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## EDITORIAL NOTES

The continuing goal of the Journal of Business, Economics and Technology (JBET) is the publication of general-interest business and economics articles that demonstrate academic rigor, while at the same time are readable and useful to others in academia. Consistent with these goals, this and future issues of JBET presents authors' papers in the three research categories recommended by AACSB: Research that advances the knowledge of business and management theory (Theoretical), Research that advances the practice of business and management (Practice), and Research that advances learning/pedagogy (Pedagogical).

In addition to being *whitelisted* in Cabell's Directory in the Journalytics category, JBET is also available through the EBSCO Host research database. The current acceptance rate for JBET is roughly 35%. In this regard we have striven to accept only high-quality research, while at the same time maintaining JBET as a realistic publishing outlet for Business, Economics and Information Technology faculty throughout the United States. Key to this process is our referees who have worked hard to help "grow" papers that have significant potential by providing authors with critical review comments. We generally require two to three rounds of review prior to accepting articles for publication. At the same time, we are attempting to shorten the average review time for each article to less than three months.

**JBET Research Notes** include, but are not limited to updates to previous work, additions to established methods, relatively short articles, research where the thesis is narrow in scope, null results, case series, research proposals, and data management plans: Articles of good quality which cannot be considered as full research or methodology articles. Further, articles in the Research Notes category have undergone the same double-blind peer review process as all articles that are published in JBET. At JBET, we support the research community across all of the disciplines of Business, Economics, and Information Technology by providing the Research Notes forum for sharing information and data of works-in-process or works that have a limited scope of application.

*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 26th Volume of JBET.

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# THE EFFECT OF COVID-19 ANNOUNCEMENT ON THE US STOCK MARKET

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## ABSTRACT

World Health Organization formally announced on 31 December 2019, that an unknown virus found in Wuhan City in China. On 20 January 2020, 282 confirmed cases of COVID-19 and 6 deaths reported from four countries, including China, Thailand, Japan and the Republic of Korea (WHO, 2020). On February 25, 2020 the Centers for Disease Control (CDC) announced COVID-19 heading to be pandemic. On the11th March 2020, officially, WHO declared that COVID 19 characterized as pandemic disease.

The COVID 19 outbreak on global stock markets was staggering. In this study, the event study method is used to examine the impact of the COVID 19 out-break on US stock markets, specifically comparing the postdate volatility following three key dates: 1) February 25, 2020 CDC's announcement 2) 11th March 2020 World Health Organization's announcement and 3) March 13, 2020 Trump/ White House's announcement. There have been other papers studying US market volatility following COVID-19 announcement dates but this paper will uniquely try to gauge and compare how investors and US markets reacted differently following the three announcements, our study will shade light on the investors behavior or reaction to each announcement and which announcement have greater impact on the US stock market. We use DOW Jones, NASDAQ, and S&P 500 indices to investigate the US stock market. Our result indicates that all the three announcements have no immediate negative impact on all three major indices. However, the Trump/Whitehouse and CDC's announcements seem to have longer term (three day to thirty days) significant and negative impact in almost all three indices compared to CRSP equally weighted market stock returns. While, CDC's announcement has only short term small negative effect on the S&P 500 and DOW Jones stock returns compared to CRSP equally weighted market returns. It could also be other variables such as the COVID 19 number of cases or deaths that may have impacted the stock returns in the long term.

## INTRODUCTION

World Health Organization formally announced on 31 December, 2019 that an unknown virus has been found in Wuhan City in China. On 20th January 2020, 282 confirmed cases of COVID-19 and six deaths had been reported from four countries, including China, Thailand, Japan and the Republic of Korea (WHO, 2020). On the 11th March, 2020, officially, WHO declared that COVID 19 can be characterized as pandemic disease. It had affected more than 100,000 people in over 100 countries killing thousands. From March, the outbreak began to appear widely outside China; as of the June 30th, 2020, the number of COVID-19 cases worldwide was 10,417,063 and the number of deaths was 509,474. The most affected countries were USA, Brazil, Russia, India, and UK amongst others. President Donald Trump declared COVID-19 as a national emergency on March 13th, 2020. The COVID 19 outbreak on global markets was staggering. International stock markets suffered historic losses, especially in the first 3 months of the year, due to COVID 19 outbreak. The Dow Jones index and London's FTSE 100 saw their biggest quarterly drops since 1987, plunging 23% and 25% respectively. The S&P 500 lost 20% during the same period, its worst since 2008.

In this study, the event study method is used to examine the impact of the COVID 19 break on US stock markets, specifically comparing the postdate volatility following three key dates: 1)25th February 2020 2) 11th March 2020 and 3) March 13th, 2020 announcements made by Center for Desis Prevention and Control (CDC), World Health Organization (WHO) and Trump/Whitehouse respectively. This paper will uniquely try to gauge and compare how investors and US markets reacted differently following the March announcements vs the WHO declaration on Dec 31st, to show if there was a delayed lag in changes investment behavior. We expect to find a stronger market volatility response to the days following Trump's declaration vs the previous two dates.

## LITERATURE REVIEW

The effect of COVID19 on the economy felt across the country and or in the world. COVID 19 effect on the US stock market was also tremendous on March 2020 the Dow Jones index fell sharply to 19,173 from its peak of 29,500 in mid-February 2020 (that is 35% decline).

Izzeldin et al. (2021) investigated the impact of Covid-19 on stock markets across G7 countries and their business sectors. They highlight the synchronicity and severity of this unprecedented crisis. They used data that comprises daily prices of the aggregate and sector equity indices for the G7 economies (Canada, France, Germany, Italy, Japan, UK and US). All indices are value-weighted and exclude dividends. The data source is Datastream and cover the period from 24/4/2018–24/4/2020. Using a novel smooth transition heterogeneous autoregressive model (ST-HAR) to identify transition between regimes. Their results show a non-linear transition to a crisis regime for all countries and sectors. Their findings are that the Healthcare and Consumer Services sectors were the most severely affected, with Telecommunications and Technology the least. Financial markets in the UK and the US took the largest hits, yet with high response heterogeneity across business sectors. Baig et. al (2021) investigate the impact of COVID-19 pandemic on the microstructure of US equity market. They collected stock market information for the S&P 500 constituent stocks is obtained from Thomson Reuters DataStream. Their data is a firm-day panel that consists of all the constituent stocks of the S&P 500 index for the period January 13th, 2020 to April 17th, 2020. Their results suggest that increases in confirmed cases and deaths due to coronavirus are associated with a significant deterioration of market liquidity and stability. Similarly, public fear and the implementation of restrictions and lockdowns seem to contribute to the illiquidity and instability of the markets.

**Event Study**

An event study is a statistical method of an empirical investigation of the relationship between security prices and economic events (Dyckman et al., 1984). Most event studies have focused on the behavior of share prices in order to test whether their stochastic behavior is affected by the disclosure of firm-specific events. Furthermore, "in a corporate context, the usefulness of event studies arises from the fact that the magnitude of abnormal performance at the time of an event provides a measure of the unanticipated impact of this type of event on the wealth of the firms' claimholders" (Kothari and Warner 2006).

## EMPIRICAL MODEL

Methodology:

This study employs a standard event study methodology, using Eventus from WRDS and we fit a standard market model to measure normal performance:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it,} \qquad \text{where } E(\varepsilon_{it}) = 0 \text{ and } \operatorname{var}(\varepsilon_{it}) = \sigma_{\varepsilon t}^2 \tag{1}$$

Each sample calendar date is converted to event time by defining the date of the NRRS announcement date (and the implementation date) as event date 0. So, for the announcement date, event date 0 is the same trading day. The regression coefficients $\alpha_i$ and $\beta_i$ are estimated in an ordinary least squares (OLS) regression during the estimation period one year (255 trading days) prior to the event period (event days -300 through -46). The event period consists of 61 trading days centered on NRRS announcement date (-30 through +30). We define four event windows based on the event date, [-30,-2], [-1, 0], [+1, +2] and [+3, +30]. As proxy for the return for the market portfolio $R_{mt}$, both the CRSP value weighted index and the CRSP equal weighted index are used.

Under standard assumptions, OLS is a consistent estimation procedure for the market model parameters. Under the assumption that asset returns are jointly multivariate normal and independently and identically distributed (iid), OLS is also efficient. The prediction errors, $PE_{i\tau}$, which represent abnormal returns, are simply the OLS residuals, $\hat{\varepsilon}_{it}$.

$$PE_{i\tau} \equiv \hat{\varepsilon}_{i\tau} = R_{i\tau} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt}) \tag{2}$$

with

$$\hat{\sigma}_{\varepsilon t}^2 = \frac{1}{255-2} \sum_{\tau=t-299}^{t-46} (R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau})^2 \quad (3)$$

The prediction error, $PE_{it}$ is used as an estimator of the abnormal return. In other words, the abnormal return is the residual term of the market model calculated on an out of sample basis. Let $AR_{i\tau}, \tau = t-30, t-29, \ldots t+29, t+30$ be the sample of 61 abnormal returns for firm $i$ in the event window. Under the null hypothesis, conditional on the event window market returns, the abnormal returns will be jointly normally distributed with a zero conditional mean and conditional variance:

$$AR_{i\tau} \sim N(0, \sigma^2(AR_{i\tau})) \quad (4)$$

The conditional variance $\sigma^2(AR_{i\tau})$ has two components. The first component is the disturbance $\hat{\sigma}_{\varepsilon t}^2$ from (3), and the second component is additional variance due to sampling error in estimating the market model parameters $\alpha_i$ and $\beta_i$:

$$\sigma^2(AR_{it}) = \sigma_{\varepsilon\tau}^2 + \frac{1}{255}[1 + \frac{(R_{m\tau} - \bar{R}_m)^2}{\hat{\sigma}_m^2}] \text{ where } \bar{R}_m = \frac{1}{255} \sum_{\tau=t-299}^{t-46} R_{m\tau} \quad (5)$$

Since the estimation window is large (255 trading days), I assume that the contribution of the second component to $\sigma^2(AR_{i\tau})$ is zero. To draw inferences about the average price impact of an event, abnormal return observations have to be aggregated across securities and through time. Average abnormal returns $AAR_\tau$ are formed by aggregating abnormal returns $AR_{i\tau}$ for each event period $\tau = t-30, t-29, \ldots t+29, t+30$. Given $N$ events (for our sample, $N = 147$),

$$AAR_\tau = \frac{1}{N} \sum_{i=1}^{N} AR_{i\tau} \quad (6)$$

Under the assumption that average abnormal returns are independent across securities, the asymptotic variance equals to

$$Var(AAR_\tau) = \frac{1}{N^2} \sum_{i=1}^{N} \sigma_{\varepsilon\tau}^2 \quad (7)$$

The average abnormal returns are aggregated through time to give the cumulative average abnormal return,

$$CAAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AAR_{i\tau} \quad (8)$$

Setting the covariance terms to be zero,

$$\text{var}(CAAR_i(\tau_1, \tau_2)) = \sum_{i=1}^{N} \text{var}(AAR_{i\tau}) \quad (9)$$

Hence $CAAR_i(\tau_1, \tau_2) \sim N(0, \text{var}(CAAR_i(\tau_1, \tau_2))$ (10)

This can be used to test the null hypothesis that the abnormal returns are zero.

The estimated variance of $AAR_\tau$ is

$$\hat{\sigma}^2_{AAR} = \frac{\sum_{\tau=t-299}^{t-46} (AAR_\tau - \overline{AAR})^2}{255-2} \text{ where } \overline{AAR} = \frac{\sum_{\tau=t-299}^{t-46} AAR_\tau}{255} \tag{11}$$

The portfolio test statistic for day $\tau$ in event time is

$$t = \frac{AAR_\tau}{\hat{\sigma}^2_{AAR}} \tag{12}$$

Assuming time series independence, the test statistic for $CAAR_i(\tau_1, \tau_2)$ is

$$t = \frac{CAAR_i(\tau_1, \tau_2)}{\sqrt{(\tau_2 - \tau_1 + 1)}\hat{\sigma}_{AAR}} \tag{13}$$

The abnormal return estimators often have different variances across firms. A common way of addressing this problem is the standardized residual method (Patell, 1976). Define the *standardized abnormal return*, $SAR_{i\tau}$ as

$$SAR_{i\tau} = \frac{AR_{i\tau}}{\hat{\sigma}_{MLE_{i\tau}}} \tag{14}$$

Where

$$\hat{\sigma}_{MLE_{i\tau}} = \hat{\sigma}^2_{\varepsilon\tau}\left(1 + \frac{1}{T} + \frac{(R_{m\tau} - \bar{R}_m)^2}{\sum_{\tau=t-299}^{t-46} (R_{m\tau} - \bar{R}_m)^2}\right) \tag{15}$$

Is the maximum likelihood estimate of the variance. Under the null hypothesis each $SAR_{i\tau}$ follows a Student's t distribution with T-2 degrees of freedom. Summing the $SAR_{i\tau}$ across the sample yields

$$ASAR_{i\tau} = \sum_{i=1}^{N} SAR_{i\tau} \text{ where } ASAR_{i\tau} \sim N(0, Q_\tau) \tag{16}$$

The Z-test statistic for the null hypothesis that $CAAR_i(\tau_1, \tau_2) = 0$ is

$$Z(\tau_1, \tau_2) = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} Z_i(\tau_1, \tau_2) \text{ where } Z_i(\tau_1, \tau_2) = \frac{1}{\sqrt{(\tau_2 - \tau_1 + 1)\frac{T-2}{T-4}}} \sum_{\tau=\tau_1}^{\tau_2} SAR_{i\tau} \tag{17}$$

The two test statistics so far discussed use the variance estimate from the market model during the estimation period to estimate the variance of the abnormal return estimator. But frequently, events increase the variance of returns, so that the event period variance is greater than the estimation period variance. The portfolio test statistic for day t in event time is

$$t = \frac{AAR_\tau}{\hat{\sigma}_{AAR_\tau} / \sqrt{N}} \text{ where } \hat{\sigma}_{AAR_\tau} = \frac{1}{N-1}\sum_{i=1}^{N}(AR_{i\tau} - \frac{1}{N}\sum_{i=1}^{N} AR_{i\tau})^2 \quad (18)$$

We use the above equation to calculate *Adjusted-t*

## RESULTS

We used event study method to analyze the effect of COVID 19 announcement on the US three major stock indexes namely S&P 500, Dow Jones, and NADSAQ. We used three announcements' dates of COVID 19. The first one, is February 25, 2020 announcements made by Center for Disease Control and Prevention (CDC) announced COVID19 heading to be pandemic, the second one is March 11, 2020 World Health Organization (WHO) declares COVID19 is pandemic, and the third date is March 13, 2020 when President Trump/ the Whitehouse announced COVID 19 as a National Emergency. The results of Event study are shown in Tables 1, Table 2 and Table 3 for S&P 500, NASDAQ, and DOW Jones respectively.

Table 1 (S&P 500) in the first panel presents the result of February 25th announcements of CDC that COVID 19 is heading to pandemic. The mean Cumulative Abnormal Return (CAR) of the first window for the announcement date, thirty days before the announcement to two days before the announcement (-30, -2), is 0.78% and not statistically significant. Result of the second window, one day before the announcement and the day of the announcement (-1, 0) was a mean CAR of -1.24%, which is highly statistically significant. This suggests that investors began factoring in COVID19 in their decision making. The mean CAR for the third window, one day after the announcement to two days after the announcement (+1, +2), is -1.05%, also highly statistically significant, indicating the announcement after it happened has a significant impact on the S&P stock returns. Finally, for fourth window of the announcement date model, three days after the announcement up to thirty days after (+3, +30), the mean CAR, was 4.15% and is statistically significant at less than one percent level of significance. Implying the announcement do not have a long lasting negative impact of the stock returns.

Table 1 second panel presents the announcement of March 11th WHO's announcement of COVID 19 is a pandemic. The mean Compound Abnormal Return (CAR) of the first window for the announcement date, thirty days before the announcement to two days before the announcement (-30, -2), is -1.08% and statistically significant. Result of the second window, one day before the announcement and the day of the announcement (-1, 0) was a mean CAR of positive 1.90%, which is highly statistically significant. This suggests that investors are not concerned about COVID19 in their decision-making process. The mean CAR for the third window, one day after the announcement to two days after the announcement (+1, +2), is 2.38%, also highly statistically significant, indicating the announcement after it happened has no negative impact on the S&P stock returns in the short term. Finally, for fourth window of the announcement date model, three days after the announcement up to thirty days after (+3, +30), the mean CAR, was -3.88% and is highly statistically significant. Implying the announcement do have a long-lasting negative impact on S&P 500 stock returns, but not in the short term.

Table 1 third panel presents President Trump's announcement of March 13th as COVID 19 is National Emergency. The mean Compound Abnormal Return (CAR) of the first window for the announcement date, thirty days before the announcement to two days before the announcement (-30, -2), is 0.88% and not statistically significant. Result of the second window, one day before the announcement and the day of the announcement (-1, 0) was a mean CAR of 2.50%, which is highly statistically significant. This suggests that investors are not concerned about COVID19 in their decision-making process. The mean CAR for the third window, one day after the announcement to two days after the announcement (+1, +2), is -0.49%, and not statistically significant, indicating the announcement after it happened has no significant negative impact on the S&P stock returns. Finally, for fourth window of the announcement date model, three days after the announcement up to thirty days after (+3, +30), the mean CAR, was -3.60% and is highly statistically significant. Implying the announcement has a significant long lasting negative effect on the S&P 500 stock returns.

Table 2 (NASDAQ) in the first panel presents the result of February 25th announcements of CDC that COVID 19 is heading to pandemic. The mean Cumulative Abnormal Return (CAR) of the first window for the announcement date,

thirty days before the announcement to two days before the announcement (-30, -2), is 2.12% and not statistically significant. Result of the second window, one day before the announcement and the day of the announcement (-1, 0) was a mean CAR of 0.27%, which is statistically significant at less than five percent significance. This suggests that investors are not factoring in COVID19 in their decision making. The mean CAR for the third window, one day after the announcement to two days after the announcement (+1, +2), is 0.96%, also statistically significant at less than ten percent level of significance, indicating the announcement after it happened has no negative effect impact on the NASDAQ stock returns. Finally, for fourth window of the announcement date model, three days after the announcement up to thirty days after (+3, +30), the mean CAR, was 17.24% and is statistically significant at less than one percent level of significance. Implying the announcement do not have a long-lasting negative impact on NASDAQ stock returns.

Table 2 second panel presents the announcement of March 11th WHO's announcement of COVID 19 is a pandemic. The mean Compound Abnormal Return (CAR) of the first window for the announcement date, thirty days before the announcement to two days before the announcement (-30, -2), is 10.28% and highly statistically significant. Result of the second window, one day before the announcement and the day of the announcement (-1, 0) was a mean CAR of positive 2.78%, which is highly statistically significant. This suggests that investors are not concerned about COVID19 in their decision-making process. The mean CAR for the third window, one day after the announcement to two days after the announcement (+1, +2), is 4.11%, also highly statistically significant, indicating the announcement after it happened has no negative impact on the NASDAQ stock returns in the short term. Finally, for fourth window of the announcement date model, three days after the announcement up to thirty days after (+3, +30), the mean CAR, was 0.95% and is highly statistically significant. Implying the announcement do not have a either short term or long term negative impact on NASDAQ stock returns.

Table 2 third panel presents President Trump's announcement of March 13th as COVID 19 is National Emergency. The mean Compound Abnormal Return (CAR) of the first window for the announcement date, thirty days before the announcement to two days before the announcement (-30, -2), is 13.16% and highly statistically significant. Result of the second window, one day before the announcement and the day of the announcement (-1, 0) was a mean CAR of 4.24%, which is highly statistically significant. This suggests that investors are not concerned about COVID19 in their decision-making process. The mean CAR for the third window, one day after the announcement to two days after the announcement (+1, +2), is 3.66%, and highly statistically significant, indicating the announcement after it happened has no negative impact on the NASDAQ stock returns. Finally, for fourth window of the announcement date model, three days after the announcement up to thirty days after (+3, +30), the mean CAR, was -4.97% and is highly statistically significant. Implying the announcement, Trump declaring COVID 19 National Emergency, has a significant long lasting negative effect on the NASDAQ stock returns, while WHO and CDC's announcements do not have any negative impact on NASDAQ returns.

Table 3 (DOW Jones) in the first panel presents the result of February 25th announcements of CDC that COVID 19 is heading to pandemic. The mean Cumulative Abnormal Return (CAR) of the first window for the announcement date, thirty days before the announcement to two days before the announcement (-30, -2), is -1.06% and statistically significant at less than five percent level of significance. Result of the second window, one day before the announcement and the day of the announcement (-1, 0) was a mean CAR of -1.45%, which is highly statistically significant. This suggests that investors are factoring in COVID19 in their decision making, were concerned about CDC's COVID 19 announcements. The mean CAR for the third window, one day after the announcement to two days after the announcement (+1, +2), is -1.39%, highly statistically significant, the loss extends beyond the announcement date. Finally, for fourth window of the announcement date model, three days after the announcement up to thirty days after (+3, +30), the mean CAR, was 10.69% and is statistically significant at less than one percent level of significance. Implying the announcement do not have a long-lasting negative impact on DOW Jones stock returns.

Table 3 second panel presents the announcement of March 11th WHO's announcement of COVID 19 is a pandemic. The mean Compound Abnormal Return (CAR) of the first window for the announcement date, thirty days before the announcement to two days before the announcement (-30, -2), is -0.41% and not statistically significant. Result of the second window, one day before the announcement and the day of the announcement (-1, 0) was a mean CAR of positive 1.80%, which is highly statistically significant. This suggests that investors are not concerned about COVID19

in their decision-making process. The mean CAR for the third window, one day after the announcement to two days after the announcement (+1, +2), is 3.89%, also highly statistically significant, indicating the announcement after it happened has no negative impact on the DOW Jones stock returns in the short term. Finally, for fourth window of the announcement date model, three days after the announcement up to thirty days after (+3, +30), the mean CAR, was -3.34% and is not statistically significant. Implying the announcement do not have a either short term or long term negative impact on DOW Jones stock returns.

Table 3 third panel presents President Trump's announcement of March 13th as COVID 19 is National Emergency. The mean Compound Abnormal Return (CAR) of the first window for the announcement date, thirty days before the announcement to two days before the announcement (-30, -2), is 1.60% and highly statistically significant. Result of the second window, one day before the announcement and the day of the announcement (-1, 0) was a mean CAR of 4.00%, which is highly statistically significant. This suggests that investors are not concerned about COVID19 in their investment decision making process i.e., COVID is not a threat to the financial market. The mean CAR for the third window, one day after the announcement to two days after the announcement (+1, +2), is 0.41%, and not statistically significant, indicating no negative impact on the DOW Jones stock returns. Finally, for fourth window of the announcement date model, three days after the announcement up to thirty days after (+3, +30), the mean CAR, was -4.77% and is highly statistically significant. Implying the announcement, Trump declaring COVID 19 National Emergency, has a significant long lasting negative effect on the DOW Jones stock returns, similar to CDC's announcement, while WHO's announcement did not have any negative impact on DOW Jones returns.

Table 1: Event Study Result of **S&P 500** stock returns after COVID 19 announcements

market Model Abnormal Returns, Equally Weighted Index

**Panel I:** CDC announced COVID19 heading to be pandemic: **February 25, 2020**

| Days | N | Mean Cumulative Abnormal Return | Precision Weighted CAAR | Positive: Negative | Portfolio Time-Series (CDA) t | p-value | Uncorrected Patell Z | p-value | Generalized Sign Z | p-value |
|---|---|---|---|---|---|---|---|---|---|---|
| (-30,-2) | 509 | 0.78% | 0.55% | 268:241 | 0.396 | 0.3460 | 1.694 | 0.0451 | 0.799 | 0.2121 |
| (-1,0) | 509 | -1.24% | -1.40% | 131:378<<< | -2.388 | 0.0085 | -16.228 | <.0001 | -11.348 | <.0001 |
| (+1,+2) | 509 | -1.05% | -1.27% | 184:325<<< | -2.026 | 0.0214 | -14.741 | <.0001 | -6.649 | <.0001 |
| (+3,+30) | 509 | 4.15% | 3.58% | 320:189>>> | 2.134 | 0.0164 | 11.109 | <.0001 | 5.409 | <.0001 |

**Panel II:** WHO declares COVID19 pandemic: **March 11, 2020**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (-30,-2) | 509 | -1.09% | -2.06% | 229:280<< | -0.599 | 0.2745 | -6.419 | <.0001 | -2.562 | 0.0052 |
| (-1,0) | 509 | 1.90% | 1.92% | 350:159>>> | 4.004 | <.0001 | 22.820 | <.0001 | 8.165 | <.0001 |
| (+1,+2) | 509 | 2.38% | 2.36% | 344:165>>> | 5.006 | <.0001 | 28.053 | <.0001 | 7.633 | <.0001 |
| (+3,+30) | 509 | -3.88% | -4.62% | 197:312<<< | -2.179 | 0.0147 | -14.676 | <.0001 | -5.399 | <.0001 |

**Panel III:** Trump Declares COVID 19 National Emergency: **March 13, 2020**

| Days | N | Mean Cumulative Abnormal Return | Precision Weighted CAAR | Positive: Negative | Portfolio Time-Series (CDA) t | p-value | Z | Uncorrected Patell p-value | Sign Z | Generalized p-value |
|---|---|---|---|---|---|---|---|---|---|---|
| (-30,-2) | 509 | 0.88% | 0.03% | 266:243 | 0.527 | 0.2991 | 0.085 | 0.4660 | 0.801 | 0.2117 |
| (-1,0) | 509 | 2.50% | 2.46% | 346:163>>> | 5.683 | <.0001 | 29.531 | <.0001 | 7.893 | <.0001 |
| (+1,+2) | 509 | -0.49% | -0.64% | 260:249 | -1.114 | 0.1326 | -7.687 | <.0001 | 0.269 | 0.3941 |
| (+3,+30) | 509 | -3.60% | -3.95% | 186:323<<< | -2.189 | 0.0143 | -12.654 | <.0001 | -6.292 | <.0001 |

The symbols (,<,<<,<<< or ),>,>>,>>> show the direction and significance of a generic one-tail generalized sign test at the 0.10, 0.05, 0.01 and 0.001 levels, respectively

Table 2: Event Study Result of **NASDAQ** stock returns after COVID 19 announcement

Market Model Abnormal Returns, Equally Weighted Index

**PaneL II:** CDC announced COVID19 heading to be pandemic: **February 25, 2020**

| Days | N | Mean Cumulative Abnormal Return | Precision Weighted CAAR | Positive: Negative | Portfolio Time-Series (CDA) t | p-value | Z | Uncorrected Patell p-value | Sign Z | Generalized p-value |
|---|---|---|---|---|---|---|---|---|---|---|
| (-30,-2) | 100 | 2.12% | 1.83% | 54:46 | 0.683 | 0.2472 | 2.147 | 0.0159 | 0.732 | 0.2320 |
| (-1,0) | 100 | 0.27% | -0.33% | 41:59< | 0.325 | 0.3725 | -1.495 | 0.0675 | -1.868 | 0.0309 |
| (+1,+2) | 100 | 0.96% | 0.28% | 57:43) | 1.173 | 0.1204 | 1.264 | 0.1032 | 1.332 | 0.0914 |
| (+3,+30) | 100 | 17.24% | 14.73% | 89:11>>> | 5.646 | <.0001 | 17.644 | <.0001 | 7.732 | <.0001 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Panel II**: WHO declares COVID19 pandemic: **March 11, 2020** | | | | | | | | | | |
| (-30,-2) | 100 | 10.28% | 7.77% | 75:25>>> | 3.451 | 0.0003 | 9.343 | <.0001 | 5.006 | <.0001 |
| (-1,0) | 100 | 2.78% | 2.75% | 79:21>>> | 3.560 | 0.0002 | 12.612 | <.0001 | 5.806 | <.0001 |
| (+1,+2) | 100 | 4.11% | 4.14% | 83:17>>> | 5.251 | <.0001 | 18.963 | <.0001 | 6.606 | <.0001 |
| (+3,+30) | 100 | 0.95% | -1.13% | 46:54 | 0.324 | 0.3731 | -1.382 | 0.0835 | -0.794 | 0.2135 |
| **Panel III**: Trump Declares COVID 19 National Emergency: **March 13, 2020** | | | | | | | | | | |
| (-30,-2) | 100 | 13.16% | 10.62% | 80:20>>> | 4.572 | <.0001 | 12.846 | <.0001 | 6.017 | <.0001 |
| (-1,0) | 100 | 4.24% | 4.25% | 83:17>>> | 5.611 | <.0001 | 19.594 | <.0001 | 6.617 | <.0001 |
| (+1,+2) | 100 | 3.66% | 2.56% | 74:26>>> | 4.846 | <.0001 | 11.807 | <.0001 | 4.817 | <.0001 |
| (+3,+30) | 100 | -4.97% | -5.50% | 32:68<<< | -1.756 | 0.0396 | -6.775 | <.0001 | -3.583 | 0.0002 |

The symbols (,<,<<,<<< or ),>,>>,>>> show the direction and significance of a generic one-tail generalized sign test at the 0.10, 0.05, 0.01 and 0.001 levels, respectively.

Table 3: Event Study Result of **DOW Jones** stock returns after COVID 19 announcements

Market Model Abnormal Returns, Equally Weighted Index

**Panel I**: CDC announced COVID19 heading to be pandemic: **February 25, 2020**

| Days | N | Mean Cumulative Abnormal Return | Precision Weighted CAAR | Positive: Negative | Portfolio Time-Series (CDA) t | p-value | Uncorrected Patell Z | p-value | Generalized Sign Z | p-value |
|---|---|---|---|---|---|---|---|---|---|---|
| (-30,-2) | 31 | -1.06% | -0.90% | 11:20< | -0.413 | 0.3399 | -0.781 | 0.2174 | -1.697 | 0.0448 |
| (-1,0) | 31 | -1.45% | -1.48% | 7:24<<< | -2.148 | 0.0159 | -4.881 | <.0001 | -3.134 | 0.0009 |
| (+1,+2) | 31 | -1.39% | -1.45% | 5:26<<< | -2.064 | 0.0195 | -4.789 | <.0001 | -3.853 | <.0001 |
| (+3,+30) | 31 | 10.69% | 10.24% | 25:6>>> | 4.235 | <.0001 | 9.044 | <.0001 | 3.332 | 0.0004 |

**Panel II**: WHO declares COVID19 pandemic: **March 11, 2020**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (-30,-2) | 31 | -0.41% | -0.67% | 14:17 | -0.179 | 0.4291 | -0.603 | 0.2733 | -0.614 | 0.2695 |
| (-1,0) | 31 | 1.80% | 2.03% | 23:8>> | 2.952 | 0.0016 | 6.926 | <.0001 | 2.619 | 0.0044 |
| (+1,+2) | 31 | 3.89% | 4.12% | 24:7>> | 6.398 | <.0001 | 14.076 | <.0001 | 2.978 | 0.0015 |
| (+3,+30) | 31 | -3.34% | -4.00% | 15:16 | -1.465 | 0.0714 | -3.655 | 0.0001 | -0.255 | 0.3993 |

**Panel III:** Trump Declares COVID 19 National Emergency: **March 13, 2020**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (-30,-2) | 31 | 1.60% | 1.57% | 17:14 | 0.713 | 0.2378 | 1.420 | 0.0778 | 0.479 | 0.3160 |
| (-1,0) | 31 | 4.00% | 4.21% | 25:6>>> | 6.805 | <.0001 | 14.459 | <.0001 | 3.353 | 0.0004 |
| (+1,+2) | 31 | 0.41% | -0.03% | 17:14 | 0.705 | 0.2404 | -0.094 | 0.4626 | 0.479 | 0.3160 |
| (+3,+30) | 31 | -4.77% | -4.79% | 9:22<< | -2.171 | 0.0150 | -4.398 | <.0001 | -2.395 | 0.0083 |

The symbols (,<,<<,<<< or ),>,>>,>>> show the direction and significance of a generic one-tail generalized sign test at the 0.10, 0.05, 0.01 and 0.001 levels, respectively.

## CONCLUSION

We analyzed the effect of COVID 19 announcements by CDC, WHO and Trump/Whitehouse on the US Stock market, namely in the three major indices S&P 500, NASDAQ, and DOW Jones. All the three announcements have no immediate negative impact on all three major indices. However, the Trump/Whitehouse and CDC's announcements have longer term (three day to thirty days) seems to have a significant and negative impact in almost all three indices compared to CRSP equally weighted market stock returns. While CDC's announcement has only short term small negative effect on the S&P 500 and DOW Jones stock returns compared to CRSP equally weighted market returns. It could also be other variables such as the COVID 19 number of cases or deaths that may have impacted the stock returns in the long term.

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# MANAGEMENT AND LEADERS UNDERSTANDING COMMUNICATION DYNAMICS: THE IMPACT OF INTERNAL COMMUNICATION ON SATISFACTION, PERFORMANCE, AND MOTIVATION

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## ABSTRACT

The purpose of this survey research study was to address the reasons communications preferences of employees are often left unfulfilled. A questionnaire was administered to employees in four mid-sized companies located in the northeastern part of the United States. The researchers found that 178 respondents desire frequent, open, honest, and transparent communication from their organizations and supervisors. Furthermore, across measurements of managers and employees, men and women, Baby Boomers (approximately born from 1940 to 1964), Generation X (approximately born from 1965-1980), and Millennials (approximately born from 1981-1995) indicate they want to know how their work tasks contribute to the organization. The findings of this study indicate that knowing the reason behind task assignments can create a favorable culture and positively impact job satisfaction, performance, and motivation. Moreover, differences in understanding the *Why* behind a task existed between blue collar and white-collar employees. White collar employees had statistical differences from blue collar, indicating they desire more information about why they were assigned work assignments and how it impacts the organization. White collar employees were also more satisfied with their jobs than blue collar employees. Finally, Baby Boomers were statistically more satisfied with their jobs than Millennials.

## INTRODUCTION

Communicating with employees is often thought to be a top management priority (Young & Post, 1993; Westley 1990). Leaders influence their followers through effective communication. Therefore, good leaders are good communicators (Kouzes & Posner, 1995; Goetsch & Davis, 2016). Although internal communication is essential to management, leaders, and organizations, literature recommends further research for identifying internal communication preferences and needs of employees (Hargie & Tourish, 2009; Welch, 2011).

Workplace dynamics and the importance of employee communication have been discussed at length in the management literature but there is a need to further examine generational cohorts in the work environment (Rudolph, Rauvola, & Zacher, 2018). Job satisfaction and performance, communication in the work place, and employee motivation have become more important to managers as Baby Boomers begin to retire and Millennials take hold in the workplace. Generational cohorts, "a society-wide peer group, born over a period of roughly the same length as the passage from youth to adulthood, who collectively possess a common persona" (Howe & Stauss, 2000: 40), have become an important component of workplace vitality and relations. Literature often focuses on the differences between these cohorts, yet Deal *et al.* (2010) indicate how inclusiveness across all generations is more effective in regards to employee relations. According to Deal (2007), all generations do share common traits like a willingness to learn and a yearning to be treated well in the workplace. This same notion of inclusiveness and shared traits could be applied to factors in the work environment, such as job satisfaction and communication, across all working generations.

## LITERATURE REVIEW

### Communication in the Workplace

The literature suggests that communication is at the heart of what determines job satisfaction for employees at all levels. Mohamad *et al.* (2017) conclude that communication is an essential component for organizational performance. Likewise, Mishra *et al.* (2014) posit that internal communications provides opportunities for employees to be more engaged, thus building trust with management. This trust nurtures and creates relationships with customers, which is crucial for generating and maintaining business. Effective internal communications are the key to an organization's success as it permits strategic leaders to engage employees and achieve organizational objectives (Harter *et al.* 2002; Welch and Jackson, 2007), which is vital for any company or organization to flourish. The role of clear, concise, and effective internal communication in employees' job satisfaction cannot be under emphasized which will be further explored through this study.

Despite communication having a pivotal role in the workplace, employees' needs and preferences regarding internal communication are not being met and need further understanding (Uusi-Rauva & Nurkka, 2010, Welch 2007). This is worrisome as poor communication is a primary factor for employee dissatisfaction (Buckingham & Coffman, 1999). Furthermore, employees struggle to understand the connection between their work and the organization's goals (Carton, 2018). There is also lacking research to identify how managers and leaders can help employees understand the impact of their work tasks. This study intends to address the problem of employees' internal communication preferences being unfilled, provide management and leaders with tools to help employees see their impact, and measure the alignment between these preferences and motivation, satisfaction, and performance.

**Job Satisfaction and Performance**

**Job satisfaction and performance are at the heart of effective and efficient companies. (Bateman, 1983;** Robbins & Coulter, 2018). Kornhauser (1965) and Khaleque (1981) found that satisfaction in one's work is increasingly important to the overall physical and mental health of employees. When employees are satisfied with their job, the organization benefits from increased productivity, positive employee relationships, decreased turnover and absenteeism. (Chen et al., 2011; Chen *et al*., 2020; Vroom, 1964). These benefits are documented by a company's bottom line.

Like job satisfaction, performance on the job is often discussed relative to communication methods implemented by management. Job performance, defined as measureable actions, behaviors, and outcomes in which employees engage that contribute to the goals of the organization (Viswesvaran & Ones, 2000; Yousef, 2000), is affected by the type of communication. Literature indicates an increase in job satisfaction and job performance when employees receive open, honest, and need-based communication (Jui-Chen *et al.,* 2006; Mazzei, 2014; Pincus, 1986), which has an impact on the organization's results (Downs & Adrian, 2012). Internal communication is pivotal for organization and individual performance (Suh *et al.,* 2018). Furthermore, the implementation of open communication between management and employees is an effective way to increase employees' performance (Neves & Eisenbrger, 2012). Likewise, Garnett *et al.* (2008) validate that internal communications have a positive impact on performance. They also found management that focuses on task-oriented communication, upward communication, and performance feedback increases performance. Most importantly, Viswesvaran and Ones (2000) indicate that job performance is a main predictor companies consider when hiring talent.

**Motivation**

Motivation and internal communications are often correlated (Harris & Nelson, 2007). Employees who are highly motivated are often more driven and more successful in their work. Young *et al.* (2021) suggest that internal communication can help to increase motivation and aid in creating a shared identity amongst employees. Communication can play an instrumental role in motivating employees. Managers or employers who instituted effective and clear downward communication led to more motivated employees and created additional benefits such as efficient work teams and a productivity boost (Ancona & Caldwell, 1992; Eisenberg & Wittenm, 1987; Kirkhaug, 2010). Intrinsic motivation also increases when employees are actively sharing knowledge in the work place (Gottschalg & Zollo, 2007; Pink, 2009). In addition to generating positivity, organizations and managers should understand the needs and interests of the employees in order to properly motivate them (Harter *et al.* 2002; Lušňáková *et al.,* 2018).

**Purpose**

Communicating purpose through internal communication also can be impactful as employees desire this information (Harter *et al.* 2002; Fine, 1996; Wrzesniewski & Dutton, 2001). Often organizations communicate goals through the company's hierarchy, but letting individuals understand how their work contributes to the organization is a want of employees that is currently unfulfilled. Although setting goals for employees can generally align with organizational strategic direction, employees often get absorbed in the narrow technical aspects of a work task and their overarching impact on the organization is not understood or provided by top management (Staw & Boetgger, 1990; Westley, 1990).

Sinek (2009) believes that purpose is what motivates employees. Sinek suggests that individuals are motivated by the *Why*, a sense of purpose or belief bigger than oneself. The *why* is what motivates and inspires employees. Sinek (2017) suggests that the *why* can be a tool to communicate more clearly, although there is a need for more empirical

research to justify this notion. Inclinations in the literature suggest this concept could be worthwhile (Delcampo *et al.,* 2011, Dicannao 2021, Palmer & Blake, 2018). This study intends to investigate this concept further and add an element to see if providing the *Why* behind a task or reason for work assignments would be desired by employees and its potential impact.

## THEORETICAL FRAMEWORK

Two distinct and interrelated theories were the catalyst for this study. Motivation Theory and Expectancy Theory laid the foundation for the interpretation of data. Kanfer *et al.* (2017) recent discussion of Motivation Theory aims to connect needs, motives, desires, and interests. Current theories seek to explain why individuals pursue different goals and what guides an individual to do what they do voluntarily, and most often motivation is a key component of that decision making.

Expectancy Theory was informed by the underpinnings of Motivation Theory. Expectancy Theory has had rigorous academic testing and support and is easily understood (Fudge & Schlater, 1990). It is also a popular theory used in measuring organizational behavior, motivation, job satisfaction, and job performance (Colquitt & Zapata-Phelan, 2007; Vroom, 1964; Vroom, 1995). Expectancy Theory consists of valence, instrumentality, and expectancy. Valence consists of the view on the outcome (Vroom, 1964). Typically, individuals will weigh the desirability or attractiveness of this outcome (Van Eerde & Theiry, 1996). The perspective of this viewpoint will provide anticipated satisfaction with the completion of the outcome. Instrumentality is an outcome-outcome association (Van Eerde & Theiry, 1996). This is the belief that the completion of the first outcome is necessary to receive the second. Vroom (1964) argued that expectancy is when the person determines the risk or probability to obtain the outcome. It is an action-outcome association. The likelihood that a particular act will follow with an event. Each of these three components can positively influence motivation (Fudge & Schlater, 1999) but coincide with how the individual determines the desire and attraction weight and preference of outcomes (Vroom, 1965). The data for this study was examined through those two lenses.

### Research Questions

The following research questions were examined in this study:

1. Are managers communicating to employees Purpose, specifically the *Why* behind a task?
2. What are the communication preferences of employees and managers?
3. What effect does knowing the *Why* behind a task have on employees'
   a. motivation?
   b. job satisfaction?
   c. job performance?

## RESEARCH DESIGN

A survey research design was utilized in this study. The researcher-created questionnaire was validated by literature, a panel of experts (Research Professors, Management Professor, Operations Manager, Vice President of Mission Services, and Internal Communication Consultant), and piloted to increase the instrument's validity and reliability (Drinkwater, 1965; Malhotra, 2006; Saris & Gallhofer, 2014). Survey research can be useful as it unravels patterns, distributions, and variances amongst respondents (Kelle, 2006). The pilot study was informed by the recommendations of Forza (2002), and included areas of feedback to ensure the instructions and questions were clear, and that no misunderstanding occurred. After feedback from the pilot was analyzed, the measurements did, indeed, demonstrate strong reliability and was then sent to the convenience sample of companies.

### Instrument

The researcher-created questionnaire utilized an 18 item five-point Likert scale that ranged from strongly disagree to strongly agree. The instrument was piloted with a convenience sample of 113 people and received a 35.4% response rate. The pilot demonstrated reliability indicating Cronbach's $\alpha = 0.873$. This prompted the researcher to then send the instrument to human resources representatives at four midsize (100-999 employees) companies, who emailed it to all company employees. The questionnaire was sent to 563 employees, and a total of 178 responses were received (31.6% response rate), reliability Cronbach's $\alpha = 0.821$. The four mid-sized companies consist of a technical training company, a grocery store distributor, a manufacturing and fabrication company, and a defense manufacturer. The participating

companies were located in the northeast part of the United States. A further breakdown of responses from each company is illustrated in Table 1.

**Table 1**
**Company Classification**

| Company | Responses | Percent |
|---|---|---|
| Technical Training | *59* | 33.2% |
| Grocery Store Distributor | *47* | 26.4% |
| Manufacturing and Fabrication Company | *41* | 23.0% |
| Defense Manufacture | *31* | 17.4% |
| Total | 178 | |

**Data Analysis**

The questionnaire results were analyzed with descriptive and inferential statistics. For descriptive statistics the researcher used the commonly used measures of mean, standard deviation, and the frequency of agreement and disagreement to examine each item (Bryman & Cramer, 2011; Rahem & Darrah, 2018). The descriptive statistics were compared amongst gender, generation, and employee classification (manager vs. employees; blue collar vs. white collar). A total item correlation, weighted independent sample *t*-tests, and a one-way ANOVA were also used to measure any differences between disaggregate groups.

