mobile device has an impact on contemporary culture. This impact comes from the belief that communication through mobile phone is better than through face-to-face communication. This relationship between culture and communication effectiveness is captured in the following linear regression equation: $Y_{(3)} = 1.57 + 0.22X$ with the t-score of 1.85.

The second cultural impact by mobile device is seen through the perception of the importance of mobile phone in the person's daily life. The simple regression equation expressing this relationship is given by: $Y_{(5)} = 0.37 + 0.56X$ with the significance level of $t = 3.30$.

The third impact of mobile phone on contemporary culture is seen through the user's desire for many features in the mobile phone. The relationships between these two variables are expressed in the following linear regression equation: $Y_{(8)} = 0.09 + 0.61X$ where the significance test shows a t-score of $t = 2.56$. In all impact factor analysis, users consistently place significance importance on the features offered by the device.

The fourth impact under simple regression analysis is explained by the use of mobile device to access the Internet. The simple regression model is given by: $Y_9 = 0.43 + 0.52X$ with the significance level of $t = 2.63$. Mobile device has a positive impact on contemporary culture; this impact was explained by the use of mobile device for Internet access.

5.1.3 Mobile Device Impact on Personal Freedom of Expression

The fourth category of impact is the expression of personal freedom through the use of mobile device. There are four specific findings under this category of impact. The impact was shown through four explanatory factors under simple regression analysis. These factors are Q3, Q5, Q6, and Q8. The first simple linear regression model is given by: $Y_3 = 1.67 + 0.30X$ with the significance level of $t = 2.52$. This model explains that without mobile phone, the Thai public has perceptible freedom of expression at 1.67; however, with the availability of mobile device, this freedom is effect by 0.30 time each unit of measurement for mobile device. The public perception is that mobile device has a positive impact on personal freedom of expression.

The second finding comes from Q5 (importance of mobile phone in daily life). The simple linear regression equation captured the relationship between Q5 and freedom of expression (Y) is given by: $Y_5 = 0.96 + 0.42X$ with the significance level of $t = 2.23$. There is a latent meaning in this finding: freedom of expression is important to the daily life of the Thai public. This finding is a novel finding because this research in the impact of mobile device has produced a measurement of how the Thai public perceives personal freedom. The importance of freedom of expression is expressed through the use of mobile device.

The third finding for simple regression of the impact of mobile device on the freedom of expression comes from Q6 (increase number of acquaintances through the use of mobile phone). The simple regression model is given by: $Y_6 = 1.44 + 0.30X$ with the significance level of $t = 2.35$.

It means that with the use of mobile phone, there is a positive impact on the increase of the number of acquaintances by a factor of 0.30 times. There explained factor is “freedom of expression;” therefore, this finding suggests that mobile device allows the public to be more self-expressive through the increase in personal network. The intensity of this increase in personal network is by a factor of 0.30 times a bare condition without mobile device.

The fourth finding is the positive impact on the freedom of expression comes from Q8 (multi-features and function of the mobile device). These functions allow the users to communicate and access the Internet. The simple regression model which captures this relationship is given by: $Y_8 = 0.02 + 0.71X$. The significance level is $t = 2.86$. Without multiple functions, i.e. $X_{(Q8)} = 0$, the expression of personal freedom is 0.02 in value with a t-critical value of $t = 0.03$ (statistically insignificant). The features defined in the survey include: chat, Internet access, and email. These three elements allow the public to engage in self expression. Their presence contributes to an increase of freedom of expression by a factor of 0.71 times.

5.2 Multiple Regression Analysis

In multiple linear regression model in the form of $Y = \beta_0 + \beta_1X + \beta_2X_2 + \varepsilon$, data analysis shows that the impact of mobile device on contemporary culture (Y) is explained by interpersonal relationship (X1) and access to technology (X2) is given as: $Y = -0.57 + 0.37X_1 + 0.68X_2$. The test of significance shows that $t_{X_2} = 2.46$ and $t_{X_2} = 2.82$ compared to the standard value of 1.64. Thus, the null hypothesis that $H_0 : \beta_0 + \beta_1 = 0$ is rejected because $\beta_0 + \beta_1 = 2.46 + 2.82 = 5.28$ or that $\beta_0 + \beta_1 \neq 0$. The relationship between X and Y under multiple regression analysis is summarized in Table 9 according to the level of statistical significance.

Table 10. Factor Combinations in Multiple Regression Model

| <i>Dependent Variable (Y)</i> | | <i>Indication of T-test Significance Level: CI = 0.95</i> | | | | | | | | |
|-------------------------------|-----------|-----------------------------------------------------------|----|----------|----|----------|----|----|----|----|
| Questions | Y_i | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 |
| Q10 = k | Knowledge | | | | | k | | | k | |
| Q11 = c | Culture | | | c1 c3 | | c1 c2 | | | c2 | c3 |
| Q12 = f | Freedom | | | f | | | f | | f | |
| | | <i>Independent variable (X)</i> | | | | | | | | |

5.2.1 Mobile Device Impact on Knowledge Acquisition

The combination of Q5 (importance of mobile phone in daily life) and Q8 (multiple features in mobile phone) do not contribute to significant impact in knowledge acquisition. This factor combination produces the following multiple linear regression equation: $Y_{(10,5,7)} = -0.29 + 0.22X_1 + 0.74X_2$. The significance level for $X_1 = Q5 = 1.37$ and $X_2 = Q8 = 3.46$. This factor combination failed significance test. This finding shows that when each factor is treated alone in simple regression model, each passes the t-test, but when combined one of the factors (Q5) failed. It means that knowledge acquisition via mobile device depends more on features or functions offered by the device than personal perception of how important is the device.

5.2.2 Mobile Device Impact on Contemporary Culture

In simple regression analysis, there are four factors that show significant explanatory power to mobile device's impact on culture. These factors were: Q3, Q5, Q8 and Q9. In combination, the following multiple regression model was obtained:

$Y_{(3,5,8,9)} = -0.51 + 0.15X_1 + 0.42X_2 + 0.23X_3 + 0.16X_4$. Among the four factors combined, only X_2 still passes significance test with $t_{Q5} = 2.21$. The remaining factors show t-value less than 1.64.

Through two-factors combination, the models passed t-test. These combinations include: (Q3, Q5), (Q5, Q8) and (Q3, Q9). The first combination (Q5, Q8) is given as: $Y_{(3,5)} = Y = -0.51 + 0.47X_1 + 0.4X_2$ where the t-value for Q5 is 2.60 and for Q8 is 1.65. This means that the positive impact that mobile device has on contemporary culture comes from the perceived importance of the mobile device in one's daily life (Q5) and the features offered by the mobile device.

The second combination of the multiple regression consists of Q3 (Communication via mobile device is better than face-to-face) and Q9 (Use mobile device to access the Internet). The multiple regression equation produced by this combination is $Y_{(3,9)} = Y = -0.29 + 0.19X_1 + 0.49X_2$. The levels of significance for the two independent variables are 1.69 and 2.50 respectively. This means that there is a significant perception among the public that mobile device has a positive impact on contemporary culture because communicating through mobile device is better than face-to-face communication and Internet access.

5.2.3 Mobile Device Impact on Personal Freedom of Expression

One of the impact measurements in this study is the impact of mobile device on the expression of personal freedom. Simple regression analysis shows that factors: Q3, Q5, Q6 and Q8 have significant contribution to the increase of expression of personal freedom. The combination of these factors in multiple regression produces the following equation: $Y_{(3,5,6,8)} = -0.48 + 0.22X_1 + 0.15X_2 + 0.22X_3 + 0.50X_4$. In this multiple regression model, factor Q5 fails to produce significant t-score. Only Q3, Q6 and Q8 produces t-score higher than 1.64. The t-score for these three factors are 1.88, 1.74 and 1.96 respectively. Factor Q5 was removed and a new regression equation was obtained: $Y_{(3,6,8)} = -0.33 + 0.22X_1 + 0.25X_2 + 0.57X_3$. The F-test statistic for multiple regression is given in Table 9. This result leads to the conclusion that the increase in the expression of personal freedom through mobile device usage came from (i) the belief that communication via mobile device is better than face-to-face, (ii) the use of mobile device increases number of acquaintances, and (iii) in order to achieve (i) and (ii) the mobile device must have many features.

