ISSN: 2790-1386

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International Journal of Cryptocurrency Research

Publisher's Home Page: https://www.svedbergopen.com/

Research Paper

Open Access

Relationship between the Pricing and Trading of Cryptocurrencies and the Collectible, Metaverse, and Art Non-Fungible Token Subcategories

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Article Info

Volume 4, Issue 2, December 2024
Received : 19 August 2024
Accepted : 21 November 2024
Published : 09 December 2024
doi: 10.51483/IJCCR.4.2.2024.12-66

Abstract

This paper aims to apply Vector Error Correction Model (VECM) to the prices and trading volume of Bitcoin and Ethereum, as they affect the non-fungible token subcategories of Collectibles, Metaverse and Art. The findings reveal that an accurate lag structure helps in capturing the lagged effects of shocks allowing the model to represent the intricate interdependencies among Bitcoin, Ethereum and the non-fungible token subcategories as indicated in the Impulse Response Function and Volatility Graph. This assists traders and investors visualize how these events and sudden increases in volatility impact the stability of cryptocurrency prices over time.

Keywords: *Vector error correction model, Cryptocurrency, NFT, NFT ecosystem, Tokenomics integration*

1. Introduction

Non-Fungible Tokens (NFTs) are a type of cryptocurrency (Fairfield, 2021) that differ from other, more well-known cryptocurrencies, such as Bitcoin. These are individually unique and are, therefore, scarce. This research will compare the relationship between the price movement and volume of trades between two of the biggest cryptocurrencies in terms of market capitalisation: Bitcoin and Ethereum, and the NFT subcategories of Collectibles, Metaverse Land, and Art.

Bitcoin has been chosen as it has the largest market capitalisation of all cryptocurrencies and is by far the most widely recognised. Ethereum has been chosen as it is currently the most common currency used to purchase NFTs. This research relates to three previous studies (inter alia, Dowling, 2022b) but addresses gaps that remain to be explored. Dowling (2022a) conducted the first study on NFT pricing, examining the price

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efficiency and movement of the value of one specific type of NFT: LAND, which is digital real estate in the online metaverse world of Decentraland. Dowling's subsequent study (2022b) investigated whether specific NFT prices are driven by Bitcoin and Ethereum. Ante (2021) built upon Dowling's studies, contributing to the second one by analysing whether the prices of Bitcoin (Pb) and Ethereum (Pe) affect the pricing of two other specific NFTs in the then-newly explored subcategories of games and collectibles. This study aims to act as a third contributor and fill a gap by examining whether the pricing of Bitcoin and Ethereum affects the NFT subcategories of Collectibles, Metaverse Land, and Art.

Examining the subcategories of NFTs allows for a greater number of completed sales per day, which hopefully leads to a less volatile and more accurate depiction of the average price of these NFT subcategories per day, based on a seven-day rolling average compared to examining just one example. As per this rationale, we attempted to address the questions: a) Is there a relationship between the daily pricing of Bitcoin and Ethereum and the subcategories of Collectibles, Metaverse Land, and Art subcategories of NFTs? and b) How volatile are the prices in Bitcoin, Ethereum, and the NFT subcategories of Collectibles, Metaverse Land, and Art?

1.1. Nonfungible Token (NFT)

Dowling (2022b) defines nonfungible tokens as unique blockchain-based digital assets. They have distinct digital identities that separate them from Bitcoin and Ethereum. Yousaf *et al.* (2023) and Dowling (2022b) list films, artworks, games, virtual properties, and music as assets. Popular digital currencies include Bored Ape Yacht (BAYC) and Crypto Punch. However, Bitcoin and other cryptocurrencies are hard to convert into money. Wang *et al.* (2021) suggest using NFTs to prove ownership of digital assets including art, souvenirs, event tickets, and real estate. Ethereum's ability to speed NFT and smart contract generation and distribution makes it popular for this. Successful NFT and P2P marketplaces may pay authors royalties. The idea is that NFTs have numerous helpful qualities that may be used to solve IP protection problems. Blockchain technology improves marketability, security, and transaction history availability.

Blockchains underpin NFTs and cryptocurrencies, guaranteeing data integrity but limiting throughput, according to NFT Tech (2022). Since cryptocurrencies are the default money for NFT transactions, their price patterns show this interconnection. NFTs are exchanged in cryptocurrency exchanges but mostly serve as digital assets, holding value, enabling transactions, and functioning as units of account. Dowling (2022b) emphasises fungibility in cryptocurrencies against NFTs. NFTs have a larger scarcity premium than limited-supply coins due to their non-fungibility.

1.2. Digital Art NFTs

Using NFTs to prove digital ownership is innovative and safe. This adds security to ownership claims, boosting trustworthiness. Before NFTs, there were no decentralised ways to quickly and definitively authenticate digital artwork ownership. These images (JPEGs) are readily downloaded and screenshotted, reducing their usefulness. Individuals and organisations find it difficult to claim exclusive ownership. NFTs solve this by adding scarcity to digital art. They allow people to own the original artwork like a painting. Mike Winkelmann, a noted digital artist, has sold his work in NFTs. He is known as 'Beeple' online, and since May 1, 2007, he has created daily digital artworks (Lyubchenko, 2022). He earned great success with "Everyday—The First 5,000 Days" and interestingly, this artwork sold for $69.3 million (Kugler, 2021).

1.3. Land NFTs

Recently, online virtual worlds have included NFT-based land sales. The most popular metaverses are Decentraland and The Sandbox. Decentraland lets users buy and sell 16-by-16-metre virtual plots of land (Ordano *et al.*, 2017). Dowling (2022b) reports 90,601 plots, 43,689 of which are private. NFTs enable land sales, which are securely recorded on the blockchain via Ethereum smart contracts. Publicly available contracts enable interested parties to observe trade specifics. In addition, many of Decentraland's virtual LAND applications may create money and be considered commercial opportunities. One may organise live musical concerts like DeadMau5, create e-commerce platforms to sell items, or curate NFT-only art exhibits. MANA, a digital currency with a market worth of $5 billion as of February 2022, is used to buy "LAND". According to

Playtoearn (2022) and Cryptonewsz (2022), "LAND" costs at least 12,000 US Dollars, or "8,800 Great British Pounds."

1.4. Relationship between Cryptocurrency and NFT Prices

Due to their recent development, NFTs have received little academic attention. Dowling (2022a) explored how cryptocurrencies affect NFT pricing, offering insight on a key component of this burgeoning sector. Bhattarai *et al.* (2020) also found that cryptocurrencies affect NFT pricing. Dowling's (2022b) and Bhattarai *et al.* (2020) studies emphasise that NFTs' functioning depends on blockchain technology, particularly Solana and Ethereum.

Cryptocurrencies are volatile and lack trustworthy information, making them dangerous investments (Makarov and Scholar, 2020; Corbet *et al.*, 2021; Scharnowski *et al.*, 2023). Herding, when investors follow others rather than making autonomous judgements, may enhance market volatility and explosiveness, which are related with market instability (Yao *et al.*, 2014; Bouri *et al.*, 2019a). To understand the correlation between cryptocurrencies and NFT pricing, Yousaf and Yarovaya (2022) suggested studying herding behaviour during cryptocurrency bubble periods, specifically from mid-2020 to mid-2021. Galariotis *et al.* (2015) propose that NFTs, particularly in decentralised finance (DeFi) sectors, herd more due to investors adopting a collective mindset and following investment trends, resulting in a lack of rational asset analysis.

However, time-varying and static anti-herding phenomena in NFTs show better efficiency than cryptocurrencies and DeFi systems. This assertion agrees with Yousaf and Yarovaya (2022), Corbet *et al.* (2020a, 2020b and 2021). These investigations found weak linkages that show NFTs are a different asset class from other cryptocurrencies.

Many market forecast experts expect NFTs to boost music rights, debt, and real estate trading. Recent research describes NFTs and cryptocurrencies as a parent-child connection. NFT price dynamics were strongly tied to bitcoin market movements and trends in its early phases. De Simone (2022) and Bolz (2022) reported a $5 billion turnover in January 2022 via OpenSea NFT trading. Bitcoin fell and caused other cryptocurrencies to follow, showing an inverse link between the NFT and cryptocurrency markets. Thompson (2022) noted movement synchronisation during the Russia-Ukraine War, which lowered cryptocurrency and NFT prices. Gailey (2022) also found that the Russian invasion of Ukraine generated geopolitical uncertainty and volatility in global financial markets, including the cryptocurrency market. Thus, bitcoin specialists have connected the incursion to market price movements.

Moratis (2021) examined bitcoin traders and NFTs. The analysis found Bitcoin to be the main driver of cryptocurrency volatility shock transmission. In a similar research, Qiao *et al.* (2020) examined trading crossover and its effect on cryptocurrency and NFT returns. This study tries to find linkages between these marketplaces to help market analysts understand cryptocurrency price trends. Dowling's (2022a) study found low volatility transmission between cryptocurrencies and NFTs, contrary to original predictions. The above results support Khuntia and Pattanayak (2018), who argue that minimal correlation between variables is key to conceptualising pricing patterns in underdeveloped countries.

Dowling (2022), building on previous research, found lower residual effects in and from NFTs than in cryptocurrencies. These data suggest that the two marketplaces vary enough to warrant independent examination and analysis (Yousaf and Yarovaya, 2022). NFTs and Defi assets exhibit limited association with traditional asset classes when compared to other chosen markets' static return and volatility spillovers. In today's financial landscape, emerging digital assets' independence from conventional financial instruments is important. This theory holds that cryptocurrency prices drive the NFT market.

1.5. Market Efficiency of NFTs and Cryptocurrency

In recent years, NFT and cryptocurrency markets have garnered attention for their efficacy. Umar *et al.* (2022) discovered that NFT marketplaces had about 25% mispricing, far greater than regular financial markets. Market efficiency is greater for Bitcoin, which has 10% mispricing. Note that the NFT ecosystem's Collectible subcategory has higher inefficiencies, typically surpassing 30%, whereas Metaverse and Art subcategories average 20% (Pinto-Gutiérrez *et al.*, 2022). These results highlight the need for more study into the complex relationship between NFTs, cryptocurrencies, and their subclasses, specifically the causes of price variations and their effects.

Umar *et al.* (2022) compared NFT returns to five major asset classes. SWC was used to analyse the study's outcomes. The findings showed that NFTs might reduce Covid-19 pandemic risks. Yousaf *et al.* (2023) claim that tokens and other assets are more interrelated during chaotic periods like Covid-19. Dowling (2022a) also found similar results in their March 2013–2018 examination of NFTs and cryptocurrency marketplaces. NFTs and cryptocurrencies have different prices, but Dowling noted that sentiment and uncertainty affect their worth. These variables affect market dynamics and inefficiency.

Dowling's (2022b) research examined inefficient pricing and the rising value of virtual real estate (LAND) in the Decentral blockchain market. The research worried that such price tendencies might cause market manipulation, fraud, and immaturity. Fraud in the bitcoin market is rare, but it may damage market efficiency and confidence. Pinto-Gutiérrez *et al.* (2022) examined NFT price from 2017 to 2021 and found that Bitcoin's recent weekly returns affected NFT demand and pricing. The research used wavelet coherence analysis to examine investor interest in NFTs due to rising cryptocurrency prices from 2021. This shows NFTs' rising popularity among investors and their connection to cryptocurrency markets.

2. Materials and Methods

This study fills a gap in the literature by investigating if Bitcoin (B) and Ethereum (E) price influences the non-fungible token subcategories of Collectibles (C), Metaverse (M), and Art (A). Answers will be provided using vector autoregressive (VAR) or vector error correction models (VECM). This research aims to re-estimate an ideal lag structure related to the Impulse Response Function and Volatility Graph to study stock price dynamics in reaction to shocks or occurrences. These topics are neglected in relevant literature.

Initially, it was planned to run VECM or VAR models by incorporating pricing and trading volume or quantity variables [of Bitcoin (B) and Ethereum (E) affects the non-fungible token subcategories of Collectibles (C), Metaverse (M) and Art (A)] as theorised by the law of demand and supply (Deaton and Muellbauer, 1980; Browning, 2005). However, since some price and trading volume or quantity variables have different stationarity properties, it is not effective to perform VECM or VAR models with variables that have different properties, such as I(0), I(1) and I(2). In the context of time series analysis and stationarity, the terms I(0), I(1), and I(2) refer to different orders of integrated processes. These concepts are associated with the order of differencing required to achieve stationarity in a time series (Pesaran and Shin, 1999; Pesaran *et al.*, 2001).

