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EDITORIAL NOTES

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In the web publication of JBET, the editors have chosen to present JBET in a single column (margin-to-margin) instead of the traditional two-column presentation of an academic journal. We have done this to enhance readability in the web presentation.

The Editors thank the officers of the National Association of Business, Economics and Technology, the NABET Executive Board, as well as the referees for their support in the production of this 28th Volume of JBET.

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SPECIAL FEATURE ARTICLE

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ABSTRACT

By assuming that a consumer's consumption preferences are merely reflexive, this paper investigates three topics, two of which are fundamental in the conventional theories of economics. The first topic is about how a consumer's set of all possible consumptions can be characteristically represented and how his preference relation can have real-valued utility representation. The second topic is on various convexities of preference relations and under what conditions a particular type of convexity appears. The third topic is on the examination about how the preference relation and order of real numbers of a consumer are related to each other. For the former two topics, a good number of results have been developed for the case that each consumer can completely order his consumption possibilities, while the ordering satisfies the condition of transitivity. Other than revealing the fact that most revisited results, well known in the present consumer theory, are not generally true, this paper establishes a series of brand-new conclusions.

INTRODUCTION

This paper represents a small step towards the goal of reestablishing the conventional consumer theory by taking the realistic assumption that a consumer's consumption preferences are merely reflective without the general completeness and transitivity (e.g., Forrest et al., 2021a; Ok, 2002). By assuming only reflectivity, many theoretical results, previously developed on the assumption that a consumer's preference relation is reflexive, transitive and complete, regarding consumer behaviors become statements that are not generally true (Dubra & Ok, 2002; Forrest et al., 2021a, b; 2023; 2024; Hervés-Beloso & Cruces, 2019).

Materializing the goal of reestablishing the conventional consumer theory is very important in terms of producing practical use values. In particular, each consumer is a form of life. To survive, he needs to simultaneously satisfy his basic, physiological needs in multiple different dimensions. The need for having a roof over the head, the respective needs for sufficient supplies of water and food, etc., cannot be compared by using his preferences. There are many instances in real life that demonstrate such multidimensionality in the need of various incomparable consumption choices. For example, other than comparing academic qualities offered by university programs and their faculties, the multidimensionality of living a fulfilling life makes most U.S. college students value living amenities, including spending on campus activities, sports, and dormitories, more than academic aspects of the campus life. It is found that only a small number of high-achieving students are concerned with different indicators of academic worthiness (Jacob et al., 2018). Heuristically speaking, when two consumption possibilities from different dimensions of physiological needs of survival are presented, the consumer will not be able to tell which one of them is preferred to the other.

Although the consumption preferences of a consumer cannot really rank each pair of consumption alternatives in real life, the assumption of the opposite has prolifically led to countlessly many theoretical reasonings and practical applications (Mas-Colell et al., 1995). Therefore, to help develop truly useful economic theories, it is important both theoretically and practically to materialize the previously described goal with basic assumptions closer to situations of real life than the ones widely adopted currently in the conventional theories.

Regarding the methodology used here, this paper continues the tradition started by Debreu (1959) through employing Euclidean spaces as the basic language, vocabulary, and reasoning. Because of the usage of this methodology, we are able to find that most of the well-known conclusions of the consumer theory visited here no longer hold true, while establishing a series of new results. By basing on individual's systems of values and beliefs, this paper introduces the concept that each consumer has its own particular way to order real numbers and explains how a set of indicators, instead of real numbers, can be used to represent utilities. Enriching the literature, this paper shows, among other results, that for each consumer, (i) there is a set of preference representations, (ii) each preordered maximal chain of consumption possibilities has a continuous real-valued utility representation, (iii) under specific conditions,

consumption preferences are of the convexity of various kinds, and (iv) the preference relation and order of real numbers are consistent of each other when certain specific conditions hold true.

The contribution this paper makes to literature can be examined on both theoretical and practical fronts. For the former, other than developing analytical conclusions, it clearly shows that to make results of economics relevant to real life, the amounts of inputs and those of outputs should not be exactly numbers. Instead, they should be interval qualities (for details, see Example 1 below). Regarding the utility representation of a consumer's preferences, this paper presents a brand new approach different from that of Efe Ok and his colleagues, making our conclusions more readily fathomable behaviorally than those derived by Ok's team (e.g., Evren & Ok, 2011; Nishimura & Ok, 2016; Ok, 2002; Ok & Masatlioglu, 2007). And, for the latter front, the allowance of individually different orders of real numbers naturally makes conclusions established herein conveniently applicable to practical circumstances that are judged by an outside standby to be irrational and/or non-optimizing (Taylor, 1989).

The rest of this paper is organized as follows. Section 2 provides a brief literature review and other related preparations for the rest of this presentation. Section 3 provides a new way to represent consumption preferences and generalizes the classical Debreu's existence theorem of continuous utility functions. Section 4 examines the topic of preferences of various convexities. Section 5 investigates how a consumer's preferences of consumption, and his order of real numbers coexist consistently. Section 6 concludes the paper with several remarks and topics that are important for future research.

PREPARATION

This section prepares the reader to smoothly follow the flows of analysis and reasoning for the sections below. It consists of three subsections with the first one devoted to literature review and how this work is relevant. The second subsection entails the basics of individuals' systems of values and beliefs. The third subsection lays down the symbolic foundations for the following logical reasoning and analysis to develop.

Literature Review

In terms of utility representations of possible consumptions, it was assumed before the 20th century that to every consumption bundle, a consumer can use a real number to reflect his level of satisfaction (or utility) when he consumes the bundle. To avoid the difficulty of practically measuring utilities, Fisher (1892), Pareto (1906) and others adopted a different approach – simply rank consumption alternatives – so that utility no longer needed to be numerically measurable (Strotz, 1953). By assuming that all available consumption alternatives can be completely ordered and satisfy the property of transitivity, Wold (1943), Debreu (1959) and many others began to study the conditions under which a utility function can represent the ranking of a consumer's preferences. And then, various refinements and generalizations were derived (e.g., Hervés-Beloso & Cruces, 2019; Mehta, 1998). Enriching this literature, the current paper generalizes Debreu's (1959) existence theorem, while imposing a particular condition based on the most recent development in mathematics (Lin, 2008).

Regarding the concept of convex consumer preferences, it plays an important role in consumer theory. There are a huge number of related studies either in theory or in applications (Jehle & Reny, 2000; Mas-Colell et al., 1995; Silberger, 2000; Simon, & Blume, 1994). Beyond being a tool for analytical reasoning, this concept also exhibits the characteristic of consumer behaviors – consumers tend to prefer a balanced diversification of commodity consumptions to any unbalanced bundle.

This work revisits some of the elementary properties of convex preferences of the following types: weak convexity, convexity, and strong convexity. Doing so naturally leads to generalized properties that hold true for incomplete and nontransitive preference relations. As for the part of this paper that investigates the close relationship between and consumer's preference relation and his particular order of real numbers, what are established here generalize what are known before (e.g., Debreu, 1959) to the case of preferences that are not complete and nontransitive.

The Focal Consumer and His Set of Consumption Possibilities

The term "consumer" stands for an individual person, a household, or a group of people which chooses and carries out a consumption plan, or simply a consumption, selected now for the present moment and the entire future (Debreu,

1959; Forrest et al., 2021a; Levin & Milgrom, 2004; Mas-Colell et al., 1995). In particular, he specifies how much each of input commodities he consumes, and how much each of output commodities he provides, subject to a set of constraints. The constraints include those of various kinds and types. For example, to maintain survival, one has to meet the basic physiological needs, and his total consumption cannot go beyond the level of his wealth. Different from a producer, assume that each consumer facilitates transactions of purchase and sale of products, such as a house, a car, etc., and consumes services and products from others.

For the convenience of our discussion, the general consumer we consider will be known as the focal consumer. To separate inputs (i.e., those goods and services consumed by the focal consumer) from outputs (= what he offers to the world), we use positive numbers to represent the quantities of commodity inputs and negative numbers for the quantities of commodity outputs. Assume that there are ℓ many different commodities, labelled as $h = 1, 2, \ldots, \ell$. As is commonly done, assume that these positive and negative quantities are real numbers.

Let $\mathbb{R}$ be the set of all real numbers and $\mathbb{R}_+$ the set of all positive real numbers. Then, each $x \in \mathbb{R}^\ell$ is seen as a consumption possibility of the focal consumer. Let X be the consumption set of all consumptions that are considered possible for him. Then, X is completely determined by the consumer's constraints. Considering how many different commodities a person in real life consumes throughout his lifetime, each consumption $x \in X$ generally contains a relatively small number of nonzero components. Additionally, a person's typical inputs of commodities are dated and location-specific goods and services with the only outputs being dated and location-specific labors he offers. Speaking differently, in this paper, goods, services, or labors a person might consume or offer at different times and/or different locations treated as different commodities.

Let $\precsim$ be the focal consumer's preference relation defined on set X so that for any $x^1, x^2 \in X$, we have: x^1 is less preferred to x^2 (written $x^1 \precsim x^2$), or x^2 is less preferred to x^1 (written $x^2 \precsim x^1$), or x^1 is indifferent of x^2 (that is, $x^1 \precsim x^2$ and $x^2 \precsim x^1$, written $x^1 \sim x^2$), or x^1 and x^2 are $\precsim$-incomparable. For any $x \in X$, the symbol $[x]$ represents the set of all consumptions that are indifferent from x.

Individually Specific Systems of Values and Beliefs

By continuing what is started in Forrest et al. (2022), this paper also bases its reasoning on the four human endowments – self-awareness, imagination, conscience, and free will. More specifically, various factors, be they cognitive, emotional, cultural or social, are all related to these natural human endowments, on which individuals in turn establish their systems of values and beliefs (Lin & Forrest, 2012). Hence, it is appropriate for us to employ human endowments and systems of values and beliefs as the starting points in the development of economic theories.

This approach generalizes the most adopted economic models developed on the assumed existence of such a rational and selfish homo economicus who has the capability to carry out unlimited number of computations and makes no mistakes (Cartwight, 2014). At the same time, it attempts to cover a much wider range of situations existent in real life. What is attempted here might seem related to positive and normative economics. However, there are fundamental differences – the latter means to examine what various economic programs, scenarios and environments are and should be (Caplin & Schotter, 2008), while our approach proposes a new way to reshape the theories of economics by originating all logical reasonings on the four human endowments, which determine individuals' systems of values and beliefs, and relevant elementary facts. If successful, it is expected that the subsequently developed theories can avoid the difficulty normative economics experiences in terms of explaining problems and issues, and that of empirical confirmations the positive economics must emphasize. This discussion suggests that by basing decision-making and related activities based on the systems of values and beliefs of economic agents, the lofty goals of behavioral economics (Zeiler & Teitelbaum, 2018) can be naturally carried forward.

Additionally, our adopted approach generalizes the long-standing convention in economics that consumers, be they individuals or firms, make their decisions by maximizing their utilities or profits. Although such an optimization-based approach can find its root in human endowments and systems of values and beliefs, it only reflects a portion of the human population. Indeed, in real life, there are individuals and firms that do not place utility/profit maximization as their primary objectives (e.g., Hussain, 2012; Jensen, 2001). For example, a good number of US chief executives have stopped implementing the mantra that firms must maximize profits for shareholders above anything else (https://opportunity.businessroundtable.org/ourcommitment/, accessed on January 30, 2021). Such managerial and

executive behaviors can be illustrated in light of the four human endowments. Specifically, the conscience underlying the thinking of these decision makers leans towards making contributions to their respective communities.

What is discussed above also supports the conception that how an individual behaves is mostly dictated by his underlying system of values and beliefs. More specific to our discussions in this paper, different systems of values and beliefs may lead to different orders of real numbers. For example, in the conventional consumer theory, $30,000 is seen as less than $3 million. However, when the concept of value-belief systems is involved, a lot of people may very well order these two amounts as $30,000 > $3 million, if it is known that the amount $30,000 is the wage income from a lawful job, while the amount $3 million is the unlawful gain from robbing a bank. Here, the different orderings of these two amounts of money stem from different systems of values and beliefs individually have.

PREFERENCE AND UTILITY REPRESENTATIONS

As the title suggests, this section studies how a consumer's consumption preferences can be represented. It also exams how Debreu's existence theorem of continuous utility function can be generalized.

Set of Preference Representations

If a subset $X^* \subseteq X$ exists such that for any x^1 and $x^2 \in X^*$, $x^1 \neq x^2 \rightarrow [x^1] \neq [x^2]$ and $X = \bigcup_{x \in X^*}[x]$, then X^* is seen as the focal consumer's set of preference representations.

Example 1. Here, a situation is constructed to show that the indifference relation $\sim$ is not transitive. For this purpose, let us fix a positive real number r and partition the set $\mathbb{R}$ of all real numbers into pairwise disjoint equivalence classes by using the modular operation $mod(r)$, where $s \in [0, r)$ is used to denote the equivalence class below:

$$s = \{x \in \mathbb{R}: s = \text{remainder of } x \div r\} = \{x \in \mathbb{R}: x\ mod(r) = s\}.$$

Intuitively, these equivalence classes can be arranged on a circle of circumference length being r, Figure 1, where the arrows signal how the classes are ordered.

For a consumption $x \in X$, let h (= 1, 2, …, ℓ) be such a particular commodity that the demanded quantity of h satisfies the following preference relation: for two demanded quantities x_h^1 and x_h^2 of commodity h, $x_h^1 \prec_{mod(r)} x_h^2$ if and only if on the shorter arc between $x_h^1\ mod(r)$ and $x_h^2\ mod(r)$, the arrow points from $x_h^1\ mod(r)$ to $x_h^2\ mod(r)$. To understand this ordering of real numbers $s \in [0, r)$, imagine the commodity as a specific nutrition the focal consumer can consume in a day with r being the ceiling the daily consumption amount cannot reach or go beyond. In this setting, for any real number $x > 0$, $x\ mod(r)$ equals the amount of the nutrition left over after the consumption of the commodity within a number of days.

Choose consumptions x^1 and $x^2 \in X$ such that

$$x_k^1 = x_k^2, k = 1, \ldots, h-1, h+1, \ldots, \ell, x_h^1 \neq x_h^2,$$

with points x_k^1 and x_k^2 (or x^1 and x^2) located on the opposite sides of a diameter of the circle in Figure 1. In other words, x^1 and x^2 are two incomparable consumptions.

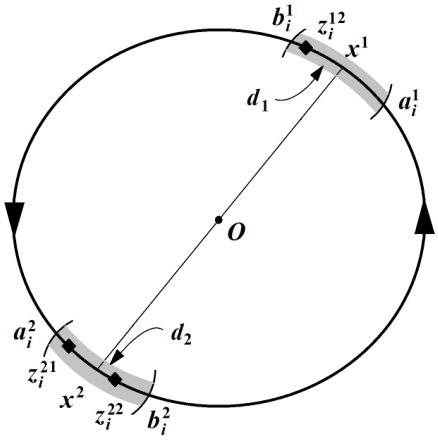

Figure 1. Quantities of a commodity that are indifferent of each other

As in real life, the demanded quantity of commodity k can never be provided for in the exactly specified amount. Hence, there are arc intervals (a_i^1, b_i^1) and (a_i^2, b_i^2), respectively, centered around x^1 and x^2, so that for any $z_i^1 \in arc(a_i^1 b_i^1)$ and $z_i^2 \in arc(a_i^2 b_i^2)$, the focal consumer has

$$z_i^1 \sim_i x^1 \text{ and } z_i^2 \sim_i x^2. \tag{1}$$

Specifically choose $z_i^{12} \in arc(a_i^1 x^1)$ and $z_i^{21}, z_i^{22} \in arc(x^2 b_i^2)$ so that $z_i^{12} \neq x^1, z_i^{21} \neq x^2 \neq z_i^{21}$ and the arc distance d_2 between x^2 and z_i^{22} is greater than the arc distance d_1 between x^1 and z_i^{12}. That is, we have

$$z_i^{12} \prec_i z_i^{21}, z_i^{21} \sim_i z_i^{22}, \tag{2}$$

and

$$z_i^{22} \prec_i z_i^{12} \tag{3}$$

Because $d_1 < d_2$ implies that the shorter arc between z_i^{22} and z_i^{12} points from the former to the latter. If the indifference relation $\sim$ is transitive, equation (2) implies that $z_i^{12} \prec_i z_i^{22}$, which contradicts equation (3). In other words, the indifference relation $\sim$ is not transitive. QED

Nontransitive indifferences in consumption preferences have been noticed by various scholars. For example, they appear when perception difficulties are considered (Luce, 1956), or when similarities are compared or regrets are examined in terms of procedural decision making (Loomes & Sugden, 1982; Rubinstein, 1988), or when time inconsistencies, as caused by relative time discounting, are looked at (Ok & Masatlioglu, 2007; Roefofsma & Reed, 2000). Contrasting to the empirical nature of the previous works, the importance of the previous example is that the general intransitivity of indifference relations can be established analytically without using data or anecdotes.

Proposition 1 (Axiom of Choice). For any chosen consumer, a set X^* of preference representations, as a subset of his/her set X of possible consumptions, exists.

Proof. The collection $\{[x]: x \in X\}$ of subsets of X surely covers X. That is, we have

$$X = \bigcup_{x \in X} [x]. \tag{4}$$

For any $x \in X$, define

$$\bar{\bar{x}} = \{y \in X: [y] = [x]\}. \tag{5}$$

Rewrite the collection $\{\bar{\bar{x}}: x \in X\}$ as

$$\{\bar{\bar{x}}_j: j \in I\}, \tag{6}$$

for some index set I so that for any $j_1, j_2 \in I$, $j_1 \neq j_2$ implies $\bar{\bar{x}}_{j_1} \neq \bar{\bar{x}}_{j_2}$.

By employing the axiom of choice, choose a representative $z_j \in \bar{\bar{x}}_j$, for each $j \in I$. Then,

$$X^* = \{z_j: j \in I\} \tag{7}$$

is a desired set of preference representations. This end is confirmed by (i) for any $j_1, j_2 \in I$, $[x_{j_1}] \neq [x_{j_2}]$, as a consequence of equation (6); and (ii) $\{\bar{\bar{z}}_j: j \in I\}$ covers X, as shown below based on equations (4) and (5):

$$X = \bigcup_{x \in X_i} [x] = \bigcup_{j \in I} \bigcup_{x \in \bar{\bar{z}}_j} [x] = \bigcup_{j \in I} \bar{\bar{z}}_j \text{ . QED}$$

The proof of the previous proposition indicates that the existence of X^* is not unique. In practical applications, a consumer generally employs a convenient set of preferred commodities from different areas of life as basic marks of measurement for preferences. In other words, using such as set X^* to determine if a specific consumption is preferred is indeed natural when compared to that of real-valued utility representations.

In terms of literature, Proposition 1 generalizes the corresponding results in Forrest et al. (2021a), where the set of preference representations is introduced for preordered preference relations.

Continuous Utility Representation

One of the most fundamental theorems of economics is that every consumption preference relation has a continuous utility representation (Mas-Colell et al., 1995), as initially shown by Debreu (1959). However, one of the key assumptions for this important theorem to hold – the consumption preferences of a consumer completely preorder his set of possible consumptions – is no longer assumed here in this paper. To face this challenge, Efe Ok and his colleagues have used various collections of real-valued functions to replace the classical one-function representation, leading to symbolically beautiful conclusions that are difficult to interpret behaviorally (e.g., Dubra & Ok, 2002; Evren & Ok, 2011; Nishimura & Ok, 2016; Ok, 2002; Ok & Masatlioglu, 2007). To avoid such practical predicament, instead of employing groups of real-valued representative functions, we look at the approach of singling out each individual preordered maximal chain in a chosen set X^* of preference representations.

To accomplish this end, specify the following naturally existing function $u: X \to X^*$, for a chosen set $X^* = \{z_j: j \in I\}$ of preference representations, as specified in equation (7), by letting $u(x) = x_j$, for some $j \in I$, so that $x_j \in \bar{\bar{x}}$. Evidently, equation (5) implies that this function u is well defined, because $[x_j] = [x]$. Because of Proposition 2 below, when the preference relation $\precsim$ is a preorder on X, function u is seen as the canonical utility function of the consumer.

Proposition 2. Assume that $\precsim$ is a preorder on X. Then, the canonical function u satisfies that for any $x^1, x^2 \in X$, $x^1 \precsim x^2$ if and only if $u(x^1) \precsim u(x^2)$.

Proof. It suffices to show: (i) for any $x^1, x^2 \in X$, $[x^1] \neq [x^2] \to [x^1] \cap [x^2] = \emptyset$; (ii) for any $x^1, x^2 \in X$, $x^1 \prec x^2 \to$ for any $z^1 \in [x^1]$ and $z^2 \in [x^2]$.

For part (i), assume by contradiction that there are $x^1, x^2 \in X$ such that $[x^1] \neq [x^2]$ and $[x^1] \cap [x^2] \neq \emptyset$. Let $z^* \in [x^1] \cap [x^2]$. So, we have

$$x^1 \sim z^* \sim x^2$$

and

$$x^1 \precsim z^*, x^1 \succsim z^* \text{ and } x^2 \precsim z^*, x^2 \succsim z^*.$$

Because $\precsim$ is a preorder on X, the condition of transitivity of $\precsim$ implies $x^1 \precsim z^* \precsim x^2$ and $x^1 \succsim z^* \succsim x^2$. That is, $x^1 \sim x^2$. That is, the indifference relation $\sim$ is transitive so that for any $z \in [x^1]$, $z \sim x^1 \sim x^2$. Hence, $z \in [x^2]$. This end implies $[x^1] \subseteq [x^2]$. Similarly, $[x^2] \subseteq [x^1]$ can be shown. Therefore, we have $[x^1] = [x^2]$, which contradicts the assumption that $[x^1] \neq [x^2]$. That implies that $[x^1] \cap [x^2] = \emptyset$.
For part (ii), as a consequence of (i), the assumption $x^1 \prec x^2$ means that $[x^1] \neq [x^2]$. Let $z^1 \in [x^1]$ and $z^2 \in [x^2]$ be arbitrary. Then we have

$$x^1 \precsim z^1, x^1 \succsim z^1 \text{ and } x^2 \precsim z^2, x^2 \succsim z^2.$$

That is, we have

$$z^1 \precsim x^1 \prec x^2 \precsim z^2.$$

Now, the condition of transitivity of $\precsim$ means that $z^1 \prec z^2$. QED

Although there are different X^*'s of preference representations, Proposition 2 implies that when the preference relation $\precsim$ is a complete preorder on the set X of all possible consumptions, these different X^*'s are all order-isomorphic to each other. Therefore, we can naturally imagine the existence of such an X^* as unique up to an order isomorphism. Practically, each set X^* of preference representations stands for a particular way for the consumer to judge which consumption possibility is preferred when compared to other alternatives.

If $X^c \subseteq X^*$ is a subset on which the preference relation $\precsim$ is complete, then X^c is referred to as a chain in X^*. For a chain $X^c \subseteq X^*$, if from that an $x \in X^*$ is comparable with every $z \in X^c$, it follows $x \in X^c$, then X^c is referred to as a maximal chain in X^*.

Proposition 3. Let $X^{max} \subseteq X^*$ be a maximal chain and $a < b$ two arbitrary real numbers. If the conditions below hold true, then a continuous utility function $u^*: u^{-1}(X^{max}) \to [a, b]$ exists.

1) Each infinity is actual;
2) $u^{-1}(X^{max})$ is connected in the Euclidean space $\mathbb{R}^\ell$;
3) For each $x \in u^{-1}(X^{max})$, the sets, defined below, are closed in $u^{-1}(X^{max})$.

$$\{z \in u^{-1}(X^{max}): z \precsim_i x'\} \text{ and } \{z \in u^{-1}(X^{max}): z \succsim_i x'\}.$$

Proof. If we replace X by $u^{-1}(X^{max})$ in Debreu's (1959) argument regarding the existence of continuous utility representations of a consumer's consumption preferences, that argument goes through in its entirety in showing the existence of the desired utility function u^* except that the validity of both steps 1 and 2 requires assumption 1). More specifically, Debreu's proof is comprised of 4 parts:

(a) A countable and dense subset D exists in $u^{-1}(X^{max})$, and each point $x \in D \subset \mathbb{R}^\ell$ contains only rational components;
(b) Define an increasing function $u': D \to [a, b]$;
(c) Extend u' to $u^*: u^{-1}(X^{max}) \to [a, b]$;
(d) Show the continuity of u^*.

In steps (a) and (b), the concept of infinity is essentially employed. However, it is recently found (Lin, 2008) that when the concept of infinity in mathematics is separated into either potential infinities or actual infinities, these

different kinds of infinities lead to inconsistent outcomes (Forrest, 2013). In particular, a potential infinity stands for either a present progressive tense or an ongoing and never-ending process; each actual infinity reflects a perfect tense (either present or past) or a procedure that ends or had ended. When demonstrating the existence of D in Step (a) and that of $u'\colon D \to [a, b]$ in Step (b), relevant potential infinities are mistakenly treated as actual infinities.

For step (a), the countability of D is established by matching *every* rational number with a unique natural number – a present progressive tense and a forever ongoing process. When the desired conclusion is needed – the set of rational numbers is countable, this potential infinity is forced to become an actual infinity.

For step (b), if D contains minimum element d^{α} and/or a maximum d^{β}, define $u'(d^{\alpha}) = a$ and $u'\left(d^{\beta}\right) = b$. From the countability of D, we can order the other elements of D and the rational numbers in (a, b) as follows:

$$(d^1, d^2, \dots, d^p, \dots) \text{ and } (r^1, r^2, \dots, r^q, \dots).$$

Then function u' is defined in an orderly fashion such that for every r^q, $q = 1,2,3, \dots$, there is a d^p so that $u'(d^p) = r^q$. Speaking differently, function u' is constructed point by point in a forever ongoing process. To claim the existence of this function, one has to assume that this forever ongoing process – a potential infinity – can be completed - an actual infinity. QED

Historically, various scholars have investigated when a preference order possesses a real-valued utility representation (Wold, 1943; Debreu, 1959; Hervés-Beloso & Cruces, 2019). By employing similar terminologies as in Proposition 3, Monteiro's (1987) and Candeal et al.'s (1998) existence theorems of continuous utility representations can be accordingly generalized. As for the possibility of utility representation of incomplete preference relations, the previous result takes a totally different direction than those developed by Ok (2002).

CONVEX PREFERENCES

This section consists of two subsections with the first one studying when the focal consumer's consumption preferences are convex of various kinds. Besides the assumption of convex preferences (i.e., diminishing marginal utility), our model requires perfect competition and demand interdependence. This might ensure the existence of general equilibrium in the economy in the end. The second subsection develops two counterexamples to show that preorder relations are generally not positively multiplicative and not additively conservative.

Two Remarks on Convex Preferences

In this section, X is assumed to be convex. That is, for any x^1 and $x^2 \in X$ and for any scalar $\alpha \in [0,1]$, $\alpha x^1 + (1 - \alpha)yx^2 \in X$. If the preference relation $\precsim$ satisfies condition (i) below, then $\precsim$ is said to be weakly convex (Debreu, 1959, p.59; Forrest et al., 2023). If condition (ii) is satisfied, then $\precsim$ is said to be convex (Debreu, 1959, p. 60; Forrest et al., 2023). If condition (iii) is satisfied, then $\precsim$is said to be strongly convex (Forrest et al., 2023).

(i) For distinct $x^1, x^2 \in X$ and arbitrary $\alpha \in (0,1)$, $x^1 \precsim x^2 \to x^1 \precsim \alpha x^2 + (1 - \alpha)x^1$;
(ii) For distinct $x^1, x^2 \in X$ and arbitrary scalar $\alpha \in (0,1)$, $x^1 \prec x^2 \to x^1 \prec \alpha x^2 + (1 - \alpha)x^1$;
(iii) For distinct $x^1, x^2 \in X$ and arbitrary scalar $\alpha \in (0,1)$, $x^1 \sim x^2 \to x^1 \prec \alpha x^2 + (1 - \alpha)x^1$

Relation $\precsim$ is said to satisfy the condition of positive multiplicativity, if for any $x^1, x^2 \in X$ and any scalar $\alpha > 0$,

$$x^1 \precsim x^2 \to ax^1 \precsim ax^2,$$

where the sign $\precsim$ will become $\prec$ in the consequence, if $\prec$ appears in the antecedent.

Relation $\precsim$ is known to satisfy the condition of additive conservation, if for any $x^j, y^j \in X$, $j = 1,2$,

$$x^1 \precsim y^1 \text{ and } x^2 \precsim y^2 \ \rightarrow x^1 + x^2 \precsim y^1 + y^2,$$

where the sign $\precsim$ will become $\prec$ in the consequence, if $\prec$ appears in at least one of the two antecedents.

Proposition 4. Assume that X is connected in $\mathbb{R}^\ell$ and $\precsim$ satisfies the conditions of positive multiplicativity and additive conservation. Then $\precsim$ is both weakly convex and convex.

Proof. Let $x^1, x^2 \in X$ and $\alpha \in (0,1)$ be arbitrary. Then, $x^1 \precsim x^2$ implies $\alpha x^1 \precsim \alpha x^2$ and $(1-\alpha)x^1 \precsim (1-\alpha)x^2$ because of the condition of positive multiplicativity. So, the condition of additive conservation leads to $x^1 = \alpha x^1 + (1-\alpha)x^1 \precsim \alpha x^2 + (1-\alpha)x^1$. The connectedness of X implies $\alpha x^2 + (1-\alpha)x^1 \in X$. This is, the preference relation $\precsim$ is weakly convex. Similarly, the convexity of $\precsim$ can be shown. QED

Proposition 5. Assume that each infinity is actual, X is convex and $u: X \rightarrow X^*$ the canonical utility function. If for any maximal chain $X^{max} \subseteq X$, $u^{-1}(X^{max})$ is a connected subset of $\mathbb{R}^\ell$, and condition 3) of Proposition 3 holds true, then $\precsim$'s strong convexity implies $\precsim$'s convexity.

Proof. Assume that $\precsim$ is strongly convex so that for any $x^1, x^2 \in X$ and $\alpha \in (0,1)$, $x^1 \sim x^2 \rightarrow x^1 \prec \alpha x^2 + (1-\alpha)x^1 \in X$, where the last membership relation is from the convexity of X. It suffices to show that if these chosen x^1, x^2 satisfy $x^1 \prec x^2$ then condition (ii) of convexity holds.

Let $X^{max} \subseteq X$ be a maximal chain so that $x^1, x^2 \in X^{max}$. Therefore, the connectivity of $u^{-1}(X^{max})$ implies $\alpha x^2 + (1-\alpha)x^1 \in u^{-1}(X^{max})$. Speaking differently, x^1, x^2 and $\alpha x^2 + (1-\alpha)x^1$ are comparable with each other.

From Debreu's (1959) existence theorem, because 1) each infinity is actual, 2) $u^{-1}(X^{max})$ is connected, and 3) $\precsim$ satisfies condition 3) of Proposition 3, there is a real-valued utility function u^r defined on $u^{-1}(X^{max})$ so that $u^r(x^1) < u^r(x^2)$. Because for any $\alpha \in (0,1)$, $x^1 \prec x' = \alpha x^2 + (1-\alpha)x^1 \prec x^2$, it follows that $u^r(x^1) < u^r(x') < u^r(x^2)$. Therefore, from the definition of real-valued utility functions, it follows that $\precsim$ is convex. QED

Positive Multiplicativity and Additive Conservation

This subsection consists of two counterexamples, one which shows that not all preorders satisfy the condition of additive conservation, while the other demonstrates the fact that not all preference relations satisfy the condition of positive multiplicativity.

Example 2. Based on his system of values and beliefs, let $\prec$ stand for how the focal consumer orders real numbers in his consumption decision making and $<$ the conventional ordering of real numbers. For our purpose, assume that $\prec$ is defined as follows: for any two x, $y \in \mathbb{R}$, $x \prec y$ if and only if $x(\text{mod}4) < y(\text{mod}4)$, where, without causing confusion, $z(\text{mod}4)$, for any $z \in \mathbb{R}$, is nonnegative.

Let $x^1, x^2, x^3 \in X$ be three consumptions, satisfying that for a fixed commodity h,

$$x_k^1 = x_k^2 = x_k^3, k = 1, 2, \dots, \ell, k \neq h,$$

and

$$x_h^1 = 2, x_h^2 = 3 \text{ and } x_h^2 = 1.$$

Hence, we have $x^1 \prec x^2$ and $x^3 \precsim_i x^3$; $x^1 + x^3 \succsim x^2 + x^3$, because $x_k^1 + x_k^3 = x_k^2 + x_{ik}^3, k = 1, 2, \dots, \ell, k \neq h$, and $x_h^1 + x_h^3 = 3 \succsim_i x_h^2 + x_h^3 = 3 + 1 =_{mod4} 0$. That is, the assumption that $\precsim$ satisfies the condition of additive conservation is essential for Proposition 4 to hold true. QED

Example 3. Continuing the previous example, we are showing that $\precsim$ (= $\leq_{mod(4)}$) is not positively multiplicative. To this end, we have

$$1 \precsim \left(\text{or } \leq_{mod(4)}\right) 2 \;\nrightarrow 2 \cdot 1 \precsim \left(\text{or } \leq_{mod(4)}\right) 2 \cdot 2 =_{mod(4)} 0$$

where the left-hand side of the implication is actually $2 \cdot 1 = 2 \succsim \left(\text{or } \geq_{mod(4)}\right) 2 \cdot 2 = 0$ = the right-hand side.

To summarize, if $x^1, x^2 \in X_i$ be two consumptions, satisfying $x_k^1 = x_k^2, k = 1, 2, \ldots, \ell, k \neq h$, and $x_h^1 = 1, x_h^2 = 2$, then it follows that $x^1 \precsim x^2$ and $2x^1 \succsim 2x^2$. That is, the consumption preferences $\precsim$ of the focal consumer is not positive multiplicative. QED

CONSUMPTION PREFERENCES AND ORDERS OF REAL NUMBERS

Assume that there are m consumers in the marketplace, labelled as $i = 1,2, \ldots, m$, and consumer i has accumulated an amount w_i of wealth. He picks consumption $x_i \in X_i$ (= the set of all possible consumptions of i) subject to $p \cdot x_i \leq_i w_i$, where $p = (p_1, p_2, \ldots, p_\ell) \in \mathbb{R}_+^\ell$ is a price vector of the commodities h (= 1,2, … , ℓ), symbol $\cdot$ the dot product of vectors in $\mathbb{R}_+^\ell$, and $\leq_i$ consumer i's order of real numbers. Let $w = (w_1, w_2, \ldots, w_m) \in \mathbb{R}^\ell$ be the wealth distribution of the population. Then, $(p, w) \in \mathbb{R}^{\ell+m}$ is the price-wealth pair (Debreu, 1959; Forrest, et al., 2024) of the population. The set of feasible price-wealth pairs of consumer i, $i = 1,2, \ldots, m$, is defined as follows:

$$S_i = \{(p, w) \in \mathbb{R}^{\ell+m} : \exists x_i \in X_i \text{ such that } p \cdot x_i \leq_i w_i\}.$$

Although consumer i's preference relation $\precsim_i$ and order $\leq_i$ of real numbers are generally not the same, they are closely related one way or another, because they are mostly determined by the consumer's system of values and beliefs (Forrest, et al., 2021b). The reason we say that "they are *mostly* determined by …" is because $\precsim_i$ can sometimes be influenced by peers and altered slightly by social pressures (Hu et al., 2021; Li, et al., 2022; Mani et al., 2013). That is, the definitions of both $\precsim_i$ and $\leq_i$ have the same root so that these binary relations cannot be generally inconsistent with each other. Another important point that needs to be cleared here is that different consumers may order real numbers differently, that is, for any $i, j = 1,2, \ldots, m$, if $i \neq j$, then it is possible that $\leq_i \neq \leq_j$, as discussed in Subsection 2.3.

To investigate the implicit consistency between consumer i's preference relation $\precsim_i$ and his ordering $\leq_i$ of real numbers, let us adopt the following axioms (Debreu, 1959; Forrest et al., 2024).

Axiom 1. For any $(p. w) \in S_i$, $x_i \in X_i$, and a chosen $x_i^* \in X_i$, $p \cdot x_i \leq_i w_i$ implies $x_i \precsim_i x_i^*$.

Axiom 2. For any $(p. w) \in S_i$, $x_i \in X_i$, and a chosen$x_i^* \in X_i$, $x_i \succsim_i x_i^*$ implies $p \cdot x_i \geq_i w_i$.

Preference relation $\precsim_i$ is said to preserve asymptotically preference ordering, provided that for any $\{x_i^q\}_{q=1}^\infty \subseteq X_i$, satisfying $x_i^q \succsim_i x_i^0$ (respectively, $x_i^q \precsim_i x_i^0$), for each $q \in \mathbb{N}$ and some $x_i^0 \in X_i$, $\lim_{q\to\infty} x_i^q \succsim_i x_i^0$ (respectively, $\lim_{q\to\infty} x_i^q \precsim_i x_i^0$), when the limit exists.

Proposition 6. For consumer i, if $w_i \neq_i \min_{z_i \in X_i} p \cdot z_i$; $\precsim_i$ is both additively conservative and positively multiplicative, and his consumptions asymptotically preserve $\precsim_i$, then Axiom 2 implies Axiom 1.

Proof. For any $(p. w) \in S_i$, $x_i \in X_i$, and a fixed $x_i^* \in X_i$, assume Axiom 2. That is, $x_i \succsim_i x_i^*$ implies $p \cdot x_i \geq_i w_i$. That is equivalent to: $p \cdot x_i <_i w_i$ implies $x_i^* \succ_i x_i$. It remains to show that for any $x_i \in X_i$, if $p \cdot x_i =_i w_i$, then $x_i \precsim_i x_i^*$ (Axiom 1).

Because $w_i \neq_i \min_{z_i \in X_i} p \cdot z_i$, there is $x_i^1 \in X_i$ such that $x_i^1 \neq x_i$, and $p \cdot x_i^1 <_i w_i$. For any $\alpha \in (0,1)$, define $z_i(\alpha) = \alpha x_i^1 + (1-\alpha)x_i$. From $p \cdot x_i^1 <_i w_i$ and $p \cdot x_i =_i w_i$, the assumed positive multiplicativity guarantees that

$$p \cdot (\alpha x_i^1) <_i \alpha w_i \text{ and } p \cdot (1-\alpha)x_i =_i (1-\alpha)w_i.$$

So, the assumed additive conservation leads to

$$p \cdot z_i(\alpha) = p \cdot \alpha x_i^1 + p \cdot (1-\alpha)x_i <_i \alpha w_i + (1-\alpha)w_i = w_i.$$

Hence, Axiom 2 implies that $z_i(\alpha) \prec_i x_i^*$ and that for any natural number q, $z_i(q^{-1}) = q^{-1}x_i^1 + (1-q^{-1})x_i \to x_i$. Now, the assumed asymptotic preservation of i's preferences entails $x_i = \lim_{q\to\infty} z_i(q^{-1}) \precsim_i x_i^*$. QED

A similar conclusion was shown by Debreu (1959) who requires that X_i is convex, and $\precsim_i$ is a continuous and complete preorder instead of the second and third assumptions in Proposition 6. Example 2 shows that not all preorders satisfy the condition of additive conservation, while Example 4 below shows that there is such a $\precsim_i$ that is not asymptotically preserving. Therefore, the previous proposition generalizes Debreu's result.

A consumption possibility $x_i \in X_i$ is referred to as satiation for consumer i (Mas-Colell et al., 1995; Forrest et al., 2024), provided that for any $y_i \in X_i$, either y_i and x_i are $\precsim_i$-incomparable or $y_i \precsim_i x_i$.

Proposition 7. If the following three conditions hold true, then Axiom 1 implies Axiom 2.

a) Both X_i and $\precsim_i$ are convex;
b) A consumption $x_i^* \in X_i$ is not a satiation;
c) Consumptions of i asymptotically preserve $\precsim_i$.

Proof. Axiom 1 is equivalent to that for any $(p.w) \in S_i$, $x_i \in X_i$, and a chosen $x_i^* \in X_i$, $x_i \succ_i x_i^* \to p \cdot x_i >_i w_i$. Pick a consumption $x_i \in X_i$, satisfying $x_i \succsim_i x_i^*$ (equivalently, $x_i \succ_i x_i^*$ or $x_i \sim_i x_i^*$). The case $x_i \succ_i x_i^*$ leads to either $p \cdot x_i >_i w_i$ or $p \cdot x_i \geq_i w_i$. For the case $x_i \sim_i x_i^*$, because $x_i^* \in X_i$ is not a satiation consumption, there is $x_i^1 \in X_i$ satisfying $x_i^1 \succ_i x_i^*$. So, the convexity of X_i implies that for any scalar $\alpha \in (0,1)$, $\alpha x_i^1 + (1-\alpha)x_i \in X_i$; and the convexity of $\precsim_i$ guarantees that $\alpha x_i^1 + (1-\alpha)x_i$ and x_i are comparable in terms of $\precsim_i$ and $x_i^* \sim_i x_i \prec_i z_i(\alpha) = \alpha x_i^1 + (1-\alpha)x_i$. Hence, we have from Axiom 1 the following:

$$p \cdot z_i(1/n) >_i w_i, n = 2,3,4, \ldots$$

From $z_i(1/n) \to x_i$, the asymptotic preservation of $\precsim_i$, combined with this last equation, produces $p \cdot x_i \geq_i w_i$. QED

Compared to what have been developed in, for example, Levin and Milgrom (2004) and Mas-Colell et al. (1995), when $\precsim_i$ is not a complete preorder, the fact that the dot product $p \cdot x_i$ is a continuous function in x_i cannot be readily employed (e.g., Dubra & Ok, 2002; Ok, 2002; Nishimura & Ok, 2016; Bosi & Herden, 2012) in the argument of Proposition 7, as the following Example 4 indicates. Specifically, the following example demonstrates that there is such a preference relation $\precsim_i$ that is not asymptotically preserving.

Example 4. Let $\precsim_i$ be the preference relation as defined in Example 2. Define $x_i^1, x_i^2, \ldots, x_i^q, \ldots \in X_i$, a sequence of consumption possibilities of consumer i, as follows: for any $k = 1, 2, \ldots, \ell, k \neq h$ and each $q = 1,2, \ldots, x_{ik}^q = x_{ik}^1$ and

$$x_{ih}^q = 3 + \frac{q}{q+1}.$$

It then can be readily seen that

$$x_i^q \to x_i^0, \text{as } q \to \infty,$$

where

$$x_{ik}^0 = x_{ik}^1, k = 1, 2, \ldots, \ell, k \neq h, \text{and } x_{ih}^0 = 0,$$

which is equal to 4 $(mod 4)$. Define x_i^{low} as follows:

$$x_{ik}^{low} = x_{ik}^1, k = 1, 2, \ldots, \ell, k \neq h, \text{and } x_{ih}^{low} = 3.$$

Then, from $x_{ik}^q = x_{ik}^1$ and $x_{ih}^q = 3 + q/(q+1)$, it follows that $x_i^q \succsim_i x_i^{low}$ and $\lim_{q\to\infty} x_i^q = x_i^0 \prec_i x_i^{low}$. In other words, this $\precsim_i$ does not satisfy the condition of asymptotic conservation. QED

SOME FINAL WORDS

This paper employs Euclidean space $\mathbb{R}^\ell$ as its playground, as what was initially done in Debreu (1959), to revisit a few previously known results of the consumer theory established on the unrealistic assumption that each consumer can completely preorder his set of all consumption possibilities (Levin & Milgrom, 2004; Mas-Colell et al., 1995). Because we in this paper only adopt the realistic assumption that for each consumer, there are consumption possibilities that are incomparable by his preference relation, one can reasonably expect that the results established in the previous sections will be more relevant to real life than those previously developed.

Other than the theoretical contributions outlined above, this paper is also a small part of a much larger effort of developing a new consumer theory so that the new theory can be employed to produce more tangible practical values than the current, prevalent theory can. This larger project was launched to answer the loud calls from front-line decision-making managers, entrepreneurs and academicians, such as Paul Krugman (*New York Times*, 2009-09-02) and Paul De Grauwe (*Financial Times*, 2009-07-21).

In terms of future research, along the lines provided in this paper, several issues can be productively addressed. First, when $\precsim$ is not assumed to be a preorder on X, can a result, like Proposition 2, be established? That is, how can a canonical utility function be defined on X for the general preference relation? Second, similar to how we challenge the adopted assumption in Proposition 2 above, one can work on if assumptions of each of the other propositions of this paper can be replaced or weakened. And the issue of non-convexity might be considered as an extension to further research (i.e., see Shapley-Folman Lemma). Third, we observe that in a certain sense, for each consumer, his consumption preferences and order of real numbers cannot be inconsistent with each other. Can this "certain sense" be identified when the underlying system of values and beliefs is specified? By comparing what is achieved in this paper with the prevalent consumer theory, one can readily find other significant topics for future research.