Table 11. F-Test Statistics for Multiple Regression: $n = 60$

| Multiple Reg. | R^2 | K | R^2 / K | $1 - R^2$ | $N - K - 1$ | $\frac{1 - R^2}{N - K - 1}$ | $F(obs)$ |
|---------------|-------|-----|-----------|-----------|-------------|-----------------------------|----------|
| Y(5,8) | 0.25 | 2 | 0.13 | 0.75 | 57 | 0.01 | 9.50 |
| Y(3,5) | 0.20 | 2 | 0.10 | 0.80 | 57 | 0.01 | 7.13 |
| Y(5,8) | 0.20 | 2 | 0.10 | 0.80 | 57 | 0.01 | 7.13 |
| Y(3,9) | 0.15 | 2 | 0.08 | 0.85 | 57 | 0.01 | 5.03 |
| Y(3,6,8) | 0.24 | 3 | 0.08 | 0.76 | 56 | 0.01 | 5.89 |

The critical F-value for two factors is $F(2,57) = 19.48$ and for three factors is $F(3,56) = 8.57$. The findings of observed F-values in table 9 could not reject the null hypothesis. However, the individual t-score for each factor in the model would have passed the t-critical value.

6.0 CONTRIBUTION OF THE RESEARCH

This research has made several contributions to the field of mass communication and the measurement of such impact on contemporary society. Firstly, the research questions the notion that mobile device is part of the mass media; at least, this is not true in Thailand. This belief is

evidenced through the use of mobile device as a medium for marketing campaigns, i.e. advertisement via mobile phone SMS (mobile marketing). However, a sample of public opinion in this survey shows that the Thai public still does not perceive that mobile device is part of the mass media. This finding implies that as long as this perception does not change, mobile marketing in Thailand is a futile effort.

Secondly, the quantitative method in this research allows us to measure the utility of mobile device as an impact indicator on contemporary society. This impact-utility is made possible through the use of the prospect theory. Under the Kahneman-Tversky's theory of prospective utility, this research shows that mobile device or mobile phone technology has positively impacted the Thai society: 0.43 in knowledge acquisition, 0.34 in contemporary culture, and 0.37 in freedom of expression. This finding is summarized in table 12.

Table 12. Utility Measurement under Kahneman-Tversky Prospect theory

| $U = \sum_{i=1}^n w(p_i)v(x_i)$ | Knowledge | Culture | Freedom |
|---------------------------------|-----------|---------|---------|
| Q10 | 0.43 | - | - |
| Q11 | - | 0.34 | - |
| Q12 | - | - | 0.37 |

Note: $w = 0.30$ equal weight among three factors: knowledge, culture and freedom of expression; $p_i = s + 1 / N + 2$; $v = \beta_0 + \beta_1 X_i$ where v is the simple regression model and X_i is the score for individual survey-question: x_i .

This research is a contribution in the current literature in quantitative methods in communication research. This research employs primary and secondary data to accomplish its objective. Primary data is used as part of background information and the primary data is used for proving specific research question. The use of secondary data as an introduction to the subject matters helps put the literature review in perspective.

7.0 CONCLUSION

The public in this survey does not see mobile device as part of the mass media. Mobile device impacts the Thai society. This research measures these impacts in three aspects, namely (i) knowledge acquisition, (ii) positive contribution to contemporary culture, and (iii) freedom of expression through the use of mobile device. This research is an exploratory research. As such, this research may serve as a catalyst for future studies on this subject.

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APPENDIX 1

L Statistic

The critical value of L at various significance levels. Lower bound = a and upper bound = b .
Source: Hart, B.I. (1942). "Significance Level for the Mean Square Successive Difference to the Variance." *Annals of Mathematical Statistics*, **13**: 445-7.

| | | Significance Level: α | | |
|-----------|------|------------------------------|------|------|
| Two-sided | | 0.10 | 0.02 | |
| One-sided | | 0.05 | 0.01 | |
| n | a | b | a | b |
| 4 | 0.78 | 3.22 | 0.63 | 3.37 |
| 5 | 0.82 | 3.18 | 0.54 | 3.46 |
| 6 | 0.89 | 3.11 | 0.56 | 3.44 |
| 7 | 0.94 | 3.06 | 0.61 | 3.39 |
| 8 | 0.98 | 3.02 | 0.66 | 3.34 |
| 9 | 1.02 | 2.98 | 0.71 | 3.29 |
| 10 | 1.06 | 2.94 | 0.75 | 3.25 |
| 11 | 1.10 | 2.90 | 0.79 | 3.21 |
| 12 | 1.13 | 2.87 | 0.83 | 3.17 |
| 15 | 1.21 | 2.79 | 0.92 | 3.08 |
| 20 | 1.30 | 2.70 | 1.04 | 2.98 |
| 25 | 1.37 | 2.63 | 1.13 | 2.87 |

APPENDIX 2

Grubbs Test

Grubbs test for single outlier using mean and SD. Test value = $|X - \bar{X}| / s$. Grubbs, Frank E. (1950).

Sample criteria for testing outlying observations. Annals of Mathematical Statistics, Vol. 21, pp. 27-58.

| <i>Df = n - 1</i> | <i>Significance Level</i> | |
|-------------------|---------------------------|-----------|
| | 5% | 1% |
| 2 | 1.15 | 1.15 |
| 3 | 1.48 | 1.50 |
| 4 | 1.71 | 1.76 |
| 5 | 1.89 | 1.97 |
| 6 | 2.02 | 2.14 |
| 7 | 2.13 | 2.27 |
| 8 | 2.20 | 2.39 |
| 9 | 2.29 | 2.48 |
| 10 | 2.36 | 2.56 |
| 11 | 2.41 | 2.64 |
| 12 | 2.46 | 2.70 |
| 13 | 2.51 | 2.76 |
| 14 | 2.55 | 2.81 |
| 15 | 2.59 | 2.85 |
| 16 | 2.62 | 2.89 |
| 17 | 2.65 | 2.93 |
| 18 | 2.68 | 2.97 |
| 19 | 2.71 | 3.00 |
| 20 | 2.73 | 3.03 |
| 30 | 2.92 | 3.26 |
| 40 | 3.05 | 3.39 |
| 50 | 3.14 | 3.49 |
| 100 | 3.38 | 3.75 |

Using Financial Instates to Analyze the Effects of Multiple Borrowings on SMEs Financial Performance in Tanzania

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ABSTRACT

This study assessed the effects of multiple borrowing on entrepreneur's business performance in Iringa Municipality using financial statements collected from 102 SMEs. To analyse the data on the influence of multiple borrowing on financial performance, ratio analysis and paired sample t-test were used. The ratio analysis was divided into four categories: liquidity, profitability, efficiency and leverage. The empirical results indicate variations on the level of influence. In case of liquidity ratios, empirical results indicate that multiple borrowings have significant positive influence on current and quick ratios. For profitability, the multiple borrowings have significant positive influence on all three out of four (i.e. gross profit ratio, net profit ratio, and return on equity). Likewise, the empirical results show that multiple borrowings have significant positive influence on all indicators of efficiency and leverage ratios. The findings suggest that despite the challenges of multiple borrowings, the approach can be used to improve financial performance of SMEs. However, for that to be achieved then it is necessary to control the risks of multiple borrowings through information sharing among MFIs, introduction of flexible financial services, financial education for microfinance clients, and introduction of friendly financial statement framework for SME.

Key words: SMEs, MFIs, multiple borrowings, SMEs' financial performance, ratio analysis, financial statements

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1.0 INTRODUCTION

A number of empirical studies find that small and medium enterprises (SMEs) operators frequently choose to borrow from multiple lenders to finance their business investments. In this study, SMEs is defined based on capital investment to include all small and medium enterprises with capital investment of up to Tanzania shillings 200,000,000. Estimates of the incidence of multiple borrowing vary across countries. For example, based on survey involving microfinance clients in Iringa Municipality in Tanzania, Mpogole *et al.* (2012), Chalu and Lubawa (2014), reported that over 65 percent of the clients had at least two loans from Microfinance Institutions (MFIs) at the same time while 33 percent had three or more loans contracts with different MFIs at the same time. Examining microfinance markets in Nicaragua, Morocco and Bosnia-Herzegovina, Chen *et al.* (2010) report incidences of multiple borrowing between 20 and 40 percent of active borrowers. Boiwa (2014) found significant relationship between loan repayment and existence of multiple borrowing in Kenya. In Bangladesh, a study estimated that 15 percent of all MFIs borrowers took loans from more than one MFI back in 1990 (de Aghion *et al.*, 2005). In Ghana, multiple borrowing has been mentioned as a source of over-indebtedness (ProCredit, 2009), while in Peru, over 20 percent of microfinance clients found to have loans from more than one institution (Copeme Microfinanzas, 2010). In India, Krishnaswamy (2007) estimates that in 17 MFIs operate, the incidence of multiple borrowing is about seven percent. These few studies suggest the existence of multiple borrowing in microfinance market. Schicks and Rosenberg (2011) point out that multiple borrowing is increasingly common, especially in more mature credit markets.