**Sample**

Demographic information within each company was collected and categorized into groups which included gender, generation, and employee classification responses. Respondents consisted of 58.5% males ($n = 93$) and 41.5% females ($n = 66$). Of the total respondents, Generation X represented 47.3% ($n = 79$), Millennials 29.3% ($n = 49$), Baby Boomer 19.8% ($n = 33$) and Generation Z 3.6% ($n = 6$). There was also 66.9% blue collar ($n = 119$) and 33.1% white collar employees ($n = 59$). Out of the total sample 67.6% were employees ($n = 119$) while managers made up 32.4% ($n = 57$).

## RESULTS

The findings from the questionnaire are presented in Table 2.

**Table 2**
**Survey Results**

| **Survey Item** | ***N*** | $\overline{X}_w$ | $\sigma$ |
|---|---|---|---|
| I expect honest communication from my organization. | *178* | 4.81 | .41 |
| I want my direct supervisor to be transparent in their communication with me. | *177* | 4.62 | .58 |
| I am motivated to complete tasks most commonly assigned to me. | *177* | 4.52 | .77 |
| My job motivation is positively related to my understanding of how I contribute to the organization. | *177* | 4.50 | .65 |
| I perform my job at a high level. | *177* | 4.47 | .66 |
| I like to receive feedback from my direct supervisor. | *178* | 4.47 | .61 |
| Communicating why tasks are assigned is essential to maintaining a positive organizational culture. | *178* | 4.44 | .76 |
| I prefer that my direct supervisor communicates organizational updates. | *176* | 4.41 | .71 |
| I understand how my work contributes to my organization's purpose. | *177* | 4.39 | .73 |
| I prefer that my direct supervisor makes me feel like my work counts. | *178* | 4.32 | .72 |

| | | | |
|---|---|---|---|
| My job satisfaction is positively related to my understanding of how I contribute to organizational purpose. | *178* | 4.31 | .76 |
| My job performance is positively related to my understanding of how I contribute to the organization. | *176* | 4.30 | .82 |
| I am satisfied with my job. | *177* | 4.28 | .80 |
| I like to be recognized for my accomplishments. | *178* | 4.14 | .80 |
| I prefer to know why tasks are assigned to me. | *177* | 4.00 | .87 |
| My current direct supervisor effectively communicates why I am assigned tasks. | *177* | 3.86 | 1.02 |
| I have made career decisions based on my communication preferences. | *177* | 3.66 | .95 |
| My organization transparently communicates with me. | *177* | 3.48 | 1.03 |

The reliability of this study is Cronbach's $\alpha = 0.821$. In addition to these results, a correlation of the highest rated items is provided in Table 3. The table displays results with Corrected Item – Total Correlation, which demonstrates the correlation between each item and overall score (Bohrnstedt, 1969). The closer to 1, the stronger the correlation. The highest correlated items are presented in Table 3.

**Table 3**
**Highest Correlated Items**

| Survey Item | Corrected Item – Total Correlation |
|---|---|
| My job satisfaction is positively related to my understanding of how I contribute to organizational purpose. | *.569* |
| My job motivation is positively related to my understanding of how I contribute to the organization. | *.524* |
| My job performance is positively related to my understanding of how I contribute to the organization. | *.506* |

Weighted Independent sample *t*-tests were generated from the total correlation measures. The *t*-tests compared managers and employees, men and women, and across Baby Boomers, Generation X, and Millennials. The results of the comparisons showed no significant differences, indicating that all groups prefer to understand how their work is contributing to their organization, and understanding their contributions positively impacts job satisfaction, job motivation, and job performance.

However, when investigating if employees were satisfied with their jobs, a one way ANOVA with three levels (Boomers, Generation X, and Millennials) revealed that there was a significant difference $F(2, 157) = 3.697$, $p = 0.027$. Bonferroni post hoc tests displayed that Boomers ($M = 4.59$) were statically more satisfied with their jobs then Millennials ($M = 4.12$), $p = 0.024$, while Generation X ($M = 4.25$) had no statistical difference with Baby Boomers or Millennials.

There were also significant differences between blue collar and white-collar employees through the Weighted Independent Samples *t*-tests. The summary of these differences is illustrated in Table 4.

**Table 4**
**Weighted Independent Samples T-tests Summary**

| Measure | Company | *N* | $\overline{X}_w$ | $\sigma$ | *T* | *df* | Sig |
|---|---|---|---|---|---|---|---|
| My job motivation is positively related to my understanding of how I contribute to the organization. | Blue Collar | 118 | 4.47 | 0.63 | 1.070 | 175 | 0.289 |
| | White Collar | 59 | 4.58 | 0.67 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| My job satisfaction is positively related to my understanding of how I contribute to organizational purpose. | Blue Collar | 119 | 4.14 | 0.76 | 4.223 | 176 | **0.000** |
| | White Collar | 59 | 4.63 | 0.66 | | | |
| My job performance is positively related to my understanding of how I contribute to the organization. | Blue Collar | 119 | 4.20 | 0.82 | 2.365 | 174 | **0.020** |
| | White Collar | 57 | 4.51 | 0.80 | | | |
| I prefer to know why tasks are assigned to me. | Blue Collar | 118 | 3.89 | 0.86 | 2.444 | 175 | **0.016** |
| | White Collar | 59 | 4.22 | 0.82 | | | |
| I am satisfied with my job. | Blue Collar | 118 | 4.19 | 0.80 | 1.984 | 175 | **0.049** |
| | White Collar | 59 | 4.44 | 0.77 | | | |

From Table 4, it is evident that white collar employees have different communication preferences than blue collar employees. White collar employees have significantly higher preferences for knowing *Why* they are assigned tasks than blue collar employees. Furthermore, white collar employees have higher expectations of understanding how they contribute to the organization, and that has a positive effect on job satisfaction and performance. Also, white collar employees are statistically more satisfied with their job than blue collar employees.

## DISCUSSION OF THE FINDINGS

*Research Question 1:* Are managers communicating to employees' purpose, specifically the *Why* behind a task?

The results from this study indicate that managers are not communicating to employees the reasons they are assigned responsibilities, and organizations often lack transparency in communication to employees. The third lowest survey item was "My current direct supervisor effectively communicates why I am assigned tasks" ( $\overline{X}_w$ = 3.86), and the lowest survey item was "My organization transparently communicates with me" ($\overline{X}_w$ = 3.48). The organization and management serve as the two social exchange relationships that employees have with their work (Masterson *et al.,* 2000). For employees to fully comprehend organizational goals and objectives, managers and organizations must communicate effectively (Holtzhausen & Zerfass, 2015). Company leaders must be cognizant that a lack of transparency ultimately affects a company's productivity (Delcampo *et al.,* 2011; Men & Stacks, 2014). Moreover, Truss *et al.* (2006) assert that managers lack the ability to make employees feel as if their work counts, has meaning, or shows how they impact the bottom line. This trend was supported by this research.

Interestingly enough, although employees are not receiving their purpose from the organization or management, employees are still finding it. The question, "I understand how my work contributes to my organization's purpose" ($\overline{X}_w$ = 4.39), which illustrates employees' perceptions of their contribution as important. Finding a purpose bigger then oneself in work is often what motivates and inspires people (Evans *et al.*, 2021; Sinek, 2009; Schabram & Maitlis 2017). When employees understand the impact or reasons behind work assignments (Delcampo et al. 2011; Dicianno, 2021; Harter *et al.* 2002), employees are more satisfied, and effort in this area could dramatically improve management and employee relations.

It was also evident that the employees believe understanding the purpose of their work creates a positive culture, as one survey item received high ratings, which was "Communicating why tasks are assigned is essential to maintaining a positive culture" ($\overline{X}_w$ = 4.44). Organizational culture consists of communication patterns and networks (Ireland & Hitt, 2005) and leadership can establish an effective organizational culture (Boal & Hooijberg, 2000; Kim & Chang, 2019). When a successful organizational culture is created, employees feel a sense of understanding how they fit into the corporation puzzle and this can be used as a competitive advantage. This finding should prove beneficial for managers, leaders, and organizations. Research also indicates that Millennials, Generation X, and Baby Boomers were more likely to be satisfied with their job if they had a positive culture (Stewart *et al.,* 2017).

*Research Question 2:* What are the communication preferences of employees and managers?

Survey results suggest that employees want honest and transparent communication from their organization and managers. The survey items "I expect honest communication from my organization" ($\overline{X}_w$ = 4.81), and "I want my direct supervisor to be transparent in their communication with me" ($\overline{X}_w$ = 4.62). Dasgupta, Suar, & Singh (2013) indicate that job performance can be enhanced with open, honest, and needs-based communication, which supports the findings in this study. Moreover, Rawlins (2008) suggests that companies should be more open, honest, and transparent as such behaviors can build trust with employees.

Furthermore, employees want feedback from their supervisor ($\overline{X}_w$ = 4.47) and want organizational updates ($\overline{X}_w$ = 4.41). These findings align with Neves and Eisenbrger's, (2012) study that indicate managers who openly communicate with employees increase employee's performance. Furthermore, Myers and Sadaghiani (2010) found that millennials favor frequent and open communication with their supervisors. This study builds on this notion as Baby Boomers and Generation X have similar preferences.

*Research Question 3:* What effect does knowing the *Why* behind a task have on employees'

a. motivation?
b. job satisfaction?
c. job performance?

The results of the survey indicated that the *Why* behind a task has a positive impact on motivation ($\overline{X}_w$ = 4.50), job satisfaction ($\overline{X}_w$ = 4.31), and job performance ($\overline{X}_w$ = 4.30). This is further validated with the results from the total correlation, as these items had the highest correlation within the survey. Employees are more motivated when they understand why they are asked to perform a particular task and employees' satisfaction with their job and performance is ultimately enhanced when with provided the reason for task assignments.

The findings in this study suggest that employees want to know how they are contributing to the company and this has a positive effect on motivation, satisfaction, and performance. Argenti (2017) found that constant and consistent communication aligns employees to the organization and when employees comprehend strategies, they often believe it is in their benefit to enhance the company's objectives and interests. Furthermore, Berggen and Bernshteyn (2007) posit that in order to improve employee performance, companies should openly communicate goals. The findings of this study build on this notion as employees should not only know the goals but understand the reason for them and the impact these goals have on the organization.

## LIMITATIONS OF THE STUDY

The generalizability of this study is a limitation because the majority of the respondents were located in the northeastern United States, which limits the ability to generalize to other parts of the country and/or other midsize companies. Also, some employees may not have answered honestly out of fear of repercussions from their company. Although unique identifiers were removed, and no individual data was shared, this could still have an impact on respondents' truthfulness. This study does not account for the pre-existing factors such as employee-manager relationships and previous work ethic of employees, which could affect results.

## IMPLICATIONS

### Managerial Implications

Although there is an argument that management and leadership are different from one another (Kotter, 1990), communication still serves an integral role for management (Harmon *et al*., 2015; Mintzberg, 1973; Mintzberg, 1994; Young & Post, 1993), leadership (Jansen *et al.,* 2009; Northouse, 2019), and organizations (Hargie & Tourish, 2009; Smidts *et al.,* 2001; Welch, 2012). This study addresses the problem that employees' communication preferences are left unsatisfied. It is evident that one of the main reasons internal communications are left unfilled is the high expectations for honest and transparent communication from their organization compared to what they are experiencing, which does not meet those honesty and transparency expectations. In addition, employees desire frequent, open, honest, and transparent communication from their organizations and supervisors, and want to know

how their work connects to the organization's purpose (the *Why* behind a task). If they are given that connection, it could have a positive impact on motivation, job performance, job satisfaction, and workplace culture.

To add to this argument is the concept of generational differences. For instance, Millennials were less satisfied with their jobs than Baby Boomers, and blue-collar workers were less satisfied than white collar workers with their employment. Blue and white collared employees also differed with regard to desire to know how their work may have contributed to the organization's purpose. White collars employees were statistically significantly higher with regard to knowing how their work contributed to the organization. Overall, the results indicated, that the *Why* positively impacted motivation and job performance compared to blue collared employees.

**Theoretical Implications**

Typically, expectancy theory is viewed through an extrinsic motivation lens in research, and that was the intent with its origins (Isaac *et al*., 2001; Vroom, 1964; Vroom 1995). However, this study applied expectancy theory from an intrinsic lens. With expectancy theory, typically, some extrinsic outcome such as a bonus with pay or promotion is connected with the event (Vroom 1995). This study applied expectancy theory through an intrinsic lens to understand the impact of employees' work on the company which served as an intrinsic outcome. Vroom (1964) believes that individuals will put forth more effort towards a task if they value the outcome, and once completing the assignment the anticipated levels of satisfaction will be received, if they were viewed as desirable.

Although Vroom (1964) argues that his theory is not in the parameters of intrinsic motivation, this research study found expectancy theory to be valid from the intrinsic lens as well. If employees value their impact on the organizations' purpose, they provide more effort, their performance is enhanced, and it aids in satisfaction. Therefore, they view making an impact on the company with their work assignments as a desirable outcome. More research would have to be conducted to determine if satisfaction occurs after the task is completed, as expectancy theory suggests and how they measure the probability of the outcome positively effecting the company. Still, the findings show it aids in positive satisfaction. This study found a way of applying expectancy theory with intrinsic motivation lens which is a new development by communicating the purpose and impact behind work task assignments

## FUTURE RESEARCH

The majority of the participants in this study were located in the northeast part of the United States. It would be beneficial to increase the sample size of this study, aggrandize to different locations, and expand to other types and sizes of companies. It would also be beneficial to measure Generation Z's internal communication preferences as they become more prevalent in the work force and compare those findings with this study. More studies are needed to understand and contextualize why Millennials are not as satisfied with their jobs compared to Baby Boomers. Moreover, understanding the differences with the *Why* behind a task and job satisfaction between blue collar employees and white-collar employees would be valuable for organizations.

## SUMMARY

The results indicated that employees have a high expectation for open and transparent communication from their supervisor and organization. The results further specified that employees desire purposeful, frequent, open, honest, and transparent communication from their organization and supervisor. These preferences were the same across generations (Baby Boomers, Generation X, and Millennials), managers and employees, and gender. Employees in these cohorts also indicated if they know how their work contributes to the organization (*Why* behind a task), it can positively impact culture, job performance, satisfaction, and motivation.

The results also exhibited that white collar and blue-collar employees had differences regarding their job satisfaction and communication preferences. The white-collar employees have a higher desire of why they are assigned tasks compared to blue collar employees. Although this information did not differ with the impact on motivation, differences were found regarding performance and satisfaction. Furthermore, it also disclosed that white collar employees were more satisfied with their jobs than blue collars. The results also found that Baby Boomers were more satisfied with their jobs than Millennials.

This information can be extremely beneficial as effective internal communication is critical to a company's success (Krogh *et al.,* 2000; Welch and Jackson, 2007; Witherspoon, 1997) and is viewed as a critical component for employee and management relations. Furthermore, the results provide simple but effective techniques that can be fruitful for managers as they are typically time-starved (Hall & Lawler, 1970; Kotter, 1982; Mintzberg 1973) and can be applied to a broader audience of employees.

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# A FIRM'S PRODUCTION, COST AND PROFIT: A SYSTEMS-BASED AXIOMATIC APPROACH

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## ABSTRACT

This paper looks at how an individual firm's system of values and beliefs, as reflected in the firm's mission statement, influences the firm's decision making. Based on a minimal level of intuition and common knowledge, four axioms are adopted as the starting points for deriving consequent conclusions, while explaining why other commonly employed assumptions should be abandoned. On the backdrop of a set-theoretic setup, the concepts of production and profit functions are investigated innovatively so that unnecessary assumptions, widely appearing in the current microeconomic theory, can be naturally avoided. Other than generalizing several known results in producer theory, such as Hotelling's Lemma, examples are introduced to show that these known results are not universally true when different systems of values and beliefs are considered. This work concludes with several suggestions for future research of expected significance.

## INTRODUCTION

The topic of how an economic agent makes decisions has been widely studied by many scholars from different disciplines, such as psychology, economics, management, etc. Although a more or less standardized procedure has been commonly developed in such studies (e.g., Forrest & Liu, 2021; Friedman, 1953; Gilboa, 2010; Gul & Pesendorfer, 2008), it has been confirmed again and again many times that this procedure is unable to capture real-life scenarios. For example, after experiencing great losses during the 2008 financial crisis, Paul Krugman provided his point of view regarding why the existing economic theories are incapable of describing, predicting and providing explanations in a timely manner on what had happened in the past and what would follow next. To this end, he commented in *New York Times* (2009-09-02) that: "… economists, as a group, mistook beauty … for truth … as memories of the Depression faded, economists fell back in love with the old, idealized vision of an economy …" That is, the following question arises naturally at the basic level underneath all investigations of decision making: To avoid the history of repeatedly falling back to treating impressive-looking beauty as truth, what can one do to alter the devastating setup of the existent theories at the most fundamental level so that all these theories can be rebuilt on a fresh start with the expectation that they will be more practically useful than before?

The importance of this question is evident, as soon as we look at the human sufferings and economic losses experienced during each economic crisis. And, it is also well witnessed by the vast amount of related literature in the name of decision making with various assumptions closely scrutinized (e.g., Hudik, 2019; Lovett, 2006; Rubinstein, 1998; Weyl, 2019). In other words, both practical and theoretical fronts have loudly called for scholars to reconstruct relevant theories, especially economic theories, so that more practically tangible benefits can be materialized.

This paper represents one step towards completely addressing the aforementioned question of fundamental importance. It examines a list of common assumptions widely adopted in the producer theory (Debreu, 1959; Levin & Milgrom, 2004; Mas-Collel et al., 1995) by applying the recent development on the natural endowments of a firm – self-awareness, imagination, conscience and free will (Forrest, Gong et al., 2021). It analyzes which of the assumptions are acceptable and which ones are problematic. After specifying four acceptable assumptions as axioms, the rest of the paper uses analytical means and systemic logical reasoning to establish conclusions under fewer conditions that generalize some well-known results established before under more strict conditions.

Beyond what is described above, one important highlight of this paper is its emphasis on the existence of a firm-specific order relation of real numbers and that of a firm-specific method of optimization. More specifically, each firm has its own particular means to prioritize the alternatives available in a decision-making situation, and very individual way to optimize its objectives. This end is very different from the assumptions widely employed in the literature, where the ordering of real numbers and the method of optimization, although some of the particular details are different, are the same no matter who the decision maker is.

Because of the novelty of how we look at related issues and concepts, this paper is able to discover the missing conditions under which some of the very basic properties of a firm' production and profit functions satisfy; and it is able to generalize a few well-known results of the producer theory to stronger versions. The established conclusions in this paper reveal the fact that firms with different systems of values and beliefs naturally make different choices when facing the same challenge or opportunity even when they are limited by the same set of constraints. In other words, this paper contributes to the literature through showing when additional conditions are needed for a desired conclusion to hold, and when a well-known conclusion holds true only under very specific conditions.

The rest of this paper is organized as follows. The following section prepares the reader for the entire presentation of this work by citing results on a firm's natural endowments and decision-making and by setting up the basic notations. After singling out four basic axioms that are intuitively correct in the business world and discussing how and why several other main assumptions adopted in the literature are not generally true, we pay a close visit to the concepts of production and profit functions and their elementary properties. On the basis of these results, the well-known Hotelling's Lemma is generalized and a general conclusion that majorly expands a main conclusion of the microeconomic theory is established. Then, the paper is concluded with several pointers to some important questions for future research.

## PREPARATIONS

This section consists of two subsections. The first one cites the key concepts and known conclusions needed for the smooth development of the rest of the paper. And the second subsection introduces the basics of our modeling of a firm that produces and offers a set of goods to the product market.

### A Firm's Natural Endowments and Decision Making

It is well-known that the concepts of self-awareness, imagination, conscience and free will have been seen as the four natural endowments each individual person possesses (Lin & Forrest, 2012). Parallel to these concepts that are defined for individuals, for a firm Forrest et al. (in press, 2021) develop a set of corresponding concepts, which, for convenience, are named with the same terms, respectively. Specifically, for a firm, its self-awareness stands for the firm's cognizance that it exists as an entity of business that is different and separate from other entities with its business strategies and secrets, such as the emphasized value propositions for customers, operational procedures, protected designs of products, among others. For a firm, its imagination defines the firm's facility to acquire and to master newly discovered facts, to originally envision what offer will be appropriate for the market, such as a completely new or an improved product, and to configure the needed method of materially producing the envisioned offer. For a firm, its conscience represents the firm's capability to tell which effort would be more advantageous than other efforts within the constraints. For a firm, its free will describes the firm's ability to keep promises, how to keep and to what degree to keep these promises, as reflected in its contracts with the partners within its supply-chain ecosystem. As is well-known from real-world experiences (McGrath, 2013), although each firm naturally possesses these natural endowments, how well a firm can mobilize these endowments is different from one firm to another. That explains why some firms do well in certain aspects of business while not as well in other aspects. Real-life examples to confirm this end are plentiful. For instance, in any economic sector, there are a few companies that dominate the market while others do not seem prominent or matter at all.

By employing systems science and its logic of thinking, Forrest et al. (in press) derive the results below, when these scholars investigate the rationality assumption (e.g., Friedman, 1953; Gilboa, 2010; Hudik, 2019):

- A firm's mission clearly states how the firm's efforts should be oriented, at least partially.
- For a firm, the rationality assumption means the selection of a best choice among available options with the so-called best defined by the firm's natural endowments.
- The system of values and beliefs is different from one firm to another.
- To make decision, a firm optimizes its potential within the limit of given constraints, where the optimization is done consistently with the firm's values and beliefs.

**Example 1**. To understand the significance of these systemic conclusions, let us cite a situation of networks from the literature (Hu, 1982; Lin, 1999, p. 136) with relevant background modified slightly. This modified situation shows

that the particularly adopted methods of optimization can be firm-specific and different from one firm to another. The differences are rooted in those found in the firms' respectively varied systems of values and beliefs. And these differences can readily produce different decisions.

Assume that a firm's market offer is produced by going through a series of steps. Assume that the sequential steps can be depicted by using the network in Figure 1. The firm desires to keep the summed weights of the chosen path from node A to node C to be minimum.

Case 1: The firm's system of values and beliefs allows real numbers to be ordered in the same way as the conventional one. Therefore, the path $A \to A_1 \to B \to C_1 \to C$ is the one the firm wants to adopt. In comparison, other paths from node A to node C have weights 2, 3, and 4, respectively, while the weight of the selected path is 1.

Case 2: The firm's system of values and beliefs determines that real numbers are ordered by the mod4 function. In particular, for two arbitrary real numbers $x$ and $y$, $x \leq y$ if and only if $x(\text{mod}4) \leq y(\text{mod}4)$. In this case of production decision making, the path $A \to A_2 \to B \to C_2 \to C$ is what the firm looks for. Specifically, this path has weight 3 + 0 + 0 + 1 = 4 (mod 4) = 0, while other paths have weights 1, 2, or 3, respectively.

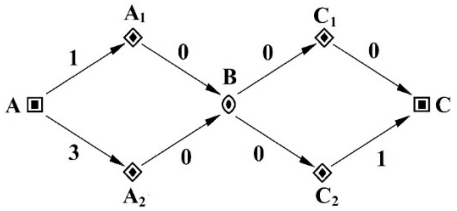

Figure 1. The concept of minimum can be defined differently

Before we summarize some key takeaways from this example, let us first address the following question: Where does one see modular functions. such as the mod4 function above, in real life? As a matter of fact, such operations appear frequently in different walks of life, such as 12-hour clocks, 7-day weeks, months of various numbers of days, where the first case involves a mod12 function, the second case deals with mod7 function, and the third case involves a combination of mod28 (or 29), mod30 and mod31 functions. And, what is more general than these examples are the durations of projects a firm is involved in. In particular, when a firm begins a new project, it starts a new round of counting (of, say, costs, profits, etc.) and/or measurement (such as how success a newly adopted business model will be).

A second related question that arises naturally with the previous example is why different systems of values and beliefs dictate their correspondingly varied ways to order real numbers. This end can be illustrated readily with the following real-life scenario of comparing two different incomes – one in the amount of \$30 K and the other \$3 million. Evidently, without involving systems of values and beliefs, one would naturally order \$30 K < \$3 million. However, if the information behind these amounts are known as follows: the first amount of \$30 K is the income from a lawful employment, while the second amount of \$3 million is the gain from robbing a bank, and if systems of values and beliefs are considered, a lot of people will order \$30 K > \$3 million. Other examples can be easily constructed if one considers corporate social responsibilities (for a description of this concept, see, e.g., Fahimnia et al., 2015). That is, each system of values and beliefs orders real numbers in its specific way.

To recapture what the previous example indicates, we see that different systems of values and beliefs dictate formulations of different priorities, such as different ways to order real numbers; and different definitions of priorities point to different approaches of optimization. That in turn generally leads to different optimal decisions. Underneath all these sets of differences is the fundamental difference in individuals' systems of values and beliefs. In terms of the theory of optimization, this example clearly says that even when the objective function of a business situation is the same in the eyes of different decision makers, the criteria of priority or approaches of optimization can be different from one decision maker to another. This end supplements the statement (Mises, 1949, p. 244) that "the value judgements a man pronounces about another man's satisfaction do not assert anything about this other man's satisfaction. They only assert what condition of this other man better satisfies the man who pronounces the judgement." In terms of neoclassical economics, the economist asserts this other man's condition that better satisfies the economist, if we rephrase what Example 1 says in the language of Mises. That surely represents one source of uncertainties and

risks the economist experiences or takes when he draws conclusions and makes claims, if the other man pursues after his own desires as driven by his values and beliefs, which is mostly the case in real life (Taylor, 1989), instead of what the economist believes and expects.

To accommodate what is observed above, for the rest of this paper, we assume that for each firm, its system of values and beliefs dictates how real numbers are ordered, especially those real numbers within the domain $D$ of decision-making activities. For a firm's, named $F$, ordering of real numbers, we use the symbol $\leq_F$ to denote less than or equal to, the symbol $\geq_F$ greater than or equal to, and the symbol $=_F$ for equality.

**Activities of the Firm**

For the sake of convenience of communication, this paper focuses on a randomly selected firm, known as the firm. As form of viable life, the firm does absorb inputs from the outside world, while gives off outputs into the environment. If it inputs an amount $x$ of a certain commodity by paying a unit price $p_x$ (or simply price), the firm then generates a debit in the amount of $xp_x$ in its account. And in the opposite direction, if the firm peddles one output (or commodity) in the amount of $y$ at price $p_y$, it produces a credit in the amount of $yp_y$ in its account.

Let us refer to all commodities the firm receives from others as inputs, and offers it provides to others as outputs. Then, the amounts of commodities, both received and given off, can be written as a vector. To distinguish inputs and outputs in such a vector, we use negative numbers to represent the quantities of the former, because debits appear for the firm from these inputs. And, we employ positive numbers to represent the quantities of outputs, because these outputs represent the firm's revenues. To make the following reasoning go smoothly, assume that in the (product) marketplace, all commodities can be exchanged readily. And, assume that all commodities are linearly ordered and respectively labelled as 1, 2, …, $\ell$. As common done in economic analysis (e.g., Pancs, 2018), assume that the quantity of each input or output commodity is a real number.

Corresponding to the vector convention given above, let $p = (p_1, p_2, \dots, p_\ell)$ be a price system and $c = (c_1, c_2, \dots, c_\ell)$ a vector of input and output commodities. Without causing confusion, $p_h$ will stand for the unit price of commodity $h$, while $c_h$ the amount of the same commodity involved with the firm's operation. Therefore, within the firm's account, there is an overall cash flow $p \cdot c = \sum_{h=1}^{\ell} p_h c_h$, where the dot $\cdot$ means the dot product of vectors $p$ and $c$. Based on the convention given above, let us assume that each price system $p = (p_1, p_2, \dots, p_\ell)$ contains only positive components, because when each commodity is market exchanged, the acquisition of any commodity will have to cost money. At the same time, most of the components of the commodity vector $c$ would be zero, because the firm only involves as its inputs and outputs a limited few commodities.

In terms of commodities, they are generally time sensitive and location specific. That is, when the time and location of delivery are different, a same commodity will be seen as different. As what is done in real life, the time axis consists of intervals of equal length, each of while stands for when a delivery takes place so that the time moments within an interval are not distinguishable. Similarly, the land is divided into a finite number of locations, in each of which exchanged commodities are delivered. That is the reason why when a commodity is available at different times and/or exchanged hands at different locations, it is seen in this paper as different commodities. Additionally, commodity prices are the present values with interests and discounts over time omitted to abridge the analysis in the following sections. And, similarly, the value of money at different locations is ignored.

For our chosen firm, its business operation consists of selecting a plan of production that specifies how much each commodity it either consumes itself or offers to the market. That is, the firm's plan $y = (y_1, y_2, \dots, y_\ell)$ of action is to select an element from the Euclidean space $\mathbb{R}^\ell$, representing the quantities of commodities the firm either consumes or offers, where $\mathbb{R}$ is the set of all real numbers and the subscripts 1, 2, …, $\ell$ denote the individual commodities. So, the price of action $y$ is given by $p \cdot y = \sum_{h=1}^{\ell} p_h y_h$, where $p = (p_1, p_2, \dots, p_\ell)$ is the price system of the commodities and $y_h$ the quantity of commodity $h$ (= 1, 2, …, $\ell$). Specifically, $y_h = 0$ means that the firm neither consumers nor produces commodity $h$.

By considering its constraining boundary conditions, the firm picks such a plan of action that optimally fits its unique system of values and beliefs. The idea of maximizing profit, as mostly deliberated in literature, represents the demand of one such particular system of values and beliefs that the ordering of real numbers is identical to the conventional

one. In the rest of this paper, $Y$ stands for the firm's set of all feasible production plans or simply productions. In other words, if $y \in Y$, then $y$ is a production possibility for the firm to technically materialize and meets the firm's moral codes, as defined by its system of values and beliefs.

At this junction, one needs to note that there are two different binary relations, $\leq$ and $\leq_F$, in the play here. One is defined on $Y$ such that $x, y \in Y, x \leq y$ if and only if for each $h = 1,2, \dots, \ell$, $x_h \leq y_h$. And the other is the firm-specific ordering $\leq_F$ of real numbers. Evidently, we cannot assume that $\leq$ is rational (i.e., $\leq$ is complete, transitive and reflexive) as assumed by Mas-Collel et al. (1995) for the preference relation of a consumer on his set of all possible consumptions. Since $\leq_F$ represents firm $F$'s specific priorities defined for the real-number domain $D$ of decision-making activities, when no confusion appears, assume that $\leq_F$ satisfies: (i) transitivity (for $x, y, z \in D$, if $x \leq_F y$ and $y \leq_F z$, then $x \leq_F z$); (ii) reflexivity (for $x \in D$, $x \leq_F x$); and (iii) anti-symmetry (for different $x, y \in D$, $x \leq_F y$ and $y \leq_F x$ cannot hold true at the same time). In short, conditions (i) – (iii) are not equivalent to assuming that the firm considered in this paper is rational for the research economist who asserts conditions that satisfy his optimal possibility, as so phrased in the language of Mises (1949).

## BASIC AXIOMS AND SOME OF THE COMMONLY ADOPTED WHILE UNREALISTIC ASSUMPTIONS

This section examines the most fundamental assumptions that have been adopted in the development of microeconomic theory (Mas-Collel et al., 1995). It first formulates some of the most intuitive business experiences into axioms that will be used as the starting points of logical reasoning. And then it discusses why other commonly implemented assumptions should not be employed any further if we desire to develop an economic theory that will be more practically useful (Forrest & Liu, 2021).

### A Set of Fewest Necessary Axioms

Without loss of generality, in the rest of this paper, the firm of our concern is assumed to satisfy the properties listed in the following Axioms 1 – 4 without further explicit declaration. And, the names of these axioms are adopted from either Debreu (1959) or Levin and Milgrom (2004).

**Axiom 1** (The possibility of inaction). The firm has the option of not making any production plan and not carrying out any production. Symbolically, what is axiomatized is $0 \in Y$.

This axiom evidently holds true for any existing firm, because when a challenge or an opportunity appears, taking no action for the moment temporarily is surely one strategy the management can adopt. When a firm has no past and does not expect to have any future, then this possibility of inaction axiom simply means that there are no stakeholders that are closely tied to the fortune of the firm. Hence, the firm can simply choose to spend no resources on the production of anything, a state of shut down (Levin & Milgrom, 2004).

**Axiom 2** (Free disposal). Although inputs are increased, the firm can choose to produce less. Symbolically, what is axiomatized here is that if $y \in Y$ and $y' \leq y$, then $y' \in Y$, where $y' \leq y$ means that for each $h = 1,2, \dots, \ell$, $y'_h \leq y_h$.

This axiom is rephrased based on (Levin & Milgrom, 2004). It is similar to the possibility of inaction axiom regarding the freedom the firm has about what it could do in its business operation and its production decisions.

**Axiom 3** (Impossibility of free production). The real-life implementation of any non-zero production plan has to use certain amounts of some inputs, such as labor, work space, etc., and produce certain outputs, such as waste, if nothing useful. Symbolically, what is axiomatized is

$$\forall y \in Y\big(y \neq 0 \rightarrow y_{h_1} < 0 \text{ and } y_{h_2} > 0, \text{for some commodities } 1 \leq h_1, h_2 \leq \ell\big). \tag{1}$$

This end can be rewritten equivalently as follows

$$Y \cap \left(\mathbb{R}^\ell - \mathbb{R}^\ell_+\right) = \{0\} = (-Y) \cap \left(\mathbb{R}^\ell - \mathbb{R}^\ell_+\right), \tag{2}$$

where $\mathbb{R}_+$ is the set of all positive real numbers, and $-Y = \{(-y_1, -y_2, \dots, -y_\ell): (y_1, y_2, \dots, y_\ell) \in Y\}$.

This axiom can be generally and readily justified as follows: Even for an output (or goods) that can be produced without applying any physical commodity as input, if such an output exists in the real world, at least some manpower is needed to have the availability of the output known to the participants of the marketplace. That is, human labor, as a commodity input, is still needed for this fictitious case.

**Axiom 4** (Irreversibility of production). No production can be reversed, meaning that if a vector $c^{in}$ of inputs leads to the production of a vector $c^{out}$ of outputs, then when $c^{out}$ is applied as inputs, it does not lead to the production of $c^{in}$. Symbolically, what is axiomatized is

$$Y \cap (-Y) = \{0\}. \tag{3}$$

By considering how commodities tend to be dated and how labors and talents can likely be specific, these inputs in real-life just cannot be produced by reversing any production process. In particular, to produce output vector $c^{out}$, the vector $c^{in}$ must contain such inputs as particularly dated commodities, such as labor, talents and others that are just not possible to produce the inputs in vector $c^{in}$ by using commodities in $c^{out}$.

At this junction, one should note that Axioms 1 – 4 above are first introduced by referencing to actual business scenarios that are mostly true in real life and then symbolized by using commonly adopted notations in mathematics. In comparison, the literature tends to take the opposite direction. In particular, the literature first introduces various assumptions so that a certain chosen mathematical theory can be smoothly applied. Some of these assumptions are then given related economic meanings, while the justification for adopting other assumptions is simply omitted with or without such a statement saying that these are needed in order to take advantage of the chosen mathematical theory. By borrowing the metaphor from Lin and OuYang (2010), the comparison between our approach and that of the literature can be described as follows: The former is like the situation of choosing a pair of shores that fit our feet, while the approach widely appearing in the literature represents the opposite: trim our feet to fit a chosen pair of shoes.

**Reasons for Not Using Other Commonly Adopted Assumptions**

Conventionally, to derive "beautiful" conclusions, assumptions, additional to the ones listed above, are introduced for the purpose of establishing economic theories that are full of impressive-looking mathematics, as Paul Krugman commented in *New York Times* (2009-09-02). For example, (i) the production possibility set $Y$ is assumed to be closed in $\mathbb{R}^\ell$ (Debreu, 1959; Levin & Milgrom, 2004; Mas-Collel et al., 1995); (ii) the set $Y$ is convex (Debreu, 1959); and others. In the rest of this subsection, we explain why this work avoids these assumptions.

First, let us examine the assumption that $Y$ is closed in $\mathbb{R}^\ell$. It means that for any sequence $\{y^q\}_{q=1}^{\infty}$ of productions that are feasible for the firm, if the sequence is convergent, then the limit $\lim_{q\to\infty} y^q = y^0$ is also a feasible production of the firm. However, this end is generally untrue in the real-life business world. For example, productions of semiconductor microchips have led to smaller and smaller chips. If we write the corresponding productions as $y^1$, $y^2$, $y^3$, …, then $\{y^q\}_{q=1}^{\infty}$ converges to $y^0$, which would produce microchips of size 0. Evidently, such a chip that will be materially used in various electronic products does not physically exist. So, such an imagined production is not feasible for any firm.

Second, let us look at the assumption of additivity, that is, $(Y + Y) \subset Y$, where $Y + Y = \{y^1 + y^2: y^1, y^2 \in Y\}$ (Debreu, 1959, p. 41). As above, this assumption is not true in general. One reason for this end is that this assumption implies that the firm cannot produce any profit other than potentially experiencing losses. In particular, assume that for a price system $p$ of commodities, there is a production $y \in Y$ such that

$$p \cdot y = \max_{y^q \in Y} p \cdot y^q > 0,$$

where $>$ represents the conventional ordering relation between real numbers and it is assumed that the firm's system of values and beliefs complies with the conventional ordering of real numbers. If the assumption of additivity holds true, that is, if $(Y + Y) \subset Y$, then for $z = 2y \in Y$, one has the following

$$p \cdot z = p \cdot 2y > p \cdot y = \max_{y^q \in Y} p \cdot y^q,$$

a contradiction. In other words, the assumption $(Y + Y) \subset Y$ implies that no production $y \in Y$ can lead to a positive profit; otherwise the contradiction, as displayed above, appears. However, if the firm does not have any production plan that can help the firm make a profit, then this firm cannot exist in real life, even for those modern firms, which, other than promises of great futures, have been losing money year after year since their initial launches (Li & Ma, 2015). Another reason for this assumption to fail generally is because when the inputs $y^{1\,in}$ in $y^1$ and those $y^{2\,in}$ in $y^2$ are added, some of the summed inputs may very well be beyond the firm's capability to handle. To this end, Forrest and Liu (2021, p. 114) developed the following result:

**Proposition 1.** For two opposing business goals A and B, any interaction between the mutually exclusive sets X and Y of resources, where resources in X lead to the realization of goal A and those in Y help actualize goal B, tends to produce undesirable effects.

For example, when the same amount of labor input, say X, is individually needed for either production $y^1$ or production $y^2$, then X + X = 2X can likely be more than the amount of labor available to the firm. That is, although $y^1$ and $y^2$ are both feasible to the firm, $y^1 + y^2$ is not. For relevant literature, the study on interacting capabilities related to new product developments, customer management, and supply-chain management suggests that trade-offs may be involved among different resource inputs (Ramaswami et al., 2009). In terms of capabilities purposefully developed for exploiting a set of proven successful competitive advantages generally do not work right with those introduced for constantly discovering new competitive advantages (McGrath, 2013). On the other hand, if two productions $y^1$ and $y^2 \in Y$ require only inputs of various knowledges, then $y^1 + y^2$ might still be a feasible production in $Y$, depending on whether or not additional manpower is needed and whether or not such additional manpower is available.

Third, we consider that assumption that $Y$ is convex, meaning that for any $y^1$ and $y^2 \in Y$ and for any scalar $\alpha \in [0,1]$, $\alpha y^1 + (1-\alpha)y^2 \in Y$. Under this assumption, for any $y \in Y$, because $0 \in Y$, it means that $\alpha y + (1-\alpha)0 = \alpha y \in Y$. So, this assumption implies that the set $Y$ of production possibilities has nonincreasing returns to scale (Mas-Collel et al., 1995). In order to develop an economic theory that can be potentially applied to address real-life problems, such strong holistic, systemic property should not be allowed to hold except for specific cases or some individual productions. In real life, various returns to scale might hold true for one production, but not the entire set of feasible productions. It is because, systemically speaking, returns to scale for one production represent the local characteristics of the production, while those for the entire set of feasible productions are holistic, systemic characteristics of the firm. If the characteristics of one production plan are seen as micro-properties of individual production possibilities, then characteristics of the firm's set of production plans will be correctly treated as macro-features of the firm. As is well-known, some micro-level economic properties do not aggregate into macro-level ones, although some do (Atalay, 2017; Gabaix, 2011; Lucas, 1977). That is, individual characteristics of one production in general cannot be elevated into holistic, systemic properties, although some do (Forrest, Gong et al., 2021). So, a more real-life like scenario should be: The firm's set $Y$ of feasible productions might not have any defined returns to scale; however, there could be some particular production $y^1 \in Y$ that has increasing returns to scale, some other production $y^2 \in Y$ has decreasing returns to scale, etc. In other words, different productions $y^k \in Y$, $k = 1, 2, 3, ...$, may have different kinds of returns to scale or none of them at all. Hence, this convexity assumption should not be adopted in general; otherwise, no production in $Y$ would have increasing returns to scale or constant returns to scale.

Fourth, the assumption we examine is that $Y$ is a cone with vertex 0. It means that for any $y \in Y$ and any scalar $\alpha \in (0, +\infty)$, $\alpha y \in Y$. That is, this assumption implies that the entire set of production possibilities has constant returns to scale. As just discussed in the previous paragraph, such a strong holistic, systemic property should not be assumed to hold true in general in real life, although this property might hold for some individual productions. For instance, after a production process has been implemented for a while, all personnel involved in the process become more efficient over time, leading to increased outputs with the same level of inputs (Forrest et al., 2019). That is, for such a production $y \in Y$, it should have increasing returns to scale.

When these listed assumptions about $Y$ are not assumed, the challenge one can expect to face is to what extent some of the most important results in economic theory can still be established.

## PRODUCTION AND PROFIT FUNCTIONS

As suggested by the title, this section creatively studies both production and profit functions of the firm so that we do not have to focus only on the situation of a single output as the literature commonly does (e.g., Levin & Milgrom, 2004; Mas-Collel et al., 1995; Pancs, 2018).

### The Production Function

For each production $y \in Y \subseteq \mathbb{R}^{\ell}$, let

$$y^{in} = \left(y_{h_1^{in}}, y_{h_2^{in}}, \ldots, y_{h_t^{in}}\right) \in \mathbb{R}_-^t \text{ and } y^{out} = \left(y_{h_1^{out}}, y_{h_2^{out}}, \ldots, y_{h_s^{out}}\right) \in \mathbb{R}_+^s$$

be respectively the sub-vector of the quantities of all the corresponding commodity inputs $h_1^{in}$, $h_2^{in}$, …, $h_t^{in}$, and that of all commodity outputs $h_1^{out}$, $h_2^{out}$, …, $h_s^{out}$, where $\mathbb{R}_-$ is the set of all negative real numbers. That is, what is implicitly meant is that in both $y^{in}$ and $y^{out}$ no zero components appear so that $h_1^{in} < h_2^{in} < \cdots < h_t^{in}$ and $h_1^{out} < h_2^{out} < \cdots < h_s^{out}$, where

$$y_{h_j^{in}} < 0 \text{ and } y_{h_k^{out}} > 0, j = 1,2, \ldots, t; k = 1,2, \ldots, s. \tag{4}$$

Now, we define the production function $f$ for the firm as follows: for any $y \in Y$, $f(y^{in}) = y^{out}$. Then, the following conclusion holds true:

**Proposition 2**. For the firm, its production function $f$ is well defined. That is, for each $y \in Y$, $f(y^{in})$ is uniquely determined.