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CORPORATE ENVIRONMENTAL ETHICS AND COMPETITIVE ADVANTAGE: EVIDENCE FROM GHANA

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ABSTRACT

This study investigates the impact of corporate environmental ethics (CEE) on competitive advantage (CA) in the Ghanaian manufacturing sector, with a particular focus on the mediating role of green innovation (GPI). Specifically, the study determines if and how ethical conduct through innovation enhances firm performance. Data was collected using a structured questionnaire drawn from 200 top executives from over 100 companies within the Accra Industrial zone, achieving an 80% response rate. The study employed a multiterm Likert scale to measure the three constructs: environmental ethics, green innovation practices, and competitive advantage outcomes. A confirmatory factor analysis confirmed the convergent validity of the constructs (GFI = 0.930, RMSEA = 0.078). The study employed a moderated mediation analysis to find that corporate environmental ethics positively impact competitive advantage, with green innovation mediating this relationship (indirect effect $\beta = 0.0114$, $p<0.05$). Notably, while agro-food processing was tested as a moderator, the relationship did not significantly alter. The findings suggest that integrating environmental ethics into business strategies fosters green innovation, thus boosting competitive advantage for the Ghanaian manufacturing sector. Also, Ghanaian policymakers can incentivize green practices through tax breaks and grants, provide support and infrastructure for research and development in green technologies, and training programs on sustainable practices for manufacturing sector personnel. The study underscores the importance of embedding sustainability into core business operations to enhance firm performance and environmental outcomes within the Ghanaian manufacturing sector.

INTRODUCTION

Green innovation has emerged as a critical strategy for organizations aiming to address environmental challenges while gaining a competitive edge. Concerns regarding environmental issues and pressure from the public, customers, and government have pushed firms to become aware of the need to integrate environmental issues into business processes (Sellitto et al., 2020). Businesses are progressively incorporating sustainable practices into their core operations to address concerns about climate change, resource depletion, and ecological degradation intensity.

Adopting green innovation practices in processes can be critical in increasing the business's overall performance (Shafique et al., 2017; Sellitto et al., 2020). The shift toward green innovation responds to regulatory pressures and society's demands for responsible corporate behavior and environmental stewardship (Porter & Van der Linde, 2020). Firms derive numerous competitive advantages by adopting green innovation. Companies that invest in sustainable technologies enhance operational efficiency, reduce costs, and increase brand loyalty (Kumar & Singh, 2022). Consumers, on their part, are becoming more discerning and actively embracing brands committed to sustainability. These actions influence purchasing decisions and brand perception (Smith, 2021).

However, pursuing green innovation is fraught with ethical considerations, especially when companies prioritize market gains over genuine sustainability, thus raising consumer doubts and skepticism (Thøgersen & Ölander, 2022). Consequently, maintaining transparency and authenticity in sustainability claims is crucial for companies aiming to build lasting consumer relationships and enhance their reputations. Despite the many competencies a company can leverage to create a competitive edge, green innovation still needs to be considered and explored. Companies that focus on being green can exploit new market opportunities, consistent innovativeness, and create more wealth (Leyva-de la Hiz et al., 2022). Green innovation has gained prominence in recent years, as it is considered more profitable for the organization in the present era (Asadi et al., 2020). In response to increasingly stringent international environmental regulations and rising consumer demand for sustainable products, competitive dynamics in industries worldwide have shifted. Firms with commitments to the natural environment can reap the rewards of being the first mover in the ways of stimulating green innovation (Nidumolu et al., 2009), which allows them to command premium prices, improve their corporate image, develop new markets, and strengthen their competitive position.

Through an act of parliament, the Ghanaian government created the Free Zones Act, which focused on establishing free zones in Ghana to promote economic development. By making these zones, the government seeks to create an integrated business environment with incentives to enhance domestic and foreign investment in the country. This study uses a quantitative approach that builds on data collected through a survey of manufacturing companies in the Accra Metropolis to determine the impact of corporate environmental ethics and green innovation on competitive advantage. Specifically, the study will investigate if there is a relationship between corporate environmental ethics and competitive advantage mediated by green innovation. The study will attempt to answer the following questions: First, is there a relationship between corporate environmental ethics and competitive advantage? Second, does green innovation impact a firm's corporate environmental ethics? Third, how does green innovation affect competitive advantage? Fourth, what is green innovation's mediating role in the corporate environment and the competitive advantage of firms operating within the free zones?

The rest of the paper is organized as : Section 2 briefly reviews previous work on corporate environmental ethics and competitive advantage. Section 3 describes the methodology and outlines the methods used in measuring the constructs and the relationship between corporate environmental ethics and firms' performance. The empirical results are presented and discussed in section 4. The paper ends with a discussion and conclusion in section 5.

LITERATURE REVIEW

The intersection of corporate environmental ethics (CEE), green innovation, and competitive advantage has garnered significant scholarly attention (Han et al., 2018; Amoako, 2020; Steblyanskaya et al., 2021). Businesses are beginning to recognize the potential of integrating ethical environmental practices into their strategies to mitigate adverse environmental impacts and enhance their competitive position (Han et al., 2018). In the following review, we identify and discuss key themes related to methodological challenges, theoretical limitations, contextual influences, and the role of green innovation in driving competitive advantage.

Methodological rigor is a central concern in the literature on CEE and competitive advantage. The literature highlights significant weaknesses in research design, particularly issues related to small sample sizes, low response rates, and the risk of Common Method Variance (CMV). Several studies suffer from small sample sizes, which undermine the generalizability of findings (Chang, 2011; Alam & Islam, 2021; Enbaia et al., 2024). Furthermore, CMV is a pervasive issue in survey-based research where there is a high potential for inflated variables or distorted results, and many studies fail to mitigate this problem through robust statistical techniques such as Harman's single-factor test (Alam & Islam, 2021; Enbaia et al., 2024). Similarly, Wu et al. (2022) suggest that reliance on cross-sectional designs limits causal inferences between corporate environmental practices and competitive advantage. Thus, methodological concerns highlight the need for more sophisticated research designs using larger sample sizes and longitudinal studies to establish stronger evidence of causal relationships.

Besides methodological issues with previous studies, the literature reveals significant theoretical gaps and conceptual ambiguities. Applying key theoretical frameworks like stakeholder theory and the resource-based view (RBV) is superficial in most studies. These theories are often invoked without a deep engagement with their core concepts, leading to a fragmented understanding of the relationship between environmental ethics and competitive advantage (Chang, 2011; Alam & Islam, 2021).

Furthermore, there is a lack of clear definitions for key constructs such as "green innovation," "corporate environmental ethics," and "corporate environmental management" (Wu et al., 2022). These constructs often overlap, leading to conceptual confusion and complicating the analysis (Wu et al., 2022). We should also highlight the need for a more nuanced theoretical framework to explain how green innovation contributes to competitive advantage when integrated with CEE. Without theoretical clarity, the existing literature struggles to develop a coherent understanding of the mechanisms through which environmental practices influence firm performance.

The importance of context is a recurring theme in previous studies. Environmental regulations, industry dynamics, and cultural factors influence how corporate environmental ethics translate into competitive advantage (Chang, 2011; Alam & Islam, 2021). For instance, firms operating in countries with stringent environmental regulations may experience different competitive pressures and opportunities compared to countries with less robust regulatory

frameworks. A concrete example is that of Ghana, where businesses that adopt green strategies can differentiate themselves in a rapidly industrializing market (Amoako, 2020). Bansal (2005) suggested that green innovation is shaped by consumer demand for environmentally friendly products and that industry-specific factors, such as consumer preferences, play a crucial role in determining the success of environmental initiatives.

Thus, the relationship between CEE and competitive advantage, moderated by green innovation, cannot be generalized without considering the specific regulatory, cultural, and market contexts in which firms operate. Understanding the relationship between corporate environmental ethics and competitive advantage requires more attention to these contextual variables to develop a more comprehensive understanding of the dynamic interplay between corporate environmental practices and competitive success.

In literature, green innovation is widely recognized as a key driver of competitive advantage. The positive impact of green innovation must be highlighted, encompassing product and process innovations on firm performance. Wu et al. (2022) show that green product and process innovations significantly enhance competitive advantage and allow firms to differentiate themselves by offering sustainable products and improving operational efficiencies. Also, when aligned with corporate environmental ethics, green innovation enhances firms' market position, particularly by improving sustainability credentials (Harris, 2001).

More empirical studies are needed to explore the mechanisms of this relationship. For instance, leadership and practical implementation strategies mediate the link between corporate environmental activities and competitive advantage (Amoako, 2020). Emphasis on the role of leadership in mediating the relationship between corporate environmental ethics and competitive advantage suggests that the successful integration of environmental practices into business strategies requires innovation, strong leadership, and organizational commitment. Moreover, it is concerning that many studies conflate green innovation with corporate environmental ethics, leading to unclear conclusions. There is a need to clearly distinguish between these concepts, grounded in strong theoretical frameworks, to understand better how each factor contributes to a firm's competitive advantage (Wu et al., 2022).

The literature on corporate environmental ethics, green innovation, and competitive advantage offers valuable insights into how businesses can leverage sustainability practices for competitive gain. However, significant challenges remain regarding methodological rigor, theoretical clarity, and contextual understanding. The current study adopts a more robust research design, deepens theoretical engagement, and incorporates context's role in shaping corporate environmental initiatives' outcomes. The research will fill these gaps and provide informed policy suggestions to help businesses make informed decisions about integrating environmental ethics into their strategies to achieve sustainability and competitive success.

METHODOLOGY

Sample and Data Collection

This study utilizes data collected from 200 Ghanaian companies to investigate the impact of environmental ethics on competitive advantage, focusing on the mediating role of green innovation. The questionnaire survey surveyed 250 manufacturing companies operating under the Ghana Free Zones Authority in the Tema Export Process Zone in the Greater Accra Region of Ghana. The Tema Export processing zone was selected because it is an industrial zone with the most concentration of companies compared to other zones and because of a higher risk of pollution due to the intensity of manufacturing activities. The sample comprised 250 respondents, of which 200 were used, pegging the response rate at 80%. To control for sample method bias, we collected data from highly experienced and top-level executives, and the information collected was backed up with company records.

Measures

In this study, respondents rate their perceptions of specific measures using a 5-point Likert scale. Each of the participants provides feedback on distinct items included in the survey. The overall perception of each construct was calculated by computing the average scores of all items using a multi-point construct. The method simplifies and summarizes responses into a single metric for each construct, making interpreting the participants' perceptions easier. The approach that averages several items helps to the impact of any potential bias or inconsistency in individual responses. The approach ensures a more accurate and representative understanding of the participant's perspective, thus ensuring the reliability of the data.

Corporate Environmental Ethics

Corporate environmental ethics is part of corporate philosophy, which refers to the moral principles and values that guide a company's actions and decisions regarding its environmental impact. Corporate environmental ethics focuses on how businesses balance profitability with environmental responsibility and ensure that operations are sustainable and harmless to the environment. To measure corporate environmental ethics, we asked the respondents to indicate how much they agree with four items: (1) the company has clear and concrete environmental policies; (2) the company's budget planning includes the concerns of environmental investment or procurement; (3) the company has integrated its environmental plan, vision, or mission into its marketing activities and (4) the company has integrated its environmental plan, vision or mission into company's culture (Henriques & Sadorsky, 1999). The anchor points were 1 for 'strongly "disagree" and 5 for "strongly agree."

Green Innovation

We used four items to measure green product innovations, further divided into green product and process innovations. Green product innovation was measured by asking respondents to evaluate the degree to which they agree on three items: (1) the company chooses the materials that produce the least amount of pollution for conducting product development or design; (2) the company uses the least amount of materials to comprise the product for conducting the product development or design,; (3) the company circumspectly deliberate whether the product is easy to recycle, reuse, decompose for conducting the product development or design (Utterback & Abernathy, 1975). (4) Green process innovation was also measured by asking the respondents to agree on one item: "The company's manufacturing process reduces the use of raw materials." These items sufficiently provide a measure of green innovation. The anchor points were 1 for 'strongly "disagree" and 5 for "strongly agree."

Competitive Advantage

We used six items to measure firm performance. Respondents were asked to indicate the extent of the likelihood or otherwise with regards to their firm performance about that of key competitors in terms of (1) the company has better quality products than the competitor, (2) the company is more profitable than its competitors, (3) the company has a better corporate image than its competitors, (4) the company's competitors are unable to overtake the company (Barney, 1999; Coyne, 1986; Porter & van der Linde, 1995). These items were critical in measuring a firm's performance.

Control Variables

The study controlled the influence of several variables, including firm size (the number of full-time employees), the number of years the company has been in operation, and the firm has a research and development unit (yes=1, no=0); we also created five dummy variables to control industrial heterogeneity. The industries included textiles/apparel manufacturing, agro-food/seafood processing, jewelry/ethnic beauty products, light industry/assembling plant, and pharmaceuticals.

Adequacy of the Measure: Reliability and Validity

The study uses confirmatory factor analysis to assess a multiterm construct's convergent and discriminant validity that links corporate ethics to competitive advantage facilitated by green innovation. The confirmatory factor analysis results in Table 1 show that the measurement model conforms to the data with a $\chi 2$=70.744 (p = 0.000), $\chi 2$/df = 32, goodness of fit index (GFI) = 0.930, comparative fit index (CFI) = 0.867, incremental fit index (0.872), root mean square error of approximation (RMSEA) = 0.078. The high values (especially GFI > 0.90) suggest that the model provides a good fit for the data, confirming that the constructs measured are converging.

Also, the RMSEA is below the 0.08 threshold, indicating a reasonable fit. Thus, with a well-fitted model, we can conclude that items in each category measure the same underlying construct, indicating evidence of convergent validity. The correlations between the constructs in Table 2 provide an additional indication that the constructs adequately explain the indicators being measured.

Table 1: Measures of model fit

Statistics	Value
Chi-square (χ^2)	70.744
Degrees of freedom (df)	32
Probability level (p)	0.000
Goodness of fit index (GFI)	0.930
Comparative fit index (CFI)	0.867
Incremental fit index (IFI)	0.872
Root Mean Square Error of Approximation (RMSEA)	0.078

RESULTS

Table 2 presents the descriptive statistics and the Pearson correlation among the variables included in the study. The mean value ranges from 0.020 (light industry assembly plant) to 4.184 (competitive advantage), suggesting that the perception of competitive advantage is higher among respondents than other constructs. The standard deviations show variability in responses but suggest that these were consistent. The results show significant correlations between competitive advantage, corporate environmental ethics, and green innovation, with notable industry-specific patterns. Competitive advantage positively correlates with corporate environmental ethics and green product innovation, suggesting that a higher competitive advantage is associated with increased corporate environmental ethics and green product innovation.

Table 2: Mean, Standard Deviation, and Pearson Correlation Matrix of the Constructs

Construct	Mean	Std. dev.	CEE	GPI	CA
Corporate environmental ethics (CEE)	3.730	0.624	1		
Green innovation (GPI)	3.901	0.827	.175*	1	
Competitive advantage (CA)	4.377	0.368	.204**	.284**	1

*** Correlation is significant at the 0.05 and 0.01 level (2-tailed)

Table 3 below shows the results of the regression. The mediator and moderator were mean centered to avoid the problem of multicollinearity among the variables. The results displayed in model 1 were obtained after conducting an integrated moderated mediation analysis with corporate environmental ethics as the independent variable, green innovation as the mediator, and Agro-food processing as the moderator with the firm performance as the dependent variable. The interaction between corporate environmental ethics and Agro-food processing was significant,

suggesting a moderation effect. Also, the indirect effect of corporate environmental ethics on competitive advantage through green innovation was positive and significant ($\beta = 0.1145$, $p < 0.05$). The model tested the impact of corporate environmental ethics on green innovation of companies operating in the Accra industrial zone and found that the relationship was positive and significant. The significant indirect effect indicates that part of the effect of corporate environmental ethics on competitive advantage is mediated by green product and process innovation.

Table 3: Results of the Moderated Mediation Analysis

	Green product/process innovation (Model 2)		Firm performance (model 1)	
Variable	**Estimate**	**t value**	**Estimate**	**t value**
Constant	2.9285***	6.86	3.5613***	17.41
Corporate environmental ethics	0.2709***	2.87	0.1004**	2.43
Green product innovation			0.1061***	3.41
CEE*Agro food pr interaction			0.1084***	2.67
Agro-food processing	-0.1060	-1.75	-0.4290	-2.78
Clothing beauty	-0.2074	-1.29	-0.0993	-1.43
Light industry plant	0.1108	0.26	0.0420	0.23
Pharmaceuticals	0.2463	1.38	-0.0894	-1.16
Joint venture partnership	-0.1756	-0.67	0.0674	0.60
Public Company	-0.1642	-0.64	0.0418	0.38
Firm size	0.0013	1.70	-0.0001	-0.18
Indirect effect			0.0114**	2.20
	Adj R2 = 0.1002 F = 2.10**		Adj R2 = 0.1331 F = 2.62***	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4 presents the results from a moderated mediation analysis that examines the relationship between corporate environmental ethics and firm performance measured with competitive advantage through green product and process innovation as the mediator and with public company status acting as the moderator. The results from the moderated mediation model suggest a significant relationship between corporate environmental ethics and firm performance. Also, green innovation is statistically significant and has a positive value, implying that increases in green innovation practices mediate the relationship between corporate environmental ethics and competitive advantage. The results also suggest that corporate environmental ethics positively affect firm performance through green innovation.

Table 4: Moderated mediation analysis of corporate environmental ethics on firm performance through green product and process innovation moderated by Agro-food processing

Predictor	**Estimate**	**SE**	**t value**	**Prob**	**95% CI**	
Corporate environmental ethics	0.094	0.041	2.32	0.021	0.014	0.174
Green product innovation	0.113	0.031	3.63	0.000	0.052	0.174
Moderator: Agrofood processing	-0.009	0.025	-0.37	0.712	-0.059	0.040
Interaction (Corp ethics x Agrofood processing)	-0.001	0.007	-0.08	0.940	-0.134	0.015

DISCUSSION AND CONCLUSION

This study investigates the impact of corporate environmental ethics on competitive advantage in Ghanaian manufacturing companies from the perspective of green innovation. The findings in this study align with those from

earlier studies by Han et al. (2019) and Wu et al. (2022) that firms with strong environmental ethics are more likely to engage in green innovation, which enhances their competitive edge. This significant relationship underscores the importance of crafting business practices with environmentally sustainable goals. The positive correlation between corporate environmental ethics and green innovations suggests that ethical considerations catalyze innovation and allow firms to outperform in competitive markets. Unlike the non-empirical study exploring the possible effects of corporate environmental activities on sustainable competitive advantage in Ghana, this study provides evidence based on sampling data, reinforcing earlier findings and claims.

Although Agro-food processing was identified as a moderator in the relationship, it did not significantly alter the outcome. This finding indicates that the benefits of corporate environmental ethics and green innovation extend beyond specific industries and are applicable across the manufacturing sector in Ghana. The reliance on collecting data from top-level executives and validating company records ensures that insights are based on information from trusted sources.

Overall, the results from this study have shown that companies that incorporate corporate environmental ethics in their operations tend to benefit more in terms of competitiveness. The mediation of green products and process innovation indicates a pathway through which ethical practices can translate into business benefits. The growing pressure on companies from various stakeholders and regulatory bodies enables businesses to incorporate sustainability into core business practices and strategies to gain strategic advantage. The study suggests that Ghanaian companies should embed sustainability in core practices to gain a competitive advantage.

These findings imply that policymakers should incentivize companies to adopt green environmental practices by offering tax breaks or grants to businesses committed to sustainable practices. These measures could enhance industry performance by aligning corporate goals with the overall environmental objectives set in the industrial-free zones. Ghana's government could also support research and development in green technologies that facilitate innovation in the manufacturing sector. Partnerships between academic institutions and industry can be established to enhance knowledge sharing and technological advancement. The government could also initiate and implement training programs for managers and employees on sustainable practices, enhancing competition and improving environmental outcomes across the country's manufacturing sector.

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DECLARATIONS

Conflict of Interest: The authors declare no conflicts of interest.

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DISCOVERING THE IMPACT OF VIETNAM'S TRADE WITH MAJOR PARTNERS: EXPLORING THE J-CURVE'S ASYMMETRIC and SYMMETRIC EFFECTS

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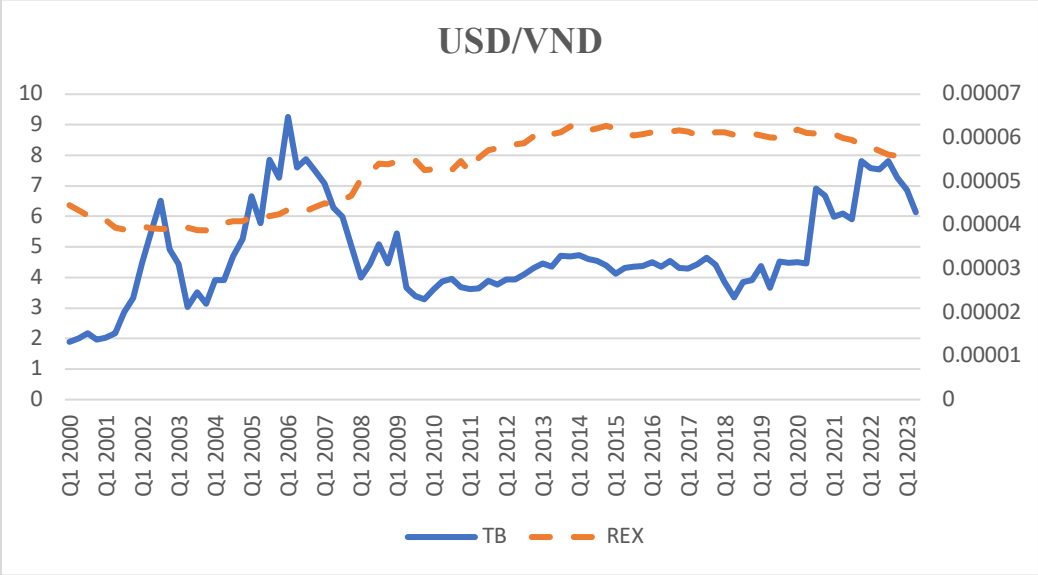
ABSTRACT

This paper presents a unique case study that explores the relationship between Vietnam and its 11 trading partners. It uses traditional and innovative non-linear approaches to provide valuable insights and evidence supporting the J-curve theory. The study reveals significant results through these novel approaches. The symmetric approach uncovered three instances of the J-curve phenomenon: China mainland, India, and Malaysia, while the asymmetric approach only found evidence in Hong Kong. In the long run, the asymmetric approach identified six countries compared to five countries using the linear approach, indicating improved trade balance with exchange rate depreciation. These findings reveal persistent and asymmetric short-run effects of exchange rate changes and emphasize the importance of this research in understanding the complex dynamics of exchange rates in Vietnam's trade relationships.

INTRODUCTION

Exchange rates are crucial in shaping a nation's trade dynamics and impacting global market economies. Vietnam's transition from a centrally planned to a market economy has significantly reduced poverty and elevated the country to lower- and middle-income status. This transformation has propelled Vietnam to become one of the most dynamic economies in East Asia, underscoring the importance of understanding exchange rate dynamics. In Vietnam, all goods and services are priced and transacted in Vietnamese Dong (VND) as mandated by law. The State Bank of Vietnam (SBV) plays a pivotal role in managing the currency's stability, including its exchange rate regime, which maintains stability against other currencies. Notably, the VND has depreciated against the USD since 2000, prompting an urgent need to understand its impact on Vietnam's trade balance and overall economy.

Figure 1



1. Source: IMF, International Financial Statistics (IFS)
2. Figure 1 plots the trade balance (TB) and real bilateral exchange rate (REX) between Vietnam and the United States
    - TB defined Vietnam’s exports over its imports with the USA. Thus, an increase in TB reflects an improvement.
    - REX as defined in the appendix but a decrease in REX indicates a real depreciation of the Vietnamese Dong.

Given Vietnam's heavy reliance on exports, any fluctuations in the exchange rate can have significant and potentially game-changing consequences. The potential impact of these fluctuations on Vietnam's economy is not to be underestimated. Thus, the SBV's pivotal role in managing the VND is not just important; it's indispensable to the success and stability of Vietnam's economy. The urgency of understanding and managing these fluctuations cannot be overstated. This research aims to provide a deeper understanding of these dynamics, offering potential strategies for managing these fluctuations effectively, which could profoundly impact Vietnam's trade dynamics.

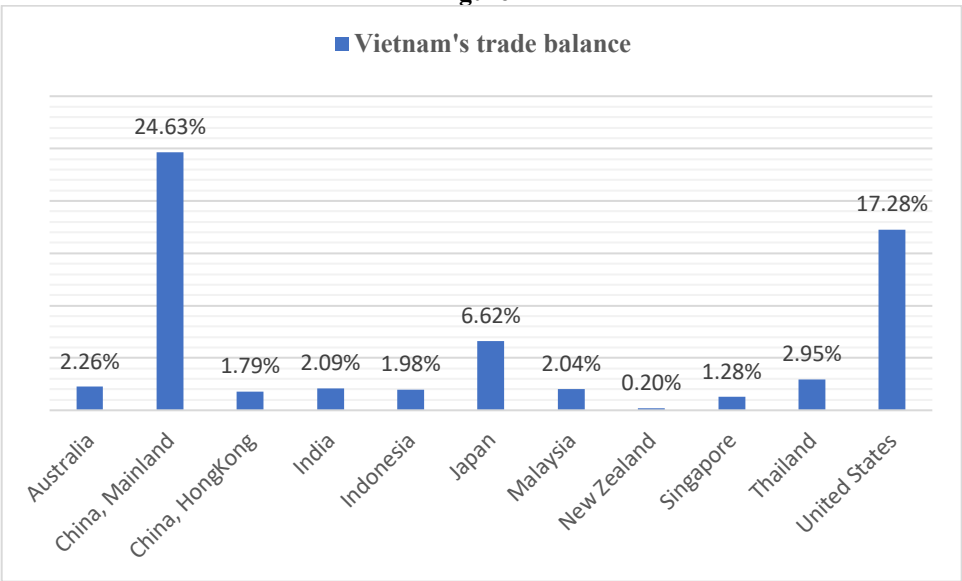
The J-curve phenomenon, a concept first observed by Magee (1973) in the U.S., is not just a concept but a pivotal aspect of this study. Understanding how a nation's trade balance reacts in the short run after an exchange rate devaluation is critical. Early studies centered on the Marshall-Lerner (ML) conditions assert that currency devaluation will improve the trade balance only if the sum of import and export demand price elasticities is greater than one. However, this approach relies on aggregate trade data. Bahmani-Oskooee and Hegerty (2010) furnish a comprehensive review of studies of the J-curve. Studies of the J-curve can be divided into two main categories using aggregated and disaggregated data. The former focuses on a nation and the rest of the world, while the latter evaluates a single country and its trading partners. Their review revealed that empirical studies on the J-curve could be categorized into two groups: those that dealt with aggregate data (between one country and the world) and those that dealt with bilateral data (a country with its trading partners). Regardless of whether the models and data were aggregated or bilateral, there was a consensus that the short-term response to currency devaluation needed to follow an identifiable pattern regarding a country's trade balance. However, in the long run, there was more supporting evidence between exchange rates and trade balance in bilateral studies.

There have been limited studies on the J-curve effect in Vietnam. Thom X.T.(2017) utilized a bivariate VAR system and impulse response function analysis with bilateral data on 11 trading partners. Her study suggests that the trade balance shape will likely follow an S rather than a J curve. In the same year, My, Sayim, and Rahman used the ARDL model approach and impulse response function to analyze 20 trading partners. Their findings indicated that the devaluation of the Vietnamese Dong did not improve the trade balance, suggesting that the J-curve effect does not hold. In 2018, Phong, Bao, and Van utilized an ARDL that included the impulse response function and found no evidence of a J-curve phenomenon between Vietnam and its trading partners. They recognized that treating Vietnam's main trading partners as an aggregate resulted in the inability to find the J-curve phenomenon. These studies so far have not found evidence of a J-curve, underscoring the unique and significant contribution of my research in this area. In addition, these studies focused on a symmetric approach. Bao and Le (2021) investigate the asymmetric impacts on Vietnam's trade balance with EU-27 countries and the UK,2000Q1–2018Q1. The results, however, have been mixed. This further highlights the novelty and importance of my research in providing a comprehensive understanding of the J-curve phenomenon in Vietnam's trade dynamics.

Bahmani-Oskooee and Fariditavana (2016) further argue that Rose and Yellen (1989) consider the effects of exchange rate changes on trade balance symmetric. They claim that studies assume that these empirical models follow a linear adjustment process. They maintain that the appreciation and depreciation of any currency may not have the same effect. For example, appreciation may be significant, while depreciation may not be significant, creating asymmetric effects on exchange rates. A non-linear approach will establish whether short-run and long-run accurate exchange rates are symmetric or asymmetric. They further show that applying the non-linear approach variation generates additional essential results. As such, they recommend adopting the error correction and cointegration approach. They support traders' expectations, and behavior responses are dissimilar to currency depreciation compared to currency appreciation so that exchange rate changes may have asymmetric effects on the trade balance. Additionally, Bussiere (2013) presents evidence that import and export prices respond asymmetrically to fluctuations in exchange rates. In this study, the trade balance also exhibits an asymmetric response to changes in exchange rates.

This study is uniquely positioned to fill this gap by comprehensively analyzing the J-curve phenomenon and applying the symmetric and asymmetric approaches in the context of Vietnam and its major trading partners. It offers fresh insights and perspectives that could significantly reshape the understanding of Vietnam's trade dynamics. This paper strictly examines Vietnam's trade balance with its 11 major trading partners, including Australia, China Mainland, Hong Kong (China), India, Indonesia, Japan, Malaysia, Singapore, Thailand, and the United States. As shown in Figure 2, these 11 countries account for over 63% of Vietnam's overall trade and are crucial for Vietnam's economic growth and stability. Therefore, understanding the dynamics of Vietnam's trade balance with these partners is paramount.

Figure 2



Source: As of 2022 *Inclusive smaller trading partners (Millions USD)

This paper investigates this topic using bilateral data and a bounds-testing approach to cointegration and error correction modeling. It is structured into four main sections: models, methodology, results, and a summary. An appendix provides a comprehensive definition of variables and data sources.

THE MODELS AND METHODS

Using quarterly data from 2000 Q1 to 2023 Q2, this paper's methodology employs error correction and cointegration structures to analyze the trade balance between Vietnam and 11 of its trading partners. Bahmani-Oskooee and Fariditavana (2016), Bahmani-Oskooee, Harvey, and Hosny (2018), and Harvey (2019, 2023) used a generic symmetric and asymmetric approach to outline exchange rate changes between a nation and its trading partners. Following their techniques, this model is specified for the long run. Building on their work, this paper enhances understanding of the complex relationship between exchange rates and trade balance, shedding new light on this critical area of international economics.

$$Ln\ TB_{i,t} = a + blnY_{V,t} + c\ Y_{i,t} + dREX_{i,t} + \Omega\varepsilon_t \ (1)$$

The trade balance is included since the model is specified in log-linear form. It is usually defined as the ratio of Vietnam's imports from partner i to its exports to partner i. Key factors influencing the trade balance (TB) include Vietnam's economic activity (Vi), trading partners' economic activity (Yi), and the real exchange rate (REXi). A positive bilateral trade balance suggests that the coefficient associated with the real bilateral exchange rate (REXi) indicates an improvement in the trade balance. The depreciation of the VND is expected to increase Vietnam's exports while reducing imports from partner i. Therefore, the coefficient d is anticipated to be positive for long-term improvement. This happens because REXi is defined such that a reduction in its value reflects a real depreciation of the VND against the partner's currency, as demonstrated in the Appendix. If the real depreciation of the VND, i.e., a decrease in REX, is meant to discourage Vietnam's imports and encourage exports (thus improving the trade balance), we would expect the estimate of REX to be positive.

Imports are expected to rise alongside economic growth in Vietnam, resulting in a positive correlation between Vi and TB. Bahmani-Oskooee (1986) posits that if Vietnam's increase in income (Vi) stems from the rise in the production of goods that substitute imports, then Vietnam may import less as its income rises. This could result in a negative correlation between Vietnam's income and the trade balance. Similarly, the economic activity of Vietnam's trading partners (Yi) can also impact the trade balance, with a positive correlation suggesting that increased economic activity in the partner country leads to greater exports from Vietnam, and vice versa, which can be either positive or negative. Equation (1) provides only long-run coefficient estimates, irrespective of how it is estimated. However, since the J-curve represents a short-run phenomenon, this paper must incorporate the short-run dynamic adjustment mechanism

into Equation (1) to explore the short run. To achieve this, Equation (1) is combined with an error-correction model (2), which was introduced by Pesaran et al. (2001).

$$\Delta TB_{i,t} = a' + \sum_{k=1}^{n} b'_k \Delta LnTB_{i,t-k} + \sum_{k=0}^{n} c'_k \Delta LnY_{V,t-,k} + \sum_{k=0}^{n} d'_k \Delta LnY_{i,t-k} + \sum_{k=0}^{n} \sigma'_k \Delta LnREX_{i,t-k}$$

$$+\pi_1 LnTB_{i,t-1} + \pi_2 LnY_{V,t-1} + \pi_3 LnY_{i,t-1} + \pi_4 LnREX_{i,t-1} + \phi \qquad (2)$$

Equation (2), both long and short runs, are completed in one stage using the OLS method. This robust approach ensures the reliability of results. Additionally, (2) short-run effects of REX are observed via σ*'* while the forecast of χ^2 discerns estimates of the long run,π_4, normalized on π_1[1]. The J-curve effect is observed when estimates of σ' are negative at lower lags and positive at higher lags. Pesaran, Shin, and Smith (2011) suggest using their critical F-test to confirm cointegration in the model. With its unique integrating property, its critical F-test eliminates the need for pre-unit-root testing, simplifying the model. If the J-curve is not observed from equation (2), then, following the adjusted model proposed by Shin, Yu, and Green-Nimmo (2014), equation (s) will be revised such that asymmetric effects of exchange rate changes on the bilateral trade balance. The exchange rate data will be divided into two distinct series: one that reflects only appreciation and another that indicates the depreciation of the VND. This model[2] is used to generate the two new time series variables:

$$PSC = \sum_{j=1}^{t} \max(\Delta LnREX_j, 0) \text{ and } NSC = \sum_{j=1}^{t} \min(\Delta LnREX_j, 0) \qquad (3)$$

In this context, PSC denotes the partial sum of positive changes representing only currency appreciation, while NSC refers to the partial sum of negative changes indicating only currency depreciation. Shin, Yu, and Greenwood-Nimmo (2014) proposed replacing Ln REX in equation (2) with the PSC and NSC variables, which will be developed as follows:

$$\Delta LnTB_{i,t} = a' + \sum_{k=1}^{n1} b'_k \Delta LnTB_{i,t-k} \sum_{k=0}^{n2} c'_k \Delta LnY^V_{t-k} + \sum_{k=0}^{n3} d'_k \Delta LnY^i_{t-k} + \sum_{k=0}^{n4} \eta'_k \Delta PSC_{t-k}$$

$$\sum_{k=0}^{n5} \psi'_k NSC_{t-k} + \phi_0 LnTB_{i,t-1} + \phi_1 LnY^V_{t-1} + \phi_2 LnY^i_{t-1} + \phi_3 PSC_{t-1} + \phi_4 NSC_{t-1} + \rho_t \quad (4)$$

In addition, they recommend using OLS to estimate both short-run and long-run effects simultaneously. The formation of the PSC and NSC variables, the model outlined by (4), is called the non-linear ARDL model. Estimating the first-differenced variables reflects short-run effects and estimates of ϕ_1–ϕ_4 normalized on ϕ_0 reflect the long-run impact.

The assessment of (4) will be based on recommended asymmetrical assumptions. The short-run asymmetric effects of appreciation versus depreciation will be confirmed if, at a specific lag *K,* the estimate of η' is different from that of Ψ'. The null hypothesis is tested to establish short-run cumulative or impact asymmetry. $\Sigma \eta'_k \neq \Sigma \psi'_k$.

Short-run impact asymmetry will be confirmed if the Wald test rejects the null hypothesis. The Wald test is a statistical tool used to test the hypothesis that the coefficients of the independent variables are jointly equal to zero. If the Wald test rejects the null, it implies that the trade balance may respond to appreciation faster or slower than depreciation, depending on the lag order of the ΔPSC and ΔNSC variables. Lastly, long-run asymmetric effects of appreciation versus depreciation will be established if the Wald test rejects the null, i.e., if normalized long-run estimates are significantly different ($-\frac{\phi_3}{\phi_0} \neq \frac{\phi_4}{\phi_0}$)The F-test establishes cointegration for the normalized estimates to be meaningful. However, when using the F-test's critical values, Shin et al. (2014) recommend treating the PSC and NSC variables as a single entry into the model to keep the F-test's critical values at a high level. This study's findings significantly

[1] In addition, π_1 measures the adjustment speed in each model and must be negative.
[2] PSC reflects appreciation, while NSC shows depreciation.

contribute to understanding exchange rate dynamics and trade balance adjustments, highlighting the importance of these factors.

THE RESULTS

This paper estimates both the linear model (2) and the non-linear model (4) between Vietnam and its 11 trading partners. The empirical analysis focuses on quarterly data from 2000QI to 2023II, with a maximum of four lags on each first-differenced variable. Akaike's Information Criterion (AIC) selects the best model. Dummy variables are included in the model to account for the Global Financial Crisis of 2008 and the Coronavirus disease (COVID-19) pandemic in 2020. The results from each table (1 to 4) are identified as L-ARDL (linear models) and NL-ARDL (non-linear models). Panel A shows the short-run estimates, while Panel B shows the long-run. Panel C shows the diagnostic tests.

Based on the linear model, short-run real bilateral exchange rates (*ΔLnREXi* in Panel A), Australia, China Mainland, Japan, China Hong Kong, Malaysia, Singapore, and Thailand, evidence shows that at least the lagged coefficient is significant. It should be noted that in the short term, fluctuations in trade balance can go both ways. However, when the real exchange rate coefficients shift from negative to positive, it supports the J-curve. This intriguing phenomenon, observed in three cases: China, India, and Malaysia, underscores the complexity of the relationship between exchange rates and trade balance. In addition, Table 1, panel B, shows that the real bilateral exchange rate carries a positive coefficient with significant results in Australia, Japan, India, Indonesia, and Thailand. By adopting the newly proposed definition of the J-curve by Rose and Yellen (1989), which denotes a short-term decline followed by long-term improvement, the manifestation of this curve is evident in the outcomes for Australia, Japan, and Thailand. From the long-run results, this paper gathers that the level of economic activity in Vietnam and its trading partners are significant determinants of trade balance in 50% of the cases.[3]These findings have practical implications for policymakers and economists. They provide insights into the dynamics of exchange rate adjustments and their impact on trade balance, guiding future policy decisions and research directions.

Is there any improvement using the non-linear approach? In each non-linear model, except those involving New Zealand and the USA, there is at least one significant lag coefficient for either ΔPSC or ΔNSC. The shift from seven significant short-term scenarios in the linear model to nine in the non-linear model underscores the crucial role of non-linear exchange rate adjustment. Moreover, the differing magnitude of the estimated coefficient associated with ΔPSC compared to ΔNSC in most cases highlights the short-term asymmetric impacts of VND appreciation versus VND depreciation. These findings stress the importance of incorporating non-linear models in understanding the dynamics of exchange rate adjustments. However, the sum of the estimates attached to ΔPSC differs from that of ΔNSC in the results for Australia and China (mainland), supporting cumulative or impact asymmetry in these two trading partners. The Wald test, which these two trading partners reported as Wald-S in Panel C, is significant.

The next step is to evaluate if the short-term asymmetrical impact leads to long-term effects. The long-run coefficient results indicated in Panel B show that the PSC or the NSC is significant, confirmed by the cointegration criterion, i.e., Australia, China mainland, China Hong Kong, India, Malaysia, and Thailand.

Following Bahmani-Oskooee and Fariditavana's (2016) J-curve supports the definition in the case of Australia and Indonesia. In this case, VND depreciation improves the trade balance, but VND appreciation worsens it. The case of China Mainland, India, and Thailand NSC shows it is positive and significant, implying that a real depreciation of the VND will improve its economic growth with these three countries. In the case of Australia, Australia is a positive and significant POS, signifying that an appreciation of the Australian dollar will hurt its trade balance. At the same time, depreciation will have no long-run effects.

The regression results can be trusted as cointegration is verified in each bilateral model through the F-test and the ECM_{t-1} test. In the ECM_{t-1} test, Pesaran et al. (2001) recommend using the normalized long-run estimates and long-run model (1) to construct the error term, known as ECM. This involves substituting ECM_{t-1} for the linear combination of lagged level variables in (2) and re-estimating the new specification using the same optimal lags. Cointegration is

[3] In the case of Singapore, it is negative and significant. This may be due to the increased production of goods that can substitute imports. Vietnam may then import less as its income rises.

confirmed if ECM_{t-1} has a significantly negative coefficient. Furthermore, given that the variables comprise both I(0) and I(1) components, Pesaran et al. (2001) offer revised critical values for the t-test.

In Panel C, additional diagnostic measures were incorporated alongside the main statistics. The Lagrange Multiplier statistic (LM) was utilized to detect autocorrelation, indicating insignificance in most models and suggesting the absence of autocorrelation in the residuals. Furthermore, results from Ramsey's RESET test predominantly displayed insignificance, implying no misspecification. To assess the stability of short-run and long-run estimates, the CUSUM and CUSUMSQ tests were employed, identifying stable estimates labeled 'S' and unstable estimates labeled 'US.' The CUSUM test indicated stable estimates across all models, while the CUSUMSQ test revealed unstable estimates in specific models. Lastly, the adjusted R2 value was included to evaluate the model's goodness of fit.

Table 1: Linear ARDL (L) and Nonlinear ARDL (NL) Models

	i=Australia		i=China, Mainland		i=Japan	
	L	**NL**	**L**	**NL:##**	**L**	**NL**
Panel A: Short–Run Estimates						
$\Delta lnTB_{i,t-1}$	0.87*	0.95*	0.67*	0.54*	0.34*	0.36*
$\Delta lnTB_{i,t-2}$	-0.004	-0.09	0.09	0.14	0.40*	0.41*
$\Delta lnTB_{i,t-3}$	-0.16	-0.15	0.001		-0.33*	-0.37*
$\Delta lnTB_{i,t-4}$			0.23*			
$\Delta ln\ Y_{v,t}$	-1.99*	-1.99*	0.59	0.05	0.08	0.16*
$\Delta lnY_{v,t-1}$	2.07*	2.73*	-0.28			
$\Delta lnY_{v,t-2}$	1.29	0.89	1.32**			
$\Delta lnY_{v,t-3}$	-2.57*	-2.83**	-1.48*			
$\Delta lnY_{v,t-4}$	1.16*	-1.13**				
$\Delta lnY_{i,t}$	0.41	1.07	1.12	0.97*	0.20	-0.71
$\Delta lnY_{i,t-1}$	-0.54	-0.73*	-1.15		-1.17**	
$\Delta lnY_{i,t-2}$	1.01*	1.19*				
$\Delta lnY_{i,t-3}$		-0.35				
$\Delta lnY_{i,t-4}$		-1.11**				
$\Delta lnREX_{i,t}$	-0.25		-0.41		-0.39**	
$\Delta lnREX_{i,t-1}$	0.76*		-1.08		0.31	
$\Delta lnREX_{i,t-2}$	-0.76*		1.36*		-0.28	
$\Delta lnREX_{i,t-3}$	0.69*				-0.03	
$\Delta lnREX_{i,t-4}$					0.58*	
ΔPSC_t		2.09*		0.41		-1.45*
ΔPSC_{t-1}		-0.32		-9.22*		1.41*
ΔPSC_{t-2}		-2.59*		7.43*		
ΔPSC_{t-3}		1.66				
ΔPSC_{t-4}						
ΔNSC_t		-4.19*		2.77*		-0.49
ΔNSC_{t-1}		4.41*				0.30
ΔNSC_{t-2}						-2.40*
ΔNSC_{t-3}						0.06
ΔNSC_{t-4}						2.19*
Panel B: Long–Run Estimates						
$ln\ Y_v$	-0.18	-0.19	45.99	0.15	0.14	0.27*
$ln\ Y_i$	2.98*	0.25	-9.23	3.06*	-1.64*	-1.20
$ln\ REX_i$	1.47*		-63.71		0.29*	
PSC		3.02*		-4.37		-0.08
NSC		0.81		8.76*		-0.58
Constant	-6.85	0.11	-1317.07	-51.32*	29.19	16.58
Panel C: Diagnostic Statistics						
F	4.37*	4.01*	1.09	3.99*	9.09*	6.51*
ECM_{t-1}	-0.29*	-0.28*	-0.003*	-0.32*	-0.59*	-0.59*
LM	0.05	1.10	1.62	0.01	0.02	0.15
RESET	0.11	0.23	0.00	0.66	1.23	1.29
Adjusted R^2	0.97	0.97	0.83	0.85	0.54	0.53
CS (CS^2)	S(S)	S(S)		S(S)	S(S)	S(S)
WALD – S		2.96**		6.73*		3.28
WALD – L		6.51*		0.12		2.13

Notes: See notes at the end of Table 4.