In practices, SMEs' operators tend to borrow from multiple credit suppliers or different relatives and friends concentrated in the same geographical business area or not. They tend to differentiate their allocation of borrowing in the sense that they do not obtain equivalent amount of credits from multiple lenders, but rather they systematically borrow more from some of the lenders being a MFI or relative or friend. Depending on data source, multiple borrowing refers to households that borrow from multiple MFIs or to households that borrow from MFIs as well as other sources like relatives, or friends (Mpogole *et al.*, 2012). SMEs are known to borrow from formal sources of credit like MFIs or other commercial banks as well as informal sources of credit like relatives, friends or neighbours. However, borrowing from informal sources of credits has got some challenges such as flexibility in loan repayment obligations and mostly no interest is charged. The amount of credit from these sources is usually not in SMEs books of accounts. Always data from these sources of credit are likely to provide limited information. Data from formal sources of credit, will obvious be available in the financial statements, and the size of loan and timing of repayment obligations are considered to be binding by SMEs.

However, for the purpose of this study, multiple borrowing refers to SMEs that borrow from multiple MFIs simultaneously and excluding other sources of credit. The prevalence of multiple borrowing in the microfinance industry is equivalent to assuming that the market cannot share information on customers they serve. The SMEs financing decision by acquiring multiple borrowing is not an amazing decision in business, rather it is a kind of innovation to boost the capital growth if the loans taken could be used solely for business purpose intended. The study is therefore guided by the major assumption that a well-planned multiple borrowing may increase debt financing and facilitate availability of funds for business opportunities arises. The study argues that therefore the presence of multiple borrowing to SMEs may improve the performance.

1.1 Causes and Consequences of Multiple Borrowing

The literature suggests a number of reasons, which have driven SMEs into multiple borrowings: first, a mismatch between the size of the loan and the business needs. In order to obtain the missing capital, SMEs operators might find it convenient to hide the real level of indebtedness and ask for additional loans at different MFIs (Jain, 2010; Diaz *et al.*, 2011; Mpogole *et al.*, 2012). A second potential cause is ex-post i.e. that is after the loan is taken and invested; some unexpected negative shocks can hurt borrowers and their businesses. This can make it impossible for them to repay the loan. Thus, borrowers might decide to take a second loan in order to repay the first loan. But this consequently increase their level of indebtedness (McIntosh *et al.*, 2005; McIntosh and Wydick,

2005; de Janvry *et al.*, 2008). A third potential cause is in case of default, the client can take out a second loan to repay an earlier loan or simply start over after the first MFIs refuses to advance another loan due to a tarnished credit history. Interest rates may also vary across the sector, encouraging client to go to a second microfinance lender (Jain, 2010). This only occurs in the presence of information asymmetry about client indebtedness (Jain, 2010). According to Chijoriga and Cassimon (1999), information asymmetry is one of the major SMEs problems. Other possible explanations for multiple borrowing have more to do with limitations inherent to the banks which limit access of SMEs to bank loans or fail to offer loan according to SMEs requirements. Carletti *et al.* (2007) argues that if a bank is unable to achieve a satisfactory level of diversification for its loan portfolio, then the bank may deliberately decrease the size of its loans in order to issue a larger number of smaller sized loans. These loans are unsatisfactory, thus drive SMEs into multiple loans. Other studies from Uganda (McIntosh *et al.*, 2005) and India (Morduch *et al.*, 2003; Venkata and Yamini, 2010) show that continuity, convenience; flexibility and reliability of access to financial services are considered reasons that drive the poor into multiple borrowing.

Advocates of multiple borrowing have revealed that the tendency can have non-financial effects too as follows; *Borrowers are less dependent on single MFI*: It is believed that one of the underlying premises of microfinance is that borrowers repay their loans in order to sustain a relationship that allows them to get another, often larger, loans (Chen *et al.*, 2010). This delicate relationship between lender and borrower can gradually be undermined as ever-higher levels of multiple borrowing take hold in a crowded market. Borrower can default with one MFI whether by choice or out of sheer necessity and retain their borrowing relationship with other MFIs. *Borrowers can borrow larger total amounts than before*: With more choices, it is expected that borrowers will have the option to increase their total borrowings. Many MFIs, especially in group – based lending, keep their loan sizes small expecting that their borrowers will be able to meet their full borrowing needs from additional sources (Chen *et al.*, 2010). This tacit loan syndication lowers a MFIs exposure to any single borrower and means borrowers have access to additional liquidity from which to repay their various loans. In this way, multiple borrowing can be beneficial to borrowers and the overall market (Chen *et al.*, 2010).

However, while the existing literatures acknowledge the presence of multiple borrowing and explanatory factors, when it comes to the consequences the literature are mixed. For example, Krishnaswamy (2007) finds that there is no difference in performance between multiple borrowers and single borrowers in terms of repayment record. Mpogole *et al.* (2012) claims that multiple loans adversely affect the loan repayment and eventually its financial performance. On the other hand, Chaudhury and Matin (2002) suggest that households borrowing from more than one MFI are observed to have a higher likelihood of irregular payment. Chalu and Lubawa (2014) suggested that multiple borrowing could lead to entrepreneur's business performance if loans taken could have been used solely for intended purpose and invested in business opportunities. Lubawa and Louangrath (2016) suggested that multiple loans has contributed to the movement of firms migrant from the Altman's Z score "safe zone" to the "gray zone" financial health of SMEs firms in Tanzania. On the effects of multiple borrowing on income levels of clients, Boiwa (2014) noted that the MFIs clients with multiple borrowing were able to increase their income, which had positive impact on other factors of daily life. In Ghana, Alnaa (2013) finds that multiple loans have a positive impact on beneficiaries' household consumption expenditure and by extension poverty reduction.

Scanty literature basing on primary data, suggests the following effects of multiple borrowing; over-indebtedness (Maurer, Klaus & Justyna Pytkowska, 2010; Wisniwski, 2010; Engel *et al.*, 2014), poor loan repayment practices (Mpogole *et al.*, 2012; Afroze *et al.*, 2014), and consequently default on loans that might lead to financing cut-off and without access to funds, business will stop growing or even go bankrupt. Other studies have also found multiple borrowing may results into increase incidences of over-indebtedness and consequently default on loans, and collapse of the business (Gwendolyn, 2001; Vogelgesang, 2003). In general, these studies have shown that lack of control and discipline in multiple borrowing can lead to over-indebtedness where

a borrower takes more loans than she or he can repay. As a result, when loans are not paid as scheduled, financing is cut off and without access to funds, and SME will stop growing or even go bankrupt. Bartocha (2010) suggested that if not well managed, multiple borrowing could become a problematic to firm's financial performance and that reflect lack of financial discipline.

Iringa Municipality has many MFIs that give loans to borrowers. The majority of these MFIs were started when the government of Tanzania developed the National Microfinance Policy in line with the overall financial reforms initiated in 1991. Micro credits that started as a result of the microfinance policy include; Promotion of Rural Initiative and Development Enterprises Tanzania (PRIDE Tz), FINCA, Mama Bahati Foundation (MBF), Bayport, Building Resources Across Community – Tanzania (BRAC-Tanzania), Small Industries Development Organization (SIDO), and several Savings and Credit Cooperative Societies (SACCOS). In this case, clients have freedom to choose from among the many MFIs to apply for loans.

