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COMPETITIVE ADVANTAGES AND VALUES CREATED AND ATTAINED OUT OF WELL-CRAFTED CUSTOMER VALUE PROPOSITIONS

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Abstract:

To help facilitate the development of a theoretically rigorous and practically useful theory of customer value propositions (CVP), as called for repeatedly by the extant literature, this paper establishes a game-theoretic theorem regarding the dynamics of market competition and potential market entry. On top of this result and by employing logical rigor and analytical reasoning, eight generally true facts are developed without suffering from the constraints of data- and anecdote-based approaches, as widely used in the literature. In particular, these established results reveal how a newly adopted CVP is associated with the three essential processes underlying a company's operation, how it will be pivotal for the company to attain competitive advantages, how the value added by adopted CVPs can be determined, etc. At the end, recommendations for decision-making managers and entrepreneurs and potential questions for future research are provided.

Key words: *cash flow; market invitation; mission; operating process; value added*

1. Introduction

As a fundamental method of communication with consumers and other players within a company's supply-chain ecosystem, the importance of customer value proposition (CVP) has been widely recognized (Webster 2002). In the area of marketing, the concept of propositions in various forms can be traced back at least one hundred plus years (Starch 1914); and as a complement to value creation, since the 2010s, the need to communicate values to customers has been greatly emphasized (Marketing Science Institute 2010).

Although its importance has been recognized for such a long history and the emphasis as a complement to value creation has been seriously placed, the CVP concept still remains poorly defined, casually tossed about and applied trivially (Payne et al., 2017). In other words, there are both theoretical and practical needs for the world of learning to develop a theory of CVPs that reveals how CVPs play their roles in all aspects of business operation in general and how CVPs help create and capture values for individual companies in particular.

Aiming at achieving this end at least partially, this paper attempts to generate a general theory on certain aspects of CVPs by using a methodological approach widely used in mathematics and natural science without suffering from the constraints of data- and anecdote-based approaches. More specifically, this paper develops generally-true conclusions based on commonly recognized facts and a game-theoretic theorem through employing logical reasoning. Subsequently, this work is able to provide general recommendations for managers and entrepreneurs to gain tangible economic benefits.

The rest of the paper is organized as follows: Section 2 reviews the relevant literature and demonstrates the contribution of this work. Section 3 studies the association between CVPs and a company's competitive advantages. Section 4 focuses on shareholder values added by adopted CVPs. Section 5 investigates the materialization of a CVP's impacts. Then the presentation concludes in Section 6 with managerial recommendations and questions for future research.

2. Literature Review

This work contributes to three areas of literature: business competitive advantages, CVP-based value addition, and impacts of CVPs. In terms of competitive advantages acquired from CVPs, Rintamäki et al. (2007) develop a framework for identifying competitive CVPs in retailing. Frow and Payne (2011) identify how the concept of CVPs provides insights into value creation within a value network. Ballantyne et al. (2011) examine the concept of *CVPs* and its functioning through a service-dominant logic lens and position reciprocal CVPs as a key to bring exchange activities, relationship development, and knowledge renewal together. Hsieh and Vermeulen (2014) study how a company's encounters with its rivals influence its inclination to follow the rivals into a new market. Sheehan and Bruni-Bossio (2015) outlines how managers can test whether their company is underperforming relative its rivals. Wouters and Kirchberger (2015) explore how interorganizational management accounting might support companies to collaborate

in order to identify which products and services are valuable for customers. Zheng et al. (2017) investigate the effect of inter-user relationship on user's perceptions of an adopted CVP of e-enterprises. Carlson et al. (2019) discuss two important steps of value-creation: identify an unmet opportunity and develop a relevant CVP. Zhang et al. (2019) identify specific CVPs and compare their competitive advantages in the sharing economy. Along this direction, this study enriches the extant literature by developing generally-true results on when a market invites for additional competition.

Regarding CVP-based value additions, our literature search only finds a few relevant studies. In particular, Wouters (2010) explores conditions under which real options can be employed to develop value propositions of a small high-tech entrepreneurial supplier of a large incumbent company to develop new technologies. Blocker (2011) investigates the measurement and modeling of CVPs from the business management prospect across five culturally-diverse countries in hope of advancing the research of customer values (CVs) beyond Western markets. As a contribution to this stream of literature, the findings of our study provide insights on not only when a CVP will help a firm enhance its competitive advantages and capabilities but also how to analytically determine particular business value added by a CVP.

As exemplary studies focusing on the impacts of CVPs, Parasuraman (1997) proposes a detailed framework to monitor and leverage CVs. Randall et al. (2010) investigate the CVPs offered by 100 U.S. motor carriers. Clarke (2001) looks at CVPs that would lead to productive mobile e-commerce strategies. Smith (2013) studies the process of value co-destruction stemming from customer-resource misuses by organizations. Holttinen (2014) aims at contextualizing CVPs by considering how consumers experience and evaluate values in practices. Yrjölä (2015) prioritizes CV dimensions from the perspective of retail executives. Rintamäki and Kirves (2017) develop and validate a scale for measuring CV and illustrate how contextual perspective can help evaluate CVPs. Among others, this current work makes its contribution to this stream of research by uncovering the following results: the implementation of a CVP needs (1) preferably accelerate earlier cash flows than later ones (2) minimize relevant investment while maximizing related revenues; and (3) augment a firm's long-term overall business value.

To round up this review section, on top of the current landscape of CVP-related research, where poorly defined concepts were casually tossed around and employed trivially, this work attempts to carry to the next level the initiation of Payne et al. (2017) to develop a more rigorous theory of CVPs so that established conclusions can be beneficially applied in practice.

3. CVPs and Companies' Competitive Advantages

In this paper, end users are referred to as consumers, and intermediate B2B (business to business) purchasers as customers. When a market offer is used simultaneously by customers and consumers simultaneously, these users will be collectively referred to as customers.

3.1. CVPs and Essential Macro-Level Processes

Customer value (CV) in business markets is the worth in monetary terms of technical, economic, service, and social benefits a customer or a consumer receives in exchange for the price it pays for a market offer (Anderson & Narus, 1998). The benefits that matter are those that are seen important by the customer; and the price stands for whatever the customer sees as paid for the offer (Lanning & Michaels, 1988). In other words, the value of a market offer is equal to the benefits minus price. Each market offer has its value to both customers and supplier(s) and its price that is the cost of a customer.