Proof. It suffices to show that for any ${}^1y, {}^2y \in Y$, if ${}^1y^{in} = {}^2y^{in}$, then ${}^1y^{out} = {}^2y^{out}$. This end follows from the fact that when outputs are different, some of the inputs have to be different, even though all physical commodity inputs can be identical from one production ${}^1y$ to another ${}^2y$. That is, it is the employment of different recourses, such as special talents or additional manpower, in the production that the identical physical inputs are assembled or combined into different outputs. QED

A function $g: U \to W$ from a set $U$ to another set $W$ is said to be partial, if the domain of $g$, denoted by domain($g$), is not equal to $U$; that is, $g(u)$ is defined for some $u \in U$ but not for every $u \in U$. A function $g: U \to W$ is said to be set-valued, if for any $u \in \text{domain}(g) \subseteq U$, $g(u)$ is a non-empty subset of $W$. For the production function $f$ of the firm, the inverse function of $f$, denoted by $f^{-1}$, is the following set-valued function: For any production $y \in Y$,

$$f^{-1}(y^{out}) = \{y^{in}: y \in Y \text{ and } f(y^{in}) = y^{out}\}.$$

**Proposition 3**. For a production $y \in Y$, if $f^{-1}(y^{out})$ contains more than one element, then at least one commodity input of $y$ has a substitute.

Proof. Assume that $u, v \in f^{-1}(y^{out})$ are two different input vectors each of which produces the same output vector $y^{out}$. Without loss of generality, let $u = \left(u_{h_1^{in}}, u_{h_2^{in}}, \ldots, u_{h_{t_1}^{in}}\right)$ and $v = \left(v_{k_1^{in}}, v_{k_2^{in}}, \ldots, v_{k_{t_2}^{in}}\right)$. For convenience of communication, let the involved sets of commodities be $H = \left\{h_1^{in}, h_2^{in}, \ldots, h_{t_1}^{in}\right\}$ and $K = \left\{k_1^{in}, k_2^{in}, \ldots, k_{t_2}^{in}\right\}$, respectively.

Now, we show the conclusion in three cases: (i) there is $h_j^{in} \in H$ such that $h_j^{in} \notin K$; (ii) there is $k_j^{in} \in K$ such that $k_j^{in} \notin H$; and (iii) $H = K$.

For case (i), it means that commodity $h_j^{in}$ can be substituted by commodities in $K$. Similarly, case (ii) implies that $k_j^{in}$ can be substituted by commodities in $H$. As for case (iii), because $u \neq v$, there must be $h_j^{in} \in H = K$ such that $u_{h_j^{in}} \neq$

$v_{h_j^{in}}$. Without loss of generality, assume that $u_{h_j^{in}} < v_{h_j^{in}}$. Then commodity $h_j^{in}$ can be partially substituted by other commodities in $H$ $(= K)$. This end is generally seen as that more efficient use of other commodities in $H$ can help reduce the demand for $h_j^{in}$. QED

Speaking differently, Proposition 3 implies that when $f^{-1}(y^{out})$ contains more than one element, there are several different combinations of commodity inputs that lead to the same specified outputs $y^{out}$. In other words, some of the inputting commodities can substitute for each other. Evidently, $f^{-1}$ is a set-valued function with domain

$$\text{domain}(f^{-1}) = \{y^{out}: y \in Y\}$$

and range

$$\text{range}(f^{-1}) = \{y^{in}: y \in Y\}.$$

A production plan $y \in Y$ is said to have increasing returns to scale, provided that each proportionate increase in inputs leads to increased outputs of a greater proportion. Symbolically, $y$ has increasing returns to scale, if

$$\forall \alpha \in (1, +\infty) \left( f(\alpha y^{in}) > \alpha f(y^{in}) \right) \tag{5}$$

If the inequality sign $>$ in equation (5) is replaced by $\geq$, then the production $y$ is referred to as having nondecreasing returns to scale.

If a production $y \in Y$ satisfies the following, then $y$ is said to have decreasing returns to scale:

$$\forall \alpha \in (0,1) \left( f(\alpha y^{in}) < \alpha f(y^{in}) \right). \tag{6}$$

In other words, equation (6) reflects the following fact: if all inputs of production $y$ are decreased by a scale $\alpha \in (0,1)$, the corresponding outputs decrease by more than the scale $\alpha$. When the inequality sign $<$ in equation (6) is replaced by $\leq$, then $y$ is referred to as having nonincreasing returns to scale.

As for the concept of constant returns to scale, we define similarly as above. In particular, a production $y \in Y$ is said to have constant returns to scale, if the following holds true:

$$\forall \alpha \in (0, +\infty) f(\alpha y^{in}) = \alpha y^{out}. \tag{7}$$

In other words, $y \in Y$ implies that for any $\alpha \in (0, +\infty), \alpha y \in Y$. Or, equivalently, $y$ has constant returns to scale if and only if the firm's production function $f$ is homogeneous of degree one with respect to the production inputs $y^{in}$.

The set $Y$ of production possibilities of the firm is said to have increasing (respectively, nondecreasing, decreasing, nonincreasing, and constant) returns to scale, if every production $y \in Y$ has increasing (respectively, nondecreasing, decreasing, nonincreasing, and constant) returns to scale.

Note that other than the situation of constant returns to scale, for a scalar $\alpha$ and a production $y \in Y$, it is very possible that $\alpha y \notin Y$. That is, our definitions of various returns to scale are different from those given by Levin and Milgrom (2004, p. 5). Additionally, in real-life, a scale of increase in a production's inputs generally does not proportionately increase the outputs. For instance, an increased input of labor might very well help make the workplace either less or more efficient, depending on what kinds of new personalities are hired. So, to reflect more adequately the concepts of various returns to scale, as given by Debreu (1959, p.40-41) and Gelles and Mitchell (1996), we introduced the concepts above, which are similar in spirit to those seen in (Mas-Collel et al., 1995).

**The Profit Function**

Assume that the firm of our concern is a price taker so that its goal of business is to choose such a production plan that best fits its system of values and beliefs, for any given price system $p$ of commodities. Symbolically, the firm's business goal can be formalized as follows:

$$\max_{y \in Y}^{F} p \cdot y, \text{for any given } p > 0, \tag{8}$$

where the idea of "best fitting the firm's system of values and beliefs" is reflected in the operation of maximization defined specifically by the firm, as reflected by the superscript $F$. Of course, both theoretically and practically this "best fit" scenario may not exist. In such a case, the firm is forever pursuing after an ideal instead of a definitely tangible target. For this end, we write $\sup_{y \in Y}^{F} p \cdot y$, for any given price system $p$, in the place of the expression in equation (8).

In equation (8), the price of production $y$ is maximized in terms of Firm $F$'s specific system of values and beliefs, if the maximum exists. Corresponding to this maximization, in neoclassic economics, there is such a long-standing convention that firms' objective is to maximize their profits (Wu, 2006). In reality, however, there are business firms that do not truly place profit maximization as its primary objective (e.g., Hussain, 2012; Jensen, 2001). Recently, a group of powerful US chief executives abandoned the idea that companies must maximize profits for shareholders above all else (https://opportunity.businessroundtable.org/ourcommitment/, accessed on January 30, 2021). "Americans deserve an economy that allows each person to succeed through hard work and creativity and to lead to a life of meaning and dignity" and "we commit to deliver value to all of them, for the future success of our companies, our communities, and our country," said the statement from the organization (https://s3.amazonaws.com/brt.org/BRT-StatementonthePurposeofaCorporationOctober2020.pdf, accessed on January 30, 2021), chaired by JP Morgan Chase CEO Jamie Dimon. Once again, the reason why many firms don't put profit maximization as the number one priority can be explained by the natural endowments. It is because the conscience of the managers directs them to contribute more to their respective communities. This of course also supports the notion that how a firm behaves is dictated by its system of values and beliefs.

Corresponding to the fact that there are firms that do not solely focus on maximizing their profits as a consequence of their values and beliefs, one might ask the following question: Can these firms financially compete with those that do? Although the answer to this question depends on the particular constraints and circumstances of each specific firm, evidence suggests that generally in a buyer's market, the answer is YES. In fact, in such a market, consumers have shown increasing levels of attention to companies that are socially responsible (Hsueh, 2014), while employees, market competitions and governments pressured downstream companies to distribute and sell socially responsible goods (Letizia & Hendrikse, 2016). In particular, in 1983, American Express's support for the Statue of Liberty encouraged consumers to use their American Express card (Adkins, 1999): each time the card was used, a 1 cent was donated to the Restoration of the Statue of Liberty fund; and for each new American Express card account approved, a $1 was donated. This three-month promotion from September to December 1983 collected over $1.7 million for the fund, while the use of American Express cards rose by 28 percent in just the first month, compared to the previous year, and new card applications increased by 45 per cent. Cone/Roper research found (Meyer & Harvey, 1993) that more than 70% of respondents are more likely to choose firms that participate in public service when faced with the same goods in terms of quality and price, and more than half of them are willing to pay a higher premium for their products and/or services.

For the firm, $\pi^F: \mathbb{R}_+^\ell \to \mathbb{R}$, defined below, is referred to as its profit function, assuming that the maximum value on the right-hand side exists according to the firm's system of values and beliefs.

$$\pi^F(p) =_F \max_{y \in Y}^{F} p \cdot y. \tag{9}$$

**Proposition 4**. The profit $\pi^F$ of the firm, as defined above, is a partial function defined on $\mathbb{R}_+^\ell$.

Proof. This conclusion follows from the definition of partial functions and the fact that the action of taking maximum in the equation $\pi^F(p) =_F \max_{y \in Y}^{F} p \cdot y$ cannot be guaranteed to be always possible for each price system $p \in \mathbb{R}_+^\ell$. QED

**Proposition 5**. Assume that the system of values and beliefs of the firm orders real numbers in the same way as the conventional one of real numbers. Then the profit function $\pi^F$ satisfies $\pi^F(\lambda p) = \lambda\pi^F(p)$, for any scalar $\lambda > 0$ and any $p \in \text{domain}(\pi^F)$. That is, the partial function $\pi^F$ on $\mathbb{R}^\ell_+$ is homogeneous of degree one on $\text{domain}(\pi^F)$.

Proof. This conclusion follows readily from the observation that for any scalar $\lambda > 0$ and any price system $p \in \text{domain}(\pi^F)$, $\pi^F(\lambda p) =_F \lambda \max^F_{y\in Y} p \cdot y = \lambda\pi^F(p)$. QED

**Proposition 6**. In general, when the system of values and beliefs of the firm is not specified, the profit function $\pi^F$ is not homogeneous of degree one.

To see why this conclusion holds true, we only need to confirm it by constructing a counterexample. To do so, let us first take the generalized modular function from Forrest, Hafezalkotob et al. (2021).

For positive $a \in \mathbb{R}$, we define an order, denoted by $<_{mod(a)}$, on $\mathbb{R}$ as follows: For two real numbers $x$ and $y \in \mathbb{R}$,

$$x <_{mod(a)} y \text{ if and only if } x\ mod(a) < y\ mod(a), \tag{10}$$

where the symbol $<$ stands for the conventional order on $\mathbb{R}$, while the expression $z\ mod(a)$ represents the remainder of $z \div a$, satisfying that $0 \leq z\ mod(a) < a$, for $z = x, y$.

It is clear to see that when all numbers involved here are limited to the set of all integers, the order $<_{mod(a)}$, just defined above, reduces to the one commonly considered in number theory (Burton, 2012). If the language of equivalence classes is applied, what is just defined above implies that for any $r \in \mathbb{R}$, satisfying $0 \leq r < a$, the following real numbers are grouped into one equivalence class, which is still represented by $r$ without instigating any confusion:

$$r \equiv \{x \in \mathbb{R}: \exists q \in \mathbb{Z}(x = aq + r)\}, \tag{11}$$

where $\mathbb{Z} = \{\ldots, -3, -2, -1, 0, +1, +2, +3, \ldots\}$ is the totality of all integers.

**Example 2**. The firm operates a specific line of production, into which a unit of each of the following commodities A, $A_1$, $A_2$, B, $C_1$, $C_2$, and C needs to be imported. Different from others, commodities $A_1$ and $A_2$ (and respectively, $C_1$ and $C_2$) are substitutes of each other. The line of production is depicted in Figure 2, where the arrows signal the order these commodities are imported into the line. And, the weights of the arrowed edges indicate the related profits generated by moving from a node to the next.

Assume that the system of the values and beliefs of the firm mandates the manager to find such a path that maximizes the overall profit of the production line.

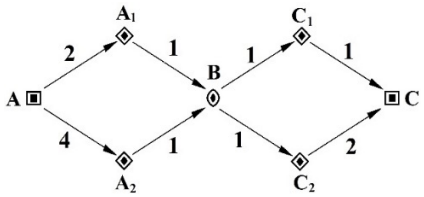

Figure 2. The directed network of a production line

Case 1: Assume that the firm's system of values and beliefs dictates its order of real numbers the same way as the conventional one. Then, the desired path is A → $A_2$ → B → $C_2$ → C that has a total weight of 8. Other three possible paths have total weights 5, 6, and 7, respectively.

Let the set of all commodities be ordered as follows:

$$A \prec A_1 \prec A_2 \prec B \prec C_1 \prec C_2 \prec C,$$

and the respective paths be:

| | |
|---|---|
| $I_1 = A \to A_1 \to B \to C_1 \to C$ | $I_2 = A \to A_1 \to B \to C_2 \to C$ |
| $I_3 = A \to A_2 \to B \to C_1 \to C$ | $I_4 = A \to A_2 \to B \to C_2 \to C$ |

Then the corresponding input vectors are respectively ${}^{i}y = \left(y_j\right)_{j \in I_i}$, and the associated output vectors respectively ${}^{i}Z_{AC}$, for $i = 1, \ldots, 4$. Corresponding to this representation of inputs and outputs, each price vector $p$ will need to be written in the following form:

$$p = \left(\left(p_j\right)_{j \in I}, \left({}^{j}Z_{AC}\right)_{j=1}^{4}\right),$$

where *I* stands for the set of all commodities involved here. Based on this setup, it can be seen that for any production $y \in Y$ of the firm, one can find an index $k$ (= 1, 2, 3, 4), satisfying that after eliminating all zero components from $y$, we have $y^{in} = {}^{k}y$ and $y^{out} = {}^{k}Z_{AC}$. Hence, for any price system $p \in \mathbb{R}^{\ell}$ and any production $y \in Y$, we have $p \cdot y = p^{in} \cdot y^{in} + p^{out} \cdot y^{out}$, where $p^{in}$ is the price vector of all the commodities in $y^{in}$ and $p^{out}$ price vector of those commodities in $y^{out}$. So, this analysis indicates the following equation for any scalar $\lambda > 0$,

$$\pi^F(\lambda p) =_F \max_{y \in Y}^{F}(\lambda p^{in} \cdot y^{in} + \lambda p^{out} \cdot y^{out}) = \lambda \max_{y \in Y}^{F} p \cdot y = \lambda \pi^F(p) = 8\lambda.$$

In other words, the conclusion in Proposition 5 is confirmed.

Case 2: Assume that the firm's system of values and beliefs dictates the ordering of real numbers based on the mod4 function, as described in Example 1. In this case, the maximum total profit is equal to 3, which is equal to 7 (mod4), because the respective total profits of the four possible paths are: 5 (mod4) = 1, 6 (mod4) = 2, 7 (mod4) = 3 and 8 (mod4) = 0.

Next, we use scalar $\lambda = 3.2$ to multiply each of the local weights, producing respectively the following results: $5 \times 3.2$ (mod4) = 0, $6 \times 3.2$ (mod4) = 3.2, $7 \times 3.2$ (mod4) = 2.4, and $8 \times 3.2$ (mod4) = 1.6. Here, the maximum total profit is equal to $3.2 = 6 \times 3.2$ (mod4), That is, we have

$$3.2 \text{ times } 7 \text{ (mod4)} \neq (3.2 \times 6 \text{ (mod4)}.$$

That is, we have confirmed the conclusion of Proposition 6. QED

According to Levin and Milgrom (2004), the following partial and set-valued function

$$\eta^F(p) = \left\{y \in Y : p \cdot y =_F \max_{y^q \in Y}^{F} p \cdot y^q\right\}, \tag{12}$$

is known as the optimal production correspondence of the firm, for any price system $p \in \mathbb{R}_{+}^{\ell}$. Intuitively, what the function $\eta^F : \mathbb{R}_{+}^{\ell} \to Y$ does is to map each price vector $p \in \mathbb{R}_{+}^{\ell}$ to the subset $\eta^F(p) \subset Y$ of all profit-maximizing productions with this fixed $p$. Evidently, for some $p \in \mathbb{R}_{+}^{\ell}$, $\eta^F(p)$ might be empty.

**Proposition 7**. If the order relation $\leq_F$ that is consistent with the firm's system of values and beliefs satisfies that for any real numbers $a_i, b_i$, $i = 1,2$, $a_1 \leq_F b_1$ and $a_2 \leq_F b_2$ imply $a_1 + a_2 \leq_F b_1 + b_2$, then the profit function $\pi^F$ is convex in $p$.

Proof. For any price systems ${}^{1}p$, ${}^{2}p \in \text{domain}(\pi^F)$ and any scalar $\alpha \in [0,1]$, let ${}^{\alpha}p = \alpha\, {}^{1}p + (1 - \alpha)\, {}^{2}p$ and pick ${}^{\alpha}y \in \eta^F({}^{\alpha}p)$. Then, we have

$$\alpha\pi^F\left({}^1p\right)+(1-\alpha)\pi^F\left({}^2p\right)\geq_F \alpha\ {}^1p\cdot\ {}^\alpha y+(1-\alpha)\ {}^2p\cdot\ {}^\alpha y$$
$$=\left[\ {}^1p+(1-\alpha)\ {}^2p\right]\cdot\ {}^\alpha y=\pi^F({}^\alpha p) \tag{13}$$

That is, $\pi^F$ is convex in $p$. QED

Evidently, the required property of inequality in Proposition 7 is not satisfied by the order relation discussed in Case 2 of Example 1. In particular, $2\leq_{mod(4)}3$ and $1\leq_{mod(4)}1$ do not lead to $2+1\leq_{mod(4)}3+1$. Instead, we have

$$2+1\not\leq_{mod(4)}3+1=_{mod(4)}0.$$

That is, Proposition 7 is not guaranteed to be generally true unless the if-condition is held. Specifically, the first line of equation (13) may very well be violated by various order relations.

**Proposition 8**. For any two price systems $p,\ p'\in\mathbb{R}^\ell_+$, and productions $y\in\eta^F(p),\ y'\in\eta^F(p'),\ (p'-p)(y'-y)\geq_F 0$.

Proof. Because $p\cdot y=_F\max^F_{y^q\in Y}p\cdot y^q$ and $p'\cdot y'=_F\max^F_{y^q\in Y}p'\cdot y^q$, we have $p\cdot y\geq_F p\cdot y'$ and $p'\cdot y'\geq_F p'\cdot y$. So, $p\cdot(y-y')\geq_F 0\geq_F p'\cdot(y-y')$, from which $(p'-p)(y'-y)\geq_F 0$ follows. QED

## ELEMENTS OF THE OPTIMAL PRODUCTION CORRESPONDENCE

This section assumes that the firm's system of values and beliefs orders real numbers the same way as the conventional one; and that the firm's profit $\pi(p)=\max_{y\in Y}p\cdot y$ exists for an arbitrarily chosen price system $p=(p_1,p_2,\dots,p_\ell)\in\mathbb{R}^\ell$. Then, the well-known Hotelling's Lemma can be generalized as follows:

**Proposition 9**. In a neighborhood of the chosen $p$, the optimal production correspondence $\eta(p)$ contains only one element, if and only if the partial derivative of the profit function $\pi(\cdot)$ with respect to each $p_h$ exists at $p$ and satisfies the following, for any $y=(y_1,y_2,\dots,y_\ell)\in\eta(p),h=1,2,\dots,\ell$:

$$\frac{\partial\pi(p)}{\partial p_h}=y_h. \tag{14}$$

Proof. ($\Rightarrow$) From the assumption that $\eta(p)$ contains only one element in a neighborhood of $p$, it follows that the envelope theorem applies so that $\partial\pi(p)/\partial p_h=y_h$, for the unique element $y=(y_1,y_2,\dots,y_\ell)\in\eta(p),h=1,2,\dots,\ell$.

($\Leftarrow$) Assume that $\pi(\cdot)$ is differentiable at $p$ with respect to each $p_h$, for $h=1,2,\dots,\ell$, with equation (14) holds true. Let us select two arbitrary productions $y^1$ and $y^2\in\eta(p)$. Then, the definition of optimal production correspondences implies $\pi(p)=p\cdot y^1=p\cdot y^2$. So, equation (14) implies that for any $h=1,2,\dots,\ell$, we have

$$y^1_h=\frac{\partial\pi(p)}{\partial p_h}=y^2_h.$$

That is, $y^1=y^2$. From the arbitrariness of $y^1$ and $y^2\in\eta(p)$, it follows that $\eta(p)$ is a singleton. QED

Based on our initial set-theoretical setup, the condition that $\eta(p)$ contains only one element in the previous proposition is different from the statement that the firm produces only one product, as assumed by Levin and Milgrom (2004) and Mas-Collel et al. (1995) in the prevalent producer theory. In particular, according to our setup, a production in $\eta(p)$ can contain a vector of many different products. Because of this reason, Proposition 9 is indeed a generalization of the known Hotelling's Lemma.

For the set $Y$ of productions, let define the following real-valued characteristic function $F:Y\rightarrow\mathbb{R}$: $F(y)=0$, if $y$ is located on the frontier of $Y$; $F(y)<0$, if $y$ is located in the interior of $Y$; and $F(y)>0$, if $y$ is positioned somewhere

outside of $Y$. By applying this function, we rewrite the following problem of maximization $\max_y p \cdot y, \text{s.t.} \, y \in Y$ as $\max_y p \cdot y, \text{s.t.} \, F(y) \leq 0$. This problem's Lagrangian is

$$L = p \cdot y - \lambda F(y), \tag{15}$$

while its first-order conditions are:

$$p_h = \lambda F_h(y^*), F(y^*) \leq 0, \text{for } y^* \in \eta(p), h = 1,2, \dots, \ell. \tag{16}$$

**Proposition 10**. Assume that price system $p = (p_1, p_2, \dots, p_\ell) \in \mathbb{R}^\ell$ satisfies $p_h > 0$, for each $h = 1,2, \dots \ \ell$. Then, the condition of continuous differentiability of $y(p) \in \eta(p)$ implies that $D_p y(p) = D_p^2 \pi(p) = 0$.

Proof. First, from Proposition 9 we have

$$D_p y(p) = \frac{\partial y(p)}{\partial p} = \left[\frac{\partial y_h}{\partial p_t}\right]_{\ell \times \ell} = \left[\frac{\partial^2 \pi(p)}{\partial p_i \partial p_j}\right]_{\ell \times \ell} = D_p^2 \pi(p)_{\ell \times \ell}, \tag{17}$$

where based on equation (16), the envelope theorem, and the assumption that $p_h > 0$, for $h = 1,2, \dots \ \ell$, the $(t, h)$ cell is equal to

$$\frac{\partial y_h}{\partial p_t} = \left(\frac{\partial y_h}{\partial p_t} p_h\right) \frac{1}{p_h} = \left(\frac{\partial y_h}{\partial p_t} F_h(y)\right) \frac{\lambda}{p_h} = \frac{\partial F(y)}{\partial p_t} \frac{\lambda}{p_h} = 0 \cdot \frac{\lambda}{p_h} = 0.$$

In this calculation, the reason why $\partial F(y)/\partial p_t = 0$ is that no matter $p$-value is, we have $y \in \eta(p)$ and $F(y) = 0$. Hence, the derivative of $F(y)$ is always zero. So, $D_p y(p) = D_p^2 \pi(p) = 0$. QED

In the prevalent producer theory, there is such a theoretical result that Levin and Milgrom (2004) claim to show the advantage of theoretical reasoning over empirical analysis. In particular, this theoretical result states that when the firm produces a single product and that $\eta(p)$ is a singleton, then the matrix $D_p y(p) = D_p^2 \pi(p)$ is symmetric, positive semi-definite. Evidently, in comparison, Proposition 10 generalizes this known result greatly.

## CONCLUSION

By employing the four natural endowments of a firm – self-awareness, imagination, conscience and free will (Forrest, Gong et al., 2021), this paper cards through the list of various common assumptions widely adopted in the producer theory (Debreu, 1959; Levin & Milgrom, 2004; Mas-Collel et al., 1995) in order to find out which assumptions are problematic either theoretically or practically or both. As a consequence, we are able to single out four of them as fundamental so that they are emphasized as axioms or starting points from which useful conclusions can be analytically or logically derived.

On the basis of a firm's endowments, this work places an emphasis on the existence of a firm-specific order relation for real numbers, and consequently the existence of a firm-specific method of optimization. Because such firm-specific order relations are different from one firm to another, one firm's optimal decision may possibly look ridiculous or stupid in the eyes of another firm. Therefore, our attempt to address the question, as posed in the beginning of this paper, about how to avoid the history of repeatedly falling back to treating impressive-looking beauty as truth by altering the devastating setup of the existent theories at the most fundamental level, is the recognition of the differences in firm-specific systems of values and beliefs.

Due to such drastically different starting points from the ones widely adopted in the literature, we are able to define a firm's production function innovatively and show, among others, that

- the firm's profit function in general is not homogeneous of degree one (Proposition 6), while it is only for very specific situations;

- for such profit function to be convex in price, the order relation, consistent with the firm's values and beliefs, has to satisfy an additivity property (Proposition 7);
- in Hotelling's Lemma, a singleton optimal production correspondence is equivalent to the equation that the rate of change of the profit in the price of commodity $h$ is equal to the amount of commodity $h$ either inputted or outputted, for each commodity $h$ (Proposition 7); and
- when each commodity costs real money, the matrix of rates of changes in commodities with respect to prices is equal to 0 (Proposition 10).

In other words, other than the contributions described above, this paper also greatly generalizes a few very well-known results many steps forward without imposing some of the key conditions as done in the past. Because of the lesser conditions imposed, our conclusions developed in this paper can be expected to be more practically useful.

For possible future research, one can investigate properties of the production and profit functions, as defined in this paper, that are specific to different systems of values and beliefs. For example, results established in Section 5, will not hold true literally for systems of values and beliefs within which the conventional order relation of real numbers is no longer the law of governance. In particular, when the mod function is the rule of game, as shown in Examples 1 and 2, an important question is: how would Propositions 9 and 10 will look like?

In terms of the literature, it has been found (Taylor, 1989) that Hotelling's Lemma (and other maintained behavioral hypotheses, such as cost minimization and utility maximization) becomes invalid when the firm of concern is not a conventional profit maximizer. In the language of this paper, the following question is both practically and theoretically important: if a firm, instead of conventionally maximizing its profit, fits its desired business outlook, such as revenue, into its stated mission by involving a different criterion of priority, does a modified version of Hotelling's Lemma still hold true? If for a particular system of values and beliefs this lemma does hold true, how will the lemma look like?

Another important question for future research is: What will happen for such a firm when it chooses its most desirable production or business operation without optimizing any foreseeable subjective function?

As the conclusion of this paper, let us look at the following real challenge that needs to be met by continuing this work and that will most likely produce additional practical benefits is the following open question: Because firms in real life are heterogeneous with their individually different systems of values and beliefs, can their interactions be investigated systemically and strategically?

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# ECONOMIC ISSUES PREVENTING GOOD HEALTHCARE

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## ABSTRACT

The purpose of this systematic review is to outline some of the challenges (and potential opportunities) inherent with the current economic evaluation of healthcare and how they are impacting the quality of healthcare. From the search of the literature, the following factors were identified as impacting good healthcare: *Ethical, Society, Research, Custom, Process, and Payment* issues. These are discussed. Economic issues can be influential in causing health problems and in preventing good healthcare practices. In the Unites States, even the rich are being deprived of good healthcare because of the difficulty in assessing true healthcare costs.

## INTRODUCTION: CHANGING DOMAIN OF HEALTHCARE ECONOMICS

The world of healthcare (especially the economics of healthcare, the healthcare potential of chronic disease prevention, workplace healthcare, wellness, and integrative healthcare) in the United States has changed drastically over the past few decades due to a variety of reasons. The rising costs of healthcare is most often cited as the main reason, but there are others. The Patient Protection and Affordable Care Act of 2010 and the repeated attempts to defang or eliminate it might be another reason. The increased use of Electronic Health Records which makes comparative economic health research much easier to accomplish very likely is another. The extremely high cost of some procedures and medications might be another. The focused attention on overtreatment and wasted costs might be another, and a growing body of evidence suggests that there is more to treatment than drugs and surgeries. This appears to be especially true with the increased incidence of chronic health problems that occur as the population grows older and lives longer. Certainly, this is another reason.

The state of healthcare research has also changed drastically. The search terms and the numbers of articles found eight years ago, listed in Table 1, tell the story of vastly changing resources for research. In 2012, the search for articles from July 2005 to June 2012 found an at-the-time-impressive 14000 articles. The exact same search done in May of 2019 for an equivalent time frame (previous seven years, July 2012 to May 2019) found over four times as many articles: 61,561. The number of searchable journals and the number of databases has expanded since 2012. The quality of the articles has expanded. And the economic health data is much more available.

A key question is: what can we learn from a systematic review of the literature on the economics of healthcare, especially with the development of integrative health, for the seven years before 2012 and the seven years after 2012? What themes arise from the literature on the economics of a more integrative management of healthcare, and what are the logical next steps based on those themes?

## METHODS

The original 2012 search was done for a project which proposed utilizing a binary logistical regression analysis to identify the factors influential in a predictive model known as the Thrive Index (Author, 2012). The Thrive Index model was conceived to predict the chances that a person will survive a treatment with a high quality of life (i.e. Thrive after the treatment). The Thrive Index was categorically the opposite of the typical economic outcomes, and it would have been used to calculate the number of quality years based upon a comparison of treatments. The Thrive index was designed to take into account many factors such as lifestyle, heredity, and ability to fulfill their role in life, and represented a personalized and individualized "health risk number" for each person, similar to the way the Fair Isaac Corporation (FICO) score represents a personalized and individualize credit risk number. The original project for the Thrive Index was dropped for political reasons and the terminology (Thrive Index) was subsequently appropriated for a completely different purpose a few years later. But the concept of a health risk assessment number has been renewed

as our healthcare costs have risen. Various Health Risk Assessments have been bandied about by many different academics and health-oriented economists in the intervening seven years.

In order to optimize the benefit from our 2012 project we changed the original study question of this project from a descriptive to a comparative description. As a result we can describe a development, comparing before and after, instead of only a single current state.

The search of the literature done for that project was a deep look at the exact same issues that influence whether economics interferes with good healthcare. In addition to building on already-accrued knowledge, the seven-year comparison may be educational and instructive in and of itself. Basically it was an original attempt at a comparison of the literature in the seven years before a major upheaval in the United States healthcare system, and the seven years after.

In both cases, the following academic databases were searched for articles on methods of economic analysis for healthcare:

Academic Search Complete

Alt HealthWatch

Business Source Complete

EconLit

Health Source: Nursing/Academic Edition

MEDLINE

In the initial search in 2012, we found 15,567 articles using the search terms in Table 1. 14,434 articles had full text and were not duplicates, and these titles were scanned based on their fit of the original search terms.

The initial search resulted in 15,567 titles. Duplicates were first eliminated, and then articles for which full text was not available (total eliminated 1133). Of the 14,434 remaining articles, the titles that were obviously not appropriate for the study were eliminated (5333). The abstracts of the resulting list (9101 records) were manually reviewed. We included the article if it met one of these criteria:

- Provided a systematic review or meta-analysis on healthcare cost research.
- Described a randomly controlled study with specific financial analysis on a common ailment.
- Provided a theoretical framework or statistical model for cost benefit research.
- Discussed issues with cost benefit models and measurements.
- Estimated the impact on society costs of general ailments.
- Discussed various healthcare models and cost impacts

Additionally, 8675 were eliminated for one of the following objective reasons:

- Not involving a financial analysis- no society or cost impact.
- Only involving a pure financial analysis - no reference to quality of life or society cost.
- Different article utilizing data from study already published.
- Dealt only with single malady with no societal implications.
- Dealt only with a single treatment with no societal implications.

Additionally, articles could be eliminated for subjective reasons:

- Not sufficiently rigorous.
- Design not sufficiently documented.
- Too specific or population too narrowly defined.

After reviewing the abstracts, 426 articles were chosen to be included. This review resulted in 117 articles on the research frameworks and models of healthcare costs, 217 articles on the estimated impact on society of various models, 28 systematic reviews or meta-analysis, and 64 articles of randomly controlled comparisons of treatments and/or chronic health issues that are most likely to impact society's healthcare costs such as diabetes, hepatitis, stroke, obesity, etc. Note that there was no attempt made to create a mutually exclusive or comprehensive list of chronic health issues; a few articles of various health issues were chosen as representative in order to validate/verify the framework and model information discussed in the economically-oriented articles.

Our thinking was that a direct comparison on the topics could be made. However, we were unable to do that comparison due to the increased volume of research.

Using the same search terms, the revised search in 2019 resulting in 61,561 articles. This was too many articles even for a team of researchers to review. At that point we chose to simply utilize the earlier search instead of trying to do a direct comparison. So starting with the original 2012 search criteria, we added a set of criteria for the 2019 search; Integrative Health.

We know from earlier work that Integrative Health (also known as complementary or alternative or integrative medicine) is a good candidate for cost-effectiveness and cost savings (Charness & Jahnke, 2012). Many researchers feel that economic evaluation is necessary in order determine if healthcare costs can be avoided through the use of Integrative Health (Herman, 2018). Narrowing the search parameters by adding "Integrative Health" in the later search to the criteria resulted in only 96 articles being chosen for further review. After reviewing the abstracts of those 96 articles, 81 articles were eliminated using the same inclusion and exclusion criteria as the 2012 search. That left 15 additional articles to be included in this review from the 2019 search.

We also returned to the original list of 426 articles from the 2012 search with our new lens of Integrative Health. While we couldn't go back in time and add a new search term, we could manually review the articles again. After reviewing the 426 articles again, 302 were eliminated as not applicable to Integrative Health, and 50 were eliminated due to outdated data. 74 were selected to be included. The articles were reviewed in full and summarized. Both searches are graphically illustrated in Figure 1.

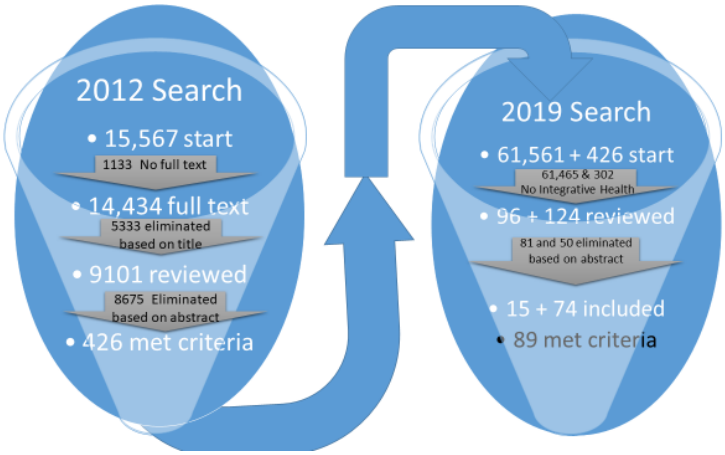


**Figure 1. Graphic illustration of search.**

## RESULTS

The final results of our search were the 89 articles discussed within this paper. Each article was read and grouped on potential themes until summarizing categories became apparent. This entire process from title review and abstract scan to paper review took more than a year (2012 to 2014) for the initial search. The second process took about six months. Each theme was independently verified by at least one other investigator.

It is interesting to note that the largest change occurred in Cost Effectiveness and Cost Analysis and Health Care Reform and Health Insurance, as can be seen in Table 1. It might be posited that the explosion was due to the seemingly sudden change in healthcare due to the implementation of the Patient Protection and Affordable Care Act of 2010 in the United States, but further observation is needed as the numbers are too small for solid conclusions. It should also be noted that the number of articles with QALY (Quality of Life Years) stayed about the same.

**Table 1. Comparison of Numbers for 2012 and 2019 Search**

| Search Terms | 2012 | 2019 | Change |
|---|---|---|---|
| Cost Impact and Healthcare | 5907 | 39365 | 6.7 fold |
| Cost Impact and Quality of Life | 4649 | 17415 | 3.7 fold |
| Cost Impact and Quantity of Life and QALY (Quality Adjusted Life Years) | 3849 | 4233 | 1.1 fold |
| Cost Effectiveness and Cost Analysis and Health care reform and Health Insurance | 29 | 548 | 18.9 fold |
| **Total Number of Articles Reviewed:** | **14434** | **61561** | **4.3 fold** |

As noted earlier, the search in 2019 was for an equivalent time-frame, seven years. The timing was not coincidental. The year 2012 was a monumental year for healthcare in the Unites States as that was the year the first sections of Patient Protection and Affordable Care Act (PPACA) of 2010 were implemented. By 2015 PPACA was fully implemented until the 2016 election when its future was again in doubt, as major sections were eliminated or not enforced by the new administration.

**Themes from Systematic Review on Healthcare Cost Issues**

After reviewing all articles, it was apparent that the articles fell into several economic categories: **Society, Ethical, Research, Custom, Process,** and **Payment.** A graphical representation of the proportion of articles for each category can be found in the graphic below.

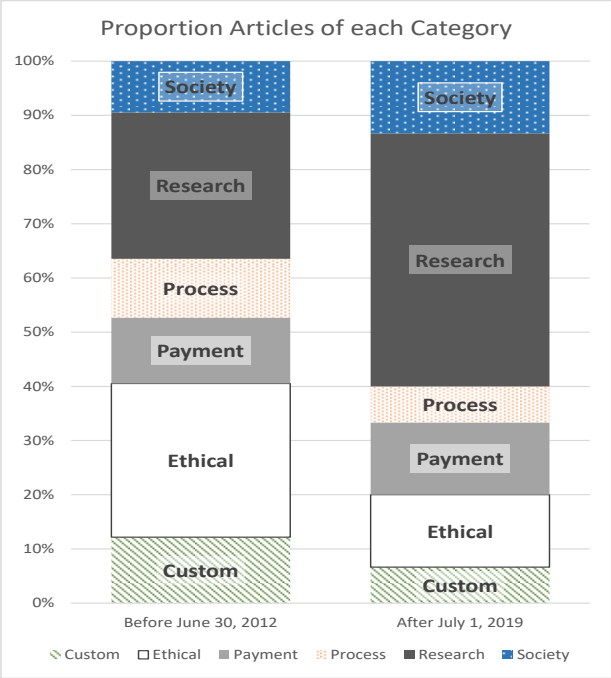


**Table 2. Proportion of Articles found in each Category, both Before and After June 30, 2012.**

Additionally, for purposes of the discussion of each category, several government-sponsored reports and white papers were included in the reviews. When dealing with healthcare costs, it would be foolish to ignore the resources of think tanks and the United States Government and their ability to provide statistics, trends, and analysis of healthcare. The total number of articles within each of the categories is summarized in Table 2.

**Table 2. Frequency of Articles by Category**

| | |
|---|---|
| Ethical | 23 |
| Society | 9 |
| Custom | 10 |
| Payment | 11 |
| Process | 9 |
| Research | 27 |
| Total | 89 |

## SOCIETY ISSUES

Society issues are healthcare quality factors that are impacted by the economic issues of our whole society. These include rising costs of healthcare, growing senior population, and increased prevalence of chronic conditions.

### Rising Costs of Healthcare

Healthcare costs have increased compared to previous years, and are expected to continue to grow, as can be seen in the graph of healthcare costs compared to Gross Domestic Product (GDP) in Figure 2, which came from Centers for Medicare and Medicaid Services, National Health Expenditure Accounts. (The tables from 2017, published in January of 2019 are available from http:// www.cms.gov/Research-Statistics-Data-and-Systems/Statistics- Trends-and-Reports/NationalHealthExpendData/Downloads/tables.pdf.) These rising costs were leveling between 2012 and 2016 when PPACA's implementation made an impact, but now are rising again as important mandates of PPACA designed to lower costs were removed.

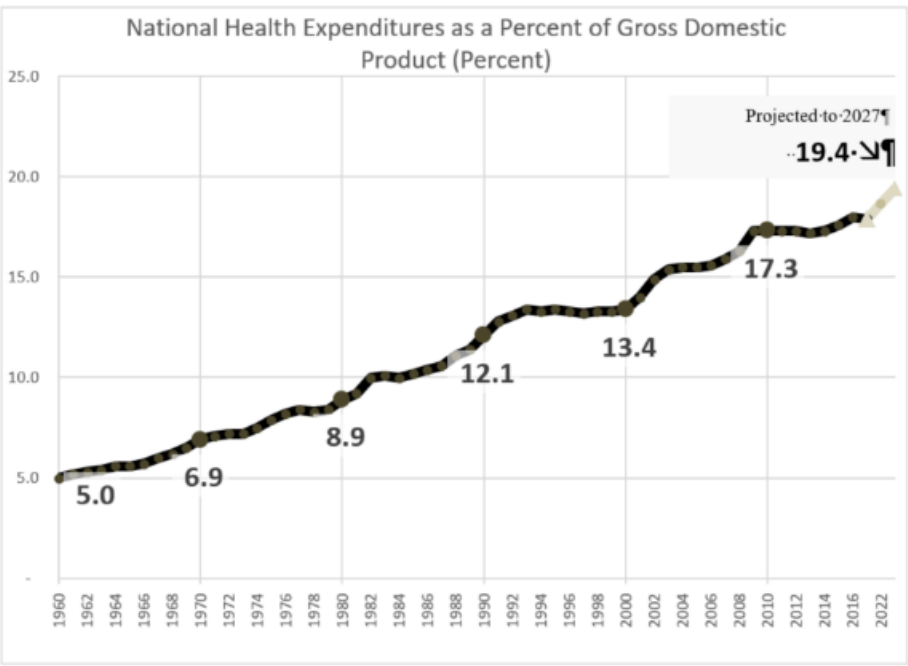


**Figure 2. Healthcare Costs as Percent of GDP According to CMS.**

In 2018, healthcare costs in the United States covering 327.2 million people were $3.6 trillion dollars ($11,002 per person). To put that in perspective, that is ten times the cost of all military spending of the government each year for the past 20 years (which was only about 300 billion dollars each year) (Crawford, 2018). If the healthcare system does not change, the health costs will increase to over $17,200 per person by 2027, 19.4% of the GDP. There are many reasons for the rise in healthcare costs that are explored in depth in the literature, but for purposes of this article it is enough to note that healthcare beyond the ability of people to pay is not actually healthcare, but health non-care.

**Growing Senior Population**

Part of the problem is the growing percentage of baby boomers entering their senior years designated by the press the "Silver Tsunami" (Seals, Justice, & LaRocca, 2016). The number of people over 65 is expected to double, and the number over 80 will triple by 2050. Seventeen percent of GDP is spent on people over 65. The basic healthcare system developed to handle broken arms and traumatic accidents is not optimized for the chronic illnesses which impact 45 percent of the population, and are especially common among older people (Kumar & Nigmatullin, 2010; Kumar & Prevost, 2011). The healthcare costs of seniors are three to five times that of a younger person (as can be seen in **Error! Reference source not found.**). If they have multiple chronic conditions, costs can be seven times more shown in Figure 4 (CDC et al., 2007). Society is facing much higher than expected costs and lower quality of healthcare as a result (Martini, Garrett, Lindquist, & Isham, 2007).