Table 2: Linear ARDL (L) and Nonlinear ARDL (NL) Models						
	i=China, Hong Kong		i=Indonesia		i=India	
	L	NL	L	NL	L	NL,##
Panel A: Short–Run Estimates						
$\Delta lnTB_{i,t-1}$	0.58*	0.46*	0.68*	0.44*	0.66*	0.76*
$\Delta lnTB_{i,t-2}$	0.28*	0.24**	0.25**	024*	0.19	0.19
$\Delta lnTB_{i,t-3}$		0.17	-0.46*	-0.45*	-0.32*	-0.63
$\Delta lnTB_{i,t-4}$		0.01	0.29*	0.22*		0.26*
$\Delta ln\ Y_{v,t}$	0.19	1.10	-0.69	0.79	0.57	-0.09
$\Delta lnY_{v,t-1}$	2.09*	2.47*	-0.63	0.27	0.11	
$\Delta lnY_{v,t-2}$	-1.78*	-1.77*	2.31*	2.18*	1.35	
$\Delta lnY_{v,t-3}$			-1.05	-1.18*		
$\Delta lnY_{v,t-4}$			-0.36			
$\Delta lnY_{i,t}$	2.23*	1.80*	-2.36	--0.48	-1.02*	-2.48*
$\Delta lnY_{i,t-1}$	-0.87	-0.94	2.56	1.21		-1.07
$\Delta lnY_{i,t-2}$	1.22**	1.16**		1.49		-0.42
$\Delta lnY_{i,t-3}$	-1.34*	-1.01		0.10		4.61*
$\Delta lnY_{i,t-4}$	-1.73*	-1.43**		-2.51		
$\Delta lnREX_{i,t}$	1.63		0.06		-0.43	
$\Delta lnREX_{i,t-1}$	0.10		-0.28		1.16*	
$\Delta lnREX_{i,t-2}$	-1.91*					
$\Delta lnREX_{i,t-3}$						
$\Delta lnREX_{i,t-4}$						
ΔPSC_t		7.74*		-0.48		-3.76*
ΔPSC_{t-1}		-4.19		1.22		2.99
ΔPSC_{t-2}		-3.21		1.49		-2.02
ΔPSC_{t-3}		5.59		0.11		0.25
ΔPSC_{t-4}		-11.75*		-2.51*		2.39**
ΔNSC_t		8.81*		2.15*		4.97*
ΔNSC_{t-1}				-0.08		
ΔNSC_{t-2}				-2.20*		
ΔNSC_{t-3}						
ΔNSC_{t-4}						
Panel B: Long–Run Estimates						
$ln\ Y_v$	3.76**	3.76*	2.37*	3.71*	1.96*	-0.22
$ln\ Y_i$	-3.62	-0.86	0.61*	-0.31	-2.22*	1.56
$ln\ REX_i$	-1.26		0.99**		1.58*	
PSC		3.88**		-0.29		-0.35
NSC		18.35*		-0.24		11.98*
Constant	-59.65	-71.44*	-61.99*	-71.67	6.33	-16.97
Panel C: Diagnostic Statistics						
F	5.92*	4.06*	6.02*	8.46*	7.74*	6.50*
ECM_{t-1}	-0.13*	-0.48*	-0.22*	-0.55*	-0.46*	-0.41*
LM	0.13	0.36	1.19	0.17	1.91	0.15
RESET	0.05	0.16	0.60	0.23	0.42	1.37
Adjusted R^2	0.98	0.98	0.85	0.87	0.98	0.98
CS (CS^2)	S(S)	S(US)	S(S)	S(S)	S(US)	S(S)
WALD – S		0.08		0.09		0.87
WALD – L		0.37		5.18*		0.11

Notes: See notes at the end of Table 4.

Table 3: Linear ARDL (L) and Nonlinear ARDL (NL) Models						
	i=Malaysia		i=New Zealand		i=Singapore	
	L	NL	L	NL	L #,##	NL
Panel A: Short–Run Estimates						
$\Delta lnTB_{i,t-1}$	0.55*	0.50*	0.79*	0.78*	0.64*	0.59*
$\Delta lnTB_{i,t-2}$	0.37*	0.36*	-0.002	0.01	0.21*	0.24*
$\Delta lnTB_{i,t-3}$	0.03	0.06	-0.20**	-0.20**		-0.17
$\Delta lnTB_{i,t-4}$	0.14	0.14				
$\Delta ln\ Y_{V,t}$	0.87	0.81	-1.69*	-1.39	0.12	0.04
$\Delta lnY_{V,t-1}$	-0.52	-0.42	1.90*	1.89*		
$\Delta lnY_{V,t-2}$	0.47	0.44				
$\Delta lnY_{V,t-3}$	1.54**	1.57**				
$\Delta lnY_{V,t-4}$	-1.98*	-1.89*				
$\Delta lnY_{i,t}$	-0.94**	-0.92**	-1.13*	-1.98**	0.13	0.86*
$\Delta lnY_{i,t-1}$	-0.07	-0.15				
$\Delta lnY_{i,t-2}$	0.42	0.30				
$\Delta lnY_{i,t-3}$	-1.23	-1.19				
$\Delta lnY_{i,t-4}$	2.14*	2.17*				
$\Delta lnREX_{i,t}$	-1.12*		0.12		0.45*	
$\Delta lnREX_{i,t-1}$	0.69**				1.04**	
$\Delta lnREX_{i,t-2}$					-1.54*	
$\Delta lnREX_{i,t-3}$					0.73	
$\Delta lnREX_{i,t-4}$						
ΔPSC_t		-1.15**		0.54		-3.63*
ΔPSC_{t-1}						5.48*
ΔPSC_{t-2}						-7.00*
ΔPSC_{t-3}						2.32
ΔPSC_{t-4}						
ΔNSC_t		-4.31*		-0.06		-0.75
ΔNSC_{t-1}		2.79				
ΔNSC_{t-2}						
ΔNSC_{t-3}						
ΔNSC_{t-4}						
Panel B: Long–Run Estimates						
ln Y_V	1.43	1.85*	-2.76*	1.19	0.79	0.13
ln Y_i	1.79*	0.81	0.53	-4.79**	0.87	2.53*
ln REX_i	-1.93		0.29		-6.43**	
PSC		-4.28		1.31		-8.37*
NSC		-5.66**		-0.15		-2.23
Constant	-64.44*	-44.67*	22.16*	26.97	-86.80	-28.91
Panel C: Diagnostic Statistics						
F	5.52*	4.03*	5.13*	4.48*	1.76	3.33
ECM_{t-1}	-0.22*	-0.26*	-0.41*	-0.41*	-0.15*	-0.33*
LM	0.18	0.17	0.32	0.04	0.91	0.01
RESET	0.93	1.19	4.92*	5.65*	0.04	0.08
Adjusted R^2	0.82	0.82	0.90	0.90	0.88	0.89
CS (CS^2)	S(US)	S(S)	S(S)	S(US)	S(S)	S(US)
WALD – S		0.22		0.58		0.40
WALD – L		0.01		0.12		10.21

Notes: See notes at the end of Table 4.

Table 4: Linear ARDL (L) and Nonlinear ARDL (NL) Models				
	i=Thailand		i=USA	
	L: #	NL: #	L :#	NL
Panel A: Short–Run Estimates				
$\Delta lnTB_{i,t-1}$	0.64*	0.62*	0.83*	0.82*
$\Delta lnTB_{i,t-2}$	0.52*	0.52*	0.36*	0.35*
$\Delta lnTB_{i,t-3}$	-0.42*	-0.39*	-0.43*	-0.43*
$\Delta lnTB_{i,t-4}$				
$\Delta ln\ Y_{v,t}$	0.53*	0.26	0.27	0.35
$\Delta lnY_{v,t-1}$		0.65	0.18	0.27*
$\Delta lnY_{v,t-2}$		0.65	1.44*	1.43*
$\Delta lnY_{v,t-3}$		-1.10*	-1.76*	-1.74*
$\Delta lnY_{v,t-4}$				
$\Delta lnY_{i,t}$	-0.46*	-0.85	-3.32*	-3.46*
$\Delta lnY_{i,t-1}$		1.04**	4.21*	4.08*
$\Delta lnY_{i,t-2}$			-1.68	-1.82
$\Delta lnY_{i,t-3}$				
$\Delta lnY_{i,t-4}$				
$\Delta lnREX_{i,t}$	0.45*		0.56	
$\Delta lnREX_{i,t-1}$				
$\Delta lnREX_{i,t-2}$				
$\Delta lnREX_{i,t-3}$				
$\Delta lnREX_{i,t-4}$				
ΔPSC_t		0.01		1.87
ΔPSC_{t-1}				
ΔPSC_{t-2}				
ΔPSC_{t-3}				
ΔPSC_{t-4}				
ΔNSC_t		1.29*		1.39
ΔNSC_{t-1}				
ΔNSC_{t-2}				
ΔNSC_{t-3}				
ΔNSC_{t-4}				
Panel B: Long–Run Estimates				
$ln\ Y_v$	2.08*	1.87*	-0.54	1.26
$ln\ Y_i$	-1.81*	0.75	-3.32*	-4.97
$ln\ REX_i$	1.78*		2.38	
PSC		0.03		7.76
NSC		5.18*		5.76
Constant	-0.38	-45.10	61.29*	47.05
Panel C: Diagnostic Statistics				
F	3.91**	2.68	5.12*	4.39*
ECM_{t-1}	-0.25*	-0.25*	-0.24*	-0.24*
LM	0.03	0.12	0.62	0.30
RESET	0.39	0.03	0.02	0.01
Adjusted R^2	0.84	0.85	0.86	0.86
CS (CS^2)	S(US)	S(S)	S(S)	S(S)
WALD – S		0.07		0.63
WALD – L		0.89		1.43

Notes:

a) The numbers in parentheses beside the coefficient estimates represent the absolute values of t-ratios. **, * indicate significance at the 10% and 5% levels, respectively.

b) The upper bound critical value of the F-test for cointegration when there are three exogenous variables is 3.77 (4.35) at the 10% (5%) significance level. These come from Pesaran *et al*. (2001, Table CI, Case III, p. 300).

c) The critical value significance of ECM_{t-1} is -3.47 (-3.82) at the 10% (5%) level when k =3. The comparable figures when k = 4 are -3.67 and -4.03, respectively. These come from Banerjee *et al*. (1998, Table 1).

d) LM denotes the Lagrange Multiplier test for residual serial correlation, following a chi-squared distribution with one degree of freedom (first order). The 5% and 10% significance critical values are 2.71 and 3.84, respectively.

e) RESET is Ramsey's test for misspecification. It is distributed as χ^2 with one degree of freedom. The critical value is 3.84 at the 5% level and 2.70 at the 10% level.

f) Wald tests are distributed as χ^2 with 1 degree of freedom i.e. critical value is 2.71(3.84) at 10% (5%) significant.

g) Symbol shows dummy is significant; # Global Financial Crisis, 2018; ## Coronavirus disease (COVID-19) pandemic, 2020. Dummy1: Global Financial Crisis, 2018; Dummy2: Coronavirus disease (COVID-19) pandemic, 2020.

As for the long-run effects of income variables, Vietnam's income is positive and significant in five linear models. Vietnam's trading partners' income carries significant negative coefficients in most models.[4]. The negative and significant coefficient obtained for ECM_{t-1} indicates that the adjustment is moving towards its equilibrium. Additionally, as Bahmani-Oskooee and Ardalani (2006) suggested, the negative and significant coefficient of ECM_{t-1} could indicate cointegration among the variables. The results reported in Table 1, panel C, clearly support all cases' adjustment toward equilibrium and cointegration.

In Panel C, review the diagnostic statistics for all models. All Lagrange Multiplier statistics (LM) show no evidence of serial correlation. In addition, Ramsey's RESET test demonstrates that most of these models are correctly specified. CUSUM and CUSUMSQ tests were identified as CS and CS^2 in Panel C to determine the stability of all estimated coefficients. Following Bahmani-Oskooee and Goswami (2003), the CUSUM and CUSUMSQ tests are applied to Equation (2) residuals. The cumulative sum (CUSUM) test plots the recursive residuals against the breakpoints. The CUSUM of squares test (CUSUMSQ) involves plotting the squared recursive residuals against the breakpoints. These two statistics are then depicted within two straight lines bounded by a 5% significance level. The null hypothesis of stable parameters is rejected if any point lies beyond this 5% level. Bahmani-Oskooee and Goswami (2003) argue that cointegration does not imply stability. As such, CUSUM and CUSUMSQ tests are applied to identify stability. Overall, most estimates are stable. They finally adjusted R^2 to consider goodness of fit.

SUMMARY AND CONCLUSION

This research underscores the profound influence of currency devaluations or appreciations on trade balance outcomes, a topic of paramount importance to policymakers and economists. Nations strategically implement different exchange rate systems to gain an advantage in trade balance, and this paper's findings provide invaluable insights for these crucial decisions. The research on the correlation between exchange rates and trade balance has made significant strides, with initial studies focusing on overall trade data and later transitioning to bilateral data, a pivotal shift in addressing aggregation bias. However, both approaches still grapple with an aggregation bias.

This study meticulously utilizes quarterly data to evaluate Vietnam's trade balance with 11 trading partners, with China and the United States representing the most significant trading partners. Does the devaluation of VND offer a trade balance advantage? There have been few studies on the J-curve effect in Vietnam. Previous studies utilized aggregate data and found no indication of a J-curve, possibly due to aggregation bias. Therefore, this study rigorously assesses disaggregated data and uses a bound testing method for cointegration and error-correction modeling with symmetric and asymmetric approaches. The symmetric approach revealed three instances of the J-curve phenomenon: China, India, and Malaysia. However, if one supports the revised interpretation of the J-curve proposed by Rose and Yellen (1989), implying an initial short-term decline followed by long-term recovery, this pattern is evident in the results for Australia, Japan, and Thailand. In the long run, the trade balance improves in the case of Australia, Japan, Indonesia, India, and Thailand.

Regarding the asymmetric styles, the J-curve evidence only indicates cases in Australia and Indonesia. As one of Vietnam's major trading partners, there is no evidence of improved trade balance in the short and long run. Compared to the symmetric results, the non-linear approach increased the number of countries to six. These findings have significant practical implications for Vietnam's trade strategy and can guide future policy decisions.

The implications of the policy emphasize Vietnam's necessity to broaden its export markets to lessen potential economic disruptions in specific countries. Vietnamese exports primarily target the United States, Japan, and China. Therefore, any economic decline in these nations could negatively impact the demand for Vietnamese goods. Decision-makers should thoroughly consider Vietnam's inflation rate and that of its trading partners before adjusting the nominal exchange rate to enhance the trade balance through the relative price channel. It is important to note that the relative price is directly correlated to the real exchange rate rather than the nominal one. Considering the inflation and nominal exchange rates of different countries and currencies will enable anticipation of the trend in the real effective exchange rate and prevent unexpected fluctuations that could adversely affect the trade balance. Reducing government intervention in the foreign exchange market can improve the flexibility of exchange rates.

[4] However, Australia, Japan, and Indonesia show positive and significant. It indicates that higher incomes lead to substituting their imports from Vietnam.

The US is the second largest trading partner, and this paper does not find any evidence showing that exchange rates impact its trade balance. In future research, it would be constructive to use disaggregated data at the bilateral level, specifically for Vietnam and the USA, and at the industry level to enhance the comprehensiveness of the analysis.

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APPENDIX

Data Definition and Sources

Sources:
Quarterly data over the period 2000QI-2023II are used to conduct the empirical analysis.
Data:

- **a.** IMF e-Library – DATA:
  - **(a)** Direction of Trade Statistics (DOT)
  - **(b)** International Financial Statistics (IFS)
- **b.** Global Financial Data

Variables:
TB_c = Vietnam trade balance with partner **i** is defined as Vietnam's imports from partner **i** over its exports to partner **i**. The data comes from source **a.(a)**.
V = Measure of Vietnam's income. It is proxied by the index of real GDP. The data come from sources **a.(a)** and **a.(b)**.
Y_i = the income of the trading partner, **i**. The country's index of real GDP also proxies this, and the data come from sources a and b.
REX_i = The real bilateral exchange rate of the Vietnamese Dong against partner **i**'s currency is defined as $REX_i = (PVT \times NEX_i / P_i)$, where NEXi is the nominal exchange rate, PVT is the price level in Vietnam (measured by CPI), and P_i is the price level in country **i** (also measured by CPI). A decrease in REX indicates a real depreciation of the Vietnamese Dong. All data comes from source IMF e-Library.

Note:
Dummy1: Global Financial Crisis, 2018
Dummy2: Coronavirus disease (COVID-19) pandemic, 2020.

Countries (i):
Australia, China, Hong Kong, India, Indonesia, Japan, Malaysia, New Zealand, Singapore, Thailand, United States

DRAWDOWN RISK REDUCTION (OR NOT) WITH DIVIDEND PORTFOLIOS IN BEAR MARKETS

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ABSTRACT

Dividend paying stocks are widely regarded as "low risk" by retail investors, and the academic research on dividend paying stocks has widely supported that viewpoint if the risk measure is volatility. However, drawdown risk measures capture more of the emotional features of what investors consider as risk. Consequently, this research investigates the drawdown risk of dividend portfolios in bear markets.

In the two worst market drawdowns of the 1927-2024 CRSP data sample (the Great Depression and the 2008 Financial Crisis), the high dividend yield portfolio has greater maximum drawdown than the CRSP total market portfolio. Consequently, the high dividend yield portfolio may be considered riskier than the market portfolio during those bear market drawdowns.

Analysis of dividend focused ETFs during recent bear markets shows that the path dependent drawdown is contingent on the investment style (blend or value) of the dividend portfolio. During the 2008 Financial Crisis and the 2020 Pandemic cycle, the large blend, high dividend growth ETFs perform better than the Russell 1000 large cap benchmark, while the high dividend yield ETFs classified as large value portfolios perform worse than the Russell 1000. While both the high dividend yield (value) ETFs and the high dividend growth (blend) ETFs perform better than the Russell 1000 during the 2022 Inflation Surge, the high dividend yield (value) ETFs have the smallest drawdown losses and shortest drawdown cycles.

INTRODUCTION

Portfolios of dividend paying stocks are often considered "low risk" or "safe", but what is meant by "low risk"? This is an especially relevant question for retirees who are often persuaded by financial advisors or the financial press to invest heavily in portfolios of dividend paying stocks for income and "low risk". While the most common risk metric in finance is standard deviation or volatility, many investors are more concerned about losses. This is especially true for retirees who withdraw funds from retirement accounts, where excessive losses in combination with continued withdrawals could deplete their retirement funds. Even from an institutional portfolio management point of view, excessive losses can lead to massive redemptions and the loss of clients. Consequently, drawdown, or the peak to trough decline during a specific period for an investment may be a better risk metric for investors.

Geboers, Depaire, and Annaert (2023) report that while the intuitive drawdown risk measure is often used in practice, it is receiving more and more academic attention for several reasons. Perhaps the most significant reason is the critical psychological impact that market drawdowns have on investors. Geboers et al (2023) detail several connections between drawdown and investor psychology:

a. Investors may sell following a severe market decline because they fear even larger losses.
b. Investors may overestimate their risk tolerance and could be astonished by the magnitude of market drawdowns.
c. Investors are increasingly considering stress testing and analyzing tail risks for risk management.

The drawdown measure then captures emotional features of what investors consider as risk. According to the seminal research on Prospect Theory by Tversky and Kahneman (1979), investors exhibit risk aversion and feel the pain of their losses more strongly than the pleasure of their gains. Focusing on the worst-case scenario, drawdown specifically looks at the largest peak-to-trough decline in price, highlighting the maximum potential loss an investor could face. On the other hand, volatility only measures the overall dispersion of returns, which can include both positive and negative price fluctuations, potentially masking significant downside risk. Clearly volatility risk is different from the tail risks of extreme events; moreover, these infrequent tail risks can decimate years of gains. Furthermore, drawdown considers the duration of a price decline, not just the magnitude of price swings, which can be crucial for understanding the

impact of a downturn on an investor's portfolio. Drawdowns present a significant risk to investors when considering the advance in share price needed to overcome a drawdown. Retirees need to be especially careful about drawdown risks in their portfolios, since they may not have a lot of time for the portfolio to recover.

While superior for measuring downside risk, drawdown alone doesn't provide the complete picture of an investment's risk profile. Given that evolution of the price path is evident in the definition, the maximum drawdown can vary significantly depending on the time period analyzed. Consequently, this study focuses on U.S. bear markets where the drawdown exceeds 20%, which seems to be precisely the time when an investor needs a portfolio of "low risk", safe stocks. Fuller and Goldstein (2011) report that dividend paying stocks outperform non-payers in declining markets, but do not consider path dependance or drawdown.

Dividend paying stocks are widely regarded as "low risk" by retail investors and the academic research on dividend paying stocks has widely supported that viewpoint. In the finance literature on dividend policy, researchers such as Hoberg and Prabhala (2009), Twu (2010), and Hauser and Thornton (2015, 2016, 2017) show that the likelihood that a stock pays dividends is correlated to its risk as measured by standard deviation or volatility. These studies show that over long time series more mature companies with low stock price volatility pay dividends while less mature companies with high stock price volatility do not pay dividends. Moreover, in the academic literature on dividend portfolio theory (Clemens, 2013; Conover, Jensen, and Simpson, 2016), there seems to be a consensus that dividend investing shows volatility risk reduction. In both the dividend policy and the dividend portfolio research studies, the greatest volatility risk reduction is generally presented between portfolios of dividend payers and non-payers. For example, Clemens (2013) reports that in the 1928-2011 sample investigated, the annualized volatility of the least volatile dividend payers is 19.5%. While this is significantly lower than the annualized volatility of the non-payers at 34%, it is much less different from even the most volatile quintile of dividend payers with an annualized volatility of 24.6%. This subtle point has tremendous implications in real world portfolios. Investors do not generally invest in portfolios of exclusively non-paying stocks. In fact, the most popular retail portfolios are broadly diversified index funds. Therefore, this research sets a diversified market index, the Russell 1000, as the benchmark for risk comparisons. Another key point is that the research of Clemens (2013) and Conover et al (2016) shows that highest volatility for dividend paying stocks occurs with the subset with the highest dividend yield. The argument is that an extremely high dividend yield may be a sign of financial distress.

Conover et al (2016) find that dividend paying stocks reduce risk, independent of value or growth investment style. This is important because historically dividend investing is often regarded as just a subset of value investing, where investors seek above average dividend yield. The findings of Conover et al (2016) and the argument against extremely high dividend yield suggest that a dividend growth portfolio may have advantages. The practitioner literature of Cheng, Srivastava, and Wang (2022), Hartford Funds (2024), Park and Chalupnik (2024), and ProShares (2023, 2024) detail the potential advantages of a high dividend growth strategy over a classical high dividend yield strategy using the performance of two popular exchange traded funds (ETFs). Cheng et al (2022) proposes several reasons why dividend growth stocks could have lower volatility than classical high dividend yield stocks. First, dividend growth stocks tend to have higher earnings quality and financial stability than the broader market. As in the case of financial distress, a high dividend yield does not necessarily signal financial strength or discipline. Second, dividend growth portfolios tend to be more diversified across sectors, and that diversification can mitigate risk. On the other hand, many high dividend yield portfolios tend to be concentrated in the Utilities, Financials, and Real Estate sectors.

Unfortunately, the risk measure discussed in most of these academic studies and practitioner literature on dividend investing is volatility. To quote Warren Buffett (2007), "Volatility is not a measure of risk." Following Cheng et al (2022), this investigation utilizes popular dividend focused ETFs to represent real dividend portfolios that are available to investors. Since drawdown risk is path dependent, I focus on drawdown during the specific U. S. bear markets.

A historical review of the high dividend yield research portfolio from the Dr. Kenneth R. French database shows that the high dividend yield portfolio usually reduces the maximum drawdown percentage and the drawdown cycle at the median, but not in every bear market cycle since 1927. In the two worst drawdowns in the data sample (the Great

Depression and the 2008 Financial Crisis), the high dividend yield research portfolio has greater losses than the CRSP total market portfolio.

Investigation of the 10 largest dividend focused ETFs (by net assets as of August 2024) shows that the drawdown risk performance of the dividend focused ETFs during bear markets is highly dependent on whether the portfolio is classified as value or blend. During the 2008 Financial Crisis and the 2020 Pandemic cycle, the high dividend growth ETFs classified as large blend portfolios perform better than the Russell 1000 large cap benchmark, while the high dividend yield ETFs classified as large value portfolios perform worse than the Russell 1000. While both the high dividend yield ETFs and the high dividend growth ETFs perform better than the Russell 1000, the high dividend yield ETFs had the smallest drawdown losses and shortest drawdown cycle periods during the 2022 Inflation Surge cycle. These results indicate that the value style of the high dividend yield portfolios performs well in some bear market cycles, but not all bear market cycles. The more diversified blend style of the high dividend growth portfolios provides more consistent drawdown risk reduction in bear markets.

In the 2007 – 2024 data set, the high dividend growth ETFs that are classified as large blend portfolios appear especially impressive with higher Sharpe ratios and higher Calmar ratios than the Russell 1000 benchmark. Dividend ETFs with the highest Sharpe ratios tend to correspond to funds with the highest Calmar ratios. However, dividend funds with the lowest volatility (standard deviation), do not always correspond to funds with the minimum drawdown losses. Drawdown risk is not volatility risk. Investors whose primary concern is capital preservation should be more concerned about maximum drawdown rather than volatility.

Finally, the drawdown risk performance of a dividend portfolio specifically constructed to reduce volatility is disappointing. The Invesco S&P 500 High Dividend Low Volatility ETF performs worse than the median large value high dividend yield ETF in both the 2020 Pandemic and the 2022 Inflation Surge.

This paper contributes to the literature on the performance of dividend portfolios as it specifically investigates path dependent drawdown risk rather than volatility. The research illuminates the considerable difference in maximum drawdown between high dividend yield (value) portfolios and high dividend growth blend portfolios. The remainder of the paper is organized as follows. Section 2 reviews the history of U.S. CRSP market drawdowns. Given that the analysis of drawdown is time period dependent, Section 3 reviews the drawdown of dividend focused ETFs in the 2008 Financial Crisis, while Section 4 presents the results of the drawdown analysis for the 2020 Pandemic. Section 5 details the drawdown of the dividend ETFs during the 2022 Inflation Surge, and Section 6 concludes.

HISTORY OF MARKET DRAWDOWNS

Given that very few ETFs operated before 2000, it is instructive to examine the historical record of market drawdowns. This research investigates the CRSP total market data provided by Dr. Kenneth R. French on his data library at: https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. The data library supports the classic Fama and French (1992) factor models of return. Using the monthly CRSP total market return data, Figure 1 shows the CRSP total market drawdown from July 1927 – June 2024. Fortunately for investors, periods of bear markets where the maximum drawdown exceeds 20% are somewhat infrequent, about one per decade in the sample.

Figure 1. History of CRSP Market Drawdowns 1927-2024

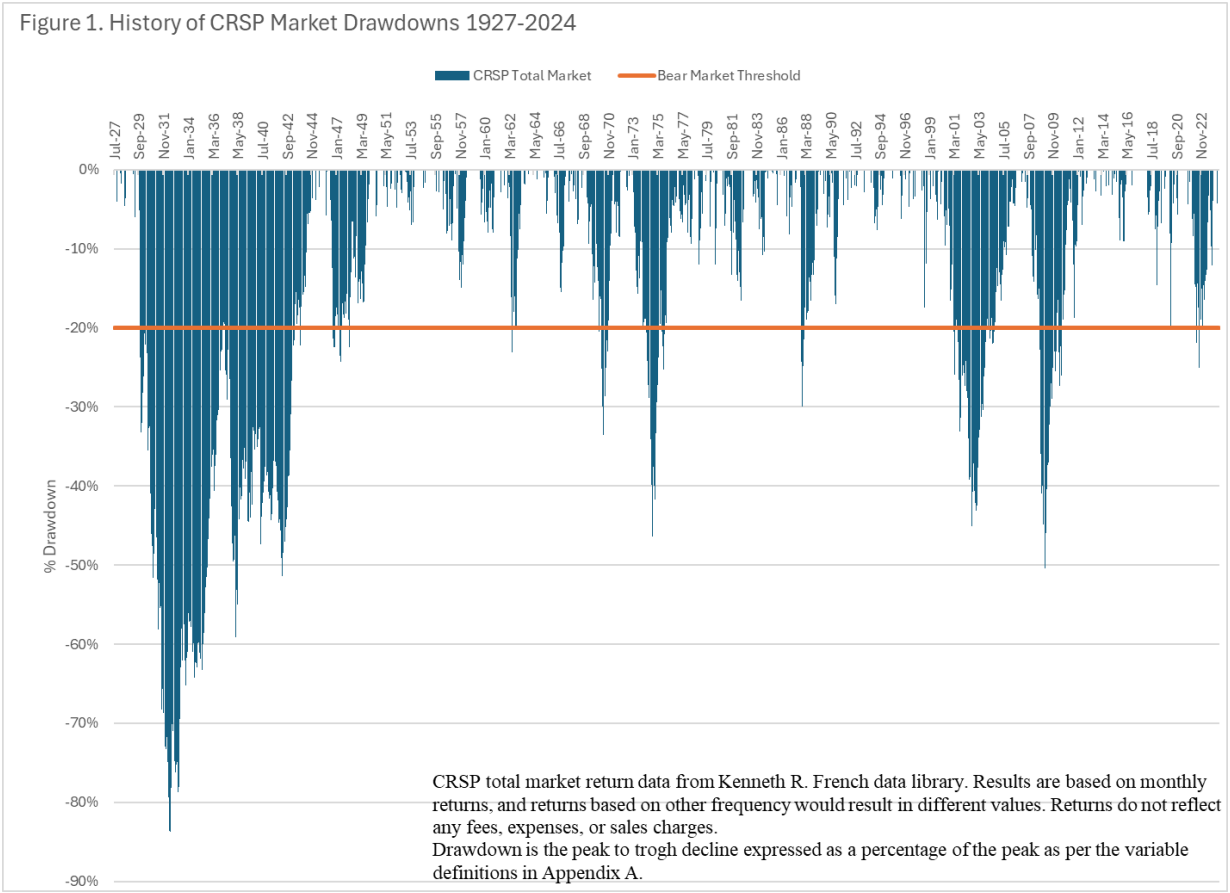

Figure 1 summarizes the market maximum drawdown percentage and market drawdown cycle for these major bear market periods. The median drawdown cycle in the sample is 40 months with the median maximum drawdown of about 32%. However, note the extreme differences between the most severe bear market cycle and the least severe bear market cycle in the data set. Investors should hope that the bear market drawdown cycle of the Great Depression (which lasted over 15 years) is an extreme outlier that never repeats but should be aware of the possibility. At the other extreme, the 2020 Pandemic bear market drawdown cycle lasted less than a year, leaving a casual investor looking only at annual returns to perhaps underestimate the risks of that period. For more historical analysis of these bear markets, the interested reader is directed to other sources such as Alexander (2000) or Duggan (2023) since the intent of this research is to simply provide the market reference as a benchmark for dividend portfolios.

Table 1. CRSP Total Market Bear Market Drawdown Cycles 1927-2024

CRSP Total Market Drawdown					
Drawdown Bear Market Cycle	Peak Date	Trough Date	Recovery Date	Drawdown Cycle (Months)	Maximum Drawdown
Great Depression	Aug-1929	Jun-1932	Dec-1944	184	-83.7%
Post WWII Recession	May-1946	May-1947	Dec-1949	43	-24.2%
Flash Crash of 1962	Dec-1961	Jun-1962	Apr-1963	16	-23.0%
Vietnam War	Nov-1968	Jun-1970	Dec-1971	37	-33.6%
1973 Oil Embargo	Dec-1972	Sep-1974	Dec-1976	48	-46.4%
1987 Crash	Aug-1987	Nov-1987	May-1989	21	-29.9%
Dot Com Crash	Aug-2000	Sep-2002	Oct-2006	74	-45.1%
2008 Financial Crisis	Oct-2007	Feb-2009	Mar-2012	53	-50.4%
2020 Pandemic	Jan-2020	Mar-2020	Jul-2020	6	-20.2%
2022 Inflation Surge	Dec-2021	Sep-2022	Dec-2023	24	-25.0%
Median Bear Market Drawdown Cycle				*40*	*-31.7%*
Notes					
CRSP Monthly return data from the Kenneth R. French data library.					
Results are based on monthly returns. Maximum drawdown is largest peak to trough decline.					

Historical Drawdown Analysis of the Large Cap, High Yield Research Portfolio

In addition to the CRSP Market data, another research portfolio of interest in the data library (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html) of Dr. Kenneth R. French is from the bivariate sort on size and dividend yield, specifically the portfolio formed by the intersection of the largest dividend paying stocks (by the market capitalization) and the highest dividend yielding stocks labeled "BIG Hi D/P". Clemens (2013) utilizes this data set to dividend investing performance. This large cap, high dividend yield research portfolio is highly relevant to this study since the bivariate sort on size and dividend yield is the fundamental basis for many of the retail ETFs discussed in the following sections.

Using the monthly total return data from the large cap, high dividend yield research portfolio, Table 2 summarizes the maximum drawdown and the drawdown cycle of the bear markets from July 1927 – June 2024. For high dividend yield research portfolio, the median drawdown cycle is 27 months with a median maximum drawdown of about 24%. Thus, at the median, the conventional wisdom that a portfolio of dividend paying stocks is "safer" seems true even with the drawdown risk measure. However, the median only describes the middle event. To analyze each individual bear market cycle, a maximum drawdown ratio was applied which compares the maximum drawdown of the dividend portfolio to the market for each bear market cycle. Likewise, the drawdown cycle ratio compares the drawdown cycle length of the dividend portfolio to the market for each bear market cycle. Examination of the results of Table 1 and Table 2 reveals that the large cap, high dividend yield portfolio often performs better than the market (7/10 bear market cycles); however, it does not *always* result in a "safer" outcome when using maximum drawdown as the criteria for risk. In the data set, the large cap, high dividend yield research portfolio performs *worse* than the market (having a larger maximum drawdown) during the Great Depression, 2008 Financial Crisis, and 2020 Pandemic bear market cycles.

Table 2. Large Cap, High Dividend Yield Research Portfolio Drawdown Cycles 1927-2024

Large Cap, High Dividend Yield Research Portfolio							
Drawdown Bear Market Cycle	Peak Date	Trough Date	Recovery Date	Drawdown Cycle Months	Maximum Drawdown	Drawdown Ratio	Drawdown Cycle Ratio
Great Depression	Aug-1929	May-1932	May-1944	177	-88.4%	105.6%	96.2%
Post WWII Recession	May-1946	Feb-1948	Dec-1949	43	-22.6%	93.2%	100.0%
Flash Crash of 1962	Feb-1962	Jun-1962	Jan-1963	11	-13.2%	57.4%	68.8%
Vietnam War	Nov-1968	Jun-1970	Jan-1971	26	-26.0%	77.5%	70.3%
1973 Oil Embargo	Nov-1972	Sep-1974	Jun-1975	31	-30.8%	66.4%	64.6%
1987 Crash	Aug-1987	Nov-1987	May-1989	17	-22.9%	76.5%	81.0%
Dot Com Crash	Jul-2001	Sep-2002	Oct-2003	27	-20.0%	44.4%	36.5%
2008 Financial Crisis	May-2007	Feb-2009	May-2012	60	-56.3%	111.7%	113.2%
2020 Pandemic	Dec-2019	Mar-2020	Jul-2020	7	-27.7%	136.9%	116.7%
2022 Inflation Surge	May-2022	Sep-2022	Nov-2022	6	-13.6%	54.5%	25.0%
Median Large Cap High Dividend Yield Drawdown Cycle				*27*	*-24.4%*	*77.0%*	*75.6%*
Notes							
Large Cap, High Dividend Yield monthly return data from the Kenneth R. French data library.							
Results are based on monthly returns. Maximum drawdown is largest peak to trough decline.							
Variable Definitions are in Appendix A.							

The historical analysis with the large cap, high dividend yield research portfolio indicates that most of the time the high dividend yield portfolio has less maximum drawdown than the market in bear market cycles. The defensive nature of the large cap, high dividend yield portfolio is impressive considering the maximum drawdowns in the Flash Crash of 1962 and the 2022 Inflation Surge do not even reach the 20% threshold for a bear market; in addition, the maximum drawdown of the large cap, high dividend yield portfolio during the Dot Com Crash is less than half of the maximum drawdown of the market. However, the historical analysis shows that the large cap, high dividend yield portfolio is not always more defensive than the market. In the worst two bear market cycles of the data set (the Great Depression and the 2008 Financial Crisis), the large cap, high dividend yield portfolio has worse losses than the diversified market portfolio.

DRAWDOWN RISK WITH DIVIDEND FOCUSED EXCHANGE TRADED FUNDS (ETFS) IN THE 2008 FINANCIAL CRISIS

The drawdown of contemporary dividend focused ETFs in the 2008 Financial Crisis was examined since there are no earlier observations of dividend focused ETFs prior that would enable analysis of any bear market cycle before the 2008 Financial Crisis. The 2008 Financial Crisis had a severe and far-reaching impact on the U.S. economy (Weinburg, 2013). Sparked by the collapse of the housing bubble, the crisis led to a major recession marked by a 4.3% decline in GDP from peak to trough—the steepest drop since World War II. Unemployment surged to 10% in October 2009, doubling from pre-crisis levels, and approximately 8.7 million jobs were lost during the recession. Financial institutions like Lehman Brothers collapsed, while others, such as AIG and Bear Stearns, required substantial government bailout. To stabilize the economy, the federal government implemented the Troubled Asset Relief Program (TARP), a $700 billion bailout aimed at shoring up the banking system, while the Federal Reserve lowered interest rates and launched large-scale asset purchases (quantitative easing) to boost liquidity. Meanwhile, the stock market plummeted reaching its trough in March 2009.

Dividend Focused ETFs Sample

This research studied the 10 largest dividend focused ETFs in terms of net assets reported by Morningstar.com as of August 2024. Due to the concentration of assets in the largest dividend focused ETFs, the data set represents an

economically significant sample as it captures the majority of investor assets while a limitation to note is that the sample is not a full cross section. The dividend focused ETFs and benchmarks are summarized in Table 3. Data are extracted from Morningstar.com as of August 2024.

Table 3. Sample Exchange Traded Funds

Fund	Ticker	Net Assets (Billions$)	Morningstar Style Category	Morningstar Rating	Inception Date	Dividend Yield	Portfolio Style Measures Avg Market Cap	P/E	P/B
Panel A	Diversified Market Benchmark								
Large Cap Benchmark ETF									
iShares Russell 1000	**IWB**	**$36.46B**	**Blend**	**4 Stars**	**5/15/2000**	**1.19%**	**$241.97B**	**22.32**	**4.07**
Largest Dividend ETFs									
Panel B	High Dividend Growth Objective								
Vanguard Dividend Appreciation Index	VIG	$97.35B	Blend	3 Stars	4/21/2006	1.77%	$188.96B	20.09	4.12
WisdomTree U.S. Quality Dividend	DGR	$13.72B	Blend	5 Stars	5/22/2013	1.55%	$248.24B	20.91	5.57
Median Blend						*1.66%*	*$218.60B*	*20.50*	*4.85*
iShares Core Dividend Growth Fund	DGRO	$28.99B	Value	4 Stars	6/10/2014	2.26%	$154.29B	18.04	3.34
First Trust Rising Dividend Achievers Fund	RDVY	$11.66B	Value	5 Stars	1/6/2014	1.80%	$47.63B	13.43	2.11
Median Value						*2.03%*	*$100.96B*	*15.74*	*2.73*
Panel C	High Dividend Yield Objective								
Vanguard High Dividend Yield Index Fund	VYM	$70.00B	Value	4 Stars	11/10/2006	2.87%	$103.26B	15.79	2.55
Schwab U.S. Dividend Equity Fund	SCHD	$58.65B	Value	4 Stars	10/20/2011	3.43%	$79.47B	15.24	3.05
SPDR S&P Dividend Fund	SDY	$20.75B	Value	4 Stars	11/8/2005	2.47%	$43.77B	18.82	2.9
iShares Select Dividend Fund	DVY	$19.32B	Value	3 Stars	11/3/2003	3.52%	$28.49B	13.55	1.76
iShares Core High Dividend Fund	HDV	$10.75B	Value	3 Stars	3/29/2011	3.33%	$132.43B	14.94	2.75
Median Value						3.33%	*$79.47B*	15.24	2.75
Panel D	Dividend Aristocrats								
ProShares S&P 500 Dividend Aristocrats Fund	NOBL	$12.06B	Value	4 Stars	10/9/2013	2.09%	$52.30B	19.96	3.24
Panel E	High Dividend, Low Volatility								
Selected Large Cap Dividend ETFs									
Invesco S&P 500 High Dividend Low Volatility Fund	SPHD	$3.91B	Value	2	10/18/2012	3.85%	$45.75B	14.64	2.11

Notes: Data are extracted from Morningstar.com as of August 2024.

Maximum Drawdown and Drawdown Cycle of the Dividend Focused ETFs

Table 4 summarizes the maximum drawdown and the drawdown cycle of the dividend focused ETFs during the 2008 Financial Crisis utilizing daily total returns. From inspection of the inception dates, the analysis is limited to only several of the largest ETFs that were established prior to the 2008 Financial Crisis. Using the iShares Russell 1000 ETF as the proxy for the large cap stock benchmark, the maximum drawdown is over 55%, based on daily total returns. From the historical CRSP total market reference in Section 2, the drawdown of the broad market during the 2008 Financial Crisis is worse only in the Great Depression drawdown cycle.

Table 4. Maximum Drawdown during the 2008 Financial Crisis Bear Market Cycle

		Bear Market Cycle			Drawdown		Maximum	Drawdown
	Morningstar	Peak	Trough	Recovery	Cycle	Maximum	Drawdown	Cycle
FUND	Category	Date	Date	Date	Days	Drawdown	Ratio	Ratio
Panel A	Diversified Market Benchmark							
iShares Russell 1000	**Blend**	**10/9/2007**	**3/9/2009**	**3/19/2012**	**1623**	**-55.4%**	**100.0%**	**100%**
Panel B	High Dividend Growth Objective							
Vanguard Dividend Appreciation Index Fund	Blend	10/9/2007	3/9/2009	2/16/2011	1227	-46.8%	84.5%	76%
Panel C	High Dividend Yield Objective							
Vanguard High Dividend Yield Index Fund	Value	10/9/2007	3/9/2009	3/13/2012	1617	-57.0%	102.9%	100%
SPDR S&P Dividend Fund	Value	6/1/2007	3/9/2009	3/13/2012	1748	-54.8%	98.9%	108%
iShares Select Dividend Fund	Value	5/22/2007	3/9/2009	1/29/2013	2079	-62.6%	113.0%	128%
Median Large Value						-57.0%	102.9%	107.7%

Notes: Drawdown calculations are based on daily total return calculations.
Maximum drawdown ratio and drawdown cycle ratio are relative to the iShares Russell 1000 benchmark.