By customer value proposition (CVP), it represents a strategic tool a company utilizes to communicate its sharing of resources and delivering of particular values to customers (Payne et al. 2017). This definition of CVP embodies such elements as a communication device, resource sharing, targeted customers and particular value that distinguishes a company's offer from those of its rivals. By using its CVP, a company makes the specified customers aware of the value its offer delivers and how they can reciprocally help improve the features of the offer (see Rintamaki et al. (2007) for the special case of retail industry). Beyond delivering the value a supplier imagined (e.g., Kowalkowski 2011), an adopted CVP also accentuates customer involvement, the importance of which has been considered as a research priority by the community of marketers (Marketing Science Institute 2010).

Internally, for a CVP to be effective, a company must be able to transform market calls for new innovations (Forrest et al., 2017) into actual design and production of innovative market offers. That is, an effective CVP directly affects the company's business processes that underpin the delivery of promises. As a functional system, each business enterprise is composed of many processes that operate simultaneously and interactively. To study how an adopted CVP might influence the transformation of existing business processes within a company, let us focus on the following essential macro-level processes (Day, 1994) that address fundamental and common business tasks that are critical for achieving what is promised in the CVP:

- Customer solution management (process 1),
- Supply-chain management (process 2), and
- Customer-relation management (process 3).

The first process defines customer solution(s) to meet the forever evolving market demand(s) by carefully analyzing market signals, while considering potential challenges to upstream suppliers and downstream complementors in order to first produce imagined market offer(s) and second deliver the offer(s) to the ultimate users (Adner et al., 2013). The second process addresses the physical production of the imagined offer(s) by acquiring supplies and by assembling parts into the imagined solution(s). The third process emphasizes on the communication with the market, as identified when the CVP is initially adopted. Works in this process include the creation of customer knowledge, the development of customer relations, and the shaping of market perception of the

organization, and eventual market offers. Due to their supporting roles, all micro-level processes of a business entity will not be considered in this paper.

Proposition 1. Assume that a focal company has been a steady player and good performer in the marketplace, a market position achieved with its clearly stated mission and a long-term, unwavering ambition. If it adopts a CVP to further its success in the marketplace and financial performance, then the CVP has to connect to the afore-described three essential operating processes in at least two fashions:

1. It must be connected to the stated mission and the long-term, unwavering ambition of the company; and
2. Individual tasks that are demanded by the CVP must be connected to specific subprocesses within each essential operating process and to the coordination, integration and streamlining of the works inherent in subprocesses across the essential processes.

To see why Fashion 1 holds true, let us first look at why a clearly stated mission and a long-term unwavering ambition are a must for a company to establish itself in the marketplace. In particular, within each company, disagreements among employees always exist regarding how the organization should be run, how operations carried out, and how labors allocated. Such disagreements stem from employees' individually different philosophical assumptions and values (Forrest & Orvis, 2016). In other words, any two employees look at the organizational system of their company differently. That difference, rooted in their individually different and personal philosophical assumptions and values, naturally leads to inconsistent behavioral patterns in the employees and the results of their works, even though one of them might just maintain his/her calm and salience without making the situation escalate into a ferocious power struggle (Forrest et al. 2018). What is implied here is the need for a functional business organization to clearly phrase and strictly practice its mission and ambition in order to avoid its daily operations from being torn apart by inconsistent and/or conflicting philosophical assumptions and value systems of individual employees. This discussion explains the reason why the CVP, adopted to further the company's success in the marketplace and financial performance, has to be connected to the company's mission and ambition. Specifically, within the focal company, each process, irrespective to its level, is created, managed, and driven by a team of individuals. So, all such teams that respectively guide the essential processes must be infused with the key elements of the CVP. That represents a means to bring corresponding promised solutions to every subprocess in order to collectively meet a particular market invitation; otherwise, each process is really meaningless when viewed in isolation.

For the truthfulness of Fashion 2, the adopted CVP, as a result of joint effort of the three essential operating processes - customer solution, supply-chain and customer-relation management, infuses a customer orientation into their subprocesses through the medium of individual tasks demanded by the CVP. With special focus on market demand, capabilities and resources that are available or potentially available to the focal company, some critical CVP-demanded tasks include

- categorizing customer segments, determining customers' current and future needs, etc., in order to develop customer solutions;
- studying the capabilities of players within the focal company's supply-chain ecosystem, identifying potential business entities that might become part of the ecosystem, etc., in order to gain better knowledge on upstream suppliers and downstream complementors; and
- learning from customers about the uses and applications of individual offers, assessing customers' responses to rivals' current and potential offers, etc., in order to strengthen the communication and relationship with customers.

Infusing the CVP-based customer orientated perspective into subprocesses can generally be accomplished through the following two approaches: (1) frequently reinvigorating subprocesses of process 3, and (2) linking, either directly or indirectly, the CVP-specific tasks inherent in subprocesses of process 3 to individual subprocesses in both processes 1 and 2. Considering the current era of transient competitive advantages (McGrath, 2013), approach (1) represents a must for our focal company to uphold its competitiveness in the marketplace of forever intensifying competition and constantly evolving customer preferences and tastes. That has been exemplified a long while ago since the distinction between marketing and sales orientations were clearly shown (Kotler, 1977). Because the execution of a subprocess tends to degenerate into accustomed task routines or into easy-to-accomplish task procedures, frequently reinvigorating essential subprocesses of process 3 is crucial if a newly adopted CVP needs to be materialized in the eventual market offer. To see the reason underneath approach (2), we only need to identify how customers' feedback on their product use and application and the information of newly revealed customer demands can generate data and information. And such information needs to practically influence the design and execution of relevant subprocesses within the two essential business processes – processes 1 and 2. The former process involves brainstorms of specific ideas, while the latter determines what upstream suppliers can realistically supply and what downstream complementors can assist in making innovative offers eventually reach the targeted customers. Simultaneously, this end confirms the fact that individual tasks, demanded by the CVP, must be connected to the coordination, integration and streamlining of the works inherent in subprocesses across the essential processes. That is, Fashion 2 in Proposition 1 is shown to hold true.

3.2. CVPs and Attainment of Competitive Advantages

To understand how forever evolving customer preferences and tastes within an extant market raise the magnitude of market competition, which then in turn forces companies, either incumbent or not in the said market, let us first look at the following theorem regarding the intensifying competition in an oligopoly market of free competition.