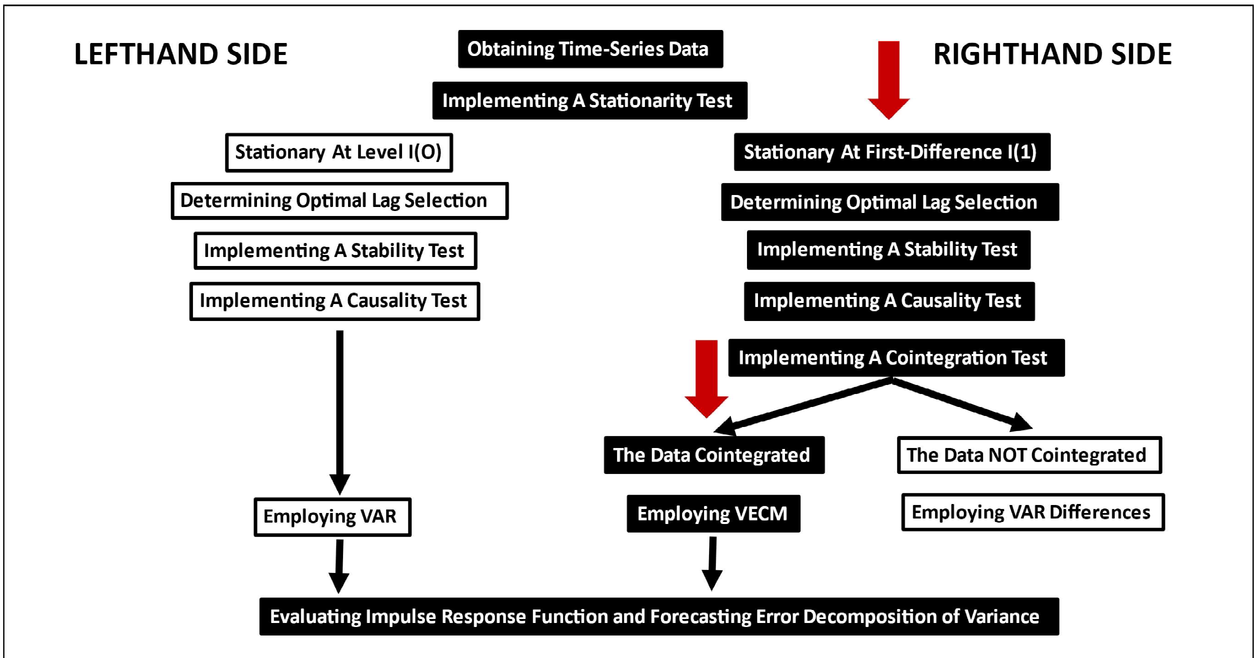

Figure 1: The Methodological Flow Chart

Although this research initially aims at examining further whether the prices (P) and trading volume or quantity (Q) of Bitcoin (B) and Ethereum (E) affect the non-fungible token subcategories of collectibles (C), Metaverse Land M) and Art (A) by using VAR or VECM, VECM was finally selected as the strategic direction as indicated in the following methodological flow chart—the righthand side (Figure 1).

In the first stage, the time-series data will be examined to determine the stationary property of the data, whether the data is stationary at levels [I(0)] or stationary at first differences [I(1)] or or stationary at second differences [I(2)]. Accordingly, to examine the stationarity of the data, a unit root test can be implemented.

- If the data is stationary at levels or I(0), VAR autoregression can be implemented to follow Step 1 (the lefthand side – Figure 1) by executing diagnostic statistics such as the lag-length tests, the stability tests and the Granger causality tests.
- On the contrary, if the data is stationary at first-difference operations or I(1), VECM can be implemented if the variables are cointegrated in the long run (the righthand side).
- Alternatively, VAR difference models (the righthand side – Figure 1) can also be executed if the variables are not cointegrated.

The cointegration tests, such as the Engle-Granger, the Johansen, and the Phillips-Ouliaris tests, and other tests can be executed to find a possible equilibrium relationship between time series processes in the long term. This cointegration concept of long-run equilibrium relationship was discovered by the Nobel laureates Engle and Granger (1987). Lastly, to evaluate the robustness of the model and trace the effect of the model on the economy, the Impulse Response Functions (IRF) and the Forecast Error Variance Decompositions can be calculated. Both measures are valuable in assessing how shocks to the time-series variables penetrate and resonate through a domestic economy, which is helpful for facilitating economic stabilization policies. Therefore, a couple of hypotheses are proposed to examine data stationarity property as follows:

- Null hypothesis (Ho): The time series has a unit root, or the series is non-stationary (trend).
- Alternative hypothesis (Ha): The time series does not have a unit root, or the series is stationary (no trend).

Following the above hypotheses, several assumptions were tested. The first test was a random-walk regression; the second test was a random-walk-with-drift regression; the third test was a random-walk-with-drift around a deterministic-trend regression. The tests were done algebraically as follows:

- The first test: $\Delta Y_t = \delta Y_{t-1} + \mu_t$
- The second test: $\Delta Y_t = \alpha + \delta Y_{t-1} + \mu_t$
- The third test: $\Delta Y_t = \alpha + \beta T + \delta Y_{t-1} + \mu_t$

Where Δ stands for a first difference operator, subscript *t* for time variable, *t* for trend variable, *Y* for natural logarithmic variables, α and β for parameter coefficients and μ for error terms.

2.1. D+ata Collection

The research project will run from March 1, 2020, to March 1, 2022. Due to the quick growth of the non-fungible token market in recent years, two years was selected instead of longer. Bloomberg will track Bitcoin and Ethereum prices, while coinmarketcap.com will track transaction volume. Data on the seven-day rolling daily average pricing and completed sales volume of collector, metaverse land, and art non-fungible token subcategories will be collected on nonfungible.com. All data will be collected between March 1, 2020, and March 1, 2022.

3. Results

Following the research methodology section, the findings of the unit root tests were produced in Table 1 below.

Following the above unit root tests (the Augmented Dickey-Fuller test), compared to other variables, it is concluded that the time-series variable Pc possesses different stationarity properties, as illustrated in Table 1 and Figure 2 below.

Table 1: The Unit Root Tests

Variables*	Exogenous: Constant		Exogeneous: Constant, Linear Trend		Exogeneous: None	
Bitcoin (B)	Level	1st diff. ***	Level	1st diff.	Level	1st diff.
Price (P)	0.6359	0.0000	0.8088	0.0000	0.7240	0.0000
Ethereum (E)						
Price (P)	0.6965	0.0000	0.3959	0.0000	0.6816	0.0000
Collectibles C)						
Price (P)	0.0320	0.0000	0.0340	0.0000	0.0316	0.0000
Metaverse (M)						
Price (P)	0.7046	0.0000	0.6676	0.0000	0.4732	0.0000
Art (A)						
Price (P)	0.2718	0.0000	0.2439	0.0000	0.1606	0.0000

Note: The Augmented Dickey-Fuller Test**.

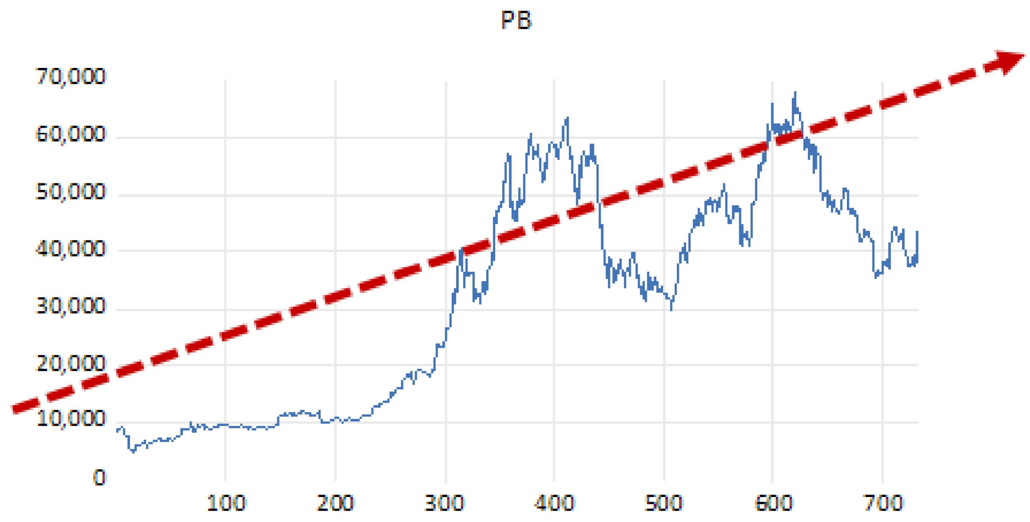

Figure 2: Stationarity Properties of the Time-Series Variables [Pb I(1)]

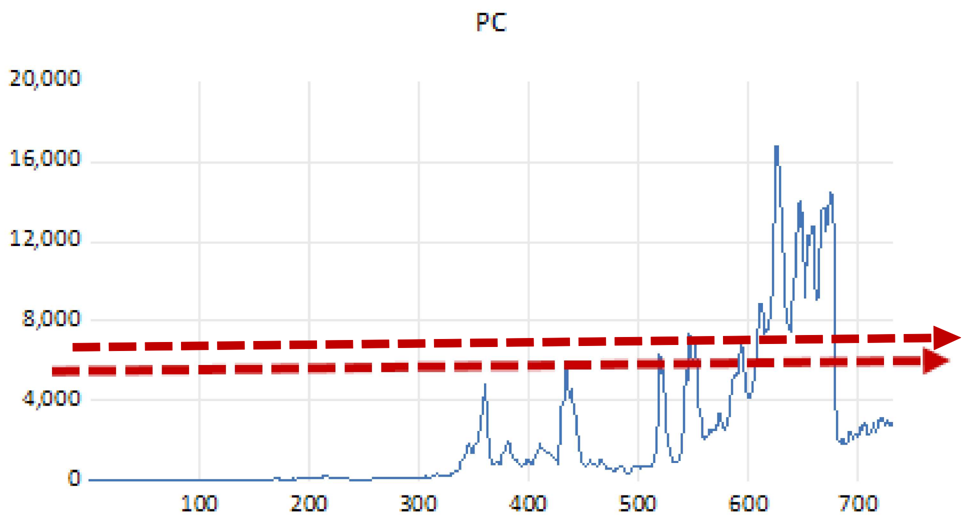

Figure 3: Stationarity Properties of the Time-Series Variables [Pc I(0)]

The initial examination showed that the time-series variables had a unit root, however they were not stationary until the first-differences operations (Table 1). After empirical investigation of data stationary property, the final VECM does not contain non-fungible token subcategories of collectible price (Pc) variables due to various property or stationarity levels. According to some studies (Pesaran *et al.*, 2001; Hikmet, 2021), a cointegration procedure can be applied to a mixture of stationarity variables, but since stationary-level variables generate their level vector and first-difference or second-difference variables generate their first-difference vector, long-run equilibrium relationships are unrealistic. Mixed variables with various stationary qualities make economic interpretation challenging, apart from mathematical concerns. Others (Baltagi, 2011; Shrestha and Bhatta, 2018) suggest that cointegration with mixed stationary characteristics is unproductive. These arguments serve as a reasoned justification for employing merely the price variables of B, E, M and A (without variable Pc) in forming VECM or a cointegrated VAR model, which consists of a VAR model of the order p - 1 on the differences of the variables, and an error-correction parameter.

As the previous analyses indicate that the price variables of Bitcoin, Ethereum, Metaverse Land and Art are stationary in first differences or I(1), the next stage was to find an optimal lag length. The literature (inter alia, Baltagi, 2011; Wooldridge, 2019) indicates that the number of lags in VECM is usually relatively small at one or two lags. Economic theory may also guide lag length choosing. In contrast, the literature considers lag duration an empirical problem (not a theoretical one) and leaves the choice to researchers or analysts. These small lags are used to avoid losing degrees of freedom. For quarterly data, one to eight delays are typical, whereas monthly data with appropriate data sets uses 12 to 24. Based on forecasting parameters like AIC, SIC, HQ, and FPE, VAR's optimum lag is the one with the lowest value. Table 2 shows that the Schwarz information criteria (219.9935) and the Hannan-Quinn information criterion (219.4619) imply that two period lags are best after numerous runs.

After Table 2, the two-period lags are realistic since the literature (Baltagi, 2011; Stock and Watson, 2019) recommends minimising multiple lags using VECM to minimise multicollinearity and losing a degree of freedom. As shown in the literature (Lütkepohl, 2006), the predicted VECM is stable and stationary since all roots have a modulus smaller than one (Table 3) and are within the unit circle (Figure 3). Roots calculations are crucial because VECM is not stable or stationary if the roots are bigger than one, invalidating impulse response standard errors (to trace time-series penetration to the economy).

Table 2: VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria						
Endogenous variables: PA PB PE PM						
Exogenous variables: C						
Date: 06/29/23 Time: 08:51						
Sample: 1 731						
Included observations: 723						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-88081.91	NA	9.30e+95	243.6789	243.7296	243.6984
1	-79580.25	16791.67	6.79e+85	220.3382	220.7946	220.5143
2	-79064.96	1006.338	1.95e+85	219.0898	219.9520*	219.4226*
3	-78961.05	200.6364	1.75e+85	218.9794	220.2473	219.4688
4	-78857.47	197.7003	1.56e+85	218.8699	220.5435	219.5159
5	-78795.24	117.4002	1.57e+85	218.8748	220.9541	219.6774
6	-78708.88	161.0265	1.48e+85	218.8129	221.2980	219.7721
7	-78639.69	127.4614	1.46e+85	218.7986	221.6894	219.9144

Note: *indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level). FPE: Final prediction error. AIC: Akaike information criterion. SC: Schwarz information criterion. HQ: Hannan-Quinn information criterion.

Table 3: The Roots of Characteristic Polynomial

Root	Modulus
Roots of Characteristic Polynomial	
Endogenous variables: PA PB PE PM	
Exogenous variables: C	
Lag specification: 1 2	
Date: 06/28/23 Time: 18:27	
Root	Modulus
0.994608 - 0.007201i	0.994634
0.994608 + 0.007201i	0.994634
0.960975 - 0.012129i	0.961051
0.960975 + 0.012129i	0.961051
0.913878	0.913878
0.808251 - 0.091442i	0.813407
0.808251 + 0.091442i	0.813407
0.664744 - 0.032548i	0.665541
0.664744 + 0.032548i	0.665541
0.453987 - 0.044439i	0.456156
0.453987 + 0.044439i	0.456156
- 0.280971	0.280971
0.244023	0.244023
- 0.157166	0.157166
0.000783 - 0.080017i	0.080021
0.000783 + 0.080017i	0.080021
No root lies outside the unit circle.	
VAR satisfies the stability condition.	