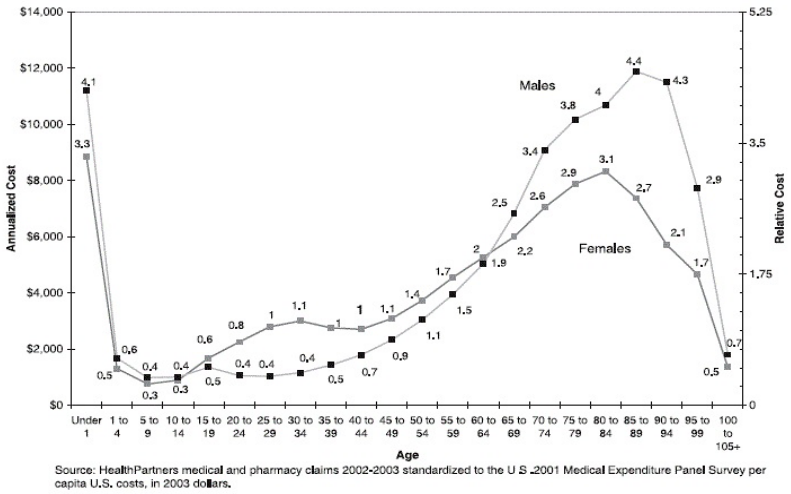


Figure 3. Typical Medical Costs by Age

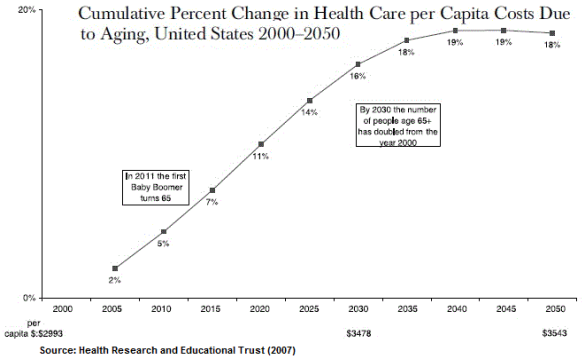


Figure 4. Change in Health Care Costs Per Capital Due to Aging

**Growing Chronic Conditions and Diseases**

Chronic conditions and diseases came up again and again throughout the literature as a major problem in today's healthcare. Seniors are not the only ones who are suffering more and more from chronic conditions (Seals et al., 2016).

Each year the United States population spends $128 billion on patients with arthritis, $148 billion on patients with Alzheimer's disease, $174 billion on patients with preventable type II diabetes, and over $432 billion on heart disease and stroke (Avila, 2011). Another $120 billion is spent on chronic autoimmune disorders such as Graves disease, lupus, vasculitis, anemia, celiac disease, and a host of others (Nakazawa, 2008). Eighty-five percent of each person's Medicare dollars are spent on preventable chronic conditions. The current system rewards treatment, not prevention (Knauf & Aronson, 2009). Seventy-five percent of each healthcare dollar currently goes to chronic illnesses that are easily preventable (Freudenberg & Olden, 2011).

Centers for Medicare and Medicaid Services published a report that shows that there has been a steady increase in post-acute care services as the number of chronic conditions increase, with at least 41 percent of the Medicare beneficiaries needing post acute care. They also noted that beneficiaries with multiple chronic conditions were more likely to be hospitalized, had more hospitalizations during the year, and that more than two-thirds of Medicare beneficiaries had multiple chronic conditions. They indicated far reaching implications of chronic illnesses for the healthcare system built on a fee-for-service model, and noted that it was important to understand the impact (Lochner, 2012).

The current healthcare system is set up for diagnosis and treatment; it does not deal with the issue of prevention and healthy lifestyle (Hoffman, 1997; Kurzweil & Grossman, 2004; Weil, 2000). There is very little support for lifestyle change guidance such as nutrition counseling, exercise programs, weight maintenance help, vitamins and supplements, stress reducing activities, etc., though the research is overwhelming that lifestyle changes are essential for the abatement of rising healthcare costs. (Anderson et al., 2009; Artnak, McGraw, & Stanley, 2011; Gallelli, Wells, Peltonen, & Groden, 2011; Mattke et al., 2010). Even the word "prevention" in the current healthcare system often only means undergoing diagnostic tests such as colonoscopy, mammogram, and pap smears, all of which can only treat a disease once it has started rather than focusing on behaviors and practices that prevent them from starting (Alexa, Marian, Jae Hak, Diana, & Stephanie, 2010).

The World Health Organization identifies healthy lifestyle issues as a global health risk. Figure 5 shows the causal chain between lifestyle and just one of the major chronic illnesses that is growing (found on page 9 of the report) (Mathers, Stevens, & Mascarenhas, 2009). The main point of this graphic is to demonstrate the complexity of even a single disease; the cause-effect is not a simple relationship that can be shown with a linear string of boxes.

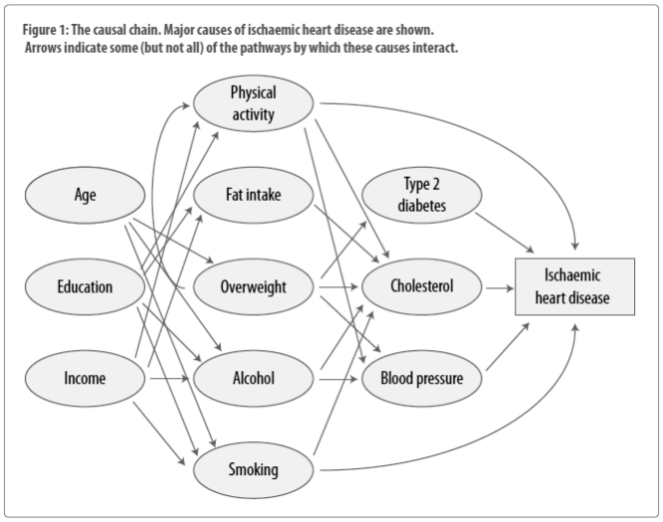


**Figure 5. World Health Organization Causal Chain**

## ETHICAL

Ethical Issues are those which, while not economic issues themselves, do impact the economics in non-scientific ways. These include the non-economics principles of healthcare and end-of-life management issues.

### Non-Economic Principles of Healthcare

Normal economics principles do not always apply to healthcare. One of the reasons economics prevents good healthcare is the ethical issues. With healthcare there is a desirable state of *access for everyone* regardless of ability to pay. Society at large does not wish to be responsible for the death of members of the community simply because they could not pay for the service (Coleman, 2011; El-Sayed, 2012; Fleck, 2011).

Additionally, many people resist the idea that financials should be part of the equation; people are often unwilling or unable to put a price on their life. Physicians ordering treatments are not expected to take financials into account. Scholars are recognizing a great concern in the community at the idea that the amount of resources available must be balanced against the outcome expected. These fears have sometimes led to an "outcry" in the media, especially while healthcare reform was under debate, accompanied with warnings of impending rationing of healthcare and so called "death panels" (Gruenewald, 2012; Kernick, 2005; Lauridsen, Norup, & Rossel, 2008; Nord, 2010; Ruger, 2008; Zunic et al., 2011).

But many people do see the value in looking at costs (Siebert, 2003). Petrou and Gray call for the use of an Incremental Cost Effectiveness Ratio (ICER) to determine if a treatment is worth the investment of public funds. The ratio would establish the maximum acceptable incremental cost ratio (Petrou & Gray, 2011). Beil reports on an interview with Dr. Thomas Smith from the Sidney Kimmel Comprehensive Cancer Center in Baltimore who noted that "*We are the only industrialized country that doesn't look at the cost balanced somehow with effectiveness in making decisions about drugs.*" He concludes that asking hard questions about health care is not a bad idea (Beil, 2012).

Another reason ethics is involved in the fact that healthcare does not follow normal economic principals is that healthcare is one of the industries where the *providers* (i.e. the doctors) are more knowledgeable about the needs of the *customers* (i.e. the patients) than the patients themselves are. The physicians, hospitals, and healthcare networks are *trusted* by the patient to do *what is necessary and right* rather than what would make the most money. Patients don't feel empowered to "go against the doctor's orders", so if the doctor says to get a test or undergo a treatment, they do so. Even if it is inconvenient, difficult, and unlikely to produce qualitative or quantitative value. Currently, to "opt out" of a physician ordered test or treatment requires signatures on forms that warn the patients of dire consequences if they don't get a recommended test. Courts have been known to mandate a physicians order even if the patient clearly states they didn't want it (Gallelli et al., 2011).

One difficulty patients have in opting out of testing, (and that physicians have in curtailing testing), is related to another contributor to the high cost of overtreatment: malpractice suits (Mulvany, 2010). The possibility of an astronomical malpractice settlement has greatly impacted the field (Bovbjerg & Bartow, 2003). Physicians need to order tests even though they may not be necessary simply to avoid the possibility of a suit. The high price of malpractice insurance is a considerable issue that severely limits the amount of money a physician can make in private practice (Callens, Volbragt, & Nys, 2006; Hermer & Brody, 2010).

### End of Life Care Management Issues

Often, we consider extending lifespan without considering health span. The availability of treatments that keep the body alive without quality of life has changed the community's concept of death.

Financing high-cost low value treatments uses up scarce resources and prevent low-cost, high value methods from being used more often, benefitting more people. However, the fact that it feels unethical to put finances above extension of life (even when the quality of life is not improved and the cost is extremely high compared to the value) is one way that economics issues impacts quality of care.

Years ago people lived at home, taken care of by family members until they died at home surrounded by family. Most commonly these days people live in nursing homes and die in a hospital (Mattke et al., 2010). Up to 33 percent of Medicare dollars get spent on the last year of life, and 40 percent of those Medicare dollars are spent in the last month of life (El-Sayed, 2012). While some authorities dispute the importance of these percentages because it does not take into account the total amount spent by Medicaid and private insurance (Aldridge & Kelley, 2015), it cannot be ignored that end of life costs are high, and getting higher.

What has caused the shift to nursing homes instead of home care? One influence is the changing economic structure of the family, most notably the fact that women, previously unpaid long-term care laborers, have much higher mobility and employment, and therefore are less able to serve as unpaid caregivers.

Some people believe that another influence on this change in behavior occurred in 1951, when the Department Of Health And Human Services, Centers for Disease Control and Prevention, and the National Center for Health Statistics stopped allowing physicians to notate old age as cause of death (Sondik, 2003). Elderly people who's health is failing are constantly taken to the hospital, again and again, in an effort to "fix" the problem, even when the cause is due to old age. Well-meaning family and friends will often take a person to a hospital even when they've clearly stated they prefer otherwise (Abel, Rich, Griffin, & Purdy, 2009; Riley & Lubitz, 2010). The fear is that family members are not "doing all that they can" if they don't take a person who may be dying to the hospital. There is a resistance to the idea that someone should be allowed to die without intervention (Artnak et al., 2011).

This is not necessarily because people want to die in a hospital. More than 75 percent of survey respondents want to convalesce and die at home (Donnelly, 2012). Brumley, Enguidanos, and Jamison found increased satisfaction with palliative home care rather than usual care (which usually indicated hospital or hospice). Additionally, costs were reduced by 33 percent ("Disease Management Update," 2007). Nonetheless, more than 80 percent of people die in a hospital, hooked up to various machines, unable to return home (Abel et al., 2009; Artnak et al., 2011; Grabowski, 2007).

Treating more people at end of life at home doesn’t necessarily help with costs, however. Lupari, Coates, Adamson, Crealey identified studies that involved nurses providing care to elderly patients with multiple chronic conditions in their own homes. While the studies reported positive qualitative outcomes, there was not a significant improvement in the number of emergency admissions, bed days, nor costs (Lupari, Coates, Adamson, & Crealey, 2011). One study found that palliative care decreased costs for terminally ill children without cancer, but increased costs (along with hospitalizations and emergency room visits) for terminally ill children with cancer (Postier, Chrastek, Nugent, Osenga, & Friedrichsdorf, 2014).

Palliative care programs, however, are perceived as higher quality. Brumley, Enguidanos, and Jamison found increased satisfaction with palliative home care rather than usual care (which usually indicated hospital or hospice).

Often palliative care is not considered, but rather every attempt is made to extend life. Beil explored the issue of the cost and efficacy of commonly prescribed cancer drugs that have all entered the market in the last few years. Americans spent $23 billion on cancer drugs, more than spent on any other type of prescription drug in any other category. These drugs provide weeks or months of additional life for cancer patients at an extremely high cost. Perjeta, a breast cancer drug, provides up to six additional months of life at a cost of $188,000. Provenge can provide a prostate cancer patient with four additional months of life, at a cost of $93,000. Yervoy, another prostate cancer drug, costs $120,000 for four months of life. Tarceva helps pancreatic cancer patients get 14 to 16 additional days of life for about $15,000 (Beil, 2012).

Baily researches the controversy of futility of care and the ethics of cost control. Baily argues that universal access to quality care cannot be affordable unless the decision makers accept the moral legitimacy of taking cost into account in health care decisions, even decisions at the end of life (Baily, 2011).

Banham, Lynch, Karnon developed an Equity-Effectiveness framework that, if utilized by a central healthcare decision making agency, would enable proper evaluations of health interventions in applied settings with an internally consistent approach. This would help physicians make better end-of-life decisions about treatment (Banham, Lynch, & Karnon, 2011).

The Framingham Heart Study resulted in an index that assesses the 10 year risk of cardiovascular disease (Kannel, 1976). This index is widely used, and has more than 50 years of additional research on it, allowing physicians to determine whether further interventions would be helpful (Brindle et al., 2003).

## PROCESS

Process issues are those where the quality of healthcare is impacted negatively because of the current process for healthcare. This includes the high administrative costs, overtreatment and waste, and lack of healthcare information technology data standards.

### High Administrative Costs of Healthcare

Administrative costs for private health insurance plans has risen dramatically over the past ten years - by over 117 percent. Compared to the administrative costs, actual healthcare costs only rose 74 percent, so administration costs are a larger part of rising healthcare costs. Researchers estimate that administrative costs eats up more than 30 percent of the United States healthcare dollar in administration and procedures (Roth, 2010; *Thinking Outside the Pillbox: A system-wide approach to improving patient medication adherence for chronic disease*, 2009; Wikler, Basch, & Cutler, 2012).

According to the majority of healthcare researchers, the United States spends more on healthcare than any other country - and the quality of the basic healthcare is lower. Germany spends less than 6 percent of their healthcare dollar on administrative systems (M. Nelson, 2010; Roth, 2010).

Most researchers believe that the high administrative costs are caused by the disconnected, bureaucratic, and for-profit competitive nature of the current healthcare system (Wikler et al., 2012).

The literature on the reasons for the high administrative costs is also related to several other areas: the non-economic principles of healthcare, the multilayer payment structure of healthcare, the burden of overtreatment, the lack of healthcare information standards, the typical sedentary lifestyle of an American, the lack of prevention guidance, and end of life care management issues.

### Overtreatment and Waste

Estimates range from 22 to 40 percent of the healthcare administration dollar being completely wasted, or going into a shareholder's pocket, but not influencing the quality or quantity of healthcare (Barthold, Nandi, Mendoza Rodríguez, & Heymann, 2014; Bernstein et al., 2004; Berwick, 2003; CDC et al., 2007; Daniel, Damon, Mark, Mark, & Richard, 2012; Roth, 2010).

Brownlee explains the causes and outcomes of overtreatment, making the claim that the current system encourages disconnects between healthcare providers, unnecessary testing, and an overwhelming number of unnecessary surgeries (Brownlee, 2008).

The Atlas Project studied hospital referral regions (HRRs) in different states and determined that local capacity determined the treatment rather than standards of care. In a play on "if you build it they will come", this study determined "if you buy the diagnostic equipment, they will be tested" whether they need it or not. They conclude that overtreatment of the chronically ill is a problem, and that better coordination of care at the preventative stage is needed to avoid it (Wennberg & Fisher, 2008).

### Lack of Healthcare Information Technology Data Standards

Lack of healthcare data standards is a major waste of healthcare dollars. Research is clear that if hospitals, physicians, healthcare networks, providers, insurance companies, and government agencies were to all use the same process, the same fieldnames, and the same codes for diagnostic, treatment, and payment, the healthcare system could save billions of dollars each year (Bouhaddou et al., 2012).

The prevailing level of data interoperability in the healthcare industry can be characterized as ***a mess***. Ghosh and Scott proposed developing catalysts and antecedents in order to aggregate data for better healthcare decision-making, but found that even with a single system, the data was not interoperable. Systematic and semantic differences caused by diversity of data entry standards, and conflicts between multiple systems made it a real challenge to develop a working model (Ghosh & Scott, 2011).

Roth noted that in the United States, even within a single government, there is a competing hodge-podge of poorly integrated and often conflicting programs each with its own standards, computer systems, database schema, rules and policies (M. Nelson, 2010; Roth, 2010).

Gruman makes the case that the lack of health information technology (HIT) standards also drastically decreases the quality of care. He notes that the current chaotic state of healthcare delivery is increasingly fragmented and increasingly relies upon the patient to keep track of all their own medical records. He notes that people with chronic illnesses generally see many physicians, and that doctors generally do not currently communicate, even when they are within the same system or have offices in the same building. He notes that personal EHR systems are time consuming to populate, and that doctors resist them in any case, wasting whatever resources were invested in populating them (Gruman, 2011; Karapinar-Çarkit et al., 2010).

Wikler, Basch, and Cutler note that because each health care payer has their own customized data requirements for transaction, the number of hours that physicians, nurses, and clerical staff spend per week in claims and authorization is staggering. Physicians spend 43 minutes each and every day, and nurses spend half of their time (21 hours per week), while clerical staff spend 53 hours per week per physician (necessitating multiple clerical staff per physician). The healthcare industry employs more billing staff than any other industry nationwide. A typical transaction consists of eight separate steps in the revenue cycle, compared with most industries which typically only have three or four (Wikler et al., 2012).

In 1996 Health Insurance Portability and Accountability Act (HIPAA) stated that it was setting standards for identified organizations to use; but then listed 13 different sets of standards maintained by 11 different organizations ("Coding Classification Standards," 2012). The relationship between these codes and the organizations that maintain them is so complex as to require eight different certifications to understand all of them. Employment in the healthcare industry had been largely immune to the 2008 recession, but it is not because the industry was hiring more doctors, it is because the industry was hiring more clerks to code medical records. A decade ago a staff to physician ratio of 3:1 was commonly acceptable. Now, staff ratio needs to be between 5 and 7 to 1 physician in order to keep up with the large amounts of coding necessary for all the different insurance companies and government organizations. Wikler, Basch, and Cutler point to poor policy design, weak implementation and enforcement, as well as a lack of leadership on the part of the federal government regarding data standards of HIPAA (Wikler et al., 2012).

The economics of paying for all this wasteful technology that cannot interoperate and must be replaced every few years lowers the amount available to be spent on actual health care. Though technology companies love all the extra income caused by disconnected Electronic Health Record systems, healthcare quality suffers.

## PAYMENT ISSUES

Payment issues are economic factors that impact healthcare quality simply because of the payment methodology itself.

### Multilayer Payment Structure of Healthcare

One of the reasons why economics impacts quality of healthcare is the multilayered payment system. Because of the multilayered payment system, the cost savings due to technology implementation that is typical in normal businesses do not apply because those who pay for the technology do not benefit from the savings of technology. As a result, healthcare is the last major industry to adopt technology to better serve its users (Taylor, 2012).

The way healthcare invoices get paid makes the economically driven rules of supply and demand less applicable than normal industries. The payer is not the recipient of the service (Schimpff, 2012a, 2012b). The only group of people who pay directly for healthcare services are the uninsured, less than nine percent of the population in 2017 (though expected to rise with the elimination of the healthcare insurance mandate of PPACA). While some uninsured patients pay out of their own pocket, many are unable to pay the high prices of care, especially emergency care. Hospitals cover billions of dollars in costs each year for uninsured patients as they are mandated to treat everyone regardless of ability to pay (Baumgarten, 2012). So even in that situation, the receiver of the service is not the payer of the service.

For the remaining 89 percent of people, healthcare costs are covered by different organizations based upon whether or not the person is employed, was in the service, is older or younger. More than 50 percent are covered by private insurance (either paid by the person or by the person's employer). Twenty-two million people also choose to supplement with a Health Savings Account (HSA). Jordan and Nocholls suggests HSA is used by people who earn more and are healthier than most (Jordan & Nicholls, 2018).

For combat veterans, the Veterans Administration (VA ) covers some or all of the healthcare costs. For seniors over 65, Medicare covers 80 percent of healthcare costs. For poor people in general, Medicaid (or Medical Assistance) covers the bills (2.18 million adults), and for children, CHIP (Children's Health Insurance Program) pays for healthcare (1.26 million children) (Claxton et al., 2012).

Sometimes who we think of as the payer is not actually the payer. When an employer pays the cost of health insurance, the recipient of the service, the patient, is not even indirectly involved in the payment and the payer of the service (the insurance company) is paid by someone other than the recipient. Even in the case of public healthcare insurance such as Medicare and Medicaid, the recipient is still not the payer, the taxpayer is the payer who pays the payer, the government. Only individual self-paid health insurance has a more direct connection between the payer and the service.

Overtreatment is also related to the multilayer payment system, because there is no direct link between the amount that employers or governments pay for insurance, and the cost that is borne by the patient (Forgione, Vermeer, Surysekar, Wrieden, & Plante, 2005; Larg & Moss, 2011). Furthermore, malpractice influences overtreatment by setting defensive standard of care that requires a great deal of unnecessary testing (Bovbjerg & Bartow, 2003; Hermer & Brody, 2010).

This odd non-economic method of payment means that there is a unique relationship between the consumer (patient), the payer (the insurance company or the government), the employer (who, at times, provides the conduit to the insurance and may pay part or all of the costs), and the providers (doctors, nurses, hospitals) and their suppliers (medical equipment, pharmacies, etc.). Mattke and the RAND team point to this "payment silos" structure of healthcare as the reason why numerous beneficial health care innovations (from the systems perspective) are not adopted. The current payment structure rewards a group other than the payers for efficiencies. For example, they note that Electronic Health Records (EHR) generally would require investment and training on the part of the providers, but the beneficiaries are the private and public insurance companies (Mattke et al., 2010). Generally, until CMS mandated the use of EHR systems for Medicare, doctors and hospitals did not invest the money despite the eventual efficiencies they might bring. Additionally, as Miller points out, the government impacts the cost of healthcare insurance by issuing mandates for required coverage (Miller, 2014).

Forgione, Vermeer, Surysekar, Wrieden and Plante advocate looking at this unique relationship in the framework of *Agency Theory*, through the lens of "optimal agreements governing interactions between the involved parties". Reviewing their activities through this lens can give public policy and healthcare advocates insight into rising and lowering costs. In Agency Theory, each involved party can be expected to work in their own best economic interests, so the balance between the parties must be taken into account when considering public policy. A chart outlining the different agencies (payers) and the economic issues involved in healthcare decisions can be found in Figure 6 (Conrad, 2016; Larg & Moss, 2011).

Agency Theory demonstrates why, despite significant evidence that prevention costs less than treatment, it is difficult to get insurance companies to pay for health promotion, wellness, self-care, or behavioral prevention. The financial

benefits of prevention occur "downstream", most likely when some other agency would be responsible for them. Childhood vaccines, for example, often don't prevent a disease for a decade or two - by which time the insurance company covering the cost of vaccines is no longer responsible for healthcare costs of the patient. Healthy lifestyle expenses such as gym membership, nutrition counseling, classes, coaching and support groups all impact costs of chronic illnesses in a major way; but often not until the person is in their sixties, by which time it is Medicare, and not the insurance company, which pays the costs. This is also why employers are often the only ones willing and able to pay for healthy lifestyle support; they are the ones who benefit the most from healthy productive employees (Baicker, Cutler, & Zirui, 2010; Berry & Mirabito, 2011; DeVries Iii, 2010).

Goetzel and Ozminkowski reviewed the research and encouraged work health programs to be funded at an optimal investment level so that program savings can obtained. They stated that more research is needed on the optimal design and cost of interventions, and this research must reach employers for these programs to be applied more broadly (Goetzel & Ozminkowski, 2008).

Nelson, Cohen, Greenberg, and Kent reviewed 887 publications reporting 2128 cost effectiveness ratios for innovative health care. They were looking for lower cost treatments that were decrementally cost effective; giving up quality for price. The number of comparison studies that increased quality and improved health (increasing costs as well) was 1533, but they found very few (1.6 percent of the sample) that were decrementally cost effective (i.e. found equivalent alternatives to decrease costs). They concluded that because insurance tends to shield both physicians and patients from the true cost of care, there is no incentive to decrease the quality in order to save the costs. Even if the quality would only decrease slightly and the cost savings were large, there was no incentive to save the money (A. L. Nelson, Cohen, Greenberg, & Kent, 2009).

Osilla, et al, investigated worksite wellness, which the majority (58 percent) of corporations take advantage of. There is an accelerating trend of employees taking part in worksite wellness programs. They reviewed 33 studies, and concluded that despite the mostly positive outcomes, the body of evidence did not support such widespread adoption of wellness programs – not because they did not work (they did) but *because the employee, and not necessarily the company, benefitted* (Chan Osilla et al., 2012).

| | **People with Health Condition** | **Family members of Person with Health Condition** | **Healthcare Insurance (public [gov] or private [employer or self])** | **Business or Industry** |
|---|---|---|---|---|
| **Healthcare Related Resource Use** | Premiums paid to private insurance. Taxes paid to public insurance. Out of pocket health costs. Transportation costs. Home and/or car modifications due to health. Food for special diets. Loss of income for unpaid leave to attend treatment. | Premiums paid to private insurance.<br>Taxes paid to public insurance.<br>Out of pocket health costs.<br>Transportation costs.<br>Home and/or car modifications due to health.<br>Food for special diets.<br>Loss of income for unpaid leave to attend treatment. | Information Systems and Infrastructure.<br>Administration.<br>Prevention programs.<br>Specialists Equipment.<br>Infrastructure.<br>Community Support Services.<br>Residential Support Services.<br>Prevention Programs.<br>Research. | Premiums paid to private insurance.<br>Taxes paid to public insurance.<br>Out of pocket health costs.<br>Transportation costs.<br>Home and/or car modifications due to health.<br>Food for special diets.<br>Loss of income for unpaid leave to attend treatment. |
| **Other Resource Use** | Legal representation.<br>Childcare. | Damage to property (i.e. for substance abuse, smoking, crime related activities) | Worker replacement costs (recruiptment, training, retraining).<br>Cost of implementing and adhering to regulations and legislation. | Regulations, inspection and monitoring, childe welfare services, disability support services, court services, police services, prison services, emergency fire services, cost of administering taxes and benefits. |
| **Production Losses** | Loss of revenue due to unpaid sick leave, treatment related time off from work, reduced on-the-job productivity, premature retirement due to health issues, loss of opportunity for promotion, early mortality. | Loss of revenue and unpaid production while caring for sick family and friends. | Loss of revenue due to unpaid sick leave, treatment related time off from work, reduced on-the-job productivity, premature retirement due to health issues, loss of opportunity for promotion, early mortality. | N/A |
| **Intangible Burdens** | Lower Quality of Life, impaired functioning, psychosocial impact, loss of leisure time, loss of life. | Psychosocial costs of caring for sick family and friends. | Deadweight. Loss of additional taxation. | Employee morale |

**Figure 6. Components of Costs and economic issues. Simplification of a chart from Larg & Moss (2011).**

## CUSTOM

Custom factors are those factors that impact healthcare quality negatively simply because "we've always done it that way". Needed changes could dramatically improve healthcare, but because it's not the typical way things get done, the changes are very slow in coming. These include lack of high-quality guidelines, and problems with research methodologies.

### Lack of High-Quality Guidelines

It is difficult to find consistent high-quality guidelines for treatment. Gabbay, et al reviewed 92 studies, over half of which purported to provide clear guidance to clinicians as to when to determine that further actions are unlikely to help a dying patient (futility), and half of which refuted that the point of futility was reached or could be determined and therefore further action was warranted. They determined that among the 47 studies that supported withholding of treatment, they did not demonstrate clear determinable guidelines for clinicians to follow. They conclude that trying to rely upon statistically driven data to make such determinations is fraught with problems, and that physicians need to rely upon their own expertise rather than relying upon published data determining futility guidelines (Gabbay et al., 2010).

Porzsolt, et al analysed guidelines for 330 treatment recommendations for three different types of cancer from 11 countries. The recommendations were categorized as congruent, incongruent, or undetermined. A congruent recommendation matched 66% of other country's recommendations, an incongruent matched less than 66%, and an undetermined recommendation did not clearly provide a recommendation in at least 66% of the modalities. Their results indicate that incongruent recommendations were 4-fold more common than congruent recommendations. Out of the 330 recommendations, only 50 were congruent (15%). One of the reasons proposed for the high level of incongruence was that some guidelines were based solely on random control studies, and some on the experience of the guideline authors – and they do not necessarily lead to the same conclusion for treatment (Authors, Manzini, Lobmeyer, & Kaplan, 2019).

### Decision Making Methods

Siebert considers economic evaluation as part of the essential decision making of healthcare (Siebert, 2003). Bong-Min researches the use of health technology assessment as a policy option in order to avoid unnecessary healthcare costs. Bong-Min found that health technology does not save money, but generally increases costs overall. Bong-Min did note that health technology assessment tools do help determine if new treatments are cost effective. He notes that some countries such as South Korea have already implemented health technology assessment policies requiring pharma-economic research (proof that a new drug will be *more cost effective* than what is already available) before reimbursing for prescriptions. He identifies culture, healthcare systems, and public trust in the government as factors that determine which countries will utilize health technology assessment (Bong-Min, 2009).

Decisions are influenced by availability of services. The Atlas project studied hospital referral regions (HRRs) in different states regarding how much they spent on Medicare enrollees with severe chronic illnesses. Researchers demonstrated that clinical decisions governing the frequency of use of such supply-sensitive care as physician visits, referrals to specialists, hospital care, and diagnostic testing are strongly affected by local capacity, which strongly influences both the quantity and per capita cost of care provided to patients with chronic illnesses. Their conclusion? That in-patient hospital care is not the best option. Other methods must be found to reduce overtreatment of the chronically ill in the inpatient setting, particularly by improving the coordination of care (Bachman et al., 2017; Postier et al., 2014; Wennberg & Fisher, 2008).

One of the major issues in healthcare decision making is the collaborative efforts of groups of physicians. There have been many studies on this topic. Kuhlmann, Gavin, and Galavotti evaluated 9 studies on integrating family planning services as part of an integrated health practice, and all reported overall satisfaction from the providers, clients, and community perspective, though only seven of the nine studies reported the measurement of the improvement, and none provided a cost benefit analysis (Kuhlmann, Gavin, & Galavotti, 2010).

White and Glazier reviewed 65 studies on cost benefit of hospitalists (special doctors hired by hospitals rather than traditional physicians who maintain hospital privileges for their patients). The majority show that hospitalists reduce patient stays and cost less, but don't necessarily provide better care. The authors were concerned that the issue has not gotten better despite the amount of research on the topic indicating problems with the method of using hospitalists instead of primary care physicians. However, they were not able to identify the underlying mechanisms driving the outcomes and associated quality of care so that it could be improved (White & Glazier, 2011).

Sikorski, Luppa, Konig, van den Bussce, and Reidel-Heller reviewed 108 articles and chose 11 that were randomized controlled trials training general practitioners in depression care. Training alone did not improve outcomes; organizational structure changes were necessary before changes were seen (Sikorski, Luppa, König, van den Bussche, & Riedel-Heller, 2012).

Chisholm-Burns et al reviewed studies on the effectiveness of pharmacists as part of the healthcare team, and concluded that the majority of studies were limited due to partial cost analysis, study design, and inappropriate statistical analysis. They encouraged future investigators to adhere to the guidelines and recommendations of the Panel of Cost-Effectiveness in Health and Medicine (Chisholm-Burns et al., 2010).

The efficacy of specialists versus primary care physicians and drug approval decision making was also the topic of study. Chauhan and Mason investigated 29 studies (out of the 1400 screened) for the reasons behind the slow progress in new prescription medicines in the United Kingdom, and concluded that though price was not the primary factor, the fact that specialists are more likely to be involved in the Drug and Therapeutic Committees gives them more access to the details of new drugs so that they are more likely to differentiate drugs with novel actions or identify areas with few alternatives. Primary care physicians are less likely to be involved in formal purchasing decision processes, and therefore are less likely to have new drugs on their consciousness (Chauhan & Mason, 2008; Mason, 2008).

Another issue with healthcare decision-making is the current penchant to try and limit healthcare to just medical factors and interventions. Many experts believe that there is a growing base of evidence to suggest that strategies to address the social determinants of health must be integrated into health care models in order to achieve the triple aim of improved population health with higher care quality at lower costs (Bachman et al., 2017).

## RESEARCH

There are several challenges to doing healthcare research and estimating the costs of the benefits of healthcare. Problems include the cost benefit methods themselves, the lack of ability to get any accurate costs because of the plethora of payment systems, the practice of cost shifting, and the impact of utilization and volume on costs.

### Healthcare Research Issues

One of the major problems of current healthcare research is that much of it is funded by pharmaceutical companies and surgical device firms (Lexchin, 2012). This causes physicians, who read the research, to rely much more heavily on costly drugs and surgeries rather than including simple and more cost effective treatments.

Integrative medicine generally relies upon more natural treatments. It does not have the same kind of research funding behind it. While there are many studies that show its cost effectiveness (Demirkol et al., 2017; Kooreman & Baars, 2012; Lien et al., 2016; Morgan, Irwin, Chung, & Wang, 2014; Selfridge, 2012; Viksveen, Dymitr, & Simoens, 2014; Wu et al., 2014; Xiong, Wang, Li, & Zhang, 2015), authors of guidelines often insist on random control trials which decreases the chance that integrative health practices will be included in the guidelines. Random control trials measure efficacy (the possibility that the treatment works under study conditions), not effectiveness (whether the treatment actually works in real world conditions). Random control trials are much more difficult to design and much more expensive to complete with integrative healthcare practices than with simple drugs or surgical devices. Physicians would not usually recommend integrative practices because they are not within the guidelines for standard of care (Menard et al., 2015).

**Estimate Cost Benefits**

Cost Benefit Analysis themselves have severe limitations. Although newer cost effectiveness analysis methods try to make adjustments, most cost benefit research only measures quantity of life, not quality. Since healthcare technology and practice has reached the point where a person can be kept alive almost indefinitely regardless of age or infirmity, the impact of treatments on the quality of life can be enormously important, more-so than the quantity of life. Furthermore, in research the value assigned to the life year is traditionally $50,000, the origins of which is several decades old and actually meaningless (Hoch & Smith, 2006).

There is no universally accepted standard for measuring the quality-of-life weights, and that estimation can result in drastically different results. Generally, researchers administer some assessment or preference-based measure such as EQ-5D (EuroQol Health States), HUI3 (Health Utilities Index Mark 3), or SF-6D (a measurement of health and wellbeing). The assessments are then valued using different valuation techniques such as Time Trade-Off, Standard Gamble, Visual Analogue Scaling, Ranking and Discrete Choice Experiments.

Unger points out that Quality Adjusted Life Year (QALY) and other economic variables do not apply well to children who cannot be surveyed using EQ-5D, and often must be provided by proxy (i.e., their parents). Unger recommends considering the family perspective, and advocates a discrete-choice method for a willingness to pay model to assess different treatments (Ungar, 2011).

Zimovetz, Wolowacz, Classi, and Birt reviewed 37 studies to treat major depressive disorder, and concluded that the variety of measurements (symptom free days, health state utilities, Disability Adjusted Life Year (DALY), QALY, and efficacy of second-line treatments) lead to difficulties in comparisons (Zimovetz, Wolowacz, Classi, & Birt, 2012).

Ferrusi, Leighi, Kulin, and Marshall concluded that researchers of comparative research studies rarely estimate anything other than costs, and that looking at costs does not provide enough information for decision-making support due to the uncertainty involved (Ferrusi, Leighl, Kulin, & Marshall, 2011).

Applying just financial factors to healthcare decisions is problematic. Detsky, and Laupacis state that QALY should not be used alone for decision making. Cost Analysis research can only provide cost effective measurement information relative to an arbitrary threshold. In other words, utilizing multiple factors for decision making will maximize the benefits within an allocated budget, but more economically attractive options may get overlooked. Furthermore, the assumptions used in the analysis may be susceptible to error and bias ("Disease Management Update," 2007).

Dalziel, Segal, and Mortimer found a number of different outcome measurements when they studied 245 health interventions. Outcomes included Life Year, QALY, and DALY. They concluded that each type of condition or modality needs to be judged on its own unique attributes; they cannot be grouped together with broad generalities. They looked at studies where the individual was able to reduce their own risk of disease or injury, or where a major cause of the condition was their own behavior (which includes almost all chronic diseases). They pointed out that these studies had a very low median incremental cost effectiveness ratio, where as diagnostic screenings, vaccinations, and mental disorders had the highest incremental cost-effectiveness ratio (Dalziel, Segal, & Mortimer, 2008).

Data from cost effectiveness studies cannot be accepted without being translated or adjusted for the country. Manca and Willan have proposed an algorithm that would help interpret the analysis for utilization in decision making or research in another country (Manca & Willan, 2006).

All of these issues with economic outcomes of health research means that, due to economic issues, the research does not always represent the actual underlying truth of the best treatments.

Another issue in cost analysis is: which costs are used? The base cost to provide the service? The cost to the patient? The cost to the insurance company? The cost to the government? The cost to society? For a single treatment, these may all be different amounts (deBrantes, Rastogi, & Soerensen, 2011; Newman & McMahon, 2011).

Tunis noted that the extent of cost benefit for any treatment or service is directly related to the choice of cost definition - which is not standardized. The study compared the estimates of a cost effectiveness results of two drugs using both the wholesale acquisition cost and the average wholesale price, and the cost effectiveness ratio went from .44 to 1.73, which would completely change the recommendation for treatment. The results were further complicated by the fact that there is not only a wholesale cost, but also a charged cost, an allowed cost, and a paid cost; often controlled by different parties (Tunis, 2009). Cutler and Marzilli found that the social cost of a resource was much different than the price. For example, the social cost of a new drug might be one-third the market price to insurance companies, and one-half the market price when paid for by one of the government healthcare options (Medicare or Medicaid) (Cutler & Marzilli Ericson, 2010; Gordon, 2012).

Prenger, Braakman-Jansen, Pieterse, der Palen, and Seydel found that behavioral intervention studies often do not include partial (though beneficial) changed. They discussed ways in which researchers could incorporate appropriate measures of partial change when reporting cost effectiveness of a treatment (Prenger, Braakman-Jansen, Pieterse, der Palen, & Seydel, 2012).

Peterson, Hollis, Pogge point out that cost benefits analysis incentivizes R&D for drugs of incremental or questionable value. The analysis provides greater returns on drugs that would be sold in high volumes, even if they did very little, while ignoring rare diseases or life saving drugs because they would only be sold in limited quantities (Peterson, Hollis, & Pogge, 2010).

Gemmill, Thomson, and Mossialos reviewed 173 studies regarding user charges (co-pays, co-insurance, deductibles, reference pricing, and formularies) on prescription drugs, which are purported to steer patients toward cost effective care. They found, however, that in practice they do lower the initial cost for healthcare but do not lead to long term control of pharmaceutical spending and do not contain total healthcare costs. They point out that providing harmful or ineffective commodities to those who are willing to pay is efficient, while providing effective and beneficial to those unable to pay is inefficient, a concept known as *allocative efficiency* (Gemmill, Thomson, & Mossialos, 2008).

Cost shifting is also an issue. There have been many attempts in legislation to lower costs using a variety of methods. Some researchers question the value of the different methods, claiming that sometimes savings at one level adds to costs at another level, i.e. *cost shifting* (Kaufman, 2011).

Roy and Madhavan reviewed 101 articles on Medicaid and Medicare policies on prescriptions drugs that solely focused on the costs of the drug themselves. Many of the studies revealed that when Medicare or Medicaid changed their policies in an attempt to rein in costs (for example, by restricting access through formularies or necessitating pre-authorization), they actually increased costs because patients had to visit their doctors to make the change - and the cost of the doctors visit would often wipe out the cost savings of the restriction (Roy & Madhavan, 2008).

Recent bills introduced in the legislature at the federal level incorporate the requirement of comparative effectiveness data, and there has been some research on the issue. Vernon, Golec, and Stevens warns that R&D costs for drug development will rise if additional comparative studies must be done in order to bring innovative treatments into the healthcare system (Vernon, Golec, & Stevens, 2010). Berger and Grainger from Eli Lilly, on the other hand, believe that comparative effectiveness analysis studies are the next step in evolving healthcare that will increase treatment options (Berger & Grainger, 2010). Like many other pharmaceutical companies, however, they are concerned that comparative effectiveness research will not be used as only one of many decision making point, but rather would dominate, causing cost-effectiveness guidelines to override healthcare decisions. Selker provides a good outline of this issue and describes guidelines for government agencies (such as keeping the policy making bodies and the research bodies separate). Selker advocates keeping the comparative effectiveness research *scientific.* Selker also believes that studies should be funded by the Agency for Health Quality Research rather than for-profit-industries (Selker, 2009).

Vos, et al, reviewed 339 studies of hospitals incorporating process improvement programs, and did not find much success. They identified three factors that hampered progress; 1) functional structure of the hospitals do not lend themselves to improvement, 2) unfamiliarity with proper process improvement techniques, and 3) the limited areas where streamlining could be useful. The authors advised hospital management to understand the factors for failure in

the existing literature and to take them into account before attempting their own process improvements (Vos et al., 2011).

Practitioners might complain that cost cutting impacts quality. However, Moore, McMullen, Woolford, and Berger did not find that quality was related to cost when they studied the variations of clinical process in birth control facilities. They recommended that clinics adopt best practices, and decrease variability in order to lower costs (Moore, McMullen, Woolford, & Berger, 2010).

Another very important issue is how utilization impacts costs in healthcare. The number of people expected to utilize a diagnostic test or treatment relates directly to its cost. An MRI machine, for example, might cost one million dollars to purchase and maintain throughout its product lifecycle. If the hospital that purchases the MRI machine only has one person who needs an MRI assessment, the cost for that one MRI scan would be *one million dollars*. But if 100,000 people use it, the cost of each of the 100,000 MRIs is *ten dollars*. (It goes without saying that if they charge $1000 for each MRI, and 100,000 people use it, the hospital makes *one hundred million dollars.)* The Medical Expenditure Panel Survey published by the Agency for Healthcare Research and Quality measures utilization as one of its factors, and estimates its impact (though redesigns of the survey have minimized the quality of the estimates (Cohen, Ezzati-Rice, Zodet, Machlin, & Yu, 2011; "How safe is your hospital?," 2012).

## CONCLUSIONS

A systematic review of the literature on economics and integrative health demonstrates that there has been a major upheaval in healthcare economics research. The review of the specific articles for themes seemed to fall under the following categories: *society, ethical, process, payment, custom and research.*

Society Issues include the Rising Costs of Healthcare and the Growing Senior Population as well as the Growing Chronic Conditions and Diseases. Ethical issues include the Non-Economic Principles of Healthcare and the End of Life Care Management Issues. Process issues include the High Administrative Costs of Healthcare, Overtreatment and Waste, and Lack of Healthcare Information Technology Data Standards. Payment Issues are mainly impacted by the Multilayer Payment Structure of Healthcare in the United States. Custom Issues focus mostly on the Lack of High Quality Guidelines and Decisionmaking Methods. And finally, Research itself is an issue, with many impacts on the quality and source of research available for healthcare advocates including Healthcare Research Issues and Estimate Cost Benefits. Problems include the cost benefit methods themselves, the lack of ability to get any accurate costs because of the plethora of payment systems, the practice of cost shifting, and the impact of utilization and volume on costs.

In reviewing and describing the articles, their themes and categories, it appeared to the researchers that the bulk of the research shows support for the contention that economic issues can impact the quality of healthcare, and that some of these economic issues are interfering in high-quality healthcare – apart from the general issue that people with money can buy better healthcare than people without money. These economic issues seem to interfere with all healthcare – no matter what the source of healthcare funding. We suggest two rich avenues for further research.

One potential avenue to explore is what would happen if the incentives that trigger high incomes for some and high costs for others without generating health value to patients were to be abolished? Money doesn't disappear; it just shifts to the benefit of other parties. Tools to establish unjustified money-migration are often considered a feature of *Clinical Economics*, and additional studies in this topic are needed.

Another potential topic surrounds an as-yet- unexercised economic windfall in the United States which may be possible that could benefit society at large. The research hints at a huge amount of money that could be saved, while at the same time improving the quality of healthcare, by simply *preventing* rather than *treating* preventable diseases. We suggest that what is needed is an economic model to put more specific and supportable cost figures forward on how large a savings that might entail.