Assume that the market is a closed system, meaning that it is free from any interference of its environment. In particular, although free competition is guaranteed,

business rivalries within the market are not influenced in any way by any other market. Assume that this market is served by *m* incumbent companies with their horizontally differentiated offers, *m* = 1, 2… Assume that each of these incumbent companies is supported by a base of loyal consumers who make purchases only from their recognized company as long as the price is not more than their reservation price. And, along with forever changing preference and taste, there are such consumers who are not totally satisfied with any of the available offers in the marketplace. For these consumers, assume that for one reason or another they make their purchases only from the company that offers the lowest price. Collectively, these consumers will be referred to as switchers, and collectively they will be known as the consumer surplus in the marketplace. So, the incumbent companies compete with each other by using price.

For the incumbent companies, assume that their management are well aware of others' pricing strategies. Hence, they play the Nash equilibrium to develop their best responses through pure self-analyses. Then for the dynamics of competition in this market, we have

Theorem 1. In Nash equilibrium, assume that the size of consumer surplus in the afore-defined oligopoly market is greater than that of the loyal-consumer base of one of the incumbent companies. Then the following conclusions hold true:

- The market will have rooms for new companies to enter with their substitute offers; and
- If the entrants randomize their prices uniformly between their costs of production and maximum expected selling price, then the expected aggregate profit of all entrants can be potentially greater than that of the incumbent with the smallest base of loyal consumers.

Proof: The first conclusion is evident, because the existing consumer surplus represents the room available for new companies to target at. The rest of this proof will focus on showing the second conclusion.

First, let us normalize production costs, reservation prices, and magnitudes of loyal customer bases of the incumbent companies that vary from one company to another. In particular, after the normalization, all production costs are set to 0, reservation prices to 1, and the variable magnitudes of loyal customer bases become a constant value x satisfying $0 < x < 1$. For details, see Appendix.

Second, for convenience, assume that just one new company enters into the described market by randomizing its price between the production cost 0 and the expected maximum price 1. If more than one company enters the market, these entrants can be collectively considered as one aggregated company. In this case, a similar argument as the following will go through smoothly. To fight off the potential abrupt disruption of the established state of mutual forbearance among the incumbent companies (Bernheim & Whinston, 1990), every incumbent sets its price after considering the prices of the new company and of all other incumbents. So, the equilibrium indifference condition of incumbent Company k is

$$x \times P + y \times P \prod_{j \neq k}^{m} (1 - P)[1 - F_j(P)] = x \times 1. \tag{1}$$

where x is the constant magnitude of any of the incumbent's base of loyal customers. So, the symmetric equilibrium pricing strategy of the incumbent companies is given as follows:

$$F(P) = 1 - \left(\frac{1 - y}{ymP}\right)^{\frac{1}{m-1}}. \tag{2}$$

The assumption that the consumer surplus $y \geq x = (1 - y)/m$ implies that equation (2) is a well-defined mixed strategy for each incumbent company for P satisfying $(1 - y)/(ym) \leq P \leq 1$, where the incumbents cannot price their offers any lower than $(1 - y)/(ym)$. Because

$$\lim_{P \to 1^-} F(P) = 1 - \left(\frac{1 - y}{ym}\right)^{\frac{1}{m-1}} \neq F(1) = 1, \tag{3}$$

the function $F(P)$ experiences a discontinuity at P = 1 with a jump $[(1 - y)/(ym)]^{\frac{1}{m-1}}$. So, the expected profits of the entrant are:

$$E_e(\Pi) = \int_0^{(1-y)/(ym)} yP dP + \int_{(1-y)/(ym)}^{+\infty} yP[1 - F(P)]^m dP \tag{4}$$

$$= \begin{cases} \dfrac{-(1-y)^2}{2ym(m-2)} + \dfrac{m-1}{(m-2)}\left[\dfrac{(1-y)^m}{ym^m}\right]^{\frac{1}{m-1}} + y\left(\dfrac{1-y}{ym}\right)^{\frac{m}{m-1}}, & \text{if } m \geq 3 \\ \dfrac{(1-y)^2}{2ym^2} - \dfrac{(1-y)^2}{ym^2} ln\dfrac{1-y}{ym} + y\left(\dfrac{1-y}{ym}\right)^{\frac{m}{m-1}}, & \text{if } m = 2 \end{cases} \tag{5}$$

where the right-hand side of equation (4) consists of two parts: (i) the entrant's expected profits when it charges the lowest price in the market place and captures the entirety of the consumer surplus, and (ii) the entrant's expected profits when it is in direct competition with the incumbent companies. At the same time, the expected profits of any incumbent are

$$E_m(\Pi) = \int_{(1-y)/(ym)}^{1} \left\{\frac{1-y}{m} P + yP(1-P) \prod_{j \neq i}^{m} [1 - F(P)]\right\} dF(P)$$

$$+ \frac{1-y}{m}\left(\frac{1-y}{ym}\right)^{\frac{1}{m-1}} = \frac{1-y}{m}. \tag{6}$$

Because $\frac{\partial}{\partial x}[E_e(\Pi) - E_m(\Pi)] > 0$, and when $y = 1/(m+1)$, $E_e(\Pi) - E_m(\Pi) > 0$, there is $x^* \in (0, 1/(m+1))$ satisfying that when $x = (1-y)/m \geq x^*$, $E_e(\Pi) > E_m(\Pi)$. That is, the entrant can actually expect to make more profits in the said market than any of the incumbents under the normalizations given in Appendix. So, the second conclusion of Theorem 1 follows.

As a corollary of Theorem 1, we have the following result:

Proposition 2. Assume that a company's particularly adopted CVP is developed on its innovative comprehension of a market invitation that is backed by a sufficiently large segment of customers. Then this CVP will be pivotal for the company to attain a competitive advantage.

In fact, the assumed CVP, backed by a sufficiently large segment of customers, means that there is a sufficient magnitude y of consumer surplus in the marketplace to which the expected amount yP_j of profit is acceptable for Company j to devote its resources. An ability to fully capture this expected amount of profit in practical terms in a competitive market means that the particular CVP has to be attractive enough to the said consumer surplus. That is equivalent to saying that the particular CVP is pivotal for the company to attain a competitive advantage.

The significance of this proposition is that the stated conclusion is true only conditionally, not as stated as a prima facie case by Srivastava et al. (1999).

4. CVP and Shareholder Value

The preceding section focused on how market invitation, forever evolving consumer preferences and market orientation affect the essential business operating processes. As the title suggests, this section examines the relationship between CVPs and shareholder values.