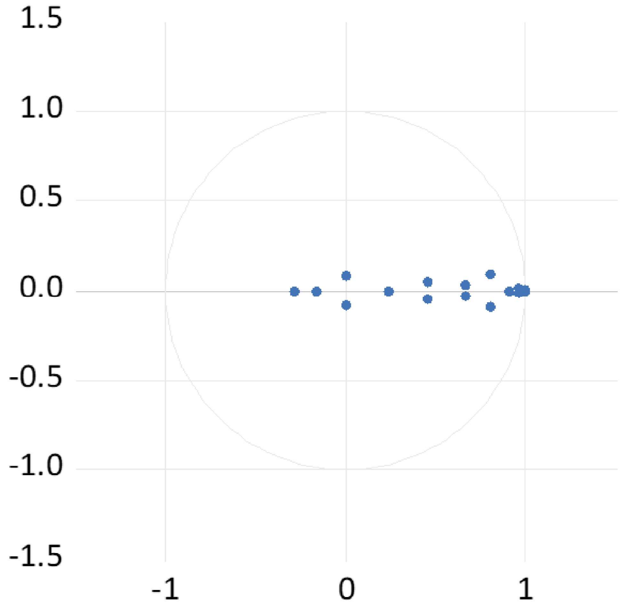

Figure 4: Inverse Roots of AR Characteristic Polynomial

The price variables (Pa, Pb, Pe and Pm) were found to be cointegrated [I(1)], and a Vector Error Correction Model (VECM) was implemented to examine the short-run and long-run dynamics of the time series. Pc was not included because Pc has a different stationarity property. Variables with similar stationarity properties can be examined by using VECM (Baltagi, 2011; Wooldridge, 2019). However, mixed variables with different stationarity properties can be examined by Pesaran's test and employing autoregressive distributed lag (ARDL) models (Pesaran and Shin, 1999; Pesaran *et al.*, 2001) estimated using the ordinary least square method.

Accordingly, following unit root and non-stationarity tests, as well as cointegration tests, the price of collectibles (Pc) and the trade volume (of Bitcoin and Ethereum to the volume of completed sales and trades of the Collectible, Metaverse, and Art NFT subcategories) cannot be examined in a vector error correction model (VECM) because they possess mixed stationarity properties of I(0), I(1), and I(2). However, this can be estimated inferiorly using an auto regressive distributed lag (ARDL) model without a long-run equilibrium relationship. In addition, although both VECM and an ARDL model can be used to analyse time-series models, VECM is superior because it can capture the dynamic equilibrium interrelationships among multiple cointegrated time-series variables (Shrestha and Bhatta, 2018). Accordingly, this research employs VECM to achieve forecasting accuracy and cryptocurrency long run analysis. Since the interest of this research is to analyse long-run equilibrium relationships among the pricing variables and short-run deviations from those equilibrium paths, the research question three was cancelled so that VECM can be estimated accordingly. The VECM includes pricing variables that share a similar stationarity property, specifically I(1), or are integrated into order one as a prerequisite for running VECM.

Accordingly, theoretical VECM for cointegrated series can be stated in the equation below:

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{n} \beta_i \Delta Y_{t-i} + \sum_{i=0}^{n} \delta_i \Delta X_{t-i} + \varphi Z_{t-1} + \mu_t$$

where Z stands for Error Correction Term (ECT), other variables and parameters have been defined in the previous pages, which is the residual from the following long-run cointegrating regressions below.

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t$$

$$z_{t-1} = ECT_{t-1} = y_{t-1} - \beta_0 - \beta_1 x_{t-1}$$

By applying the above models to the data, the equation below is the estimated VECM with Pa as a target variable (Refer to Appendix 1 for detailed statistical performance). Pa is the price of the non-fungible token subcategories of Art (A).

$$\Delta Pa_t = -0.061418 ECT_{t-1} + 0.196450 \Delta Pa_{t-1} + 0.180304 \Delta Pa_{t-2} + 0.006255 \Delta Pb_{t-1} - 0.009809 \Delta Pb_{t-2}$$

$$-0.009809 \Delta Pe_{t-1} + 0.081918 \Delta Pe_{t-2} + 0.083008 \Delta Pm_{t-1} - 0.045696 \Delta Pm_{t-2} + 0.232126$$

While the equation below is the cointegrating or long-run model of VECM (Refer also to Appendix 1).

$$ECT_{t-1} = 1.0000 Pa_{t-1} + 0.011576 Pb_{t-1} - 1.657014 Pe_{t-1} + 0.056627 Pm_{t-1} + 335.4578$$

From the above equation, the error correction term (ECT) coefficient (φ) is also known as the speed of adjustment, which measures the rate at which Y returns to equilibrium after a change in X. This ECT coefficients should be between -1 and 0, with the negative sign indicating correction (Baltagi, 2011). Thus, -0.061418 was the pace of adjustment towards long-run equilibrium. A t value of -5.706948 is extremely significant. The coefficient meets the economic theory requirement for a statistically significant and negative φ(phi) as variables move towards long-run equilibrium. The model does not converge in the long run due to data, instability, or model misspecification if the error correction is positive. Thus, each period corrects -0.061418 or 6.14% of long-run equilibrium disturbance (Appendix 1).

Appendix 1 indicates that the VECM consists of two equations: the long-run (cointegrating) equation with associated coefficients and the short-run equations with associated equations. Then the p values and t statistics can be estimated accordingly. In the short run, any change in the previous year's cryptocurrency price of the non-fungible token subcategories of and Art (Pa) will affect Pa in the next following year so that:

- When Pa_{t-1} increases by 1 unit or US dollar, *Pa* will increase by 0.196450 unit or US dollar.
- Analogously, when Pa_{t-2} increases by 1 unit, *Pa* will increase by 0.006255 unit.
- When Pa_{t-1} increases by 1 unit, *Pm* will increase by 0.058821 unit.
- When Pe_{t-1} increases by 1 unit, *Pb* will decrease by 2.323310 unit.
- When Pe_{t-1} increases by 1 unit, *Pe* will decrease by 0.147042 unit.
- When Pe_{t-2} increases by 1 unit, *Pe* will increase by 0.414582 unit.
- When Pm_{t-1} increases by 1 unit, *Pe* will increase by 0.034015 unit.
- When Pm_{t-1} increases by 1 unit, *Pm* will increase by 0.405843 unit.

In the longer run, any change in the previous year's cryptocurrency price of Ethereum (Pe_{t-1}) will affect *Pa* in the next following year. Additionally, when Pe_{t-1} increases by 1 unit, *Pe* will decrease by -1.657014 unit.

Following the above VECM analyses, the Granger causality test was employed to verify the direction of causality from a variable to another variable in order to determine which structural pattern exists among the prices of Bitcoin (*Pb*), Ethereum (*Pe*) and the non-fungible token subcategories of metaverse (*Pm*) and Art (*Pa*), accordingly the Granger causality test (Gujarati, 2011; Granger and Newbold, 1974) was employed to estimate the following regressions.

$$A = \alpha + \theta A_{-1} + \beta B_{-1} + \pi t \quad ...(1)$$

$$B = \gamma + \delta A_{-1} + \lambda B_{-1} + \phi t \quad ...(2)$$

The number of lags (k = 1 or k = 2, where k stands for period lags) is determined by a trial-and-error experimentation (Wooldridge, 2019). Accordingly, there are four possible scenarios.

1. Unidirectional causality from *B* to *A* occurs if only the estimated coefficient of B_{-1} in Equation 1 is statistically significant and the estimated coefficient A_{-1} is not significant.
2. Unidirectional causality from *A* to *B* occurs if the estimated coefficient of A_{-1} in Equation 2 is statistically significant and the estimated coefficient of B_{-1} in Equation 1 is not significant.
3. Bilateral causality or a multidirectional relationship is indicated if the estimated coefficient of B_{-1} in Equation 1 is statistically significant, and the estimated coefficient of A_{-1} in Equation 2 is statistically significant.
4. Independence is suggested when the parameter coefficient of B_{-1} and A_{-1} are not statistically significant in Equations 1 and 2.

There are three possible scenarios, namely a unidirectional, multidirectional or independent relationship between the prices of Bitcoin (*Pb*), Ethereum (*Pe*) and the non-fungible token subcategories of the Metaverse Land (*Pm*) and Art (*Pa*). As mentioned earlier, the price of the non-fungible token subcategories of Collectibles (*Pc*) was not included because *Pc* has different stationarity properties. VECM requires running variables with the same stationarity property to achieve long-run equilibrium explanations. Accordingly, the findings (Table 4) indicate the following outcomes of the Pairwise Granger Causality Tests.

- Table 4 indicates that *Pb* affects *Pa* with a *P* value smaller than 5% or 0.05 (P = 0.0142). However, *Pa* does not affect *Pb*. Hence, the relation is one-way (unidirectional causality) from *Pb* to *Pa*.
- Similarly, *Pe* affects *Pa* with a *P* value smaller than 5% or 0.05 (P = 0.0031). *Pa* does not affect *Pe* as well. Hence, the relation is one-way from *Pe* to *Pa*.
- *Pa* affects *Pm* with a *P* value smaller than 5% or 0.05 (P = 0.00004). However, *Pm* does not affect *Pa*. Hence, the relation is one-way from *Pa* to *Pm*.
- *Pe* affects *Pb* with a *P* value smaller than 5% or 0.05 (P = 0.0232). However, *Pb* also affects *Pe* with a *P* value smaller than 5% or 0.05 (P = 0.0060). Hence, the relation is two-way (multidirectional causality), simultaneously from *Pe* to *Pb* and then from *Pb* to *Pe*.

Table 4: Pairwise Granger Causality Tests

Sample: 1 731			
Lags: 1		F-Statistic	Prob.
Null Hypothesis	**Obs**		
PB does not Granger Cause PA	730	6.03639	0.0142
PA does not Granger Cause PB		0.09834	0.7539
PE does not Granger Cause PA	730	8.79078	0.0031
PA does not Granger Cause PE		0.71299	0.3987
PM does not Granger Cause PA	730	0.00409	0.9490
PA does not Granger Cause PM		17.1890	4.E-05
PE does not Granger Cause PB	730	5.17596	0.0232
PB does not Granger Cause PE		7.59675	0.0060
PM does not Granger Cause PB	730	2.95841	0.0859
PB does not Granger Cause PM		8.59793	0.0035
PM does not Granger Cause PE	730	1.08102	0.2988
PE does not Granger Cause PM		11.6716	0.0007

- *Pb* affects *Pm* with a *P* value smaller than 5% or 0.05 (*P* = 0.0035). However, *Pm* does not affect *Pb*. Hence, the relation is one-way from *Pb* to *Pm*.
- Lastly, *Pe* affects *Pm* with a *P* value smaller than 5% or 0.05 (*P* = 0.0007). However, *Pm* does not affect *Pe*. Hence, the relation is one-way from *Pe* to *Pm*. Following the Granger causality test, the causality graph is shown in Figure 5 below.

The findings (Figure 5—The Causality Graph) indicate that: Pb affects Pe and vice versa (bi-directional causality). This might be due to the following phenomena …

- This could be indicative of market participants reacting to historical price movements in one cryptocurrency (Bitcoin or Ethereum) when making decisions about trading another (Ethereum or Bitcoin).
- Crypto markets are susceptible to herding behavior, where market participants follow trends and patterns in price movements. Technical analysis, which involves studying historical price charts, is widely used in

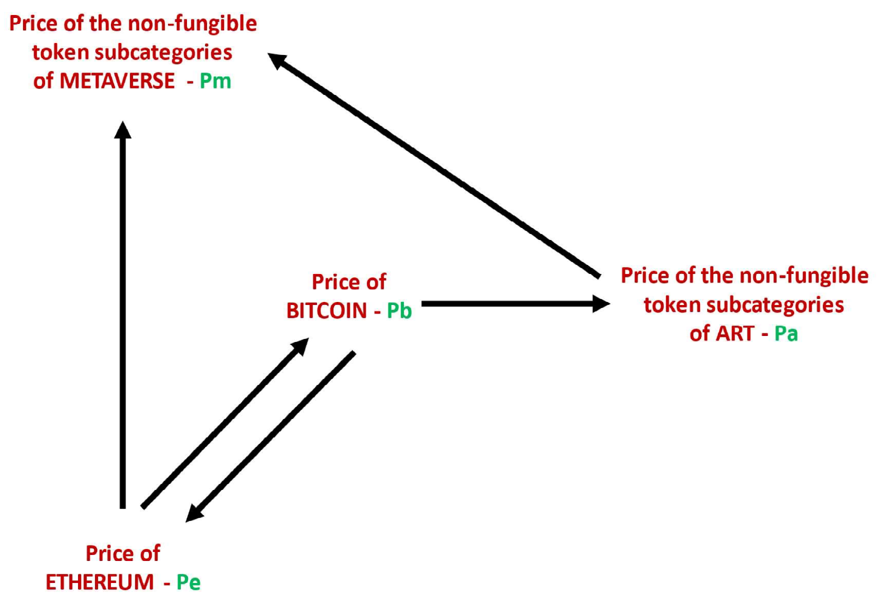

Figure 5: The Causality Graph

crypto trading. Traders may react to past price movements, leading to feedback loops and the emergence of Granger causality.