It is believed that the microfinance industry in Iringa Municipality recently has been growing at the unprecedented rates over the recent years (Mpogole *et al.*, 2012). This growth has been driven by increasing competent and confident MFIs with a social mission to increase outreach to the poor and the unbanked. It is also believed that the increment has caused a great competition among the MFIs available at Municipality (Mpogole *et al.*, 2012). Competition is increasingly a cause for concern in microcredit markets at Municipality. A growing number of institutions enter the market, motivated by goals spanning from poverty reduction to profit maximization. This competition is a positive phenomenon, because on the other hand has enabled microfinance clients to have a wider choice of services as from which MFIs they take a loan. Mpogole *et al.*, 2012 has shown that the prevalence of multiple borrowing at Iringa was very high, over 70% of the 250 microfinance, clients interviewed had at least two loans from different MFIs at the same time and consequence a borrower is associated with poor loan repayment schedules. Although these findings have obtained from different environments, but their important are also directly speak to Iringa environment too.

However, multiple borrowing should not be condemned or discouraged as a harmful behaviour. This is because there are yet others who managed multiple loans and make successfully of their businesses. Some evidence show that multiple borrowing may even is associated with better repayment rates in some environments (Krishnaswamy, 2007). Other benefits of multiple borrowing include; borrowers' less dependent on a single MFI and borrowing of larger amounts than before that lead to business growth (Chen *et al.*, 2010).

It is suggested that the tremendous growth of microfinance industry is expected to be one of the best alternative sources of capital to most SMEs operators and also as a means of improving their business performance. Yunus (1984) argued that the availability of credit to small business and low income households could greatly enhance their economic strength and eventually break the vicious circle of low income – low saving – low investment – low income. Growth of MFIs in Iringa has led to competition among existing credit suppliers (Mpogole *et al.*, 2012). As such make them reluctant to share information about the fundamentals of their debtors due to the lack of well-functioning credit information system (Chalu and Lubawa, 2014), and puts pressure on them to innovate credit prices and drive costs down, by considering that a customer is a foundation of a business and ensures its existence (Drucker, 1985).

Empirical studies conducted in this area used different techniques for data analysis. For instance, Chalu and Lubawa (2014) used descriptive analysis to study the primary data on the perceptions of SMEs' operators on the effects of multiple borrowing on business performance. Mpogole *et al.* (2012) used descriptive and logistic regression analysis to study the primary data on the effects of multiple borrowing on loan repayment. The results for these studies are based on perceptions of SMEs owners. None of these studies has used financial records to arise that effect. As such apart from findings, this is the case, the extent literature conducted so far. The present study used ratio analysis and paired sample t-test to study secondary financial data to analyse the effects of multiple borrowing on SMEs financial performance by comparing when an SME had single loan in previous financial year and then the same SME acquired multiple loans on the

following financial year from multiple MFIs simultaneously. Basically the objective of this study is to assess whether financial statements data can help us to understand the effect of multiple borrowing on SMEs performance. This approach we consider to be more appropriate because SMEs becomes a unit of analysis.

This study therefore attempt to cover the that knowledge gap by focusing on the financial statement, which is likely to be used to compare the performance of a SME at different situation, hence being consistent with financial ratio analysis which is one approach of measuring and monitoring financial performance. According to Sørensen (2012), the ratio analysis drawn on the contents of the financial statements can be used to show how business venture earn money (profitability), meets short-term obligations (liquidity), productivity use of assets (efficiency) as well as manage long-term debt (leverage). To address, the main objectives for the study were; to assess the extent do multiple borrowings influence liquidity, profitability, efficiency and leverage of SMEs.

2.0 LITERATURE REVIEW AND HYPOTHESIS STATEMENTS

2.1 SMEs and Financial Performance Indicators

The study reviews the relationships between multiple borrowings and the SMEs financial performance. Performance measurements in SMEs is a subject which has been covered by a number of studies (Brouther and Nakos, 2004; Chong, 2008; Oweseni and Adeyeye, 2012; Phillips, Tan-Tsu and Shanka (2012), Torugsa, O'Donohue and Hecker, (2012). These studies have different perspectives on the performance measures. For example, Oweseni and Adeyeye (2012) consider SMEs performance as a degree of achievement of organizational goals. This perspective defines performance in broad aspect to include both financial and non-financial performance measures. The broad perspective is supported by Phillips *et al.* (2012), who argues that broad perspective of performance measures is necessary for effective strategic management. Phillips and others provide three types of measures which include; resource input measures (e.g. employee skills and organizational commitment); behavioural measures (e.g. operational process and compliance to procedures) as well as outcome measures (e.g. sales, profit, customer satisfaction and customer loyalty). Phillips and others as well as Oweseni and Adeyeye (2012) used both financial and non-financial performance measures and found that financial measures are used more than non-financial measures. This is contrary to Chong (2008) who found that owner-managers of SMEs tend to use combined approach by using both financial and non-financial performance measures. In this study, we use financial measures for three reasons. First, while non-financial performances are relevant, but they may be influenced more by other variables than multiple borrowings. Second, multiple borrowings has financial implications as such using financial measures can help us detect the financial impact of multiple borrowing. Lastly, financial measures are being accepted by various studies as good indicators of performance (Boardman and Vining, 1989; Commmander, Fan and Schaffer, 1996).

In accounting, financial performance of the organization is usually assessed through financial statement analysis (Palepu *et al.*, 2013). As argued by Palepu *et al.* (2013), that financial statement summarizes economic consequences of business activities of the organization. These financial statements are constructed from entity's activities in accordance with generally accepted accounting principles (GAA), or international financial reporting standards (IFRS). In case of SMEs, there are special accounting standards for SMEs (IASC Foundation, 2009) which set out a stand-alone set of principles and disclosures for SMEs to meet the financial reporting needs and to maintain easy and accurate economic decision making by a broad range of resource providers and other users, such as non-manager owners, lenders, vendors, and other creditors, customers, and employees (Pacter, 2009).

These standards prescribe the financial statements which have to be produced by SMEs. Financial performance can be measured using return on equity, solvency, sales growth, liquidity and profitability (Piotroski, 2002; Sørensen, 2012). This approach will allow usage of complementary

measures to access financial performance because using only one approach may limit the differentiation between good performance and bad performance (Piotroski, 2002).

Developing and running the business requires cash for short-term obligations as well as long-term Sørensen (2012). It is therefore particularly important for the business developer to continually assess whether the growth of the business is maintained through earnings or if further external capital is required. If external capital is needed, should it be single loan or multiple loans. The question of source of the finance for SMEs or any business venture requires the financial plan (Sørensen, 2012). Therefore, it is expected that SME taking multiple loans is part of their financial plan, and expected to yield positive results. According to Saccurato (1994) and Chittenden (1998), SMEs in emerging markets tend to rely heavily on own financing, trade credit and short term bank loans to finance their operations. However, in practices, it is not commonly for SMEs operators to have formal finance plan (formalized and written out), their plans and records for daily activities and future activities sometimes went unrecorded. Even though SMEs are getting problem or there are difficulties facing SMEs to prepare financial statements, number of efforts have been done to help SMEs. For example, efforts by the international accounting standard board (IASB), with IFRS for SMEs, American Institute of Certified Public Accounts (AICPA), and so on have helped to provide accounting framework to enable SME prepare financial statements (AICPA, 2013; IASB, 2007; Stainbanh, 2008). These efforts recognized the need for financial reporting is there in SMEs and other companies. The differential reporting according to Stainbanh (2008) is justified by two reasons users' needs and cost/benefit constraints. The first justification i.e. users' needs is the one which motivate this study, because users have to use and evaluate information contained in the financial statements to make decisions. Users' needs underscore the unpaid of financial statements in making predictions about future financial performance of the organizations. A number of studies have used financial statements to assess financial performance of different organizations (Piotroski, 2002). Ponikvar *et al.* (2009), for example used financial performance to determine managerial decision-making in a growing firm. Fagiolo and Luzzi (2006) determined the negative impact of liquidity ratios on the growth of Italian manufacturing firms. Beaver's (1966) examined the significance of financial ratios with reference to corporate bankruptcy. Thus, this study classified financial ratios to evaluate four aspects of operating performance and financial conditions which were liquidity, profitability, efficiency and leverage.

2.2 Liquidity for SMEs

Liquidity reflects the ability of a firm to satisfy its short-term obligations as they become due (Khan and Jain, 2012). Liquidity management in small firms can be defined as the planning and controlling of cash flow by owner-managers in order to meet their daily commitments (Collis and Jarvis, 2000). In this study the analysing involves examining the relationship between current assets and current liabilities to determine whether the SMEs' can fulfil its obligations for current liabilities in the short run before and after taking of multiple loans. To achieve that, three ratios; current ratios (CUR), quick ratios (QUR) and cash ratios (CAR) were used to assess the liquidity of SMEs.