4.1. CVPS-Based Advantages and Capabilities that Drive Shareholder Value

Continuing the previous discussions on mission and ambition, the result below follows:

Proposition 3. Assume that on top of its mission and a long-term, unwavering ambition, a focal company, as a steadily well performing business entity, adopts a CVP with corresponding investment in the three essential macro-level operating processes to further its success in the marketplace and financial performance. Then the CVP will result in competitive advantages and capabilities that the company can tap into to drive shareholder value.

First, the assumption of this proposition implies, based on Proposition 1, that tasks demanded by the CVP must be connected to each of the essential operating processes

and are practically accomplishable, at least to a degree, due to the assumed corresponding investment. These tasks help coordinate, integrate and streamline the works inherent in the essential processes.

The effort to develop and adopt such a CVP for the assumed purpose is likely a lead function in managing the three essential processes: customer solutions, supply-chain partner associations, and customer relationships. It plays an important role in sensing market signals and disseminating information first internally within the organization, second among the members of the company's supply-chain ecosystem, and third externally in the marketplace. The effort critically helps with the formulation of the CVP that adequately while comprehensively reflects what the market signal means. And it aids the development of customer solutions that will potentially satisfy the market demand. When the development of such solutions and the management of supply-chain partners are dominated by technicians and engineers, a key role to be played by tasks of the adopted CVP will be to influence necessary changes in the culture towards resolving customer needs.

In particular, the focal company can enable process 1 through various means, such as investment in research and development (R&D), development of new platforms that potentially create multi-sided markets and connect sellers and buyers directly (Adner, 2017), networks that play the role of sharing knowledge, resources and information (Fuentelsaz & Gómez, 2006; Hendrikse et al., 2015), and alliances that help members expand their market exposures (Nohria & Garcia-Pont, 1991). By enabling process 1, the company can develop both tangible and intangible assets. The former may consist of such assets as superior products, innovative services and/or informational goods of extraordinary value, while the latter patents, proprietary business secrets, relationships with suppliers and distributors, etc. Similarly, the company can boost its process 2 by investing in infrastructures, such as capital assets (Robins, 1992), intelligent manufacturing (Acemoglu & Restrepo, 2016), etc. Such investments lead to tangible assets that materialistically support the infrastructure and healthy operation of the supply-chain ecosystem of the company. And, investment in process 3 helps nurture brand development and customer-installed base and enhances the customer-based market territory, leading jointly to market-based assets, such as brand reputation, customer loyalty and market share (Pyper et al., 2019; Williams & Naumann, 2011; *Khantimirov,* 2017).

When the company is more able than its rivals to sense market signals, to coordinate, integrate and streamline works both internally and externally in its effort to develop customer solutions, and to disseminate information within itself and throughout the market, it surely has acquired competitive advantages and capabilities that the company can tap into to drive shareholder value.

Because CVPs might be pivotal for a company to attain a competitive advantage (Proposition 2) and might result in competitive advantages and company-specific capabilities when appropriately supported financially (Proposition 3), a natural question the following section addresses is: how can one evaluate the value added by implementing a particular CVP?

4.2. Evaluation of the Value Added by a Particular CVP

Because the effect of implementing a particular CVP tends to be long term across at least several accounting periods, the value added from instigating the CVP can be theoretically estimated as follows:

Proposition 4. Let E_t stands for the mathematical expectation as of period t, δ the rate of physical depreciation of the capital invested in the implementation of a CVP, D_{t+1} and d_{t+1}, respectively, the relevant stochastic dividends and gross discount rate at t for dividends received in period (t + 1), and V_{t+1} the value added for period $t+1$. Then the value added V_t for period t after initial implementation of a particular CVP can be theoretically estimated as follows:

$$V_t = E_t\left(\frac{D_{t+1} + (1-\delta)V_{t+1}}{d_{t+1}}\right) \tag{7}$$

$$= E_t\left(\frac{D_{t+1}}{d_{t+1}} + (1-\delta)\frac{D_{t+2}}{d_{t+1}d_{t+2}} + (1-\delta)^2\frac{V_{t+2}}{d_{t+1}d_{t+2}}\right) \tag{8}$$

$$= E_t\left(\frac{D_{t+1}}{d_{t+1}} + (1-\delta)\frac{D_{t+2}}{\prod_{i=1}^{2} d_{t+i}} + (1-\delta)^3\frac{D_{t+3}}{\prod_{i=1}^{3} d_{t+i}} + (1-\delta)^3\frac{V_{t+3}}{\prod_{i=1}^{3} d_{t+i}}\right) \tag{9}$$

$$= \cdots,$$

where the values of D_{t+i} and d_{t+i} are known in period t, for i = 1 in equation (7), for i = 1, 2, in equation (8), and i = 1, 2, 3, in equation (9).

In fact, to estimate the value added by implementing a CVP, there are many well-established valuation approaches, such as price/earnings multiples, market/book-value ratio, economic value added (EVA), market value added (MVA), shareholder value (SHV), and others. Considering the fact that the effect of an adopted CVP tends to be longer lasting than just one or two time periods, among these approaches, only those based on cash flow, such as EVA and SHV, will be more appropriate (Grant, 2003; Fernando et al., 2017) for our purpose of estimation. In comparison, the EVA approach is able to link compensation and incentive systems to factors that help create economic value added when it is combined with associated value-based management approaches. Even so, it is mostly near-term determined without paying much attention to growth potential and intangible assets (Grant, 2003). On the other hand, SHV is calculated as the net present value of all projected future cash flows that will be created by the business processes related to the particular CVP.