- Bitcoin and Ethereum are considered as the most widely used cryptocurrencies in the market as competing cryptocurrencies. Bitcoin's market capitalisation is over $363 billion USD while Ethereum's is around $161 billion USD.
- Cryptocurrency markets are known for their sensitivity to market sentiment and behavioural factors. Significant bi-directional causality might arise if past price movements in one cryptocurrency (Bitcoin or Ethereum) influence the sentiment of market participants, leading to predictable reactions in the prices of other cryptocurrencies (Ethereum or Bitcoin).
- The prices of cryptocurrency are determined by the interaction between the demand for and supply of the cryptocurrency, however, the literature (inter alia, Jalan *et al.*, 2022; Yarovaya *et al.*, 2021; Baur *et al.*, 2018) also indicates that the demand for cryptocurrency prices is related more to investors' psychological sentiment, speculation and bubble behaviour and significant external events. For example, when investors feel confident and have a strong view of Bitcoin, more investors want to own more of Bitcoin, resulting in a rise in the demand for and the price of Bitcoin because of this psychological sentiment.
- Traders often exploit arbitrage opportunities between different cryptocurrencies. If there is a bi-directional causality between the prices of two cryptocurrencies (Bitcoin and Ethereum), it may be indicative of arbitrageurs taking advantage of price differentials, leading to a significant predictive relationship.

In conclusion, the reasons for significant Granger causality among crypto prices are multifaceted and involve a combination of market dynamics, behavioral factors, algorithmic trading, external events, and the unique characteristics of cryptocurrency markets.

Lastly, this paragraph discusses variance decomposition, which indicates the amount of information each price volatility (*Pa*, *Pb*, *Pe* and *Pm*) contributes to each other in the analysis.

- Table 5 shows that during the first day within a month (around 25 observations), the price of the NFT subcategories of Art (*Pa*) was significantly affected by the variable itself (Pa_{t-1}). Specifically, *Pa* depends significantly on a lag value of *Pa*, as indicated in Column 2, with figures such as 100.0000, 99.61645, 99.24557, 98.91227, 98.59643, 98.27230, etc.
- This declining effect can also be observed in the impulse response function (IRF) and volatility graph (Figure 5). The IRF can be described here as the volatility of the price variables over a specified time horizon after a shock within one month (Figure 5 – Refer the response of *Pa* to *Pa* innovation) shows that the influence of *Pa* on itself has declined over time, from 100% in the first period to 99.62% in the second period, then to 99.25% in the third period, etc.

This finding can be compared to the next volatility graph. While the impact of Pa_t-1 on *Pa* has declined, the influence of the *Pb* on *Pa* has increased gradually (Refer to the Figure 6—The response of *Pb* to *Pa* innovation), from 0.00% to 0.19% to 0.37% to 0.56%, etc. This effect has also been shown significantly in the causality test (Table 5). This suggests that the *Pb* can be used as a forecasting tool for predicting the volatility of *Pa*. Interestingly, it should be noted that the influence of *Pb* on *Pe* volatility, and vice versa, showed a very sharp decline in the first period. The effects in the subsequent periods have levelled off and declined gradually towards zero.

- The volatility graph (Figure 6) and the causality test (Table 5) also indicate that *Pe* and *Pm* do not have any impact on *Pa*. However, during the second period, other pricing variables, such as *Pe* and *Pm*, started to exert influence on *Pa*'s volatility, as indicated in Column 3: from 0.000000, 0.189239, 0.373645, 0.562463, 0.764656, 0.984651, etc.
- This volatility graph can serve as a key component in risk management for both traders and investors. The volatility graph can be used to assess the level of risk associated with holding or trading a particular asset. High volatility may indicate higher risk, influencing portfolio allocation and risk management strategies.
- As discussed previously, among the three variables (*Pb*, *Pe*, and *Pm*), *Pb* affects *Pa*'s volatility significantly more than *Pe* and *Pm* do. During the second period, the impact of *Pb* was 18.92%, while *Pa*'s influence on

Table 5: Variance Decomposition Analysis					
Variance Decomposition of PA	**1**	**2**	**3**	**4**	**5**
Period	**S.E.**	**PA**	**PB**	**PE**	**PM**
1	406.6602	100.0000	0.000000	0.000000	0.000000
2	629.8696	99.61645	0.189239	0.084408	0.109905
3	790.4926	99.24557	0.373645	0.147754	0.233028
4	912.2615	98.91227	0.562463	0.223941	0.301324
5	1008.163	98.59643	0.764656	0.318900	0.320011
6	1085.822	98.27230	0.984651	0.433921	0.309125
7	1150.040	97.92122	1.224487	0.568495	0.285803
8	1204.028	97.53211	1.484938	0.721315	0.261634
9	1250.041	97.09950	1.766048	0.890697	0.243759
10	1289.724	96.62152	2.067391	1.074774	0.236315
11	1324.311	96.09868	2.388221	1.271590	0.241511
12	1354.751	95.53296	2.727562	1.479157	0.260319
13	1381.785	94.92732	3.084272	1.695494	0.292912
14	1406.004	94.28531	3.457090	1.918654	0.338942
15	1427.878	93.61086	3.844677	2.146755	0.397712
16	1447.790	92.90805	4.245647	2.377997	0.468303
17	1466.051	92.18107	4.658596	2.610681	0.549653
18	1482.916	91.43403	5.082123	2.843225	0.640619
19	1498.594	90.67094	5.514855	3.074175	0.740025
20	1513.257	89.89564	5.955458	3.302212	0.846693
21	1527.049	89.11172	6.402655	3.526153	0.959469
22	1540.088	88.32257	6.855232	3.744957	1.077246
23	1552.472	87.53126	7.312046	3.957719	1.198972
24	1564.284	86.74063	7.772033	4.163669	1.323667
25	1575.590	85.95321	8.234209	4.362162	1.450422

itself declined from the first period to the next, from 99.62% to 99.24% to 98.91%, etc. (Column 2). For example, during the 25th period (approximately one month), the impact of lag Pa_t-1 on *Pa*'s volatility was 85.95%, while the impact of *Pb* on *Pa*'s volatility increased from 0.19% in the second period to 8.23% in the 25th period. (Refer to Appendix 1 for more information on a 6 months period).

- The volatility graph reveals patterns and seasonality in stock price volatility. For example, intraday patterns, day-of-the-week effects, or monthly patterns may influence volatility. Recognizing these patterns is crucial for understanding the regularities in stock price behaviour.

In conclusion, both the Impulse Response Function and Volatility Graph offer valuable insights into the dynamic behaviour of stock prices. The IRF helps understand how stock prices respond to shocks, while volatility graphs provide a comprehensive view of the variability and risk associated with stock returns over time. Critically assessing these tools enhances traders and investors understanding of stock price behavior and contributes to more informed decision-making in financial markets.

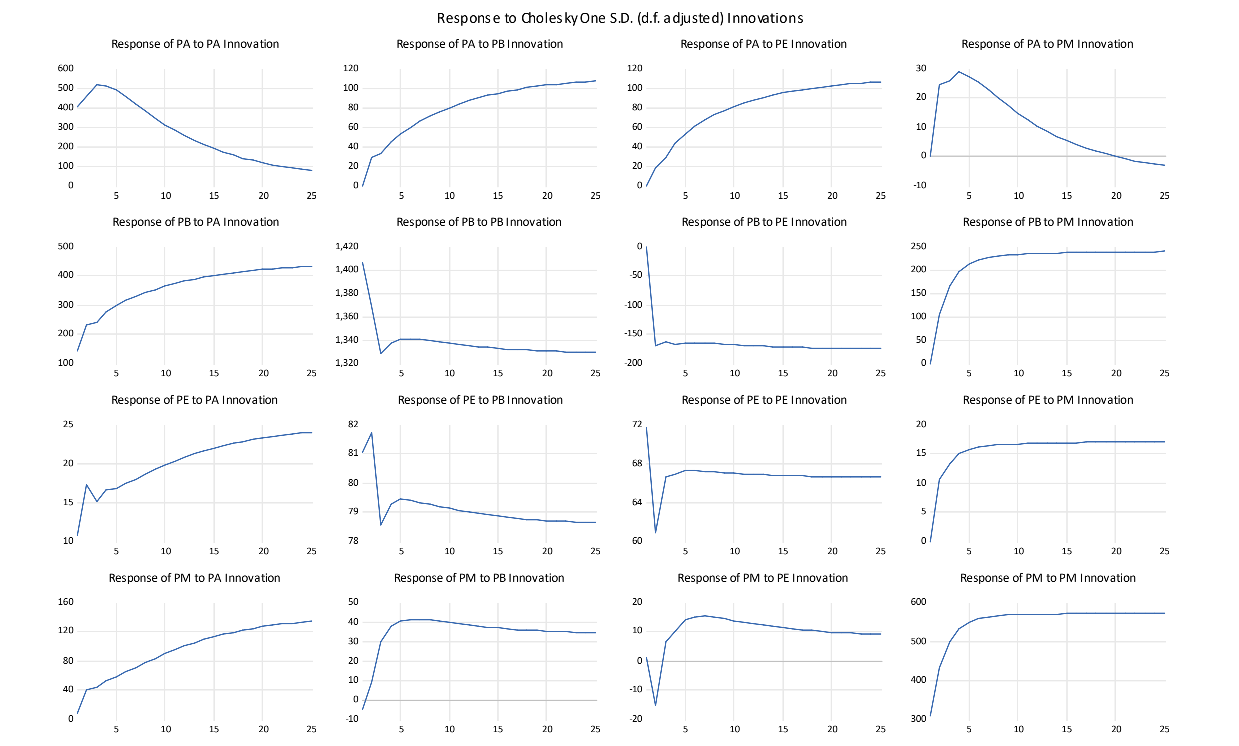

Figure 6: The Impulse Response Function and Volatility Graph

4. Conclusion and Direction for Further Research

In summary, this research initially aims to apply Vector Error Correction Model (VECM) to the Prices (P) and trading volume or Quantities (Q) variables of Bitcoin (B) and Ethereum (E), as they affect the non-fungible token subcategories of Collectibles (C), Metaverse (M) and Art (A). However, of the time-series variables (*Pa, Pb, Pc, Pe, Pm, Qa, Qb, Qc, Qe* and *Qm*), four are stationary at the first-difference operation, or I(1). The other time-series variables have mixed stationary properties in that some variables are stationary at level, or I(0), and some are stationary after a second-difference operation, or I(2). The literature (Pesaran and Shin, 1999; Pesaran *et al.*, 2001) indicates that the Toda-Yamamoto method can be used to model the variables that are stationary at a second-difference operation, or I(2). If the time-series variables are stationary at a level operation, or I(0), a simple Ordinary Least Squares (OLSQ) method can be employed. However, if all variables are stationary at a first-difference operation, or I(1), and the variables are also co-integrated, a VECM method should be employed. If all variables are stationary at a first-difference operation, or I(1), but the variables are not co-integrated, a VAR model can be employed. Lastly, if the time-series variables have mixed stationary properties, such as if some time-series variables are stationary at a level operation, or I(0), and some variables are stationary at a first-difference operation, an Auto Regressive Distributed Lag (ARDL) model can be utilised.

All approaches cannot be used with mixed time-series variables, such as those that are stationary at a first-difference operation and others at a second-difference operation. The literature also indicates that mixed time-series variables with differing stationary qualities cannot be cointegrated, hence there is no stationary linear combination. As indicated, variables with varying stationary properties may cause interpretation issues.

The final formulation in this study used VECM since the time-series variables are cointegrated and stationary like I(1). The price volatility results show that *Pb* impacts *Pe* and vice versa. *Pe* impacts *Pm* and *Pb*, whereas *Pa* does not. By investigating the co-movement of pricing among cryptocurrencies, we hope to spark further theoretical discussions on pricing theory among cryptocurrencies since it is currently impossible to separate investors' psychological sentiment, external events, government regulations, speculative motives, or broader adoption from cryptocurrency demand. Besides psychological emotion, this study shows that an appropriate lag structure captures shock delayed effects. Enables the model to depict the complicated interdependencies between Bitcoin (B), Ethereum (E), and the non-fungible token subcategories (NFTs) as seen in the Impulse

Response Function and Volatility Graph displaying cryptocurrency values' dynamic responses to shocks and events. Overall, this helps traders and investors visualise how these events and unexpected volatility affect bitcoin price stability over time.

Further research can be expanded by using investigating price volatility among cryptocurrency among variables, which have mixed stationarity properties using a VAR difference model or an auto regressive distributed lag (ARDL) model with different equilibrium properties.

5. References

Ante, L. (2021a). *The Non-Fungible Token (NFT) Market and its Relationship with Bitcoin and Ethereum,* June 6, Accessed 21 August 2023. available at SSRN: https://ssrn.com/abstract=3861106 or http://dx.doi.org/10.2139/ssrn.3861106

Ante, L. (2021b). Smart Contracts on the Blockchain—A Bibliometric Analysis and Review. *Telematics and Informatics*, 57(101519). https://doi.org/10.1016/j.tele.2020.101519

Baltagi, B.H. (2011). Econometrics. *Springer Texts in Business and Economics*, Springer, New York, USA.

Baur, D.G., Hong, K. and Lee, A.D. (2018). Bitcoin: Medium of Exchange or Speculative Assets?. *J Int Finan Markets Inst Money*, 54, 177-189.

Bhattarai, S., Chatterjee, A. and Park, W.Y. (2020). Global Spillover Effects of US Uncertainty. *Journal of Monetary Economics*, 114, 71-89. doi: https://doi.org/10.1016/j.jmoneco.2019.05.008

Bolz, Anna. (2022). A Regulatory Framework for the Art Market?. Springer Nature.

Bouri, E., Gupta, R. and Roubaud, D. (2019a). Herding Behaviour in Cryptocurrencies. *Finance Research Letters*, 29, 216-221.