There are two general classifications for dividend investment strategies: Dividend portfolios that target higher dividend yield or dividend portfolios that target higher dividend growth. While there are a number of practitioner studies (Cheng et al, 2022; Hartford Funds, 2024; ProShares, 2023, 2024) that focus on the return performance of these dividend growth and dividend yield strategies, none have focused on drawdown risk. The only ETF following a high dividend growth strategy in existence at the time of the 2008 Financial Crisis was the Vanguard Dividend Appreciation ETF, and the results are summarized in Panel B of Table 4. Interestingly, the high dividend growth strategy of the Vanguard Dividend Appreciation ETF shows remarkable performance during the 2008 Financial Crisis bear market cycle as the maximum drawdown is only about 85% of the market and the drawdown period is only about 80% of the market's drawdown cycle length. Clearly this is the risk reduction that a risk averse investor is attempting to find in dividend portfolios. Table 3 indicates that Morningstar classifies the high dividend growth portfolio as a large blend portfolio, indicating the dividend portfolio has a mix of growth and value characteristics.

Panel C in Table 4 shows the maximum drawdown percentage of the dividend focused ETFs with a high dividend yield strategy is worse than the market benchmark. Furthermore, the drawdown cycle time of the high dividend yield ETFs is longer than the benchmark. Consequently, in the bear market cycle with the worst losses since the Great Depression, investors in the most popular dividend focused ETFs with a high dividend yield strategy suffer worse losses (and for a longer time period) than investors who simply invest in a broad market index fund.

The relatively poor drawdown risk performance of the high dividend yield ETFs is not surprising when considering the relationship of these ETFs to the large cap, high dividend yield research portfolio detailed in Section 2.1 where the annual returns of the high dividend yield ETFs are about 95% correlated with the research portfolio. Consequently, we can recall from Table 2 that the research portfolio fares worse than the CRSP total market portfolio during the 2008 Financial Crisis. Although some of the most popular dividend focused ETFs with a high dividend yield strategy have stricter portfolio construction parameters than the simple bivariate sort of the research portfolio, the high dividend yield approach still performs worse than the market portfolio. For example, the SPDR® S&P Dividend ETF requires that its high yielding stocks have increased their dividends for 20 consecutive years. Note that Table 3 shows that these high dividend yield ETFs are classified as value portfolios. During the 2008 Financial Crisis, value portfolios, which usually have large positions in the Financials sector, clearly underperform.

Drawdown Performance Measures of the Dividend Focused ETFs

Table 5 summarizes the drawdown performance measures of the dividend focused ETFs during the 2007 – 2023 period, which includes the 2008 Financial Crisis, the 2020 Pandemic and the 2022 Inflation Surge cycles. While the

primary focus of this research is investigating drawdown risk, investors should consider performance measures that consider both investment return and risk.

Table 5. Maximum Drawdown and Performance Measures 2007 - 2023

Fund	Average Annual Return	Standard Deviation of Returns	Sharpe Ratio	Compound Annual Return	Maximum Drawdown	Calmar Ratio
Panel A	Diversified Market Benchmark					
iShares Russell 1000	**11.22%**	**18.80%**	**0.54**	**9.44%**	**-55.4%**	**0.17**
Panel B	High Dividend Growth Objective					
Vanguard Dividend Appreciation Index Fund	10.21%	14.38%	0.63	9.23%	-46.8%	0.20
Panel C	High Dividend Yield Objective					
SPDR S&P Dividend Fund	9.06%	13.59%	0.59	8.21%	-54.8%	0.15
Vanguard High Dividend Yield Index Fund	9.00%	14.59%	0.54	7.95%	-57.0%	0.14
iShares Select Dividend Fund	8.05%	15.87%	0.44	6.82%	-62.6%	0.11
Median High Dividend Yield	*9.00%*	*14.59%*	*0.54*	*7.95%*	*-57.0%*	*0.14*

Notes: Drawdown calculations are based on daily total return calculations. Maximum Drawdown occurs during 2008 Financial Crisis.
Variable definitions are in Appendix A.

For comparison to the drawdown performance measure, Table 5 first considers Sharpe Ratio (1994) as the typical performance measure. For a drawdown performance measure, I report Young's (1991) Calmar ratio, which is defined as the compound average return divided in the period divided by the maximum drawdown in the period. All the large cap dividend ETF portfolios with performance history in the 2007-2023 period have a lower standard deviation (lower volatility) than the iShares Russell 1000 market benchmark. Consequently, one might consider the large cap dividend ETF portfolios to be less risky than the market if volatility is the primary measure of risk. But clearly volatility risk is not drawdown risk, because only the high dividend growth portfolio has less drawdown than the benchmark. Investors concerned about capital preservation should then focus on drawdown risk rather than volatility risk.

In this time period, growth has outperformed value; therefore, the Russell 1000 benchmark has a larger average and compound return. Using the Sharpe Ratio, it seems that the median high dividend yield ETF portfolio (with the lower volatility) has about the same risk adjusted performance as the Russell 1000 benchmark. This might lead an investor to believe that the lower return with high dividend yield portfolio is offset by lower risk. However, an investor focused on drawdown risk (minimizing capital losses) has seen that high dividend yield portfolios have more drawdown than the diversified market benchmark, the Russell 1000. On Calmar ratio basis, the benchmark performs considerably better than the high dividend yield ETF portfolios. To many investors, the Calmar ratio would seem to make more intuitive (or emotional) sense since the compounded return of the benchmark is better; furthermore, the benchmark lost less at its absolute worst.

With the benefit of history, the high dividend growth strategy appears especially appealing with a higher Sharpe ratio and a higher Calmar ratio than the market. Again, the Calmar ratio would seem to make more intuitive (or emotional) sense since the compounded return of the high dividend growth portfolio is just about the same of the benchmark; however, the high dividend growth portfolio lost less than the benchmark at its absolute worst. During the 2008 Financial Crisis cycle, the high dividend growth strategy is the only dividend ETF portfolio that performs better than the diversified benchmark.

DRAWDOWN RISK WITH DIVIDEND FOCUSED EXCHANGE TRADED FUNDS IN THE 2020 PANDEMIC

In this section, I investigate the drawdown of the largest dividend focused ETFs during the 2020 Pandemic bear market cycle. The COVID-19 pandemic had a profound impact on the U.S. economy, leading to a historic contraction and widespread job losses (Ihrig, Weinbach, and Wolla, 2020). In early 2020, widespread lockdowns and social distancing measures led to massive disruptions in industries like hospitality, travel, and retail, resulting in unprecedented job

losses and business closures. In 2020, real GDP shrank by 3.5%, marking the first annual decline since the 2008 financial crisis and the sharpest since 1946. The second quarter of 2020 saw an unprecedented 31.4% drop in GDP due to the lockdown measures, reduced consumer demand, and widespread business closures. Approximately 22 million jobs were lost in March and April 2020 alone, pushing unemployment to levels not seen in decades, with a peak of 14.8% in April 2020. Certain sectors, particularly hospitality, travel, and retail, were hit hardest by the pandemic's effects, while industries like e-commerce and digital services grew as businesses adapted to the new environment. In response, the U.S. government introduced multiple relief measures, including the CARES Act and other stimulus packages, totaling over $2.7 trillion, to mitigate the economic fallout.

Dividend Focused ETFs Sample

The 10 largest dividend focused ETFs in terms of net assets reported by Morningstar as of August 2024 are examined, which are clearly some of the most popular ETFs available. Note from the inception dates in Table 3, all the 10 largest dividend focused ETFs have performance data.

Maximum Drawdown and Drawdown Cycle of the Dividend Focused ETFs

Table 6 summarizes the maximum drawdown and the drawdown cycle of the dividend focused ETFs during the 2020 Pandemic bear market cycle utilizing daily total returns. Again, using the iShares Russell 1000 ETF as the proxy for the large cap stock benchmark, the maximum drawdown was about 35%. From the historical CRSP total market reference in Section 2, the 2020 Pandemic drawdown cycle time of 6 months is the shortest drawdown cycle in the data set beginning in 1927. Given the short drawdown cycle length, the maximum drawdown calculation for the 2020 Pandemic bear market cycle is sensitive to the use of daily or monthly data. While investors did suffer a drawdown in 2020, the rapid recovery actually led to positive market gains on an annual basis.

Table 6. Maximum Drawdown during the 2020 Pandemic Crisis Bear Market Cycle

		Bear Market Cycle			Drawdown		Maximum	Drawdown
	Morningstar	Peak	Trough	Recovery	Cycle	Maximum	Drawdown	Cycle
FUND	Category	Date	Date	Date	Days	Drawdown	Ratio	Ratio
Panel A	Diversified Market Benchmark							
iShares Russell 1000	**Blend**	**2/19/2020**	**3/23/2020**	**8/6/2020**	**169**	**-34.6%**	**100.0%**	**100%**
Panel B	High Dividend Growth Objective							
Vanguard Dividend Appreciation Index Fund	Blend	2/14/2020	3/23/2020	8/26/2020	195	-31.7%	91.7%	115%
WisdomTree U.S. Quality Dividend Growth Fund	Blend	1/17/2020	3/23/2020	8/10/2020	217	-32.0%	92.6%	128%
Median Large Blend						*-31.9%*	*92.1%*	*121.9%*
iShares Core Dividend Growth Fund	Value	2/12/2020	3/23/2020	11/9/2020	272	-35.1%	101.5%	161%
First Trust Rising Dividend Achievers Fund	Value	2/12/2020	3/23/2020	11/9/2020	272	-40.6%	117.3%	161%
Median Large Value						*-37.8%*	*109.4%*	*160.9%*
Panel C	High Dividend Yield Objective							
Vanguard High Dividend Yield Index Fund	Value	1/17/2020	3/23/2020	12/31/2020	350	-35.2%	101.7%	207%
SPDR S&P Dividend Fund	Value	2/14/2020	3/23/2020	11/24/2020	286	-36.7%	106.1%	169%
iShares Select Dividend Fund	Value	1/23/2020	3/23/2020	2/9/2021	384	-41.5%	120.1%	227%
Schwab U.S. Dividend Equity Fund	Value	1/23/2020	3/23/2020	9/2/2020	223	-33.4%	96.4%	132%
iShares Core High Dividend Fund	Value	1/2/2020	3/23/2020	3/8/2021	433	-37.0%	106.9%	256%
Median Large Value						*-36.7%*	*106.1%*	*207.1%*
Panel D	Dividend Aristocrats							
ProShares S&P 500 Dividend Aristocrats Fund	Blend	1/17/2020	3/23/2020	10/8/2020	266	-35.4%	102.4%	157%
Panel E	High Dividend, Low Volatility							
Invesco S&P 500 High Dividend Low Volatility Fund	Value	1/17/2020	3/23/2020	3/10/2021	418	-41.4%	119.6%	247%

Notes: Drawdown calculations are based on daily total return calculations.
Maximum drawdown ratio and drawdown cycle ratio are relative to the iShares Russell 1000 benchmark.

Panel B of Table 6 summarizes the results of the largest dividend focused ETFs with the high dividend growth objective. While these ETFs have high dividend growth as an objective, differences in the portfolio construction methodologies lead some of the ETFs to still be classified as large value portfolios (even if growth is in the fund name). Note in Table 3, this subset of value portfolios has nearly the same portfolio P/E and P/B ratios as the high dividend yield value portfolios in Panel C. The high dividend growth ETFs in the subset with the portfolios most focused on growth (consequently low dividend yield) are classified as large blend portfolios. From Table 3, this subset of blend portfolios has nearly the same portfolio P/E and P/B as the market benchmark portfolio. The high dividend growth funds classified as large blend funds have lower maximum drawdown than the diversified benchmark. On the other hand, the high dividend growth funds classified as large value funds have higher maximum drawdown than the diversified benchmark. Both subsets of high dividend growth ETFs (large blend and large value) have slightly longer median drawdown cycles in the 2020 Pandemic than the Russell 1000 benchmark, although the drawdown cycle is longest for the subset of large value.

The drawdown results during the 2020 Pandemic bear market of the largest dividend focused ETFs with the objective of high dividend yield are summarized in Panel C of Table 6. All dividend focused ETFs with the high dividend yield objective are classified as large value portfolios. The median maximum drawdown percentage of the dividend focused ETFs with a high dividend yield strategy is worse than the diversified market benchmark. Furthermore, the median drawdown cycle time of the high dividend yield ETFs was longer than the benchmark. Again, the relatively poor risk performance of the high dividend yield ETFs is not surprising when considering the relationship of these ETFs to the large cap, high dividend yield research portfolio detailed in Section 2.1. The results of Table 2 indicate that the high yield research portfolio also fares worse than the CRSP total market portfolio during the 2020 Pandemic with regards to a larger maximum drawdown loss and longer drawdown cycle period. Recall from Section 3.2, the high dividend yield ETFs are highly correlated with the high yield research portfolio from the Dr. Kenneth R. French data library.

Panel D of Table 6 summarizes the results for one of the largest dividend focused ETFs with the objective of tracking the Dividend Aristocrats in the S&P 500. The Dividend Aristocrats is a portfolio of dividend payers that have increased their dividend payouts for more than 25 consecutive years (Soe, 2008). The portfolio strategy is not a true high dividend growth strategy; rather, it requires long term consistent dividend growth. As such, the ETF's portfolio has been classified as large value (since 2020) or large blend (prior to 2020). Given that Table 3 shows that the ProShares S&P 500 Dividend Aristocrat's portfolio is somewhat between a blend portfolio and a value portfolio, the drawdown performance is somewhat in the middle. The maximum drawdown percentage is just slightly higher than the benchmark. Meanwhile, the drawdown cycle time is longer than the subset of the high dividend growth funds classified as large blend funds (the subset with the most growth-oriented portfolios) but shorter than the high dividend yield funds classified as large value funds (the subset with the most value-oriented portfolios).

Although the Invesco S&P 500 High Dividend Low Volatility ETF is not one of the 10 largest dividend focused ETFs, clearly its objective makes the fund highly relevant in this research investigating risk reduction. The portfolio construction of the Invesco S&P 500 High Dividend Low Volatility ETF is a two-stage sort where the first sort screens for the highest dividend yielding stocks in the S&P 500 and the second sort removes the stocks with the highest trailing volatility. Panel E of Table 6 summarizes the drawdown results for the Invesco S&P 500 High Dividend Low Volatility ETF during the 2020 Pandemic bear market cycle. Despite the fund's named objective, the maximum drawdown is much worse than the benchmark (ranking 10th of 11 dividend focused funds in the sample. Furthermore, the drawdown cycle length is much worse than the diversified benchmark (ranking 10th of 11 dividend focused funds in the sample).

Drawdown Performance Measures of the Dividend Focused ETFs

Table 7 summarizes the drawdown performance measures of the 10 largest dividend focused ETFs during the 2017 – 2023 period where all of the largest dividend focused funds have performance history. While the primary focus of this research is investigating drawdown risk, investors should consider performance measures that consider investment return and risk.

Table 7. Maximum Drawdown and Performance Measures 2017 - 2023

Fund	Average Annual Return	Standard Deviation of Returns	Sharpe Ratio	Compound Annual Return	Maximum Drawdown	Calmar Ratio
Panel A	Diversified Market Benchmark					
iShares Russell 1000	**14.57%**	**18.95%**	**0.68**	**13.06%**	**-34.6%**	**0.38**
Panel B	High Dividend Growth Objective					
WisdomTree U.S. Quality Dividend Growth Fund	14.53%	14.87%	0.87	13.66%	-32.0%	0.43
Vanguard Dividend Appreciation Index Fund	13.37%	14.33%	0.82	12.55%	-31.7%	0.40
Median Large Blend	*13.95%*	*14.60%*	*0.84*	*13.11%*	*-31.9%*	*0.41*
iShares Core Dividend Growth Fund	12.75%	14.50%	0.76	11.93%	-35.1%	0.34
First Trust Rising Dividend Achievers Fund	14.60%	19.52%	0.66	13.08%	-40.6%	0.32
Median Large Value	*13.68%*	*17.01%*	*0.71*	*12.51%*	*-37.8%*	*0.33*
Panel C	High Dividend Yield Objective					
Schwab U.S. Dividend Equity Fund	12.69%	14.33%	0.77	11.90%	-33.4%	0.36
SPDR S&P Dividend Fund	9.37%	11.82%	0.65	8.83%	-36.7%	0.24
Vanguard High Dividend Yield Index Fund	9.72%	12.61%	0.64	9.10%	-35.2%	0.26
iShares Core High Dividend Fund	7.49%	10.63%	0.55	7.04%	-37.0%	0.19
iShares Select Dividend Fund	8.70%	14.57%	0.48	7.89%	-41.5%	0.19
Median High Dividend Yield	*9.37%*	*12.61%*	*0.64*	*8.83%*	*-36.7%*	*0.24*
Panel D	Dividend Aristocrats					
ProShares S&P 500 Dividend Aristocrats Fund	11.51%	13.55%	0.73	10.79%	-35.4%	0.30
Panel E	High Dividend, Low Volatility					
Invesco S&P 500 High Dividend Low Volatility Fund	6.13%	13.24%	0.34	5.44%	-41.4%	0.13

Notes: Drawdown calculations are based on daily total return calculations. Maximum Drawdown in period occurs during 2020 Pandemic.
Variable definitions are in Appendix A.

As per the previous analysis in Table 5, the traditional Sharpe Ratio (1994) based on volatility risk before comparison to the Calmar ratio based on drawdown risk was applied. Again, the Calmar ratio is defined as the compound average return divided in the period divided by the maximum drawdown in the period. Except for the First Trust Rising Dividend Achievers Fund, the large cap dividend ETF portfolios have a lower standard deviation (lower volatility) than the iShares Russell 1000 market benchmark. Consequently, one might consider the large cap dividend ETF portfolios to be less risky than the market if volatility is the primary measure of risk. But clearly volatility risk is not drawdown risk, because only the large blend high dividend growth portfolios have less drawdown than the benchmark.

During this period, the benchmark outperforms all large value portfolios (whether high dividend growth or high dividend yield objective) on a Sharpe ratio or Calmar ratio basis. In this 2017-2023 period, growth has outperformed value; therefore, the Russell 1000 benchmark has a larger average and compound return. Interestingly, the dividend portfolios with the most growth characteristics, the high dividend growth ETFs classified as large blend funds outperformed the Russell 1000 benchmark on the basis of Sharpe ratio, maximum drawdown, and Calmar ratio. In fact, high dividend growth ETFs classified as large blend funds have less drawdown than the Russell 1000 benchmark during both the 2008 Financial Crisis and the 2020 Pandemic bear market cycles.

Overall, funds in Table 7 with the highest Sharpe ratios tend to correspond to funds with the highest Calmar ratios. However, the ProShares S&P 500 Dividend Aristocrats provides an interesting case for intuitive interpretation of the Calmar ratio versus the Sharpe ratio. The Sharpe ratio exceeds the benchmark, which may lead an investor to believe that the tradeoff of the lower return is worth it for the lower volatility risk. Yet, the ProShares S&P 500 Dividend Aristocrats has a larger maximum drawdown than the benchmark and lower return, consequently, the Calmar ratio is lower than the benchmark, which seems to make more sense.

In addition, funds with the lowest volatility (standard deviation), do not always correspond to funds with the minimum drawdown losses. For example, the iShares Core High Dividend Fund has the lowest standard deviation in the sample

set, but one of the highest maximum drawdown percentages. Investors concerned about losses need to focus on drawdown because volatility is not providing this critical information.

DRAWDOWN RISK WITH DIVIDEND FOCUSED EXCHANGE TRADED FUNDS IN THE 2022 INFLATION SURGE

Lastly, the drawdown of the largest dividend focused ETFs is investigated during the 2022 Inflation Surge bear market cycle utilizing daily total returns. The inflation surge in 2022 had significant consequences for the U.S. economy, driven by a mix of factors including pandemic-related supply chain disruptions, robust federal spending, and geopolitical events like the war in Ukraine. Inflation reached levels not seen since the 1980s, with the Consumer Price Index peaking at over 9% in mid-2022. This sharp rise in prices heavily impacted essential sectors, particularly energy, where gas prices soared by almost 49% year-over-year. To combat this inflation, the Federal Reserve raised interest rates aggressively, leading to a slowdown in interest-sensitive sectors such as housing and a drop in equity prices (Ihrig and Waller, 2024).

Dividend Focused ETFs Sample

The 10 largest dividend focused ETFs in terms of net assets reported by Morningstar as of August 2024 are again examined. All the 10 largest dividend focused ETFs have performance data available for the 2022 bear market cycle.

Maximum Drawdown and Drawdown Cycle of the Dividend Focused ETFs

Table 8 summarizes the maximum drawdown and the drawdown cycle of the largest dividend focused ETFs during the 2022 Inflation Surge bear market cycle. Again, using the iShares Russell 1000 ETF as the proxy for the large cap stock benchmark, the maximum drawdown was about 25%. From the historical CRSP total market reference in Section 2, the 2022 Inflation Rate Spike drawdown cycle is less severe than the median drawdown of 31.7% and shorter than the median cycle duration of 40 months.

Table 8. Maximum Drawdown during the 2022 Inflation Surge Bear Market Cycle

		Bear Market Cycle			Drawdown		Maximum	Drawdown
	Morningstar	Peak	Trough	Recovery	Cycle	Maximum	Drawdown	Cycle
FUND	Category	Date	Date	Date	Days	Drawdown	Ratio	Ratio
Panel A	Diversified Market Benchmark							
iShares Russell 1000	**Blend**	1/3/2022	10/12/2022	12/14/2023	710	-25.2%	**100.0%**	**100%**
Panel B	High Dividend Growth Objective							
Vanguard Dividend Appreciation Index Fund	Blend	1/4/2022	9/30/2022	12/11/2023	708	-20.4%	80.9%	100%
WisdomTree U.S. Quality Dividend Growth Fund	Blend	1/4/2022	10/12/2022	6/12/2023	524	-17.3%	68.5%	74%
Median Large Blend						*-18.8%*	*74.7%*	*86.8%*
iShares Core Dividend Growth Fund	Value	1/4/2022	9/30/2022	12/14/2023	710	-19.3%	76.6%	100%
First Trust Rising Dividend Achievers Fund	Value	1/4/2022	9/30/2022	12/14/2023	709	-25.3%	100.5%	100%
Median Large Value						*-22.3%*	*88.6%*	*99.9%*
Panel C	High Dividend Yield Objective							
Vanguard High Dividend Yield Index Fund	Value	4/20/2022	9/30/2022	11/30/2022	224	-15.8%	62.9%	32%
SPDR S&P Dividend Fund	Value	4/20/2022	9/30/2022	11/15/2022	210	-14.6%	58.0%	30%
iShares Select Dividend Fund	Value	4/20/2022	9/30/2022	3/28/2024	710	-17.3%	68.8%	100%
Schwab U.S. Dividend Equity Fund	Value	1/11/2022	9/30/2022	12/28/2023	718	-16.8%	66.8%	101%
iShares Core High Dividend Fund	Value	4/20/2022	9/30/2022	11/30/2022	226	-15.4%	61.2%	32%
Median Large Value						*-15.8%*	*62.9%*	*31.8%*
Panel D	Dividend Aristocrats							
ProShares S&P 500 Dividend Aristocrats Fund	Value	1/4/2022	9/30/2022	7/20/2023	563	-17.9%	71.1%	79%
Panel E	High Dividend, Low Volatility							
Invesco S&P 500 High Dividend Low Volatility Fund	Value	4/20/2022	9/30/2022	5/15/2024	758	-19.3%	76.6%	107%

Notes: Drawdown calculations are based on daily total return calculations.
Maximum drawdown ratio and drawdown cycle ratio are relative to the iShares Russell 1000 benchmark.

Panel B of Table 8 summarizes the results of the largest dividend focused ETFs with the high dividend growth objective. While these ETFs have high dividend growth as an objective, differences in the portfolio construction methodologies lead some of the ETFs to still be classified as large value portfolios (even if growth is in the fund name). The high dividend growth ETFs in the subset with the portfolios most focused on growth are classified as large blend portfolios. The high dividend growth funds classified as large blend funds have lower maximum drawdown than the diversified benchmark. Also, the high dividend growth funds classified as large value funds have less maximum drawdown than the diversified benchmark. Both subsets of high dividend growth ETFs (large blend and large value) have just slightly shorter drawdown cycles in the 2022 bear market cycle.

The drawdown results during the 2022 Inflation Surge bear market of the largest dividend focused ETFs with the objective of high dividend yield are summarized in Panel C of Table 8. All dividend focused ETFs with the high dividend yield objective are classified as large value portfolios. The median maximum drawdown percentage of the dividend focused ETFs with a high dividend yield strategy is much lower than the diversified market benchmark. Furthermore, the median drawdown cycle time of the high dividend yield ETFs is much shorter than the benchmark. The defensive performance of the dividend focused ETFs with the high dividend yield objective (classified as large value portfolios) is also superior to either subset of the high dividend growth ETFs in Panel B. The results suggest that when value strategies are in favor, high dividend yield portfolios will perform well. Again, the excellent risk performance of the high dividend yield ETFs is not surprising when considering the relationship of these ETFs to the large cap, high dividend yield research portfolio detailed in Section 2.1. The results of Table 2 indicate that the research portfolio fares much better than the CRSP total market portfolio during the 2022 Inflation Surge with regards to a smaller maximum drawdown loss and shorter drawdown cycle period. It is interesting to note that the large cap, high dividend yield research portfolio also performs better than the CRSP total market during other notable periods with high inflation such as the Vietnam War and 1973 Oil Embargo bear market cycles.

Panel D of Table 8 summarizes the results for one of the largest dividend focused ETFs with the objective of tracking the Dividend Aristocrats, which are dividend payers that have increased their dividend payouts for more than 25 consecutive years (Soe, 2008). Since the ProShares S&P 500 Dividend Aristocrat's portfolio is somewhat between a blend portfolio and a value portfolio, the drawdown performance is somewhat between the high dividend growth and high dividend yield. The maximum drawdown percentage is better than the benchmark and the drawdown cycle is shorter than the benchmark. Meanwhile, the drawdown cycle time is shorter than the subset of the high dividend growth funds classified as large blend funds (the subset with the most growth-oriented portfolios) but longer than the high dividend yield funds classified as large value funds (the subset with the most value-oriented portfolios).

The low volatility objective of the Invesco S&P 500 High Dividend Low Volatility ETF is highly relevant in this research on risk reduction with dividend portfolios. The portfolio construction of the Invesco S&P 500 High Dividend Low Volatility ETF is a two-stage sort where the first sort screens for the highest dividend yielding stocks in the S&P 500 and the second sort removes the stocks with the highest trailing volatility. Panel E of Table 8 summarizes the drawdown results for the Invesco S&P 500 High Dividend Low Volatility ETF during the 2022 Inflation Surge bear market cycle. While the maximum drawdown is somewhat better than the benchmark, it is not as good as the other high dividend yield funds. Furthermore, the drawdown cycle length is worse than the diversified benchmark and ranks the worst of any ETF in the sample. Again, this illustrates that volatility risk is not drawdown risk. A portfolio constructed specifically to minimize volatility risk has some of the worst drawdown performance.

SUMMARY AND CONCLUSIONS

A historical review of the large cap high dividend yield research portfolio shows that the dividend portfolio reduces the median maximum drawdown percentage and the drawdown cycle. However, drawdown risk reduction does not occur in every bear market cycle. In the two worst drawdowns in the data sample (the Great Depression and the 2008 Financial Crisis), the large cap high dividend yield research portfolio has greater losses than the CRSP total market portfolio.

This study finds that the 10 largest dividend focused ETFs (by net assets as of August 2024) generally follow either a high dividend growth objective or a high dividend yield objective. While all the high dividend yield ETFs are classified as value portfolios, the high dividend growth ETFs can be either value portfolios or blend portfolios with more growth characteristics. The drawdown risk performance of the dividend focused ETFs during bear markets is highly dependent on whether the portfolio is value or blend investment style.
During the 2008 Financial Crisis cycle, the high dividend growth ETFs classified as large blend portfolios perform better than the Russell 1000 large cap benchmark, while the high dividend yield ETFs classified as large value portfolios perform worse than the Russell 1000. Likewise, during the 2020 Pandemic cycle, the high dividend growth ETFs classified as large blend portfolios have lower maximum drawdown losses than the Russell 1000 large cap benchmark, while the high dividend yield ETFs classified as large value portfolios have worse drawdown losses than the Russell 1000.

Overall, the 10 largest dividend focused ETFs outperform the Russell 1000 benchmark during the 2022 Inflation surge cycle. While both the high dividend yield ETFs and the high dividend growth ETFs perform better than the Russell 1000, the high dividend yield ETFs had the smallest drawdown losses and shortest drawdown cycle periods during the 2022 Inflation surge cycle.

The high dividend yield ETFs are highly correlated with the large cap high dividend yield research portfolio despite ETF portfolio construction techniques that attempt to remove risky companies. Consequently, the drawdown risk performance of the high dividend yield ETFs mirrors the large cap high dividend yield research portfolio. When the high dividend yield research portfolio does worse than the CRSP total market portfolio during the 2008 Financial Crisis and the 2020 Pandemic, then the high dividend yield ETFs are worse than the Russell 1000 benchmark. Furthermore, When the high dividend yield research portfolio does much better than the CRSP total market portfolio during the 2022 Inflation Surge, then the high dividend yield ETFs perform better than the Russell 1000 benchmark.

In recent bear markets, the high dividend growth ETFs that are classified as large blend appear especially impressive with a higher Sharpe ratios and Calmar ratios than the Russell 1000 benchmark. Although the data subset is small, the large blend high dividend growth ETFs have lower maximum drawdown losses than the Russell 1000 benchmark in the 2008 Financial Crisis, the 2020 Pandemic, and the 2022 Inflation Surge. The diversified nature of the large blend high dividend growth portfolios seems to provide robust drawdown risk reduction. In general, funds with the highest Sharpe ratios tend to correspond to funds with the highest Calmar ratios. However, the interpretation of the Calmar ratio seems more intuitive. Moreover, funds with the lowest volatility (standard deviation), do not always correspond to funds with the minimum drawdown losses. Volatility risk is not drawdown risk.

One of the popular dividend focused ETFs has the objective of tracking the Dividend Aristocrats in the S&P 500, a portfolio of dividend payers that have increased their dividend payouts for more than 25 consecutive years. A key finding of this research is that the drawdown of dividend portfolios during bear markets is highly dependent on whether the portfolio is value or blend investment style. Given that the ProShares S&P 500 Dividend Aristocrat's portfolio is somewhat between a blend portfolio and a value portfolio, the drawdown performance is somewhat moderate between the high dividend growth ETFs and the high dividend yield ETFs.

Finally, the drawdown risk performance of a dividend portfolio specifically constructed to reduce volatility is disappointing. During the 2020 Pandemic cycle, the Invesco S&P 500 High Dividend Low Volatility ETF has greater maximum drawdown losses and a longer drawdown cycle than the Russell 1000 large cap benchmark. Furthermore, it performs worse than the median large value high dividend yield ETFs. During the 2022 Inflation Surge bear market cycle, the Invesco S&P 500 High Dividend Low Volatility ETF has somewhat better maximum drawdown than the benchmark, but it is not as good as the other high dividend yield funds. Furthermore, the drawdown cycle length is worse than the diversified benchmark and ranks the worst of any ETF in the sample during the 2022 Inflation Surge.

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APPENDIX A

Variable Definitions

Variable	Definition
Calmar ratio	The ratio of the compound average return during a specific period over the maximum drawdown.
Drawdown	The peak to trough decline during a specific period for an investment, measured as a percentage of the peak.
Drawdown cycle	The duration of time from the peak value of an investment until it recovers back to that peak.
Drawdown cycle ratio	The ratio of the drawdown cycle length of an investment relative to the drawdown cycle length of the market benchmark.
Maximum Drawdown	The largest peak to trough loss during a specific period for an investment, measured as a percentage of the peak.
Maximum Drawdown ratio	The ratio of the maximum drawdown of an investment relative to the maximum drawdown of the market benchmark.
Sharpe ratio	The ratio of the arithmetic average annual excess return of the investment over the standard deviation of the annual returns, where the excess return is defined as the annual return of the investment minus the risk-free rate.

INTERNAL INTEGRATION AS STRUCTURAL IMPACT OF ANALYTICS CAPABILITY IN SUPPLY CHAINS

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ABSTRACT

This study draws on structuration theory to argue that execution of dynamic capabilities will induce changes in structure and thus a new structure favoring the dynamic capabilities will emerge. This emergent structure will then impact firm performance. In light of this argument, this study investigates internal integration as an outcome of practicing analytics capability and its mediating role in influencing a firm's supply chain performance indicated by its strategic alliance, knowledge co-creation, and supply chain product performance with its partners. The research model consisting of these constructs and corresponding hypotheses summarizing their relationships was tested and then supported with survey data. The findings were then discussed with regard to their theoretical as well as practical implications.

INTRODUCTION

Managerial and scholarly attention to data analytics is mainly triggered by rapid accumulation of massive amounts of data generated by digital devices, which is commonly known as big data (McAfee & Brynjolfsso, 2012). Early interest mostly focused on discovering the utility value of big data and advanced analytics. Examples include improving demand forecasting (McAfee & Brynjolfsso, 2012), enhancing inventory management (Waller & Fawcett, 2013), upscaling production and service scheduling (Barton & Court, 2012), and even making new but popular entertainment products (Carr, 2013). Exploring this area further, researchers (e.g., Chen, Preston, & Swink, 2015; Grover, Chiange, Liang, & Zhang, 2018; Gupta & George, 2016; Wamba et al., 2017) emphasized the need for firms to integrate data, technology, and managerial resources to develop a data analytics capability, hereafter called analytics capability, which then have been demonstrated to be powerful in enhancing overall firm performance as shown mainly in financial and market performance (Gupta & George, 2016; Wamba et al., 2017). Recent research interest has shifted to exploring possible mediators between analytics capability and firm performance. These mediators include entrepreneurial orientation (Ciampi et al., 2021), capability-strategy alignment (Akter et al., 2016), other organizational capabilities such as infrastructure, management, human resources capabilities (Yasmin et al., 2020), marketing and technological capabilities (Milalef, Krogstie, Pappas, & Pavlou, 2020), and contextual factors such as environmental and organizational factors (Milalef & Krogstie, 2020).

These mediators, however, are mostly not direct outcomes of analytics capability or its derivatives, as they can be developed independently from analytics capability. Yet, analytics capability, when practiced, will produce outcomes other than business performance such as operational, marketing, and financial performances, which will then impact business performance. Specifically, those outcomes can be structural. The strategy literature strongly indicates that dynamic capabilities are associated with structural change. For example, Girod and Whittington (2017) noted that dynamic capabilities involve restructuring and reconfiguring. On the other hand, development, and then proper functioning of dynamic capabilities, and especially the realization of their perceived benefits to the organization require a good-fitting or matching structure (Felin & Powell, 2016). This suggests that analytics capability, conceptualized as a dynamic capability (see Chen et al., 2015; Grover et al., 2018; Gupta & George, 2016; Wamba et al., 2017), trigger structural change which then will mediates its impact on firm performance.

To date, the research literature provides little, if not at all, understanding of how analytics capability may induce organizational structural change that would facilitate its effect on firm performance. Thus, the purpose of this study is to investigate the mediating role of organizational internal integration in the performance impact of analytics capability. More specifically, we will draw on the structuration theory (Giddens, 1979, 1984), especially the adaptive structuration theory (DeSanctis & Poole, 1994), to argue that the practice of analytics capability induces internal integration, a concept representing structural properties, which then serves as both outcome as well medium of analytics capability, a concept the reifies human action. Based on this argument, we build a research model that consists of analytics capability, an antecedent construct, internal integration, a mediator construct, and supply chain performance (SCP) as operationalized by strategic alliance, knowledge co-creation, and supply chain product performance as outcome constructs.

This study will contribute to the analytics capability literature in three ways. First, this study will show that analytics capability, besides enhancing firm performance directly, will promote internal integration which will then positively contribute to firm performance. The second possible contribution this study will make is that it will help to demonstrate that analytics capability will trigger organizational structural change that mediates the impact of analytics capability on firm performance. In doing that, this study will address a research gap in analytics capability research. Thirdly, this study will contribute to the literature by showing that analytics capability helps to enhance a new area of SCP with the conceptualization of strategic alliance as part of SCP. This is another research gap that this study will address because prior research has hardly examined the possible impact of analytics capability on supply chain strategic alliance and the path of this possible impact.

The rest of the paper is organized as follows. We will start to review the theory of structuration, especially the adaptive structuration theory in light of the interaction between technology-based capabilities and organizational structure. Then we will further review the literature on analytics capability, internal integration, and the three constructs of SCP: strategic alliance, knowledge co-creation, and supply chain product performance (SCPP). In doing that, we will construct the research model of this study and propose the corresponding hypotheses regarding the relationships between these constructs. Following the theory and literature sections is the methodology section where we will introduce our data collection and analysis process. Then we will present the results of data analysis and hypothesis testing. Finally, we will discuss the findings of this study with regard to how they contribute to research and practice and directions that future research can take.

THEORETICAL BACKGROUND

In this section, we will draw on structuration theory to build a rationale for conceiving internal integration as a mediator for the relationship between analytics capability and SCP. In doing that we will also introduce the concepts included in our research model. Further, we will explain why we select supply chain knowledge co-creation, strategic alliance, and SCPP as indicators of SCP.

Our overall argument is that practicing analytics capability involves structuring, in which a new structure emerges to match the practice of analytics capability. This emergent structure represents organizational change, a change in structure. As analytics capability inherently requires integration based on the dynamic capabilities perspective (Teece, Pisano, & Shuen, 1997), internal integration is supposedly an outcome of practicing analytics capability. Internal integration is not an end itself in the impact of analytics capability. It further impacts firm performance, most directly, a firm's SCP (Flynn, Huo, & Zhao, 2010; Turkulainen, Roh, Whipple, & Swink, 2017).

Structuration Theory

Structuration theory, as discussed in Giddens' works (1979, 1984), is a grand theory that addresses social phenomena at a high level of abstraction. A key idea of structuration is duality of structure, which is about the interplay of structure and agency. While agency refers to autonomy of human action, i.e., human action being independent of or free from structure influence, structure is defined as "rules and resources organized as properties of social systems" (1984, p. 25). To Giddens, structuration is a process of structuring. Traditionally, social phenomena are seen as determined either by so-called objective social structures or by autonomous human agents. Rejecting these traditional dualistic views, Giddens proposed that structure and agency mutually constitute duality. Structure shapes human actions, while human actions substantiate structure. Human agents draw on rules and resources of structure in their actions, and at the same time, these actions serve to produce and reproduce those rules and resources of structure. Thus, structure is both a medium as well as outcome of human action.

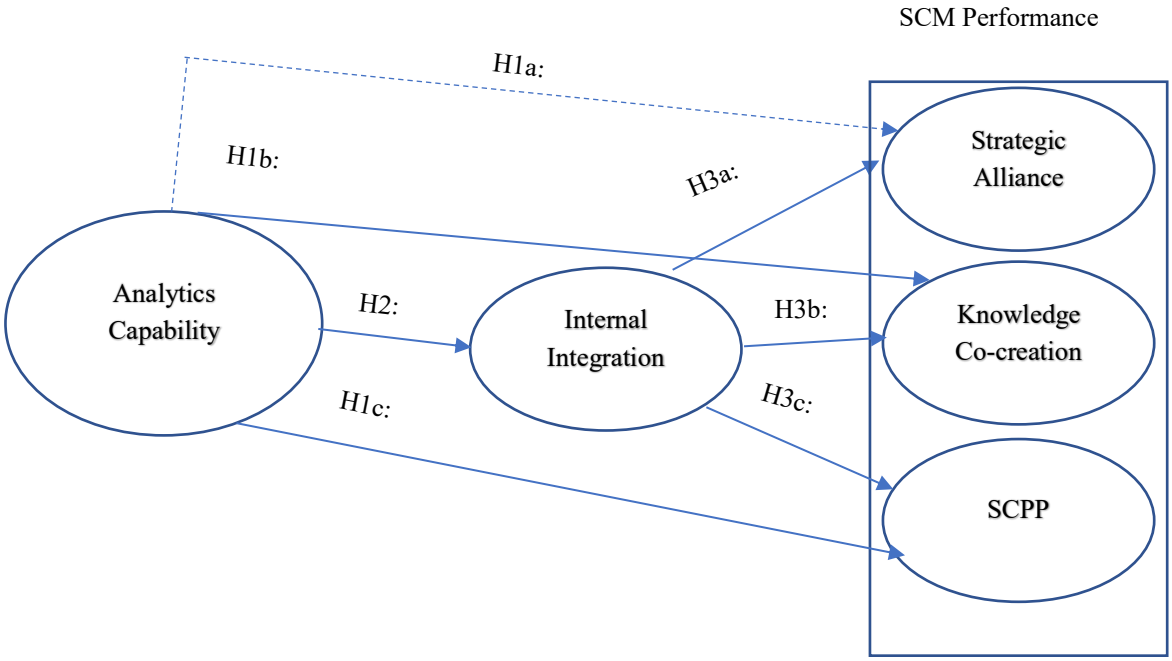
As its central concern is the relationship between individuals and society, structuration theory is extensively applied in organization studies including business management research to examine the interplay of individual actions and organizational goal attainment. For example, drawing heavily on Giddens' idea of structuration, DeSanctis and Poole (1994) proposed the adaptive structuration theory (AST) as a theoretical lens to inform research on IT deployment and implementation in organizations. AST, together with other theoretical derivatives of structuration such as technologies-in-practice (Orlikowski, 2000), offered insightful explanations of technology implementation and use faithful to or deviated from organizational goals originally attached to it. In the process of technology implementation and use, organizational members may draw on rules and resources associated with the technology such as the ideas that the designers or inventors of the technology originally attach to it, and/or cite rules and resources from other

sources such as culture and work experience to justify their actions with the technology. Thus, a new structure is created regarding use of the technology. In this sense, structure is emergent and human interactions with the technology serves to enact the emerged structure.

While illuminating Giddens' idea of duality of structure with the case of technology implementation and use, AST can also be used in operations and supply chain management research, to examine, for example, supply chain coordination (Holweg & Pil, 2008). In this study, we mainly apply structuration theory to explore the relationship between analytics capability and internal integration. Analytics capability is heavily technology-based. Development and thereafter practice of analytics capability must be similar to the process of technology implementation and use. Next, internal integration is a concept of organizational structure as it involves the rules and resources of unification, concentration, and consistency. While developing and later practicing analytics capability, organizational members act to create and then enact a relevant structure. We argue that internal integration has structural properties relevant and conducive to analytics capability and therefore will be enhanced while analytics capability is developed and practiced.

The literature of supply chain integration suggests that internal integration is an antecedent to SCP (Demeter, Szász, & Rácz, 2016), which is also multifaceted (see the recent review by Lehyani, Zouari, Ghorbel, & Tollenaere, 2021). In this study, we choose to use strategic alliance, knowledge co-creation, and SCPP as proxies of SCP. First, selection of SCPP is because of its comprehensiveness in capturing the functional and operational aspects of SCP such as resources efficiency, technological efficiency, responsiveness, productivity, quality, reliability, innovativeness, and flexibility which have been used as key performance indicators of SCP in the literature (Lehyani et al., 2021). Second, knowledge is an important input to product performance, and internal knowledge creation is associated with integration (Graham, 2018). We reasonably contend that this association can be also extended to the supply chain. Thus, knowledge co-creation with supply chain partners is another indicator of SCP in this study. Next, as collaboration with stakeholders has been widely treated as a key indicator of SCP in the literature (Lehyani et al., 2021), it can be best captured by strategic alliance with supply chain partners. Thus, our research model, shown in Figure 1, consists of these concepts: analytics capability, internal integration, and SCP (strategic alliance, knowledge co-creation, and SCPP). The following section presents a short review and definitions of these concepts.

Figure 1: Conceptual Model



Analytics Capability

Analytics capability is a concept developed in big data research. Extensive use of digital devices in work and life produces tremendous amounts of real-time data that is of high-volume, high-velocity, and high-variety, which is now commonly known as big data (McAfee & Brynjolfsson, 2012). In the gold mines of big data lies hidden business value (Barton & Court, 2012; Carr, 2013; Pigni, Piccoli, & Watson, 2016; Sanders, 2016), which drives the search for tools and methods to extract it. The search results point to the development of big data analytics (Grover et al., 2018; Mikalef, Boura, Lekakos, & Krogstie, 2019; Wamba et al., 2017). Further, research shows that the full functioning of data analytics requires supporting resources that include technologies and IT infrastructure (Wamba et al., 2017), and corresponding human, financial, and other intangible resources (Mikalef et al., 2019; Wamba et al., 2017).