According to Bernanke and Gertler (1999) and Forrest et al. (2013), the market value of an investment or a project or a business initiative, collectively known as a depreciable capital, is reflected in the net present value of all future cash flows expected to accrue throughout the indefinite future (or until the ending moment of the investment). Symbolically, the market value V_t in period t is given by

$$V_t = E_t\left(\sum_{i=0}^{\infty}\left[\frac{(1-\delta)^i D_{t+1+i}}{\prod_{j=0}^{i} d_{t+1+j}}\right]\right)$$
$$= E_t\left(\frac{D_{t+1}}{d_{t+1}} + \frac{(1-\delta)^1 D_{t+2}}{d_{t+1}d_{t+2}} + \frac{(1-\delta)^2 D_{t+3}}{d_{t+1}d_{t+2}d_{t+3}} + \cdots \frac{(1-\delta)^{k-1} D_{t+k}}{\prod_{i=1}^{k} d_{t+i}} + \cdots\right) \quad (10)$$

where D_{t+i} and d_{t+i} stand respectively for the relevant stochastic dividends and gross discount rate at t for dividends received in period (t + i). Then, equation (10) can be rewritten as follows:

$$V_t = E_t\left[\frac{D_{t+1}}{d_{t+1}} + \frac{(1-\delta)}{d_{t+1}}\left(\frac{D_{t+2}}{d_{t+2}} + \frac{(1-\delta)^1 D_{t+3}}{d_{t+2}d_{t+3}} + \cdots \frac{(1-\delta)^{k-2} D_{t+k}}{\prod_{i=2}^{k} d_{t+i}} + \cdots\right)\right]$$
$$= E_t\left(\frac{D_{t+1}}{d_{t+1}} + \frac{(1-\delta)}{d_{t+1}} V_{t+1}\right), \text{ if values of } D_{t+1} \text{ and } d_{t+1} \text{ are known}$$
$$= E_t\left(\frac{D_{t+1} + (1-\delta)V_{t+1}}{d_{t+1}}\right), \text{ if values of } D_{t+1} \text{ and } d_{t+1} \text{ are known.}$$

This end proves equation (7). To show equations (8) and (9), …, we only need to repeatedly apply equation (7) on itself by consecutively substituting the following, as obtained from equation (7), into equation (7) with the appropriate assumptions on D_{t+i} and d_{t+i}:

$$V_{t+1} = E_t\left(\frac{D_{t+2} + (1-\delta)V_{t+2}}{d_{t+2}}\right) \text{ and } V_{t+2} = E_t\left(\frac{D_{t+3} + (1-\delta)V_{t+3}}{d_{t+3}}\right).$$

Hence, Proposition 4 is established.

5. Materialization of a CVP's Impacts

The practical significance of value estimation in equation (7) is accentuated by the proportions, such as V_{t+1}, V_{t+2}, …, of the future value that is based on perceived growth potential and associated risks, as reflected in the stochastic dividends D_{t+i} and stochastic gross discount rate d_{t+i}, for i = 1, 2, 3, … Hence, a practical challenge is how to demonstrate and measure the expected value V_t created by resources devoted to the implementation of a particularly adopted CVP in terms of their impact on current outcomes and on perceptions of future financial performance.

5.1. Demonstration of the Impact of an Adopted CVP

Although challenges abound in regarding the practical measurement of the impact of an adopted CVP on value creation and capture, equations (7) – (9) do provide some clear clues, as those stated in the following Propositions 5 through 8.

Proposition 5. All effort devoted to the implementation of a particular CVP needs to accelerate cash flows with earlier cash flows preferred to later ones.

The reason behind this conclusion is that the factor $(1-\delta)$ is a number between 0 and 1 so that the sequence of positive numbers $(1-\delta)$, $(1-\delta)^2$, $(1-\delta)^3$, … is of drastically decreasing magnitudes. That means distant future contributions of the devoted resources to the present value of the CVP become increasingly minor and ignorable. Additionally, the present era of the globalizing economy has made once sustainable competitive advantages transient and short lived (McGrath, 2013). The consequent accelerating change in the marketplace makes expectations of long-term values more uncertain and much riskier than ever before. Jointly, all these factors reduce the scale of value contribution of later cash flows.

In terms of the three essential macro-level operating processes, a company can materially accelerate its cash flows by

- Improving its learning and absorbing capabilities, keeping up with technology updates, quickly converting market invitations into market offers;
- Communicating effectively with partners within the supply-chain ecosystem so that upstream suppliers can timely provide necessary components and downstream complementors can adequately construct the needed infrastructure for customers to make their adoptions;
- Shortening the time for market acceptance by effective marketing and by actively involving customers in market solution development.

Proposition 6. The investment in the implementation of a particular CVP, in the forms of working capital, fixed investments, equipment, real estate properties, etc., needs to be minimized, while revenues increased.

The logic behind this conclusion directly comes from equations (7) – (9), where "revenues" are reflected in the periodic "dividends" D_{t+1}, D_{t+2}, D_{t+2}, …, and "investment" in the "rate of physical depreciation" of the capital invested δ. In other words, the net present value V_t of the adopted CVP will assume a greater value when the numerators in equations (7) – (9) are larger, while the factors $(1-\delta)$, $(1-\delta)^2$, $(1-\delta)^3$, …, are closer to 1.

In terms of the three essential macro-level operating processes, a company can materially minimize its investment in the implementation of an adopted CVP while increasing revenue by

- Differentiating its offers from those provided by rivals through
  - Innovation of new offers and cannibalizing existing ones;
  - Reflecting customer feedbacks in improved and new offers;
  - Sharing resources and knowledge among different departments;
  - Acquiring most updated technologies; and

    - Reducing costs.
- Reengineering supply-chain processes and increasing the communication efficiency with supply-chain partners in order to
    - Cut down the rate of problem incidences;
    - Receive perfectly expected components from upstream suppliers;
    - Speed up the time for new offers to reach the end users by working with downstream complementors;
    - Minimize unnecessary costs, while reducing capital investments;
    - Reduce inventories and enhance capacity use.
- Maximizing CV and company revenue by
    - Assembling customer demands into customer solutions through competitive market offers and follow-up services;
    - Building branded offers and superior service;
    - Bundling and marketing individual offers into packages;
    - Developing and refining customer bases;
    - Lowering costs, such as those related to product launches, sales and services.

5.2. Risk and Value in the Implementing of a CVP

Uncertainties associated with the stochastic quantities D_{t+i} and d_{t+i}, i = 1, 2, 3, …, need to be reduced as much as possible so that expectations of the future, that is, the later terms in equations (7) – (9), can more assuredly stay around expected values. In practical terms, this end implies that volatilities and vulnerabilities associated with periodic future cash flows, such as the cost of capital, need to be reduced and possibly minimized. Therefore, we have

Proposition 7. The implementation of a particular CVP needs to aim at reducing the risk associated with cash flows.