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Appendix A: List of Articles found in Systematic Search

**Table 3. Table of Articles Found in Systematic Search**

| Number | Authors | Year | Primary Category | Before or After June 30, 2012 |
|---|---|---|---|---|
| 1 | Abel, Rich, Griffin, & Purdy | 2009 | Ethical | Before |
| 2 | Aldridge & Kelley | 2015 | Ethical | After |
| 3 | Alexa, Marian, Jae Hak, Diana, & Stephanie | 2010 | Society | Before |
| 4 | Anderson et al. | 2009 | Society | Before |
| 5 | Artnak, McGraw, & Stanley | 2011 | Society | Before |
| 6 | Bachman et al. | 2017 | Custom | After |
| 7 | Baicker, Cutler, & Zirui | 2010 | Payment | Before |
| 8 | Baily | 2011 | Ethical | Before |
| 9 | Banham, Lynch, & Karnon | 2011 | Ethical | Before |
| 10 | Barthold, Nandi, Mendoza Rodríguez, & Heymann | 2014 | Process | After |
| 11 | Berger & Grainger | 2010 | Research | Before |
| 12 | Berry & Mirabito | 2011 | Payment | Before |
| 13 | Berwick | 2003 | Process | Before |
| 14 | Bong-Min | 2009 | Custom | Before |
| 15 | Bouhaddou et al. | 2012 | Process | Before |
| 16 | Brindle et al. | 2003 | Ethical | Before |
| 17 | Callens, Volbragt, & Nys | 2006 | Ethical | Before |
| 18 | Chan Osilla et al. | 2012 | Payment | Before |
| 19 | Chauhan & Mason | 2008 | Custom | Before |
| 20 | Chisholm-Burns et al. | 2010 | Custom | Before |
| 21 | Cohen, Ezzati-Rice, Zodet, Machlin, & Yu | 2011 | Research | Before |
| 22 | Coleman | 2011 | Ethical | Before |
| 23 | Conrad | 2016 | Payment | After |
| 24 | Cutler & Marzilli Ericson | 2010 | Research | Before |
| 25 | Dalziel, Segal, & Mortimer | 2008 | Research | Before |
| 26 | Daniel, Damon, Mark, Mark, & Richard | 2012 | Process | Before |
| 27 | deBrantes, Rastogi, & Soerensen | 2011 | Research | Before |
| 28 | Demirkol et al. | 2017 | Research | After |
| 29 | DeVries III | 2010 | Payment | Before |
| 30 | Donnelly | 2012 | Ethical | Before |
| 31 | Ferrusi, Leighl, Kulin, & Marshall | 2011 | Research | Before |
| 32 | Fleck | 2011 | Ethical | Before |
| 33 | Forgione, Vermeer, Surysekar, Wrieden, & Plante | 2005 | Payment | Before |
| 34 | Freudenberg | 2017 | Society | After |
| 35 | Gabbay et al. | 2010 | Custom | Before |
| 36 | Gemmill, Thomson, & Mossialos | 2008 | Research | Before |
| 37 | Ghosh & Scott | 2011 | Process | Before |
| 38 | Grabowski | 2007 | Ethical | Before |
| 39 | Gruenewald | 2012 | Ethical | Before |
| 40 | Gruman | 2011 | Process | Before |
| 41 | Hermer & Brody | 2010 | Ethical | Before |
| 42 | Hoch & Smith | 2006 | Research | Before |
| 43 | Jordan & Nicholls | 2018 | Payment | After |
| 44 | Kannel | 1976 | Ethical | Before |
| 45 | Karapinar-Çarkit et al. | 2010 | Process | Before |
| 46 | Kaufman | 2011 | Research | Before |

| Number | Authors | Year | Primary Category | Before or After June 30, 2012 |
|---|---|---|---|---|
| 47 | Kernick | 2005 | Ethical | Before |
| 48 | Knauf & Aronson | 2009 | Society | Before |
| 49 | Kooreman & Baars | 2012 | Research | Before |
| 50 | Kuhlmann, Gavin, & Galavotti | 2010 | Custom | Before |
| 51 | Kumar & Nigmatullin | 2010 | Society | Before |
| 52 | Kumar & Prevost | 2011 | Society | Before |
| 53 | Larg & Moss | 2011 | Payment | Before |
| 54 | Lauridsen, Norup, & Rossel | 2008 | Ethical | Before |
| 55 | Lexchin | 2012 | Custom | Before |
| 56 | Lien et al. | 2016 | Research | After |
| 57 | Lupari, Coates, Adamson, & Crealey | 2011 | Ethical | Before |
| 58 | Manca & Willan | 2006 | Research | Before |
| 59 | Martini, Garrett, Lindquist, & Isham | 2007 | Society | Before |
| 60 | Mason | 2008 | Custom | Before |
| 61 | Menard et al. | 2015 | Research | After |
| 62 | Moore, McMullen, Woolford, & Berger | 2010 | Research | Before |
| 63 | Morgan, Irwin, Chung, & Wang | 2014 | Research | After |
| 64 | Mulvany | 2010 | Ethical | Before |
| 65 | M. Nelson | 2010 | Process | Before |
| 66 | A. L. Nelson, Cohen, Greenberg, & Kent | 2009 | Payment | Before |
| 67 | Nord | 2010 | Ethical | Before |
| 68 | Peterson, Hollis, & Pogge | 2010 | Research | Before |
| 69 | Petrou & Gray | 2011 | Ethical | Before |
| 70 | Postier, Chrastek, Nugent, Osenga, & Friedrichsdorf | 2014 | Ethical | After |
| 71 | Prenger, Braakman-Jansen, Pieterse, der Palen, & Seydel | 2012 | Research | Before |
| 72 | Riley & Lubitz | 2010 | Process | Before |
| 73 | Ruger | 2008 | Ethical | Before |
| 74 | Schimpff, | 2012 | Payment | Before |
| 75 | Schimpff, | 2012 | Payment | Before |
| 76 | Seals, Justice, & LaRocca | 2016 | Society | After |
| 77 | Selfridge | 2012 | Research | Before |
| 78 | Siebert | 2003 | Ethical | Before |
| 79 | Sikorski, Luppa, König, van den Bussche, & Riedel-Heller | 2012 | Custom | Before |
| 80 | Tunis | 2009 | Research | Before |
| 81 | Ungar | 2011 | Research | Before |
| 82 | Vernon, Golec, & Stevens | 2010 | Research | Before |
| 83 | Viksveen, Dymitr, & Simoens | 2014 | Research | After |
| 84 | Vos et al. | 2011 | Research | Before |
| 85 | White & Glazier | 2011 | Custom | Before |
| 86 | Wu et al. | 2014 | Research | After |
| 87 | Xiong, Wang, Li, & Zhang | 2015 | Research | After |
| 88 | Zimovetz, Wolowacz, Classi, & Birt | 2012 | Research | Before |
| 89 | Zunic et al. | 2011 | Ethical | Before |

# THE BLOCKCHAIN TECHNOLOGY AND DIGITAL MARKETING

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## ABSTRACT

This paper reviews the literature on blockchain technology in light of digital marketing. Along with a glance of the current state of the disruptive technology, it highlights specific characteristics of that technology that is revolutionizing business practices. To demonstrate the wide-ranging effect, this paper presents applications of blockchains in different areas of business, such as financial services, supply chains, health care, tourism, location of shipments, disintermediation of third parties for investment growth, and smart contracts to execute secure transactions on exchanges. Specifically, digital marketing is emphasized within the environment of social networks, such as Facebook, Twitter, YouTube, LinkedIn and Instagram, by examining its potential benefits in many commercial contexts. Based on the behavioral data of customers within social networks, this paper also describes the current state of digital marketing and its future trends. A conclusion derived herein is that blockchain technology will consistently influence future operations of digital marketing, social media marketing (including influencer marketing), e-commerce, and analysis of networks.

## INTRODUCTION

As a new paradigm of economic development, the digital economy represents a turnaround in business relationships based upon information use. In this sense, information technologies and networks represent fundamental factors for economic globalization which contribute to the rapid transition of theoretical studies from autonomous economic agents to those agents of social networks; they ensure the digital economy to be solidly supported by innovative business processes (Vovchenko et al., 2017).

Specifically, blockchain technology originates from bitcoin, a cryptocurrency with a peer-to-peer payment system (McKinney et al., 2015). Cryptocurrencies using blockchain technologies bring competitive advantages to financial contracts from lower costs associated with interactions amongst economic agents, acquisition of information, transparency of and capital control over operational risks. Moreover, blockchain technology provides a means for high-quality contract execution between the economic agents of the digital economy by its contributions to the financial security of operations (Negroponte, 1996). In fact, sectors of the economy and society associated with the digital economy have undergone fundamental changes from the emergence of blockchain technology. Hence, experts (cf. Osipov & Zotova, 2015) consider the technology to be a platform for businesses, especially in areas of high-growth, technology, investment and finance.

The 2008 financial crisis motivated an anonymous group of computer enthusiasts to develop a stable, decentralized, autonomous and sustainable financial system to ideally eliminate the influence of financial institutions (cf. Chuen, 2015; McKinney et al., 2015). Satoshi Nakamoto (2008), a pseudonym who was the main promoter of cryptocurrency, designed the first blockchain database. These events linked with the phenomena of privatized profits and socialized losses have made financial intermediaries lose their public confidence which prompted connoisseurs of information technology to utilize computers and the Internet as a tool of defense. In this defensive environment, Bitcoin as the first cryptocurrency was launched in 2009. This fully digital currency consists of a system of electronic payments between peers. Since 2009, there have been ~2,677 cryptocurrencies by the middle of 2020.

Bitcoin is not authorized by a country (Chuen, 2015). When used in transactions, banks do not have to be involved within the Bitcoin transaction process as it is decentralized. Thus, international payments are easy to complete. That is, commercial actors who are connected by a blockchain will no longer require third parties to complete transaction completion. Despite these conveniences and advantages, this technology is just beginning to be known even though it was launched almost a decade ago. Whilst some suggest that cryptocurrencies are not subject to regulations, there has been significant movements towards increased regulations; however, these regulations are somewhat inconsistent (McKinney et al., 2021).

Although the future of Bitcoin remains unclear, it is assured that blockchain technology has enormous potential to bring about large-scale improvements in finance, economics, and business operations (Chuen, 2015). Such technology could reduce the influence of many large global corporations and institutions, particularly those that are greatly interested in preserving existing hierarchies, by altering the power structures. That is, the potential of this technology still remains untapped.

Because of its suitability to handle business transactions, currencies, contracts and assets, Tapscott and Tapscott (2016) note that blockchain technology represents an opportunity for a more prosperous, safer, inclusive, and open world. The rapid development of the Internet, Social Media, and Mobile Media offer marketers a variety of options that did not previously exist. Hence, marketers must reevaluate their media strategies and rethink the processes through which customers make decisions (Belch & Belch, 2014). Specifically, marketers must investigate within the current digital era how various media vehicles influences individuals and how persuasive messages may be effectively communicated.

Simultaneously, the proliferation of sophisticated e-commerce platforms with mobile device applications has fueled the rapid growth of business-to-customer commerce, reshaped organizational structures, and renewed the processes of value-creation and capture (Rejeb et al., 2020). These new technologies have altered the foundation of brand marketing by allowing a far broader market reach with a more personalized market segmentation that increases brand trust and improves customer loyalty. Marketers can create new online sales venues and generate new demands. That is, blockchain technology is the disruptive technology that brings forward various innovations in commerce that empowers the paradigm of consumer-centric marketing. Additionally, blockchains encourage disintermediation, helps combat fraud, reinforces trust and transparency, improves privacy protection, enhances security, and enables creative loyalty programs.

The potential of blockchain technology is seen as the forefront of revolutionizing industries and economic sectors; it is expected to lead the digital world (Filimonau & Naumova, 2020). Digital supply chains have been integrating towards blockchain technology with improved security and profitability of transactions (Korpela et al., 2017). This will drastically transform how companies organize, manage, and conduct their operations (Coita et al., 2019). Such technology represents competitive advantages in financial contracts due to cost reduction in the interaction of economic agents (Vovchenko et al., 2017). It also contributes to the disintermediation and decentralization of business endeavors within business (Ertemel, 2018). Blockchains can represent practical solutions to the challenges of online advertisement that involves thousands of intermediaries who distort and make the diffusion of goods and services more expensive (Pärssinen et al., 2018). The growth of the Internet, along with emerging technologies, has had a substantial impact on the traditional marketing mix (i.e., product, price, place and promotion); technologies, known as big data analytics, have allowed companies to aggregate large and complex data sets, and use sophisticated methods to mine additional information about customers (Stone & Woodcock, 2014). Another very important contribution of blockchain technology is that it can reduce the asymmetry of information amongst buyers and sellers so that negotiations between various parties can take place on level fields (Zavolokina et al.,2019). Similarly, with blockchain technology, smart contracts can be developed to facilitate, verify, and automatically enforce the implementation of digital contracts without the involvement of a central authority (Wang et al, 2019).

Considering the potentials and advantages of blockchain technology delineated above, this paper presents the characteristics, potentialities and applications of blockchain technology in the field of digital marketing. To this end, the rest of this paper is organized as follows: a description of the research methodology used, the main characteristics of blockchain technology, different applications of the technology, and applications of the technology in marketing. In conclusion, this paper details its contributions and future applications of blockchain technology.

## METHODOLOGY

This paper employs the method of sorting through published research works on blockchain, relevant technology, and digital marketing to identify patterns and associations between blockchain technology and digital marketing. This provides general theoretical knowledge about the possible origins of this disruptive technology and its consequent competitive advantage.

The methodology of documentary research facilitates a broad view of the bibliography and systemic review of the literature. It allows for a creative, organized access to and evaluation of a body of available but unorganized

knowledge. The eventually organized knowledge is achieved through a series of systematic steps that describe facts and phenomena by using logical procedures, consisting of analysis, synthesis, deduction and induction. The compilation of data from documented sources allows for the discovery of hidden patterns and facts, suggestion of problems, and orientation towards other seemingly unrelated sources. It naturally points to appropriate techniques useful for locating and selecting data, analyzing documents and contents.

## MAIN CHARACTERISTICS AND OPERATIONS OF BLOCKCHAINS

Each blockchain is very similar to an Excel spreadsheet: it consists of many linked blocks of data that can be shared by users. Each blockchain can be simply viewed as a chain of connected blocks. Each block stores data for specific transaction at particular times. For example, a block in a payment blockchain contains payment data. Each transaction will be recorded in the involved blocks and broadcasted to all the blocks. All blocks are chained together to form a distributed database.

Storing data in blockchains follow a consensus algorithm among users in terms of what information to store in a decentralized ledger (Cheun, 2015). Each block is valid for the previous block which collectively become a strong network without the danger of failure from a central point. Underlying the working of a blockchain, there is an encoded algorithmic property that protects the chain from malicious attacks. Blockchain technology is embedded in cryptography, mathematics, algorithms and economic models. Each blockchain combines peer-to-peer networks and uses a distributed consensus algorithm to solve traditional synchronization problems of distributed databases. It stands for an integrated multi-field infrastructure.

Once a piece of information is saved under mutual agreement and encrypted, no user, including administrators, is allowed to add, edit or delete the information stored in any of the blocks (Cheun, 2015). That is the main reason why blockchains are highly secure and manifests the authenticity of information.

Blockchains are developed based on the studies of a well-known problem of distributed consensus in computing; each blockchain appears when independently running computers can reliably agree on a common data set in the presence of flaws.

This problem arises in large distributed networks like the internet; and many software companies, including Google, Facebook, and Yahoo, employ algorithms to protect access to critical data (Casey et al, 2018). Figure 1 depicts how a representative blockchain works when a person A wants to send money to person B. In a blockchain, i.e., a decentralized system, a successful transaction is known to all peers in the system. But in a centralized system, it is only known to administrator (bank authority) and sender and receiver themselves.

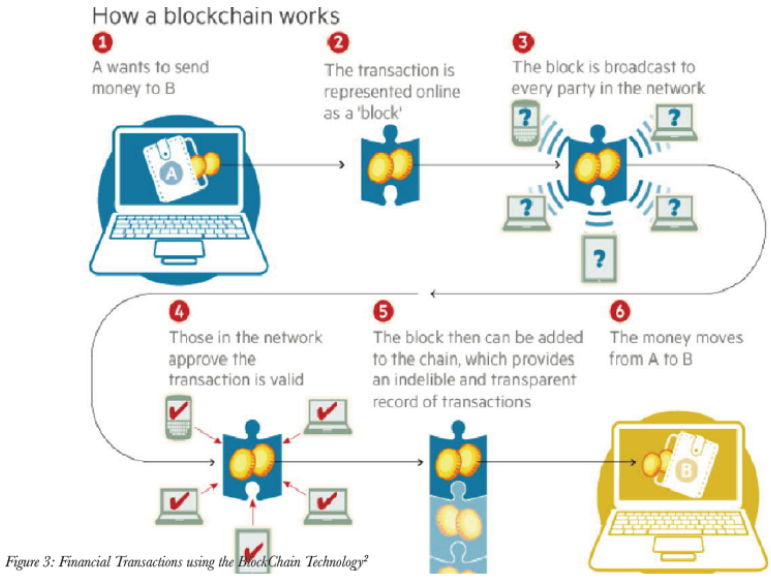


Figure 1 How a blockchain works. reprinted from Crosby et al. (2016)

These properties have made blockchains a symbol of trust and security. It is predicted that blockchain technology will *"…grow by 58.7 percent between 2016-2024"* (Kuno Creative, 2018). Due to these characteristics of blockchains, marketers should take advantage of this technology to make their strategies more efficient and accurate.

Blockchain technology has six key features: decentralization, transparency, open source, autonomy, immutability, and anonymity (Lin & Liao, 2017). In particular, decentralization means that each blockchain does not have to depend on a centralized node to record and store data and update distribution dates. The feature of transparency means that data records within a blockchain system is transparent; and for each node, the available data are also transparent in terms of relevant dates. That is why information stored in a blockchain can be trusted. As for the feature of open source, most blockchain systems are open to everyone in the world; each record can be publicly verified; and people can also apply blockchain technology as desired. By autonomy, it means that because of the consensus implemented, each node in a blockchain system can safely transfer or update data so that people can individually trust the entire system, in which no one can intervene. The feature of immutability represents that records will be reserved forever and cannot be changed unless someone can take control of more than 51% nodes simultaneously. Finally, with anonymity, blockchain technology has successfully solved the trust problem between nodes so that the transfer of data and transaction data can be 'anonymous' with only the addresses of individuals within a blockchain being communicated.

Because of these key features, blockchains' promise of great potentials emerge due to the following reasons:

- Because a large number of participants from different geographical locations share one blockchain, each blockchain can readily resist outages and attacks (Sato et al., 2020).
- Each blockchain system does not need to worry about a single-node failure potentially causing a wide-ranging system failure (Kakavand et al., 2017).
- If a node of a participant blockchain network fails, other nodes will continue to function, making stored information in the network continuously and constantly available and reliable (Azaria et al., 2016).
- Transactions on a blockchain are transparent to participants, which increases a chain's auditability and trust (Kamble et al., 2020).
- It is almost impossible for someone to make changes to a blockchain without detection, which reduces opportunities for fraud and thereby increases confidence in the information it carries (Guerar et al., 2020).
- It is almost possible to make transactions irrevocable, which increases the accuracy of records and data whilst simplifying administrative processes (Myeong & Jung, 2019). Note: In some cases, it has been theorized and discussed that 'cancelling, and reissuing' bitcoins might be done under circumstances where a majority of Senior Administrations and nodes agree on this.
- Digitally, almost any document or asset can be expressed in codes and encapsulated or referenced by a ledger entry. This means that blockchain technology has very broad range of applications, most of which have not been imagined, much less implemented (Schatsky & Muraskin, 2015, p. 11).

## DIVERSE BLOCKCHAIN APPLICATIONS

The concept of blockchains holds many promises for both the financial sector and financial market infrastructure. In fact, key drivers behind the wave of blockchain innovations is to facilitate transitions from centralized and proprietary ecosystems to their decentralized and mutualized equivalents. For financial actors and those actors particularly within the banking industry, this could mean greater risks of disintermediation and potential threats to relevant activities, especially activities for which banks act as the central coordinator (Collomb & Sok, 2016).

Blockchain has a potential to make the whole insurance ecosystem to move to streamline operations and lower expense ratios from 'back-office' operations to do efficient asset tracking, risk pricing, and quick claim settlement (Gatteschi et al., 2018). For example, several blockchain startups and insurance companies have launched flight delay insurance. Smart contract is applied to guarantee the claim. Travelers simply enter the personal information and details of the flight and customize the suitable insurance, such as coverage amount, delay conditions. The platform automatically calculates the price. After the purchase, the insurance information will be written onto the blockchain, meanwhile a smart contract will be generated. When the delay condition is satisfied, the smart contract will be triggered. Travelers will receive the compensation immediately without complex manual checks (Figure 2).

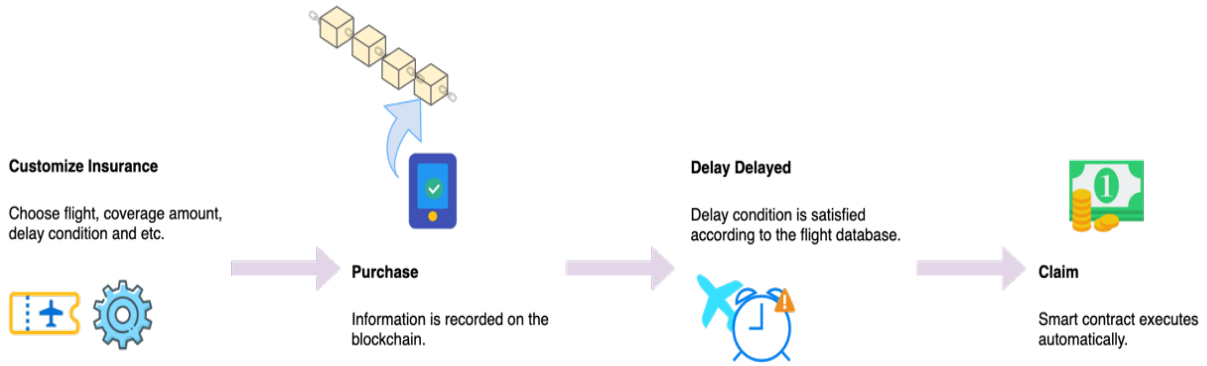


Figure 2. Flight delay insurance on blockchain

P2P lending takes place by borrowing the advantages of blockchain. Lendoit is one of the lending platforms facing global participants (Arvanitis, 2019). On that platform, borrowers, lenders, credit agencies and debt-collectors perform lending activities. In the traditional P2P lending mode, information asymmetry and default events significantly obstacle the development of P2P lending market. While the characteristics of blockchain offset these situations. Only after a borrower is assessed and verified by a professional credit agency, he/she can make a request of lending. Although collateral is unnecessary, part of the loan is transferred into Smart Compensation Fund, used to compensate for the lender if default occurs. The lender also can sell the default to debt-collectors, who will collect the debt according to the framework in each country. Meanwhile, lenders are allowed to resell the debt to other lenders to solve their own finance problem(s) just in case. Through blockchain technology, all related information is public in the leading market, the secondary market, and the collector market. All lending participants appreciate the transparent environment and actively promote the market liquidity.

The application of blockchain technology has also been introduced in areas related to health services: public health management, pharmaceuticals, medical research, and user-oriented healthcare, based on personal data of patients, and preventing counterfeiting of medicines. The technology can eliminate intermediaries by allowing direct transactions between buyers and sellers; thereby the influence of a central actor, who controls data and collect high levels of commissions, can be limited. For example, blockchain technology has been used to securely request genomic data from individuals without compromising an individual's identity. All patients' DNA data and health records can be securely stored through blockchain without the risk of a crash or data leak (Gursoy et al., 2020). Furthermore, Blockchain allows for pharma companies to request genomic data straight from individual patients rather than using a third-party company by giving these individuals more control of their genomic data. Hence, future applications of blockchains can create new possibilities for market operations in the health care area by avoiding intermediaries (Mettler, 2016).

Also, blockchain technology is expected to transform current modes of financial transactions and radically alter how tourism activities are transacted, creating opportunities for travel companies to track the preferences of their travelers so that customer services can be more meaningful and personalized. That is, the technology will be able to extract more value out of loyalty programs. Specific to the tourism industry, blockchain represents the latest development in a long line of technological innovations that have the potential to significantly stimulate tourism (Treiblmaier & Önder, 2019). The reduced transaction costs, resulting from the blockchain technology will also transform the organizational structure of the tourism industry. That will in turn help innovative companies improve their market shares. However, considering the contribution of the tourism industry to the world GDP, a greater diffusion of blockchain technology is required.

The characteristics of blockchain technology open doors to the disintermediation of third parties in innumerable types of transactions so that relevant transaction costs are lowered; that reduces the growth of vital investments (Coase, 1937, 1960; Williamson, 1975; 1985), and increases the potential for innovation in major industries. The main sources of risks that originate in transaction costs are: limited rationality, the general uncertainty of the economic system and specificities of transactions. In this sense, among others, transaction costs have been those associated with products, negotiations, formalization and induction compliance with various agreements. Hence the importance of contracts that

provide protection against various contingencies. Although the employment of contracts is not new, their inclusion as part of a blockchain implementation certainly is. The term "*smart contract*" has been coined (Gal & McCarthy, 2018) to indicate the creation of a contract that is encoded and included as part of a blockchain. Each smart contract consists of a group of conditions that are coded in a computer language and is added as a transaction to a blockchain.

Another important application of blockchain technology is tracking the location of shipments that require delivery at precise times (Klein, 2020). Examples include some same-day services from Amazon, Wal-Mart, Federal Express, and DHL. However, even though such services are generally reliable and offer tracking services, errors occasionally occur during shipments. For example: whilst there is a small chance of error, a package may miss a flight or a truck may be delayed due to weather, traffic conditions or accidents. For extremely urgent shipments such as medication, there is a need for extremely accurate tracking systems and methods that are superior to those methods of the latest generation that may include blockchain(s).

According to Waters (2003), each supply chain consists of an ordered series of activities where materials are mobilized from initial suppliers to final customers. When organizations within a supply chain actively and collaboratively manage activities and relationships to maximize customer values and to achieve sustainable competitive advantages, this is effective supply-chain management. Such management consists of the development of new products, supplies, productions, logistics, the management, coordination and integration of demands. In this regard, blockchain technology promises potentially reliable, secure and authenticated logistics and an information exchange system on the supply chain of supply networks (Dujak & Sajter, 2019). Effective supply chain management creates a superior competitive advantage.

Furthermore, AI technologies are implemented on blockchains. For example, Cotex is a decentralized AI autonomous system running on blockchains (Chen et al., 2018). It adds AI algorithms to support smart contracts so that anyone can add AI to their smart contracts. The model providers are paid by a certain amount of Endorphin, which is the price unit that is required for payments that deals with transactions or executes AI smart contracts on the Cortex chain. The Cortex blockchain stores the hash values of the model and the data. Users could post task on the machine learning platform, submit models, make inferences by calling intelligent contracts, and create their own AI DApps (Artificial Intelligence Decentralized Applications).

## APPLICATIONS OF BLOCKCHAIN TECHNOLOGY IN MARKETING

In this section, we will address the question of how will blockchain technology affect digital marketing? In many aspects, the technology will influence marketing activities. Harvey et al. (2018) argue that it will impact marketing by eliminating intermediaries, allowing to significantly reduce transaction costs, putting an end to the payments that companies usually make to banks through credit cards, and passing those costs to consumers. In this wave of transitions, digital marketers will have access to a new type of model. While limiting the Google-Facebook duopoly, companies will experience an increasing level of competition in the field of electronic commerce; and concentrations of traffic will appear at a few particular sites and advertising networks.

According to the 2019 Digital Economy Report (https://unctad.org/webflyer/digital-economy-report-2019), digital advertisement will increase to 60% of the total marketing promotional outlay in 2023. Also, advertising in the traditional media will suffer losses of about $4 billion. The combined share of Google and Facebook has grown 20% since 2010 mainly due to spending on social networks. For these companies, their digital advertisement in 2017 brought in $200 billion of revenues worldwide; and 65% of their profits were created through digital advertisements. These two internet platforms brought in the most incomes from electronic advertising.

Additionally, Szabo's (1996) original idea of smart contracts with blockchain technology was revived. A smart contract is essentially a self-executing computer program that represents a contract on a blockchain. The computer program takes actions at specified times and/or based on the satisfaction of preconditions (e.g., delivery of money or asset). The transaction records, assets and other entities of the organization are maintained on a blockchain. Such contracts are designed to facilitate, verify and automatically enforce the negotiation and implementation of digital contracts without any need for central authorities. Currently, smart contracts are in the process of adaptation in order to address security and privacy concerns (Wang et al., 2019).

Similarly, adopting blockchain technology will improve consumer trust in brands in three ways: enhancement of brand transparency, reduction of the circulation of counterfeit bills, and increase of brand confidence in online markets (Boukis, 2020). Consumer trust is very important and must be generated for those consumers who make purchases through electronic commerce. In this regard, it is both theoretically and practically important to understand the key aspects of developing relationships with consumers on the Internet (Corbitt et al., 2003), where trust is a fundamental attribute driving purchase decisions (Beatty et al., 2011).

Furthermore, although cybersecurity has been improving, fraud prevention is still high on the agenda of companies around the world. Altering or eliminating information in the accounting systems, changing electronic documents, such as the creation of fraudulent electronic files, have been the main methods employed to hide frauds. According to Cybersecurity Ventures (2020) (https://cybersecurityventures.com/hackerpocalypse-cybercrime-report-2016/, accessed on January 31, 2021), the global costs of cybercrime will grow 15% per year over the next five years, reaching $10.5 trillion annually by 2025, compared to $3 trillion in 2015. That represents respectively a larger amount than the losses caused by natural disasters in one year and the profit of global trade of major illegal drugs. To this end, financial institutions are using blockchain-based technology to reduce risk and prevent cyber frauds (Singh & Singh, 2016). The characteristics of blockchain technology prevent accounting records or electronic documents from being altered or deleted. The capability to share information with many business partners, stakeholders, managers, auditors allows everyone to participate by conducting independent reviews of transactions and deliveries in real time (Dai et al, 2017).

When consumers make purchases or other business transactions by using online platforms and social networks, companies collect an enormous amount of data from consumers. So, the danger of violating consumer privacies often exists. Regarding this issue, scholars propose various models based on the concept of blockchain to protect user data in order to avoid any security breach. Most social networking databases are distributed systems that are accessible by system administrators. Therefore, data transfers to third parties represent a latent threat. An example is the consumer information that Facebook leaked to Cambridge Analytica (Chen et al., 2019) for electoral purposes. This event ignited an intense debate among companies, experts and government officials regarding the protection of consumer privacies. It is within this environment that the concept of surveillance capitalism gained prominence. It is a term coined by Shoshana Zuboff (2019) to represent the exacerbated monetization of the information that users share in the digital environment. The concept presumes the existence of manipulation and surveillance derived from the analysis and data-sharing techniques utilized by many companies.

For researchers, trust is a key factor in electronic commerce, online banking and social networks that can be enhanced by employing blockchain technology (Fleischmann & Ivens, 2019). In this regard, studies find that blockchain technology promotes higher levels of consumer trust in that such technology can be considered an innovation in the area of business models, as consequences of digital marketing (Seppälä, 2016). Additionally, trust is a key factor for successful transactions in risky exchanges; and digital technologies have consistently shown that trust is strongly related to consumer acceptance. The greater the trust users have in online services, the less effort they will need to validate the details and legitimacies of these services (Shin, 2019).

Blockchain technology has also a built-in bitcoin wallet that helps customers pay and earn in crypto. Disruption of influencer marketing, taking advantage of the transparency and immutability of blockchains, helps marketers authenticate the identity of an influencer, validate their followers, obtaining a guarantee with the help of smart contracts, in which a payment can be kept in custody until a desired transaction is completed (Kuno Creative, 2018). Also, interactive marketing represents a recent, highly innovative development. That includes an online affiliate, and platforms (e.g., Amazon, e-bay and Apple and specialized start-ups). These platforms support the automated auction of advertising spaces for individual consumers who can navigate via mobile phone or other devices (Stone & Woodcock, 2014).

The ecosystem of digital marketing is composed of social networks (Balathandayutham & Anandanatarajan, 2020). Each of these networks consists of different types of applications, such as collaborative projects (e.g., Wikipedia), blogs / microblogs (e.g., Twitter), community content (e.g., YouTube), social networking sites (e.g., Facebook), virtual game worlds (e.g., World of Warcraft) and virtual social worlds (e.g., Second Life). These networks have a very important role in promoting digital marketing and charting its evolution, as they are also popular digital advertising platforms. During the last decade, the use of Social Media in marketing has increased. Many (e.g., Salo et al., 2013; Moschini, 2012) have commented that Social Media can enhance the power of viral marketing. Others (e.g., Hajli, 2014; Kang & Schuett, 2013) suggest that Social Media increases the speed at which consumers share experiences

and opinions with an increasing audience. Social Media can provide a better understanding of consumer needs and collaborative responses for solutions. In addition, social relations take an active role in the internationalization of companies as they serve as an effective means to generate knowledge about the markets that a company is interested in entering (Crosby et al., 2016).

Entrepreneurs can digitally advertise their brands in social networks, the most suitable virtual space. Within this space, their power of influence is very broad, since in a matter of seconds an advertisement reaches a large audience, which greatly reduces per capita advertisement cost. Because of the large number of users online, marketers can conveniently employ this channel to complement their marketing efforts. In summary, marketers can easily reach to a large number of potential and actual buyers at a lower CPM (cost per thousand) than in print or television media advertising (Henderson, 2020).

To understand the current state of digital marketing and future trends, it is very important to review various reports, digital marketing statistics, surveys, research data and results in order for businesses to stay updated and competitive. Doing so helps marketers observe the latest trends and tactics of digital marketing. This paper presents the following information on digital marketing gleaned from social networks.

Social media platforms have registered an unprecedented growth of users in the last decade, from 970 million users in 2010 to that exceeding 3.96 billion in 2020. That represents almost half of the world's population. Among all such platforms, Facebook ranks first with 2.7 billion monthly active users, followed by YouTube (2 billion), WhatsApp (2 billion), FB Messenger (1.3 billion) and WeChat (1.2 billion). By gender, the current global average of social media users is 54% male versus 46% female. However, in the US, women constitute the main base of users: 76% of all female Internet users have social media accounts compared to 72% of all men. In 2020, the average time spent on social media per day is 2 hours 24 minutes globally for users aged 16 to 64 on any device. The total of 144 minutes is a 1.4% increase from the 142 minutes of the previous year and a 38% increase in the last 5 years. Regarding the use of social networks by device, 99% of people in the world access networks exclusively on a mobile device (tablet or phone). Around 78% access platforms only from their mobile phone, compared to only 1.32% who visit their social networks only through the desktop. For details, see Dean (2021).

## CONCLUSIONS AND RECOMMENDATIONS

Blockchain technology is highly valued and holds immense potential for businesses due to the technology's decentralized infrastructure and peer-to-peer nature. It has practical applications in a great variety of endeavors far beyond Bitcoin. The technology has demonstrated its potential and capability to transform a traditional industry with its key features: decentralization, persistence, anonymity, and auditability (Antoniadis et al., 2019). However, the actual adoption of this technology has been relatively slow due to associated risks. Because of this reason, understanding the disruptive effect of this technology's potential on industries and people's lives as a consequence of adopting the technology can prepare the world to eventually embrace the technology in the years to come (Casino et al., 2019).

In the virtual environment, digital and social media have created important changes. That effect of the media and relevant social and digital networks has motivated marketers to recognize how they can more effectively serve customers with their offerings than ever before. Hence, many companies adopt digital and social media as an important part of their marketing communications mix. Promotional activities in marketing have three main objectives: increasing the awareness of a product, persuading people to buy the product, and reminding people that the product exists (Kotler & Keller, 2007). To achieve these purposes, the choice of promotional tools, such as advertising or direct marketing, depends on the desired marketing objective, consumer preference and the resources available for accomplishing this objective. Among promotional tools, organizations are beginning to recognize the power of the Web, mobile technology, digital television, email, and databases. This is confirmed by the trends registered in the behavior statistics of the main social networks (Appel et al., 2020).

It is clear that blockchain technology increasingly influences digital marketing and will continue to do so in the future. This technology allows companies to acquire more relevant knowledge and more reliable data from customers, while it also allows customers to retain the ownership over their data. Therefore, blockchain technology helps provide relevant information and customer preferences so that companies have access to their customer data.

Furthermore, the discussions above suggest that blockchain technology can minimize the involvement of intermediaries and the number of or even eliminate fraudulent activities, such as deep forgeries and illegitimate reviews, within digital marketing. Accompanying the great many potentials, blockchain technology also faces many challenges and obstacles. For example, large companies like Google may feel threatened by the technology; and therefore, these companies may very well introduce countermeasures to interrupt or simply slow down the implementation of blockchain technology. In addition, along with the growth of electronic commerce the number of cyberattacks has increased, involving compromises of large amounts of highly sensitive data, including private customer information, financial information, and breaking into well protected computer-network systems to steal confidential data (Teo, et al., 2020).

Based on information presented within this paper, it can be concluded that blockchain technology will consistently influence major digital marketing efforts, such as Social Media marketing (including influencer marketing), e-commerce, and network analysis. The media will contribute to the veracity, speed, value and volume of big data because of blockchain's abilities. Additionally, blockchain technology will drive changes in data ownership and customer empowerment. Consequently, these changes will mitigate fraudulent activities. They will influence how customers acquire, store and retrieve information and how such information is communicated (Yogesh et al., 2020).

Specifically, this paper makes both managerial and social contributions. In terms of the former, this work develops the relevant management knowledge and necessary awareness of blockchain technology. It demonstrates this technology’s influence on digital marketing so that marketing managers will be prepared for the forthcoming disruptive changes. In terms of the social contribution, this paper shows how blockchain technology can mitigate the activities of scammers in digital marketing and how the digital industry can benefit society by making itself more transparent and effective than before. In other words, blockchain technology has the potential to either minimize the number of or even eliminate fraudulent activities, such as the dissemination of fake news and propaganda that adversely affect society.

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# IS FREE CASH FLOW HELPFUL IN INVESTMENT DECISIONS? THE CASE OF THE U.S. UTILITIES INDUSTRY SECTOR

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## ABSTRACT

The purpose of this study is to identify the accounting definition of free cash flow (FCF) that is the most helpful to investors in the Utilities companies. The results would help retail investors make better decisions and may encourage accounting standards setters to require the Utility Industry Sector companies to use a specific definition of FCF to enhance comparability. Using correlations and multiple regression analysis on a sample of 3,352 observations covering the 30-year period from 1988 to 2021, the author concludes that FCF information is not helpful in investment decision-making with respect to the Utility Industry sector. This result agrees with some prior research in the literature review.

## INTRODUCTION

Free Cash Flow (FCF) is a useful piece of information for investors to make investing or divesting decisions because it is difficult to manipulate whereas net income (NI) may be manipulated. Also, companies cannot pay their bills (for example for salaries, construction of a new factory, or dividends) with NI. All of these should be paid in cash. Thus, it may be argued that a business's ability to generate cash is what really matters. NI, earnings per share (EPS), and return on investment (ROI), which are computed based on accrual accounting, are important metrics of measuring a company's profitability and are used by many to make investment decisions. However, the income statement (I/S), which reports NI and EPS, spreads out the cash spent on long-term investments over time. So, if a company, like Apple, buys $1 billion in computer equipment, the expense is spread out over 3-5 years on its I/S in the form of depreciation. However, unless Apple gets the equipment and pays for it in bonds or stocks (i.e., a non-cash transaction) it will have to pay for the computer equipment in cash. Thus, while the I/S smooths out a business's use of cash over time, the Statement of Cash Flows (SCF), from which FCF is calculated, offers no such smoothing benefit.

Maksy (2016) observed that prior research is not conclusive as to whether FCF is associated with stock prices, i.e., whether it is relevant to equity valuation. Maksy (2017) noted that the accounting literature has a wide variety of FCF definitions, and he used a sample comprising the U.S. Information Technology sector over 30 years, to identify which FCF definition is value relevant to that sector. He concluded that the FCF computed as "cash flow from operations less capital expenditures less preferred stock dividends" is the most significantly associated with stock price changes. While Cash Flow for Capital Expenditures (CFCE) represents most (and sometimes all) Cash Flow for Investing activities (CFI) for many companies, some companies' CFI is much larger than CFCE. Given that industry sectors vary significantly in terms of their CFCE and CFI activities, the aim in this paper is to identify which FCF definition, if any, is the most value-relevant for the Utilities Industry Sector (UIS) companies. Is it the same as the one that is most value-relevant for the information technology companies? Or is it totally different?

This study aims to provide two contributions to the literature. First, if FCF is helpful to investment decisions with respect to UIS companies, knowing which definition is the most helpful is a valuable piece of information for people contemplating investing in these companies because they would use that definition of FCF in making their investment decisions. If none of the FCF definitions is helpful, then investors may not need to waste their time to include FCF in their decision-making process. Second, if there is a specific definition of FCF that is most value-relevant to UIS companies, there are implications for financial accounting standard setters. While the Financial Accounting Standards Board (FASB) requires companies [in Statement of Financial Accounting Standard (SFAS) No. 95 as originally issued in 1987 and as converted to Topic 230 in the FASB Codification Project], to report CFO on the SCF, it has so far discouraged companies from reporting CFO per share. The FASB is concerned that requiring, or even encouraging, companies to report CFO per share may be construed by some that it is moving away from accrual-basis accounting toward cash-basis accounting. Thus, it requires companies to report EPS, which is based on accrual accounting, on the face of the I/S but discourages companies from reporting CFO per share on the face of the SCF or anywhere else in the annual report. The results of this study might be considered by the FASB if it wants to engage in a project to decide whether to require UIS companies to report a specific definition of FCF (but not FCF per share) in the body of the SCF or in the supplementary disclosures at the bottom of the SCF, together with cash paid for income taxes and cash paid for interest expense. Or the FASB might just consider whether to prohibit UIS companies from voluntarily disclosing FCF of whatever definition they prefer or require those companies to use a specific definition of FCF to enhance comparability. Companies that voluntarily disclose FCF information use a wide variety of definitions of FCF (apparently, each company is using the definition that shows the highest amount of FCF). These companies, on

average, are less profitable and more leveraged than other firms in their own industries (Adhikari and Duru, 2006). Having all companies, in a given industry sector, reporting FCF that is calculated in the same way would enhance comparability of accounting information across firms in that sector (Maksy, 2016 and 2017).

The North American Industry Classification System (NAICS) describes the Utilities sector as comprising establishments engaged in the provision of the following utility services: electric power, natural gas, steam supply, water supply, and sewage removal. Within this sector, the specific activities associated with the utility services provided vary by utility: electric power includes generation, transmission, and distribution; natural gas includes distribution; steam supply includes provision and/or distribution; water supply includes treatment and distribution; and sewage removal includes collection, treatment, and disposal of waste through sewer systems and sewage treatment facilities.

The utilities sector is considered a secular, defensive sector because utility companies have a steady revenue stream, and their performance is unaffected by changes in the economy. When times are bad, consumers are still purchasing these necessities. This is why many investors turn to the sector during times of economic turmoil – the consistent, stable returns of utility companies are especially attractive when it seems like everything else in the economy is going sour. However, even though the utilities sector tends to attract investors during economic downturns, the opposite is true when economic growth is on the horizon. When times are good, most people invest in cyclicals. The utilities industry sector is also heavily regulated, which means the companies within the sector have fewer competitors, giving them certain monopolistic capabilities. This enables utility companies to have predictable cash flows and profits. But regulation also exposes these companies to some significant risks. Because utility companies provide necessary services to society, the government dictates how much these companies can charge customers. This means that utility companies have lower earnings potential, and the companies can't adjust their prices when the costs of the commodities they rely on – like oil or gas – rise. In other words, regulations can increase the cost of doing business for utility companies. Furthermore, utility companies also face challenges as weather trends shift and more natural disasters occur in the U.S. These companies are responsible for repairs from fires, floods and storms, which can eat into their cash flows.