Additionally, diagnostic analysis of big data project case studies suggests that some organizational dynamics shape the success of big data analytics (Chen et al., 2015; Pigni et al., 2016; Sanders, 2016). This pushed a search for theoretical explanation of why this happens. Among the theories used in the literature to underscore the importance of big data analytics, the resource-based view and its extension, dynamic capabilities perspective, are the most dominant ones (see the review in Yasmin et al., 2020). In the gist of these two theories, analytics and the other supportive resources should be well integrated to formulate an organizational dynamic capability that sets the firm distinguishably apart from others in terms of competitive advantage and then firm performance. Thus, analytics is conceptualized as a dynamic capability.

There has been increasing amount of empirical evidence supporting the contributing role of analytics capability in firm performance in the literature and thereby justifying conceptualizing analytics as a dynamic capability. For example, among other benefits, big data analytics can enhance market, financial, and operational performance in general (Gupta & George, 2016; Wamba et al., 2017), and more specifically, bolster innovation (Mikalef et al., 2019), enhance decision making quality (Ghasemaghaei & Calic, 2019; Shamim, Zeng, Shariq, & Khan, 2019), and implement knowledge management to enhance organizational agility and performance (Corte-Real et al., 2017). Given this background, analytics capability is defined here in this study as *a series of routines and processes where organizational members, taking advantage of technologies and other relevant resources from across sources, collect, store, and analyze various types of data for the purpose of creating business value*.

Internal Integration

Internal integration is incorporated in the research model of this study to represent organizational change incurred by the execution of analytics capability, which then impacts SCP. If achieved, integration is a state of collaboration in which the firm works as a unified whole that enables efficient information transfer and exchange across the organizational units (Turkulainen & Ketokivi, 2012). For example, marketing-manufacturing integration within a firm depends on marketing's knowledge of manufacturing and manufacturing's effective evaluation of marketing communication (Calantone, Droge, & Vickery, 2002). In the supply chain management literature, integration has been examined as a contributor to firm performance (see, for example, Ataseven, Nair, & Ferguson, 2018; Flynn et al., 2010; Wei, Yin, & Chen, 2021). As a process of redefining and connecting entities through coordination and information and resources sharing in a supply chain (Katunzi, 2011), supply chain integration consists of internal as well as external integration (Droge, Vickery, & Jacobs, 2012). While the latter mainly means integration with suppliers and customers, the former refers to integration happening within the boundaries of an organization (Droge et al., 2012). This study only examines internal integration.

Internal integration is achieved through the implementation of integration mechanisms, such as sharing values and norms, rules, regulations, and standards, as well as information systems, cross-functional teams, and direct contacts (Ruiz, Brion, & Parmentier, 2018; Turkulainen et al., 2017). Further, internal integration is enacted in activities or processes such as information sharing, joint decision making, innovation sharing, technology use to support communication, and the use of a network level performance management system (Szász, Scherrer-Rathje, & Deflorin, 2015). These activities are found to be critical to the flow of materials, information/knowledge, and financial resources across units within a firm. Specifically, information sharing enables organizational learning and helps to facilitate flow of goods across units (Flynn et al., 2010; Rudberg & Olhager, 2003). Similarly, joint decision making provides access to diverse knowledge structures and thereby fosters knowledge acquisition and assimilation (Jansen, Van den Bosch, & Volberda, 2005). Likewise, innovation sharing (Ferdows, 2006; Rabbiosi, 2011; Vereecke, Van Dierdonck, & De

Meyer, 2006), and personal-based as well as technology-based communication (Andersen & Foss, 2005; Ferdows, 2006; Gupta & Govindarajan, 2000; Luo, 2005; Rabbiosi, 2011) promote knowledge sharing and transferring.

The following example will showcase the benefits of internal integration. Enabled by advanced information systems facilitating information flow across all functions of a firm, integration of marketing and logistics, two separate yet interdependent functions of a firm, benefits the firm through joint inventory and pricing activities/processes (Titah, Shuraida, & Rekik, 2016; Zhang & Chen, 2013). More specifically, these same information systems help the marketing department to gain knowledge of product demand and supply functions that enables them to make optimal pricing decisions, which then inform the logistics department in making optimal ordering and inventory decisions (Titah et al., 2016). Based on this short literature review, internal integration is therefore defined as *the extent to which distinct and yet interdependent organizational units seek to become a unified whole through information/knowledge sharing, joint decision making, and coordinated actions*.

Supply Chain Performance

For SCP, we define it as firm performance in relation to its supply chain partners, including strategic alliance, knowledge co-creation, and SCPP. The supply chain management literature suggests that integration enhances firm performance, but the findings were mixed and inconsistent (Droge et al., 2012; Szász et al., 2015; Titah et al., 2016; Wei et al., 2021). While these inconsistent findings may be due to research design deficiencies such as missing variables (Droge et al., 2012) or contextual factors in previous research (Wei et al., 2021), another explanation can be that many previous studies measured firm performance in terms of market and financial performances (for a list of those studies, see Flynn et al., 2010). Market and financial performances are not immediate outcomes of integration; between them there are multiple linking variables. Further, market and financial performances are outcomes of multiple contributing variables. With some of these variables missing in the research model, it is difficult to assess and conclude about the relationship between integration and firm performance regardless of the test results. For example, only about 11% of the variation in financial performance is explained by internal integration and other explanatory variables included in the research model of Droge et al. (2004). This suggests that missing variables contribute more to financial performance than those included in their study. For these reasons, it is more appropriate to examine the effect of internal integration on operational performance rather than on general firm performance, as the former is more direct and immediate (Demeter et al., 2016). Thus, in this study, we use SCP as the performance construct.

SCP is a multifaceted construct. We choose to use supply chain strategic alliance, knowledge co-creation, and SCPP as indicators of this construct for the following reasons. First, based on the social capital theory (Coleman, 1990; Nahapiet & Ghoshal, 1998), and supported by the empirical research results, strategic alliance with supply chain partners is critical to the functioning of supply chains for a firm (Giunipero et al., 2008; Terpend, Tyler, Krause, & Handfield, 2008). For this reason, supply chain strategic alliance becomes the first construct reflecting SCP in this study. Terpend et al.'s (2008) review indicated that well-structured and well-functioning buyer-supplier alliances contribute to supplier's operational performance, integration-based value, and financial performance. Although past studies examined diverse aspects of inter-firm alliance, they also reveal that trust, commitment, collaboration, long-term orientation constitute a positive alliance (Griffith, Harvey, & Lusch, 2006; Johnston, McCutcheon, Stuart, & Kerwood, 2004; Monczka, Petersen, Handfield, & Ragatz, 1998; Tangpong, Michalisin, & Melcher, 2008). Thus, *strategic alliance* in this study is defined as *a firm's effort to develop an alliance with their SC partners at the strategic level, which is shaped by mutual trust, commitment, collaboration, and long-term orientation.*

Next, based on the knowledge-based view (Grant, 1996), knowledge is the most important strategic resource for a firm (Conner & Prahalad, 1996), and therefore it is pivotal for the firm to develop and integrate knowledge dispersed and residing in different units of the firm and translate it into products and services (Grant, 1996). Thus, consistent with the knowledge-based view, to develop analytics capability is to produce knowledge required by developing and maintaining competitive advantage. This is the idea inherent in the studies that adopted the knowledge-based view as its theoretical foundation for studying analytics capability (Kamble & Gunasekaran, 2020). Additionally, knowledge production is an operational performance construct, as it is a means to the end of enhancing firm performance. Therefore, knowledge co-creation with supply chain partners is included as another construct representing SCP in this study. Integrating multiple approaches on knowledge creation examined in prior research, in this study, we define *knowledge co-creation as a process in which supply chain partners collaboratively collect and process information regarding the market, customers, product/service, and technologies, and then transforming it into knowledge.*

Finally, according to the dynamic capabilities perspective, developing analytics capability is to enhance a firm's competitive advantage in the market, which is best revealed in product performance (Koufteros, Vonderembse, & Doll, 2002). Research has affirmed product performance's positive link to overall firm performance consistently, and examined its effect as a multifaceted construct covering multiple dimensions such as speed and quality (Calantone & Di Benedetto, 2000; Harter, Krishnan, & Salughter, 2000), time and cost (Graves, 1989), and innovation (Brown & Eisenhardt, 1995; Montoya-Weiss & Calantone, 1994), all of which are strong indexes of operational performance. Thus, product performance with supply chain partners is selected in this study as an outcome construct showcasing SCP.

The literature has captured two major dimensions of product performance: competence (Schoenherr et al., 2014) and manufactuability (Doll, Hong, & Nahm, 2010). Product performance competence is reflected in multiple aspects such as a firm's absorptive capacity, teamwork, coordination and collaboration capability, its process execution capability, as well as scientific, technological, and managerial skills (Schoenherr et al., 2014). Similar to competence, manufacturability is also a generic construct about product performance. According to Doll et al., (2010), manufacturability refers to the degree of easiness of designing, manufacturing, assembling, and marketing a new product. Manufacturability is further indicated by project development time (also termed as time-to-market, cycle time, project lead time, innovation speed, or speed to market, etc.), product quality, project cost, and value to customers (Chen, Damanpur, & Reilly, 2010; Perols, Zimmermann, & Kortmann, 2013; Swink, 1999; Swink & Song, 2007). Additionally, product performance outcome has been examined as product innovation (Kourfteros, Cheng, & Lai, 2007; Salvador & Vilena, 2013), and design quality and efficiency (Yan & Dooley, 2013). Summarizing this thread of literature, we define *SCPP* in this study as firm's *ability as well as a process of working with its supply chain partners to innovatively translate a business idea into a manufacturable product that will generate business value, involving a series of activities such as assessing market opportunities and technical possibilities, building and testing a prototype, and launching it at the market* (Doll et al., 2010; Kourfteros et al., 2007; Pavlou & Al Sawy, 2006; Perols et al., 2013; Schoenherr et al., 2014).

HYPOTHESES

Relationship Between Analytics Capability and SCP

There is strong theoretical support to perceive a link between analytics capability and knowledge co-creation in supply chains. Based on a recent review by Kamble and Gunasekaran (2020), two major theoretical perspectives have been used to inform empirical research on analytics capability. One is the resource-based view and its extension, the dynamic capabilities perspective, which treat analytics as a collection of organizational resources and a dynamic capability built on the basis of integration of those resources. In light of this perspective, knowledge is a resource that can be generated by analytics, and thereby knowledge making is a value creating dynamic capability.

The other perspective is represented mainly by the knowledge-based, and the related organizational information processing theory and information success theory. For example, drawing on the information success theory, Ren et al. (2017) found that analytics systems help to ensure information quality, which is a prerequisite for the transformation of information into knowledge. The knowledge-based view has been employed to justify the development of analytics capability and support its role in producing and processing information and subsequently transforming it into knowledge, which is the most strategically significant resource for a firm, which is valuable, rare, not imitable, and not substitutable (Kamble & Gunasekaran, 2020). Additionally, Pauleen and Wang (2017), drawing on the literature of knowledge management, argued that analytics works interactively with contextual knowledge to produce new knowledge needed for addressing business issues and problems. As both the resource-based view and the knowledge management literature view knowledge as an outcome of analytics and the knowledge-based view conceptualizes analytics as a knowledge making capability, a path from analytics capability to knowledge co-creation with supply chain partners can be visualized.

While the linkage between analytics capability and knowledge co-creation gets strong theoretical support, theory does not point to a connection between analytics capability and strategic alliance with supply chain partners. As a functional capability, analytics alone should not lead to changes in the social aspect of supply chains. There are hardly any findings from empirical research suggesting such a possibility either.

Finally, both theory and empirical research suggest a connection between analytics capability and SCPP. SCPP is a process that is thirsty for knowledge about customers (Cooper, 2014; Zhang, Zhou, Lu, & Chang, 2017). Thus, both the resource-based view and the knowledge-based view would suggest a linkage between analytics and SCPP based on our previous discussions. More importantly, findings from prior and recent empirical research suggest that analytics capability tends to enhance the competence and manufacturability aspects of SCPP. On the competence side, analytics capability involves acquisition and development of skills including technical, human, and managerial competencies (see Akter et al., 2019; Mikalef et al., 2020; Wamber & Akter, 2019), which are compatible with elements of the SCPP competence dimension. Research shows that analytics capability cultivates the manufacturability elements of SCPP. For example, Dubey et al. (2019) found that analytics capability has significant positive impact on operational performance in terms of cost effectiveness, quality, service level, and delivery performance. Similarly, according to Srinivasan and Swink (2018), because it ensures information accuracy and currency, analytics capability can help to avoid costly activities such as overtime production, expedited shipments, lost sales, and high inventory, and markdowns to reduce cost, and enables firms to make better resource allocations and product positioning decisions so as to ensure product and volume flexibility. Their argument regarding analytics capability enhancing these operational performance indicators was empirically affirmed in their study. These operational performance indicators are close to the manufacturability aspects of SCPP. Next, empirical research also provides support to the view that analytics capability promotes innovation (see Michalef at al., 2019), which is another dimension of SCPP. This short literature review of analytics capability and SCP leads us to propose the following hypotheses:

H1a: There is no direct significant relationship between analytics capability and strategic alliance.
H1b: Analytics capability positively impacts knowledge co-creation.
H1c: Analytics capability positively impacts SCPP.

Relationship Between Analytics Capability and Internal Integration

Both structuration theory and dynamic capabilities theory suggest that there should be a positive relationship between analytics capability and internal integration. First, based on dynamic capabilities theory (Teece et al., 1997), besides acquiring firm-specific resources, firms must develop organizational routines that help to integrate firm-specific assets so as to enable employees to perform distinctive activities, and core competencies that sustain their core businesses. Further, firms must have the capability to integrate, build, and reconfigure their internal and external competencies. From this perspective, it is important for firms to cultivate cultural norms and values, and implement rules and regulations, to match the needs of integration inherent in their dynamic capabilities. Thus, analytics capability represents an inclination for organizational culture and structure that emphasize centralization, coordination, and collaboration, which are core elements of internal integration. Case studies have documented the process in which development of analytics capability is accompanied by organizational changes such as changes in organizational culture and policies that have played an important role in facilitating the development of analytics capability (Jha, Agi, & Ngai, 2020; Gust et al., 2017; Vidgen, Shaw, & Grant, 2017). Such coevolution can happen in the case of the interactions of analytics capability and internal integration, suggesting that analytics capability can lead to emergence or heightening of internal integration.

Next, the duality of structure of structuration theory indicates that structure is medium as well as outcome of human action. In our case, human action refers to actions and activities involved in the development and execution of analytics capability, whereas structure should be internal integration. Structural properties of internal integration include but not limited to centralization, unification, coordination, collaboration, and consistency, to name a few, as discussed above. In the process of developing and then practicing analytics capability, these structural properties are drawn on, and then enacted, thus enhancing the structural status of internal integration. Integration may or may not be high in the firm prior to the practice of analytics capability. If it is there and has a fair extent of existence, it is conducive to the development of analytics capability. And when analytics capability is practiced, it is frequently drawn on. If integration is not there or has a weak extent of existence, then it will be cultivated while analytics capability is being developed. Either way, integration can be considered as a result of analytics capability practice. Thus, based on this short review of the two theories with regard to analytics capability and internal integration, we propose the following hypotheses:

H2: Analytics capability is positively associated with internal integration.

Relationship Between Internal Integration and SCP

A heightened argument in the literature of operations and supply chain management is that internal integration is an important antecedent to external integration and SCP (Germain & Iyer, 2006; Graham, 2018). This is because the experiences, learning, and capabilities gained in internal practices are important resources for developing and enhancing more advanced practices at the supply chain level (Graham, 2018; Jacobs, Yu, & Chavez, 2016). This suggests that internal integration likely has a positive effect on those SCPs that external integration enhances as reported in previous literature. From this perspective, we argue that internal integration positively impacts strategic alliance, knowledge co-creation, and SCPP respectively.

First, the relationship between internal integration and strategic alliance in supply chains can be examined in the larger relationship between internal and external integration, which covers supply chain strategic alliance to a large extent. Justice and fairness have been identified as factors impacting external integration (Duffy et al., 2013; Griffith, Harvey, & Lusch, 2006; Liu, Huang, Luo, & Zhao, 2012). Wei et al. (2021) found that procedural justice, which is a social element of the exchange relationship between the supply chain partners (Brown, Cobb, & Lusch, 2006; Griffith et al., 2006), positively moderates the relationship between internal and external integration. This suggests that there is a positive association between internal integration and procedural justice. Further, procedural justice is helpful to establishing a relationship that is characterized by trust, commitment, and long-term collaboration (Wei et al., 2021), which is what supply chain strategic alliance is about in our definition. Thus, it can be reasoned that internal integration should be positively associated with strategic alliance.

Additionally, as internal integration operates on the basis of centralization, unification, and collaboration, interdepartmental relationships within a firm should be predictably positive. A collaborative relationship between departments is thus presupposed in internal integration. Such a collaborative relationship can be reasonably expected in external integration. As internal integration is deemed as an antecedent to external integration, a collaborative interdepartmental relationship inherent in internal integration should be expected to be present between a firm and their supply chain partners, which is also the essence of external integration. Such a collaborative relationship between supply chain partners is established through strategic alliance. Therefore, it can be established that internal integration is positively associated with strategic alliance in supply chains.

Next, based on the knowledge-based view, performance depends on creating, sharing, and integrating knowledge within a firm (Grant, 1996). The importance of knowledge to internal performance should be the same to SCP. Internally, in the creation stage, information flow across organizational units is critical. With easy and smooth information flow enabled, internal integration paves the way for organizational units to learn from each other (Gupta & Govindarajan, 2000), and then creates value including new knowledge (Jansen et al., 2005). Similarly, once knowledge is created, it is important that it can be smoothly transferred and shared across these units as well, in the integration stage. It has been discussed earlier that internal integration facilitates information flow, knowledge sharing, and innovation sharing within the firm's well-established personal as well as technology-enabled information and communication systems (Szász et al., 2015). Smooth information flow, and knowledge and innovation sharing are equally critical to knowledge creation at the supply chain level. In this sense, internal integration should facilitate knowledge co-creation in supply chains.

Finally, our previous discussion of how internal integration involves strategic alliance and how it contributes to knowledge co-creation can lead us to make a clear argument that internal integration facilitates SCPP. SCPP involves significant amount of knowledge management (knowledge sharing and creation) regarding customers (Cooper, 2014; Zhang, Zhou, Lu, & Chang, 2017), as knowledge about customers translates into product requirement. The internal integration activities of information and knowledge sharing should facilitate customer knowledge management inherent in SCPP. Furthermore, SCPP is a process of product innovation engagement (Song, Montoya-Weiss, & Schmidt, 1997; Szymanski, Kroff, & Troy, 2007). Internal integration, which is conducive to innovation sharing, should benefit SCPP. Thus, overall, internal integration must be positively associated with SCPP. To conclude this short review of the literature on the relationship between internal integration and SCP, we posit the following hypotheses:

H3a: Internal integration is positively associated with strategic alliance in supply chains.
H3b: Internal integration is positively associated with knowledge co-creation in supply chains.
H3c: Internal integration is positively associated with SCPP.

Finally, based on our discussion of the literature regarding analytics capability, internal integration, and SCP, we propose the following mediation hypotheses:

H4a: Internal integration fully mediates the relationship between analytics capability and strategic alliance.

H4b: Internal integration mediates the relationship between analytics capability and knowledge co-creation.

H4c: Internal integration mediates the relationship between analytics capability and SCPP.

METHODOLOGY AND DATA COLLECTION

We adopted the survey methodology for this study, because of its demonstrated benefits. Compared to other methodologies, surveys are usually associated with good generalizability of the findings, easy replication of a research study, examination of multiple concepts in one study (Pinsonneault & Kraemer, 1993; Straub, Boudreau, & Gefen, 2004), and identification of general tendency or patterns and relationships between the variables in a sample (Gable, 1994). Thus, it fits the research goal of this study.

Questionnaire Development and Measures

We developed two scales measuring analytics capability and strategic alliance respectively in this study. In doing that, we followed Churchill's (1979) approach. It was a three-stage process. It started with a systematic literature review, which helped to determine the content domain of the constructs. Then measurement items were drafted based on this review. The second stage was a pre-pilot study with ten academicians who specialized in this area of research and eight industry experts. Feedback and comments were solicited from the academicians to check face validity of the newly drafted measurement items and make needed improvements. Then the constructs, their definitions, and measurement items were passed to the eight industry experts, who after a careful reading of them, matched the items with the constructs that they thought the items measure well.

The third stage was a small-scale pilot study aimed to further improve the measurement scales. The questionnaire was posted on a research website (www.qualtrics.com) and a list of potential participants was formulated after searching the LexisNexis database. Then an email was sent to these potential participants inviting them to participate this study. A total of 45 responses was obtained and then analyzed using SPSS. Some items with unsatisfactory Cronbach's alpha, Corrected Item-Total Correlation (CITC), and factor loading values were removed. The result of this three-stage scale development process was a four-item scale measuring analytics capability, and an eight-item scale measuring strategic alliance. The analytics capability scale measures competence and capability in general data analytics as well in specific areas of analytics. The Cronbach value of this scale is 0.82. The strategic alliance scale measures the qualities of trust, commitment, collaboration, and long-term orientation in the relationships with buyers and suppliers. These qualities were identified and examined in the relationship literature. Most prior studies focused on one or two of these qualities and developed corresponding measurement scales, for example, Griffith et al. (2006) for long-term orientation, Johnston et al. (2004) for trust, Monczka et al. (1998) for collaboration and commitment. We developed the scale measuring strategic alliance based on those individual quality scales from those prior studies. This scale has a Cronbach value of 0.93.

Besides the scales for analytics capability and strategic alliance, the scales for the other three constructs are adapted from previous studies. The measurement scale for internal integration is adapted from Danese, Romano, and Formentini (2013) and Williams, Roth, Tokar, and Swink (2013). It has four items, with a Cronbach value of 0.81. The eight-item knowledge co-creation scale is adapted from Anand, Ward, and Takikonda (2010), and Ho and Ganesan (2013), measuring production of explicit and implicit knowledge through socialization, externalization, combination, and internalization. It has a Cronbach value of 0.81. The SCPP measurement scale includes five items measuring product competitive advantage (Swink & Song, 2007), product innovativeness (Song et al., 1997), and product competence (Schoenherr et al., 2014). Its Cronbach value is 0.80. Additionally, consistent with previous studies on the same topic (see, e.g., Gupta & George, 2016), industry and organization size are used as two control variables in this study. Thus, the survey questionnaire consists of two self-developed scales measuring analytics capability and strategic alliance, three adapted scales measuring internal integration, knowledge co-creation, and SCPP, and two control variables (see the Appendix).

Respondents and Data Collection Procedure

The data collection procedure was contracted to Qualtrics.com, a commercial research firm with a large list of business panel members representing different firms across industries. Potential respondents were identified using the key informant approach (Phillips & Bagozzi, 1986). Employees in high-level managerial positions in IT, operations, and business analytics were deemed as such key informants. Emails were then sent to invite panel members to do the online survey on www.Qualtrics.com.

Following the recommendations from Schoenherr, Ellram, and Tate (2015), we implemented a number of methods and mechanisms to ensure data quality in the data collection process. To begin with, we informed Qualtrics.com representatives of the purpose of this research project and the detailed requirements for potential respondents. Then, we requested not placing an initial purpose statement at the beginning of the survey. This was to avoid the possibility that respondents use the statement as a guide for them to complete the survey, choosing the answers that they believe "best fit" our purpose. Next, we used screening questions at the beginning of the survey to ensure that only respondents with the required characteristics take the survey. Besides, we also used attention filters throughout the survey instrument to ensure that respondents answer the questions with full attention. Similarly, we implemented a mechanism to avoid so-called "speeders", which automatically removes responses done in less than 9 minutes. Additionally, respondent ip addresses were recorded. This was to identify and then get rid of so-called repeat respondents. Finally, a "Not Applicable" response option was added to each questionnaire item. As many as 2200 panel members were identified as right respondents for this study, who were managers in the manufacturing and service industries. From this pool, a total of 273 responses was obtained. After removing 22 incomplete responses, the final sample for this study consists of 251 responses.

RESULTS

This section presents a discussion of the measurement model, structural model, and hypothesis test including mediation test results. Specifically, we will discuss how we addressed validity and reliability concerns with results from in the measurement model. Then, we will show the structural model and hypothesis testing results.

Measurement Model

The measurement model consists of a confirmatory factor analysis of the five constructs: analytics capability, internal integration, and the three SCP constructs: strategic alliance, knowledge co-creation, and SCPP. All these five constructs were measured with reflective measurement items. Table 1 shows the descriptive statistics for the measurement items including mean and standard deviation, loading, composite reliability, and Cronbach alpha values.

Table 1: Descriptive Statistics, Loading, Composite Reliability, and Cronbach's Alpha

Latent Construct	Item	Mean	Standard Deviation	Loading	Composite Reliability	Cronbach's Alpha
Analytics	AC1	5.12	0.92	0.73	0.72	0.82
Capability	AC2	4.99	1.01	0.71		
	AC3	5.06	0.99	0.76		
	AC4	4.94	1.09	0.69		
Internal	II1	5.22	0.89	0.76	0.84	0.81
Integration	II2	5.05	1.02	0.83		
	II3	5.13	0.86	0.69		
	II4	4.97	1.01	0.75		
Strategic	SA1	5.34	1.01	0.83	0.93	0.93
Alliance	SA2	5.28	1.02	0.80		
	SA3	5.21	1.03	0.79		
	SA4	5.14	0,92	0.78		
	SA5	5.37	0.92	0.81		
	SA6	5.31	0.96	0.80		
				0.75		
				0.80		

	SA7	5.21	1.02	0.73		
	SA8	5.22	0.92	0.69		
Knowledge	KC1	5.39	0.73	0.77	0.89	0.84
Co-creation	KC2	5.14	1.04	0.78		
	KC3	5.20	1.02	0.68		
	KC4	5.16	0.94	0.67		
	KC5	5.14	0.97	0.66		
	KC6	5.16	1.01	0.74		
	KC7	5.11	1.03	0.63		
	KC8	5.14	0.97	0.58		
Supply	SCPP1	5.09	0.89	0.68	0.81	0.80
Chain	SCPP2	5.18	0.93	0.72		
Product	SCPP3	6.05	0.91	0.76		
Performance	SCPP4	4.89	0.83			
	SCPP5	5.19	0.90			

We assessed the constructs' validity and reliability by following Anderson and Gerbing (1988)'s recommendations. We first used the Cronbach alpha value to assess reliability. All the five constructs have good reliability based on the alpha values which range from 0.80 to 0.93, well above 0.70 (see Table 1). Next, we assessed reliability by using composite reliability values as well. According to Raykov (1998), composite reliability is a more rigorous measure in structural equation modeling. With 0.70 as the threshold value for composite reliability (Bagozzi & Yi, 1988; Gefen, Straub, & Boudreau, 2000; Nunnally, 1978), the results suggest that items measuring the same construct are highly interconnected and that the constructs have good construct reliability in this study, as the composite reliability values of all the constructs are higher than 0.7 (See Table 1).

As for validity assessment, we also used multiple approaches. First, we assessed construct validity. As introduced earlier, the measurement items were designed, developed, and refined based on literature reviews, interviews of practitioners and academics knowledgeable in the content domain. Then they were further cross checked with the practitioners and academics. This vigorous process helped to ensure content validity. Second, we used item loadings from the measurement model results to assess convergent validity. As it is shown in Table 1, all measurement items have a loading value higher than 0.5, the cutoff point traditionally used in the literature. Third, we assessed discriminant validity by examining whether the square roots of the average variance extracted (AVE) for each construct are greater than the corresponding correlation coefficients (Formell & Larcker, 1981). Our results met this criterion. The correlation coefficient and AVE values are shown in Table 2. Recently, Hensler, Ringle, and Sarstedt (2015) proposed using a new criterion called the heterotrait-monotrait ratio (HTMT) to assess discriminant validity. Based on this approach, a HTMT ratio value that is less than 0.85 demonstrates sufficient discriminant validity. The HTMT values of the five constructs are all below 0.85, indicating that they all have sufficient discriminant validity.

TABLE 2
Correlations and Average Variance Extracted

	AC	**II**	**SA**	**KC**	**SCPP**
AC	0.39				
II	0.50**	0.58			
SA	0.39**	0.44**	0.61		
KC	0.62**	0.53**	0.47**	0.51	
SCPP	0.61**	0.63**	0.48**	0.54**	0.39

**: Correlation is significant at the 0.001 level (2-tailed).
Average variance extracted values are printed in diagonal.

Additionally, the confirmatory factor analysis results established the uni-dimensionality of the constructs, as all item loading values are well above the suggested threshold of 0.50 (Byrne, 2010). Finally, with satisfactory content validity, uni-dimensionality, reliability, and convergent and discriminant validity, construct validity is ensured for all the constructs in this study (O'Leary-Kelly & Vokurka, 1998).

The measurement model test results showed that the model has good fit. The CMIN/DF ratio (= 1.64) shows superior model fit. The CFI (= 0.97) and TLI (= 0.96) values indicate superior fit, as these two values are greater than the 0.95 cutoff line. Lastly, the RMSEA value (= 0.04) suggests superior model fit.

Following the traditional approach adopted in previous studies (e.g., Swafford, Ghosh, & Murthy, 2006), we used the *t*-test method to evaluate non-response bias. Randomly selecting five items from the questionnaire, all measured with an interval scale, as dependent variables, we then performed a *t*-test for each comparing the responses of the first 30 and last 30 respondents. Results of all the five *t*-tests showed that there is no significant difference between the two groups at the 0.05 level, suggesting no evidence of non-response bias in the data.

We used multiple methods to address the concern of common-method bias possibly existing in the questionnaire administration process. First, we followed recommendations from Podsakoff, MacKenzie, and Lee (2003) to use the empirical method to assess common-method bias. More specifically, we performed a Harman's single-factor test. The test results indicates that the measurement model exhibits significantly better fit than the single-factor model. This suggests that common-method bias is not a serious concern in this study (Malhotra, Kim, & Patil, 2006; Podsakoff & Organ, 1986). Next, using the procedures suggested in Schwarz et al. (2017) and Williams, Hartman, and Cavazotte (2010), we created three models: baseline, common latent factor, and marker variable, and then compared the models using a chi-square difference test. The comparison test between these models shows no significant difference, suggesting that common method is not a serious issue.

Structural Model

The structural model was tested by entering all the constructs and their pre-specified relationships in the model. The test results support keeping all the following constructs with their measurement items in the model: analytics capability, internal integration, strategic alliance, knowledge co-creation, and SCPP. The model test results also indicate that the model has a good fit. The CMIN/DF ratio (= 1.64) shows superior model fit. Both the CFI (= 0.96) and TLI (= 0.95) values indicate strong goodness-of-fit. The RMSEA (= 0.04) suggests superior model fit. Thus, overall, these indicators show a good model fit.

Hypothesis Test Results

The hypotheses covered in the structural model test are as follows: H1a, H1b, H1c, H2,
H3a, H3b, H3c, H4a, H4b, and H4c. Hypothesis 1a indicates that there is no direct significant relationship between analytics capability and strategic alliances. The results support this hypothesis ($\beta = 0.06$, $p < 0.60$). Hypothesis 1b posits that analytics capability is positively related to knowledge co-creation. The test results indicate that analytics capability has a strong positive relationship with knowledge co-creation. Thus, H1b ($\beta = 0.40$, $p < 0.0001$) is supported. Similarly, hypothesis 1c suggests that analytics capability is positively related to SCPP. The results ($\beta = 0.22$, $p < 0.05$) show that H1c is supported. Further, hypothesis 2 posits that analytics capability is positively related to internal integration. The test results ($\beta = 0.72$, $p < 0.0001$) show that H2 is strongly supported. Hypothesis 3a indicates that internal integration positively impacts strategic alliance. The test results ($\beta = 0.56$, $p < 0.0001$) supports H3a. Hypothesis 3b posits that internal integration positively impacts knowledge co-creation. The test results strongly indicate that there is a strong positive relationship between internal integration and knowledge co-creation. Thus, hypothesis 3b ($\beta = 0.49$, $p < 0.0001$) is supported. Finally, hypothesis 3c shows that internal integration positively impacts SCPP. Hypothesis 3c is supported by the results ($\beta = 0.71$, $p < 0.0001$).

Mediation Testing

The bootstrapping method was used to test mediation in this study. According to Hayes (2009), besides providing greater statistical power, the bootstrapping method offers two more benefits: directly measuring indirect effect and not assuming normality in the mediation effect. The second benefit adds validity to the mediation test results as normal distribution may not necessarily be assumed in indirect effect (MacKinnon et al., 2002). Following the convention

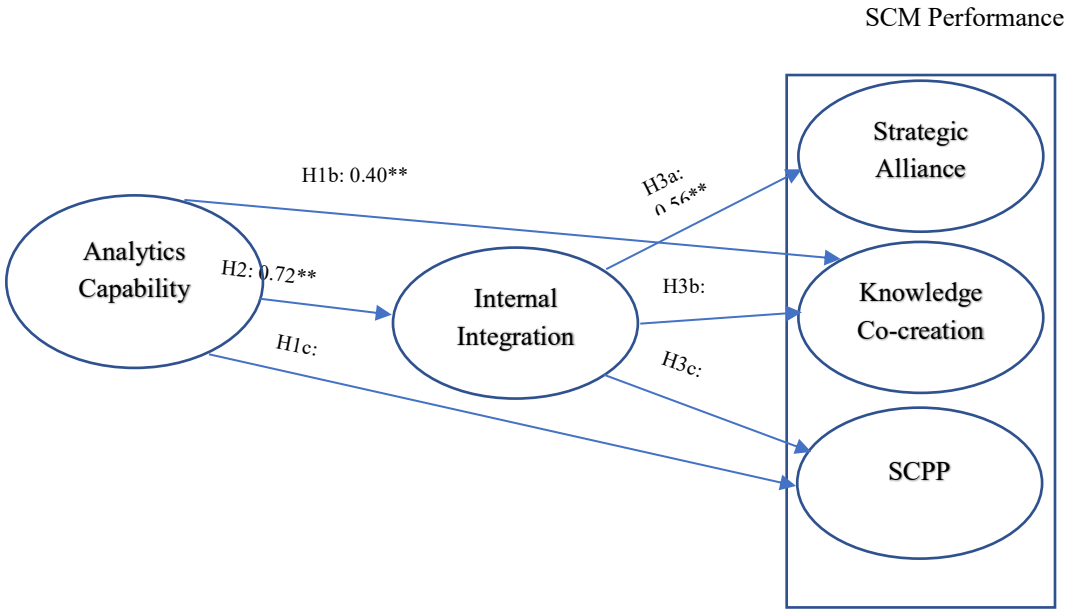
adopted in the literature (e.g., see Anwar et al., 2018; Kulkarni, Robles-Flores, & Popovic, 2017; Mikalef et al., 2019; Wamba & Akter, 2019), we used the 95% confidence interval and 5,000 resamples when running the bootstrapping tests.

Using this bootstrapping method, the three mediation hypotheses (H4a, H4b, and H4c) were tested. The mediation test results are shown in Table 3. Hypothesis 4a states that internal integration fully mediates the effect of analytics capability on strategic alliance. The results show that the mediation effect is significant, as 0 does not fall between the lower bound of 0.21 and upper bound of 0.71. Thus, hypothesis 4a is supported. Additionally, the results show that this is a full mediation effect, as analytics capability does not have a significant direct effect on strategic alliance. Hypothesis 4b indicates that internal integration partially mediates the effect of analytics capability on knowledge co-creation. The test results indicate that this mediation effect is significant, as 0 does not fall between the lower bound of 0.12 and the upper bound of 0.37. Therefore, hypothesis 4b is supported. Further, the results show that this is a partial mediation effect. Finally, hypothesis 4c states that internal integration partially mediates the relationship between analytics capability and SCPP. The test results provide support for this hypothesis, as 0 does not fall between the lower bound of 0.14 and upper bound of 0.32. Based on these test results, the conceptual framework is supported (as shown in Figure 2).

TABLE 3
Results of Bootstrapped CI Tests for Mediation Hypotheses:

X variable	Mediator	Y variable	Mediation Test (*ab*)			Full/Partial Mediation Test (*c*)			Type of mediation
			Lower bound	Upper bound	Zero included?	Lower bound	Upper bound	Zero included?	
AC	Integration	SA	.13	.60	No	.21	.71	No	Full
AC	Integration	KC	.12	.37	No	.57	.89	No	Partial
AC	Integration	SCPP	.14	.32	No	.30	.51	No	Partial

Figure 2: Supported Conceptual Model



Note: *$p < 0.05$; ** $p < 0.000$

DISCUSSION

Although prior and current research has examined the direct and indirect performance impact of analytics capability, we have limited knowledge about whether it induces structural change which may shape its influence on firm performance. Additionally, past research has investigated the effect of analytics capability on various aspects of SCP, but these aspects are mostly functional, rarely social. Yet, SCP includes social aspects such as collaboration with stakeholders (Lehyani et al., 2021). To address these two research gaps, this study examined the impact of analytics capability on SCP, and more importantly, explored whether the impact is induced by internal integration as well. Along this line of inquiry, this study also assessed the impact of analytics capability and internal integration on strategic alliance in supply chains, an under-researched aspect of SCP.

While addressing these two issues, this study provided important findings about the relationships between analytics capability, internal integration, and SCP. First, this study found that analytics capability has direct effect on two aspects of SCP, knowledge co-creation and SCPP, both as indicators of functional SCP. A second finding of this research is that analytics capability positively influences internal integration, which then positively impacts SCP, including strategic alliance. This suggests that internal integration positively mediates the relationship between analytics capability and all the three aspects of SCP.

With these findings, this study has made important contributions to the analytics capability research literature. First, the findings of this study added empirical evidence to support the view, which has already articulated in the literature, that analytics capability helps to enhance the functional aspects of SCP. Thus, this study has helped to enhance this view. Related to the first contribution, our second contribution is that this study revealed that for direct effect on SCP, analytics capability mostly influences the functional indicators of SCP. Prior literature rarely examined whether analytics capability influences the social aspects of SCP. Thus, there was little understanding of this possible relationship in the literature. By showing that analytics capability directly influences knowledge co-creation and SCPP but not on strategic alliance, this study explicitly raised and then empirically supported a point of view that analytics capability impacts the functional aspects of SCP but not the social aspects.

Thirdly, this study contributes to the literature in that it found that analytics capability, while directly shaping performance, triggers structural change, i.e., internal integration, which then facilitates the impact of analytics capability on performance. Prior research did realize the importance of structure to the analytics capability's effect on performance. For example, it was noted that organizational culture, a determinant of structure, shapes the impact of analytics capability on performance (see, Dubey et al., 2019). However, previous studies rarely raised the possibility that analytics capability, besides directly affecting performance, can also induce structural change such as internal integration, which then shapes its impact on performance. In this regard, the current study contributed to the literature by revealing this possibility. Meanwhile, this study also pointed to a direction where future research can direct attention to. Thus, this study enhanced our understanding of the power of analytics capability in facilitating performance.

In addition to these theoretical contributions, this study generated important implications for managerial practice. The findings of this study provide encouraging news to companies that exercising their analytics capability benefits both functional and social aspects of SCP. First, this study reinforces the view, which has been well-received, as it has been articulated and supported in other studies, that analytics capability helps companies to create knowledge and develop new products. Yet, on the basis of that, this study also sends a new message to companies that analytics capability helps them and their supply chain partners to co-create knowledge. This is possible because analytics capability also contributes positively to strategic alliance with supply chain partners. This contribution works in a way that analytics capability drives internal integration which then provides a supportive climate for strategic alliance with supply chain partners. Thus, the findings of this study show companies new benefits from analytics capability, which will enhance their confidence in investing in, developing, and practicing analytics capability. Finally, the findings of this study imply that companies should proactively foster internal integration if they plan to develop and practice analytics capability. This is because internal integration facilitates analytics capability's contribution to SCP in both functional and social aspects.

Although this study contributes to both theory and practice, it has limitations inherent in its design. The findings of this study are based on analysis of data that were mainly collected through a one-time survey. Such data only reflects a snapshot of firm practice in analytics capability, internal integration, and SCP. More importantly, a bigger limitation

inherent in the use of survey data is that it cannot provide a process view of the mutual engagement between the practice of analytics capability and emergence of internal integration as well as its influence on the former, as structuration theory implicitly suggests. Because of this limitation, this study only provided a partial view of the mutuality of analytics capability and internal integration, i.e., analytics capability's stimulation of internal integration. Additionally, the survey method allowed for little control in research design. Thus, we can hardly claim causality in the relationships between the constructs employed in this study. Because of these limitations, it is cautioned that the findings of this study should not be overly generalized to companies. Future research should attempt to collect time-series data if the survey method is used. More importantly, other methods such as experiment should be used to collect data. Finally, future research should make efforts to collect qualitative data such as time series interviews and firm historical records, with which we can provide a better view of how analytics capability and internal integration mutually constitutes or influences each other.

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Appendix: Survey Instrument

Codes	Questionnaire Items
	Analytics Capability (AC)
AC1	We are skilled in data mining and analysis.
AC2	We are skilled in dealing with unstructured textual data.
AC3	We are skilled in analyzing web sites.
AC4	We are skilled in mobile computing.
	Internal Integration (II)
II1	Functional units in our firm are aware of each other's responsibilities.
II2	Operational and tactical information is regularly exchanged between functional units in our firm.
II3	Planning decisions are based on plans agreed upon by all functional units in our firm.
II4	All functional units use common product roadmaps and other procedures to guide product launch.
	Strategic Alliance
SA1	Our firm's relationship with our customers is based on trust.
SA2	Our firm is committed to our relationship with our customers.
SA3	Our firm has a collaborative relationship with our customers.
SA4	Our firm develops a relationship with our customers based on long-term considerations.
SA5	Our firm's relationship with our suppliers is based on trust.
SA6	Our firm is committed to our relationship with our suppliers.
SA7	Our firm has a collaborative relationship with our suppliers.
SA8	Our firm develops a relationship with our suppliers based on long-term considerations.
	Knowledge Co-creation (KC)
KC1	Our firm and our supply chain partners have created new skills and knowledge by working together.
KC2	Our firm and our supply chain partners formally codify objective project results into standard operating procedures.
KC3	Our firm and our supply chain partners systematically recording objective findings and results for future reference.
KC4	Our firm and our supply chain partners use codified reports to initiate discussions about project performance.
KC5	Our firm and our supply chain partners implement documented changes using on-the-job training.
KC6	Our firm and our supply chain partners extensively discuss our projects.
KC7	
KC8	
SCPP1	
SCPP2	
SCPP3	
SCPP4	
SCPP5	
Industry	
Organization size	

	Our firm and our supply chain partners formally and systematically list implied customer requirements. Our firm and our supply chain partners convert subjective customer requirements to objective requirements. Supply Chain Product Performance (SCPP) Working with our supply chain partners, we have developed products with unique features. Working with our supply chain partners, we have developed products that superbly meet customers' needs. Working with our supply chain partners, we have developed high quality products. Working with our supply chain partners, we have developed products that have superior technical performance. Working with our supply chain partners, we have developed highly innovative products. Control Variables Your company is _____ industry. How many employees does your company have? _____.

CRITICAL THINKING GAINS THROUGH COLLABORATIVE LEARNING

Brian Hoyt, Ohio University

ABSTRACT

A Pre-Post study on developing critical thinking of business students using a collaborative learning software platform reveals a statistical relationship between collaborative learning and development of critical thinking. The study also reports a statistical relationship between collaborative learning and developing the important workplace skill of employee performance evaluations. The online asynchronous management course used a collaborative learning software platform that prompts and facilitates almost twenty critical thinking opportunities per analysis assignment through peer-to-peer evaluation and feedback. The study adds to the body of knowledge on collaborative learning and critical thinking for students, particularly with online asynchronous courses where student engagement and peer based collaborative learning is difficult to execute. The collaborative learning software platform also uses Artificial Intelligence (AI) features to calibrate the effectiveness of peer evaluations and ratings to a standardized rating rubric. University business programs are increasingly focusing on learning outcomes such as critical thinking to better prepare graduates for the work required by organizations. Critical thinking is a skill that the business college accreditors (i.e. AACSB) and talent management expert organizations (i.e. Society for Human Resource Management) have identified as one of the most important skills for students to demonstrate and apply as they enter the workforce. Asynchronous collaborative learning using advanced software platforms, including AI, is a new thread in the contribution to the Body of Knowledge in collaborative learning and development of critical thinking skills.

INTRODUCION

University business programs are increasingly focusing on learning outcomes such as critical thinking to better prepare graduates for the work required by organizations. Critical thinking is a skill that the business colleges and organizations have identified as one of the most important skills for students to demonstrate and apply at graduation.