In relation to the three essential macro-level operating processes, a company can materially reduce the risk associated with cash flows through

- Adopting an organizational culture that supports flexibility and change necessary for successfully riding the wave of transient competitive advantages so that
    - The rate of innovation can be ramped up to stay in sync with the fast-evolving market demands and forever changing consumer preferences so that market-driven offers are designed, produced, and provided to the market in a timely fashion;
    - Technology and strategic networks and alliances are formed to share resources, information and knowledge, and to establish market-driven standards, leading market position;

    - Beyond exploiting remaining values of existing offers, the focus of business moves towards the creation of unprecedented differentiations and innovative offers, such as products that are hard to imitate, unique bundles of products and services, etc.;
    - The synergies within portfolios of offers and between production and consumption are maximized so that dynamic market demands and consumer preferences are met.
- The communication and association with supply-chain partners are optimized so that desired components can be provided and innovative offers can efficaciously reach the end users. In particular,
    - Desired innovative components are designed jointly with upstream suppliers by considering their technological capabilities so that the expected supplies can be realistically delivered;
    - Associations with distributors are entangled through using such programs as services, incentives, and loyalties so that their switching costs will be high, while competitions among and within delivery channels are proactively managed;
    - Processes of supply and delivery are designed and configured in such a way that they are difficult for rivals to imitate;
    - Production and order delivery systems are integrated in such a way that they are flexible and demand-driven, and constantly changing market signals are opportunely incorporated into production-related decisions;
- CV is maximized dynamically in concert with customer changing preferences and tastes. To accomplish this end, for example, a company can employ any of the following strategies:
    - Customer needs are configured into the features of market offers;
    - Products and services are bundled together so that customer switching cost will be high by, for example, providing price concessions for long-term delivery contracts;
    - Intangibles and experiential attributes are designed and delivered to boost customer satisfaction;
    - Market-based assets, such as value networks, online blogs, etc., are optimally leveraged through, for example, customer education and training programs;
    - Flexible selling methods are utilized, such as leasing programs, cross-sales or cross-leasing of bundled parts, consumables, and complementary services, etc.

Proposition 8. The implementation of a particular CVP needs to augment the long-term overall value of the business of the underlying company.

This conclusion follows directly from the fact that the current globalizing economy is in the era of transient competitive advantages (McGrath, 2013). In this era, market demands and consumer preferences make an adequate CVP today quickly obsolete tomorrow. Such fast-evolving business environment forces business companies to ride

waves of short-lived competitive advantages for survival and development. For achieving this end objective, the implementation of an adopted CVP needs to help grow the underlying business enterprise in order for it to gain additional strength to surf the next tidal wave of advantages through developing flexible, while more powerful, operating processes that result in assets, be they tangible or intangible.

6. Conclusion

Although CVPs represent extremely important strategic tools for companies to create and capture value, the current state of affairs is that the relevant concepts remain poorly defined, casually tossed about and applied trivially, as revealed by Payne et al. (2017). To help grow a systematic knowledge on CVPs while lifting the scattered studies on related topics, this work positively contributes to the development of a theoretically rigorous and practically useful theory of CVPs for scholars and front-line decision makers. To accomplish this goal, this work chooses a calculus-based analytical approach as the method of reasoning, instead of any statistics-based logic. Because of this reason, all established conclusions in this paper are free from the limitations of data and anecdotal analyses, as widely used in the literature. In particular, this work establishes the following generally-true theoretical results among others:

- If a company adopts a CVP to further its level of accomplished market success, then the specific CVP has to be connected to the company's stated mission and long-term, unwavering ambition, and demands tasks to be accomplished through coordination, integration and streamlining of relevant works within the following essential processes: process 1, 2, and 3 (Proposition 1).
- The value V_t added for period t after initial implementation of a particular CVP can be theoretically estimated as the expected sum of the present values of periodic future returns (Proposition 4).
- The implementation of a CVP needs to accelerate cash flows with preference given to earlier ones (Proposition 5), relevant investments minimized while revenues increased (Proposition 6).

6.1. Managerial Recommendations

Within the present landscape of managerial exercises, commonly employed (Duan et al., 2019; McGrath, 2013) are implementing best practices and making data-driven decisions. However, consequences of the former approach can fluctuate widely, while the logic underlying the latter tactic is generally not valid in any setting different from where and when the data were originally collected. Because of these reasons, the practical significance of this work exposes itself vividly through providing general recommendations instead of suggestions for decision-making managers and entrepreneurs. For example, the theoretical results developed in this paper naturally lead to the following recommendations for general managerial purpose.

- Each company needs to develop its specific CVP according to its clearly stated mission and a long-term, unwavering ambition, while any adopted CVP has to be developed on an innovative comprehension of a market invitation with sufficient market depth (Propositions 1 and 2);
- When implementing a CVP, a company needs to aim at developing new competitive advantages by investing in its essential operating processes 1 – 3, while prior due-diligence needs to be given to estimate expected returns (Propositions 3 and 4);
- When planning to adopt a CVP, a company needs to aim at augmenting its long-term overall business value, accelerating periodic cash flows, while minimizing the relevant investment and associated risks (Propositions 5 – 8).

6.2. Limitations and Questions for Future Research

The logical reasonings underneath all established results in this paper implicitly assume that the financial solvency of each company considered here is guaranteed by positive cash flows from market exchanges between the company's offerings in the marketplace and customer purchases. However, in today's business landscape, such an assumption is no longer generally true (Li & Ma, 2015). So, a series of important questions for future research will include: for a company that is not established for this assumed purpose, how can one derive generally true results corresponding to the ones derived in this paper? What practically useful recommendations will these new conclusions lead to for front-line decision makers?

Another set of important questions for future research is related to big data, which have been affecting strategic decisions of various companies of different success levels (Duan et al., 2019; McGrath, 2013). However, as pointed out earlier in this section and by Lin and OuYang (2010), the logic behind such decision tactic is not scientifically sound. So, before implementing a recognized best practice and before making any decision based on a discovered data-pattern, it is theoretically and practically important to demonstrate their generality and common existence.

7. References

Acemoglu, D., Restrepo, P. (2016), *The race between man and machine: Implications of technology for growth, factor shares, and employment*. NBER Working Papers No.22252.

Adner, R. (2017), *Ecosystem as Structure: An Actionable Construct for Strategy.* Journal of Management, Vol. 43, no. 1, pp. 39-58.

Adner, R., Oxley, J.E., Silverman, B.S. (eds.) (2013): *Collaboration and Competition in Business Ecosystems*. Emerald: Bingley, UK.

Anderson, J.C., Narus, J.A. (1998), *Business marketing: Understand what customers value*. Harvard Business Review, Vol. 76, no. 6, pp. 53–65.