In light of the above discussion of upside potential and downside risk of investment in UIS companies, can FCF be a major factor in deciding whether to invest or not invest in these companies? This study is an attempt to answer this question. While the UIS is the smallest industry sector in the US, it is still a large sector, and an important part of the U.S. economy, with a market capitalization of over $1.5 trillion as of March 2021 (Murphy 2021). Furthermore, as Maksy (2016) noted, comparability in one specific sector is one of the enhancing qualitative characteristics of useful financial information as stated in FASB's Statement of Financial Accounting Concepts (SFAC) No. 8. The remaining sections of the paper cover the literature review, sample, statistical results, and conclusions of the study, respectively. The final section provides study limitations and some suggestions for further research.

## LITERATURE REVIEW

The accounting literature has many definitions of FCF (Maksy 2016). FCF is defined differently from textbook to textbook, professional article to professional article, academic article to academic article, from company to company (and some companies change their definition of FCF from time to time), and from all these to the popular press. A case in point, Mandalay Resort (formerly known as Circus Circus) was one of the first companies to report FCF information in its 1988 annual report. Over the years, it has changed its FCF definition. In 1988 it defined it as Operating Income (OI), but in 2000, it added back pre-opening expenses, abandonment loss, depreciation and amortization expense (D&A), interest, dividend, and other income, as well as proceeds from disposal of equipment and other assets. Coca-Cola defined FCF as CFO less CFI prior to 1999, but in 1999 it changed the definition to CFO less "acquisitions and investments." That change in definition increased its FCF in 1999 by almost $2 billion. Different definitions of FCF are reported by popular magazines and investment advisory service organizations such as Money, Forbes, the Motley Fool, Value Line, and InvestLink (Mills, et. al, 2002). Also, there are different definitions of FCF in textbooks. For example, Subramanyam (2014) discusses several definitions of FCF but seems to favor one in particular: FCF = CFO – Cash Flow required to maintain productive capacity – all preferred and common stock dividends. The definition of FCF in Kieso, Weygandt, and Warfield,18th ed. (2022) remains the same: CFO - CFCE – Total Dividends. This is the same definition as in the 2019 edition of that most adopted Intermediate Accounting book by U. S. colleges and universities.

A search for "free cash flow definitions" on Google produced about 3.46 million entries for this title, the first of which is "Definitions of Free Cash Flow on the Web" (Maksy 2016). Table 1 presents the 15 definitions under this title, together with the web address associated with each definition. It is interesting to note that every definition is different. Adhikari and Duru (2006) reported that of 548 firms of their sample that voluntarily reported FCF information, 283 (or 51.6%) defined FCF as CFO – CFCE; 117 (or 21.4%) defined FCF as CFO – CFCE – Total Dividends; and 64 (or 11.7%) defined FCF as CFO – CFI. The remaining 84 firms (or 15.3%) defined FCF in four different other ways.

Previous research studies about FCF present conflicting results as to whether FCF is positively associated with stock prices. Some studies report no significant association or even negative association and some report significant positive association. For example, Penman and Yehuda (2009), using a definition of FCF as CFO less cash investments, find negative association and state that "a dollar more of FCF is, on average, associated with approximately a dollar less in the market value of the business." They also find that this FCF definition has no association with changes in the market value of the equity. Moreover, after they controlled for the cash investment component of FCF, they find that CFO also reduces the market value of the business dollar-for-dollar and is unrelated to the changes in market value of the equity. Additionally, GuruFocus.com, a website that tracks market insights and news of investment gurus, published two research studies, Gurufocus (2013a and 2013b), concluding that earnings and book values are significantly correlated with stock prices but FCF, defined as CFO – CFCE and acquisitions, is not. On the other hand, companies with greater FCF, defined as CFO less CFCE, and greater growth opportunities, have higher value prices and their FCF is positively associated with stock returns (Habib, 2011). Furthermore, Shahmoradi, (2013), using the same definition of FCF (CFO – CFCE) and a sample of listed companies on Tehran Stock Exchange between 2002 and 2011, reported a relationship (significant at the .05 level) between FCF and stock returns.

The literature review presented above, especially the accounting literature, indicates that FCF is defined in so many different ways. The objective of this study is to determine which one of these definitions, if any, is most correlated with (and, thus, is hypothesized to be the best predictor of) stock price changes for the UIS companies in the U.S.

Maksy (2016 and 2017) proposed his own definition of FCF which is CFO less Capital Expenditure required to Maintain Productive Capacity (CEMPC) less Preferred Stock Dividends (PSD). However, he used eight other most commonly used definitions of FCF to determine which one is most significantly associated with stock price changes. To identify which FCF definition is most significantly associated with stock price changes of U IS companies, the author will use the same nine definitions used in Maksy (2016 and 2017) as listed below:

FCF1 = CFO - CEMPC

FCF2 = CFO - CFCE

FCF3 = CFO - CFI

FCF4 = CFO - CEMPC - PSD

FCF5 = CFO - CFCE - PSD

FCF6 = CFO - CFI – PSD

FCF7 = CFO – CEMPC - TD

FCF8 = CFO – CFCE – TD

FCF9 = CFO – CFI - TD

Where: TD = Total Dividends paid on common and preferred stock, and the other abbreviations are as described previously.

FCF2 is the most commonly used FCF definition in the financial press and the web, and FCF8 is Standard & Poor's definition and is reported directly in its COMPUSTAT database from which the study sample was collected. It should be noted that the second three FCF definitions (FCF4 to FCF6) are the same as the first three FCF definitions (FCF1 to FCF3) except that PSD is subtracted in each definition. Similarly, the third three FCF definitions (FCF7 to FCF9) are the same as the first three FCF definitions (FCF1 to FCF3) except that TD is subtracted in each definition.

The change in the stock price per share (ΔSPPS) may be affected by changes in sales per share (ΔSPS), earnings per share (ΔEPS), dividend per share (ΔDPS), and book value per share (ΔBVPS). For this reason, all these variables are included in the model so they can be controlled for to show the effect of change in FCF per share (ΔFCFPS) on ΔSPPS. Moreover, to control for the size of the firm, the natural logarithm of total assets (*lnta*) and the natural logarithm of total sales (*lnsale*) are included in the model. Furthermore, the author controls for year-end fixed effects. Thus, the proposed model as reported in Maksy (2016 and 2017) is as follows:

$\Delta SPPS = B_0 + B_1\Delta SPS + B_2\Delta EPS + B_3\Delta DPS + B_4\Delta BVPS + B_5\Delta FCFPS_{1\text{-}9} + B_6 lnsale + B_7 lnat + €.$

ΔFCFPS is computed as follows: $FCFPS_t - FCFPS_{t-1}$ where $FCFPS1_t$ = FCF1/weighted average number of common shares outstanding during year t. This weighted average number of common shares is computed by dividing (NI – PSD) by EPS for year t. The same rule applies to all nine definitions of FCFPS (FCFPS1 through FCFPS9). Appendix A provides full definitions of the model variables.

## THE STUDY SAMPLE

All UIS companies listed in COMPUSTAT for the 34-year period 1988 to 2021 are included in the sample. All firm year observations that have missing variables are eliminated which resulted in a final sample of 3,352 observations. The study period starts from 1988 because SFAS 95 was issued in 1987 (however, all FASB SFASs, including SFAS 95, have been superseded in 2009 when the FASB Codification project became effective and the SCF is now under Topic 230 in the FASB Codification), which requires companies to disclose CFO. Since the model uses the changes from year to year, 1988 observations represent the changes from 1987 to 1988 data and all other years observations are derived in a similar manner. The study period ends in 2021 because this is the last year with available data on COMPUSTAT at the time of collection. As Maksy (2016 & 2017) noted, one of the years of the study period, 2008, was a very abnormal year as total market indexes took a big dive because of the world's financial crisis that started during that year. During 2008, the Dow Jones Industrial average lost 31 percent of its value (but at one point, in November of that year, it was down 39 percent). Also, the NASDAQ index lost 39 percent (but in November 2008 it was down 46 percent). Similarly, the S&P 500 Cash Index lost 36 percent (but in November 2008 it was down 43 percent). It is possible that, because of that abnormality, the change in stock prices during 1988 was affected by psychological factors much more so than by financial factors. Because of that possibility, the author ran the model using a sample of observations ending in 2007 and ran it another time using a sample that excludes 2008 observations. The results from these different samples were not significantly different from the results based on the study entire sample from 1988 to 2021.

## STATISTICAL RESULTS

Pearson correlation coefficients for all the study and control variables are presented in TABLE 2. As that TABLE indicates, three of the nine FCF definitions (FCF 3, 6, and 9) have negative associations with changes in stock price (*Δspps*) at the .05 significance level. The other six FCF definitions (FCF 1, 2, 4, 5, 7 & 8) do not have statistically significant associations with *Δspps.* Among the control variables, changes in sales per share (*Δsps*) and changes in book value per share (*Δbvps*) are negatively associated with *Δspps* at the .05 significance level. However, changes in earnings per share (*Δeps*) have positive but not significant associations with *Δspps;* and changes in dividends per share (*Δdps*) have negative but not significant associations with *Δspps. [* Changes in dividends per share (*Δdps*), natural log of sales (*lnsale)* and natural log of total assets *(lnat)* are not significantly associated with *Δspps.]* Also, *Δsps* is significantly and negatively associated with changes in three FCF definitions (2, 5 & 8), significantly and positively associated with changes in two FCF definitions (7 & 9), and not significantly associated with changes in the remaining four FCF definitions (1, 3, 4 & 6). On the other hand, *Δeps* is significantly and negatively associated with changes in three FCF definitions (2, 5 & 8) and significantly and positively associated with the changes in the remaining FCF definitions (1, 3, 4, 6,7 & 9). Additionally, *Δdps* is significantly and negatively associated with changes in three FCF definitions (7, 8 & 9) and significantly and positively associated with the changes in the remaining FCF definitions (1 to 6). Interestingly, *Δbvps* is significantly and positively associated with changes in all nine FCF definitions. Natural log of sales (*lnsale)* and Natural log of total assets (*lnat)* are not significantly associated with any of the FCF definitions suggesting that these variables would be appropriate controls.

TABLE 2 correlations presented some interesting results which are further validated in a multivariate framework shown in TABLE 3 which presents regression coefficients for nine models by including one FCF definition at a time in the model. Besides the control variables specified in the model, the author also includes year fixed effects. These fixed effects control for heterogeneity at the year level that may not be captured by the set of controls. As TABLE 3

indicates, six FCF definitions (FCF1, 3, 4, 6, 7 & 9) have negative associations with *Δspps* at the .01 significance level after controlling for other determinants of changes in stock price. The other three FCF definitions (FCF 2, 5 & 8) have negative but not significant associations with *Δspps* at the 1% significance level after controlling for other determinants of changes in stock price. Among the control variables, *Δsps* is significantly and negatively associated with *Δspps* at the .01 level across all FCF definitions. On the other hand, *Δeps* is significantly and positively associated with *Δspps* at the .01 level under three FCF definitions (1, 4 & 7) but not significantly associated with *Δspps* at the .01 level under the remaining FCF definitions (2, 3, 5, 6, 8 & 9). However, *Δdps* is significantly and negatively associated with *Δspps* but only at the .10 level of significance and only under one FCF definition (FCF 7). The associations between *Δdps* and *Δspps* are not significant across all other FCF definitions. Finally, there are significant and negative associations between *Δbvps* and *Δspps* and these associations are statistically significant at the .01 level across all FCF definitions, except FCF 3, 6 & 9 where the negative associations are at the .05 level of significance. As under the univariate correlations, *lnsale* and *lnat* are not statistically significantly associated with any of the FCF definitions suggesting that these variables would be appropriate controls.

## CONCLUSIONS

In light of the above statistical results, the author concludes that FCF4 (CFO – CEMPC – PSD) is the most value-relevant definition of FCF for UIS companies. It is interesting to note that the most commonly used definition in the financial press and the web (FCF2) and Standard & Poor's definition reported directly in its COMPUSTAT database (FCF8) are negatively and significantly associated with stock price changes. The author does not want to go as far as to recommend that the standards setters, particularly the FASB, should require UIS companies to disclose FCF4 definition in the body of the SCF, or at its bottom, before a more extensive body of research is produced in support of this idea. At this time, the author recommends that UIS companies (that *voluntarily* disclose FCF in their annual reports) should, at the very least, use only the FCF definition identified by this study.

In light of the statistical results above, the author concludes that none of the nine definitions of FCF used in the study is helpful in investment decision-making with respect to the Utility Industry sector of the U.S. This conclusion is in agreement with some of the results of prior research, specifically Penmann and Yehuda (2009) and GuruFocus.com (2013a and 2013b). In light of this conclusion, investors contemplating investing in the UIS of the U.S. should not consider free cash flow as a factor in their decision-making process. The results of this study show that not only that changes in FCF are not significantly associated with changes in stock prices, but they are actually negatively associated with changes in stock prices. Put in other words, the higher the free cash flows of the utility companies, the lower their stock prices and vice versa. This result may be explained by the assumption that most people who invest in utility companies do so for the dividends paid by these companies. Since, in most FCF definitions, dividends are deducted from cash flows from operations, utility companies that pay higher dividends show lower FCF. Furthermore, not only that FCF is not value relevant to investment in the utility sector but also the univariate test and the multivariate test give conflicting results about the value relevance of sales per share, earnings per share, dividend per share, and book value per share.

## LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Most research studies are subject to some limitations and this study is no exception. By far, the most important limitation of this study is the possibility that the study model did not include other variables that could have affected stock price changes. When a statistical model does not include all possible variables, the combined effect of those other possible variables is represented by the error term $\sum$ in the model. While the author added year fixed effects, which should help mitigate some concerns, they do not eliminate all concerns regarding unobservable explanatory variables. One other limitation of the study is the possibility that other definitions for FCF which may be value-relevant, have not been included in the study. The author tried to develop as comprehensive a list of FCF definitions as possible, however, other FCF definitions may possibly exist.

For future research, the author suggests that the study be replicated using other variables that could possibly have some effect on stock price changes in addition to the variables included in this study model. A second suggestion is to include other definitions of FCF that are not tested in this study. A third suggestion is to investigate whether a contrarian investing strategy could be developed buying stocks of UIS companies which have negative change in one or more measures of FCF definition over the prior year.

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## APPENDIX A

## VARIABLE DEFINITIONS

| | |
|---|---|
| *Δspps* | Change in stock price between the end of the current fiscal year and the end of the prior fiscal year. |
| *Δfcfps1* | Change in the difference between cash flow from operations (CFO) and depreciation and amortization expense (D & A) over the current fiscal year. |
| *Δfcfps2* | Change in the difference between CFO and cash flow for capital expenditures (CFCE) over the current fiscal year. |
| *Δfcfps3* | Change in the difference between CFO and cash flow for investing activities (CFI) over the current fiscal year. |
| *Δfcfps4* | Change in CFO minus D & A minus preferred stock dividends (PSD) over the current fiscal year. |
| *Δfcfps5* | Change in CFO minus CFCE minus PSD over the current fiscal year. |
| *Δfcfps6* | Change in CFO minus CFI minus PSD over the current fiscal year. |
| *Δfcfps7* | Change in CFO minus D & A minus total dividends (TD) over the current fiscal year. |
| *Δfcfps8* | Change in CFO minus CFCE minus TD over the current fiscal year. |
| *Δfcfps9* | Change in CFO minus CFI minus TD over the current fiscal year. |
| *Δsps* | Changes in total sales per share over the current fiscal year. |
| *Δeps* | Change in earnings per share over the current fiscal year. |
| *Δdps* | Change in dividends per share over the current fiscal year. |
| *Δbvps* | Change in book value per share over the current fiscal year. |
| *Lnsale* | Natural logarithm of total sales for the current fiscal year. |
| *Lnat* | Natural logarithm of total assets at the current fiscal year end. |

**TABLE 1**

**DEFINITIONS OF FREE CASH FLOW ON THE WEB**

1. In corporate finance, free cash flow (FCF) is cash flow available for distribution among all the securities holders of an organization. They include equity holders, debt holders, preferred stock holders, convertible security holders, and so on. en.wikipedia.org/wiki/Free cash flow.
2. Net income plus depreciation and amortization, less changes in working capital, less capital expenditure. en.wiktionary.org/wiki/free cash flow.
3. Adjusted operating cash flow less interest and tax paid, prior to distributions to shareholders. This is the cash flow available for payments of dividends and share buybacks as well as repayments of capital on loans.www.reed-lsevier.com/investorcentre/glossary/Pages/Home.aspx
4. Cash flow from operating activities, investments, financial items and tax and the effect of restructuring measures on cash flow. www.investor.rezidor.com/phoenix.zhtml.
5. EBITDA minus net interest expense, capital expenditures, change in working capital, taxes paid, and other cash items (net other expenses less proceeds from the disposal of obsolete and/or substantially depleted operating fixed assets that are no longer in operation). www.cemex.com/ic/ic_glossary.asp.
6. This item on the cash flow statement represents the sum of cash flows generated by operating and investing activities. investors.benettongroup.com/phoenix.zhtml.
7. How much money a company could pay shareholders out of profits without expanding, but without running down its existing operations either. moneyterms.co.uk/d/
8. Represents a common measure of internally generated cash and is defined as cash from operations less fixed asset purchases. portal.acs.org/portal/PublicWebSite/about/aboutacs/financial/WPCP_012234.
9. Cash available after financing operations and investments, available to pay down debt. www.graduates.bnpparibas.com/glossary.html.
10. A stock analyst's term with a definition that varies somewhat depending on the particular analyst. It usually approximates operating cash flow minus necessary capital expenditures. www.jackadamo.com/glossary.htm.
11. The amount of money that a business has at its disposal at any given time after paying out operating costs, interest payments on bank loans and bonds, salaries, research and development and other fixed costs. www.premierfoods.co.uk/investors/shareholder- services/Glossary.cfm.
12. Net Operating Profit After Tax minus Year-to-Year change in Net Capital. www.intrinsicvalue.com/glossary.htm
13. The increase in cash from one period to the next. www.knowledgedynamics.com/demos/BreakevenFlash/GlossaryMain.htm.
14. Cash flow after operating expenses; a good indicator of profit levels. healthcarefinancials.wordpress.com/2008/01/24/equity-based-securities-terms-and-definitions-for-physicians/.
15. The surplus cash generated from operating activities recognized in the profit and loss account. This expresses a company's internal financing power, which can be used for investments, the repayment of debt, dividend payments and to meet funding requirements. www.deutsche-euroshop.de/berichte/gb2004/glossar_e.php

**Table 2**
Pearson Correlation Coefficients

| | **Δspps** | **Δfcfps1** | **Δfcfps2** | **Δfcfps3** | **Δfcfps4** | **Δfcfps5** | **Δfcfps6** | **Δfcfps7** | **Δfcfps8** | **Δfcfps9** | **Δsps** | **Δeps** | **Δdps** | **Δbvps** | **lnsale** | **lnat** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Δspps** | 1.00 | | | | | | | | | | | | | | | |
| **Δfcfps1** | 0.00 | 1.00 | | | | | | | | | | | | | | |
| **Δfcfps2** | 0.00 | **0.68** | 1.00 | | | | | | | | | | | | | |
| **Δfcfps3** | **-0.11** | **0.79** | **0.22** | 1.00 | | | | | | | | | | | | |
| **Δfcfps4** | 0.00 | **1.00** | **0.68** | **0.79** | 1.00 | | | | | | | | | | | |
| **Δfcfps5** | 0.00 | **0.68** | **1.00** | **0.22** | **0.68** | 1.00 | | | | | | | | | | |
| **Δfcfps6** | **-0.11** | **0.79** | **0.22** | **1.00** | **0.79** | **0.22** | 1.00 | | | | | | | | | |
| **Δfcfps7** | 0.01 | **0.84** | **0.50** | **0.71** | **0.84** | **0.51** | **0.71** | 1.00 | | | | | | | | |
| **Δfcfps8** | 0.01 | **0.58** | **0.86** | **0.19** | **0.58** | **0.86** | **0.19** | **0.71** | 1.00 | | | | | | | |
| **Δfcfps9** | **-0.10** | **0.73** | **0.16** | **0.97** | **0.73** | **0.16** | **0.97** | **0.79** | **0.26** | 1.00 | | | | | | |
| **Δsps** | **-0.11** | -0.02 | **-0.25** | 0.02 | -0.02 | **-0.25** | 0.02 | **0.05** | **-0.19** | **0.04** | 1.00 | | | | | |
| **Δeps** | 0.01 | **0.23** | **-0.09** | **0.37** | **0.23** | **-0.09** | **0.37** | **0.24** | **-0.07** | **0.38** | **0.33** | 1.00 | | | | |
| **Δdps** | -0.03 | **0.17** | **0.24** | **0.04** | **0.17** | **0.24** | **0.04** | **-0.40** | **-0.30** | **-0.19** | **-0.11** | **-0.05** | 1.00 | | | |
| **Δbvps** | **-0.09** | **0.29** | **0.34** | **0.29** | **0.29** | **0.34** | **0.29** | **0.39** | **0.46** | **0.33** | **-0.06** | **0.42** | **-0.23** | 1.00 | | |
| **lnsale** | -0.03 | 0.01 | 0.02 | 0.00 | 0.01 | 0.02 | 0.00 | 0.01 | 0.02 | 0.00 | -0.01 | -0.02 | -0.01 | **0.03** | 1.00 | |
| **lnat** | -0.02 | 0.00 | 0.02 | -0.01 | 0.01 | 0.02 | -0.01 | 0.01 | 0.02 | -0.01 | -0.02 | -0.02 | 0.00 | 0.03 | **0.95** | 1.00 |

Variables are defined in Appendix A. Numbers in bold indicate significance at the 5% level.

**Table 3**Association Between Various Measures of Free-Cash-Flow and Changes in Stock Prices

| Variables | Predicted Sign | Δspps (1) | Δspps (2) | Δspps (3) | Δspps (4) | Δspps (5) | Δspps (6) | Δspps (7) | Δspps (8) | Δspps (9) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Δfcfps1** | + | -0.206*** (-4.11) | | | | | | | | |
| **Δfcfps2** | + | | -0.059 (-1.19) | | | | | | | |
| **Δfcfps3** | + | | | -0.084*** (-4.16) | | | | | | |
| **Δfcfps4** | + | | | | -0.205*** (-4.1) | | | | | |
| **Δfcfps5** | + | | | | | -0.058 (-1.18) | | | | |
| **Δfcfps6** | + | | | | | | -0.084*** (-4.16) | | | |
| **Δfcfps7** | + | | | | | | | -0.206*** (-4.11) | | |
| **Δfcfps8** | + | | | | | | | | -0.059 (-1.19) | |
| **Δfcfps9** | + | | | | | | | | | -0.084*** (-4.16) |
| **Δsps** | | -0.051*** (-4.37) | -0.048*** (-4.15) | -0.044*** (-3.8) | -0.051*** (-4.37) | -0.048*** (-4.15) | -0.044*** (-3.8) | -0.051*** (-4.37) | -0.048*** (-4.15) | -0.044*** (-3.8) |
| **Δeps** | | 0.183*** (4.04) | 0.003 (0.34) | -0.003 (-0.32) | 0.182*** (4.03) | 0.003 (0.34) | -0.003 (-0.32) | 0.183*** (4.04) | 0.003 (0.34) | -0.003 (-0.32) |
| **Δdps** | | -0.212 (-0.9) | -0.225 (-0.95) | -0.212 (-0.9) | -0.213 (-0.91) | -0.225 (-0.96) | -0.212 (-0.9) | -0.417* (-1.74) | -0.284 (-1.17) | -0.295 (-1.26) |
| **Δbvps** | | -0.131*** (-3.34) | -0.108*** (-2.77) | -0.081** (-2.04) | -0.131*** (-3.35) | -0.108*** (-2.77) | -0.081** (-2.04) | -0.131*** (-3.34) | -0.108*** (-2.77) | -0.081** (-2.04) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **lnsale** | -0.021<br>(-0.07) | -0.028<br>(-0.1) | -0.06<br>(-0.22) | -0.021<br>(-0.08) | -0.028<br>(-0.1) | -0.06<br>(-0.22) | -0.021<br>(-0.07) | -0.028<br>(-0.1) | -0.06<br>(-0.22) |
| **lnat** | -0.06<br>(-0.22) | -0.056<br>(-0.21) | -0.025<br>(-0.09) | -0.06<br>(-0.22) | -0.056<br>(-0.21) | -0.025<br>(-0.09) | -0.06<br>(-0.22) | -0.056<br>(-0.21) | -0.025<br>(-0.09) |
| **Intercept** | 4.385***<br>(3.13) | 4.279***<br>(3.05) | 4.415***<br>(3.15) | 4.391***<br>(3.13) | 4.281***<br>(3.05) | 4.417***<br>(3.15) | 4.385***<br>(3.13) | 4.279***<br>(3.05) | 4.415***<br>(3.15) |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 3,352 | 3,352 | 3,352 | 3,352 | 3,352 | 3,352 | 3,352 | 3,352 | 3,352 |
| Adjusted $R^2$ | 0.208 | 0.2043 | 0.2081 | 0.208 | 0.2043 | 0.2081 | 0.208 | 0.2043 | 0.2081 |

This table provides the results of regressing the change in future stock prices of a firm (Δspps) on various measures of changes in free cash flow (Δfcfps1 - Δfcfps9) and control variables. Coefficients are provided with t-statistics in parentheses below. Variables are defined in Appendix A. ***, **, and * represent two-tailed p-value significance levels of 0.01, 0.05, and 0.1 respectively

# Research Notes

# MULTI-CHANNEL CUSTOMER RELATIONSHIP MANAGEMENT SOLUTIONS AND CUSTOMER SATISFACTION

Manely Collins, Collins Incorporated

## ABSTRACT

Disruptive technologies have facilitated the evolutions of Customer Relationship Management (CRM) enterprise systems to highly complex Multichannel Customer Relationship Management solutions capable to host CRM needs for any organization with access to the internet. The quantitative correlational study used a Likert response format survey to capture the correlation evidence between excellence drivers and customer satisfaction. Complexity and the richness of features could create challenges in providing high quality level of excellence for the customers. The problem investigated was to find what organizations' leadership can do to maximize customer satisfaction. The aim of the study was to examine the common functional patterns of the CRM systems and probe the stakeholders regarding their relevance in reaching customer satisfaction. The sample included fifty-two (52) users, stakeholders from the multichannel CRM space. The excellence drivers were quality of product, quality of service, response time, and easy to understand process. The analysis of data produced statistical evidence supporting the hypotheses concerning the CRM excellence drivers. A recommendation was customer continues to use the appropriate channel, such as texting, reading recommendations, to achieve customer satisfaction. Another recommendation was the organization continuous provide those channels, such as texting, phone calls, social media, and virtual assistants, throughout the purchasing process to achieve high levels of customer satisfaction.

## INTRODUCTION

Many service organizations have used technology for working virtually. One type of technology or application was customer relationship management (CRM), which has become an important tool for service representatives, sales personnel, and manufacturing operators engaged in virtual work. However, CRM systems can have a completely different infrastructure than traditional CRMs. In this study, the term CRM was used throughout the document.

The initial problem was to study the employee-input to-CRM system, customer-input to-CRM system, CRM system outputs, and how each interaction via every type of communication path creates customer loyalty. However, the problem was too large to study, and it was narrowed down to exclude the CRM system and the employees. The problem focused on the customer and associated relationship management processes to create customer satisfaction.

Wang, Wu, Lin, Shafiee (2019) Enterprises should not ignore the importance of customer satisfaction with products in favour of profit, as high customer satisfaction is correlated with an enterprise's long-term survival. Chen, Hsieh, Rai, and Xu (2021) To attain customer satisfaction, service firms invest significant resources to implement customer relationship management (CRM) systems to support internal customer service (CS) employees who provide service to external customers in both face-to-face and virtual channels.

Peppers and Rogers (2017) demonstrated powerful empirical evidence which enterprises strive to increase profitability without losing high-margin customers by increasing their customer retention rates or the percentage of customers who have met a specified number of repurchases over a finite period of time. A retained customer, however, is not necessarily a loyal customer (Peppers and Rogers, 2017). The customer may give business to competing business for many different reasons (Peppers and Rogers, 2017). For example, by decreasing the customer defection rate by 5%, service companies can boost profits by 25% to 85%, which was calculated by comparing the net present values of the profit streams over the average customer life at current and 5% lower defection rates (Peppers and Rogers, 2017).

Peppers and Rogers (2017) stated when a firm undertakes a customer-focused effort, a great deal of integration is required in all aspects of the enterprise. The management team has to buy in at the very top; and if it does, we should expect certain types of activity and behavior at the leadership level. The leaders of any customer strategy enterprise will accumulate expertise about managing customer relationships and will be cheerleaders for this business model. The leaders will highlight it in company meetings and in business gatherings; they will openly share their expertise in and around the organization; in sum, they will be authorities on the relationship management business model (Peppers and Rogers, 2017). Peppers and Rogers (2017) stated in a leadership role, a manager must be capable of sponsoring a customer-focused project and in some cases sheltering the people involved in the pilot project. One of the easiest ways to make progress in the journey toward customer centricity is to engage in a series of increasingly comprehensive pilot

(Peppers and Roger, 2017). Fotiadis and Vassiliadis (2017) stated some have defined CRM as a process, but others see it as a strategy, philosophy, skill or even a technological tool. However, it is labelled, and CRM now constitutes a relationship management procedure of high strategic value on how it combines the best business practices, available resources and business knowledge with CRM software of the company, thereby improving the response to its customers' individualized needs and growing their devotion and loyalty (Fotiadis and Vassiliadis, 2017).

Wang, Wu, Lin, Shafee (2019) Customers might therefore pay more attention to the committed delivery dates, which in turn may affect the degree of customer satisfaction. Chen, Hsieh, Rai, and Xu (2021) As firms expand from single-channel to multichannel service delivery, they deploy CRM systems widely to support their employees' interactions with customers in either face-to-face (e.g., retail stores-RSs) or virtual (e.g., contact centers-CCs) channels. Zare and Honarvar (2021) mentioned ever increasing growth of information and the pivotal role of the internet in the human life has brought about new events which have changed the way of doing procedures.

Chen, Hsieh, Rai, and Xu (2021) Research is needed to fill these gaps and inform managers about how to benefit from their organizations' CRM systems-particularly in the context of multichannel service provisioning, which is common today. Zare and Honarvar (2021) mentioned internet of things (IoT) facilities relationships in the business world. With the increased usage of new Internet services and intense competition between businesses, organizations should pay special attention to customer relationship management in order to survive and grow in the market (Zare and Honarvar, 2021).

Ngo, Pavelkova, Phan, and Van Nguyen (2018) stated competitive advantage sources are explained in some theories in marketing literatures. Day and Wensley developed the SPP framework (Sources, Position and Performance) to describe the casual chain which led to the competitive advantage (Ngo et al, 2018, p.65). Completing this framework are the feedback mechanism from the performance outcome back to the sources of advantage to identify key success factors and the necessary investments in skills and resources (Ngo et al, 2018). The theoretical framework adopted for the study was an adaptation of Thompson's theoretical framework. The framework included a technical core and boundary-spanning components linked to the technical core and process-oriented components.

This manuscript is important and unique because it addresses the connection between multichannel customer relationship management solutions and customer satisfaction. Gopalsamy and Gokulapadmanaban (2021) stated managing mutual relationship with customer is a decisive task in every sector. The main aspect of implementing customer relationship management is to solve the customer problem and satisfy their wants and needs (Gopalsamy and Gokulapadmanaban, 2021). To know the problem, it is mandatory for every organization to have a customer database (Gopalsamy and Gokulapadmanaban, 2021). Not only does the organization need a customer database, but the variety of channels to capture the information and interactions with the organization. This manuscript is a subset of the complete study on multichannel customer relationship management solutions and customer satisfaction.

Kassem, Asfoura, Hart, and Althuwaini (2022) mentioned companies should recognize the opportunities arising. The audience for this article is composed of chief executive officers, chief management officers, chief technology officers, chief customer experience officers, vice presidents, directors, managers, business teams, technology teams, business analysts, and project leaders. Every type of organization, such as customer to business, customer to customer, and business to business, will benefit from this study. Startup organizations will benefit from the study because it helps them understand the past, present, and future of customer relationship management.

## METHOD

The quantitative correlational study used a Likert response format survey to capture the correlation evidence between excellence drivers and customer satisfaction. The aim of the study was to examine the common functional patterns of the CRM systems and probe the stakeholders regarding their relevance in reaching customer satisfaction. The independent variables were the quality of the product, quality of service, response time, and easy to understand process. The dependent variable was the customer satisfaction within the relationship. The variables are measured on a holistic view from the consumer. The consumer had from one (1) iteration or interaction with the system to two hundred (200) iterations or interactions with the system. The frequency as based on one purchase or numerous purchases online.

It is common to differentiate between studies that use bivariate or multiple regression/correlation into two types: (a) Those who attempt to predict events or behavior for practical decision-making purposes in applied settings, and (b) those who attempt to understand or explain the nature of a phenomenon for purposes of testing or developing theories (Grimm & Yarnold, 2000). A quantitative design was selected because it is appropriate for the systematic empirical investigation of social phenomena via statistical, mathematical, or numerical data or computational techniques. An extensive literature review revealed a lack of contemporary studies exploring the multi-channeled connections from consumer to firm (Hsiao, Ju Rebecca Yen, & Li, 2012; Peterson, Grone, Kammer, & Kirscheneder, 2010).

The objective of the correlation study using a statistical approach was to explore the variety of electronic and non-electronic methods for interacting with the CRM system from consumer-to-firm. The design met the guidelines used to determine the fit of correlation study methods by determining whether and to what degree a relationship exists between two or more quantifiable variables and the degree of the relationship is expressed as a coefficient of correlation (Jacobs, 2012).

The research design for the study was correlational using surveys. The research design measurement used descriptive statistics plus Pearson R for testing and relating the variables. In order to obtain a sample, a general posting about the research was provided on the Web; in addition, small note cards were distributed to unknown information technology professionals and consumers through small talk, conversation or the researcher posing a question, and/or pinned to a specific company's bulletin board if permitted. The professionals and consumers were individuals, not business; thus, the meaning one individual based on their personal experience per survey. This was a business-to-consumer (B2C) research study. The geographic location for the study was in the United States. The United States serves a variety of industries, such as hospitals, schools, finance, insurance, banking, retail, real estate, publishing, biotechnology, and conglomerate media.

One survey was made available to between 1,500 to 2,000 population living in the United States of America and its territories. Fifty-two (52) individuals, who are of an age to consent to participate in the survey, became the sample population. A sample of N =52 participants who have engaged with a CRM system in the past month in the United States and possibly outside of the region will be selected based on criteria. The confidence level to be used was 99% and the confidence interval was .01. Prior to participation in the study, customers and professionals performed a transaction with the CRM system within the last or few months. Customers and professionals had combination of formal training and experience with the CRM system. The participating customers and professionals did not use the same CRM system. Customers and professionals' levels of experience ranged from beginner, to intermediate, to advanced. Customers and professionals were identified through email distribution groups, social media groups, food/restaurant delivery drop offs, and gym/fitness center community boards.

The name of the instrument was CRM Questionnaire. This particular instrument was not published but utilized the example of customer behavior survey template 61 provided by electronic survey vendor. The rationale for developing the template was to capture the interactions between the customer and the organization during the shopping process. Response format choice had to simple enough for an everyday customer and similar to other major organizations capturing data when a customer is asked to take a survey. Scoring weight gave strongly disagree with weight of one (1) to strongly agree with a weight of five (5). The number of total questions was fifty-five (55) questions. Each section contained eleven (11) questions.

For this study, one questionnaire was developed based on Mouboukila-Poha (2018) CRM survey, which was based on the Wiley SPLI: Leadership Practices Inventory. The entire survey was modified using the Likert scale response

format to align with the current study. Before the survey was sent out to the public of 1600-1800 people, the first email invitation went out to the public of eight (8) possible customers. The field test experiment got three (3) completed responses back. The three (3) completed responses were included in the sample size n=52 completed surveys. The data was sent to the SPSS software Version 25 to be able to read the data appropriately. All participants provided valid answers to anonymous demographics to include their responses. The special email invitation was sent through the vendor's mass mailing 62 web tool. The email invitation list was derived from group distribution lists sent to the researcher and also social media contact information. The pop-up survey was sent via social media postings. The research poster was disseminated on street light poles, gym community boards, and passing out by hand directly to people. The SurveyMonkey data tool provided a consumer identification number without the participants providing any personal information, such as name, address, phone number, etc. The SurveyMonkey survey recorded respondent's IP address, set survey end date, and record respondent email address, which will be translated into a consumer identification number. The data analysis tool provided the option to anonymize values.

Demographics are representative of the same population pool. Only original data was used. No prescribed instructions were given to the population who complete the survey. Instructions, such as the basis of survey was given, but no instructions to manipulate the initial or original attitudes and thoughts of a CRM system. No verbal or in-person interviews conducted. Data was processed and manipulated using SPSS and proven manual mathematical calculations. The vendor used for providing the survey has been in the business for over a decade or more. A ranking scale was provided, and participants ranked the responses to the statements on a 5-point Likert-type response format from strongly agree to strongly disagree. This instrument was the first of its kind and will be conducted with the sample population, but very similar to those utilized by large companies on a daily basis, such as Giant (Stop and Shop), Amazon, Google, Apple, Safeway, and United States Postal Service.

The data was collected electronically using a Web-based tool and the CRM Questionnaire was created by the researcher. Primary storage of the data is in a hierarchical document library on a computer with limited Internet access. But they were secured with a complex username and password. The folders and data on the computer is given general names only coded by researcher. A secondary storage area was on a detachable storage drive. The data will be stored for a period of three years in a backpack inside a locked storage unit. After the period of three years, the data will be destroyed by deleting the data from the computer, performing a secure overwriting of the area where the data were stored, and/or possibly melting the device so the data are irrecoverable. Independent variable "quality of the product" was in relation to any type of product purchased by the consumer. Independent variable "quality of the service" was in relation to any type of service purchased by the consumer. Independent variable "response time" was in relation to any type of communication or confirmation onward to the next step in the process of making purchases within the system. "Simple process and/or easy-to-understand process" meant the language provided, and intuitiveness of the online ordering or information lookup, was easy or hard while making a purchase in the system. The dependent variable "customer satisfaction" was way the organization provided a quality of product, quality of services, response time, and simplicity of process through connecting to the consumer via text, email, phone, online virtual assistant, social media, or postal mail.

To analyze the data, manual calculations and computer-generated results using Microsoft Excel and IBM SPSS Version 25.0 statistical software was used to present the characteristics of the sample. In addition, the Pearson R technique applied to test the relationships between variables. Other analysis included frequencies, mean, standard deviation and count. The measurement tool consists of a Likert five-point response format using five potential answers to the questions presented. The responses coded as follows:

- Strongly disagree (1),
- Disagree (2),
- Neutral (or Neither Agree or Disagree) (3),
- Agree (4), and
- Strongly agree (5).

The "quality of the product" measurement or selection of strongly agree meant the consumer feels highly satisfied within the system he/she is using to make purchases. The "quality of the product" measurement or selection of strongly disagree meant the consumer is not satisfied within the system he/she is using to make purchases. The "quality of the service" measurement or selection of strongly agree meant the consumer feels highly satisfied within the system he/she is using to make purchases. The "quality of the service" measurement or selection of strongly disagree meant the customer is not satisfied within the system he/she is using to make purchases. The "response time" measurement or

selection of strongly agree meant the customer is getting an excellent response from the system he/she is making purchases. The "response time" measurement 65 or selection of strongly disagree meant the customer is getting a bad response or trouble
from the system he/she is making purchases. The frequency of response time was less than one (1) second up to a thirty (30) minute wait time. The "easy to understand process" measurement or selection of strongly agree meant the process and entire site was easy to use while he/she is making purchases. The "easy to understand process" measurement or selection of strongly disagree means the process and entire site was
difficult to use while he/she is making purchases. The frequency measured could be the arrangement of buttons, adding items, removing items, calculating totals, finding substitutes and compliments, placement of the description, providing payments, and/or updating profile and account information. The "customer satisfaction" measurement or selection of strongly agree means a certain type of communication mechanism was used. The "customer satisfaction" measurement or selection of strongly disagree meant a certain type of communication mechanism was not used.

## RESULTS

The research question for this study was the following: How important are the customer satisfaction drivers to improve the overall behavior of the CRM system? The research question was focused on the following relationships: Consumer-to-organization and organization-to-consumer; the internal operations of CRM from data input by the consumer or employee within the United States; the behavior of the system while the United States consumer goes through a purchase from start-to-finish or start-to-save; and linking the tools available and used by United States consumers.

The hypotheses to be tested are as follows and sub research questions supporting the main question was as follows:

1. Is there a relationship between quality of the product and customer satisfaction?

$H_1$: There is a relationship between the quality of the product and customer satisfaction.

$H_{1o}$: There is no relationship between the quality of the product and customer satisfaction.

The mean of quality of product section was $p$=0.000. The significance level is α=.01. According to scientific rules, $p < \alpha$ signifies the first hypothesis is accepted and the null hypothesis is rejected. The mean of $r$ , which is strength and direction, totaled $r$=0.897.

2. Is there relationship between quality of the service and customer satisfaction?

$H_2$: There is a relationship between the quality of the service and customer satisfaction.

$H_{2o}$: There is no relationship between the quality of the service and customer satisfaction.

The mean of quality-of-service section was $p$=0.000. The significance level is α=.01. According to scientific rules, $p < \alpha$ signifies the second hypothesis is accepted and the null is rejected. The mean of $r$ , which is strength and direction, totaled $r$=0.930.

3. Is there relationship between response time and customer satisfaction?

$H_3$: There is a relationship between the response time and customer satisfaction.

$H_{3o}$: There is no relationship between the response time and customer satisfaction.

The mean response of time section was $p$=0.000. The significance level is α=.01. According to scientific rules, $p < \alpha$ signifies the acceptance of the third hypothesis and the null is rejected. The mean
of $r$ , which is strength and direction, totaled $r$=0.953.

4. Is there a relationship between easy-to-understand process and customer satisfaction?

$H_4$: There is a relationship between the simple and easy to understand process, and customer satisfaction.

$H_{4o}$: There is no relationship between the simple and easy to understand process,
and customer satisfaction.

The mean of easy-to-understand process section was $p$=0.001. The significance level is α=.01. According to scientific rules, $p < \alpha$ signifies the fourth hypothesis is accepted and the null is rejected. The
mean of $r$ , which is strength and direction, totaled $r$=0.893.

Previous research has not measured the current trends for online CRM systems gathering customer information. The findings were consistent with data input and data output interactions with an electronic CRM system. Authors, Buttle,

Maklan, Mantrala, Srisamran and Ractham, have addressed different populations, such front-office employees, back-office employees, and consumers, who are connecting to the CRM system. The intention of the study was to provide statistics about communication mechanisms within CRM. Previous research has discussed formal one-on-one interviews between senior leadership and middle management with employees as a method to gather data about CRM use.

**Sub-research question #1**: Is there a relationship between quality of the product and customer satisfaction?

From the completion of the study, the first sub-research question was concluded the quality of product is important to the customer. Per the results from the survey and graphs, it was concluded to be true is the customer is dependent on detailed descriptions, endorsements, or social media to purchase the product. From the completion of the study, it was concluded to be true is the customer is dependent on feedback and reviews, having a phone call and discussion regarding the product to ensure he/she is getting the right product. Based on the quality of product findings, the conclusions meant there is a correlation between quality of product and detailed description, social media, and postal mail marketing.

**Sub-research question #2**: Is there relationship between quality of the service and customer satisfaction?

From the completion of the study, the second sub-research question was concluded the customer will keep the product. Per the results from the survey and graphs, it was concluded the customer will utilize the organizational benefits of the service provided. Therefore, the study proved the customer will need information from and about the services the organization provides. Based on the quality-of-service findings, the conclusions meant there is a correlation between quality of service and detailed description, feedback and reviews, and certain company or brand.