Browning, M. (2005). A Working Paper from April 1985: Which Demand Elasticities Do we know and Which Do we need to know for Policy Analysis?. *Research in Economics*, 59(4), 293-320. https://doi.org/10.1016/j.rie.2005.09.001

Corbet, S., Lucey, B. and Yarovaya, L. (2021). Bitcoin-Energy Markets Interrelationships-New Evidence. *Resources Policy*, 70, 101916.

Corbet, S., Larkin, C., Lucey, B., Meegan, A. and Yarovaya, L. (2020a). Cryptocurrency Reaction to FOMC Announcements: Evidence of Heterogeneity Based on Blockchain Stack Position. *Journal of Financial Stability*, 46, 100706.

Corbet, S., Larkin, C., Lucey, B., Meegan, A. and Yarovaya, L. (2020b). The Impact of Macroeconomic News on Bitcoin Returns. *European Journal of Finance*, 26(14), 1396-1416.

Cryptonewsz. (2022). Forecast. Available at: www.cryptonewsz.com [Accessed October 29, 2022].

De Simone, F. (2022). *Diritto Penale e Intelligenza Artificiale, Nuovi Scenari*. Available at: file:///C:/Users/ACF3ALSHAS/Downloads/6096-Article%20Text-10683-1-10-20231103.pdf

Deaton, A. and Muellbauer, J. (1980). *Economics and Consumer Behavior*, Cambridge University Press, Cambridge, UK.

Dowling, M. (2021a). Is Non-Fungible Token Pricing Driven by Cryptocurrencies?. *Finance Research Letters*, 102097, 1544-6123. available via: https://doi.org/10.1016/j.frl.2021.102097 [Accessed 15 March 2022].

Dowling, M. (2021b). Fertile LAND: Pricing Non-Fungible Tokens. *Finance Research Letters*, 102096, 1544-6123. available via: https://doi.org/10.1016/j.frl.2021.102096 [Accessed 14 March 2022].

Engle, R.F. and Granger, C.W.J. (1987). Cointegration and Error Correction Representation: Estimation and Testing. *Econometrica*, 55, 251-276.

Fairfield, J. (2021). Tokenized: The Law of Non-Fungible Tokens and Unique Digital Property?. *Indiana Law Journal*, Forthcoming. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3821102

Gailey, A. (2022). 55% of Bitcoin Investors Started in the Last Year: 5 Things You Should Know if You're New to Crypto. *NextAdvisor with TIME*. https://time.com/nextadvisor/investing/cryptocurrency/things-to-know-for-new-crypto-investors/

Galariotis, E.C., Rong, W. and Spyrou, S.I. (2015). Herding on Fundamental Information: A Comparative Study. *Journal of Banking & Finance*, 50, 589-598. doi: https://doi.org/10.1016/j.jbankfin.2014.03.014

Granger, C.W. and Newbold, P. (1974). Spurious Regressions in Econometrics. *Journal of Econometrics*, 2(2), 111-120.

Gujarati, D.N. (2011). Econometrics by Example. Palgrave Macmillan.

Hikmet, A. (2021). Re: VAR or VECM for a Mix of I(1) and I(2) Order Variables?. Available at: https://www.researchgate.net/post/VAR_or_VECM_for_a_mix_of_I1_and_I2_order_variables/ 607ee230915bd3595d1bce58/citation/download. https://time.com/nextadvisor/investing/cryptocurrency/things-to-know-for-newcrypto-investors/.j.frl.2018.07.008.jae.616

Jalan, A., Matkovskyy, R., Urquhart, A. and Yarovaya, L. (2023). The role of Interpersonal Trust in Cryptocurrency Adoption. *J Int Financ Mark, Inst Money*, 83, 101715. doi: https://doi.org/10.1016/j.intfin.2022.101715

Khuntia, S. and Pattanayak, J.K. (2018). Adaptive Market Hypothesis and Evolving Predictability of Bitcoin. *Economics Letters*, 167, 26-28. doi: https://doi.org/10.1016/j.econlet.2018.03.005

Kugler, L. (2021). Non-Fungible Tokens and the Future of Art. *Communications of the ACM*, 64(9), 19-20. doi: https://doi.org/10.1145/3474355

Lu¨tkepohl, H. (2006). Forecasting with VARMA Models. in Elliot, G., Granger, C.W.J. and Timmermann, A. (Eds.), *Handbook of Economic Forecasting*, 1, 287-325, Elsevier, Amsterdam.

Lyubchenko, Irina. (2022). What is Art? NFTs, Beeple, and Art Connoisseurship in the 21st Century. *Interactive Film and Media Journal*, 2(3), 174-190. doi: https://doi.org/10.32920/ifmj.v2i3.1532

Makarov, I. and Schoar, A. (2022). Cryptocurrencies and Decentralized Finance (DeFi). *Brookings Papers on Economic Activity*, (1), 141-215. doi: https://dx.doi.org/10.1353/eca.2022.0014

Moratis, G. (2021). Quantifying the Spillover Effect in the Cryptocurrency Market. *Finance Research Letters*, 38, 101534. doi: https://doi.org/10.1016/j.frl.2020.101534

NFT Tech. (2022). NonFungible Report. Available at: https://www.nfttech.com/newsroom/web3-report

Ordano, E., Meilich, A., Jardi, Y. and Araoz, M. (2017). Decentraland: A Blockchain-Based Virtual World. *Decentraland*. Available at: https://decentraland.org/whitepaper.pdf

Pesaran, M.H. and Shin, Y. (1999). An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis. *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, Cambridge University Press, Cambridge, UK.

Pesaran, M.H., Shin, Y. and Smith, R.J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics*, 16(3), 289-326.

Pinto-Gutiérrez, C., Gaitán, S., Jaramillo, D. and Velasquez, S. (2022). The NFT Hype: What Draws Attention to Non-Fungible Tokens?. *Mathematics*, 10,335. doi: https://doi.org/10.3390/math10030335

Playtoearn. (2022). Top Gaming Tokens. Available at: www.playtoearn.online [Accessed October 29, 2022].

Qiao, X., Zhu, H. and Hau, L. (2020). Time-Frequency Co-Movement of Cryptocurrency Return and Volatility: Evidence from Wavelet Coherence Analysis. *International Review of Financial Analysis*, 71, 101541. doi: https://doi.org/10.1016/j.irfa.2020.101541

Scharnowski, M. Scharnowski, S. and Zimmermann, L. (2023). Fan Tokens: Sports and Speculation on the Blockchain. *Journal of International Financial Markets, Institutions and Money*, 89. Available at: https://doi.org/10.1016/j.intfin.2023.101880.

Shrestha, M.B. and Bhatta, G.R. (2018). Selecting Appropriate Methodological Framework for Time Series Data Analysis. *The Journal of Finance and Data Science*, 4(2), 71-89. https://doi.org/10.1016/j.jfds.2017.11.001

Stock, J.H. and Watson, M.W. (2019). *Introduction to Econometrics, Global Edition*, 4th Edition, Publisher, Pearson.

Thompson, M.G., Natarajan, K., Irving, S.A. *et al.* (2022). Effectiveness of a Third Dose of mRNA Vaccines Against COVID-19–Associated Emergency Department and Urgent Care Encounters and Hospitalizations among Adults During Periods of Delta and Omicron Variant Predominance — VISION Network, 10 States, August 2021-January 2022. *MMWR Morb Mortal Wkly Rep*, 71(4), 139-145. doi: 10.15585/mmwr.mm7104e3

Umar, Z. *et al.* (2022). Covid-19 Impact on NFTs and Major Asset Classes Interrelations: Insights from the Wavelet Coherence Analysis. *Finance Research Letters*, 47, 102725. doi: https://doi.org/10.1016/j.frl.2022.102725

Wang, Y., Lucey, B.M. and Vigne, S. (2022). Bubbles All the Way Down? Detecting and Date-Stamping Bubble Behaviour in DeFi and NFT Markets. *SSRN Electronic Journal* [Preprint]. Available at: https://doi.org/10.2139/ssrn.4038320

Wooldridge, J. (2019). *Introductory Econometrics: A Modern Approach*, 7th Edition, South-Western College Publishing, Nashville, USA.

Yao, J., Ma, C. and He, W.P. (2014). Investor Herding Behaviour of Chinese Stock Market. *International Review of Economics & Finance*, 29, 12-29. Available at: https://doi.org/10.1016/j.iref.2013.03.002

Yarovaya, L., Matkovskyy, R. and Jalan, A. (2021). The Effects of a 'Black Swan' Event (COVID-19) on Herding Behavior in Cryptocurrency Markets. *Journal of International Financial Markets, Institutions and Money*, 75, 101321. Available at: https://doi.org/10.1016/j.intfin.2021.101321

Yousaf, I. and Yarovaya, L. (2022). Static and Dynamic Connectedness Between NFTS, DeFi and Other Assets: Portfolio Implication. *Global Finance Journal*, 53, 100719. Available at: https://doi.org/10.1016/j.gfj.2022.100719

Yousaf, I., Abrar, A. and Yarovaya, L. (2023). Decentralized and Centralized Exchanges: Which Digital Tokens Pose a Greater Contagion Risk?. *Journal of International Financial Markets, Institutions and Money*. Available at https://doi.org/10.1016/j.intfin.2023.101881

Appendices

Appendix A				
Vector Error Correction Estimates				
Date: 08/16/23 Time: 16:12				
Sample (adjusted): 4 731				
Included observations: 728 after adjustments				
Standard errors in ( ) & t-statistics in [ ]				
Cointegrating Eq:	**CointEq1**			
PA(-1)	1.000000			
PB(-1)	0.011576			
	(0.02867)			
	[0.40376]			
PE(-1)	-1.657014			
	(0.48768)			
	[-3.39773]			
PM(-1)	0.056627			
	(0.09806)			
	[0.57748]			
C	335.4578			
Error Correction:	**D(PA)**	**D(PB)**	**D(PE)**	**D(PM)**
CointEq1	-0.061418	0.040708	0.001640	0.009533
	(0.01076)	(0.03794)	(0.00292)	(0.00827)
	[-5.70695]	[1.07296]	[0.56214]	[1.15287]
D(PA(-1))	0.196450	0.192952	0.014605	0.058821
	(0.03640)	(0.12831)	(0.00987)	(0.02796)
	[5.39755]	[1.50382]	[1.48008]	[2.10342]
D(PA(-2))	0.180304	-0.049477	-0.010925	-0.052970
	(0.03672)	(0.12945)	(0.00996)	(0.02821)
	[4.91038]	[-0.38222]	[-1.09744]	[-1.87754]
D(PB(-1))	0.006255	0.111913	0.009220	0.024849
	(0.01605)	(0.05659)	(0.00435)	(0.01233)
	[0.38964]	[1.97745]	[2.11840]	[2.01456]
D(PB(-2))	-0.009809	-0.034622	-0.007429	-0.012712
	(0.01615)	(0.05692)	(0.00438)	(0.01241)
	[-0.60750]	[-0.60822]	[-1.69713]	[-1.02468]
D(PE(-1))	-0.009809	-2.323310	-0.147042	-0.220508
	(0.20912)	(0.73720)	(0.05670)	(0.16067)
	[0.72970]	[-3.15153]	[-2.59354]	[-1.37240]
D(PE(-2))	0.081918	0.102989	0.085860	0.414582
	(0.21073)	(0.74290)	(0.05713)	(0.16191)
	[0.38873]	[0.13863]	[1.50280]	[2.56050]
D(PM(-1))	0.083008	0.337863	0.034015	0.405843
	(0.04818)	(0.16986)	(0.01306)	(0.03702)

Appendices

Appendix B

Response of PA				
Period	**PA**	**PB**	**PE**	**PM**
1	406.6602	0.000000	0.000000	0.000000
2	479.4179	27.40031	18.29964	20.88141
3	474.2892	39.80010	24.25703	31.93912
4	450.5602	48.43665	30.66602	32.42745
5	423.0338	55.59652	37.11590	27.29267
6	395.6168	61.94524	43.29768	19.80010
7	369.4024	67.71874	49.01936	11.63601
8	344.6875	73.02020	54.20258	3.585598
9	321.5176	77.90655	58.83270	-4.014603
10	299.8521	82.41613	62.92539	-11.03903
11	279.6197	86.57869	66.50920	-17.45799
12	260.7399	90.41947	69.61723	-23.28386
13	243.1311	93.96092	72.28332	-28.54649
14	226.7139	97.22350	74.54036	-33.28200
15	211.4130	100.2262	76.41964	-37.52783
16	197.1568	102.9864	77.95057	-41.32054
17	183.8784	105.5208	79.16071	-44.69496
18	171.5147	107.8444	80.07575	-47.68387
19	160.0064	109.9717	80.71965	-50.31791
20	149.2982	111.9159	81.11472	-52.62566
21	139.3379	113.6896	81.28174	-54.63371
22	130.0770	115.3044	81.24000	-56.36681
23	121.4696	116.7711	81.00748	-57.84794
24	113.4730	118.0999	80.60087	-59.09845
25	106.0471	119.3003	80.03567	-60.13816
26	99.15427	120.3812	79.32630	-60.98547
27	92.75936	121.3508	78.48611	-61.65742
28	86.82937	122.2167	77.52751	-62.16982
29	81.33343	122.9863	76.46202	-62.53732
30	76.24262	123.6663	75.30029	-62.77348
31	71.52984	124.2627	74.05221	-62.89085
32	67.16975	124.7816	72.72692	-62.90103
33	63.13861	125.2284	71.33290	-62.81475
34	59.41419	125.6080	69.87797	-62.64191
35	55.97569	125.9253	68.36937	-62.39167
36	52.80364	126.1846	66.81379	-62.07246
37	49.87984	126.3901	65.21740	-61.69204
38	47.18724	126.5454	63.58589	-61.25757
39	44.70989	126.6543	61.92450	-60.77564
40	42.43289	126.7200	60.23806	-60.25230