Ballantyne, D., Frow, P., Varey, J.R., Payne, A. (2011), *Value* propositions as communication practice: Taking a wider view. Industrial Marketing Management, Vol. 40, no. 2, pp. 202-210.

Bernanke, B.S., Gertler, M. (1999), *Monetary policy and asset price volatility*. Economic Review, Federal Reserve Bank of Kansas City, fourth quarter, pp. 17–51.

Bernheim, B.D., Whinston, M.D. (1990), *Multimarket contact and collusive behavior*. RAND Journal of Economics, Vol. 21, no. 1, pp. 1-26.

Blocker, C.P. (2011), *Modeling* customer value perceptions in cross-cultural business markets. Journal of Business Research, Vol. 64, no. 5, pp. 533-540.

Carlson, C., Polizzotto, L., Gaudette, G.R. (2019), *The "NABC's" of value propositions*. IEEE Engineering Management Review, Vol. 47, no. 3, pp. 15-20.

Clarke, I., III. (2001), *Emerging value propositions for M-commerce*. **Journal of Business Strategies, Vol. 18, no. 2,** pp. 133-148.

Day, G.S. (1994), *The capabilities of market-driven organizations*. Journal of marketing, Vol. 58, no. 4, pp. 37-52.

Duan, Y.Q., Edwards, J.S., Dwivedi, Y.K. (2019), *Artificial* intelligence for decision making in the era of Big Data – evolution, challenges and research agenda. International Journal of Information Management, Vol. 48, no. October, pp. 63-71.

Fernando, C.S., Sharfman, M.P., Uysal, V.B. (2017), *Corporate Environmental Policy and Shareholder Value: Following the Smart Money*. Journal of Financial and Quantitative Analysis, Vol. 52, no. 5, pp. 2023-2051.

Forrest, J.Y-L., Buttermore, J., Wajda, T. (2017), *At Nash equilibrium when new market competitions appear*? Kybernetes: The International Journal of Cybernetics, Systems and Management Sciences, Vol. 46, no. 2, pp. 256–271.

Forrest, J.Y-L., Hopkins, Z., Liu, S. F. (2013), *Currency wars and a possible self-defense (I): How currency wars take place*. Advances in Systems Science and Application, Vol. 13, pp. 198-217.

Forrest, J.Y-L., Orvis, B. (2016), *Principles of management efficiency and organizational inefficiency*. Kybernetes: The International Journal of Cybernetics, Systems and Management Sciences, Vol. 45, no. 8, pp. 1308-1322.

Forrest, J.Y-L., Tucker, R., Lin, C.C., Mondal, S. (2018), *Impacts of manufacturing firms' culture, structure and leadership on innovation: A systemic approach*. Proceedings of the 2018 Annual Conference of NABET, pp. 95-120.

Frow, P., Payne, A. (2011) *A stakeholder perspective of the value proposition concept*. European Journal of Marketing, Vol. 45no. 1-2, pp. 223-240.

Fuentelsaz, L., Gómez, J. (2006), *Multipoint competition, strategic similarity and entry into geographic markets*. Strategic Management Journal, Vol. 27, no. 5, pp. 477-499.

Grant, J.I. (2003): *Foundations of Economic Value Added*. Wiley, New York.

Hendrikse, G., Hippmann, P., Windsperger, J. (2015), *Trust, transaction costs and contractual incompleteness in franchising*. Small Business Economics, Vol. 44, no. 4, pp. 867-888.

Holttinen, H. (2014), *Contextualizing* value propositions: Examining how consumers experience value propositions in their practices. Australian Marketing Journal, Vol. 22, no. 2, pp. 103-110.

Hsieh, K.Y., Vermeulen, F. (2014), *The structure of competition: How competition between one's rivals influences imitative market entry*. Organization Science, Vol. 25, no. 1, pp. 299-319.

Khantimirov, D. (2017), *Market share as a measure of performance: Conceptual issues and financial accountability for marketing activities within a firm*. Journal of Research in Marketing, Vol. 7, no. 3, pp. 587-592.

Kotler, P. (1977), *From sales obsession to marketing effectiveness*. *Harvard Business Review*, Vol. 55, no. 6, pp. 67-75.

Kowalkowski, C. (2011), *Dynamics of value propositions: Insights from service-dominant logic*. European Journal of Marketing, Vol. 45, no.1/2, p. 277-294.

Lanning, M., Michaels, E. (1988), *A business is a value delivery system*. McKinsey Staff Paper No. 41, July.

Li, T., Ma, J.H. (2015), *Complexity analysis of dual-channel game model with different managers' business objectives*. Communications in Nonlinear Science and Numerical Simulation, Vol. 20, pp. 199-208.

Lin, Y., OuYang, S.C. (2010): *Irregularities and Prediction of Major Disasters*. CRC Press, New York.

McGrath, R.G. (2013): *The end of competitive advantage: How to keep your strategy moving as fast as your business*. Harvard Business Review Press, Boston.

Nohria, N., Garcia-Pont, C. (1991), *Global strategic linkages and industry structure*. Strategic Management Journal, Vol.12, Summer Special Issue, pp.105-124.

Parasuraman, A. (1997), *Reflections on gaining competitive advantage through customer value*. Journal of the Academy of Marketing Science, Vol. 25, 154. https://doi.org/10.1007/BF02894351

Payne, A., Frow, P., Eggert, A. (2017), *The customer value proposition: evolution, development, and application in marketing*. Journal of the Academy of Marketing Science, Vol. 45, pp. 467-489.

Pyper, K., Doherty, A.M., Gounaris, S., Wilson, A. (2019), *Investigating international strategic brand management and export performance outcomes in the B2B context*. International Marketing Review, Vol. 37, no. 1, pp. 98-129.

Randall, W.S., Defee, C.C., Brady, S.P. (2010), *Value Propositions of the U.S. Trucking Industry*. *Transportation Journal, Vol. 49, no. 3, pp.* 5-23.

Rintamäki, T., Kirves, K. (2017), *From* perceptions to propositions: Profiling customer value across retail contexts. Journal of Retailing and Consumer Services, Vol. 37, no. July, pp. 159-167.

Rintamaki, T., Kuusela, H., Mitronen, L. (2007), *Identifying competitive customer value propositions in retailing*. Managing Service Quality, Vol. 17, no. 6, pp. 621-634.

Robins, J.A. (1992), *Organizational considerations in the evaluation of capital assets: Toward a resource-based view of strategic investment by firms*. Organization Science, Vol. 3, no. 4, pp. 442-562.