The current ratio (CUR) is current assets divided by current liabilities (Friedlob and Schleifer, 2003). In this study, research, the conversional rule of 2 to 1 is considered satisfactory assuming that there is no standard measure (Khan and Jain, 2012). However, one limitation of CUR is that it does not consider the degree of liquidity of each of the components of current assets. In other words, if the current assets of firms were mainly cash, they would be much more liquid than if comprised of mainly inventory. If the ratio is less than one, current liabilities exceed current assets, and then firm's liquidity is threatened. For a firm with multiple loans it is expected that current assets would be large enough to cover its current liabilities because will have enough fund for business operations, acquire inventory reducing the possibility that the level of stock will not fall below normal hence adequate cash and cash equivalents.

Quick ratio (QUR) is current assets minus inventories, divided by current liabilities (Friedlob and Schleifer, 2003). The QR also known as acid test ratio is the more rigorous test of short-term liquidity because it addresses the limitations of current ratio. It uses only the most liquid

current assets such as cash, short-term investments and accounts receivable. The conversional rule of 1 to 1 is considered optimal assuming that there is no standard measure (Khan and Jain, 2012). A firm needs to maintain a QUR that is neither too low nor too high. A ratio that is too high indicates inefficient use of resources while a ratio that is too low is a sign of possible cash shortages.

The cash ratio (CAR) is even stricter than the quick ratio and measure the ability of a firm to pay its current liabilities with the cash and investments it has on hand. The ratio of 1 to 1 is considered optimal in case there is no standard (Khan and Jain, 2012). The CAR is useful when the collectability of an enterpriser's accounts receivables is in doubt as practices revealed that small firms tends to feel powerless to late payments from their debtors (Drever,2005). As such the following hypothesis was tested: *Multiples borrowings are positively related to liquidity level of the SMEs.*

2.3 Profitability for SMEs

One of the most important issues for any business is maintaining profitability. As SMEs strive toward growth, the need for a profitable the need for external funding, which particularly affects profitability because interest paid reduces the net profitability and the surpluses available for distribution as shareholder dividends (Sánchez *et al.* 2011). The profitability of a firm can be measured by profitability ratios on the basis of either sales or investments (Khan and Jain, 2012). In this study, the gross profit margin(GPM), Net profit margin(NPM), net return on total assets(ROA), return on equity(ROE) were used to assess the profitability ratios of SMEs. The Gross profit margin (GPM) indicates how well the company can generate a return at the gross profit level. It is calculated by dividing the gross profit by sales. The higher GPM ratio, the better. The net profit margin (NPM) is widely used as measure of a firm's profitability; is calculated as the firm's net income after taxes divided by net sales. The higher NPM ratio is considered the better. The net return on total assets (ROA) is measured as the firm's net income divided by total assets. Here the study measured the return on investment in assets after SME had covered its operating expenses, interest costs, and tax obligations. The higher the ROA ratio, the better. The return on equity (ROE) measures the return that shareholders (SMEs' operators) earned on their equity invested in the firm. It indicated how well the firm had used the resources of owners. The return on equity is measured as the firm's net income divided by stockholders' equity.

The literature on profitability suggests positive relationship between profitability and debt. While some authors identified positive association between debt and profitability, others got a negative relationship between firm's profitability and capital structure. For instance; Taub (1975), found significant positive relationship between debt ratio and profitability. Nerlove (1968), Baker (1973), Petersen and Rajan (1994), Margaritis and Psillaki (2010), Aliakbar, Seyed and Pejman (2013), also identified positive association between debt and profitability. Ross (1977) and Heinkel (1982) suggest that increasing leverage, by acquiring debts should have positive implications for firm value and performance. The previous studies concluded that firms prefer debt financing because they anticipate higher returns. Abor (2005), investigated also the link between capital structure and profitability of firms listed in Ghana Stock Exchange by using regression analysis, he witnessed a significantly positive relation among return on equity(ROE) and the short-term debt and total debt, while a negative relationship with long-term debt.

It could be expected therefore that for a firm financed by multiple loans, and use the borrowed funds efficiently and effectively by capitalising on existing opportunities, then profitability can be guaranteed. It was therefore hypothesized in general that: *Multiple borrowings are positively related to profitability level of SMEs.*

2.4 Efficiency for SMEs

Efficiency ratios—for the most part, turnover ratios—can be used to evaluate the benefits produced by specific assets, such as inventory or accounts receivable, or to evaluate the benefits produced by the totality of the firm's assets (Fabozzi *et al.*, 2003). A low ratio could mean that SME was overcapitalized or carrying too much inventory. A high ratio could be deceptive. A firm with fully

depreciated older assets could have an artificially high ratio even though those assets were no longer operating efficiently. However, efficiency ratios are not independent of liquidity ratios (Karaduman *et al.*, 2010). Poor debtors or inventory turnover ratios limit the usefulness of the current and acid-test ratios (Khan and Jain, 2012). Therefore, efficiency ratios should be examined in conjunction with relevant liquidity ratios affecting efficiency ratios. Three efficiency ratios were considered for this study, which are inventory turnover (INT), Accounts Receivable Turnover (ART), and Total Assets Turnover (TAT).

The first measure of efficiency ratios is INT which indicates how quickly SME has used inventory to generate the goods and services that are sold, and how fast inventory is sold. A high ratio is good from the viewpoint of liquidity and vice versa. The second measure of efficiency is ART which measure how effectively a firm is using credit extended to customers to increase sales (Fabozzi *et al.*, 2009). The downside to extending credit is the possibility of default - customers may not pay according to their promise. The benefits obtained from extending credit is referred to as net credit sales (i.e. sales on credit less returns and refunds). The ratio indicates the number of times debtors turnover each year into cash. The third measure of efficiency is TAT which measure of how well assets are being used to produce revenue. A high TAT is beneficial for a firm.

However, the INT and ART mentioned above reflects the benefits obtained from the use of specific assets (inventory and accounts receivable) (Fabozzi *et al.*, 2009). Because total assets include both tangible and intangible assets, these turnover indicates how efficiently all assets were used. If the liquidity is expected to have positive relationship with multiple borrowing, the same could be observed in efficiency ratios. It was therefore hypothesized in general that: *Multiple borrowings are positively related to efficiency level of SMEs.*

2.5 Financial Leverage for SMEs

Financial leverage, according to Gill and Mathur (2011), is defined as the degree to which a firm utilizes borrowed money. As such financial leverage or gearing is concerned with using borrowed fund to acquire assets. As put by Kumar and Rao (2015), the acquisition of assets is usually done based on the assumptions that these assets will generate revenues which are greater than costs of borrowing. This is consistent with the views of Modigliani and Miller (M&M) that firm can maximize their values by maximizing the use of debt financing (Lewellen & Mc Connell, 1978). According to Modigliani and Miller theorem in Corporate Finance of 1958, under certain assumption, the value of a firm is not affected by whether it is financed by equity or debt (borrowing money). According to Modigliani and Miller theorem in Corporate Finance of 1958, under certain assumption, the value of a firm is not affected by whether it is financed by equity or debt (borrowing money). Financial leverage therefore, is expected to allow SMEs to increase investment beyond what would be possible through their own funds. Likewise, financial leverage can increase return on investment to shareholders and provide tax advantages. As argued by Ghosh and Jain (2000), financial leverage may increase benefits to the shareholders through the tax deductibility of interest payments corporate dept. However on the issue of tax advantages, existing evidence from existing literature is still inconclusive (Ghosh & Join, 2000). It is expected that multiple borrowings can provide those advantages to SMEs. However, on the contrary, SMEs with multiple borrowings may increase risk of bankruptcy as per optimal capital structure theories (Ghosh & Jain, 2000; Kumar, 2008). As such the SMEs will be expected to balance between debt and equity financing. Three leverage ratios were considered namely; Debt to Total Asset (DT), Debt to Equity (DE) and Times interest Earned (TIE). It was therefore hypothesized in general that: *Multiple borrowings are positively related to leverage level of SMEs.*

3.0 METHODOLOGY

This research was carried out in Iringa Municipality, in, Tanzania. The location was purposively selected for major reason that prevalence of multiple borrowing is very high due to growing number of MFIs competing for microfinance services provision (Mpogole *et al.*, 2012, Chalu and Lubawa, 2014). The study was carried out between June to November 2012, and involved a survey covered 102 SMEs in Iringa Municipality. The design component of the study was undertaken under single blind condition to assure objectivity and minimize behaviour modification by the subjects (Dubourg, 1852). The study adopted purposive sampling technique, where 102 SMEs were reached to get financial annual reports with their consent. The 102 firms included in the sample were the ones that had required specific characteristics required for this study. Sample size was estimated by using the following formula (Amin, 2002).

$$n = \frac{Z^2 \sigma^2}{E^2} \quad (1)$$

where n = sample size; σ = estimated population standard deviation; and E = standard error determine by $E = \sigma / \sqrt{n}$. Table 1 provides the distribution of the sample by industry.