Appendices

Appendix B (Cont.)				
41	40.34228	126.7455	58.53101	-59.69309
42	38.42502	126.7338	56.80744	-59.10312
43	36.66893	126.6874	55.07109	-58.48704
44	35.06260	126.6089	53.32539	-57.84912
45	33.59537	126.5006	51.57349	-57.19327
46	32.25730	126.3645	49.81826	-56.52303
47	31.03908	126.2027	48.06234	-55.84165
48	29.93202	126.0169	46.30812	-55.15208
49	28.92801	125.8090	44.55779	-54.45697
50	28.01947	125.5805	42.81331	-53.75875
51	27.19932	125.3328	41.07649	-53.05961
52	26.46096	125.0673	39.34896	-52.36150
53	25.79824	124.7853	37.63219	-51.66621
54	25.20539	124.4880	35.92748	-50.97531
55	24.67706	124.1763	34.23604	-50.29022
56	24.20825	123.8514	32.55891	-49.61219
57	23.79429	123.5142	30.89705	-48.94234
58	23.43084	123.1654	29.25128	-48.28163
59	23.11386	122.8059	27.62236	-47.63093
60	22.83957	122.4365	26.01092	-46.99098
61	22.60445	122.0578	24.41754	-46.36241
62	22.40525	121.6704	22.84269	-45.74578
63	22.23892	121.2749	21.28680	-45.14152
64	22.10263	120.8718	19.75022	-44.55003
65	21.99375	120.4617	18.23325	-43.97160
66	21.90983	120.0449	16.73611	-43.40647
67	21.84860	119.6219	15.25900	-42.85482
68	21.80795	119.1931	13.80206	-42.31677
69	21.78593	118.7588	12.36539	-41.79239
70	21.78070	118.3194	10.94906	-41.28171
71	21.79059	117.8751	9.553095	-40.78471
72	21.81404	117.4262	8.177491	-40.30135
73	21.84959	116.9730	6.822220	-39.83153
74	21.89590	116.5157	5.487225	-39.37514
75	21.95174	116.0545	4.172429	-38.93205
76	22.01596	115.5896	2.877730	-38.50209
77	22.08749	115.1212	1.603011	-38.08507
78	22.16535	114.6494	0.348138	-37.68080
79	22.24866	114.1745	-0.887039	-37.28905
80	22.33656	113.6965	-2.102681	-36.90960

Appendices

Appendix B (Cont.)				
81	22.42829	113.2155	-3.298963	-36.54219
82	22.52316	112.7317	-4.476069	-36.18657
83	22.62050	112.2452	-5.634190	-35.84248
84	22.71973	111.7561	-6.773527	-35.50965
85	22.82029	111.2645	-7.894285	-35.18780
86	22.92169	110.7704	-8.996677	-34.87666
87	23.02346	110.2740	-10.08092	-34.57593
88	23.12520	109.7752	-11.14723	-34.28534
89	23.22652	109.2742	-12.19583	-34.00459
90	23.32706	108.7711	-13.22695	-33.73340
91	23.42653	108.2658	-14.24081	-33.47148
92	23.52462	107.7584	-15.23763	-33.21855
93	23.62109	107.2491	-16.21766	-32.97432
94	23.71570	106.7377	-17.18110	-32.73851
95	23.80824	106.2244	-18.12820	-32.51083
96	23.89852	105.7092	-19.05917	-32.29101
97	23.98637	105.1922	-19.97424	-32.07879
98	24.07165	104.6733	-20.87363	-31.87388
99	24.15423	104.1526	-21.75756	-31.67603
100	24.23398	103.6302	-22.62625	-31.48497
101	24.31081	103.1060	-23.47992	-31.30045
102	24.38463	102.5801	-24.31879	-31.12222
103	24.45536	102.0525	-25.14305	-30.95003
104	24.52295	101.5233	-25.95293	-30.78364
105	24.58733	100.9925	-26.74862	-30.62281
106	24.64847	100.4601	-27.53033	-30.46732
107	24.70633	99.92606	-28.29825	-30.31695
108	24.76088	99.39051	-29.05259	-30.17146
109	24.81211	98.85344	-29.79354	-30.03065
110	24.86001	98.31486	-30.52128	-29.89431
111	24.90456	97.77481	-31.23600	-29.76224
112	24.94577	97.23332	-31.93789	-29.63424
113	24.98364	96.69039	-32.62712	-29.51012
114	25.01819	96.14607	-33.30387	-29.38969
115	25.04943	95.60038	-33.96832	-29.27278
116	25.07737	95.05334	-34.62062	-29.15920
117	25.10205	94.50497	-35.26096	-29.04880
118	25.12347	93.95531	-35.88948	-28.94139
119	25.14168	93.40437	-36.50636	-28.83683
120	25.15670	92.85219	-37.11175	-28.73496

Appendices

Appendix B (Cont.)				
121	25.16857	92.29880	-37.70579	-28.63563
122	25.17731	91.74421	-38.28865	-28.53870
123	25.18297	91.18846	-38.86047	-28.44402
124	25.18558	90.63157	-39.42139	-28.35146
125	25.18518	90.07358	-39.97155	-28.26090
126	25.18182	89.51451	-40.51110	-28.17220
127	25.17553	88.95439	-41.04016	-28.08524
128	25.16635	88.39325	-41.55888	-27.99991
129	25.15434	87.83112	-42.06737	-27.91610
130	25.13953	87.26803	-42.56578	-27.83369
131	25.12196	86.70401	-43.05422	-27.75258
132	25.10169	86.13909	-43.53281	-27.67267
133	25.07875	85.57331	-44.00168	-27.59387
134	25.05319	85.00669	-44.46095	-27.51608
135	25.02506	84.43927	-44.91072	-27.43920
136	24.99439	83.87108	-45.35111	-27.36317
137	24.96124	83.30215	-45.78224	-27.28788
138	24.92565	82.73251	-46.20420	-27.21327
139	24.88766	82.16220	-46.61712	-27.13926
140	24.84732	81.59125	-47.02108	-27.06577
141	24.80467	81.01970	-47.41620	-26.99274
142	24.75976	80.44758	-47.80257	-26.92009
143	24.71262	79.87491	-48.18029	-26.84777
144	24.66331	79.30175	-48.54946	-26.77571
145	24.61186	78.72812	-48.91018	-26.70386
146	24.55831	78.15405	-49.26254	-26.63216
147	24.50271	77.57959	-49.60662	-26.56055
148	24.44510	77.00476	-49.94253	-26.48899
149	24.38551	76.42960	-50.27034	-26.41742
150	24.32400	75.85415	-50.59014	-26.34581
151	24.26059	75.27844	-50.90203	-26.27410
152	24.19532	74.70251	-51.20608	-26.20226
153	24.12825	74.12640	-51.50238	-26.13024
154	24.05939	73.55013	-51.79100	-26.05801
155	23.98879	72.97375	-52.07204	-25.98554
156	23.91650	72.39728	-52.34556	-25.91278
157	23.84253	71.82078	-52.61165	-25.83971
158	23.76693	71.24426	-52.87037	-25.76630
159	23.68974	70.66778	-53.12182	-25.69251
160	23.61098	70.09136	-53.36606	-25.61832

Appendices

Appendix B (Cont.)				
161	23.53070	69.51503	-53.60316	-25.54371
162	23.44893	68.93884	-53.83319	-25.46865
163	23.36569	68.36283	-54.05624	-25.39312
164	23.28102	67.78702	-54.27236	-25.31710
165	23.19496	67.21145	-54.48163	-25.24057
166	23.10753	66.63616	-54.68411	-25.16351
167	23.01877	66.06118	-54.87988	-25.08591
168	22.92871	65.48655	-55.06900	-25.00774
169	22.83737	64.91230	-55.25153	-24.92899
170	22.74479	64.33847	-55.42755	-24.84966
171	22.65099	63.76509	-55.59711	-24.76972
172	22.55600	63.19221	-55.76028	-24.68917
173	22.45986	62.61984	-55.91712	-24.60799
174	22.36258	62.04803	-56.06770	-24.52619
175	22.26420	61.47682	-56.21207	-24.44374
176	22.16475	60.90623	-56.35030	-24.36064
177	22.06424	60.33629	-56.48245	-24.27688
178	21.96271	59.76706	-56.60858	-24.19247
179	21.86018	59.19855	-56.72874	-24.10739
180	21.75667	58.63079	-56.84300	-24.02163
181	21.65221	58.06384	-56.95141	-23.93520
182	21.54683	57.49771	-57.05403	-23.84810
183	21.44054	56.93244	-57.15091	-23.76031
184	21.33338	56.36806	-57.24213	-23.67185
185	21.22536	55.80460	-57.32772	-23.58270
186	21.11651	55.24210	-57.40775	-23.49287
187	21.00684	54.68059	-57.48227	-23.40236
188	20.89639	54.12010	-57.55133	-23.31117
189	20.78517	53.56066	-57.61500	-23.21930
190	20.67321	53.00230	-57.67332	-23.12675
191	20.56052	52.44506	-57.72635	-23.03352
192	20.44713	51.88895	-57.77414	-22.93962
193	20.33306	51.33403	-57.81674	-22.84506
194	20.21832	50.78030	-57.85421	-22.74982
195	20.10294	50.22781	-57.88659	-22.65393
196	19.98694	49.67658	-57.91395	-22.55738
197	19.87033	49.12665	-57.93632	-22.46017
198	19.75313	48.57803	-57.95377	-22.36232
199	19.63537	48.03077	-57.96634	-22.26383
200	19.51707	47.48488	-57.97408	-22.16470

Appendices

Appendix B (Cont.)				
201	19.39823	46.94040	-57.97704	-22.06493
202	19.27888	46.39736	-57.97528	-21.96455
203	19.15903	45.85577	-57.96883	-21.86355
204	19.03871	45.31568	-57.95776	-21.76194
205	18.91792	44.77710	-57.94211	-21.65972
206	18.79670	44.24006	-57.92192	-21.55691
207	18.67504	43.70459	-57.89726	-21.45351
208	18.55298	43.17071	-57.86815	-21.34954
209	18.43052	42.63845	-57.83466	-21.24498
210	18.30769	42.10784	-57.79683	-21.13987
211	18.18449	41.57890	-57.75470	-21.03420
212	18.06094	41.05165	-57.70833	-20.92798
213	17.93707	40.52612	-57.65776	-20.82122
214	17.81288	40.00234	-57.60304	-20.71393
215	17.68838	39.48032	-57.54421	-20.60613
216	17.56361	38.96010	-57.48132	-20.49781
217	17.43855	38.44168	-57.41441	-20.38899
218	17.31325	37.92511	-57.34354	-20.27967
219	17.18770	37.41039	-57.26874	-20.16987
220	17.06191	36.89755	-57.19006	-20.05960
221	16.93592	36.38662	-57.10755	-19.94886
222	16.80972	35.87761	-57.02125	-19.83767
223	16.68334	35.37055	-56.93121	-19.72603
224	16.55677	34.86545	-56.83747	-19.61395
225	16.43005	34.36234	-56.74007	-19.50145
226	16.30318	33.86124	-56.63906	-19.38854
227	16.17617	33.36217	-56.53448	-19.27522
228	16.04904	32.86514	-56.42637	-19.16150
229	15.92180	32.37019	-56.31479	-19.04740
230	15.79446	31.87731	-56.19976	-18.93293
231	15.66703	31.38654	-56.08134	-18.81809
232	15.53953	30.89790	-55.95957	-18.70289
233	15.41196	30.41139	-55.83448	-18.58735
234	15.28435	29.92705	-55.70613	-18.47147
235	15.15669	29.44487	-55.57455	-18.35527
236	15.02901	28.96490	-55.43979	-18.23876
237	14.90131	28.48713	-55.30188	-18.12194
238	14.77361	28.01159	-55.16087	-18.00483
239	14.64591	27.53829	-55.01680	-17.88743
240	14.51823	27.06725	-54.86972	-17.76977

Appendices

Appendix B (Cont.)				
241	14.39057	26.59849	-54.71965	-17.65184
242	14.26295	26.13201	-54.56665	-17.53365
243	14.13539	25.66784	-54.41075	-17.41523
244	14.00787	25.20599	-54.25200	-17.29657
245	13.88043	24.74647	-54.09043	-17.17769
246	13.75307	24.28930	-53.92608	-17.05860
247	13.62580	23.83449	-53.75900	-16.93931
248	13.49862	23.38205	-53.58922	-16.81982
249	13.37155	22.93201	-53.41678	-16.70016
250	13.24460	22.48436	-53.24172	-16.58032
251	13.11778	22.03913	-53.06409	-16.46032
252	12.99110	21.59632	-52.88391	-16.34017
253	12.86456	21.15595	-52.70123	-16.21987
254	12.73817	20.71803	-52.51609	-16.09945
255	12.61195	20.28257	-52.32852	-15.97890
256	12.48590	19.84959	-52.13857	-15.85824
257	12.36004	19.41908	-51.94627	-15.73748
258	12.23436	18.99107	-51.75165	-15.61662
259	12.10889	18.56556	-51.55476	-15.49568
260	11.98362	18.14257	-51.35563	-15.37467
261	11.85856	17.72209	-51.15431	-15.25359
262	11.73373	17.30415	-50.95082	-15.13246
263	11.60914	16.88876	-50.74520	-15.01128
264	11.48478	16.47591	-50.53750	-14.89006
265	11.36067	16.06562	-50.32774	-14.76882
266	11.23681	15.65790	-50.11596	-14.64756
267	11.11322	15.25275	-49.90220	-14.52630
268	10.98990	14.85018	-49.68650	-14.40503
269	10.86686	14.45021	-49.46888	-14.28377
270	10.74410	14.05283	-49.24939	-14.16253
271	10.62164	13.65806	-49.02807	-14.04132
272	10.49947	13.26590	-48.80493	-13.92015
273	10.37761	12.87636	-48.58003	-13.79902
274	10.25607	12.48944	-48.35339	-13.67794
275	10.13485	12.10515	-48.12505	-13.55693
276	10.01395	11.72349	-47.89504	-13.43598
277	9.893395	11.34448	-47.66340	-13.31512
278	9.773176	10.96811	-47.43016	-13.19434
279	9.653304	10.59439	-47.19535	-13.07366
280	9.533786	10.22333	-46.95901	-12.95309