Sheehan, N.T., Bruni-Bossio, V. (2015), *Strategic* value curve analysis: Diagnosing and improving customer value propositions. Business Horizons, Vol. 58, no. 3, pp. 317-324.

Smith, A.M. (2013), *The value co-destruction process: a customer resource perspective*. European Journal of Marketing, Vol. 47, no. 11/12, pp. 1889-1909.

Srivastava, R.K., Shervani, T.A., Fahey, L. (1999), *Marketing, business processes, and shareholder value: An organizationally embedded view of marketing activities and the discipline of marketing*. Journal of Marketing, Vol. 63, no. 4, pp. 168-179.

Williams, P. Naumann, E. (2011), *Customer satisfaction and business performance: a firm-level analysis*. Journal of Services Marketing, Vol. 25, no. 1, pp. 20-32.

Wouters, M. (2010), *Customer value propositions in the context of technology commercialization*. International Journal of Innovation Management, Vol. 14, no. 6, pp. 2099-1127.

Wouters, M., Kirchberger, M.A. (2015), *Customer* value propositions as interorganizational management accounting to support customer collaboration. Industrial Marketing Management, Vol. 46, no. April, pp. 54-67.

Yrjölä, M. (2015), *Uncovering executive prioritization: Evaluating customer value propositions with the pairwise comparison method*. Journal of Service Science and Management, Vol. 8, no. 1, 10.4236/jssm.2015.81001.

Zhang, T.C., Gu, H.M., Jahromi, M.F. (2019), *What* makes the sharing economy successful? An empirical examination of competitive customer value propositions. Computers in Human Behavior, Vol. 95, no. June, pp. 275-283.

Zheng, C.D., Yu, X.F., Jin, Q.M. (2017), *How user relationships affect user perceived value propositions of enterprises on social commerce platforms*. Information Systems Frontiers, Vol. 19, pp. 1261-1271.

Appendix: Normalization of Boundary Conditions for Theorem 1

For incumbent company i, let its cost of production and loyal customers' reservation price be respectively C_i and R_i. Then the company's price P_i for its market offer satisfies $C_i \le P_i \le R_i$, assuming that each company considered in this paper exists for the sole purpose of satisfying a market demand by positive cash flows produced from the product marketplace. Hence, we have $P_i = C_i + \alpha_i(R_i - C_i)$, for some $0 \le \alpha_i \le 1$. So, in real life, the incumbent companies compete with each other by adjusting this parameter α_i. Without loss of generality, we treat α_i as the price of company i, and still denoted it by P_i. By doing so, we normalize each production cost to 0 and each reservation price to 1.

No matter how successful a company is, its operation is always constrained by its unique boundary conditions. Assume that the offers of the incumbent companies are influenced by factors x_1, x_2, x_3, … Then the magnitude M_i of company i's loyal customer base has to be bounded by an upper limit $U_i(x_1, x_2, x_3, \dots)$ and lower limit $L_i(x_1, x_2, x_3, \dots)$. That is, we have $M_i = L_i(x_1, x_2, \dots) + x_i[U_i(x_1, x_2, \dots) - L_i(x_1, x_2, \dots)]$, for $0 \le x_i \le 1$. So, instead of using M_i we can use x_i as the normalized magnitude of company i's loyal customer base with the lower boundary condition set to 0 and upper boundary to 1. Let $y = 1 - \sum_{i=1}^{m} x_i$ be the magnitude of the consumer surplus.

After applying all the normalizations above, it can be shown readily that in Nash equilibrium, the given oligopoly market does not have any pure strategy of pricing for the incumbent companies (Forrest et al., 2017). At the same time, the magnitudes of loyal-customer bases and the price distribution $F_i(P)$ of company i satisfy

$$F_i(P) = 1 - \frac{1}{x_k}\left(\frac{(1-P)\prod_{i=1}^{m} x_i}{yP}\right)^{\frac{1}{m-1}}, F_i(1) = 1 \text{ and } F_i\left(\frac{x_i}{x_i + y}\right) = 0 \tag{11}$$

In fact, in the game the incumbent companies play, company i's objective is to choose $F_i(P)$ so that the following expected profits $E(\Pi_i)$ will be maximized:

$$E(\Pi_i) = \int_{-\infty}^{+\infty} \left\{ x_i P + \prod\nolimits_{k=1, k\neq i}^{m} [1 - F_k(P)]\, yP \right\} dF_i(P). \tag{12}$$

The equilibrium indifference condition for company i

$$x_i P + \prod\nolimits_{k=1, k\neq i}^{m} [1 - F_k(P)]\, \beta P = x_i, i = 1, 2, 3, \dots \tag{13}$$

implies $1 - F_j(P) = x_i[1 - F_i(P)]/x_j$, $i, j = 1, 2, 3, \dots, m$. Substituting this expression into equation (13) produces equation (11), where the last equation comes from the fact that company i likes to attract as many switchers as possible to potentially increase its profits from the guaranteed level x_k from its loyal consumers by charging them the reservation value 1. So, $x_i P + yP \ge x_i$, which means $P \ge x_i/(x_i + y)$. So, the last part of equation (11) follows.

Next, we show $x_i = x_j$, for $i, j = 1, 2, 3, \dots, m$, by contradiction. Assume that there are $i, j\ (= 1, 2, 3, \dots, m)$ such that $x_i \neq x_j$. Let $x_k = \max\{x_1, x_2, \dots x_m\}$ and choose k_0 satisfying $1 \leq k_0 \leq m$ such that $x_k > x_{k_0}$. Then, the expected profits of company k, equation (12), in Nash equilibrium are

$$E(\Pi_k) = \left(\prod\nolimits_{j=1, j\neq k}^{m} x_j\right)^{\frac{1}{m-1}} \geq x_k = \left(\underbrace{x_k x_k \dots x_k}_{m-1 \text{ times}}\right)^{\frac{1}{m-1}},$$

where the inequality becomes from the assumptions about the loyal consumers. But, this end contradicts the following based on the assumptions of x_k and x_{k_0}:

$$\left(\prod\nolimits_{j=1, j\neq k}^{m} x\right)^{\frac{1}{m-1}} < \left(\underbrace{x_k x_k \dots x_k}_{m-1 \text{ times}}\right)^{\frac{1}{m-1}} = x_k.$$

Therefore, we must have $x_i = x_j$, for $i, j = 1, 2, 3, \dots, m$,