In the Society for Human Resource Management's 2019 special report on skill gaps (SHRM 2019), 83% of respondents (HR managers) reported having problems recruiting desired candidates. 75% of those respondents who have problems securing desirable also reported that candidates are missing important skills. The top 3 missing soft skills were critical thinking (37%), dealing with complexity and ambiguity (32%), and communication (31%). Organizations recognize they can't effectively address the skill gap without partnering with higher education. 51% reported that education systems have done little to nothing to help address the skills gap organizations are experiencing. Critical thinking was reported to be specific help target for higher education in improving the skill gap for organizations seeking new graduates to fill positions.

Presently, organizations continue to focus on talent acquisition and talent management as a profit lever and competitive advantage differentiator (Falcone, 2024). SHRM's 2023-2024 State of the workplace report (SHRM 2024) reported 58% of respondents (human resource managers) claimed a lack of qualified candidates for the 2023 labor shortage issues. 70% of the respondents stated that a top priority for 2024 was to find and recruit talent with the necessary skills. A leading leadership assessment company, Peregrine Global services, works with both organizations and business colleges and highlights the importance of critical thinking. Critical thinking skills are important to effectively solve problems, develop solutions, and innovate. Their experience with employers points to organizations who seek employees who can independently evaluate a situation using logical thought, offer the best solution, and make decisions. Their work with business colleges emphasizes programs that prepare graduates with valuable critical thinking skills (https://peregrineglobal.com/). Employers reported an increase in measurable efforts in the implementation of hiring for skills where candidates will be evaluated for their capacity to learn instead of criteria such as past positions or education levels (Maurer, 2024).

The international accredited body for business schools, AACSB, recently commissioned an "accelerator" team focused on emphasizing new mindsets, competencies, and skills needed for future leaders in the workplace. The accelerator effort is intended to guide business schools in developing leaders ready for emerging organizational needs. The accelerator effort included identifying competencies and how business schools and students will adopt leadership in the future. One of the tenets of their findings included an emerging competency of discernment.

> "Discernment enables leaders to consciously intervene in opportunities, initiatives, and relationships to achieve their desired impact. Discernment can be compared to critical thinking but has a greater focus on the ability to judge right from wrong and to determine whether further inquiry is needed." (AACSB, 2023)

As business schools respond to the increased pressure to develop critical thinking skills, use advanced learning methods, curriculum design and use of technology in an asynchronous format there is an equally urgent call for research probing effective critical thinking training. The focus of this study was to examine the collaborative learning of peer-to-peer evaluation in a problem-based and asynchronous online environment. The collaborative environment was facilitated by an innovative software platform that develops critical thinking. Few, if any, involve peer to peer assessment that is structured, facilitated by software and AI applications, provides closed loop feedback, doesn't eliminate faculty involvement or examine asynchronous engagement.

LITERATURE REVIEW OF RESEARCH CONSTRUCTS

Collaborative Learning

Collaborative learning has a deep foundation in research. Early descriptions introduced instructional approaches at the university level involving two or more students working jointly, guided by faculty to achieve a common learning goal (Gokhale, 1995). As the body of knowledge grew collaborative learning focused on feedback as a method to improve task performance (Kollar and Fischer, 2010; Tan and Chen, 2022). Moving forward collaborative learning is a generally accepted construct in the literature as any activity where learners work together to achieve a common learning goal, with an emphasis on techniques to support working together (Barkley, Cross, and Major, 2014). Currently, the generally accepted definition describes collaborative learning as any activity that positions learners to work together to achieve a shared learning goal and requires students to be engaged in their own learning while enhancing peer interaction (Loes, 2022). A recent focus on learning outcomes and assessment has much of the research on collaborative learning overlapping the principles of problem-based learning including shifting faculty as facilitators, requiring specific steps to solve real world problems, problems must be complex to require collaboration, and the assessment of learning must align with resolving the problem (Laal & Laal, 2012; Cheong, Bruno, & Cheong, 2012 ; Carriger, 2016; Wiggins, Chiriac, Abbad, Pauli, and Worrell, 2016; Loes, 2020; Alt and Raichel, 2022; Hoyt and Jones, 2023).

Collaborative learning has an established research basis for the positive relationship between collaborative learning and a variety of learning outcomes (Table 1).

Table 1 Collaborative Learning Outcomes

Learning Outcome	Research studies
Motivation and quality of knowledge gains	Loes 2022 Chang, Yan and Lu, 2022
Critical thinking	Nanzhe and Shukor, 2023; Loes and Pacarella, 2017; Yilmaz and Yilmaz, 2020; Rabu and Badlishah, 2020; Lu, Pang and Shadiev, 2021 Warsah, Morganna, Uyun, Hamenghubuwono, and Afandi, 2021
Writing skills	(Strijbos and Wichmann, 2018 Zou, Xie, and Wang, 2023
Collaborative learning practices	Muukkonen, Lakkala, Nuuttila, Ilomaki, Karlgren, and Toom, 2020 Strijbos and Wichmann, 2018
Development of knowledge-based configurations	Schaffer, Frohlig, Mayr, and Franke, 2019
Individual contributions	Ma, Yan, and Wang, 2020
Learner satisfaction	Altinay, 2017
Lifelong learning	Alt and Raichel, 2022
Psychological adjustment and well being	Hanson, Trolian, Paulsen,&Pascarella, 2016
Increased interaction with peer	Loes, An, Saichaie, & Pascarella, 2017

Collaborative learning approaches can be categorized by faculty based on the type of collaborative assignment including pairing students after individual reflection or task completion, case studies assigned to small groups, peer assessment often used with discussion boards or writing assignments in class, or a presentation assignment including tutoring or presentation to a group of peers. Collaborative learning research, as an independent variable is categorized by the collaboration structure (Table 2).

Table 2 Collaborative learning structures

Collaborative learning structure	Research Studies
Scaffolding	Strijbos and Wichmann, 2018; Deiglmayr, 2018 Lu, Pang, and Shadiev, 2021 Cortazar Nussbaum, Hoyos, Goni, and Alvares, 2022
Group interactions	Ma, Yana and Wang, 2020 Loes, 2022; Alt and Raichel, 2022 Mendoza, Cheng, and Yan, 2022; Tan and Chen2022 Schäffer, Fröhlig, Mayr, and Franke, 2019 Muukkonen, Lakkala, Nuuttila, Ilomäki, Karlgren, and Toom, 2020; Loes and Pascarella, 2017; Zou, Xie, and Wang 2023),
Group writing	Zou, Xie, and Wang 2023),
Group flipped class activity	Chang, Yan and Lu, 2022

A growing, but much smaller research thread examining the independent variable of collaborative learning also includes collaborative platform facilitated by technology studies including Adobe Connect (Altınay, 2017); discussion boards (Lee, Kim, Kim, 2014; Gizem, Yilmaz and Yilmaz, 2020; Rabu & Badlishah, 2020), Google Docs (Warsah, , Uyun, Hamengkubuwono, 2021, and group discussion (Afandi 2021; Nanshe and Shukor, 2023). Less numerous studies but equally important to the growing body of knowledge on collaborative learning includes peer to peer collaboration. Studies measuring this independent variable include one on one tutoring (Loes, 2022; and Loes and Pascarella, 2017), and online discussions (Berstein and Isaac, 2018; Giacumo and Savenye, 2020).

Critical Thinking

Critical thinking in higher education has extensive roots in the work of Bloom and his colleagues where a framework for critical thinking was examined to help identify specific learning objectives that directed planning of learning experiences and evaluation metrics and tools. The resultant model, Bloom's Taxonomy, developed into a framework that also could be used to assess the process of developing critical thinking and assess the development of students' critical thinking and faculty's effectiveness in supporting critical thinking. The initial model identified 6 cognitive levels of critical thinking including Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. (Paul, 1985; Bloom 1956). By the early 2000's the taxonomy had a renewed integration into higher education including a revision (Krathwohl, 2002). The revised model, also, with six cognitive levels (Remember, understand, apply, Analyze, Evaluation, Creation) suggested a less hierarchical interpretation of cognitive development and focused actions evidenced at each level and outcomes demonstrated by learners (Nentl and Zietlow, 2008, Ragonis and Shmallo, 2022). The revised model also considered the extension or object of the cognitive knowledge as four dimensions including Factual, Conceptual, Procedural, and Metacognitive. These domains represent the potential for student's critical thinking. A domain reached by a student enables them to use and experience their cognitive skills at the corresponding cognitive level (Hadzhikoleva, Hadzhikolew, and Kasakliev, 2019). Concurrently, researchers and practitioners were expanding the body of knowledge on the taxonomy and applying the revised model to better

understand the factors that impact critical thinking. The early 2000s was testing ground for business courses and curriculums using Bloom's taxonomy to guide the development of critical thinking. The evolving of the model shifted from a structured hierarchal guide for setting learning objectives to a two tier model with lower and higher order thinking skills where the lower order skills (knowledge, understand, apply) are hierarchical and the higher orders skills (analysis, evaluation, create) are metacognitive and can be used to assess learners' critical thinking skills (Krathwohl, 2002; Shareef and Sadiq, 2023; Ragonis and Shmallo, 2019). It is the metacognitive and higher order skills that university business programs focus on to develop graduates' critical thinking skills for the rigor of the workplace. An important factor in moving from lower order levels and higher order levels is skill transfer. Skill transfer is generally defined as the extent to which trainees can effectively apply skills learned/gained in a training session to actual job context (Baldwin & Ford, 1988). Skill transfer includes sustained learning (Hughes, Zajac, Woods**,** and Salas, 2020**)**, retention (Velada & Caetano, 2007) and transfer resulting in improved performance (Noe et al., 2014). Other studies report the design features of a learning experience can strengthen skill transfer. The theoretical framework for connecting the learning design environment and predicting workplace performance is based on the theory of planned behavior (Ajzen, 1987, 1991, 2012; Bosnjak, Ajzen, Schmidt, 2020).

> "According to the TPB, human behavior is guided by three kinds of considerations: beliefs about the likely consequences of the behavior (*behavioral beliefs*), beliefs about the normative expectations of others (*normative beliefs*), and beliefs about the presence of factors that may facilitate or impede performance of the behavior (*control beliefs*). In their respective aggregates, behavioral beliefs produce a favorable or unfavorable attitude toward the behavior; normative beliefs result in perceived social pressure or subjective norm; and control beliefs give rise to perceived behavioral control or self-efficacy. The effects of attitude toward the behavior and subjective norm on intention are moderated by perception of behavioral control" (Bosnjak, Ajzen, and Schmidt, 2020).

Movement through the lower-level critical thinking to the higher order levels often require some external prompts that encourage observation, probing, analyzing, and application of new knowledge. The development of critical thinking includes learners acquiring complex content and concepts with progressive steps from passive to active learning (Brookfield, 2012; Heinrich, Habron, Johnson, and Goralinkik, 2015; Zapalska, McCarty, Young, and White, 2018; Zaidi, Grob, Monrad, Kurtz, Tai, Ahmed, Gruppen, and Santen, 2018).

Problem-Based Learning

As business education shifts toward competency-based curriculums the focus on critical thinking using problem-based learning has been emphasized. The problem-based learning construct (PBL) is represented by five interrelated features of problem-based learning including facilitation rather than presenting information as knowledge, must follow a set of explicit steps to resolve the problem, use unresolved, real-world problems, the problem must be complex enough that an individual learner requires collaboration with others, and the assessment of learning must align with the unresolved real-world problem (Newman, 2005). The real-world problems presented by PBL are the beginnings of acquiring and integrating new knowledge. While providing an opportunity for students to be fully responsible for their learning, students become active learners and more skilled problem solvers (Walker, Leary, Silver, and Ertmer, 2015, Cortazar, Nussbaum, Harcha, Alvares, Lopez, Goni, and Cabezas, 2021). Connecting PBL to collaborative learning has included research on team problem solving team problem solving (Joham and Clarke, 2012; Tan, Vand der Molen, and Schmidt, 2016; Chulkov and Nizovtsev, 2015; Carvalho, 2016; Pike, Spangler, Williams, and Kollar,2017; Solcan, 2016; Sroufe, and Ramos, 2015; Stahl & Dunning, 2015a, 2015b) and comparing cooperative, collaborative, and PBL (Davidson and Major, 2014; Wood, Marquez, and Hamilton, 2016).

Collaborative Learning and Critical Thinking

Collaborative learning and the learning outcome of critical thinking has a growing research base (Loes and Pascarella, 2017). Collaborative learning supports critical thinking by extending the time learners have to consider the problem and solutions (Swart, 2017; Nanzhe and Shukor, 2023), frequency of reflective thinking (Rabu and Badlishah, 2020) and flexibility in time and place (Lee, Kim, and Kim, 2014). It is reported to increase engagement (Zhout, Xie, Wang, 2023) and that engagement stimulates the student's participation and self-regulated learning toward developed critical thinking (Winstone and Boud, 2019; Yu and Liu, 2021). Retention of critical thinking skills, as a result of collaborative learning, is a reported benefit (Warsah, Morganna, Uyun, and Afandi, 2021). Collaborative learning provides a

platform for deeper learning approaches that enhance higher order thinking skills (Lu, Pang, Shadiev, 2021) and allows different feedback forms (Yilmaz and Yilmaz, 2020).

Asynchronous collaborative learning and advanced software platforms including AI is a new thread in the contribution to the Body of Knowledge in collaborative learning and development of critical thinking skills. Improvements in critical thinking requires formative and summative feedback on the development and evidence of developed critical thinking.

Conceptual Framework for Study: The Collaboration Platform Model

For this research a proprietary peer assessment software platform was used. Kritik is a student-centered software platform that supports an engaged collaborative learning environment for students. Kritik is designed to improve student engagement, interactions among students, improve the student led experience, and with peer assessment students learn to provide constructive feedback to peers that elevates their learning experience. The platform includes an AI component for assignment and rubrics design. Kritik is used by over 200,000 student users and over 250 higher education institutions (https://www.kritik.io/).

The Kritik platform provides opportunities to strengthen course concepts, theories and models as well as developing specific skills important for students to apply. The collaborative environment has a full circle experience increasing the number of required analysis engagement from initial submission through peer evaluation (from and to peers) and finishes with reflective feedback stage. Most problem-based collaborative learning environments provide students with multiple opportunities to examine a workplace situation and exercise critical thinking. In a more traditional case analysis, a student may be exposed to levels of critical thinking two or three times, once to review the assignment, second in framing their response, and third when they receive feedback from faculty comments. With collaborative learning, specifically using Kritik's platform, students could be engaged in the critical thinking process up to 20 times in a single problem-based assignment. The first is when reviewing the problem and the second when framing their response. The next five critical thinking engagements are when reviewing peer analysis using the faculty prepared evaluation rubric. The second set of five critical thinking engagements occur when reviewing peer assessments of their own work. The last five critical thinking engagements take place when they provide feedback to their peers noting the importance of the peer assessments to improved future analysis work.

The application of this software platform for collaborative learning facilitates the implementation of each level of cognition that matches the curriculum requirement and the cognition level on Bloom's Taxonomy hierarchy. Each phase in the collaborative level was executed to strengthen critical thinking and aligns with standardized Bloom's taxonomy and curriculum interventions as outlined by Shareef & Sadiq below.

1. Remembering level (using videos, documents, and self-paced learning).
2. Understanding level (tracking, assessment, and addressing questions).
3. Applying level (showing solid examples, games, and role-play).
4. Analyzing level (through debates, discussion, and problem-solving).
5. Evaluating level (peer-editing, presenting, and competitions).
6. Creating level (collaboration and group work to solve problems
(Shareef & Sadiq, 2023)

This study mirrored this outline with a 4-criteria evaluation matrix (Appendix - Table 3: Critical Thinking Evaluation Matrix).

Table 4 below outlines the connections between each collaboration step in a problem-based assignment using a collaborative learning platform, the level of critical thinking based on Bloom's taxonomy, and the data collection measurement point.

Table 4 Collaboration Platform

Collaboration step	Bloom level	Research measure
Step 3a. Students prepare for problem-based analysis	remembering	Count access to resource materials
Step 3b. Draft analysis report	Understand and apply- explain scenario and elaborate on the given problem and situation and remark on importance	Accuracy to rubric
Step 4a. Students receive and review faculty evaluation of creation	Analyze - evaluate assumptions and alternative perspectives	Count access to faculty evaluation/score
Step 5a. Score peers work with rubric	Apply and analyze – Draw conclusions	Accuracy to faculty evaluation of same peers
Step 5b. provide written feedback to peers	Apply, analyze, and evaluate – explain related implications and consequences	Completeness of comments aligning with rubric
Step 6a and 6b. Students provide feedback to peers' evaluations	Analyze and evaluate – defend own views and perspectives	Written evaluation score from peers
Step 7a and 7b – students' reflection on final scores in all stages and adjusted peer evaluator strength adjustments	Analyze, Evaluate, Create – communicate effectively	1. Analysis grade relative to peers 2. Improvement in next problem-based analysis

The Critical Thinking Assessment is designed to support teaching and learning through peer assessment. The assessment effectively measures critical thinking by evaluating all levels of the cognitive domain according to Bloom's Taxonomy. The assessment utilizes a standardized rubric (Appendix Table 5) that covers five sub-criterions of critical thinking including:

- Explain scenario and/or elaborate on the given problem or situation presented and its importance.
- Evaluate assumptions and alternate perspectives.
- Draw conclusions and explain related implications and consequences.
- Defend own views and perspectives.
- Communicates effectively.

Hypotheses

HO1: Collaborative learning using software supported peer-to-peer evaluation will not increase critical thinking skills

HO2: Stronger critical thinking skills will not transfer to practical workplace skills

METHODOLOGY

Sample

The data for this study was collected from a senior level undergraduate required course for business management majors (n = 45). Students who submitted incomplete analysis work (i.e. faculty grading < 40%) were not included in the collection of data for each analysis. The course is an asynchronous online modality. The program learning

outcomes and aligned program goals and course learning objectives are AACSB compliant (Appendix Table 3) and direct the written analysis assignments facilitated by the collaborative learning software platform developed by Kritik (kritik.io).

Data Collection

In this study data was analyzed from a sample of students participating in an online course using an advanced collaborative learning software platform. The study measured critical thinking levels using Bloom's Critical Thinking Taxonomy as students progressed through a series of three management analysis situations. The collaborative learning software platform supports multiple opportunities for students to examine peer analysis work, provide detailed evaluations using a standardized evaluation rubric, include written feedback on performance to the rubric, and comment on peer evaluations' constructive and motivational value. Data was collected from students after their written analysis was submitted and evaluated using standardized rubric aligned with Bloom's Taxonomy by faculty and recorded as the basis for critical thinking knowledge and comprehension levels and compared to the last analysis assignment to determine if improvement in critical thinking was realized. Data was collected from each student and their evaluations of 3-5 peers using the same standardized rubric. Each peer rating was compared to the faculty rating and a calculated score is assessed to determine the strength of their evaluation to determine the application and analysis critical thinking levels also representing workplace evaluation of performance skills. Data was collected from assessments of comments accompanying rubric ratings that students provided to their peers. Each written comment was assessed a rating based on constructiveness and motivation to improve aligning with rubric criteria to determine the analysis and evaluation critical thinking levels. Assessment data was drawn from 3 separate analysis assignments.

1. Faculty member evaluates each student analysis submission based on a Bloom influenced critical thinking rubric (Appendix Table 2) and assigns a "Creation" score.
2. Each student, using the same critical thinking rubric, evaluates and scores 3-5 peers
3. Each student receives a "Grading" score based on a comparison of their peer evaluations and the faculty evaluation of those same peers using the same critical thinking rubric.
4. Each student responds to their peer evaluations and assesses the level of constructive and motivational value of those peer evaluations, resulting in a "Written Evaluation "score.
5. Each student provides feedback, responding to the constructive and motivational comments provided.

Setting up the collaborative platform requires seven steps

1. Establish evaluation rubric as evaluation form (based on AACSB on Critical Thinking)
2. Assign problem-based activity using a Wall Street Journal case
3. Students prepare for and submit analysis of problem (Creation stage)
    a. Preparation includes chapter reading, presented problem-based scenario, review of articles outlines and videos on analysis topics, and review of evaluation rubric. The critical thinking target is the Remembering level by using videos, documents, and self-paced learning
    b. Draft analysis report – The critical thinking target is the Understanding level by using tracking, assessment, and addressing questions).
4. Evaluation standard is set
    a. Faculty evaluate each Creation and assesses using critical thinking rubric (Appendix Table 2). Each student receives a Creation score from faculty.
5. Students analyze and evaluate 3-5 of their peers' Creations using the same established rubric faculty uses. Each student will score peer's work on 4 criteria with 4 levels of performance per criterion. The critical thinking target is the Applying level by showing solid examples, use of established evaluation rubric and the analyzing level by discussion and problem solving (stating problem and recommending solutions)
    a. Provide written feedback on each scored criterion.
6. Students provide feedback to peers on the quality of the evaluations. The critical thinking target is the Evaluating level by using peer-editing, presenting rationale, and noted improvement areas to apply.
    a. Constructive – comment on the use of rubric criteria to frame comments.
    b. Motivational – comment on areas to improve for next problem-based activity.
7. Final grades are posted.

a. Students receive breakdown of scores in Creation, Evaluation, and feedback stages.
b. Students can appeal any of the evaluation stages and faculty will review and respond.
c. Students' peer evaluation accuracy is AI adjusted to reflect development of peer analysis and evaluation.

Data collection occurred three times during the spring 2024 semester with three weeks between each data collection. For each written analysis collaborative learning assignment ("mini case") data was collected from each student's initial submission graded by faculty member (critical thinking baseline), from 3-5 peer evaluations compared to faculty evaluations of the same 3-5 peers (higher level critical thinking and workplace skills), and from feedback on written evaluations from peers (higher level critical thinking and workplace skills). The collaborative learning software exports data into Excel spreadsheets for each analysis cycle.

Variables

Dependent variable 1 – critical thinking based on Bloom's taxonomy and measured by increased scores in remembering, understanding, apply, and analyze critical thinking levels.

Dependent variable 2 – workplace skills including conducting performance evaluations and measured by increased scores in remembering, understanding, apply, and analyze critical thinking levels.

Independent variable – peer to peer collaborative problem-based learning using asynchronous interactive software platform

Analysis Plan

Independent T-test was used to determine whether or not two population means are equal. **The test determines whether or not this difference in means is statistically significant.**

A paired samples t-test was used to compare the means of two samples when each mean observation in one sample (Pre - first collaborative learning assignment) can be paired with an mean observation in the other sample (Post -final collaborative learning assignment).

Cohen's D is calculated to determine the effect size. The effect size will quantify the impact of the statistical difference between two groups, indicating how large the difference is for practical significance.

- d = **0.20** indicates a **small** effect,
- d = **0.50** indicates a **medium** effect and
- d = **0.80** indicates a **large** effect.

FINDINGS

Paired T-tests were conducted to determine if there were mean differences in critical thinking from the first analysis to the third analysis involving collaborative learning assignments. The results identified several conditions where development of critical thinking was strengthened through collaborative learning using an integrated software facilitation platform. The data suggests that the collaborative learning environment advances lower-level critical thinking to higher order critical thinking. The null hypothesis was not supported. The data suggests that stronger critical thinking skills will transfer to practical workplace skills. The null hypotheses were not supported.

H01: Collaborative learning using software supported peer-to-peer evaluation will not increase critical thinking skills

Paired T-tests were conducted to determine if there were mean differences in critical thinking skills comparing critical thinking skills from the first and last analysis. The post mean critical thinking scores were higher than pre critical thinking scores and were not statistically significant. The difference between critical thinking scores pre (M=73.78, SD=16.86) and post (M=77.69 , SD=13.34) conditions; t(35) = -1.398, p= .171

Paired T-tests were conducted to determine if there were mean differences in higher level critical thinking (HLCT) skills comparing HLCT (Grading Score) between the first and last analysis opportunity. There was a statistical difference (≤.01) in HLCT skills after collaborative learning experience. The difference between workplace skills/accuracy peer evaluation scores pre (M=64.63 , SD=10.98) and post (M=71.36 , SD=10.88) conditions; t(33) = -2.902, p= .007

HO2: Collaborative learning will not transfer to practical workplace skills.

Independent T-tests were conducted to determine if there were mean differences between students with higher critical thinking and students with lower-level critical thinking and performance evaluation skills (Kritik Grading Score) for each analysis. For analysis #1 students with stronger critical thinking skills had higher workplace skill scores than students with lower critical thinking skills. The difference between workplace skills/accuracy of peer evaluation scores between higher critical thinking scores (M=68.75 , SD =9.06) compared to lower level critical thinking scores (M=60.89 , SD =12.04) conditions; t(26)= 2.12 , p = .044. Cohen's d effect size = .702 (strong effect). For analysis #2 students with stronger critical thinking skills had higher workplace skill scores than students with lover critical thinking skills. The difference between workplace skills/accuracy of peer evaluation scores between higher critical thinking scores (M =68.85, SD =4.85) compared to lower level critical thinking scores (M=49.88, SD =19.96) conditions; t(48) =2.65 , p =.011. Cohen's effect size = 1.023 (strong effect). For analysis #3 students with stronger critical thinking skills did not have higher workplace skill scores than students with lover critical thinking skills. The difference between workplace skills/accuracy of peer evaluation scores between higher critical thinking scores (M =66.8, SD =10.74) compared to lower level critical thinking scores (M= 71.36, SD =10.74) conditions; t(40) = -1.09 , p =.28. Cohen's effect size = -.393(minimal effect).

Independent T-tests were conducted to determine if there were mean differences between students with higher critical thinking scores and students with lower critical thinking scores comparing the value of their peer evaluations as motivating and constructive for each analysis. For analysis #1 students with stronger critical thinking skills had higher peer evaluation value scores than students with lower critical thinking skills. The difference between valued evaluation feedback of peer evaluation scores between higher critical thinking scores (M=88.13, SD =5.28) compared to lower level critical thinking scores (M=85.19, SD =5.82) conditions; t(36)= 1.452 , p = .155. Cohen's effect size = .519 (moderate effect). For analysis #2 students with stronger critical thinking skills had higher peer evaluation value scores than students with lower critical thinking skills. The difference between valued evaluation feedback of peer evaluation scores between higher critical thinking scores (M=92.67, SD =4.46) compared to lower level critical thinking scores (M=85.74, SD =5.58) conditions; t(39)= 3.56 , p = <.001. Cohen's effect size = 1.3(strong effect). For analysis #3 students with stronger critical thinking skills had higher peer evaluation value scores than students with lower critical thinking skills. The difference between valued evaluation feedback of peer evaluation scores between higher critical thinking scores (M=91, SD =4.1) compared to lower level critical thinking scores (M=91.62, SD =1.8) conditions; t(48)= 2.27 , p = .027. Cohen's effect size = .877 (strong size effect).

Paired T-tests were conducted to determine if there were mean differences in accuracy in evaluating peer performance (Grading Score) between the first and last analysis opportunity. There was a statistical difference (≤.01) in workplace skills after collaborative learning experience. The difference between workplace skills/accuracy peer evaluation scores pre (M=64.63 , SD=10.98) and post (M=71.36 , SD=10.88) conditions; t(33) = -2.902, p= .007

DISCUSSION

The results of the study support the hypothesis that higher order critical thinking skills transfer to stronger workplace skills of evaluation and assessment. The results also supported the hypothesis that collaborative learning will develop higher level critical thinking levels.

The results are consistent with the general findings on the development of critical thinking where mastery of lower levels (Bloom's remember, understand, apply) of critical thinking can further develop higher levels of critical thinking of Bloom's analyze, evaluate, create (Krathwohl, 2002; Shareef and Sadiq, 2023; Ragonis and Shmallo, 2019). The results are also consistent with the more narrow and less studied, application of software as a platform for collaborative learning (Altınay, 2017; Lee, Kim, Kim, 2014; Gizem, Yilmaz and Yilmaz, 2020; Rabu & Badlishah, 2020, Warsah,

Uyun, Hamengkubuwono, and Afandi, 2021). The results also are consistent with studies linking problem-based learning, collaborative learning, and critical thinking (Joham and Clarke, 2012; Tan, Vand der Molen, and Schmidt, 2016; Chulkov and Nizovtsev, 2015; Carvalho, 2016; Pike, Spangler, Williams, and Kollar,2017; Solcan, 2016; Sroufe, and Ramos, 2015; Stahl & Dunning, 2015a, 2015b).

The results are also consistent with studies on training transfer. A specific application of critical thinking in the workplace involves evaluating peers and subordinates in a human resource department, hiring manager, or team lead role. Training transfer, also identified as skill transfer, is effective when trainees can apply gained skills training to actual job context. This study's results align with studies on sustained learning and improved performance (Hughes, Zajac, Woods**,** and Salas, 2020; Noe et al., 2014).

CONCLUSIONS, LIMITATIONS, AND IMPLICATIONS FOR FUTURE RESEARCH

In conclusion, this collaborative learning approach, using a student engagement software platform, increases the opportunities for students to develop critical thinking skills. In one semester, students are engaged in critical thinking activities a minimum of 18 events for each of the three analysis assignments. The number of critical thinking events alone is a substantial improvement as a pedagogical approach to developing critical thinking. The collaborative learning software platform supports multiple opportunities for students to examine peer analysis work, provide detailed evaluations using a standardized evaluation rubric, include written feedback on performance to the rubric, and comment on peer evaluations' constructive and motivational value. Using the rating data provided by the software faculty can provide specific comments to students regarding developing their levels of critical thinking. Students can gauge their development in lower critical thinking levels and higher critical thinking levels throughout the semester. Collaborative learning using student engagement software is particularly useful for online asynchronous courses where peer to peer engagement is difficult to manage. The use of software supporting collaborative learning is an effective approach to pursuing AACSB learning outcomes and improving workplace skill gaps for recent graduates.

There are several limitations of the study to consider. First, the control was the first analysis assignment for the same student sample rather than a duplicate course with students not using the collaborative learning software. A control group made up of students not using the software would provide insight into the magnitude difference between students' critical thinking development. A second, and important, limitation was the study did not control for gender, GPA, previous performance in other similar management courses, student profile (non-traditional vs. traditional relative to working status), or differences between in-class and online asynchronous deliveries.

Implications for future research could include controlling additional confounding variables (gender, GPA, student profile, etc.). Including these variables would add value to the body of knowledge on developing critical thinking in higher education. Further research could be undertaken to test the difference between using collaborative software for different course modalities including in-class exercises, use of flipped exercises, and synchronous online courses. Studies examining the retention of improved critical thinking would add value to the body of knowledge on critical thinking. Also, studies could be performed examining the data and conclusions of a study using collaborative learning software with other standardized critical thinking assessments. Lastly, using trained artificial intelligence (AI large language models) to calibrate faculty and student evaluations or replace faculty evaluations could be beneficial to facilitating the time and effort to deliver high quality collaborative learning approaches.

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APPENDIX

Table 3: Critical Thinking Evaluation Matrix

	Novice ★	**Intermediate** ★★	**Proficient** ★★★	**Advanced** ★★★★
Concept (model or theory) understanding	Mentions model/theory in response but does not fully define the model	Fully defines models used for analysis	Demonstrates complete understanding of models with full definition and explanation of the model (discusses all components)	Demonstrates a thorough understanding of the model/theory by providing definition and robust explanation of the model including importance to management, all components, how the model works, outcomes when using the model
Application in workplace	No connection is made between model and workplace application referenced in article/case	Workplace application is discussed, and model is mentioned but not connected directly	Connection between model and workplace application is direct and covers the full model description	The workplace application is directly connected to the model using visual representation of the model 9table, etc.) to compare/contrast
Completed all assignment components	Some components of the assignment were not completed (i.e. not all questions answered)	All components were addressed but not all are full responses or address the model	All assignment components are addressed; full responses; supporting evidence from the article used in responses	All components addressed; full responses including description of model; use of article details to support responses; use of textbook to support the model; use of research articles, outlines, recorded lectures.
Organization of material into general business report formatting including headings, subheadings, bullets, graphics (tables, charts), APA citations	Submission does not have report formatting	The submission is minimally organized with some headings or bullets	The submission is organized effectively with business formatting adding value to the flow of material presented	The submission is organized effectively including graphics/visuals that assist in understanding concepts/models. The format adds value to the logic of the analysis

Table 5 Program Learning Outcomes

Bachelor of Science in Business (BSB) Program Learning Outcomes

- Demonstrate *business thinking* by applying general business concepts to strategic decision-making situations.
- Demonstrate *critical thinking* by exploring issues, ideas, and events before accepting or formulating conclusions.

BSB Learning Goals

1. *Business Thinking.* Students will be able to apply general business concepts to strategic decision-making situations.
2. *Critical Thinking***.* Students will be able to demonstrate the ability to explore issues, ideas, and events before accepting or formulating conclusions.
3. *Problem Solving*.* Students will be able to design, evaluate, and implement a strategy to answer an open-ended question or achieve a desired goal.

Course Learning Outcomes

1. Explanation of issues. Students will be able to critically state, describe, and consider an issue or problem
2. Evidence. Students will be able to use information from source(s) with enough interpretation/evaluation to develop a comprehensive analysis or synthesis.
3. Influence of context and assumptions. Students will be able to systematically and methodically analyze assumptions and carefully evaluate the relevance of contexts when presenting a position.
4. Define problem. Students will be able to construct a clear and insightful problem statement with evidence of relevant contextual factors.
5. Identify strategies. Students will be able to identify multiple approaches for solving problems within specific contexts.
6. Propose solutions. Students will be able to propose one or more solutions that indicates a comprehension of the problem and are sensitive to ethical, logical, cultural, and other contextual factors.
7. Evaluate potential solutions. Students will be able to evaluate solutions considering the history of the problem, logic / reasoning, feasibility, and impact of the solution.
8. Implement solution. Students will be able to implement (or suggest an implement) that addresses multiple contextual factors.
9. Evaluate outcomes. Students will be able to articulate, anticipate, or review results of the solution to the problem.
10. Human Resource Management. Students will be able to apply human resource management concepts to specific decision-making situations.

RESEARCH NOTES

ENHANCING DIGITAL MARKETING: INTEGRATING GENERATIVE AI INTO THE MARKETING-INFORMATION-KNOWLEDGE MODEL

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ABSTRACT

This qualitative study refines the MIK (Marketing, Information System, Knowledge) model, a robust systemic framework initially proposed in 2007 and updated in 2017 and 2020 to incorporate Web 3.0, social networks, and evolving digital tools. This research examines the integration of generative AI into marketing practices in 2025, exploring its impact on digital marketing, inbound marketing, and design thinking. Emphasizing the increasing importance of data reliability for robust AI applications, the findings introduce a novel "Generative AI Layer" to the MIK model, providing theoretical advancements and practical managerial strategies for leveraging AI to enhance marketing effectiveness.

INTRODUCTION

The Marketing-Information-System-Knowledge (MIK) model, first introduced in 2007 and refined in 2017 and 2020, has served as a systemic framework to integrate market insights, information systems, and customer knowledge for effective marketing practices. With the advent of Web 3.0, social networks, and digital tools, the model has evolved to address emerging technologies and shifting consumer dynamics. However, the 2020 iteration of the MIK model lacks integration of artificial intelligence (AI), particularly generative AI, missing critical opportunities to leverage its capabilities for personalization, content creation, and innovation in marketing strategies. This research gap underscores the need to update the MIK framework to reflect the transformative potential of generative AI in 2025, a period marked by rapid AI advancements and their growing influence on digital marketing, inbound marketing, and design thinking. This study aims to refine the MIK model by incorporating a "Generative AI Layer," exploring its impact on marketing practices and offering both theoretical and practical contributions. The paper is structured as follows: the literature review synthesizes recent studies on generative AI and its relevance to marketing and the MIK framework; the methodology outlines the qualitative approach used to investigate AI's role and impact; the findings present key insights from the analysis; the updated model introduces the revised MIK framework with the generative AI layer; and the discussion explores implications, limitations, and future research directions. Through this structure, the study seeks to advance the theoretical foundation of the MIK model and provide actionable strategies for marketers to harness generative AI effectively.

LITERATURE REVIEW

The Marketing-Information-System-Knowledge (MIK) model traditionally emphasizes the integration of market insights, information system role, and customer knowledge management to drive marketing effectiveness. However, the rapid evolution of artificial intelligence (AI), particularly generative AI, offers transformative capabilities such as content creation, predictive analytics, and personalization. This literature review synthesizes recent research to explore how generative AI can enhance the MIK model, justifying updates to its components—specifically, insight generation, strategy formulation, and execution processes. By integrating findings from contemporary studies, this review highlights the potential of generative AI to refine and augment the MIK framework.

Generative AI's Capabilities in Marketing

Generative AI, including large language models (LLMs) and other advanced systems, has emerged as a powerful tool for marketing applications. Arora et al. (2023) demonstrate that a human–LLM hybrid approach enhances efficiency and effectiveness in marketing research, particularly in qualitative tasks like data generation and analysis. LLMs can create sample characteristics, generate synthetic respondents, and moderate in-depth interviews, producing information-rich data that surpasses human-only efforts in depth and insightfulness. This capability directly benefits the MIK models for its market-M insight generation phase, where robust consumer data is critically feeding the Information-System-I with raw data, leading to a refined set of manageable information, later converted in knowledge-K, which accelerates the understanding, and potentially creation of the market needs by the marketing department.

In content creation, Schamp et al. (2023) note that off-the-shelf LLMs such as ChatGPT, Dall-E and Midjourney exhibit remarkable zero-shot capabilities, a term used in machine learning approach that enables models to classify new tasks without prior examples, allowing models to generalize and categorize data, based on large unlabeled datasets. This enables rapid generation of marketing content. However, they caution that training data from sources like Common Crawl (a nonprofit organization that crawls the web and freely provides its archives and datasets to the public) often lacks specific brand context or perceptual measures like brand image, suggesting a need for fine-tuning. This aligns with the MIK model's strategy formulation component, where tailored content based on the acquired knowledge is essential for effective campaigns.

Personalization is another key area. Zwanka et al. (2023) propose a regenerative AI (ReGenAI) model that uses context, time, and user awareness to generate personalized customer touch points in the Fast-Moving Consumer Goods (FMCG) sector. Their recursive approach provides deep insights into customer journeys, applying and enhancing the MIK model's execution phase by enabling dynamic, individualized marketing communications. Similarly, Ferraroa et al. (2023) explore virtual influencers created by generative AI, finding that diversity representation boosts novelty and likeability, mediating positive outcomes for brands and influencers. This suggests generative AI can refine execution strategies within the MIK framework by leveraging innovative, diverse digital personas.

Predictive analytics also benefit from generative AI. Arora et al. (2023) highlight that LLMs, enhanced by few-shot learning and retrieval-augmented generation (RAG), accurately predict answer direction and valence in quantitative research, improving synthetic data quality. This capability strengthens the MIK model's insight generation and strategy formulation, enabling data-driven predictions for market trends in outbound marketing.

Challenges and Considerations

Despite these advancements, challenges persist, particularly in branding activity. Schamp et al. (2023) emphasize the risk of bias in generative AI models trained on subjective marketing metrics, as internet-sourced data may not capture nuanced brand perceptions. This limitation suggests the MIK model's insight generation phase requires careful integration of AI to ensure data quality and relevance in regard to perceived brand image. Sarstedt et al. (2023) further explore silicon samples, noting their promise in pretesting and pilot studies but cautioning variability in main study results. This underscores the need to update the MIK model's research processes to balance human and AI inputs effectively.

Ethical concerns also arise. Belanche et al. (2023) address the dark side of AI in services, identifying potential negative impacts on privacy, social inequalities, and service interactions. These findings suggest the MIK model's execution phase must incorporate ethical guidelines to mitigate risks when deploying generative AI particularly in Services industry. Similarly, Campbella et al. (2023) discuss synthetic ads and deepfakes, proposing a framework to understand consumer responses to manipulated content. This highlights the need for the MIK model to adapt its strategy and execution components to address authenticity and trust in AI-generated advertising.

AI-Enhanced Creativity and Collaboration

Generative AI also unlocks marketing creativity. Pagani and Wind (2023) outline a framework where AI inspires agile methods, augments human creativity, and fosters unconventional thinking. By serving as an instrumental resource and a tool for exploring possibilities, AI can dramatically enhance the MIK model's strategy formulation, encouraging innovative campaign designs as well as nurturing their design thinking practice. Kim et al. (2023) further demonstrate that generative AI chatbots like ChatGPT boost user satisfaction and engagement through enjoyable, user-centered interfaces, supporting the MIK model's execution phase by improving customer interactions.

Applications in Diverse Contexts

Generative AI's versatility extends to niche applications. Dorasamy, Jun, Kaliannan, and Jambulingam (2023) show that ChatGPT enhances foreign language learning by providing personalized instruction, vocabulary expansion, and conversational practice. This adaptability suggests the MIK model's insight generation and execution phases could leverage generative AI for cross-cultural marketing strategies, a remarkable possibility that was unthinkable a few years ago. On the other hand, Kovács (2023) raises concerns about trust, noting that humans and AI detectors struggle

to distinguish AI-generated online reviews from human ones, impacting consumer trust. This necessitates updates to the MIK model's insight generation to ensure authenticity in feedback collection.

JUSTIFYING UPDATES TO THE MIK MODEL

The reviewed literature above justifies updating the MIK model in three key areas:

Insight Generation- the M part: Generative AI, as shown by Arora et al. (2023) and Sarstedt et al. (2023), enhances data collection and analysis, producing richer consumer insights and supporting synthetic data for pretesting. Integrating LLMs and RAG into this phase improves the accuracy and depth of market understanding.

Strategy Formulation: Schamp et al. (2023) and Pagani and Wind (2023) highlight generative AI's role in content creation and creative exploration, enabling tailored, innovative strategies. Updating this component ensures the MIK model leverages AI for dynamic, context-aware campaign planning.

Execution: Zwanka et al. (2023), Ferraroa et al. (2023), and Kim et al. (2023) demonstrate AI's ability to personalize touchpoints, deploy virtual influencers, and enhance user experiences. Incorporating generative AI here optimizes customer engagement and campaign delivery. This to update the "K" part of the MIK model

These updates address current limitations in the MIK model, such as static data collection and limited personalization, while mitigating risks like bias and ethical concerns through careful design and human oversight (Belanche et al., 2023; Campbella et al., 2023).

RESEARCH HYPOTHESIS

Based on the literature, generative AI's capabilities in content creation, predictive analytics, and personalization offer a compelling case for updating the MIK model. Thus, we propose the following qualitative research hypothesis:

H1: The productivity increase in marketing departments relies on the adoption and effective implementation of an updated AI-MIK model, leveraging generative AI to enhance insight generation, strategy formulation, and execution processes.

METHODOLOGY

This study adopts a qualitative research approach to refine the Marketing-Information-System-Knowledge (MIK) model by integrating generative AI, focusing on its impact on digital marketing, inbound marketing, and design thinking. The complexity of the MIK model, as a systemic framework, necessitates the use of systemic modeling approaches to preserve its original structure while effectively incorporating and exploring the influence of generative AI. Systemic modeling allows for a holistic examination of the interrelationships between market insights, information systems, and customer knowledge, ensuring that the addition of a "Generative AI Layer" aligns with the MIK framework's interconnected components. This approach facilitates a structured analysis of AI's transformative effects on marketing practices, maintaining consistency with the model's foundational design.

Given the theoretical and systemic focus of this research, traditional qualitative methods such as interviews and surveys were not employed. Instead, the study relies on a comprehensive review and synthesis of existing literature and case studies to model the integration of generative AI. As noted by Saunders et al. (2016), systemic modeling and literature-based research are well-suited for theory development and framework refinement, particularly when addressing complex, interrelated systems like the MIK model. Similarly, Yin (2014) emphasizes that qualitative research focused on theoretical advancement can effectively utilize existing data and structured analysis over empirical data collection methods like interviews, allowing for a robust exploration of conceptual updates. This methodology, therefore, leverages systemic modeling to map generative AI's impact on digital marketing, inbound marketing, and design thinking, ensuring a rigorous and consistent update to the MIK framework.

Findings

This section presents the key findings from the qualitative analysis aimed at refining the Marketing-Information-System-Knowledge (MIK) model by integrating generative AI. The results highlight the transformative impact of AI on marketing practices and the MIK framework, while identifying a critical concern regarding data reliability. The findings are organized into three subsections: themes, model insights, and validation.

Housing data

The Digital Information System is central to the MIK model, and over the years, tremendous progress in this domain has highlighted the crucial competencies required for structured databases, data lakes, and data warehouses to produce actionable knowledge for marketers. The challenge posed by the volume of unstructured data has been addressed by the data Lakehouse, a hybrid of data warehouses and data lakes, capable of extracting actionable insights from distributed sources (Harby &Zulkermine, 2025).