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Appendix B (Cont.)				
281	9.414628	9.854921	-46.72118	-12.83263
282	9.295836	9.489181	-46.48187	-12.71228
283	9.177417	9.126108	-46.24114	-12.59207
284	9.059376	8.765706	-45.99900	-12.47200
285	8.941719	8.407978	-45.75549	-12.35206
286	8.824453	8.052929	-45.51064	-12.23229
287	8.707582	7.700559	-45.26450	-12.11267
288	8.591113	7.350873	-45.01707	-11.99322
289	8.475050	7.003873	-44.76841	-11.87394
290	8.359401	6.659560	-44.51854	-11.75485
291	8.244169	6.317937	-44.26749	-11.63595
292	8.129360	5.979006	-44.01529	-11.51724
293	8.014979	5.642768	-43.76197	-11.39875
294	7.901032	5.309224	-43.50756	-11.28046
295	7.787524	4.978376	-43.25210	-11.16240
296	7.674459	4.650224	-42.99562	-11.04456
297	7.561842	4.324769	-42.73813	-10.92695
298	7.449678	4.002012	-42.47968	-10.80959
299	7.337973	3.681952	-42.22030	-10.69247
300	7.226729	3.364590	-41.96000	-10.57561
301	7.115952	3.049925	-41.69883	-10.45900
302	7.005647	2.737957	-41.43680	-10.34267
303	6.895818	2.428686	-41.17396	-10.22661
304	6.786468	2.122110	-40.91032	-10.11083
305	6.677603	1.818229	-40.64592	-9.995336
306	6.569226	1.517040	-40.38078	-9.880137
307	6.461341	1.218544	-40.11493	-9.765237
308	6.353953	0.922738	-39.84840	-9.650642
309	6.247064	0.629620	-39.58122	-9.536359
310	6.140680	0.339188	-39.31341	-9.422394
311	6.034804	0.051441	-39.04500	-9.308753
312	5.929439	-0.233625	-38.77602	-9.195440
313	5.824589	-0.516012	-38.50650	-9.082463
314	5.720257	-0.795722	-38.23645	-8.969827
315	5.616447	-1.072759	-37.96591	-8.857538
316	5.513163	-1.347126	-37.69490	-8.745600
317	5.410407	-1.618826	-37.42345	-8.634020
318	5.308183	-1.887863	-37.15159	-8.522803
319	5.206493	-2.154240	-36.87933	-8.411954
320	5.105342	-2.417961	-36.60671	-8.301478

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Appendix B (Cont.)				
321	5.004731	-2.679030	-36.33375	-8.191381
322	4.904664	-2.937452	-36.06047	-8.081667
323	4.805144	-3.193230	-35.78690	-7.972343
324	4.706174	-3.446370	-35.51306	-7.863411
325	4.607755	-3.696875	-35.23898	-7.754878
326	4.509891	-3.944752	-34.96468	-7.646749
327	4.412584	-4.190004	-34.69019	-7.539027
328	4.315837	-4.432638	-34.41552	-7.431718
329	4.219653	-4.672657	-34.14071	-7.324825
330	4.124033	-4.910069	-33.86576	-7.218355
331	4.028980	-5.144878	-33.59072	-7.112310
332	3.934495	-5.377091	-33.31560	-7.006696
333	3.840583	-5.606713	-33.04041	-6.901516
334	3.747243	-5.833750	-32.76520	-6.796775
335	3.654479	-6.058209	-32.48997	-6.692477
336	3.562292	-6.280096	-32.21474	-6.588626
337	3.470684	-6.499417	-31.93955	-6.485225
338	3.379657	-6.716180	-31.66441	-6.382280
339	3.289213	-6.930391	-31.38934	-6.279793
340	3.199354	-7.142056	-31.11437	-6.177769
341	3.110080	-7.351184	-30.83951	-6.076210
342	3.021395	-7.557781	-30.56478	-5.975122
343	2.933298	-7.761855	-30.29021	-5.874507
344	2.845792	-7.963413	-30.01582	-5.774368
345	2.758879	-8.162462	-29.74162	-5.674710
346	2.672558	-8.359011	-29.46764	-5.575535
347	2.586833	-8.553067	-29.19389	-5.476847
348	2.501703	-8.744639	-28.92040	-5.378649
349	2.417170	-8.933734	-28.64718	-5.280944
350	2.333236	-9.120360	-28.37425	-5.183736
351	2.249900	-9.304527	-28.10164	-5.087026
352	2.167165	-9.486242	-27.82935	-4.990819
353	2.085031	-9.665513	-27.55742	-4.895117
354	2.003499	-9.842351	-27.28584	-4.799923
355	1.922569	-10.01676	-27.01466	-4.705239
356	1.842243	-10.18876	-26.74388	-4.611069
357	1.762522	-10.35835	-26.47351	-4.517414
358	1.683405	-10.52553	-26.20359	-4.424278
359	1.604894	-10.69033	-25.93411	-4.331663
360	1.526989	-10.85275	-25.66511	-4.239571

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Appendix B (Cont.)				
361	1.449690	-11.01280	-25.39660	-4.148005
362	1.372998	-11.17049	-25.12859	-4.056967
363	1.296914	-11.32583	-24.86111	-3.966459
364	1.221437	-11.47882	-24.59416	-3.876484
365	1.146569	-11.62949	-24.32776	-3.787043
366	1.072308	-11.77783	-24.06194	-3.698139
367	0.998656	-11.92386	-23.79670	-3.609773
368	0.925612	-12.06758	-23.53206	-3.521948
369	0.853177	-12.20902	-23.26803	-3.434665
370	0.781350	-12.34817	-23.00464	-3.347926
Response of PB				
Period	**PA**	**PB**	**PE**	**PM**
1	131.4566	1399.706	0.000000	0.000000
2	208.5052	1352.203	-173.6109	111.1756
3	242.2049	1354.215	-179.0731	146.7458
4	262.6746	1353.726	-188.8635	156.7190
5	277.3712	1352.301	-196.4159	154.4546
6	289.1644	1350.527	-202.9485	146.6230
7	299.2422	1348.595	-208.9761	136.3212
8	308.1418	1346.588	-214.7393	124.9752
9	316.1288	1344.535	-220.3545	113.2425
10	323.3492	1342.445	-225.8803	101.4284
11	329.8944	1340.320	-231.3481	89.67673
12	335.8294	1338.156	-236.7764	78.05755
13	341.2057	1335.948	-242.1773	66.60658
14	346.0672	1333.691	-247.5595	55.34336
15	350.4531	1331.381	-252.9299	44.27956
16	354.3989	1329.012	-258.2939	33.42276
17	357.9373	1326.582	-263.6561	22.77825
18	361.0987	1324.086	-269.0202	12.34982
19	363.9111	1321.521	-274.3895	2.140246
20	366.4008	1318.884	-279.7663	-7.848544
21	368.5920	1316.174	-285.1529	-17.61530
22	370.5073	1313.387	-290.5507	-27.15936
23	372.1677	1310.523	-295.9610	-36.48062
24	373.5927	1307.578	-301.3844	-45.57942
25	374.8004	1304.554	-306.8216	-54.45654
26	375.8077	1301.447	-312.2725	-63.11315
27	376.6303	1298.258	-317.7370	-71.55076
28	377.2825	1294.986	-323.2148	-79.77115
29	377.7778	1291.631	-328.7051	-87.77643
30	378.1287	1288.191	-334.2073	-95.56892

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Appendix B (Cont.)				
31	378.3468	1284.669	-339.7203	-103.1511
32	378.4427	1281.063	-345.2429	-110.5258
33	378.4263	1277.373	-350.7739	-117.6959
34	378.3068	1273.601	-356.3118	-124.6643
35	378.0927	1269.746	-361.8551	-131.4342
36	377.7918	1265.809	-367.4023	-138.0090
37	377.4113	1261.791	-372.9516	-144.3918
38	376.9579	1257.692	-378.5013	-150.5862
39	376.4377	1253.514	-384.0495	-156.5955
40	375.8565	1249.257	-389.5946	-162.4234
41	375.2194	1244.922	-395.1345	-168.0732
42	374.5313	1240.511	-400.6675	-173.5487
43	373.7965	1236.024	-406.1915	-178.8532
44	373.0192	1231.462	-411.7047	-183.9905
45	372.2030	1226.826	-417.2052	-188.9641
46	371.3515	1222.119	-422.6910	-193.7774
47	370.4676	1217.340	-428.1603	-198.4341
48	369.5544	1212.491	-433.6111	-202.9377
49	368.6144	1207.573	-439.0416	-207.2915
50	367.6499	1202.588	-444.4500	-211.4991
51	366.6633	1197.537	-449.8344	-215.5638
52	365.6564	1192.421	-455.1930	-219.4890
53	364.6311	1187.241	-460.5241	-223.2780
54	363.5890	1181.999	-465.8259	-226.9340
55	362.5317	1176.697	-471.0968	-230.4602
56	361.4604	1171.334	-476.3350	-233.8598
57	360.3763	1165.913	-481.5391	-237.1359
58	359.2806	1160.435	-486.7073	-240.2915
59	358.1742	1154.901	-491.8383	-243.3296
60	357.0580	1149.313	-496.9304	-246.2530
61	355.9329	1143.671	-501.9822	-249.0648
62	354.7994	1137.978	-506.9924	-251.7675
63	353.6582	1132.234	-511.9595	-254.3641
64	352.5099	1126.441	-516.8823	-256.8572
65	351.3550	1120.599	-521.7595	-259.2493
66	350.1938	1114.711	-526.5899	-261.5431
67	349.0268	1108.777	-531.3722	-263.7410
68	347.8542	1102.799	-536.1053	-265.8455
69	346.6763	1096.778	-540.7882	-267.8590
70	345.4934	1090.715	-545.4198	-269.7838

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Appendix B (Cont.)				
71	344.3057	1084.611	-549.9991	-271.6221
72	343.1133	1078.467	-554.5251	-273.3762
73	341.9163	1072.286	-558.9969	-275.0482
74	340.7149	1066.066	-563.4135	-276.6403
75	339.5091	1059.811	-567.7743	-278.1543
76	338.2990	1053.521	-572.0783	-279.5924
77	337.0846	1047.197	-576.3248	-280.9566
78	335.8660	1040.841	-580.5130	-282.2485
79	334.6431	1034.452	-584.6424	-283.4702
80	333.4160	1028.033	-588.7121	-284.6234
81	332.1846	1021.585	-592.7217	-285.7098
82	330.9490	1015.108	-596.6706	-286.7311
83	329.7090	1008.604	-600.5581	-287.6890
84	328.4646	1002.073	-604.3838	-288.5851
85	327.2158	995.5173	-608.1473	-289.4209
86	325.9626	988.9368	-611.8480	-290.1979
87	324.7048	982.3329	-615.4855	-290.9177
88	323.4425	975.7065	-619.0596	-291.5816
89	322.1755	969.0586	-622.5697	-292.1911
90	320.9039	962.3901	-626.0157	-292.7474
91	319.6275	955.7020	-629.3972	-293.2520
92	318.3462	948.9952	-632.7139	-293.7061
93	317.0601	942.2705	-635.9657	-294.1109
94	315.7691	935.5288	-639.1522	-294.4676
95	314.4730	928.7711	-642.2734	-294.7775
96	313.1720	921.9982	-645.3290	-295.0417
97	311.8658	915.2109	-648.3189	-295.2612
98	310.5545	908.4100	-651.2431	-295.4372
99	309.2380	901.5965	-654.1013	-295.5707
100	307.9162	894.7711	-656.8936	-295.6628
101	306.5892	887.9346	-659.6199	-295.7144
102	305.2569	881.0878	-662.2801	-295.7265
103	303.9192	874.2315	-664.8743	-295.7001
104	302.5762	867.3665	-667.4025	-295.6360
105	301.2278	860.4935	-669.8647	-295.5352
106	299.8740	853.6132	-672.2609	-295.3985
107	298.5148	846.7265	-674.5913	-295.2268
108	297.1501	839.8339	-676.8558	-295.0208
109	295.7800	832.9363	-679.0547	-294.7815
110	294.4044	826.0344	-681.1880	-294.5095