Table 1. Industry distribution of the sample

| Industry name | Number of firms |
|-----------------------------------|-----------------|
| Flour and Mills | 22 |
| Cement and Construction materials | 12 |
| Manufacturing | 18 |
| Foods | 20 |
| Retail & Wholesale | 30 |
| Total | 102 |

From this sample size of 102 SMEs 2010 and 2011 financial statements were collected. The financial statements collected were income statement, balance sheet and cash flow statement. In other words, the study utilized basic financial statements only. One justification for using basic financial statements, is that most SMEs are not sophisticated as far as accounting is concerned, as such most of them they just prepare basic financial statements. This perspective is also supported by the international accounting standard board (IASB) action of developing simplified version of IFRS applicable to SMEs only (IASC Foundation, 2009). Another justification is based on the previous one that majority of SMEs do not prepare financial statements for external uses. This implies that the financial statements prepared by SMEs since are not for external consumers, usually will not have in-depth disclosures. And in some cases, financial statements are prepared if the SMEs want to access loan particularly from MFIs. As argued by Epstein (2007), that financial statements should serve as an anchor between the credit suppliers and SMEs to predict the amount of the perceived risk.

The financial statements collected were divided into two categories before multiple borrowing (i.e. single borrowing) phase and after multiple borrowing phase. Average values were computed for each phase for every variable of financial performance (that is items/ratios of efficiency, liquidity, profitability and leverage).

The data collected were analysed by employing descriptive statistics, financial ratio analysis and paired samples t-test was used to test whether the difference between financial performance pre and post-acquisition of multiple loans were statistically different for liquidity, profitability, efficiency, and SMEs.

4.0 FINDINGS AND DISCUSSION

The results of this study are categorised into validity, reliability and descriptive statistics as well as inferential statistics. In case of reliability test, the results are presented in Table 2. According to

results in Table 2, Cronbach's Alpha ranges between 0.602 (for efficiency variable) to 0.737 (for liquidity variable). Then results indicates that internal consistency has been achieved because the Cronbach's Alpha is greater than 0.6.

$$\alpha = \frac{K}{K-1} \left(1 - \frac{\sum_{i=1}^k \sigma_{Y_i}^2}{\sigma_x^2} \right) \quad (2)$$

where σ_x^2 is the variance of the observed total, and $\sigma_{Y_i}^2$ is the score of the component i in the sample.

Table 2. Reliability Analysis Summary (Cronbach's Alpha)

| Indicator | Number of Items | Cronbach's Alpha | Status |
|---------------|-----------------|------------------|---------------------|
| Liquidity | 6 | 0.737 | Reasonably reliable |
| Profitability | 8 | 0.710 | Reasonably reliable |
| Efficiency | 6 | 0.602 | Reasonably reliable |
| Leverage | 5 | 0.619 | Reasonably reliable |

In case of content validity, a pilot study with SMEs owners was conducted to determine the relevance and representativeness of items such as individual questions in a questionnaire to the intended setting. Eby (1993) described content validity as validation concerned with the relevance and representativeness of items, such as individual questions in a questionnaire, to the intended setting. Therefore, for SME to be included in the study sample the following criteria were considered; the existence of financial records, annual reports for time frame under study for financial year 2010 and 2011, amount of capital, multiple borrowings records/history, and loan contracts were the information asked during the pilot study with SMEs owners' to make assurance that the study designed to intended sample and ascertain respondents' knowledge. Our sample is carefully chosen in order to minimise selection-based endogeneity probability. We exclude those firms that do not keep financial records, do not prepare annual financial reports, no loan contracts and all SMEs that do not have multiple loan comparative financial information. The methodology adopted is supported by literature reviews and documentary evidence.

For the descriptive analysis, the results are presented on Table 3. Profitability ratios offer several different measures of the firm's ability to generate profits. According to table 3, the mean values of GPM, NPM, ROA and ROE show that there are statistical differences in using assets to generate revenues pre and post-multiple loans acquisitions. The standard deviations values of profitability indicators were found to be higher after multiple loans acquired. The mean variation is an indication of multiple loans higher profitability level.

In case of liquidity, the descriptive results indicates that with exception to CAR which generally deteriorated after multiple borrowing acquisitions, the mean values of CUR, QUR are in satisfactory level though there was slightly decrease at post-multiple loans acquisitions. However, the liquidity general trend shows good short term financial strength of the SMEs at post-multiple loans acquisitions. The mean differences is an indication that multiple loans decreases liquidity level.

In case of efficiency ratios, the descriptive statistics indicates that the mean for INT and TAT decrease after multiple loans acquisitions while ART show an increase in efficiency. This is an indication that after acquiring multiple loans there is fluctuation in efficiency variables. In case of leverage, the mean values of DTA, and DE, were expected to increases as debt proportion tends to

increase as results of multiple loans. The mean for TIE tremendously decreases at post – multiple loans acquisitions.

Table 3. Descriptive Statistics Summary

| Variable | Item | Mean | | Standard Deviation | | Sample (N) |
|---------------|------------------------------|---------|----------|--------------------|----------|------------|
| | | Before | After | Before | After | |
| Profitability | Gross Profit Margin | 23.7216 | 12.3125 | 4.75983 | 27.89010 | 102 |
| | Net Profit Margin | 17.5704 | 8.6057 | 2.74831 | 25.23936 | 102 |
| | Return on Assets | 20.5745 | 20.8716 | 5.21830 | 6.32492 | 102 |
| | Return on Equity | 24.8049 | 29.1020 | 5.78346 | 7.87985 | 102 |
| Liquidity | Current ratio | 4.6267 | 2.1529 | 11.29757 | 0.88601 | 102 |
| | Quick ratio | 1.4339 | 1.0075 | 1.91355 | 0.49525 | 102 |
| | Cash ratio | 1.0638 | 0.8203 | 1.65292 | 0.40308 | 102 |
| Efficiency | Inventory Turnover | 6.0048 | 4.3541 | 4.01956 | 3.12805 | 102 |
| | Accounts Receivable Turnover | 37.8137 | 44.0910 | 26.28520 | 29.14015 | 102 |
| | Total Asset Turnover | 1.2954 | 1.1224 | 0.50654 | 0.43317 | 102 |
| Leverage | Debt to Total Assets | 9.2176 | 30.8892 | 5.44332 | 6.06396 | 102 |
| | Debt to Equity | 6.2371 | 30.2588 | 5.63222 | 18.25895 | 102 |
| | Times interest Earned | 86.0088 | 1.1922E2 | 70.46391 | 83.80546 | 102 |

To analyze the relationship between multiple loans and financial performance of SMEs, paired sample T-tests were performed to determine whether there is significant relationship between multiple loans and SMEs' financial performance in terms of on liquidity, profitability, efficiency and leverage. These results therefore are presented in the following sections.

(i) Multiple borrowing and liquidity of the SMEs

In this first variable, it was hypothesized, multiple borrowing are positively related to liquidity of SMEs. Three items current ratio, quick ratio and cash ratio were used to access the financial performance difference of SMEs between before and after multiple borrowings. The results for the first hypotheses are presented in Table 4. According to Table 4, two items (current and quick ratio) show significance difference between before and after multiple borrowings. Current ratio with $T = 2.246$ and $p\text{Value} = 0.027$ and quick ratio ($T = 2.019$ and $p\text{Value} = 0.046$) were tending to be significant at 5%. However, a cash ratio ($T = 1.358$ and $p\text{Value} = 0.178$) was found to be not significant. As such the H_1 is partially supported by two items, namely current and quick ratios only.