AI-Driven Personalization

Generative AI enables unprecedented levels of personalization in marketing by leveraging big data to create tailored content, recommendations, and customer experiences. Through advanced algorithms, AI analyzes consumer preferences, behaviors, and trends to deliver highly individualized campaigns, enhancing customer satisfaction and loyalty in digital marketing contexts.

Automation of Inbound Marketing

The automation of inbound marketing emerges as a key theme, with generative AI streamlining content creation, lead generation, and customer journey management. AI tools produce blogs, social media posts, and personalized emails at scale, reducing manual effort and improving efficiency while often attracting and nurturing leads effectively (Scheier and Held, 2024).

AI-Enhanced Design Thinking

Generative AI augments design thinking by accelerating ideation, prototyping, and testing phases. AI-generated visuals, simulations, and predictive models empower marketers to innovate rapidly, aligning solutions with customer needs and fostering creative, user-centric approaches in campaign and product design (Magistretti et al., 2024).

MODEL INSIGHTS

Generative AI strengthens three core components of the MIK model: Information System, the Marketing department of the Organization, and its environment, the market. Within the *Information System*, AI enhances data analytics by processing vast datasets to uncover actionable insights, improving decision-making precision. For the *Organization*, AI drives innovation by enabling rapid content generation and adaptive strategies, fostering a culture of agility and creativity (Böckle et al. 2023). In the *Environment*, AI boosts patron engagement through personalized interactions and dynamic responses to market shifts, deepening customer relationships. However, a primary concern arises with data reliability. As the updated AI-MIK model relies heavily on big data exploitation, it introduces challenges related to data safety, engulfed in trust. Inaccurate, biased, or fake data inputs risk undermining the authenticity of marketing outputs, potentially skewing strategies and eroding credibility (Lebovitz et al. 2021).

VALIDATION

These findings align with existing literature on AI's transformative role in marketing. Studies confirm AI's capacity to enhance personalization, automate processes, and drive innovative design, supporting the integration of a "Generative AI Layer" into the MIK model. However, the concern of data reliability echoes research highlighting the risks of biased or unverified data in AI-driven systems. The reliance on big data necessitates strict control of authenticity throughout the process to prevent outbound marketing and design thinking outputs from being misled by flawed inputs, ensuring the integrity of marketing strategies.

RECOMMENDATION AFTER FINDINGS

The findings demonstrate that generative AI significantly enhances the MIK model by advancing personalization, automation, and design thinking while strengthening its core components. However, the shift toward exploiting big data raises critical concerns regarding data reliability, safety, and trust, necessitating rigorous oversight to ensure authentic outputs. The literature review and prior modeling experience reveal that data management is now an upstream component of knowledge production within the MIK model. This paper addresses the model's update, which must rigorously integrate the data component. To achieve such rigor, we propose adopting elements of the Total Quality Management (TQM) approach, combined with its recognized complement, the International Organization for Standardization (www.iso.org) recommendations. For data stewards seeking to validate data quality within a TQM context, a hybrid approach integrating ISO 9001 and ISO 8000 is optimal. This involves leveraging ISO 9001 to establish a broad TQM framework and applying the Plan-Do-Check-Act (PDCA) cycle to structure data quality processes, while employing ISO 8000-150 for provenance tracking to ensure trustworthiness. Consequently, it is recommended that future applications of the AI-MIK model closely monitor its AI components, implementing robust data validation and verification processes to mitigate risks and uphold the integrity of marketing strategies.

UPDATED MIK MODEL

The AI-MIK model (Fig. 1) advances the original MIK framework by integrating a "Generative AI Layer" that connects the Market, Information System, and Knowledge sub-systems, revolutionizing data-driven inbound marketing. This conceptual framework positions generative AI as a cross-cutting influence, enhancing each domain: in the Market sub-system, it leverages data inputs (cookies, web logs, user activity, customer ratings) to refine targeting and content creation across channels like social networks, blogs, and apps; in the Information System, it powers a data integration layer (comprising data warehouses, data lakes, and AI agents) to process raw data into actionable information; and in the Knowledge sub-system, it transforms information into deep customer insights, predictive models, and personalized strategies via design thinking. The Generative AI Layer unifies these domains, applying Total Quality Management (TQM) principles per ISO 9001 and data quality standards from ISO 8000-150, while embedding the Plan-Do-Check-Act (PDCA) cycle for continuous improvement, and also, following the ISO 8000 recommendation, adding a position labeled as data manager within the organization. This originality addresses pre-AI limitations—such as fragmented data processing and inconsistent quality—offering a novel, AI-driven framework that ensures trustworthiness, transparency, and efficacy in inbound marketing, delivering a cohesive, data-centric approach to customer engagement.

DISCUSSION

Theoretical Contributions

This study advances the Marketing-Information-System-Knowledge (MIK) model by integrating a "Generative AI Layer," marking a significant theoretical contribution to marketing scholarship. By embedding generative AI, the AI-MIK model enhances the framework's capacity to process vast datasets, generate insights, and deliver personalized strategies. The AI-MIK model leverages generative AI to dynamically adapt to market shifts, refine insight generation, and innovate strategy formulation and execution. This evolution extends the MIK framework beyond its 2019 iteration, addressing prior limitations in handling emerging technologies and offering a robust, AI-driven approach to understanding and responding to complex consumer dynamics.

Systemic Integration of New Marketing Tools

The AI-MIK model applies systemic modeling to incorporate the newest tools accessible to marketers, creating a comprehensive yet user-friendly framework. By connecting the Market, Information System, and Knowledge sub-systems through a Generative AI Layer, the model holistically integrates tools like data lakehouses, AI-driven analytics, and automated content generation. This systemic approach ensures that generative AI enhances each component—refining data collection from diverse sources (e.g., cookies, web logs), processing raw data into actionable information via advanced algorithms, and transforming insights into knowledge for strategic decision-making. The simplicity of the AI-MIK model lies in its unified structure, which streamlines complex processes into a cohesive, accessible framework, empowering marketers to leverage cutting-edge tools effectively and consistently.

Managerial Implications

The AI-MIK model offers practical strategies for marketers to adopt generative AI across key areas. In content creation, AI tools enable rapid production of tailored blogs, social media posts, and visuals, reducing manual effort and enhancing campaign relevance. For customer relationship management (CRM), the model supports personalized touchpoints by analyzing consumer data to deliver individualized experiences, boosting satisfaction and loyalty (Zwanka et al., 2023). In innovation, generative AI augments design thinking, accelerating ideation and prototyping to align solutions with customer needs (Magistretti et al., 2024). Marketers can implement these strategies by investing in AI platforms, training teams on AI tools, and establishing data quality protocols per ISO 9001 and ISO 8000-150 to ensure reliable outputs. These approaches enable firms to optimize marketing effectiveness, adapt to trends, and foster competitive advantage.

Future Research

Future studies should focus on measuring generative AI's impact on marketing outcomes to validate the AI-MIK model's efficacy. Quantitative research could assess metrics such as campaign ROI, customer engagement rates, and conversion improvements driven by AI-enhanced personalization and automation. Longitudinal studies might explore how the AI-MIK model influences long-term brand loyalty and market share in dynamic contexts. Research should also address mitigating biases in AI-generated outputs, ensuring ethical deployment and alignment with consumer trust, as highlighted by Belanche et al. (2023).

CROSS-RESEARCH WITH ISO 30401 on KNOWLEDGE MANAGEMENT

The AI-MIK model holds potential for cross-research with managerial applications of ISO 30401, the standard for knowledge management systems. By integrating generative AI, the model enhances knowledge creation, sharing, and application—core principles of ISO 30401. Researchers could explore how the AI-MIK framework supports organizations in capturing market insights, processing them into actionable knowledge via AI, and disseminating findings to drive strategic decisions. For instance, applying the model's Generative AI Layer to ISO 30401's focus on knowledge flow could optimize CRM by personalizing customer interactions at scale. Cross-disciplinary studies might investigate how the AI-MIK model, combined with ISO 9001 and ISO 8000-150 for data quality, aligns with ISO 30401 to build robust, AI-driven knowledge management systems, offering managers a unified approach to leverage insights for innovation and competitiveness.

CONCLUSION

This study refines the Marketing-Information-System-Knowledge (MIK) model by introducing a "Generative AI Layer," advancing its theoretical foundation and practical utility for marketing scholars and practitioners. The AI-MIK model integrates generative AI to enhance insight generation, strategy formulation, and execution, leveraging capabilities like personalization, content creation, and predictive analytics to address the dynamic demands of digital marketing, inbound marketing, and design thinking in 2025. Far from disrupting or destroying the marketing domain, generative AI emerges as a powerful tool that empowers marketers, as demonstrated by the updated AI-MIK framework. This model, a stable and systemic description of the relationship between marketers and their environment, unifies the Market, Information System, and Knowledge sub-systems, enabling marketers to harness AI for deeper consumer insights, innovative strategies, and effective campaign delivery. By applying Total Quality Management principles and ISO standards (ISO 9001 and ISO 8000-150), the AI-MIK model ensures data reliability and trustworthiness, mitigating risks and reinforcing its efficacy. This research underscores generative AI's role as a transformative asset, not a threat, offering marketers a robust, adaptable framework to navigate complex market dynamics and drive sustainable success. The AI-MIK model's significance lies in its capacity to bridge theory and practice, providing a cohesive, AI-enhanced approach for future exploration and application in marketing.

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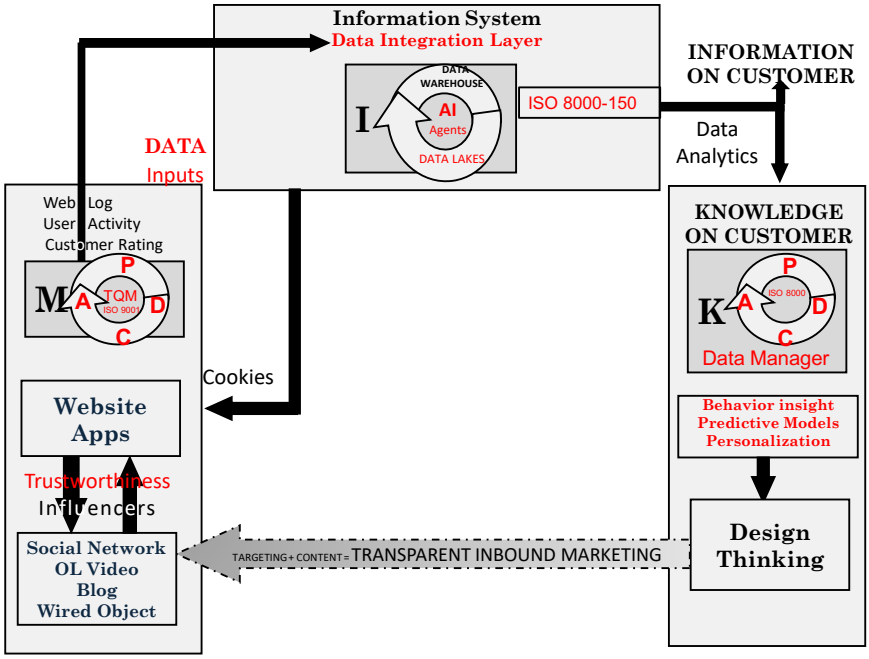
APPENDIX

Fig. 1: The AI-MIK model



HOW DO SMALL BUSINESSES IMPACT THE ECONOMY?

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ABSTRACT

Extensive research underscores the critical role small businesses play in fostering economic prosperity. These enterprises not only stimulate competition in emerging industries but also drive innovation and economic growth across diverse regions. This paper presents empirical evidence drawn from state-wide survey data on small businesses collected between 1999 and 2019 in New York, New Jersey, Pennsylvania, and Massachusetts. The study explores how small business employment and output influence the economic performance of these states, particularly in labor and product markets. The research highlights that very small businesses offer numerous macroeconomic benefits often championed by advocates of small enterprises. States with a higher concentration of extremely small businesses (10–19 employees) tend to have a more efficient workforce and experience greater GSP growth compared to those dominated by medium-sized businesses. Interestingly, New York, characterized by a high density of extremely small businesses, stands out with lower levels of wage inflation and reduced unemployment rates. As a result, macroeconomic policies and strategies tend to have a more positive impact in states with a significant presence of extremely small businesses, particularly when coupled with a workforce that includes marginally skilled workers.

INTRODUCTION

Small businesses (SB) play a crucial role in the United States (U.S.) economy. With over 27 million SBs generating approximately 50% of the country's Gross Domestic Product (GDP) (Office of Advocacy, 2010), these enterprises have significantly shaped the business landscape. Notable SB founders, such as Henry Ford and Thomas Edison, have secured their places in history, while contemporary figures like Bill Gates (Microsoft), Sam Walton (Wal-Mart), Steve Jobs (Apple), Michael Dell (Dell, Inc.), Steve Case (AOL), and Larry Page and Sergey Brin (Google) have transformed modern business practices. Collectively, millions of other small business founders have contributed to the nation's standard of living.

Despite their impact, small businesses often receive less attention in the business world compared to large corporations, which dominate media coverage with their profit and loss data, new products, and corporate scandals. However, small businesses make up 99% of all U.S. businesses and are essential to the American economy.

Over the past two decades, extensive research has highlighted the importance of small businesses in driving economic prosperity. New businesses not only enhance competition in emerging sectors but also contribute to economic growth and innovation across various regions. Key political interests in entrepreneurship include job creation, economic growth, and poverty reduction (Battilana & Casciaro, 2012; Willis, 2011).

This paper provides empirical evidence based on state-wide survey data of small businesses from 1999 to 2019, focusing on medium-sized (100-499 employees) and small-sized (10-19 employees) enterprises in New York (NY), New Jersey (NJ), Pennsylvania (PA), and Massachusetts (MA). The study examines the impact of small business employment and output on these states' economic performance, particularly in labor and product & service markets. These states share similar characteristics, including a high level of urbanization along the Atlantic Coast, racial diversity, significant immigrant populations, and temperate climates.

Our analysis explores the relationship between small business employment and economic variables such as productivity, Gross State Product (GSP), unemployment, and wage inflation. The findings indicate that small firms drive economic growth, with increased shares of small business employment correlating with higher productivity and GSP growth, lower wage inflation, and reduced unemployment rates.

The paper is organized as follows: Section 2 reviews the literature on the benefits of small businesses in product and labor markets. Section 3 outlines the research model, methodology, and data. Section 4 presents the main empirical results. Section 5 offers conclusions.

LITERATURE REVIEW

The literature on small business performance spans two key macroeconomic aspects: product/service market effects and labor market effects, encompassing productivity, innovation, unemployment, and wage inflation.

In the U.S., researchers have long studied small and medium-sized enterprises (SMEs) and recognize the need for SMEs to postulate strategies to compete and succeed in the global market. Higon and Bonvin (2024) research examines the impact of digitalization on the participation of SMEs in export and import activities. They find that productivity has a stronger impact on SMEs' trade behavior than the direct channel of digitalization. Belitski et al (2022) shed light on the economic effects of the COVID–19 pandemic by looking at the macro and microeconomic effects on entrepreneurship and small businesses as well as the role of financial support policies and well-being in both developed and developing countries. Burke and Cowling (2020) explored the extent and manner in which freelancers create value-added and affect net job change for employees. Stephie Mansion and Andreas Bausch (2020) perform a meta-analysis to synthesize empirical evidence from 167 studies on the role of human and relational capital endowments in different dimensions of export behavior.

According to them, SMEs are perceived to be a major societal asset and play a dominant role in fostering socioeconomic prosperity. Dabic et al (2020) research report that SMEs and international entrepreneurs are increasingly fueling economic growth and innovation, and these trends are presenting both opportunities and challenges to both multinational corporations and SMEs in the global arena. Karami, Wooliscroft, and McNeill (2020) review the SME internationalization literature to clarify the way effectual theory helps international entrepreneurship scholarship. Exposito and Sanchis-Llopis (2020) analyze the role of different types of innovation in the internationalization process of SMEs. Malca, Pena-Vinces, and Acedo (2020) focus their analysis on the joint impact of both external and internal factors on the export performance of SMEs. Conroy and Weiler (2016) research uses an economic growth framework to analyze the impacts of male- and female-owned forms on economic performance. Prabal and Nagaraj (2014) research on manufacturing firms in India found that firms in the lowest quintile of the asset distribution that invest in research and have better liquidity are the most productive. Research by Armstrong and Read (2002) argues that small island states growth performance is greatly constrained by their vulnerability to exogenous shocks because of their size.

Small businesses with fewer than 500 employees, particularly in accommodation, food services, and retail trade, employ the most workers. However, small business employees tend to be more financially vulnerable than those in large firms. The Bureau of Labor Statistics reports that fewer small business employees have access to benefits such as retirement plans, healthcare, paid sick leave, life insurance, or disability insurance.

In the manufacturing sector, small businesses create jobs at rates comparable to the service industry. Flexible production technologies have enabled small manufacturing firms to innovate and boost productivity (Bednarzok, 2000; Acs & Audretsch, 1990, 1993; Carlsson, 1989, 1990). Additionally, small businesses exhibit higher levels of innovation than larger firms, playing a vital role in technology development and transfer (Holton, 1965; Acs & Audretsch, 1998; Pratten, 1991; Almeida & Kogut, 1997). The U.S. Small Business Administration highlights the importance of "churning" – the continuous creation and dissolution of businesses – for injecting new ideas into the economy, thereby benefiting the states and the nation (Headd, 1998).

Balkenhol's (1990) study indicates that small businesses utilize production factors more economically than large enterprises, particularly through the employment of unskilled labor in developing countries. Small businesses convert unproductive family savings into constructive investments and serve as practical training grounds for future national entrepreneurs. Their agility in responding to market fluctuations, coupled with job creation capabilities, makes labor costs more of a fixed than a variable expense (Heneman et al., 2000). Furthermore, small businesses enrich worker talents through informal on-the-job training, offering a more diverse skill set compared to the specialized training prevalent in large corporations (Bowles, 1994).

According to the U.S. Small Business Association (SBA) 2019 report, small businesses account for 44% of economic activity in the United States, create two-thirds of new jobs, and contribute 43.5% of the GDP. Small businesses also

lead in innovation, producing 16 times more patents per employee than large firms. They reflect the diversity of the U.S. population, with 36% owned by women, 9% by veterans, and 14.6% by people of color, including 2.3 million Latinx, 109 million Black, and 1.6 million Asian business owners.

Small businesses significantly impact employment. The U.S. Small Business Association reports that businesses with 500 or fewer employees comprise 99.9% of all U.S. businesses and 99.7% of firms with paid employees. From 1995 to 2020, small businesses created 62% of new jobs (12.7 million) compared to 7.9 million by large enterprises. However, small businesses often offer lower wages, with Solomon (1986) finding they pay on average 20% less than big businesses, which can stifle wage inflation.

Small businesses not only provide more jobs but also contribute to local economies by reinvesting through paychecks and taxes, supporting the creation of new businesses, and improving public services. They serve as less expensive suppliers of component parts for large businesses and optimize labor and capital utilization by engaging the secondary labor market, which includes first-time job seekers, the long-term unemployed, part-time workers, specific minority groups, immigrants, and short-term employees. This makes small businesses a crucial conduit for integrating millions into the economic and social fabric of the U.S. (Acs, 1999).

Aside from general economic contributions, small business founders drive growth and vitality in specific areas of economic and socioeconomic development. Small businesses can adapt more readily to customer needs and market changes, providing insulation against economic downturns (Binks & Jennings, 1986; Bednarzik, 2000). This adaptability allows small businesses to buffer the economy during recessions and act as a stabilizing force during inflationary periods (Solomon, 1986).

Studies consistently show that small businesses are generally more innovative than large ones (Bannock, 1981; LaFalee, 1990; Almeida & Kogut, 1997). They attract talent and bring new solutions to business practices that larger corporations may struggle to incorporate. The ability to develop and transfer technology is a distinct advantage of small firms. While a strong economy supports both large and small businesses, no society can thrive without the presence of small businesses.

Politically, small businesses are seen as central to economic development and employment opportunities (Kempnich et al., 1999). Promoting small businesses based on local requirements is expected to improve wealth distribution, participation, and democracy. Development should promote equitable distribution of economic and non-economic factors (Sivard, 1991). Small, labor-intensive businesses can prevent the concentration of investment seen with large, capital-intensive enterprises, leading to broader asset ownership and higher income and investment distribution.

METHODOLOGY AND MODEL

This research employs simultaneous equations to estimate the relationships between various economic indicators. Specifically, two pairs of simultaneous equations are estimated, addressing the joint determination of GSP growth and productivity growth, as well as unemployment rates and wage inflation. The simultaneous equations technique is equivalent to a three-stage least squares estimation with instrumental variables.

The first set links GSP growth with productivity growth in the output market. The second set focuses on estimating rates of unemployment and annual percentage change in wage inflation in the labor market. Each equation contains a constant, the lagged dependent variable, and a feedback factor (the dependent variable from the other equation). Small business employment is an independent variable in both pairs of equations. We estimate these pairs for firms with 10-19 employees and those with 100-499 employees, based on SBA classifications, using data from 1999-2019 for four states: NY, NJ, PA, and MA.

The first pair of equations examines the linkage between GSP growth and productivity growth. The empirical model for the joint determination of productivity growth and GSP growth in the output market can be written as follows:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 sb_t + \alpha_3 g_t + \alpha_4 u_{t-1} + \alpha_5 w_t + e \quad (1)$$

$$g_t = \beta_0 + \beta_1 g_{t-1} + \beta_2 y_t + e \quad (2)$$

Where y_t is the annual productivity growth rate (measured as the annual percentage change in the ratio of GSP/employment), g_t is the annual growth of the GSP. y_{t-1} and g_{t-1} are the lags of the dependent variables. sb is the percentage of the employed in small businesses. u_{t-1} is the annual lagged unemployment rate. w_t represents the annual changes in wages and e is an error term. Incorporating lagged variables is a control for autocorrelation and provides a measure of persistence. The feedback terms in both equations are expected to be positively correlated to the dependent variable.

We expect the sb to have a positive effect on productivity. Small businesses have advantages in utilizing production factors more economically than large enterprises, through their exploitation of unskilled laborers. By their nature, they can react to market fluctuations faster than their counterparts. Small businesses grow because they draw innovation, attracting talent that brings inventions or new solutions to old ways of doing business that larger corporations have less flexibility to incorporate.

The unemployment rate has a positive effect on productivity if the remaining employed continue to produce the same level of output. In any event, when unemployment rates increase, the remaining employed workers are less likely to shirk. Instead, they employ greater effort into their job, so they do not get laid off (Shapiro and Stiglitz, 1985).

Small business firms create low-wage jobs. Researchers find that small businesses on average pay 20 percent lower wages than big businesses (Solomon, 1986). An increase in wages is expected to have a positive effect on productivity. Compensating workers above market wages, also called efficiency wages, results in more effort, less shirking, and less turnover by workers (Katz, 1986; Addison and Hirsch, 1989).

The second set of simultaneous equations attends to the joint determination of unemployment and wage inflation.

$$w_t = \alpha_0 + \alpha_1 u_t + \alpha_2 sb_t + \alpha_3 g_t + e \quad (3)$$

$$u_t = \beta_0 + \beta_1 u_{t-1} + \beta_2 g_t\text{-}1 + \beta_3 w_t + e \quad (4)$$

Where w_t represents the annual changes in wages; u_t is the annual unemployment rate; u_{t-1} is the annual lagged unemployment rate; g_t is the annual growth of the GSP; g_{t-1} is the lagged annual growth of GSP; sb is the percentage of the employed in small businesses; and e is an error term. Including lagged variables is a control for autocorrelation and provides a gauge of persistence.

Small business firms create low-wage jobs. Solomon (1986) notices that small businesses on average pay 20 percent lower wages than big businesses. This is frequently quoted as a positive benefit as it creates a stifling effect on wage inflation. Whereas big businesses pass their costs on to the consumers in the form of higher prices, small businesses' reaction to inflation is to make workers work harder to absorb the cost of higher resource costs. We expect SB to be negatively associated with wage inflation.

Equation 3 captures the Phillips curve relation (Phillips, 1958), expecting a negative correlation between unemployment and wage inflation. The Phillips curve posits that rising wages should lead to higher prices for products and services in an economy, ultimately pushing the overall inflation rate higher. A negative coefficient of sb in the wage inflation equation is empirical evidence that small businesses lower the state's Phillips curve.

We expect that an increase in the state's GSP will lead to an increase in wage inflation. Evidence in the past (Feldstein, 1998), as well as in the 2020s, indicates that increases in the GSP have led to a tighter labor market, and thus an increase in wages.

The lagged unemployment rate in Equation 4 is expected to have a negative impact on GSP growth (Okun, 1962). The coefficient of the lagged unemployment rate estimates the speed of adjustment for unemployment rates. If this coefficient is one or closer to one, it means the adjustment process is slower.

RESULTS OF TABLE 1 (a-d)

The regression analysis results are presented in Table 1a (NY), 1b (NJ), 1c (PA), and 1d (MA). Columns 1 and 3 detail the simultaneous analysis of productivity growth and GSP growth, using small business employment by firms with 10-19 employees (column 1) and by firms with 100-499 employees (column 2).

Table 1a: New York Output market estimates (standard error in parenthesis)

	sb 10-19 employees Productivity growth (y_t)	**sb 100-499 employees Productivity growth (y_t)**	**GSP growth (g_t)**
Constant	17.57 (7.98)**	8.72 (19.40)	0.98 (0.34)***
Lagged Dep	0.08 (0.10)	0.14 (0.11)	0.19 (.12)
sb	-2.58 (1.24)**	-1.12 (2.87)	
Feedback	1.30 (0.12)***	1.22 (0.13)***	0.67 (0.11)*
U_{t-1}	-0.21 (0.12)*	-0.26 (0.13)*	
w_t	-0.44 (0.08)***	-0.39 (0.10)***	
Adjusted R^2	0.8663	0.8273	0.6491

*** Significant at .01; ** significant at .05; * significant at .10

Table 1b: New Jersey Output market estimates (standard error in parenthesis)

	sb (10-19 employees) Productivity growth (y_t)	**sb (100-499 employees) Productivity growth (y_t)**	**GSP growth (g_t)**
Constant	-4.30 (12.14)	-13.33 (0.29)	0.81 (0.35)**
Lagged Dep	-0.19 (0.18)	-0.28 (0.16)	0.15 (0.15)
sb	1.81 (3.98)	4.93 (0.25)	
Feedback	0.65 (0.18)***	0.62 (0.002)	1.09 (0.21)***
U_{t-1}	-0.14 (0.12)	-0.11 (0.33)	
w_t	-0.39 (0.23)*	-0.37 (0.10)	
Adjusted R^2	0.6130	0.6446	0.5702

*** Significant at .01; ** significant at .05; * significant at .10

Table 1c: Pennsylvania Output market estimates (standard error in parenthesis)

	sb 10-19 employees Productivity growth (y_t)	**sb 100-499 employees Productivity growth (y_t)**	**GSP growth (g_t)**
Constant	-5.49 (7.33)	-3.70 (5.49)	0.72 (0.48)
Lagged Dep	-0.47 (.18)***	-0.41 (0.19)**	0.04 (0.18)
Sb_t	1.89 (1.77)	1.33 (1.20)	
Feedback	0.66 (0.16)***	0.58 (0.15)***	0.90 (0.24)***
U_{t-1}	-0.31 (0.14)**	-0.24 (0.13)*	
w_t	-0.20 (0.20)	-0.21 (0.20)	
Adjusted R^2	0.5979	0.6000	0.4049

*** Significant at .01; ** significant at .05; * significant at .10

Table 1d: Massachusetts Output market estimates (standard error in parenthesis)

	sb 10-19 employees Productivity growth (y_t)	sb 100-499 employees Productivity growth (y_t)	GSP growth (g_t)
Constant	-17.79 (10.17)	3.48 (10.61)	1.13 (0.59)*
Lagged Dep	0.20 (0.16)	0.31 (0.20)	0.08 (0.17)
sb	7.55 (4.12)*	-0.98 (3.78)	
Feedback	0.91 (0.26)***	0.84 (0.29)***	0.78 (0.21)***
U_{t-1}	-0.15 (0.17)	-0.18 (0.20)	
w_t	-0.29 (0.22)	-0.32 (0.26)	
Adjusted R^2	0.5525	0.4479	0.3880

*** Significant at .01; ** significant at .05; * significant at .10

For very small businesses (10-19 employees), small business employment positively impacts productivity growth in NJ, PA, and MA, but negatively and significantly in NY. NY tends to hire more from the secondary labor market potentially paying lower wages which results in higher worker turnover and lower productivity. For medium-sized businesses (100-499 employees), the effect is positive in NJ and PA but negative in NY and MA. States that promote small business employment see productivity growth increases, particularly when they focus on very small businesses. States that support the expansion of small business employment experience accelerated productivity growth, especially when targeting micro-enterprises. Consequently, states that nurture small businesses see faster growth compared to those relying heavily on large corporations. Additionally, there is a significant correlation between productivity growth and Gross State Product (GSP) growth. An increase in GSP positively reinforces productivity growth and enhanced productivity consistently correlates with GSP growth across all four states.

The lag coefficient associated with GSP reveals the enduring nature of this growth trend, indicating a fundamental growth rate inherent within GSP. The adjustment period varies, with 19% of the previous period's growth carrying over in New York, 15% in New Jersey, 4% in Pennsylvania, and 8% in Massachusetts.

Lagged unemployment rate and wage inflation are included as control variables to account for labor market dynamics. An increase in unemployment results in decreased productivity in all four states, indicating a negative relationship between unemployment and productivity growth. Wage inflation is also negatively associated with productivity growth in all four states.

RESULTS OF TABLE 2 (a-d)

The results from the second set of regressions (equations 3 and 4) are presented in Table 2a (NY), 2b (NJ), 2c (PA), and 2d (MA). Columns 1 and 2 show the simultaneous analysis of unemployment rates and wage inflation for small businesses with 10-19 employees. Column 3 replicates the estimation using the small business variable derived from employment within firms employing 100-499 individuals.

Table 2a: New York Labor market estimates (standard error in parenthesis)

	unemployment rate (U_t)	**sb 10-19 employees wage inflation (w_t)**	**sb 100-499 employees wage Inflation (w_t)**
Constant	1.83 (0.69)**	56.38 (18.22)***	19.74 (36.69)***
U_{t-1}	0.81 (0.11)***		
g_{t-1}	-0.04 (0.11)		
Feedback	-0.22 (0.07)***	-0.68 (0.31)**	-0.46 (0.32)
sb_t		-7.79 (2.88)***	-16.95 (5.52)***
g_t		0.70 (0.32)**	0.54 (0.31)*
Adjusted R^2	0.8036	0.4323	0.4788

*** Significant at .01; ** significant at .05; * significant at .10

Table 2b: New Jersey Labor market estimates (standard error in parenthesis)

	unemployment rate (U_t)	**sb 10-19 employees wage inflation (w_t)**	**sb 100-499 employees wage Inflation (w_t)**
Constant	3.12 (1.15)**	-8.16 (12.88)	-2.63 (11.66)
U_{t-1}	0.70 (0.14)***		
g_{t-1}	-0.10 (0.13)		
Feedback	-0.50 (0.17)***	-0.13 (0.14)	-0.13 (0.14)
sb_t		3.59 (4.16)	1.88 (3.93)
g_t		0.34 (0.15)**	0.39 (0.14)*
Adjusted R^2	0.7628	0.4490	0.4314

*** Significant at .01; ** significant at .05; * significant at .10

Table 2c: Pennsylvania Labor market estimates (standard error in parenthesis)

	unemployment rate (U_t)	**sb 10-19 employees wage inflation (w_t)**	**sb 100-499 employees wage Inflation (w_t)**
Constant	3.33 (1.04)***	-7.78 (9.18)	-2.60 (5.89)
U_{t-1}	0.68 (0.13)***		
g_{t-1}	-0.06 (0.12)		
Feedback	-0.49 (0.16)***	-0.44 (0.16)***	-0.38 (0.14)***
sb_t		2.97 (2.26)	1.61 (1.37)
g_t		0.39 (0.14)***	0.29 (0.15)*
Adjusted R^2	0.7476	0.4697	0.4590

*** Significant at .01; ** significant at .05; * significant at .10

Table 2d: Massachusetts Labor market estimates (standard error in parenthesis)

	unemployment rate (U_t)	**sb 10-19 employees wage inflation (w_t)**	**sb 100-499 employees wage Inflation (w_t)**
Constant	2.36 (0.86)***	-1.88 (10.90)	8.93 (7.92)
U_{t-1}	0.73 (0.12)***		
g_{t-1}	-0.07 (0.10)		
Feedback	-0.25 (0.08)***	-0.23 (0.20)	-0.24 (0.20)
sb_t		1.71 (4.54)	- 2.44(2.83)
g_t		0.94 (0.17)***	0.93 (0.16)***
Adjusted R^2	0.7865	0.7074	0.7180

*** Significant at .01; ** significant at .05; * significant at .10

For both small and medium-sized businesses in New York, and for medium-sized businesses in Massachusetts, employment by small businesses significantly negatively impacts wage inflation. States promoting the expansion of small business employment experience a more pronounced reduction in wage pressure, supporting the idea that small businesses tend to hire from the secondary labor market. These employees may receive lower wages due to potentially marginal skill levels or limited commitment to the labor market. In New Jersey and Pennsylvania, the results do not provide clear evidence of the inverse relationship between unemployment and inflation. An increase in small business employment increases wage inflation, though not significantly. This could be due to productivity improvements as a result of the large-scale adoption of technology and demographic changes in the labor force, with more aging baby boomers and fewer workers from the secondary labor market. Because wages are an important component of a firm's costs, a booming labor market may signal higher inflationary pressure.

Wage inflation exerts negative feedback on the unemployment rate. As expected, the findings show that the lagged growth measure of GSP negatively influences unemployment rates across all four states. The lagged coefficient of the unemployment rate within the unemployment equation suggests that unemployment rates adjust relatively slowly (0.81 in NY, 0.70 in NJ, 0.68 in PA, and 0.73 in MA).

The coefficient of the unemployment rate (feedback) within the wage inflation equation reflects the slope of the traditional Phillips curve. According to column 2, a one percentage point reduction in unemployment leads to a wage inflation increase of 0.68 in NY, 0.13 in NJ, 0.44 in PA, and 0.23 in MA. Similarly, based on column 3, a one percentage point decrease in unemployment results in a wage inflation rise of 0.46 in NY, 0.13 in NJ, 0.38 in PA, and 0.24 in MA.

CONCLUSION

This paper investigates the impact of small business employment on economic activity at the state level in NY, NJ, PA, and MA. The research reveals that extremely small businesses yield many macroeconomic advantages advocated by small enterprise supporters. States with a higher proportion of extremely small businesses (10-19 employees) exhibit a more efficient workforce and higher rates of GSP growth compared to medium-sized businesses. Notably, only New York, abundant in extremely small businesses, demonstrates lower levels of wage inflation and reduced unemployment rates. Consequently, macroeconomic policies and strategies have a more beneficial impact on states with a substantial presence of extremely small businesses along with the presence of marginal-skill workers.

Small businesses are increasingly recognized as the backbone of urban economies, especially since the Great Recession. However, city leaders and economic developers often do not prioritize small businesses in their economic growth plans, focusing instead on attracting and retaining large businesses. Despite providing numerous benefits to the economy, small businesses do not receive the same government support as large corporations. They do not receive the same tax breaks, local and state incentives for production facilities, or research and development support. Large companies can receive federal bailout money in times of financial turmoil, an option not available to small businesses. Small businesses bring jobs and revenue to local economies by offering jobs, and local products, paying sales and property taxes, and using local vendors and supporting services. An SBA study shows that for every dollar spent at a small business, 68 percent funnels back into the community, compared to 46 percent from large businesses.

Data Sources

1. Small business was defined in two ways, an independently owned and operated firm with fewer than 20 employees, and one with less than 500 employees.
2. Data on employment and unemployment are taken from the U.S. Department of Labor, Bureau of Labor Statistics.
3. Gross State Product (GSP) data are from the U.S. Department of Commerce, Bureau of Economic Analysis.
4. Wage rate data are from the U.S. Department of Labor, Employment, and Training Administration.

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SPECIAL FEATURE ARTICLE

THE JOURNAL OF BUSINESS, ECONOMICS, AND TECHNOLOGY: AUTHORSHIP AND IMPACT

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ABSTRACT

This paper provides statistics regarding who publishes in the *Journal of the Northeastern Association of Business, Economics, and Technology* (the *Journal*), what topics appear most often in the *Journal*, and an accounting of how often papers published in the *Journal* have been cited. We find that what was once a provincial publication has significantly expanded its footprint in the Northeastern United States and shows signs that it is expanding outside of that region and even internationally. We also find significant growth in citations over the *Journal's* life span.

INTRODUCTION

The *Journal of Business, Economics and Technology* (the *Journal*) was first published in 1989, and at that time titled the *Pennsylvania Journal of Business and Economics* (PJBE). The *Journal* published under this name from its inception through 2006. In 2007, the non-profit sponsoring organization (run entirely by volunteers), the Association of Pennsylvania Business and Economics faculty (APUBEF) changed its name to the Northeastern Association of Business, Economics and Technology (NABET). The reason for the name change was that it had successfully broadened its reach beyond the Pennsylvania State System of Higher Education (PASSHE). As a result, the *Journal* was re-branded as well in 2007 as the *Northeastern Journal of Business, Economics and Technology*. However, the *Journal's* new name lasted only one year. In 2008 the *Journal's* name was changed to the *Journal of the Northeastern Association of Business, Economics and Technology*. That name lasted until 2017 when the *journal* got its current name, *Journal of Business, Economics and Technology*.[1] In 2009, Kramer, Roth, and Walker traced the evolution of the *Journal* over its first 20 years and concluded that the *Journal* had evolved significantly in its first 20 years by attracting editors and authors from outside of PASSHE, listing in Cabell's, and improving the quality of scholarship published in the *Journal*. Now that the *journal* is approaching 40 years old, and with the recent emphasis being placed on "impact" by various accrediting bodies, this paper looks at the continued evolution of the *Journal* as well as indicators of its impact.

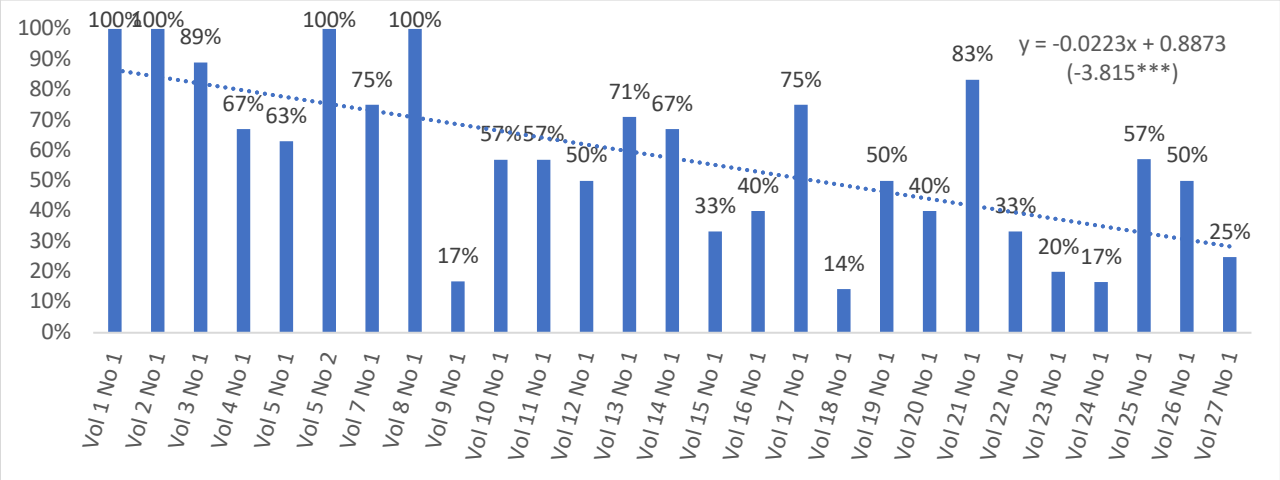
HISTORY OF THE *JOURNAL*

The *Journal* has published 27 times over the last 34 years for an average of one issue approximately every 1.25 years (there were 10 years with no issues (1990, 1991, 1994, 1996, 1998, 1999, 2003, 2012, 2014, and 2015) and one year with two issues (1997). The *Journal* began in an era when the leaders and members of the sponsoring organization were primarily from PASSHE universities, and the *Journal* reflected that. The editor of the first issue as well as all authors were employed by PASSHE. The following two issues included a written policy that "a minimum of one author must be a member of Pennsylvania's State System of Higher Education." By the fourth issue, the policy had been somewhat relaxed but remained provincial – "High priority is given to the studies that address and emphasize the problems or issues deemed significant to Pennsylvania." The fifth and sixth issues (both published in 1997) maintained the provincial tone with a statement that the editors believe that "… the journal would be a natural instrument for Pennsylvania topics, pedagogical developments, or conceptual papers that appear to have no other outlets." The limiting effect of these early policies (1989-1997) is reflected in the author affiliations over this period with 81% of listed author affiliations being from PASSHE universities. From the years 2000 through 2024, no such limiting policies existed and the percentage of authors with PASSHE affiliations fell to 42%, and *lead* author affiliations fell from 87% to 46% during this period. Figures 1 and 2 illustrate the statistically significant decrease in PASSHE author affiliations over the life of the *Journal*. In the most recent issue (2024) only 22% of author affiliations are from PASSHE universities and only 25% of lead author affiliations are from those institutions.[2] This is most

[1] The Journal has never charged a fee for publication, is staffed by volunteers, and the current submission fee is $20.
[2] Since 2017, the Journal has included a section titled Research Notes. The editorial notes describe these as "…published to encourage the further development of work that cannot be considered as full research or methodology articles." The Research notes have not been included in the statistics compiled for this paper.

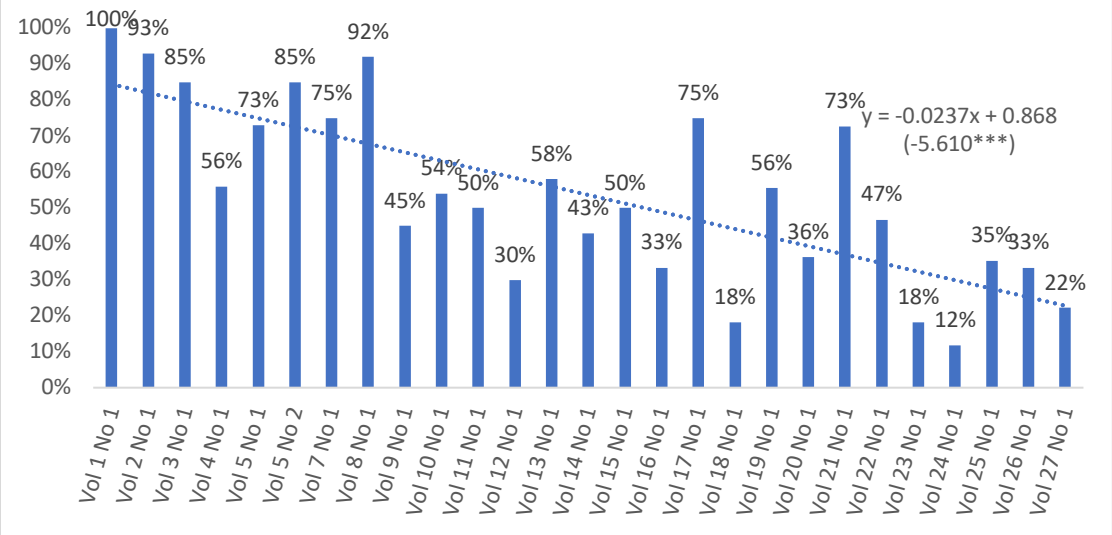
likely the result of the *Journal* being listed in Cabell's Directory of Publishing Opportunities (now known as Cabells Journalytics Academic) since 2002 (Volume 9), and NABET's successful efforts to attract people from beyond PASSHE to its annual meetings.