**Sub-research question #3**: Is there relationship between response time and customer satisfaction?

From the completion of the study, the third sub-research question was concluded the customer is reading the materials sent to them by the organization. Per the results from the survey, it was true that the organization is reading any materials sent from the customer. Therefore, the study proved the customer believes other customers about response time from the particular organization. The study concluded the organization is promoting or marketing its product and/or service. Based on the response time findings,
the conclusions meant there is a correlation between response time through word-of-mouth, postal mail marketing, and social media.

**Sub-research question #4**: Is there a relationship between easy-to-understand process and customer satisfaction?

From the completion of the study, the fourth sub-research question was concluded the customer likes options to interact with the organization. Per the results from the survey, it concluded the customer has an appropriate computing or mobile device to utilize while interacting with the organization. Therefore, the study concluded the customer is able to use the method most comfortable according to his/her possible impairment or non-impairment. The study concluded the organization in invested appropriate documents and other communication mechanisms for the customer to obtain information. Based on the easy-to-understand process findings, the conclusions meant there is a correlation between easy-to-understand process and social media, texting, and phone calls with a discussion.

*Based on the conclusions and implications for quality of product*, the researcher recommended the customer buys the product. The researcher recommended the organization provide a good supply of the materialistic or physical product according to the best customer demands through the CRM system and online shopping. Examples of product could be farm-raised, no-GMO chicken eggs; plant-based, gluten-free beef; or more Tesla SUVs. The researcher recommended leadership provide an appropriate vision and theme to instill the customer confidence and employee belief the product is right-to-market. The researcher recommended management provide an appropriate message to get people to purchase the product.

*Based on the conclusions and implications for quality of service*, it is recommended that the customer retrieve as much information necessary to purchase the service. It is recommended that the organization continue to solicit feedback through verbal and non-verbal communication. With the feedback, the organization is responsible to promote informative notes about its service. It is recommended that leadership provide the appropriate organizational dynamics

to continue positive service or keep the customer relationship. It is recommended that management provide the appropriate transactional techniques to manage the customer relationship. Management is responsible for promoting the one message or one vision provided by leadership.

*Based on the conclusions and findings for response time*, it is recommended that the customer validate all non-sources informative media that are not promoted by the organization. It is recommended that the organization to provide process management techniques to solidify which methods works regarding response time. It is recommended that leadership to provide a realistic transformative message to lower response time metrics. It is recommended that management provide lessons learned and implement all metric strategies to provide the best response time.

*Based on the conclusions and implications for easy-to-understand process*, it is recommended that customers continue to fill out surveys from the organization to be able to improve the process. It is recommended the organization continue to invest in streamlined technologies to adapt to the on-demand customer as well as the slow response customer and information challenged customer. It is recommended leadership to provide transformative leadership techniques to keep the process bureaucracy at a minimum. It is recommended management to continue training in the latest quality and process methods that work for the new disruptive organizations.

The recommendations for future research could extend to a greater population, a different country, or different industry. Another recommendation for research is the study could be within the area of business intelligence, advanced analytics, supply chain management, or machine learning in connection with customer relationship management. This study captures the changes and relationships according to the use of the variety of channels available to the customer. The recommendation for future research can be narrowed to divide which social media mechanism or smartphone application can provide the highest value to an organization. Another recommendation is the ability to focus on process management techniques to manage customer relationships. Another recommendation is the ability to gather high leadership methods or visions for a qualitative study on how leaders view the customer relationship. Another recommendation is delving into quantitative studies on the response time metrics provided by organization. Thus you can measure the time of speed or speed of information during a customer relationship. Another recommendation is the ability to measure what is quality in product or service.

Customer Relationship Management (CRM) is an evolving process that requires input from the customer and the organization's acceptance of the customer request. CRM approach is vastly different than any other system approach. This study provided processes surrounding not only the customer, but the technologies as well. This study provided insight where CRM has been and where it is going. This dissertation provides the intercorrelation with other systems, such as ERP, SCM, machine learning, and artificial intelligence. The processes surrounding CRM builds on top of business intelligence's use of data and information. This research brought to the forefront the needs for major organizations to focus on and invest in a good and dynamic approach to CRM. This research study can be applied at a country's capitalism level with major organizations or small businesses that would like to grow to the next level. The value of this research provided chief executives, managers, leaders, department teams, and others knowledge on how to become better at customer relationship management and achieve higher levels of customer satisfaction.

This research provides the information necessary to develop the process, strategy, philosophy, and skill. With this study, you are the customer who has the power to build on this research and convey a message with each person, place, or organization you are connected.

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# ANALYZING THE COVID-19 INTERVENTION EFFECTS ON BUSINESS SKILLS OF UNDERGRADUATE B-SCHOOL STUDENTS

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## ABSTRACT

Mitigating a global pandemic was certainly not at the forefront of planning for educators prior to March 2020. Educators were forced to move classes out of the classroom in a matter of days, while still offering students the level of education they expected and deserved. Students were expected to navigate online learning while working through various obstacles like poor to no Internet access, time zone differences and the distraction of family members. This challenged students mentally, socially, and psychologically as they were eventually required to return to campus with one foot in the classroom and one foot remaining in remote learning. This empirical study examines the effects of COVID–19 on the Educational Testing Service's Major Field Test taken by undergraduate students studying in the business department of one university in Northern Pennsylvania in the USA, through analytics methods applied to data collected during a four-year period.

## INTRODUCTION

The emergence of the Coronavirus (COVID-19) pandemic presented an unprecedented challenge for universities at administrative and pedagogical levels. The highly contagious nature of the virus forced the demand for social distancing while limiting face-to-face contact outside the confines of one's household. To curb infection rates, educational institutions were temporarily shut down around the world and immediately forced to implement emergency online instruction using remote methods of learning, while relying significantly on technology. Instructors were faced with increased workloads as they were tasked with rethinking the modality of content and assessment while also providing support to the students.

The emergency transition to remote learning came at a time when most universities were well into their academic year. Faculty and students were forced into a new learning mode with little time to wrap their heads around what was happening to plan and adjust to the change. Emergency online instruction has been shown to aggravate psychological health issues already inherent in students (Cleofas & Rocha, 2021; Hamaideh et al., 2021; Khawar et al., 2021) while research on past epidemics suggested that lockdowns and quarantine measures could rouse negative psychological impacts like depression, stress, and anxiety (Brooks et al., 2020).

Students have dealt with increased depression, feelings of loneliness, anxiety about the lack of productivity, finances, future job offers, and contracting the virus. Interestingly, students have reported a general trend of decreased prevalence of symptoms as students got closer to their graduation date (Lee et al., 2021). The United Nations noted that 94% of the world's student population was affected by COVID-19. Students who were admitted to international universities were restricted by global travel restrictions and were not able to join the academic programs, causing them emotional stress. As universities switched to emergency remote teaching, students who were deprived of the necessary digital tools faced major setbacks due to spatial, economic, and social reasons. A large proportion were frustrated with online learning to the extent they were losing interest in and dropping out of college.

Researchers have studied the effects of the online learning modality on student's retention. Al-Kumaim et al. (2021) investigated whether the online learning platforms used by university students during the COVID-19 period presented any challenges to their learning by developing a conceptual model to reduce the impact of the challenges. Montenegro-Rueda et al. (2021) found that continuous assessment, not focused on the exams, but rather in a more qualitative way is the best course to assess at a distance. Some studies report that online learning leads to worsened outcomes whereas other studies report comparable outcomes to face-to-face instruction (Knight et al., 2021). Hickey and White (2021) studied the effects of COVID-19 on the scores of the ETS Major Field Test at the United States Coast Guard Academy. The study did reveal a decline with an 11-percentage point decrease over the previous 2 years in the ETS scores for the class of 2021, but in areas that were not affected by the COVID disruption. The authors proposed two possible explanations for the decline in the scores; a larger than normal class size and the students took the ETS exam electronically rather than in paper form.

This paper examines the effects of COVID–19 on the ETS's Major Field Test (MFT) taken by undergraduate students studying in the business department of one university in Northern Pennsylvania in the USA, on data collected during

a four-year period intervened by the pandemic. Results show that although there was a drop in the performance of the students on the MFT, this decrease was not statistically significant. The student population reacted resiliently to adapting to the new modes of instruction.

## LITERATURE REVIEW

There are some works in the literature studying the impact of COVID-19 on student's performance. Montenegro-Rueda et al. (2021) presented a systematic review of literature on the impact of assessment in higher education during the pandemic. Selecting 13 studies out of 51, the authors suggested that faculty and students faced numerous challenges in moving to virtual environments and rampant practices of dishonesty and misconduct in relation to the students. Suggestions provided for assessing students other than through examination would include through academic assignment, assessing student progress through the educational stage and through continuous assessment (Montenegro-Rueda et al., 2021). Jehi et al. (2022) conducted a comprehensive literature review on the prevalence of anxiety among the students of higher education during the pandemic. From the 37 studies that met the authors inclusion criteria, two themes were developed; prevalence of anxiety and the factors associated with the anxiety during the COVID-19 confinement period. The challenges that were experienced from this emergency transition to remote teaching also contributed to students increased anxiety (Jehi et al., 2022).

Lee et al. (2021) surveyed 200 domestic U.S. college students ages 18 – 24 attending a 4-year university before the pandemic. The authors presented 11 multiple choice questions to the respondents that homed in on the physical, emotional, and social impacts of COVID-19. The authors also included a final open-ended question to capture the student's verbatim feelings. **How has COVID-19 impacted your mental health?** 60.8% reported increased anxiety; 54.1% reported depression and 59.8% reported feeling of loneliness. Interestingly, the authors found a general trend of decreased prevalence of symptoms as students got closer to their graduation date (Lee et al., 2021). Knight et al. (2021) performed a qualitative study using an inductive thematic approach to explore the impact of COVID-19 by studying the perspectives of both students and staff members. International and first year studies were particularly impacted as COVID-19 made it harder to develop friendships and social networks. As per this study, evidence on the impact of the shift to online instruction on learning outcomes has been mixed. Students in this study reported a motivational decline to engage with their academic work and responsibilities (Knight et al., 2021). Zhou and Zhang (2021) found that students' learning experience during COVID-19 was positive. The students surveyed reported fair mental health, a good belonging to their learning community, and satisfaction with remote learning. There were reports of inadequate interactions between students, but the hybrid learning model was still shown to be a positive learning option even a year after the outbreak of the pandemic (Zhou & Zhang, 2021).

Marklein (2020) suggested that this opened a whole new area of inequity as the digital gap is more than just a lack of equipment. The digital gap also includes the capacity to handle the devices and the ability to effectively use them for learning. The authors suggested that face-to-face learning creates a motivation for students to engage and take their studies more seriously, and that remote learning limits opportunities for peer learning and social interaction between teachers and students and student to student. Baglione and Tucci (2022) concur as the student participants in their study had a more favorable response to Zoom as a learning tool when they were allowed to remain on campus with limited face-to-face interaction. Al-Kumaim et al., (2021) collected data from 486 students in different universities in Malaysia wherein the students disclosed various obstacles they encountered using IT platform applications for online learning. The obstacles included working with information overload received from instructors, inadaptability and unfamiliarity of the new online learning environment, and personal health challenges related to stress and anxiety. Browning et al. (2021) collected 2,500 survey responses from seven US universities using web-based questionnaires to identify the psychological impacts of COVID-19 on students and evaluate potential risk factors that could make students more likely to experience these impacts. They reported effects like lack of motivation, anxiety, stress, isolation, social distancing, education changes and going out less. This study showed that students who were women, non-Hispanic Asian, in fair/poor health, of below-average relative family income, or someone who knew a family/community member infected with COVID-19 appeared to be more strongly impacted by the pandemic (Browning et al., 2021).

Bailey (2021) surveyed 165 declared business majors to capture information on their experiences as they transitioned to online learning to finish the semester. In response to how the Coronavirus impacted them, at 69.1%, emotional stress was the most mentioned, followed by travel plans, financially, family, and other. Despite the negative factors associated with the transition, most students indicated that they were glad they had the ability to move to the online format so they could complete the semester. Green et al. (2022) studied the Major Field Test and the role it plays in

Assurance of Learning (AOL) assessment at business schools. Use of the AOL assessment is accepted by all three major business school accrediting agencies – AACSB, ACBSP, and IACBE. The authors suggested that the MFTB test results are scored and reported in a manner that makes it impossible to determine how well business students have learned the common body knowledge expected of business graduates. The comparisons of MFTB performances either across time or across institutions are invalid because the test results are significantly driven by individual student characteristics of an unknown group of students enrolled at diverse non-random business schools (Green et al., 2022).

## METHOD AND RESULTS

The impact of COVID on the learning medium of students was mostly felt during the year of 2020 when learning was abruptly shifted to the online mode and students and educators had to adopt to the new normal. For this study, data was collected from the ETS website for the past performance of students in the university for four semesters preceding the semesters of Spring 2020 and Fall 2020, followed by three semesters after 2020. In all 354 students took the test during the nine semesters and the summary statistics of each group are stated below.

Table 1: Summary statistics of the sample of data

| Year | SP18 | FA18 | SP19 | FA19 | SP20 | FA20 | SP21 | FA21 | SP22 |
|---|---|---|---|---|---|---|---|---|---|
| Count | 28 | 48 | 38 | 52 | 44 | 48 | 21 | 44 | 31 |
| Mean | 153.6 | 155.6 | 153.4 | 153.8 | 149.4 | 153.8 | 151.8 | 151.0 | 155.6 |
| Median | 154.0 | 153.0 | 152.5 | 151.5 | 150.5 | 152.5 | 153.0 | 151.5 | 157.0 |
| Std dev | 11.1 | 13.3 | 11.6 | 11.1 | 9.5 | 9.0 | 15.1 | 10.9 | 16.9 |
| Coeff of Variation | 7.25% | 8.54% | 7.56% | 7.23% | 6.37% | 5.87% | 9.96% | 7.21% | 10.84% |

As can be seen from Figure 1, trend in the Mean and Median was the least for the semester of Spring 2020 and is roughly showing return to previous trend from the semester of Fall 2020 onwards. This indicates that students' learning and application of the quantitative skills were affected by the shift in the teaching mode.

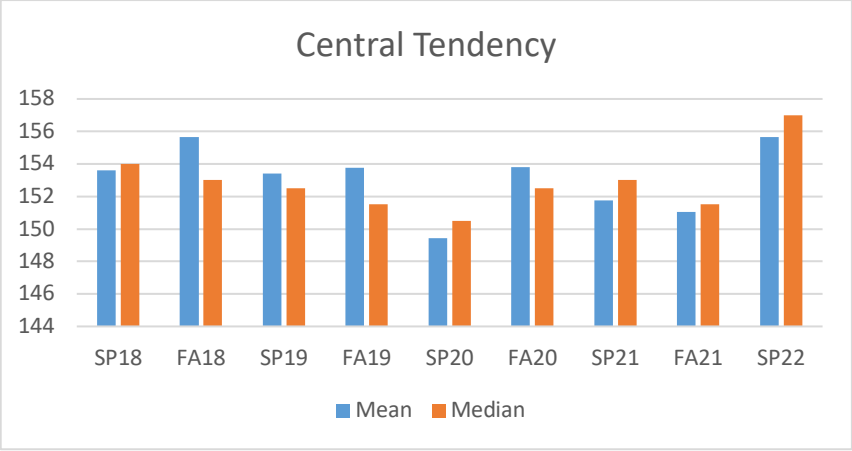



Figure 1: Central Tendency of the sample of students over nine semesters

If you consider the combined effect of the mean and the standard deviation as captured in the coefficient of variation shown in Figure 2, we can see that the coefficient of variation was the least for the Spring 2020 and Fall 2020 semesters, further proving that COVID had a marked effect on student's quantitative abilities.

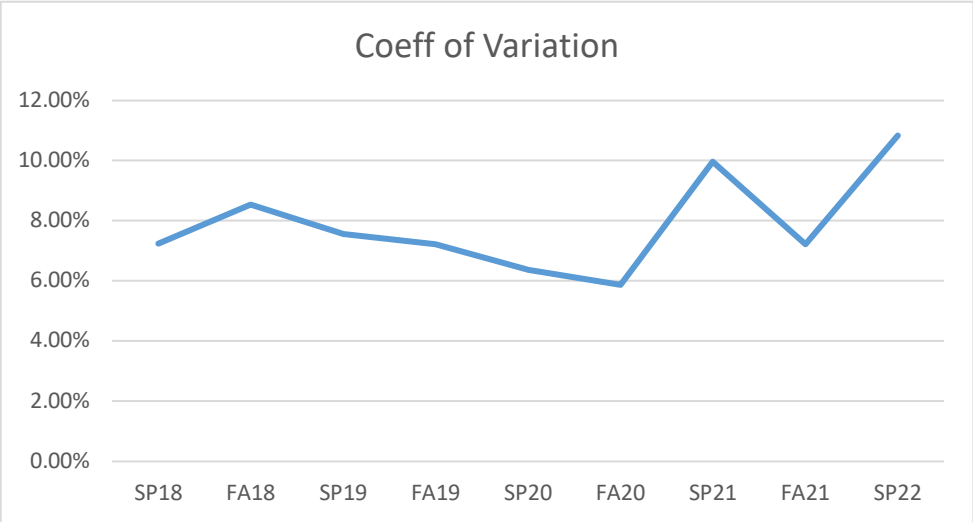



Figure 2: Coefficient of Variation of the sample of students over nine semesters

To compare the overall performance of all the students from each semester during the period of the analysis, we constructed box-and-whiskers plot for the data. We can observe that the Spring 2020 semester was the semester of the lowest performance of all the students on the SFT.

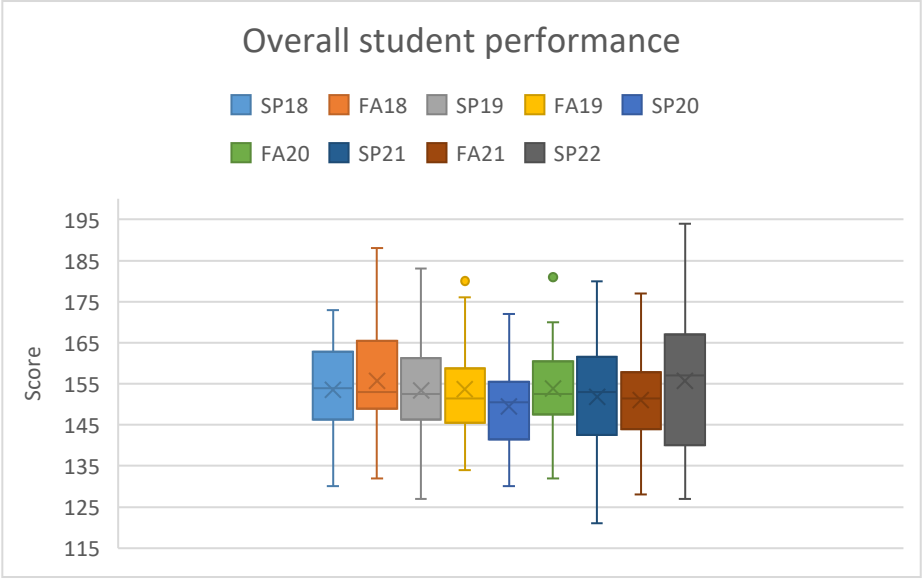



Figure 3: Box and Whiskers plots of the sample of students over nine semesters

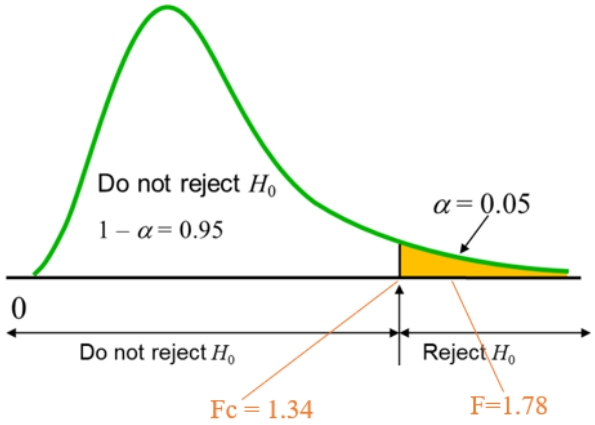
To check the statistical significance of the difference in the students' performance for the COVID affected 2020 semesters, we created two groups of data. We grouped the data for the performance of the four semesters preceding 2020 and the three semesters after 2020 into one group. The second group consisted of the data for the two semesters of 2020. We conducted an F test for equality of variances and found that we can conclude that the variances of the two groups are unequal. The results are shown in Table 2.

H0: The variance of score on the SFT is the same for COVID semesters as compared to non-COVID semesters

H1: The variance of score on the SFT is different for COVID semesters as compared to non-COVID semesters

Table 2: F-Test Two-Sample for Variances

| | *X1* | *X2* |
|---|---|---|
| Mean | 153.645 | 151.7174 |
| Variance | 160.2988 | 89.74343 |
| Observations | 262 | 92 |
| Df | 261 | 91 |
| F | 1.78619 | |
| P(F<=f) one-tail | 0.000759 | |
| F Critical one-tail | 1.344028 | |




As F > F Critical, we can reject the null
We can conclude that the variances are different

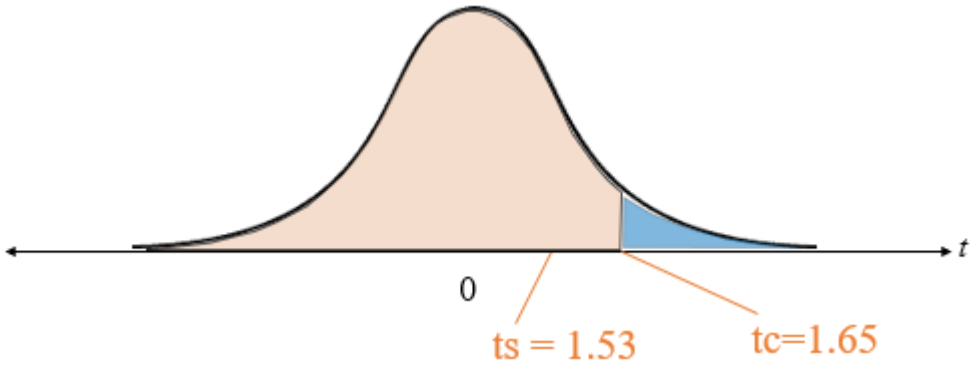
Since the variances can be concluded to be different, we conducted a two-sample hypothesis test assuming unequal variances to check if we can conclude that the population averages of the two samples are the same. In other words, we tested if we could conclude that COVID had no impact on the SFT scores of business students. We conducted the two-sample t-test assuming unequal variances with alpha values of 0.05 and 0.1. As shown in table 3 and table 4, we cannot statistically conclude that COVID had a significant impact on the SFT scores of business students.

H0: The average of score on the SFT for COVID semesters is at least the same as the average compared to non-COVID semesters

H1: The average of score on the SFT is less for COVID semesters as compared to non-COVID semesters

Table 3: Two-Sample t-Test Assuming Unequal Variances, alpha = .05

| | *X1* | *X2* |
|---|---|---|
| Mean | 153.645 | 151.7174 |
| Variance | 160.2988 | 89.74343 |
| Observations | 262 | 92 |
| Hypothesized Mean Difference | 0 | |
| Df | 212 | |
| t Stat | 1.530023 | |
| P(T<=t) one-tail | 0.063751 | |
| t Critical one-tail | 1.652073 | |
| P(T<=t) two-tail | 0.127502 | |
| t Critical two-tail | 1.971217 | |

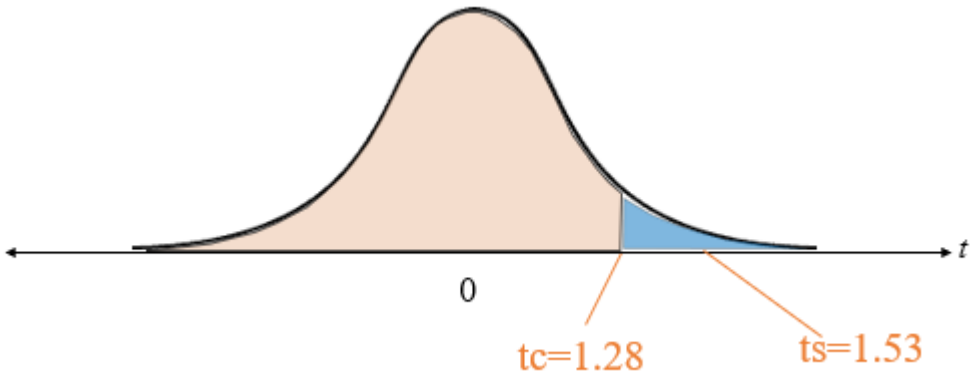



As t Stat < t Critical one-tail right side, we cannot reject the null
We cannot conclude that COVID has influenced the SFT score.

To further investigate where the effect of COVID is significant at a .10 level of significance, we conducted another t test assuming unequal variances.

Table 4: Two-Sample t-Test Assuming Unequal Variances, alpha = .10

| | *X1* | *X2* |
|---|---|---|
| Mean | 153.645 | 151.7174 |
| Variance | 160.2988 | 89.74343 |
| Observations | 262 | 92 |
| Hypothesized Mean Difference | 0 | |
| Df | 212 | |
| t Stat | 1.530023 | |
| P(T<=t) one-tail | 0.063751 | |
| t Critical one-tail | 1.285558 | |
| P(T<=t) two-tail | 0.127502 | |
| t Critical two-tail | 1.652073 | |




As t Stat > t Critical one-tail right side, we can reject the null
We can conclude that COVID has influenced the SFT score

To investigate if the major pursued by the different students had any effect on their performance in the SFT, we made a breakup of all the data as per the majors as seen in Table 5.

Table 5: Mean% Correct answers by Majors

| | Mean% Correct | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **SP18** | **FA18** | **SP19** | **FA19** | **SP20** | **FA20** | **SP21** | **FA21** | **SP22** |
| Accounting | 46 | 48 | 49 | 49 | 47 | 46 | 47 | 46 | 52 |
| Economics | 48 | 52 | 46 | 51 | 43 | 47 | 49 | 58 | 58 |
| Management | 68 | 62 | 66 | 65 | 59 | 64 | 61 | 55 | 58 |
| Quantitative Business Analysis | 30 | 37 | 32 | 36 | 32 | 34 | 35 | 34 | 37 |
| Finance | 44 | 46 | 43 | 44 | 41 | 48 | 45 | 41 | 44 |
| Marketing | 59 | 56 | 56 | 54 | 54 | 54 | 50 | 56 | 61 |
| Legal and Social Environment | 49 | 53 | 45 | 44 | 46 | 48 | 45 | 51 | 56 |
| Information Systems | 50 | 53 | 54 | 51 | 47 | 56 | 49 | 41 | 40 |
| International Issues | 46 | 45 | 39 | 49 | 39 | 43 | 45 | 46 | 51 |

As you can see graphically in Figure 4, there appears to be no apparent major that has been affected by COVID.

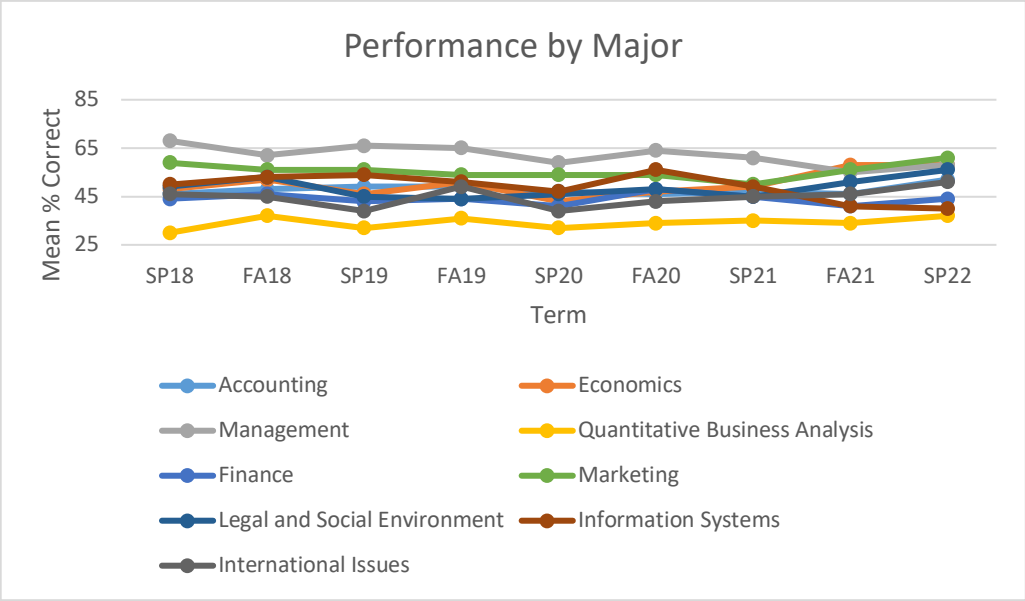



Figure 4: SFT scores by majors over nine semesters

To statistically evaluate the effect of the major on the SFT scores, we conducted a one-way ANOVA on all the data in Table 5.

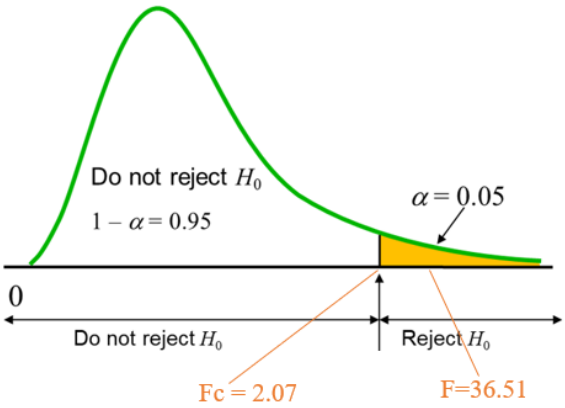
H0: The major has no effect on the performance on the SFT

H1: The major has an effect

Table 6: Single Factor ANOVA, alpha = .05

ANOVA

| *Source of Variation* | *SS* | *Df* | *MS* | *F* | *P-value* | *F crit* |
|---|---|---|---|---|---|---|
| Between Groups | 4292 | 8 | 536.5 | 36.5104 | 2.2E-22 | 2.069832 |
| Within Groups | 1058 | 72 | 14.69444 | | | |
| Total | 5350 | 80 | | | | |




As F>F crit, we can reject the null

We can conclude that major influences the Standardized Field Test results.

## CONCLUSION

Even though graphically there appears to be an effect of COVID on the results of the SFT, this effect is statistically significant only at a level of significance of .10 or higher as illustrated by the t-test. The Major pursued by the students does not seem to influence the results of the SFT as illustrated by both the graphical results, but the effect is statistically significant as illustrated by the ANOVA.

The results have some limitations. For example, there could be differences that are visible in slicing and dicing the data in different ways, but they are not visible at present. Did we administer the exam in a different format? Did we have the students take it online vs in class during this year? This study also does not differentiate the results as per the level of the students: bright, average, struggling.

The effects of the majors could be explored further to see if there are students of specific majors that have been more affected compared to others, but two problems hindered further investigation through this route. Firstly, the data for individual students was not readily available through ETS, and many privacy concerns had to be addressed before this data could be available at individual student level. Secondly, after slicing the data by the majors, the resulting sample sizes would be too small for assumptions of normality of the data to hold and subsequent feasibility of conducting ANOVA.

For future research, this work could be extended to more universities. As we consider the next few years, do the results change given the class status of students during COVID – for example the students taking the exam in 2020 were Jr's and Sr's prior to COVID, those who took it in 2021 only had to experience the change during their senior year etc.

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# MORE THAN BOOK KNOWLEDGE: FINANCIAL LITERACY AND HABITS OF COLLEGE STUDENTS

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## ABSTRACT

This paper analyzes the influences impacting college students' decisions related to banking accounts, investment accounts, and spending habits. Additionally, we measured students' perceived knowledge compared to actual financial literacy knowledge using FINRA's financial literacy assessment. Our results indicate that an overwhelming majority of college business students mirror their parents' behaviors when selecting a bank and bank products. Additionally, the majority of students are confident in their financial literacy, yet the results from the survey indicate that they are not familiar with the concepts of inflation, interest rates, and diversification. Using Welch's t-test for unequal variances, results from a basic finance or financial literacy class significantly improve scores for questions related to inflation and also for bond yields/prices for all student populations, suggesting that colleges should consider adoption of such programs for all students.

## INTRODUCTION

### Financial Wellness and Educational Systems

On March 22, 2022, Florida Governor Ron DeSantis signed SB 1054 into law requiring all students entering high school in 2023-2024 to complete a financial literacy course prior to graduating from high school. Students will be required to take a half credit course that is focused on how to open a bank account, the importance of establishing good credit, completing loan applications, and various savings/investment accounts (News Service of Florida, 2022). The bill passed unanimously in both the Florida House and Senate, suggesting that regardless of one's political affiliation, the impact of financially literate graduates positively impacts society as a whole – not just the student.

Florida is not the first state to recognize the connection between financial literacy and lifelong habits. Seven other states currently have a requirement for students in K-12 to take at least on semester of financial literacy according to Forbes (Smith, 2022). The article confirms that nationwide, there are currently 43 bills pending in 21 additional states to add a requirement for personal finance to be taught in some capacity.

The far-reaching impact of these programs cannot be measured currently, as many of the programs are in their infancy or not even part of a well-defined curriculum. Additionally, the outcomes may be difficult to analyze on a state-by-state level later, as in most cases the curriculum design is left to the school district itself rather than a widespread adoption at the state level for implementation.

As such, the emphasis of this research paper is to provide additional support and data for legislators, academics, program designers, and subject matter experts to implement initial programs for consideration. This research study is divided into a brief literature review covering financial wellness impacting society as a whole and the different influences impacting financial knowledge and confidence. Next, we discuss the methodology of our study. The results of our study will be documented, and finally, areas of future research will be analyzed.

### Financial Literacy and Societal Wellness

Numerous studies have been conducted over the past 20 years, with an increase in attention occurring after the great recession. The studies have confirmed that students living in states that require financial education as a component of their curriculum for graduation experience a higher rate of savings, fewer late payments on credit accounts, and a healthier amount of financial risk compared to their peers in states not requiring financial literacy (Gutter, 2010).

Similarly, empirical studies have confirmed that both young adults and grown adults who have participated in a structured financial literacy course are less likely to be unbanked; still a serious component in U.S. society (FDIC,

2019). The report indicated that over 7 million households still had no bank account (checking account, savings account, or passbook account) as of 2019. Over 29% of those responding as unbanked suggested that not having sufficient savings to meet the minimum required balance to open an account was a reason, and 16% of those who were unbanked indicated that they simply didn't trust banks. Finally, the study also reflected that regardless of income, the use of non-traditional lending sources (payday loans, title loans, pawn shops, or income tax refund) were much more prevalent among less educated, minority, and working-age disabled households than other segments of the population (FDIC).

The pandemic of 2020-2021 seems to have exacerbated those disparities, according to studies conducted by the Federal Reserve. For instance, less than two-thirds of Black and Hispanic adults were doing okay financially, compared with 80 percent of White adults and 84 percent of Asian adults. The gap in financial well-being between White adults and Black and Hispanic adults grew by 4 percentage points since 2017. Similarly, 43% percent of adults rated their local economic conditions as "good" or "excellent" in 2020, markedly lower than the 63% percent of adults who had a positive assessment of their local economic conditions in 2019 (Federal Reserve, 2021).

Reflecting these perceptions, U.S. household debt grew by $1 trillion in 2021, despite the majority of American consumers receiving one or more type of stimulus checks. Credit card balances increased by $52 billion the last quarter of 2021, perhaps reflecting consumers running out of savings from pandemic stimulus funds and an ever-increasing cost of living, which has been at its' highest points since 1982 (Cox, 2022). A report conducted by Bankrate.com indicated that 56% of Americans would be unable to cover an expense of $1000, and 25% of the respondents would not be able to cover a $500 emergency without going into debt (Bennett, 2022).

With the Federal Reserve already increasing rates twice this year and an expectation that several more increases will occur, the cost of credit will increase as well; ultimately reducing consumer savings accounts as a result. Approximately 42 million Americans have indicated that they will likely miss at least one credit card payment in the next 12 months, resulting in lower credit scores, higher interest rates, and increasing fees (Kiernan, 2022).

The trends point toward an ever-widening gap in wages between different demographics, and as such, a deeper burden on US taxpayers moving forward. Currently, Black and Hispanic Americans have the highest combined poverty rate of 36.5% (19.5% for Blacks and 17% for Hispanics) while White Americans are the lowest with 8.2% (US Census Bureau, 2021). Prior to the pandemic, nearly 22% of all US families depended at least one form of public assistance such as SNAP, Housing Assistance, or Supplemental Social Security (Irving, 2015). This has resulted in billions of dollars annually in subsidies to assist working families.

An unintended outcome of financial stress is health-related issues such as obesity, anxiety, nervousness, eating disorders, insomnia, and even substance abuse (Cambridge Credit Counseling Corporation, 2017). These inherent issues are ultimately paid for as a society through increased health care costs, public policy initiatives, and added expenditures to all members of a community.

"The biggest contributing factor to finances," however, according to Tania Brown, a CFP from Atlanta, "is behavior. If you make shifts in spending habits, it will help you save" (Bennett, 2022).

**Student Confidence and Decision Making**

The behaviors Brown references find their roots in behavioral finance and decision-making, which entered academic studies in the mid-1980s when Richard Thaler, Amos Tversky, and Daniel Kahneman started poking holes in efficient market theories that permeated academic literature for centuries. In particular, an empirical study was conducted that asked participants to provide a 90% confidence level for particular situations and scenarios. In over 50% of the time, respondents were inaccurate with their estimate, suggesting that their perceived confidence was misaligned (Kahneman, 2011). Utilizing this as a platform, overconfidence has been studied in various capacities since then with similar outcomes which support the notion that it is now considered the "mother of all biases" (Moore, 2018). Moore further supports this with a study in which 93% of American drivers believe they are better than the median driver – a statistical impossibility.

This emphasis on confidence is warranted according to a study conducted from 2017-2019. The study empirically tested graduating seniors at a private four-year college through voluntary participation in personal finance seminars

over a six-week period. Pre-test financial literacy surveys compared to post-test financial literacy surveys, along with confidence surveys conducted both pre- and post-test, indicated that students participating in the personal finance seminars scored significantly higher than their pre-test score and also felt more confident, while the control group of students who did not participate in the seminars did not experience significant improvements in scores; yet their self-assessed confidence also increased without merit (Handy, 2021).

A study conducted on adults echoes these results as well. An analysis of consumer confidence in their financial knowledge revealed that overconfident individuals with low financial knowledge fared no better than under confident individuals as it relates to retirement preparedness (Angrisani, 2019).
There are many studies supporting these findings as it relates to financial literacy. For instance, overconfidence in one's knowledge of finance actually results in those undergraduate students carrying higher credit card balances and not paying them off monthly (Peach, 2017).

The analysis of objective knowledge and subjective knowledge is one of importance for both academicians and practitioners, as confidence can have either positive or negative effects for consumers and society as a whole. One such study confirmed similar findings which suggests that as financial knowledge increases, overall financial confidence increases and thus, financial satisfaction, occurs when consumers utilize credit accounts (Atlas, 2019).

To help young adults 'see' the impact of their financial decisions, a study was conducted that utilized age-progression software as students answered questions related to their confidence levels on financial topics. As community college students saw avatars of themselves progressing into older aged avatars, their interest in participating in financial literacy also increased (Sims, 2020).

Gielan found that financial optimists were more likely to experience better financial health and engage in more positive financial behaviors than pessimists (Gielan, 2019).

Improved financial literacy, and ultimately improved financial decision-making, will lead many consumers to feel better about themselves and also experience better overall health (Xiao, 2015). This should lead to lower health-related issues for society to contend with, in addition to improved retirement savings, lower credit card burdens, and enhanced saving patterns for those participating in financial literacy programs.

The primary influence from parents and family, however, cannot be understated. Financial socialization is a term that means "the process of acquiring and developing values, attitudes, standards, norms, knowledge, and behaviors that contribute to financial viability and individual well-being" (Danes, 1994). The far-reaching impact of a parent's knowledge and attitude about financial matters has a lifetime effect on their children, whether the knowledge is passed on directly or indirectly (Gudmunson, 2011).

Further studies analyze the impact of financial socialization on investing, bank selection, and savings. Explicit financial socialization by parents has been verified to have the biggest impact on how their child conducts themselves financially during their own lifetime (Jorgensen, 2010). Furthermore, explicit financial socialization is related to increased financial responsibility (Kim, 2019), financial confidence, and increased savings (Jorgensen).

Implicit financial socialization also impacts how a student learns and ultimately reacts to financial decision-making. One study quantified that parents who possessed lower levels of financial literacy lacked the proper information and skills to model positive financial behaviors to their children (Sherradden, 2010).

**Methodology**

We conducted our study over a one-year period encompassing two academic semesters. This study included students who were enrolled in business studies at a four-year public university in southwestern Pennsylvania, as well as business students enrolled in a two-year community college in southwestern Pennsylvania. They were asked to anonymously complete a 20-question survey related to financial attitudes, demographics, and the FINRA Investor literacy exam, which is only five questions. Students participating in the study were not compensated financially to complete the survey, although if a certain percentage of the entire class completed the quiz, several bonus points were provided to all students. A copy of the survey can be found in Appendix 1 at the end of this study.

A second survey was provided that was administered in a similar fashion. This survey was related to banking characteristics and decision-making, as well as desired financial products and services that the students could elect. That survey is also included as Appendix 2.

As a result of our study, 279 students participated in both face-to-face classrooms (5) and 100% online classes taught asynchronously (5) between the spring of 2021 and the fall of 2021.

Upon completion of a financial literacy component embedded in the business courses, as well as a managerial finance class, the FINRA test was administered again. Analysis was conducted using Welch's t-test for unequal variances to measure overall score improvements, as well as question-specific improvements. The formula for Welch's t-test is below:

$$t = \frac{m_{a-} m_b}{\sqrt{\frac{s_a^2}{n_a} + \frac{s_b^2}{n_b}}} \quad (1)$$

## DESCRIPTIVE STATISTICS

The majority of these respondents were male (152 – 54%) which also reflects the general population trends across higher education currently; and approximately 75% of the participants were between the ages of 18-22 years old. Confirming national averages for the unbanked population, 11 of the participants in our survey did not have any checking or savings account which is 4% - slightly lower than the national average of 5.6%. At the community college level, 71% of the students had one or more parent that was a college graduate and at the four-year university, 62% identified one or more parent as being a college graduate. Over half (54%) of all respondents currently reside in a town that is between 2,500 – 50,000 residents. A large majority, 250 out of 279 attended public school and only 45 total respondents indicated that their school district required them to participate in a financial literacy course. Finally, an overwhelming number of the respondents (75%) worked part-time in high school and felt very confident in their personal finance skills (71% of the community college students and 80% of all four-year university respondents). According to Insidehighered.com, this is approximately twice as high as the average college student, which is about 42%. This might be attributed to the survey population, which was business students who may have been exposed to some basic finance concepts already.

Respondents were also asked about their banking habits, along with their likes and dislikes. An overwhelming number of respondents (94%) currently utilize one or more mobile banking services offered by their bank, yet only 6% of them chose a bank based upon the mobile features offered by the bank. Instead, over half of the students chose to bank where their parents' bank and about a third chose a bank that was close to home. Contradictory to their selection due to physical location, 40% of the students banked exclusively online and 55% haven't visited their bank in person in the past 12-months. Consistent with this trend, 78% of the respondents pay all of their bills online and about 42% have an online trading account such as Acorns, Mint, or something else. Finally, three quarters of the students indicated that they did not budget monthly but would like to take a class that taught them how to budget properly.

## SURVEY RESULTS PRE-FINANCIAL LITERACY CURRICULUM

We segmented the questions so that they were identically worded to match the FINRA 5-question test for financial literacy assessment purposes.

Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account?

Respondents were provided a) more than $102 b) exactly $102 c) less than $102 and d) I don't know

65% of the community college students answered this correctly
84% of the four-year university students answered this correctly

Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?

Students were provided the chance to answer a) more than today b) exactly the same c) less than today d) I don't know

57% of the community college students answered this correctly
51% of the four-year university students answered this correctly

If interest rates rise, what will typically happen to bond prices? Rise, fall, stay the same, or is there no relationship?