Table 4. Paired Sample Test for Liquidity

| | | Paired Differences | | | | | T | df | Sig. (2-tailed) |
|--------|--------------------------------------------------------------------------------------|--------------------|-------|------------|----------------------------------------------------|-------|------|-----|--------------------|
| | | Mean | SD | SE Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | Current Ratios Before Multiple Borrowings - Current Ratios After Multiple Borrowings | 2.47 | 11.12 | 1.10 | 0.29 | 4.66 | 2.25 | 101 | 0.027 |

| | | | | | | | | | |
|--------|----------------------------------------------------------------------------------|------|------|------|-------|------|------|-----|-------|
| Pair 2 | Quick Ratios Before Multiple Borrowings – Quick Ratios After Multiple Borrowings | 0.43 | 2.13 | 0.21 | 0.01 | 0.85 | 2.02 | 101 | 0.046 |
| Pair 3 | Cash Ratios Before Multiple Borrowings – Cash Ratios After Multiple Borrowings | 0.24 | 1.81 | 0.18 | -0.11 | 0.60 | 1.36 | 101 | 0.178 |

(ii) Multiple borrowings and profitability of SMEs

The second variable for financial performance is profitability. In this study it was hypothesized (H₂) that multiple borrowings are positively related with profitability of SMEs. Four items: GPM ratio, NPM ratio, ROA ratio and ROE ratio were used. The results presented on Table 5, indicate that three items GPM (with T = 4.252, pValue = 0.000); NPM (T = 3.552, pValue = 0.001) and ROE (T = 7.339, pValue = 0.000) were found to be significant at 1% significance level. On the other hand ROA (T = 0.722, pValue = 0.472) was found not to be significant. As such out of four items of profitability, three (3) items indicate that multiple borrowings have improved financial performance.

Table 5. Paired Sample Test for Profitability

| | | Paired Differences | | | | | T | df | Sig. (2-tailed) |
|--------|----------------------------------------------------------------------------------------------------------------|--------------------|-------|------------|-------------------------------------------------|-------|------|-----|--------------------|
| | | Mean | SD | SE Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | Gross Profit Margin Ratios Before Multiple Borrowings- Gross Profit Margin Ratios After Multiple Borrowings | 1.141 | 27.10 | 2.68 | 6.08643 | 16.73 | 4.25 | 101 | 0.000 |
| Pair 2 | Net Profit Margin Ratios Before Multiple Borrowings- Net Profit Margin Ratios After Multiple Borrowings | 8.97 | 25.51 | 2.53 | 3.96 | 13.98 | 3.55 | 101 | 0.001 |
| Pair 3 | Return on Assets Ratios Before Multiple Borrowings- Return on Assets Ratios After Multiple Borrowings | -.297 | 4.16 | 0.41 | -1.11 | 0.52 | 0.72 | 101 | 0.472 |
| Pair 4 | Return on Equity Ratios Before Multiple Borrowings- Return on Equity Ratios After Multiple Borrowings | -4.30 | 5.91 | 0.59 | -5.46 | -3.14 | 7.34 | 101 | 0.000 |

(iii) Multiple borrowings and Efficiency of SMEs

The third variable used to test financial performance is efficiency. It was hypothesized that “multiple borrowings are positively related to efficiency of SMEs”. Three ratios were involved namely; Inventory turnover, accounts receivable turnover and total assets turnover. The results for the third hypotheses are presented in Table 6. According to Table 6, all three indicators inventory turnover (T=13.090 and pValue =.000), accounts receivable turnover (T = -2.934 and pValue = 0.004) and total assets turnover (T = 5.147 and pValue = 0.000) show significant difference before and after acquisition of multiple loans.

Table 6. Paired Sample Test for Efficiency

| | | Paired Differences | | | | | T | df | Sig. (2-tailed) |
|-----------|--------------------------------------------------------------------------------------------------------------------------------|--------------------|-------|------------|-------------------------------------------------|-------|-------|-----|--------------------|
| | | Mean | SD | SE Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | Inventory Turnover ratios Before Multiple Borrowings – Inventory Turnover ratios After Multiple Borrowings | 1.65 | 1.27 | 0.13 | 1.40 | 1.90 | 13.09 | 101 | 0.000 |
| Pair 2 | Accounts Receivable Turnover ratios Before Multiple Borrowings – Accounts Receivable Turnover Ratios After Multiple Borrowings | -6.28 | 21.61 | 2.14 | -10.52 | -2.03 | -2.93 | 101 | 0.004 |
| Pair 3 | Total Assets Turnover Ratios Before Multiple Borrowings – Total Assets Turnover Ratios After Multiple Borrowings | .173 | 0.34 | 0.034 | 0.11 | 0.24 | 5.15 | 101 | 0.000 |

(iv) Multiple borrowings and Leverage of SMEs

The fourth variable used to test financial performance is leverage. It was hypothesized that “multiple borrowings are positively related to leverage of SMEs”. Three ratios were involved namely; debt to total assets ratio, Debt to Equity ratio and Times Interest Earned. The results for the third hypotheses are presented in Table 7. According to Table 7, all three indicators debt to total assets ratio (T= -30.943 and pValue =.000), debt to equity ratio (T = -13.536 and pValue = 0.000) and times interest earned (T = -12.520 and pValue = 0.000) show significant difference before and after acquisition of multiple loans.

Table 7. Paired Sample Test for Leverage

| | | Paired Differences | | | | | T | df | Sig. (2-tailed) |
|--|--|--------------------|----------------|-----------------|-------------------------------------------|-------|---|----|-----------------|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |

| | | | | | | | | | |
|--------|--------------------------------------------------------------------------------------------------------------|-------|-------|------|--------|--------|--------|-----|-------|
| Pair 1 | Debt to Total Assets Ratios Before Multiple Borrowings Debt to Total Assets Ratios After Multiple Borrowings | -2.16 | 7.07 | 0.70 | -23.06 | -20.28 | -30.94 | 101 | 0.000 |
| Pair 2 | Debt to Equity Before Multiple Borrowings – Debt to Equity Ratios After Multiple Borrowings | -2.40 | 17.92 | 1.77 | -27.54 | -20.50 | -13.53 | 101 | 0.000 |
| Pair 3 | Times Interest Earned Before Multiple Borrowings – Time Interest Earned Ratios After Multiple Borrowings | -3.32 | 26.78 | 2.65 | -38.46 | -27.94 | -12.52 | 101 | 0.000 |

This study assessed the effects of multiple borrowings on SME's business performance by using financial statements where financial variables; liquidity, profitability, efficiency and leverage ratios were used. The results indicate that current ratios, liquid ratios, gross profit margin, net profit margin, return on equity, inventory turnover, accounts receivable turnover, total assets turnover, debt to total assets ratios, debt to equity ratios and times interest earned of SMEs – were statistically positively related to multiple borrowings. These variables show that multiple borrowings have effects on SMEs' financial performance. As it observed from practices, it make valuable for SMEs to undertake multiple loans as most of them are poor cash.

4.2 The Influence of Multiple Borrowings on SMEs Liquidity

The analysis has revealed that firms' liquidity was in good ratios both before and after multiple borrowings. However, liquidity ratios magnitudes were decreases post – multiple loans. It is expected that this decrease would affect the cash management of SMEs as confirmed by downsized cash ratio that went below minimum (i.e.1:1) after multiple loans. The good performance in other areas such current and quick ratios actually expected to have indirect impact to cash management. This is an indicative that after acquisition of multiple loans, cash management did not disrupt the SMEs and lead to insolvency as the firms are still in operations. It can be argued that SMEs have done enough to manage the liquidity position, as justified by the MFIs decision to provide additional loans, though there were slight decreases in liquidity ratios.

The study also suggests that cash liquidity observed might have been influenced by the ability of SMEs to settle for multiple loans. Mpogole *et al.* (2012) claims that multiple loans adversely affects loan repayment. The problem here is how can SMEs manage current assets, current liabilities, cash conversion cycle and still balance its risk and return so as to ensure sustainable profits under influence of multiple loans.