Figure 1: **Percent of Lead Author Affiliations from PASSHE Institutions**



* Significant at the 0.10 level
** Significant at the 0.05 level
*** Significant at the 0.01 level

Figure 2: **Percent of Author Affiliations from PASSHE Institutions**

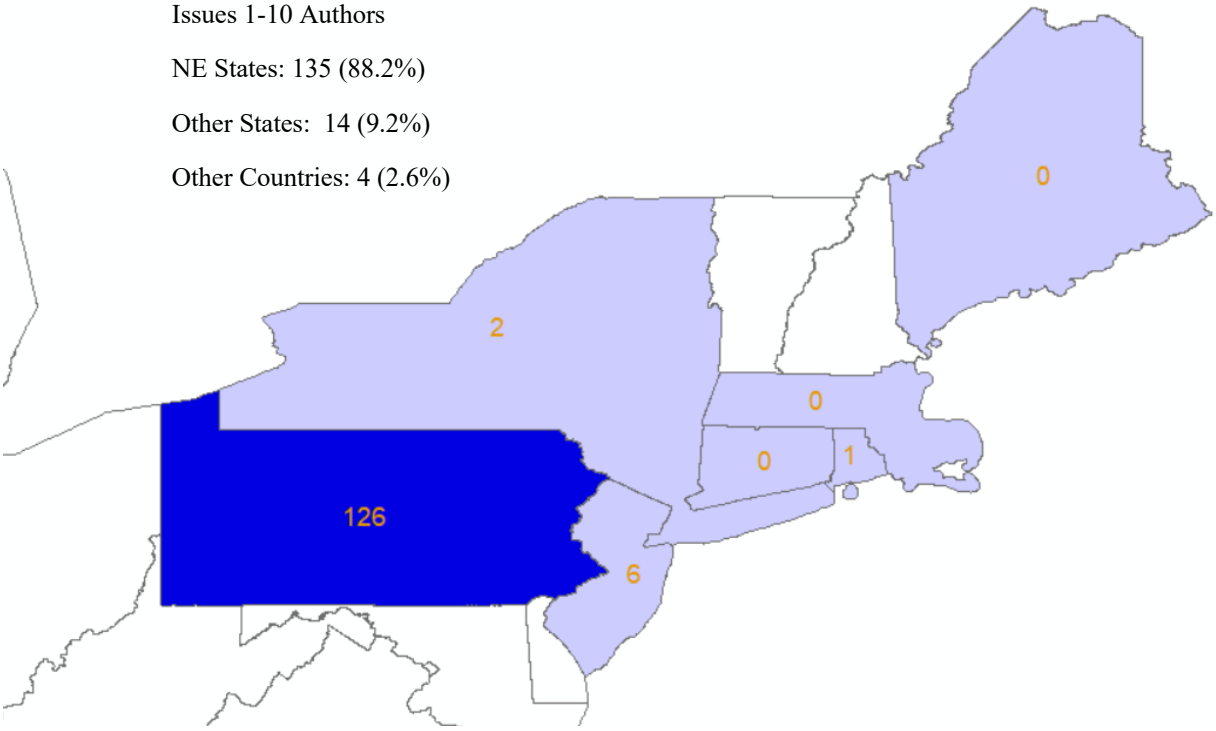


* Significant at the 0.10 level
** Significant at the 0.05 level
*** Significant at the 0.01 level

AUTHOR AFFILIATIONS IN THE NORTHEASTERN UNITED STATES AND INTERNATIONALLY

Figures 3 and 4 map the expansion of author affiliations by state within the Northeastern United States (Northeast)[3]. In the first 10 issues, 88% of authors were from schools located in the Northeastern United States, with 93% of those authors hailing from Pennsylvania (see Figure 3).

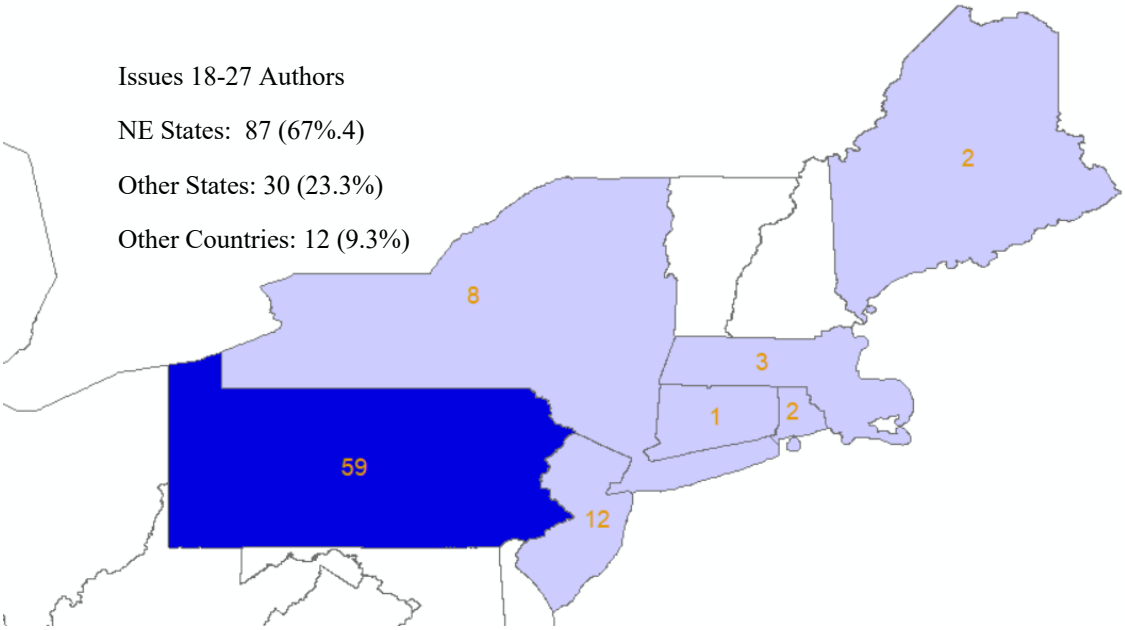
Figure 3: **Author Affiliations by State in the Northeastern Region (1989-2004)**



In the most recent 10 issues, only 67% of the authors are from schools located in the Northeast. This decrease in authors from that region/increase in authors from other regions might be the result of the word "Northeastern" being removed from the tile of the *Journal* beginning in 2017 (Vol. 20). While 93% of authors from the Northeast were from Pennsylvania in the first 10 issues, only 68% of those authors were from the state of Pennsylvania (see Figure 4) in the most recent 10 issues.

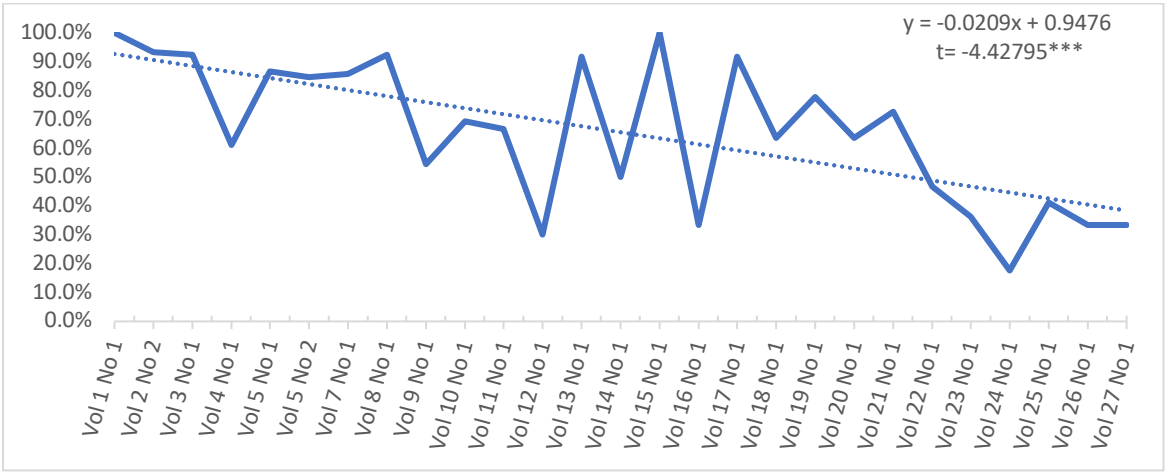
[3] As defined by the U.S. Census Bureau.

Figure 4: **Author Affiliations by State in the Northeastern Region (2013 -2024)**



So, while authors from the Northeast still constitute the majority of authors publishing in the *Journal*, the percentage from the state of Pennsylvania have declined/authors from outside of Pennsylvania have increased at a statistically significant rate (see Figure 5) since the *Journal's* inception. The broadening scope of geography of authors may well reflect increased collaboration between Pennsylvania faculty co-authors and academics and practitioners in many states and abroad. This is a positive finding, as increased academic connections is generally considered an enhancement to academic institutions in both directions.

Figure 5: **Pennsylvania Authors' Share of Total Authorship by Issue (Issues 1 – 27)**



* Significant at the 0.10 level
** Significant at the 0.05 level
*** Significant at the 0.01 level

Also of note is that the *Journal* has attracted more authors from outside of the United States over time. In the first 10 issues (1989 – 2004), only 2.6% of the authors resided outside of the United States. In the most recent 10 issues (2013-2024), 9.3% of the authors are from schools located outside of the United States.[4] This could be the result of dropping the word "Northeastern" from its title after 2017. Overall, the geographical impact of the *Journal* has been increasing over time.

WHO PUBLISHES IN THE *JOURNAL*?

Approximately two-thirds (66%) of the authors who have published in the *Journal* from Vol. 1 (1989) through Vol. 27 (2024) have been either Full Professors or Associate Professors at the time of publication (See Table 1). That is, most of those publishing in the *Journal* have been in at least the second phase of their academic career. This finding is almost identical to the finding of Kramer, Roth, and Walker (2009) (67%) for Volumes 1 through 14. Therefore, the thirteen *journals* published since 2009 (Volumes 15 through 27) have had essentially the same mix of authors with respect to the stage of their careers. Therefore, we conclude that, although the *Journal* is welcoming of junior scholars, those publishing in it have been overwhelming professors likely to already have tenure and be experienced scholars in at least the second phase of their academic careers.

Table 1: **Author Titles**

Rank at Time of Publication	Percent of Authors (Vol. 1 – Vol. 27)
Full	34%
Associate	32%
Assistant	20%
Instructor	5%
University Administrator	2%
Practitioner	4%
Ph.D. Candidate	2%
Masters Candidate	2%

TOPICS PUBLISHED IN THE *JOURNAL*

Since its inception as *The Pennsylvania Journal of Business and Economics* in 1989, the *Journal* has focused on publishing research in all areas of business and economics. In 2007, the *Journal* changed its name to the *Northeastern Journal of Business, Economics and Technology* and the word "technology" has remained in the title since then. In this section, we present an accounting of the volume and trends in the topics published in the *Journal*.

Exhibit 1 shows the topic scheme that we used to classify each paper's topic. Table 2 contains an accounting of the number of papers that have been published on those topics since the *Journal's* inception. More papers have been published in the *Journal* about Economics (34), Finance (32), and Education (pedagogy and curriculum matters) (31) than any other topics (see Appendix A). Together, they account for over half of all papers (54%) of all papers published over the life of the *Journal* (see Table 2). While the word "technology" has now been in the *Journal's* title for 18 years (over half of the *Journal's* life span), only 5 technology-related papers have appeared in the *Journal*.

[4] Authors from outside of the United States have hailed from 10 different countries: China, Kazakhstan, Canada, Mexico, Iran, Bulgaria, Greece, Germany, Sweden, and Poland.

Kramer, Roth, and Walker (2009) report that the most common topic in the first 20 years of the *Journal's* existence was Education (pedagogy and curriculum matters) with 24 papers published between Vol. 1 and Vol. 14. In this paper we show that only 7 papers on Education have been published in the most recent 15 years. While it is impossible to definitively attribute this to one thing, it could have to do with the fact that, in the early years of the *Journal's* existence it drew a larger percentage of its submissions from the PASSHE system which has a long history of being teaching institutions going all the way back to the founding of all PASSHE universities as State Normal Schools. The broadening of the *Journal's* audience over the years seems to have led to more discipline-specific papers and fewer pedagogical ones.

Exhibit 1: **Topic Classification Scheme**

Marketing (Mkt): General marketing, consumer behavior, and market research

Management (Mgm): General management including operations management and logistics and supply chain management

Finance (Fin): Including corporate finance, financial markets and institutions, investments, portfolio management, and personal financial planning.

Economics (Eco): Micro and macroeconomics as well as econometric methods

Accounting (Acc): Financial and managerial accounting as well as tax issues

Information Systems (IS)*: Broad range of papers from office automation to evaluation methods for accounting software, to the effects of different data storage systems on decision making, etc.

Education (Edu)*: Studies on pedagogy and curriculum matters

Accreditation Issues (AI): Papers focusing on the process of accreditation

Other (Oth): Not related to one of the above

* Adapted from Fleming et al. (2000, p. 46)

Table 2: **Paper Topics (Vol. 1 through Vol. 27)**

	No. of all Papers	Percent of all Papers	Slope of Trend Line
Economics	34	19%	0.0034
Finance	32	18%	0.0089**
Education (Pedagogy & Curriculum)	31	17%	-0.0062
Marketing	26	14%	-0.0053*
Accounting	19	10%	3.343E-05
Management	18	10%	0.0014
Other	11	6%	-0.0008
Accreditation Issues	6	3%	-0.0015
Information Systems	5	3%	0.0002

* Significant at the 0.10 level
** Significant at the 0.05 level
*** Significant at the 0.01 level

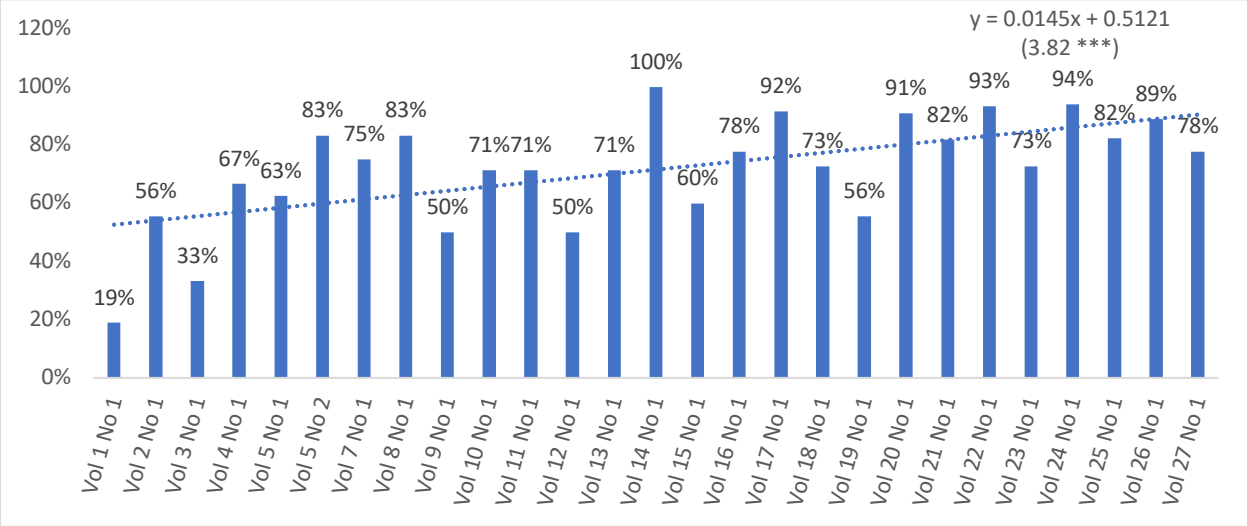
CO-AUTHORSHIP

The *Journal's* sponsoring organization has always promoted collegiality through its Annual Meetings which are moderate in size (allowing people to interact several times vs. large conferences where you rarely see the same person twice), always held in the same location (State College, PA) (providing a familiar atmosphere), and include several meals and a social that encourage interaction between colleagues. Co-authorship is one form of collegiality. Therefore, it is not surprising to find that co-authorship has increased at a statistically significant rate over the *Journal's* life span (see Table 3 and Figure 6). This is consistent with the sponsoring organization's initiatives regarding fostering collegiality.

Table 3: **Authorship of Papers**

	Sole	Co-authored
Vol 1 No 1	81%	19%
Vol 2 No 1	44%	56%
Vol 3 No 1	67%	33%
Vol 4 No 1	33%	67%
Vol 5 No 1	38%	63%
Vol 5 No 2	17%	83%
Vol 7 No 1	25%	75%
Vol 8 No 1	17%	83%
Vol 9 No 1	50%	50%
Vol 10 No 1	29%	71%
Vol 11 No 1	29%	71%
Vol 12 No 1	50%	50%
Vol 13 No 1	29%	71%
Vol 14 No 1	0%	100%
Vol 15 No 1	40%	60%
Vol 16 No 1	22%	78%
Vol 17 No 1	8%	92%
Vol 18 No 1	27%	73%
Vol 19 No 1	44%	56%
Vol 20 No 1	9%	91%
Vol 21 No 1	18%	82%
Vol 22 No 1	7%	93%
Vol 23 No 1	27%	73%
Vol 24 No 1	6%	94%
Vol 25 No 1	18%	82%
Vol 26 No 1	11%	89%
Vol 27 No 1	22%	78%

Figure 6: **Authorship Trend (% of papers co-authored per Issue)**

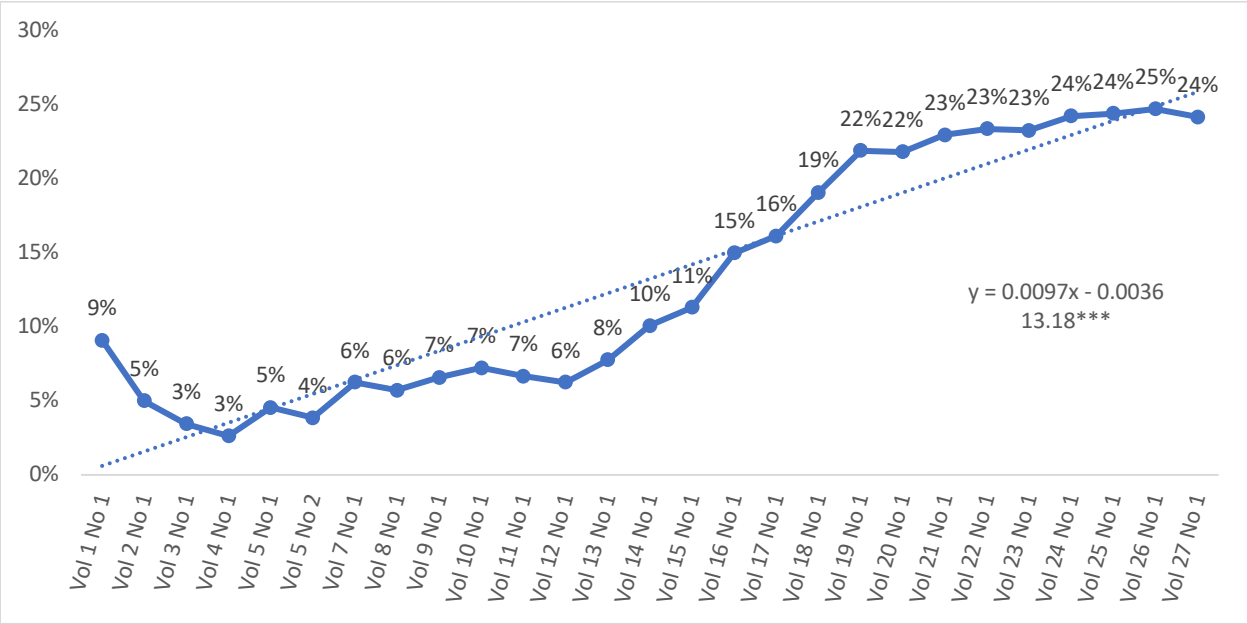


CITATIONS

As the need to quantitatively assess the impact and quality of research for various reasons, including accreditation, various measures of journal quality have been developed. Two of the most well-known include Cabells and the Journal List of the Australian Business Deans Council (ABDC). The *Journal* is not listed on the ABDC List but has been listed in Cabells since 2002. Nevertheless, Cabells does not provide any citation data for the *Journal* that would be useful to gauge impact and/or quality. So, in this paper, we compile citation data for the *Journal* using Google Scholar.

The title of each article published from 1989 – 2024 (Vol. 1 – Vol. 27) was fed into Google Scholar on May 29, 2025 and the number of citations for each paper as of that date was recorded. Figure 7 shows that there has been a statistically significant increase in cumulative citations relative to the cumulative number of papers published since the *Journal's* inception. The few citations in the early years of the *Journal's* publication are not surprising since, at that time, the *Journal* was only distributed in hard copy to association members and PASSHE libraries. The years following the *Journal's* listing in Cabell's (2001, Vol. 9) show an increase in the number of citations relative to the number of published papers. However, more significant growth began with Vol. 13 (2007) after the sponsoring organization re-branded itself and the *Journal* to be more geographically diverse. Around the same time, *newly released Journal* issues became available on the sponsoring organization's website. These two changes seem to have had a consequential influence on citations. Since September 2023, *all* the *Journal's* issues back to Vol. 1 have been available online. Therefore, it is likely that citations will increase in the future as the archive is now completely available online.

Figure 7: Cumulative Citations relative to Cumulative Number of Papers Published in the *Journal*



* Significant at the 0.10 level
** Significant at the 0.05 level
*** Significant at the 0.01 level

Since one heavily cited paper could influence the statistics shown in Figure 7, we also calculated the percent of the papers in each issue[5] that have been cited at least once between their publication date and May 29, 2025. The results of this analysis are shown in Figure 8. Once again, the data show that after the re-branding of the *Journal* and its sponsoring organization, citations grew significantly with 46% of all published papers published between 2007 and 2023 being cited at least once (see Figure 9).

[5] We do not include Vol. 27 (2024) in the various periods since that issue was published so recently that it is highly unlikely that the papers included in that volume could have been cited in a published article in the elapsed amount of time.

Figure 8: **Percent of Papers in each issue that have been cited at least once as of 2025**

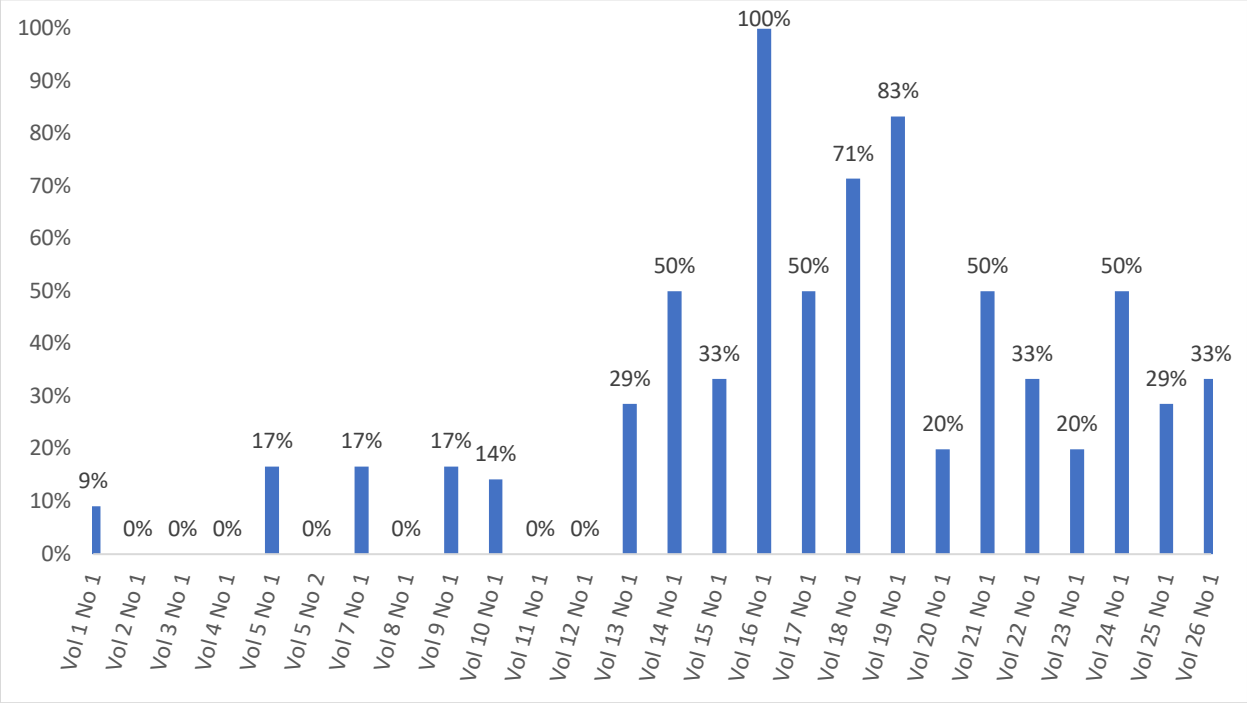
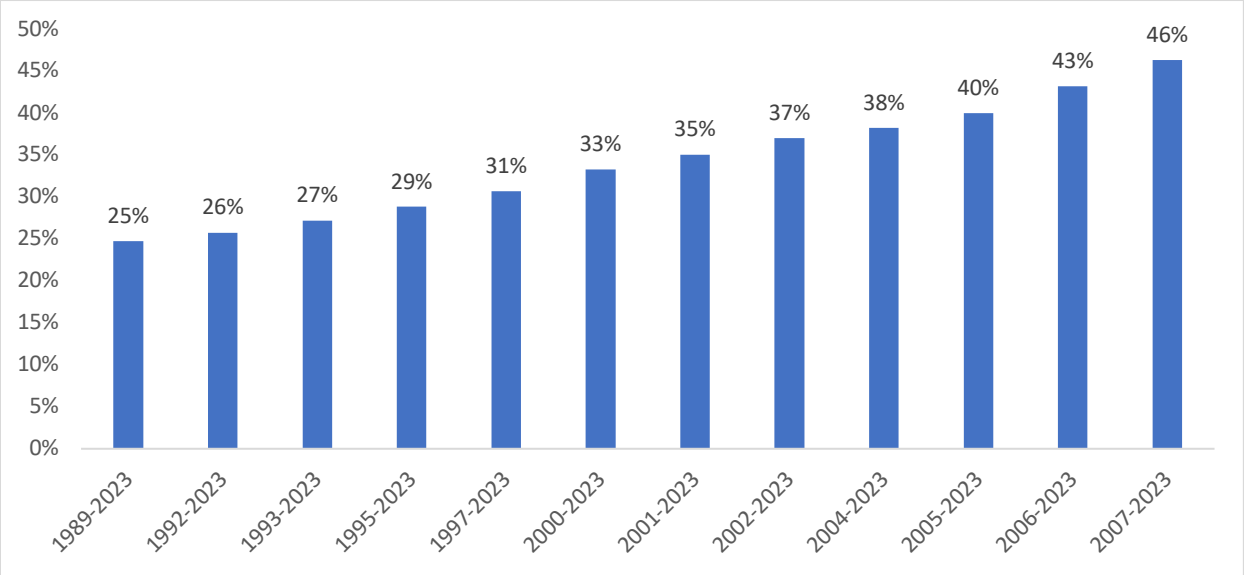


Figure 9: **Percent of Papers Published during various Periods that have been cited at least once as of 2025**



An increase in citations is generally considered as one indicator of greater research impact. However, we must keep in mind that measuring impact is no easy task. In a comprehensive overview of the concepts and theories of using citations to measure research impact, Aksnes, Langfeldt, and Wouters conclude that "The view generally held among experts within bibliometrics seem to be that citations represent a good but not perfect impact measure." Nevertheless, the data presented here indicates that the *Journal's* impact, as measured by citations, has been increasing over time.

CONCLUSIONS AND FUTURE DIRECTIONS

We find that, while the *Journal* was once a provincial publication it has significantly expanded its geographic impact, especially in the Northeastern United States but also outside of that region including internationally. Since starting with Volume 1, No. 1 in which 100% of its authors were from PASSHE (and thus Pennsylvania) to its most recent issue with only 22% of authors from PASSHE, it has published authors from half of the 50 States in the United States, and 10 countries outside of the United States.

The *Journal's* co-authorship statistics show that the *Journal* reflects the sponsoring organization's goal of promoting collegiality. The type of individual most likely to publish in JBET in the past is an academic in at least the second phase of their career in the fields of Economics or Finance publishing with a colleague. However, other business disciplines like Management, Marketing, and Accounting are well represented too. Despite having the word "technology" in the *Journal's* title for over half of its existence, technology papers do not seem to be finding their way into the *Journal*. We are uncertain whether this is because of a lack of submissions or a high rejection rate, but this is something that future editors might want to conduct further research on if technology is going to remain in the *Journal's* title.

The impact of the *Journal* as measured by citations has been increasing over time at a statistically significant rate. This is likely the result of the sponsoring organization's initiatives to widen its geographic profile and make issues of the *Journal* available online as the Internet has evolved.

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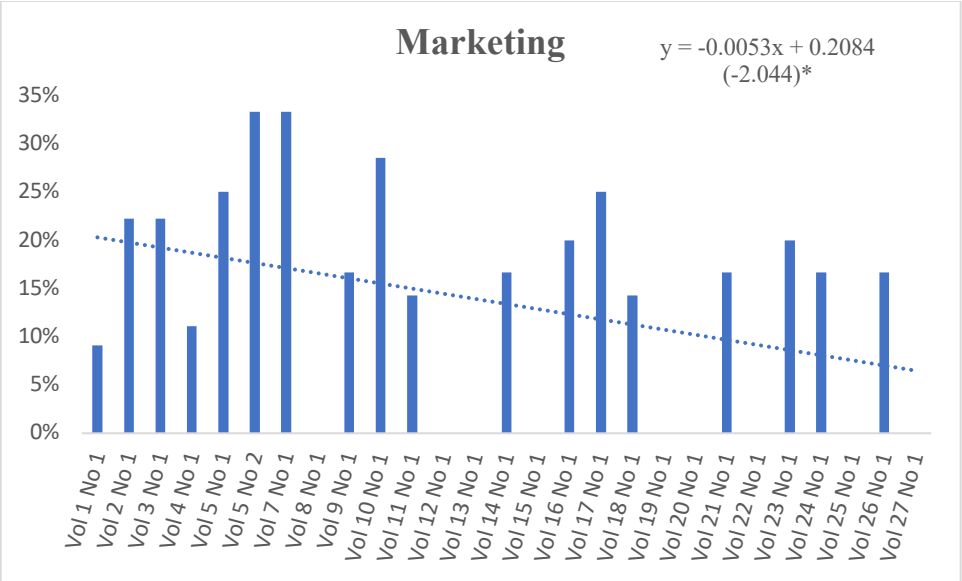
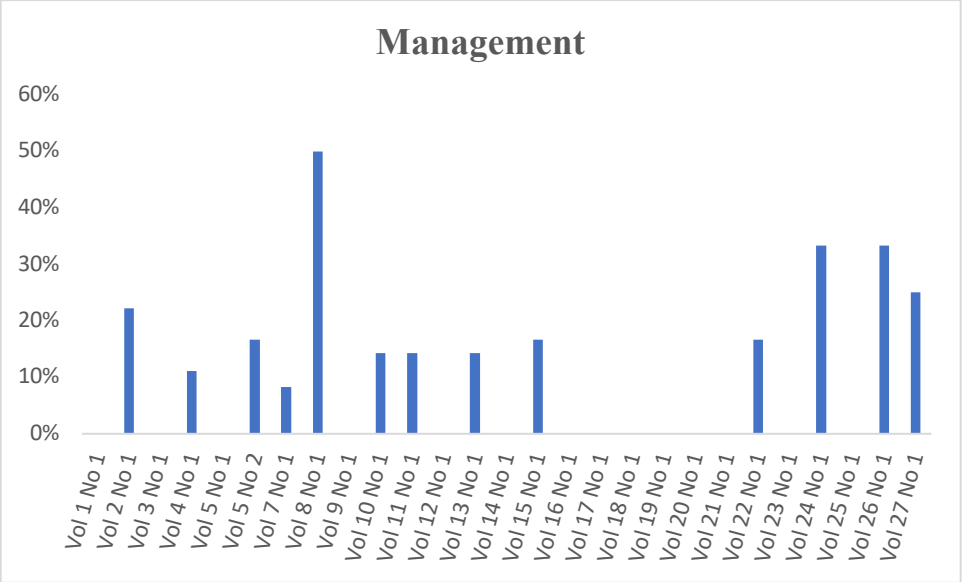
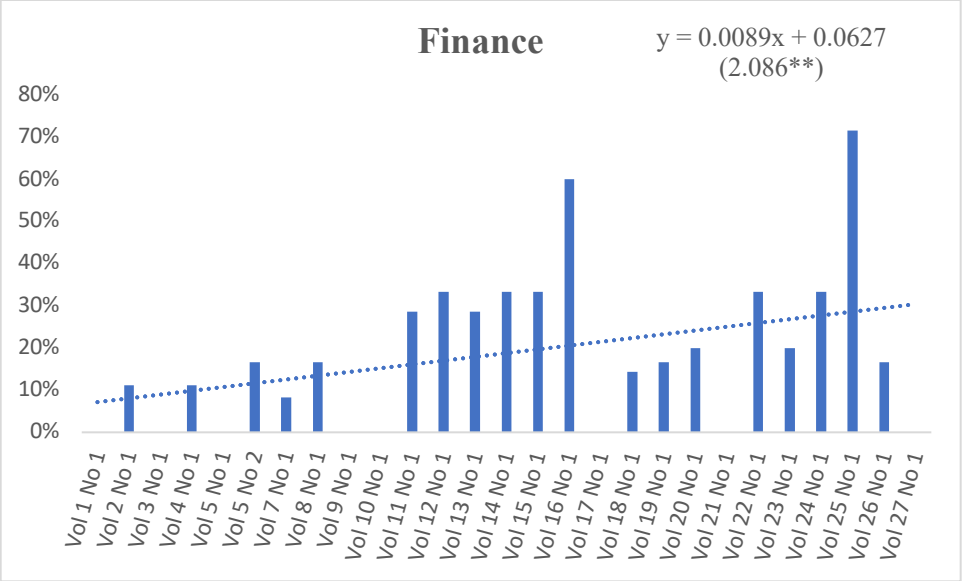
APPENDIX A: QUANTITY AND TRENDS OF THE VARIOUS ACADEMIC DISCIPLINES (AS A PERCENT OF PAPERS PER ISSUE)



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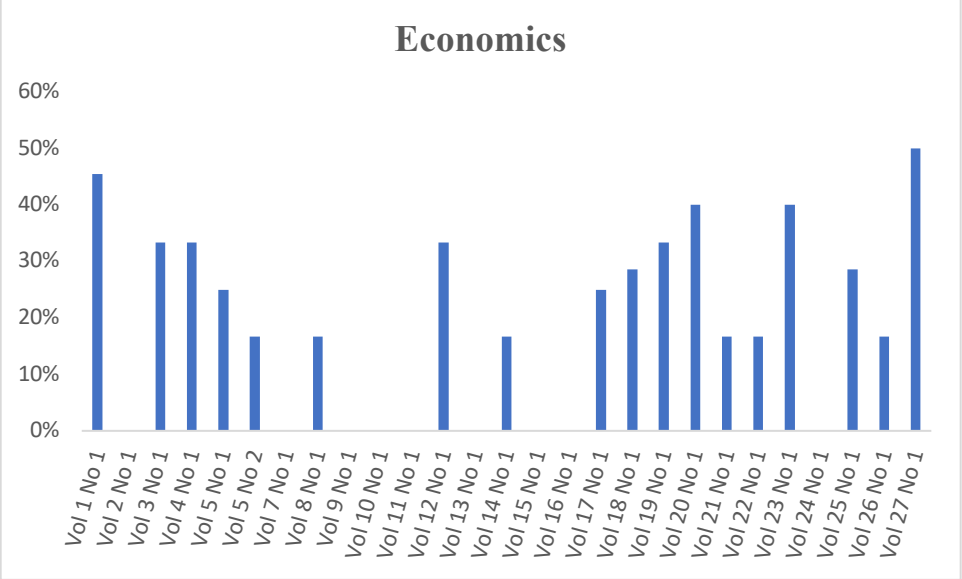
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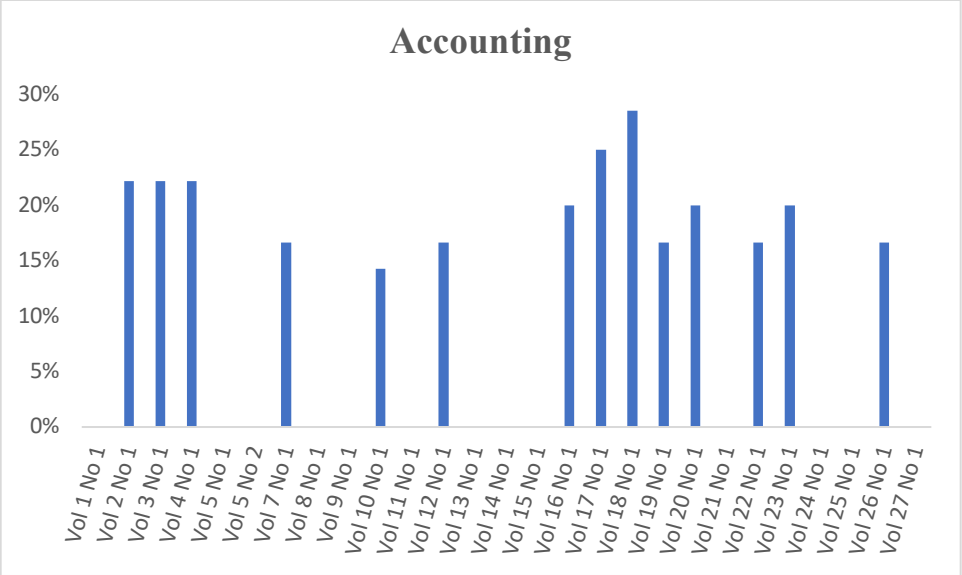
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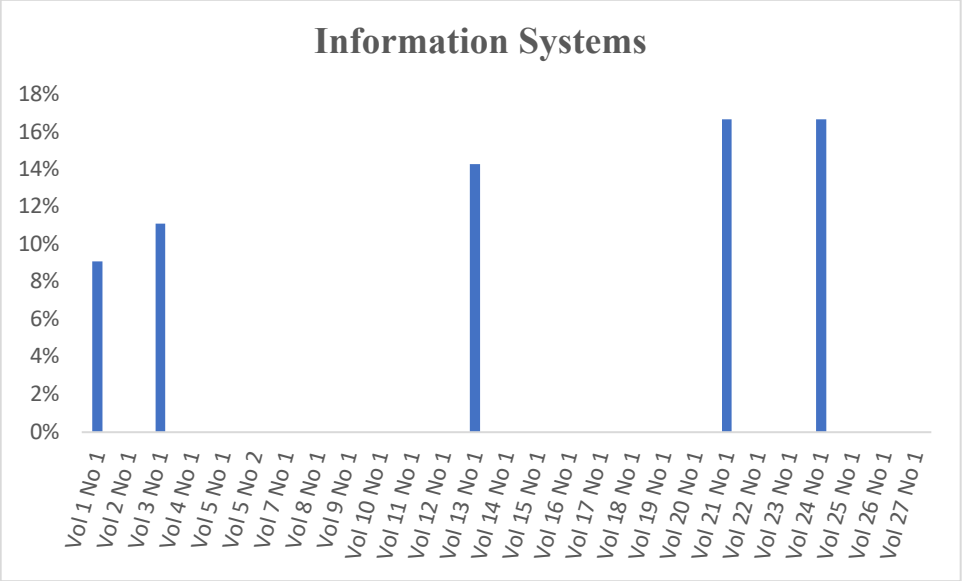
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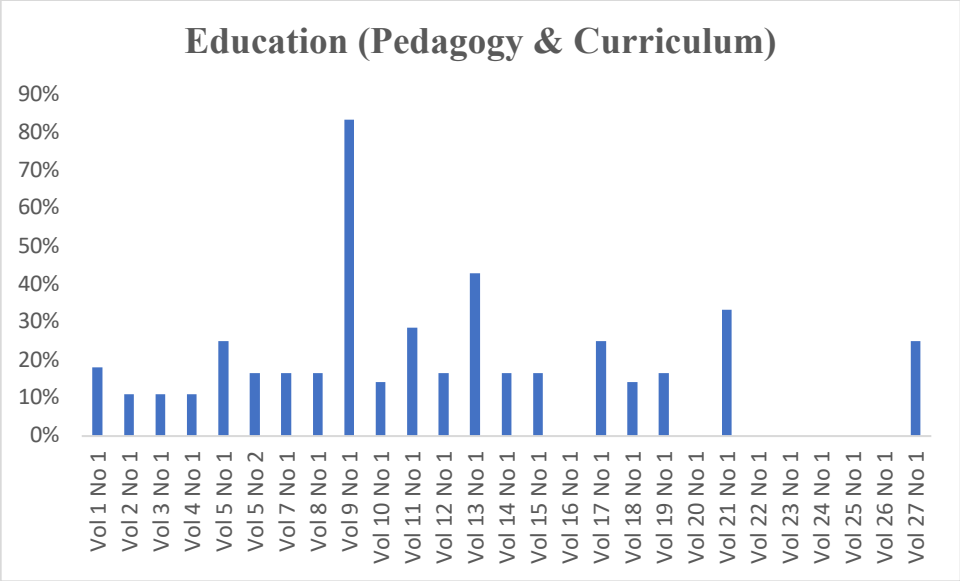
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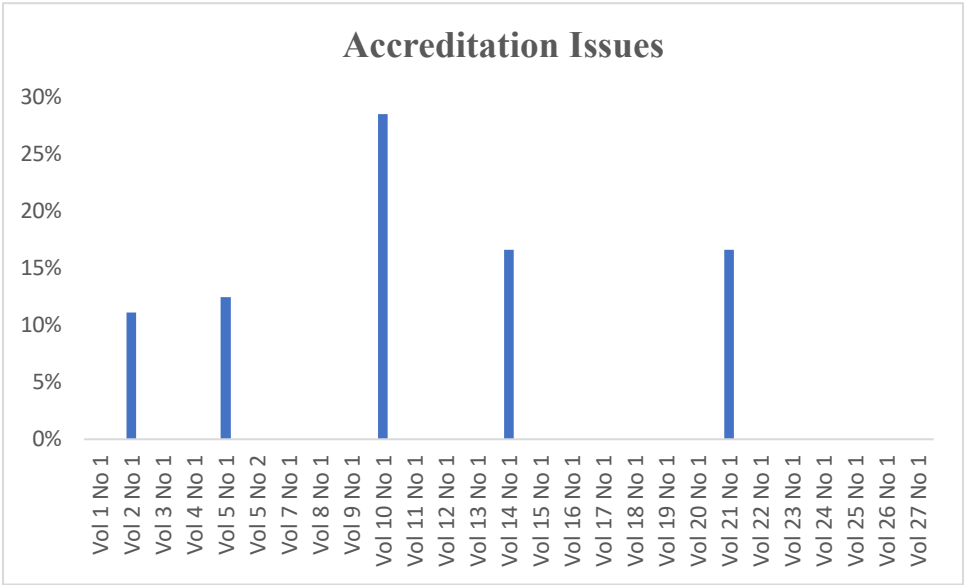
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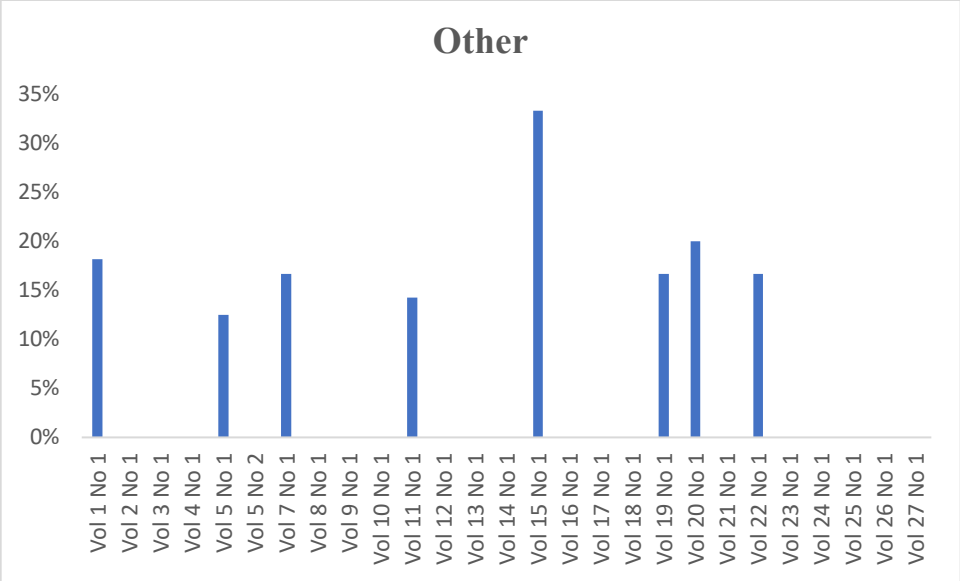
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