The choices were a) rise b) fall c) stay the same d) there is no relationship

32% of the community college students answered this correctly
49% of the four-year university students answered this correctly

A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage but the total interest over the life of the loan will be less.

This was simply a True or False question

76% of both groups of students answered this correctly

Buying a single company's stock usually provides a safer return than a stock mutual fund.
Students were provided the choice of either True or False

56% of the community college students answered this correctly
51% of the four-year university students answered this correctly

Upon review of the responses, a few interesting points stand out.

First, the students performed about the same as the general U.S. population in general, which is about 3 out of 5 correct answers.

Next, it is apparent that both groups of students struggle with the concepts of inflation, interest rates, and portfolio diversification. Most notably, the relationship between bond prices and bond yields challenges the majority of all students. This may be because bonds are not typically covered in any general business class, and in most cases, not introduced until a managerial or corporate finance course is required in the curriculum.

All of the students seemed to struggle with the concept of portfolio diversification as well, achieving just above 50% on a True/False question. This suggests that while they might be familiar with the stock market in general, they do not understand the critical thinking that accompanies reducing risk through adding new assets. It is interesting to note that the community college students actually scored higher on this question, albeit slightly at 56% accuracy versus 51% accuracy from 4-year university students. Given it is a True/False question, however, that might be merely the result of better guessing with a 50/50 chance of guessing correctly.

Finally, inflation is clearly a topic the students are not at all familiar with given the low percentage of correct responses. Again, the community college students scored slightly higher, with a 57% accuracy compared to a 51% accuracy for the 4-year university respondents. This may reflect a student population that is more familiar with the value of a dollar, thus their initial choice to attend the community college. Regardless, it is a safe assumption that based upon the average age of all respondents, none of them have experienced inflation in the true sense, with 11 of the last 30 years having 2% annual inflation or less, and all but five years at 3% or less.

## POST-FINANCIAL LITERACY SURVEY RESULTS

Overall, the students had an average score of 3.81 out of 5 before taking a financial literacy component to the course, which was higher than the overall U.S. population. Additionally, the standard deviation for the pre-course quiz was 19. Upon completing a financial literacy component contained in the course, the average overall score increased to 4.08 with a standard deviation of 16.

However, and most notably, scores for the two most frequently missed questions, both of which were multiple choice, yielded interesting improvements and result. For instance, the third question, "If interest rates rise, what will typically happen to bond prices?" revealed a statistically significant improvement by respondents, moving from 45% accurate prior to taking the financial literacy curriculum to 66% accuracy by all respondents, resulting in a p-value of .04.

The second most frequently missed question during the pre-test, "Imagine that the interest rate on your savings account was 1% per year and inflation was 2%per year. After 1 year, how much would you be able to buy with the money in this account?" also experienced much greater student success after going through the financial literacy curriculum. Pre-test results indicated that about 52% of the combined students taking the exam successfully answered the question. Post-financial literacy training, however, witnessed students getting the question correct 71% of the time with a standard deviation of 41.5. This resulted in a p-value of .03.

Both groups of students improved on the True or False questions (2 total), which would be expected given only one of two outcomes.

## FUTURE RESEARCH

The results from our pre-test/post-test assessments suggest that financial literacy courses can have an impact on a student's fundamental knowledge of core consumer finance topics. These topics are relevant not just to businesses, but employers, families, and society in general; leading to better-informed decisions by those receiving specialized instruction. There were a few limitations to our study, however, that suggest additional research is necessary.

First, due to the environment of assessment being contained to a business classroom, the students may show a preconceived interest in the topics being assessed. This could lead to both improved initial responses as well as better post-test results. As such, a more inclusive environment for pre/post-post class assessment could be administered. Perhaps it could be included the curriculum as part of a general education course, freshmen level introduction course coupled with pre-graduation class, or administered through the financial aid office.

The results would also be interesting to analyze based upon self-identified gender, as well as selected major and/or minor course of study. This would align with other studies related to perceived knowledge versus actual knowledge, as well as confidence comparisons between men and women.

Comparison of results based upon ethnicity is yet another avenue of exploration. While it was considered initially as part of this assessment, it was ultimately rejected due to a number of political factors occurring at the time that might have had more students opt out of answering, or perhaps self-reporting demographics that were false. This would have led to erroneous data.

Finally, a deeper understanding of student banking habits could be explored to find out if their perception of banking choices changed after taking a financial literacy class. For instance, once a student was familiar with interest rates and mobile banking technology, they could be asked if they were more likely to change banks than before taking the course.

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# STUDENT RESPONSE SYSTEMS TECHNOLOGY AND STUDENT ENGAGEMENT IN LARGE CLASS TEACHING

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## ABSTRACT

We examine how and why Student Response Systems (SRSs) influence students' academic and social engagement in a large classroom setting, and in turn, influence learning outcomes. We conducted a field study of 143 students and used partial least square structural equation modeling (PLS-SEM) to analyze our data. We found that students' perception of SRSs is positively related to their academic engagement (i.e., class participation) and to their social engagement (i.e., interaction with peers and teacher). In addition, student class participation, peer interaction, and teacher interaction influence achieving learning outcomes of knowledge and communication skills.

## INTRODUCTION

In higher education, large classes are used by many business schools to compensate for shrinking resources, such as staffing or funding issues (Cullen, 2011). There are many challenges in teaching large classes including delivering high-quality and equitable learning opportunities (Maringe & Sing, 2014). Another challenge is student engagement in large classes (Hedgcock & Rouwenhorst, 2014). Today's undergraduate students are digital learners and less tolerant of impassive learning environments, and so they expect more interactivity in the learning process (Daher & Lazarevic, 2014). The logistics of engaging individual students, however, limit the interaction between students and teachers in large classes (Wood & Shirazi, 2020).

According to theory of game-based learning, computer technology can be used to enhance student engagement and learning (Wouters, et al., 2013). And one type of technology is Student Response Systems (SRSs). Some of the recognized SRS brands include iClicker, Poll Everywhere, Kahoot, and Socrative. Also known as audience response systems, SRSs are recognized as valuable technologies for enhancing student engagement and achieving learning outcomes in higher education (Wood & Shirazi, 2020). For example, Owen and Licorish (2020) found that the use of Kahoot increases students' learning and knowledge retention of lecture content. SRSs allow teachers in large classes to efficiently create interactive learning environments. They allow students to infuse their responses into traditional lecture settings via an electronic device. Some allow students to respond using their mobile devices. The effects of SRSs are recognized by teachers and students across the disciplines (Herrada, Banos, & Alcayde, 2020). However, in the existing SRS literature, there is little theory-based research that investigates the underlying mechanism regarding why and how SRSs engage students in learning (Florenthal, 2019). Existing SRS literature using technology acceptance model (TAM) or uses and gratifications (U&G) theory does not contain social factors to examine how SRSs influence students' social engagement in their learning process (e.g., Florenthal, 2019; Rana & Dwivedi, 2016).

In a study of university e-learning environments, Kim, Hong, and Song (2019) found that student engagement can be increased using innovative technologies to connect students, instructors, and the course content to facilitate academic success. In addition, Carini, Kuh, and Klein (2006) found a positive relationship between engagement and learning outcomes. According to Kuh et al. (2008), student engagement represents both the time and energy students invest in educationally purposeful activities and the effort institutions devote to using effective educational practices" (2008, p. 542). Many scholars view student engagement as a meta-construct that includes different types of engagement, such as academic and social (Coates, 2007; Krause & Coates 2008). Mehdinezhad (2011) refers to student engagement as students' engagement in activities that contribute to their learning achievement and their sense of belonging to the academic community. Finn, Pannozzo, and Achilles (2003) developed a theoretical framework that can be used to explain the relationship between student engagement and their classroom learning processes. According to Demaris and Kritsonis, "The classroom is the central point of the higher educational structure; the social and academic integration which occurs therein is a major feature in the learning experience" (2008, p. 2).

The objective of this research is to understand why and how SRSs influence students' engagement in the learning process, and in turn, influence learning outcomes in a large class. This study uses the theories of classroom student engagement and game-based learning to investigate the relationships between student response systems and student engagement (both academic and social). A better understanding of these relationships will not only extend the SRS

research but also provide practical suggestions on how to use SRSs effectively to enhance engagement and learning in large class teaching. We begin with a review of literature on challenges in large class teaching, theory of classroom student engagement, game-based learning, and SRS systems.

## LITERATURE REVIEW

### Challenges in Large Class Teaching

In higher education, class size varies greatly across institutions and disciplines. As institutions of higher education face pressure to limit increases in tuition price, many institutions consider increasing class size (Ake-Little, von der Embse, & Dawson, 2020). Although there is no accepted definition of a large class (Wang & Calvano, 2021), Mateo and Fernandez (1996) categorized a large class as one with 60 to 149 students. Some business schools consider sections of 200 to 350 students to be large (Raimondo, Esposito, & Gershenberg, 1990).

Class size affects how a classroom functions (Weaver & Qi, 2005). Many scholars argue that large classes negatively impact student learning processes (Blatchford, Russell, & Brown, 2009). One negative impact of large class size is lower class participation. Large classes permit students' greater anonymity and enable students to seat themselves in the periphery of the classroom allowing them to have a passive role in the classroom (Weaver & Qi, 2005). Students may hide themselves in a large class and this may affect how students interact with other students and their instructor (Ehrenberg et al., 2001). Additionally, according to Blatchford et al. (2009), in large classes teachers are less attentive to individual students than teachers in small classes. In their empirical study, Bai and Chang (2016) found lower classmate supportiveness, student preparedness, and class participation in larger classes compared to smaller classes.

### Theory of Classroom Student Engagement

In their research on the relationship between class size and student behavior, Finn and colleagues (2003) identified two types of engagement, academic and social. They argue "that students become more engaged academically and more engaged socially when class sizes are reduced, and this increased engagement in the classroom is a compelling explanation for increased learning in all subject areas" (Finn et al., 2003, p. 322).

#### *Academic Engagement*

Finn and colleagues define *academic engagement* as "student behaviors related directly to the learning process" (Finn et al., 2003, p. 323). Examples of academic engagement are "time on task, attentiveness, participation in learning activities, and effort and initiative taking in the classroom" (p. 323). Fredricks, Blumenfeld, and Paris (2004) addressed a related term, *student behavioral engagement* and defined it as students' involvement in learning and academic tasks. Examples of behavioral engagement include effort, persistence, concentration, attention, asking questions, and contributing to class discussion. The last two are related to participation. Weaver and Qi (2005) describe class participation as students' remarks or questions *directed* toward the instructor within the confines of the classroom, and Fassinger (1995) defines it as students' comments made or questions raised in class.

#### *Social Engagement*

Finn and colleagues defined *social engagement* as "the nature of students' interactions with the teacher or with fellow students" (2003, p. 323). Bai and Chang (2016) described classroom interaction as a two-way process both between faculty and students, and among classmates in the classroom.

Finn and colleagues (2003) argued that both academic and social engagement have consistent, strong correlations with academic performance. These are the processes that contribute to learning in the classroom. When a student is not engaged in learning, she or he is less likely to acquire the material presented in the class (Finn et al., 2003).

### Theory of Game-Based Learning And Student Response Systems (SRS)

The use of computer games for the purpose of learning and instruction is widespread and often referred to as game-based learning (Wouters et al., 2013). Using computer games as inspiration, Malone (1981) developed a theory of intrinsically motivating instruction based on three categories, challenge, fantasy, and curiosity. He argues that when game-like activities on computers offer interactive, challenging, competitive, or timely feedback, these activities

provide a source to design intrinsically motivating instructional environments, in which students are highly motivated and learn better.

Through mobile or laptop devices and availability of Wi-Fi, SRSs appeal to all students with equal opportunities, combining both a cooperative fast-paced learning environment and friendly competition (Kapp, 2012). SRSs (e.g., Kahoot, Poll Everywhere) have similar characteristics to computer games and are regarded as game-based learning technologies (e.g., Paz, 2017; Plump & LaRosa, 2017). For example, Plump and LaRosa (2017) suggest teachers may use Kahoot! to create game-based quizzes or discussions to increase engagement learning. SRSs technologies add positive energy and add fun to the classroom. Owen and Licorish (2020) found that the use of a game-like SRS, Kahoot! positively influenced students' attention and focus, engagement, interaction, learning and knowledge retention, as well as fun and enjoyment. Importantly, Owen and Licorish found that after using Kahoot! students reported that "they were able to compare their answers and performance to the classmates, which prompted positive social interactions through discussion and boosted individual students' confidence" (2020, p. 537). Additionally, Wouters et al. (2013) in their meta-analysis of 190 game-based learning studies found that students with game-based activities learned more, compared to those taught with conventional instruction methods. These studies suggest that the use of SRS technology as an antecedent of student engagement and learning outcomes.

Instructors in large classes can increase classroom participation (i.e., academic engagement) and interaction (i.e., social engagement) by using technology. Undergraduate students today are digital learners and tech savvy. SRSs are becoming a dominant technology used in higher education to enhance learning and teaching (Herrada et al., 2020). SRSs are software/hardware devices that allow teachers to create more interactive and engaging classroom environments by asking students questions (Florenthal, 2019). SRSs can be used to ask students questions, and students can use their mobile devices to answer questions to participate. Students can respond individually in real time using their desktops, laptops, or smartphones (Rana & Dwivedi, 2016). Most importantly, responses are collated and can be displayed immediately in charts or graphs (Herrada et al., 2020). With the advanced technologies, SRSs may not only offer a variety of questions, such multiple-choice or open-ended questions, but also allow students to share different types of collated responses, such as choices, comments, or images.

## RESEARCH HYPOTHESES

Figure 1 displays the conceptual model and research hypotheses in this study. It is based on the Finn et al. (2003) framework in which learning behavior (both academic and social engagement) influences academic achievement. According to the literature of game-based learning, the use of SRS system offers interactive, challenging, competitive, or timely feedback activities to increase student engagement in learning process. As students are more engaged, they may learn better. In this paper, we add student perception of SRS, and we examine academic engagement, and two forms of social engagement to the Finn et al. (2003) framework.

According to Florenthal (2019), students are motivated to use technologies more often during the class time because of ease of use. Rana and Dwivdei (2016) used the Technology Acceptance Model (TAM) to examine SRS user behavior in a large class. They found that students' perceptions of ease of use and usefulness of clickers, a type of SRS, positively influenced the students' use behaviors. They also found a positive relationship between ease of use of SRS technology and behavioral intention. When a student finds the SRS easy to operate and use, they may be more likely to use it. Similarly, when a student thinks the SRS is a useful tool to improve their learning, they are more likely to use it.

Heaslip, Donovan, and Cullen, (2014) found that in large classes, the use of a SRS increases student engagement. As noted above, one form of engagement is participation (Finn et al., 2003). Therefore, we believe that if a student's perception of usefulness and usability of SRS technology is positive, they will increase their class participation.

*H1: A student's positive perception of SRS technology may increase the level of class participation.*

A classroom includes both students and the teacher. Students can learn from their teacher as well as from their classmates. Classmates play a crucial role in classroom interaction (Fassinger, 1995). Students can learn by comparing their responses to the responses of others (King, 2016), and from discussing or solving problems together (Bai & Chang, 2016).

SRSs may facilitate learning from interaction with classmates. SRS provides the opportunity for students to compare results, discuss, and problem solve (Plump & LaRosa, 2017). Hoekstra (2008) suggests that SRSs may make the learning environment more cooperative as students may help each other by evaluating each other's reasoning. SRSs can strengthen the cooperation. In addition, the Internet allows SRSs to display students' responses immediately and collectively (Herrada et al., 2020). Some SRSs offer features to present the results in a variety of visual formats, such as graphs or charts in real time, allowing students to review all responses of fellow students, their peers, quickly, and then learn from their responses. The immediate display of collective responses allows students to compare their responses to others, which facilitates learning (King, 2016). Thus, we believe that if students' perception of the usefulness and usability of SRS technology is positive, students will increase their level of interaction with peers. Hence, it follows:

*H2: A student's positive perception of SRS technology may enhance the level of peer interaction.*

A second form of social engagement, in addition to peer interaction, is the interaction between students and teachers (Finn et al., 2003). To be successful, students must be actively engaged in the learning process (Wood & Shirazi, 2020) and interaction with teachers is a form of engagement. Teachers often drive the student and teacher interaction. Teachers ask students questions to create an engaging learning environment and answering questions is a form of participation. SRSs allow teachers to create different types of questions (Herrada et al., 2020), such as multiple-choice, open-ended, brain storming, etc. A variety types of questions can be used via PowerPoint slides, on mobile apps, or on the web, and accessed by all students in the class. Regardless of class size, SRSs offer a means for all students to have an opportunity to transmit their individual answers to the teacher's questions in real time. Most modern SRSs are cloud-based tools. Students' answers can be collected, collated, and displayed in real-time via the web allowing the teacher and students in large classes to review all students' answers immediately (Audience Response). Based on the collated responses, the teacher can assess where students have problems in the learning process, and then, offer immediate feedback on student responses, including explanations and feedback on problems (Wood & Shirazi, 2020). Thus, we believe that if a student's perception of the usefulness and usability of SRS technology is positive, they will increase their level of interaction with their teacher. Hence, it follows:

*H3: A student's positive perception of SRS technology may enhance the level of teacher interaction.*

According to Finn et al. (2003), student academic engagement (i.e., class participation) and social engagement (i.e., peer interaction and teacher interaction) are related to student academic performance and learning. In education, we use learning outcomes to assess students' academic performance and learning. Maher (2004) argued that student academic achievement is directly related to meeting learning outcomes.

Watson wrote that learning outcomes are achieved when changes occur "within a person as a result of a learning experience" (2002: 208). Maher argued that learning outcomes "enhance the educational process" (2004, p. 53), that learning outcomes "offer a means by which attention can be focused on the actual achievements of students" (2004, p. 47).

Watson argued that what and how of learning are closely associated, i.e., "what students learn is closely associated with how they go about learning it" (2002:209). Because students learn through academic and social engagement (Finn et al., 2003), we anticipate that student academic engagement (i.e., class participation) and social engagement (i.e., peer interaction and teacher interaction) may be related to meeting learning outcomes. According to the Association to Advance Collegiate Schools of Business (AACSB), learning outcomes should reflect broad educational expectations for each degree program. Business knowledge and communication skills are two broad educational expectations that are used by the business school in which this study was conducted. Accordingly, we believe that student academic engagement (i.e., class participation) and social engagement (i.e., peer interaction and teacher interaction) in the classroom should influence meeting the learning outcomes of business knowledge and communication skills. Hence, it follows:

*H4: A student's learning outcome of knowledge is influenced by their (a) level of class participation, (b) level of peer interaction, and (c) level of teacher interaction.*

*H5: A student's learning outcome of communication skills is influenced by their (a) level of class participation, (b) level of peer interaction, and (c) level of teacher interaction.*

## METHODOLOGY

This study was conducted in the business school of a US public university. Participants were students from a large Principles of Marketing course, an introductory marketing course. While enrollment in most classes in this business school have 25 to 40 students, this class had 180 students. It is considered to be a large class (Mateo & Fernandez, 1996). The instructor in this large class used the Poll Everywhere SRS each week during one semester. At the end of the semester, the students in the class were invited by the instructor to take an online anonymous survey voluntarily for extra credit. A total of 143 students participated in the survey, which is an overall response rate of 79%.

The model consists of six constructs, which are listed in Table 1. There is one exogenous variable and five endogenous variables. The exogenous variable is Student Perception of SRS, labeled as SRS perception. It was adapted from Rana and Dwivedi (2016) and measured using two questions that address ease of use and usefulness. The questions used to measure SRS perception are listed in Table 1.

There are five endogenous variables. The first three were measures adapted from Bai and Chang (2016). They are Class participation, Peer interaction, and Teacher interaction. Class participation was measured using two questions, peer interaction was measured using two questions, and teacher interaction was measured using three questions. There are two additional endogenous variables. They are student learning outcomes (SLOs) of Knowledge and Communication. The SLOs were part of the business school's AACSB assurance of learning (AOL) process, specifically the assessment of business core courses. Knowledge was measured using three questions used to assess business knowledge, and communication skills was measured using two questions used to assess communication skills. The questions are listed in Table 1. In this business school's assessment of business core courses, the answers to the questions used seven-point scales.

## RESULTS

We used structural equation modeling (SEM) to study the relationship between a student's perception of SRSs and their academic engagement (class participation) and social engagement (peer interaction and teacher interaction), as well as the relationship between engagement (academic engagement and social engagement) and student learning outcomes (business knowledge and communication skills). In this study, we used the partial least square structural equation modeling analysis (PLS-SEM) to test the research hypotheses. PLS-SEM is an efficient method to use in complex structural models, with multi-item measures and small sample sizes. PLS-SEM makes no assumptions for the distribution of the data (Hair et al., 2017). SmartPLS 4 software was used to run the PLS-SEM analysis.

The measurement model's convergent validity and construct reliability were assessed using PLS Algorithm. The indicator's outer loadings exceeded the threshold value of 0.7. (See Table 2.). Cronbach's alpha and the composite reliability values of all the constructs exceeded the standard level of 0.70 as shown on Table 3. The average variance extracted (AVE) for all the constructs exceeded the lower accepted limit of 0.50. To assess discriminant validity, we used the Fornell and Larcker criterion (Fornell & Larcker, 1981) and the heterotrait-monotrait ratio of correlations (HTMT) (Hair et al., 2017). Based on Table 4, each indicator's loading on its assigned construct is higher than all of its cross-loadings with other constructs. On Table 5, HTMT confidence intervals do not include 1. All the HTMT values differed significantly from 1. The statistic results of the measurement model provided evidence of good convergent validity, construct reliability, and discriminant validity (Hair et al., 2017, p. 122). Figure 2 is the measurement model. Table 6 lists the descriptive statistics of constructs and the correlation matrix.

We ran PLS-SEM bootstrapping test to assess the significance of the hypotheses (i.e., path coefficients) shown in the Figure 1 path model. The path model was considered a good fit as the SRMR was 0.065, which is less than the suggested limit of 0.08 (Hair et al., 2017). The VIF values of all indicators were higher than 0.2 and lower than 5, which eliminates collinearity issues (Hair et al., 2017). As shown on Table 7, all path coefficients were statistically significant. Figure 3 displays the structural model.

In sum, all the hypotheses were supported. Students' perception of SRSs has a positive influence on their class participation (H1: path coefficient=0.261), peer interaction (H2: path coefficient=0.469), and teacher interaction (H3: path coefficient=0.554). Students' learning outcome of knowledge was influenced by their class participation (H4 a: path coefficient=0.188), peer interaction (H4 b: path coefficient=0.228), and teacher interaction (H4 c: path

coefficient=0.555). Student learning outcome of communication skills was influenced by their class participation (H5 a: path coefficient=0.320), peer interaction (H5 b: path coefficient=0.189), and teacher interaction (H5 c: path coefficient=0.376).

## DISCUSSION

Previous research in higher education has found that large class size is negatively related to student learning (Monk & Schmidt, 2011). One way to improve student learning in large classes is to use technology. As technology advances and the use of it proliferates, college students are becoming digital learners and less tolerant of impassive learning environments (Daher & Lazarevic, 2014). SRSs have been widely used in higher education as universities have recognized their importance in supporting and enhancing teaching and learning (Heaslip et al., 2014). Most research studies on SRSs focus primarily on educational outcomes (Wood & Shirazi, 2020). Very few studies draw on theories and explain the underlying role of SRSs in the student learning process (Florenthal, 2019). Moreover, no research has examined the relationship of SRSs, and student social engagement in the student learning process (Rana & Dwivedi, 2016). To fill the void in the existing SRS literature, this study draws on the theory of student engagement in the classroom (Finn et al., 2003) and theory of game-based learning (Wouters et al., 2013) to explain how SRSs influence students' academic engagement and social engagement in their learning process. Further, a field empirical study was conducted to test research hypotheses. Our research findings are an important contribution to the SRS literature.

Rana and Dwivedi (2016) found that ease of use and usefulness of the SRSs are key determinants for students to form a positive perception of the SRS. We found that students' perception of SRSs is positively related to their academic engagement (i.e., class participation) and to their social engagement (i.e., interaction with peers and instructor) in a large class setting. This suggests that SRSs may not only help students increase their class participation but also enhance student interaction with fellow students and their instructor in large classes. Interestingly, it seems that the positive effect of SRSs is higher for social engagement (H2: path coefficient=0.469, H3: path coefficient=0.554) than for academic engagement (H1: path coefficient=0.261).

The $R^2$ value represents the amount of explained variance of the target construct (Hair et al., 2017). The study results show the $R^2$ values of the knowledge learning outcome and the communication skills learning outcome are 0.673 and 0.505, respectively. This suggests that the combination of student class participation, peer interaction, and teacher interaction represent a good amount of explained variance for learning outcomes. Hence, it is critical for future research on student learning outcomes to include both student academic engagement and social engagement.

Regarding the knowledge learning outcome, our results indicate that a student's interaction with their instructor is the most influential factor, followed by peer interaction. For the communication skills learning outcome, a student's interaction with instructor and class participation are the two most important variables. These findings highlight the importance of social engagement in the classroom learning process. For example, teachers might consider offering more Q&A sessions, one method of engaging students socially, for students to ask questions. Additionally, Heaslip et al. (2014) found that students appreciate the anonymity afforded by SRSs in large classes. By allowing students to offer anonymous responses via SRS's key feature, instructors may encourage students to share more of their questions or comments than they would if they were required to speak in large classes.

## CONCLUSION

This study contributes a more nuanced understanding of the influences of the use of SRS technology in higher education. This is the first SRS study that draws on the theory of student engagement (Finn et al., 2003), examining both student academic and student social engagement in the classroom learning process. A classroom consists of students and a teacher. This study offers explanations of how SRSs may enhance student peer interaction, as well as interaction between student and teacher.

Based on the systematic review of SRSs by Wood and Shirazi (2020), this study is one of very few empirical studies conducted in a large classroom setting. This study uses the theory of student classroom engagement to lay a foundation for future research on SRS technology and other forms of teaching technology, such as online collaboration tools, simulation software, and apps (Paz, 2017). To study the impact of teaching technology, future research might apply the theory of Finn et al. (2003) as it contains not only student academic engagement but also student social engagement in the learning process. In addition, there are a variety of teaching delivery methods used in higher education, such as

face-to-face, online, or blended (Holland & Holland, 2014). This study provides theory to investigate how teaching technologies in different delivery methods impact student engagement and learning outcomes.

## RECOMMENDATIONS

Large classes are a means by which universities can address shrinking resources. In traditional learning settings, large classes involve difficult logistics of engaging with individual students, and so faculty may find teaching large classes to be very challenging. Based on the results of this study, we suggest that SRSs are an effective tool to support and enhance large class teaching. With SRSs, instructors in large classes can increase student engagement and enhance the student learning process. To improve student engagement and learning outcomes, the study results suggest that colleges and universities would benefit from investing in SRSs in large classes. Thus, we recommend that institutions of higher education consider investing in SRSs and offering training to help faculty use SRSs in teaching in large classes. Using SRSs requires that students have access to a laptop or mobile device. This study used Poll Everywhere, an SRS that allows students to use cellphones, smartphones, or laptops as response devices. Many students used mobile devices in this field study. According to PEW Research (April 2021), 100% of Americans who are 18-29 years own cellphones, and 96% have smartphones. Colleges and universities would be wise to consider the SRS-mobile device interface when evaluating different SRSs.

The results of this study offer several teaching suggestions for faculty to effectively use an SRS in large class teaching. First, it is advantageous for the instructor, early in the semester, to help their students use the SRS and to understand the usefulness of an SRS in the learning process. For example, it would be helpful for the instructor to introduce the SRS in the first class and let students practice many times until they master using the SRS. Also, it would be helpful if the instructor would help students understand that their SRS responses will benefit the instructor in assessing the students' learning and in identifying areas for improvement. Second, to increase peer interaction, it is advantageous for the instructor to display students' collated responses in the classroom. This provides students with opportunities to review their classmates' responses and to compare their answers to their classmates' answers. Students may also learn from mistakes of their classmates. This process may make the learning environment more cooperative and socially engaging. Third, based on the collated responses, it would be advantageous for the instructor to offer feedback immediately to correct the wrong responses or reinforce the right answers. The teacher should pay close attention to address any wrong responses. A wrong response indicates that the student does not fully understand the material. Offering feedback is especially important in a large class because some students find it intimidating to raise their hand to ask questions. While students have opportunities to ask questions via SRSs, the teacher should quickly engage with students by offering feedback.

## LIMITATIONS AND FUTURE RESEARCH

This study was conducted in a large introductory Marketing course using Poll Everywhere SRS. The study results may not be generalized to advanced courses. Bloom's Taxonomy identifies six levels of cognitive learning. Some advanced courses may require higher level of learning outcomes, such as comprehension, application, or synthesis. Future research should investigate how to use SRSs to help students achieve different levels of learning outcomes in non-business disciplines. Also, because the use of technology may vary by age group (Olson et al., 2011), future research may also extend the current study to different student age groups. Since the start of the COVID pandemic, Drea (2021) notes that there have been tremendous changes in course delivery modality in higher education. Future research may also investigate how SRSs impact student academic and social engagement in a virtual classroom or in non-traditional settings.

Due to the nature of course, the instructor mainly used multiple choice questions and the learning outcomes focused on knowledge and communication skills. Many SRSs offer a variety of question types that allow instructors to create more engaging methods. Future research might include a variety of types of questions. In addition, questions that address other learning outcomes and/or a larger number of learning outcomes would be informative. Finally, future research may also study how to design SRSs, the impact of SRSs on student engagement, and the impact of SRSs on learning outcomes.

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Table 1. Measure Constructs, Indicators, And Questions/Statements

| Measure construct | Indicator | Questions/Statement |
|---|---|---|
| Knowledge | Know1 | I have a better understanding of business concepts as a result of taking this class. |
| | Know2 | The course material in this class will be useful to me in the future. |
| | Know3 | This class helped me gain practical knowledge about the business world. |
| Communication | Comm1 | This class improved my ability to communicate my ideas. |
| | Comm2 | I feel more confident expressing my ideas as a result of this class. |
| Participation | Part1 | I shared my thoughts in class discussions. |
| | Part2 | I participated in discussions easily. |
| Peer Interaction | Peer1 | I encouraged and supported other students in this class. |
| | Peer2 | I cooperated with other students in this class. |
| Teacher Interaction | Teacher1 | The teacher wanted me to ask questions in this class. |
| | Teacher2 | The teacher encouraged me to offer my opinions on the text in this class. |
| | Teacher3 | The teacher encouraged me to make a further exploration on the issues (think critically) in this class. |
| SRS Perception | Tech1 | It was very easy to use Poll Everywhere technology. |
| | Tech2 | I think Poll Everywhere technology was a useful tool for my learning. |

Table 2. Outer Loadings For Construct Reliability

| Indicator | Construct | | | | | |
|---|---|---|---|---|---|---|
| | Knowledge | Communication | Participation | Peer Interaction | Teacher Interaction | SRS Perception |
| Know 1 | 0.894 | | | | | |
| Know 2 | 0.858 | | | | | |
| Know 3 | 0.883 | | | | | |
| Comm1 | | 0.930 | | | | |
| Comm2 | | 0.919 | | | | |
| Part1 | | | 0.926 | | | |
| Part2 | | | 0.944 | | | |
| Peer1 | | | | 0.880 | | |
| Peer2 | | | | 0.885 | | |
| Teacher1 | | | | | 0.838 | |
| Teacher2 | | | | | 0.861 | |
| Teacher3 | | | | | 0.886 | |
| Tech1 | | | | | | 0.924 |
| Tech2 | | | | | | 0.922 |

Table 3. Construct Reliability

| | Cronbach's Alpha | Composite Reliability | Average Variance Extracted (AVE) |
|---|---|---|---|
| Communication | 0.83 | 0.921 | 0.854 |
| Knowledge | 0.852 | 0.91 | 0.771 |
| Participation | 0.857 | 0.933 | 0.874 |
| Peer Interaction | 0.716 | 0.876 | 0.779 |
| Teacher Interaction | 0.827 | 0.897 | 0.743 |
| SRS Perception | 0.826 | 0.92 | 0.852 |

Table 4. Fornell And Larcker Criterion

| | Communication | Knowledge | Participation | Peer Interaction | Teacher Interaction | Technology |
|---|---|---|---|---|---|---|
| Communication | 0.924 | | | | | |
| Knowledge | 0.701 | 0.878 | | | | |
| Participation | 0.525 | 0.476 | 0.935 | | | |
| Peer Interaction | 0.535 | 0.656 | 0.29 | 0.883 | | |
| Teacher Interaction | 0.629 | 0.783 | 0.395 | 0.677 | 0.862 | |
| Technology | 0.373 | 0.579 | 0.261 | 0.47 | 0.554 | 0.923 |

Table . Confidence Intervals For HTMT

| | Original Sample (O) | Sample Mean (M) | Bias | 2.50% | 97.50% |
|---|---|---|---|---|---|
| Participation -> Communication | 0.322 | 0.320 | -0.002 | 0.180 | 0.452 |
| Participation -> Knowledge | 0.191 | 0.188 | -0.003 | 0.080 | 0.314 |
| Peer Interaction -> Communication | 0.187 | 0.189 | 0.002 | 0.004 | 0.383 |
| Peer Interaction -> Knowledge | 0.224 | 0.228 | 0.004 | 0.066 | 0.383 |
| Teacher Interaction -> Communication | 0.375 | 0.376 | 0.001 | 0.181 | 0.559 |
| Teacher Interaction -> Knowledge | 0.556 | 0.555 | -0.001 | 0.394 | 0.686 |
| SRS Perception-> Participation | 0.261 | 0.261 | 0 | 0.098 | 0.411 |
| SRS Perception -> Peer Interaction | 0.470 | 0.469 | -0.001 | 0.267 | 0.625 |
| SRS Perception-> Teacher Interaction | 0.554 | 0.554 | 0 | 0.350 | 0.709 |

Table 6

Descriptive Statistics And Correlation Matrix

| Construct | Mean | Standard Deviation | Communication | Knowledge | Participation | Peer Interaction | Teacher Interaction | SRS Perception |
|---|---|---|---|---|---|---|---|---|
| Communication | 4.93 | 1.59 | 1 | | | | | |
| Knowledge | 5.58 | 1.50 | 0.701 | 1 | | | | |
| Participation | 4.26 | 1.82 | 0.525 | 0.476 | 1 | | | |
| Peer Interaction | 5.48 | 1.56 | 0.535 | 0.656 | 0.29 | 1 | | |
| Teacher Interaction | 5.45 | 1.60 | 0.629 | 0.783 | 0.395 | 0.677 | 1 | |
| SRS Perception | 5.73 | 1.74 | 0.373 | 0.579 | 0.261 | 0.47 | 0.554 | 1 |

Table 7

PLS-SEM Path Coefficients

| Path | Mean (M) | Standard Deviation (STDEV) | T Statistics (\|O/STDEV\|) | P Values |
|---|---|---|---|---|
| H1: SRS Perception-> Participation | 0.261 | 0.081 | 3.236 | 0.00* |
| H2: SRS Perception -> Peer Interaction | 0.469 | 0.090 | 5.223 | 0.00* |
| H3: SRS Perception -> Teacher Interaction | 0.554 | 0.091 | 6.105 | 0.00* |
| H4a:Participation -> Knowledge | 0.188 | 0.060 | 3.167 | 0.00* |
| H4b:Peer Interaction -> Knowledge | 0.228 | 0.081 | 2.757 | 0.00* |
| H4c:Teacher Interaction -> Knowledge | 0.555 | 0.074 | 7.524 | 0.00* |
| H5a:Participation -> Communication | 0.320 | 0.070 | 4.612 | 0.00* |
| H5b:Peer Interaction -> Communication | 0.189 | 0.097 | 1.924 | 0.05** |
| H5c:Teacher Interaction -> Communication | 0.376 | 0.097 | 3.879 | 0.00* |

Note: * significant at level of 0.01; ** significant at level of 0.05

Figure 1. Research Model

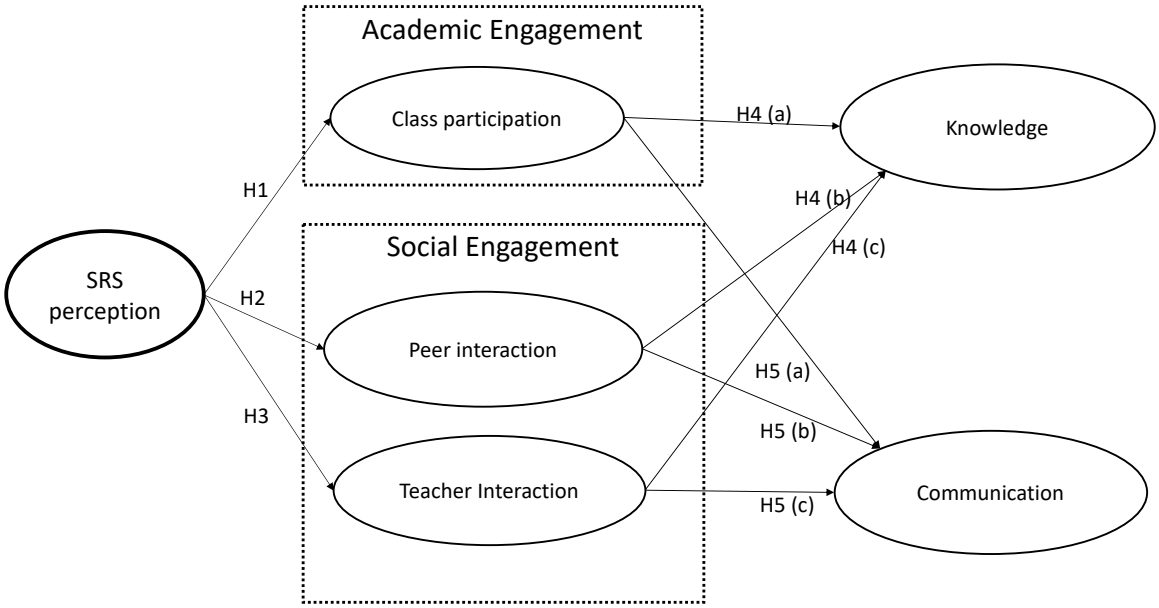


Figure 2. Measurement Model

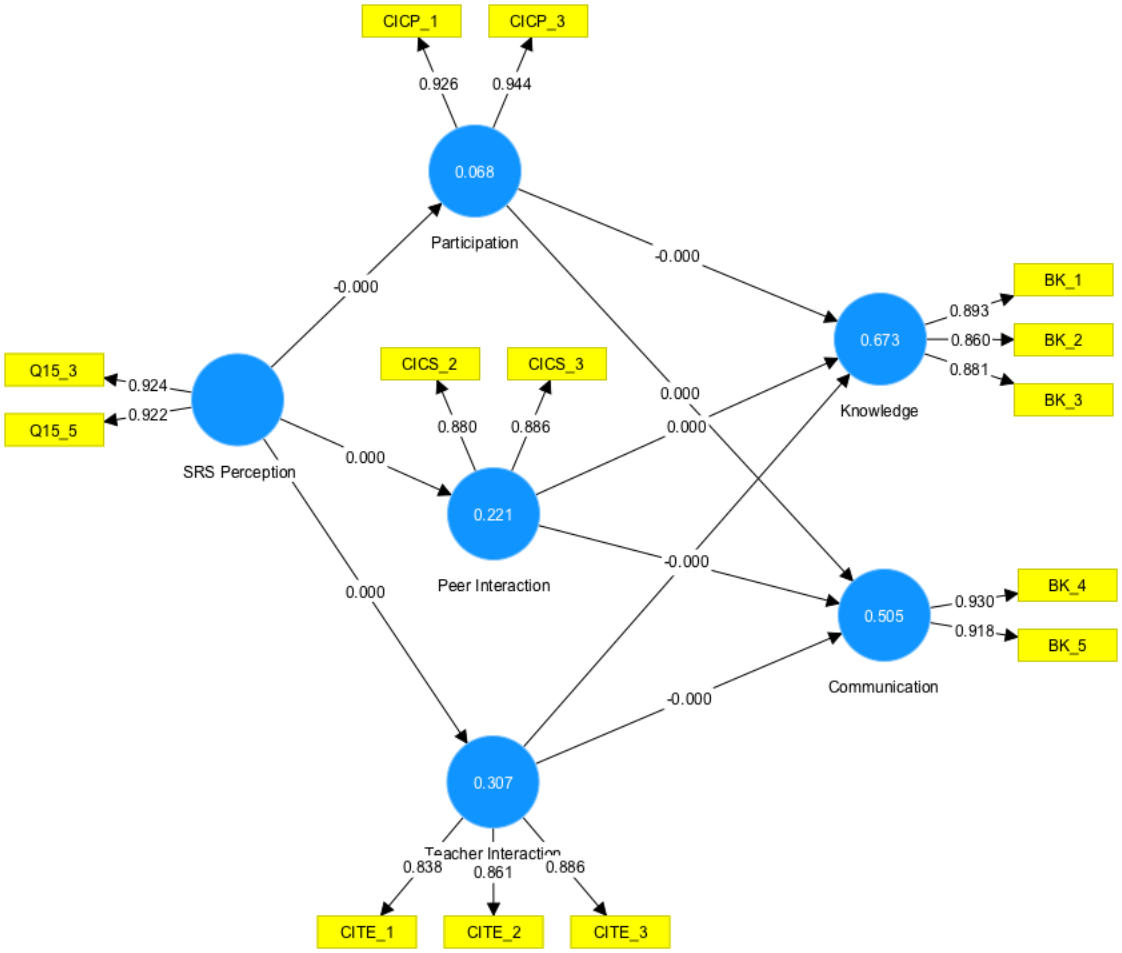
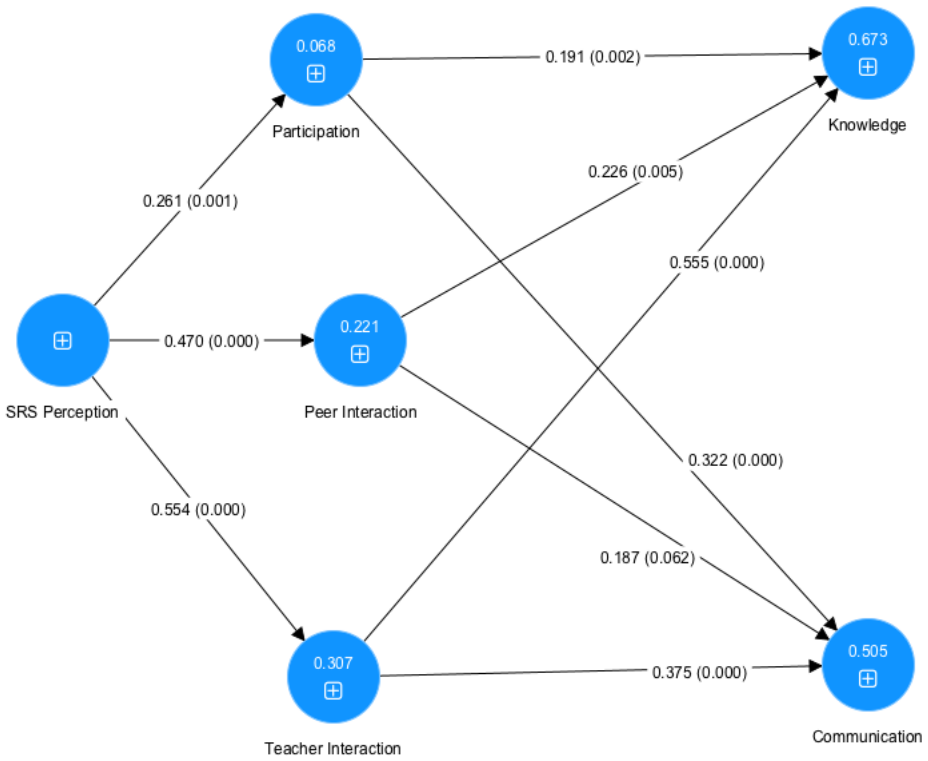


Figure 3. Structural Model



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