As observed in really practices in Tanzania, most SMEs operators accepted the preparation of financial reports by their lenders just to support their loans applications. However, there is doubt if the SMEs operators are using the financial statements information contents to regulate their business as most of them are not good at working capital management (Atrill, 2006). Experience shows that most of SMEs in Tanzania operates without credit control department, no proper debt collection procedures, and poor methods of records keeping. Therefore, it can be argued that, multiple borrowing supported with good working capital management practices, will let the SMEs sector be improved significantly. It should be also noted that most of SMEs' assets are in form of current assets and they depend heavily on current liabilities as main sources of external financing against long-term capital markets (Petersen and Rajan, 1997). Thus it could be argued that effective liquidity management is indicative of overall SME management.

4.3 The Influence of Multiple Borrowings on SMEs Profitability

The results also show that there were improvements in firm's profitability. With exception to ROE, the results of this study showed signs consistent with theoretical predictions that profitability (GPM, NPM, ROA) is assumed to have a positive relationship with multiple borrowings. The relationship between profitability and multiple borrowings implies that access to multiple loans tended to improve sales, profitability and hence internal financing, if at all the loans taken were whole and exclusive employed in the intended businesses as planned and in new profitable business opportunities emerged.

However, practical experience shows that most SMEs have no debt collection procedures, and even credit policy. This casts doubt on the effect that delaying debts collection from debtors and payments to suppliers may have on SMEs profitability. Therefore, it can be argued that, good performance on profitability may have influenced by good performance on liquidity as evidenced by the findings. Diacogiannis (1994) confirmed the direct relation between profitability and working capital management. Therefore, it can be argued that despite of all managerial deficiency SMEs are facing, multiple loans are manageable to them and enhance room for profits.

4.4 The Influence of Multiple Borrowings on SMEs Efficiency

The results confirmed that efficiency ratios were in good position to most of SMEs after multiple borrowings. Although inventory ratios showed slight decreases but this did not endanger the performance of most firms. Being in good liquidity position after multiple borrowing is an indication the SMEs are selling fast and goods do not stay in shelves.

However, the slightly decrease in inventory ratios, might have been caused by the possibility that SMEs operators were busy coping with increased operational activity that they did not have time to control its inventory position or due poor working management. The effect of this is obvious that the average payment period to suppliers and other stakeholders might have been decreased but not to the extent that affected the profitability and liquidity position of firms. The decrease in inventory ratio would adversely increase storage and inventory management costs and increase the risk of inventory obsolescence, eventually affect the SME profitability.

Despite the facts that SMEs tend to work manual, without proper debts collection procedures, however, the analysis revealed that the Accounts receivable turnover (ART) of the firms had been improving position for the period under review from 2009/2010 to 2010/2011. It indicated a shorter time between making a sale and collecting the cash. This may have been influenced by the acquiring of multiple loans and hence forced many firms to speed up cash collections so that they could pay multiple loan interests as they become due to avoid financial risk.

For total assets turnover, findings revealed that firms were less successful in keeping active the firm's assets after had been acquiring multiple loans in the year 2010/2011, due to decreased turnover of inventory. Despite these downtrends in turnover, majority of the SMEs operated under normal profits, confirming a significant relation between SME's profitability and number of days of accounts receivable and of inventory turnover. Results revealed by efficiency ratios, confirmed theoretical predictions, that working capital management is important to small and medium-sized enterprises because most of these firms' assets are in form of current assets., current liabilities are also one of their main sources of external finance. The findings comply with results of Peel and Wilson (1996), who noted the same that "efficient working capital management is particularly important for smaller companies. In this context, the efficiency ratios have provided empirical evidence about the efficiency of SMEs operators' on managing the business toward performance under multiple borrowings. However, it can be argued that, the good picture provided by the efficiency should be taken with highly consideration as it might be contributed by nature of business environment, which heavily depend on individual retailers as traditionally do business on cash basis to avoid defaults on payments.

4.5 The Influence of Multiple Borrowings on SMEs Leverage

On leverage ratios, the analysis revealed, Debt-total assets ratios of the firms had been increasing for the period under review from 2009/2010 to 2010/2011. The higher ratio is not a good indication as it imply that more assets have been financed by outside funds (multiple loans). The low ratios are desirable from the point of credit suppliers as it is an indicative of sufficient margin of safety. This increase does not mean that more assets were acquired by addition of second loan, rather might have been contributed by other factors. For instance, most of SMEs' assets are in form of current assets (Pedro Juan *et al.*, 2007). Large portion of current assets were consisting of larger amount of accounts receivable, thus decreased or increased in accounts receivable would actually tend to decrease or increase total assets of these firms and affect the debt to total assets ratios. Current liabilities are also one of their main sources of external finance to these firms (Pedro Juan *et al.*, 2007) and thus increase or decrease in current liabilities would actually tend to increase or decrease total debt and affected the debt-total assets ratios. An increase in debt to total assets ratio is not a good sign as business heavily depend on external financing. This is imply that the large portion of profit generated is spent on debt repayment.

In case of Debt-Equity ratios, the analysis revealed that the Debt-Equity ratios had been increasing position for the period under review from 2009/2010 to 2010/2011. This increment meant that creditors (MFIs) have put more funds in the SMEs than the owners themselves. Khan and Jain, (2012) suggests that a high proportional in the capital structure would lead to inflexibility in the operations of the firm as creditors would exercise pressure and interfere in management.

It should be noted also that, any time SMEs use debt financing, they are running the risk of bankruptcy and the more debt financing they use, the higher the risk of bankruptcy. The danger of this is that SMEs owners may behave irresponsibly and indulge in speculative activity (Khan and Jain, 2012). However, the results of this study have shown that in the presence of multiple loans, Debt-Equity-mix has a significant influence on the performance of SME. The results indicate that multiple borrowings positively affect return on equity (ROE) of SMEs. The findings comply with other studies such as by Ross (1977), Heinkel (1982) and Noe (1988) who suggested that increasing leverage, by acquiring debt should, have positive implications for firm value and performance. It also complies with the Modigliani and Miller Capital theory (1963) who studied on incorporating tax benefits as determinant of the firm's' capital structure choice. They argue that SMEs are able to maximize their value by employing more debt because of tax-shield benefits associated with debt use. Interest on debt is considered as a tax-allowable expense. However, the access to external finance should not go beyond its payment ability so as to avoid financial risk, as acquiring more loans is not a positive sign to the SMEs. Abor (2007) argued that employing excessive debts for SMEs is likely to result in high bankruptcy cost which affects firm's performance.

On the times-interest earned, the analysis revealed that the ratios had been increasing percentage wise for the period under review from 2009/2010 to 2010/2011. However, the increase may imply unused debt capacity. However, low ratios is a danger signal the SMEs are using excessive debt and does not have the ability to offer assured payment of interest to lenders. In general debt ratio have shown positive relationship with the performance of the SMEs. The debt ratios findings comply with other studies from several countries. For instance, Taub (1975) found significant positive relationship between debt ratio and measures of profitability. Hadlock and James (2002) also concluded that companies prefer debt financing because they anticipate higher returns (Khan and Jain, 2012).

5.0 CONCLUSION AND IMPLICATIONS

The results provide evidence that by using financial ratios there are financial performances differences between prior and post multiple loans of SMEs. The empirical results are indicative that multiple loans have significant influence on liquidity, profitability, efficiency and leverage of SMEs' especially for those who properly used the additional loans and invested on the existed opportunities. The results suggest that if well managed, multiple loans are not detrimental to financial status of SMEs, and in long run may lead to more productive operations. It therefore

recommend to a need of establishing an effective and efficient information sharing system (a credit Bureau) to prevent unnecessary over-borrowing among microfinance borrowers.

The findings contribute to the assessment of financial management practices in SMEs, and how these should be improved, as most existing literature tended to be based solely on the standards and practices used by large companies or those adopted by professionals such as accountants, consultants, banks, etc., with relatively little attention being paid to the practices actually used by owner-managers themselves. Nayak and Greenfield (1994) argue that owner-managers in their survey of 200 SMEs in the West Midlands did not use financial management techniques very effectively. Yet, these techniques are those designed for large companies and consequently the process of financial management and associated decision-making in SMEs remains something of “a black box” (Deakins *et al.*, 2000).

LIMITATIONS OF THE STUDY

This research study was mainly based on financial data derived from the SMEs’ financial statements (annual reports). The reliability and the finding are contingent upon the data published in financial statements. Accounting ratios have its own limitation, which also applied to the study. The study is limited to one year before multiple loans acquisitions and the subsequent year with multiple loans, in order to be more certain, it is suggested study period to be extended.

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