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Appendix B (Cont.)				
111	293.0234	819.1288	-683.2559	-294.2056
112	291.6370	812.2202	-685.2584	-293.8706
113	290.2451	805.3094	-687.1958	-293.5052
114	288.8478	798.3969	-689.0683	-293.1100
115	287.4452	791.4834	-690.8760	-292.6858
116	286.0371	784.5696	-692.6191	-292.2332
117	284.6237	777.6561	-694.2979	-291.7529
118	283.2050	770.7436	-695.9126	-291.2456
119	281.7810	763.8326	-697.4633	-290.7117
120	280.3517	756.9238	-698.9505	-290.1519
121	278.9172	750.0178	-700.3742	-289.5669
122	277.4776	743.1151	-701.7349	-288.9571
123	276.0328	736.2164	-703.0327	-288.3231
124	274.5830	729.3223	-704.2680	-287.6656
125	273.1281	722.4332	-705.4410	-286.9849
126	271.6683	715.5498	-706.5521	-286.2816
127	270.2036	708.6726	-707.6016	-285.5563
128	268.7340	701.8022	-708.5899	-284.8094
129	267.2597	694.9390	-709.5171	-284.0414
130	265.7806	688.0837	-710.3838	-283.2528
131	264.2969	681.2368	-711.1902	-282.4440
132	262.8087	674.3987	-711.9367	-281.6155
133	261.3160	667.5700	-712.6236	-280.7677
134	259.8188	660.7511	-713.2514	-279.9011
135	258.3173	653.9426	-713.8204	-279.0160
136	256.8116	647.1450	-714.3309	-278.1129
137	255.3017	640.3587	-714.7834	-277.1923
138	253.7878	633.5842	-715.1783	-276.2544
139	252.2698	626.8219	-715.5159	-275.2997
140	250.7479	620.0724	-715.7967	-274.3285
141	249.2223	613.3360	-716.0210	-273.3412
142	247.6929	606.6133	-716.1893	-272.3383
143	246.1599	599.9046	-716.3020	-271.3200
144	244.6234	593.2104	-716.3595	-270.2866
145	243.0834	586.5310	-716.3622	-269.2386
146	241.5401	579.8671	-716.3106	-268.1763
147	239.9936	573.2188	-716.2051	-267.0999
148	238.4440	566.5867	-716.0461	-266.0099
149	236.8913	559.9712	-715.8340	-264.9065
150	235.3357	553.3726	-715.5693	-263.7901

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Appendix B (Cont.)				
151	233.7773	546.7913	-715.2525	-262.6609
152	232.2162	540.2278	-714.8840	-261.5193
153	230.6525	533.6823	-714.4642	-260.3655
154	229.0863	527.1552	-713.9935	-259.1999
155	227.5177	520.6470	-713.4725	-258.0226
156	225.9467	514.1580	-712.9016	-256.8341
157	224.3737	507.6885	-712.2812	-255.6346
158	222.7985	501.2389	-711.6118	-254.4243
159	221.2214	494.8095	-710.8939	-253.2035
160	219.6424	488.4006	-710.1279	-251.9724
161	218.0617	482.0127	-709.3143	-250.7315
162	216.4794	475.6459	-708.4535	-249.4808
163	214.8955	469.3007	-707.5460	-248.2206
164	213.3102	462.9773	-706.5923	-246.9512
165	211.7236	456.6761	-705.5928	-245.6728
166	210.1359	450.3974	-704.5481	-244.3857
167	208.5470	444.1414	-703.4585	-243.0901
168	206.9572	437.9084	-702.3245	-241.7862
169	205.3665	431.6988	-701.1467	-240.4742
170	203.7751	425.5129	-699.9254	-239.1544
171	202.1831	419.3508	-698.6612	-237.8271
172	200.5905	413.2129	-697.3545	-236.4923
173	198.9975	407.0995	-696.0058	-235.1504
174	197.4041	401.0108	-694.6156	-233.8014
175	195.8106	394.9470	-693.1843	-232.4458
176	194.2170	388.9085	-691.7124	-231.0836
177	192.6234	382.8955	-690.2003	-229.7150
178	191.0300	376.9081	-688.6486	-228.3403
179	189.4367	370.9468	-687.0577	-226.9597
180	187.8438	365.0116	-685.4281	-225.5733
181	186.2514	359.1029	-683.7602	-224.1814
182	184.6595	353.2208	-682.0545	-222.7841
183	183.0683	347.3656	-680.3116	-221.3816
184	181.4779	341.5375	-678.5317	-219.9741
185	179.8883	335.7367	-676.7155	-218.5618
186	178.2997	329.9634	-674.8633	-217.1448
187	176.7122	324.2178	-672.9757	-215.7234
188	175.1258	318.5002	-671.0531	-214.2977
189	173.5408	312.8107	-669.0959	-212.8680
190	171.9571	307.1495	-667.1047	-211.4343

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Appendix B (Cont.)				
191	170.3750	301.5168	-665.0799	-209.9968
192	168.7944	295.9127	-663.0219	-208.5557
193	167.2155	290.3375	-660.9312	-207.1112
194	165.6384	284.7914	-658.8083	-205.6634
195	164.0632	279.2745	-656.6536	-204.2125
196	162.4900	273.7869	-654.4675	-202.7587
197	160.9189	268.3289	-652.2506	-201.3021
198	159.3500	262.9005	-650.0033	-199.8429
199	157.7833	257.5020	-647.7260	-198.3811
200	156.2190	252.1335	-645.4191	-196.9171
201	154.6572	246.7952	-643.0832	-195.4508
202	153.0979	241.4871	-640.7187	-193.9826
203	151.5413	236.2095	-638.3260	-192.5124
204	149.9874	230.9624	-635.9055	-191.0406
205	148.4364	225.7460	-633.4578	-189.5671
206	146.8883	220.5604	-630.9831	-188.0922
207	145.3432	215.4058	-628.4821	-186.6160
208	143.8012	210.2823	-625.9550	-185.1386
209	142.2624	205.1899	-623.4024	-183.6601
210	140.7268	200.1288	-620.8247	-182.1808
211	139.1947	195.0991	-618.2223	-180.7007
212	137.6659	190.1009	-615.5957	-179.2199
213	136.1407	185.1343	-612.9452	-177.7387
214	134.6191	180.1995	-610.2713	-176.2571
215	133.1013	175.2964	-607.5744	-174.7752
216	131.5871	170.4252	-604.8549	-173.2933
217	130.0769	165.5861	-602.1133	-171.8113
218	128.5706	160.7789	-599.3500	-170.3295
219	127.0683	156.0040	-596.5654	-168.8479
220	125.5700	151.2612	-593.7598	-167.3667
221	124.0760	146.5508	-590.9338	-165.8860
222	122.5862	141.8727	-588.0877	-164.4058
223	121.1007	137.2271	-585.2220	-162.9265
224	119.6196	132.6140	-582.3370	-161.4479
225	118.1430	128.0334	-579.4331	-159.9703
226	116.6709	123.4855	-576.5108	-158.4938
227	115.2034	118.9702	-573.5704	-157.0185
228	113.7406	114.4877	-570.6123	-155.5444
229	112.2826	110.0379	-567.6370	-154.0717
230	110.8293	105.6210	-564.6448	-152.6006

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Appendix B (Cont.)				
231	109.3810	101.2370	-561.6361	-151.1310
232	107.9376	96.88583	-558.6113	-149.6632
233	106.4992	92.56763	-555.5708	-148.1972
234	105.0659	88.28242	-552.5150	-146.7331
235	103.6377	84.03021	-549.4443	-145.2710
236	102.2148	79.81104	-546.3589	-143.8111
237	100.7971	75.62494	-543.2594	-142.3533
238	99.38474	71.47191	-540.1461	-140.8979
239	97.97777	67.35200	-537.0193	-139.4449
240	96.57625	63.26520	-533.8795	-137.9944
241	95.18024	59.21154	-530.7269	-136.5465
242	93.78979	55.19102	-527.5620	-135.1013
243	92.40496	51.20365	-524.3851	-133.6588
244	91.02580	47.24944	-521.1966	-132.2193
245	89.65238	43.32840	-517.9968	-130.7827
246	88.28474	39.44051	-514.7862	-129.3491
247	86.92293	35.58579	-511.5650	-127.9187
248	85.56702	31.76421	-508.3335	-126.4915
249	84.21704	27.97578	-505.0923	-125.0677
250	82.87304	24.22049	-501.8415	-123.6472
251	81.53509	20.49832	-498.5815	-122.2301
252	80.20322	16.80926	-495.3128	-120.8167
253	78.87749	13.15328	-492.0355	-119.4068
254	77.55793	9.530375	-488.7501	-118.0007
255	76.24460	5.940515	-485.4569	-116.5984
256	74.93753	2.383675	-482.1562	-115.1999
257	73.63678	-1.140172	-478.8483	-113.8054
258	72.34239	-4.631056	-475.5336	-112.4149
259	71.05439	-8.089009	-472.2125	-111.0285
260	69.77283	-11.51407	-468.8851	-109.6462
261	68.49775	-14.90626	-465.5519	-108.2682
262	67.22919	-18.26564	-462.2131	-106.8944
263	65.96718	-21.59224	-458.8691	-105.5251
264	64.71177	-24.88610	-455.5201	-104.1602
265	63.46299	-28.14727	-452.1666	-102.7997
266	62.22088	-31.37580	-448.8087	-101.4439
267	60.98546	-34.57174	-445.4469	-100.0927
268	59.75679	-37.73514	-442.0813	-98.74621
269	58.53488	-40.86605	-438.7123	-97.40448
270	57.31978	-43.96453	-435.3403	-96.06758

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Appendix B (Cont.)				
271	56.11151	-47.03064	-431.9654	-94.73556
272	54.91011	-50.06444	-428.5880	-93.40849
273	53.71560	-53.06600	-425.2084	-92.08643
274	52.52802	-56.03537	-421.8268	-90.76944
275	51.34739	-58.97262	-418.4435	-89.45756
276	50.17374	-61.87782	-415.0589	-88.15087
277	49.00710	-64.75104	-411.6732	-86.84941
278	47.84749	-67.59235	-408.2867	-85.55324
279	46.69495	-70.40183	-404.8996	-84.26241
280	45.54948	-73.17956	-401.5122	-82.97698
281	44.41113	-75.92560	-398.1248	-81.69699
282	43.27990	-78.64004	-394.7377	-80.42250
283	42.15583	-81.32295	-391.3511	-79.15355
284	41.03894	-83.97443	-387.9653	-77.89020
285	39.92924	-86.59456	-384.5806	-76.63249
286	38.82676	-89.18342	-381.1971	-75.38047
287	37.73151	-91.74110	-377.8152	-74.13419
288	36.64351	-94.26768	-374.4351	-72.89368
289	35.56279	-96.76327	-371.0570	-71.65900
290	34.48935	-99.22795	-367.6812	-70.43019
291	33.42322	-101.6618	-364.3080	-69.20728
292	32.36441	-104.0650	-360.9376	-67.99033
293	31.31294	-106.4375	-357.5702	-66.77937
294	30.26881	-108.7795	-354.2060	-65.57444
295	29.23205	-111.0911	-350.8454	-64.37559
296	28.20266	-113.3724	-347.4885	-63.18284
297	27.18066	-115.6234	-344.1355	-61.99624
298	26.16606	-117.8444	-340.7868	-60.81582
299	25.15887	-120.0353	-337.4424	-59.64162
300	24.15910	-122.1963	-334.1027	-58.47367
301	23.16676	-124.3276	-330.7678	-57.31201
302	22.18186	-126.4292	-327.4380	-56.15667
303	21.20441	-128.5012	-324.1134	-55.00768
304	20.23440	-130.5437	-320.7944	-53.86507
305	19.27186	-132.5569	-317.4811	-52.72888
306	18.31679	-134.5409	-314.1737	-51.59914
307	17.36919	-136.4957	-310.8724	-50.47586
308	16.42906	-138.4216	-307.5774	-49.35909
309	15.49641	-140.3186	-304.2890	-48.24884
310	14.57125	-142.1869	-301.0072	-47.14516

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Appendix B (Cont.)				
311	13.65358	-144.0265	-297.7324	-46.04805
312	12.74340	-145.8376	-294.4647	-44.95755
313	11.84070	-147.6203	-291.2043	-43.87368
314	10.94550	-149.3748	-287.9514	-42.79647
315	10.05780	-151.1011	-284.7061	-41.72593
316	9.177585	-152.7994	-281.4687	-40.66209
317	8.304864	-154.4698	-278.2394	-39.60497
318	7.439635	-156.1125	-275.0183	-38.55460
319	6.581895	-157.7275	-271.8055	-37.51099
320	5.731641	-159.3151	-268.6014	-36.47416
321	4.888872	-160.8753	-265.4060	-35.44412
322	4.053584	-162.4082	-262.2195	-34.42091
323	3.225772	-163.9141	-259.0420	-33.40453
324	2.405432	-165.3930	-255.8739	-32.39500
325	1.592558	-166.8450	-252.7151	-31.39233
326	0.787146	-168.2704	-249.5659	-30.39655
327	-0.010812	-169.6692	-246.4265	-29.40766
328	-0.801321	-171.0416	-243.2969	-28.42569
329	-1.584390	-172.3878	-240.1773	-27.45063
330	-2.360026	-173.7078	-237.0680	-26.48251
331	-3.128237	-175.0017	-233.9690	-25.52134
332	-3.889032	-176.2699	-230.8805	-24.56712
333	-4.642421	-177.5123	-227.8026	-23.61987
334	-5.388413	-178.7291	-224.7355	-22.67960
335	-6.127018	-179.9205	-221.6793	-21.74631
336	-6.858248	-181.0866	-218.6342	-20.82002
337	-7.582113	-182.2276	-215.6003	-19.90073
338	-8.298626	-183.3435	-212.5777	-18.98845
339	-9.007798	-184.4346	-209.5665	-18.08318
340	-9.709642	-185.5010	-206.5670	-17.18494
341	-10.40417	-186.5429	-203.5791	-16.29373
342	-11.09140	-187.5603	-200.6032	-15.40954
343	-11.77134	-188.5534	-197.6391	-14.53239
344	-12.44401	-189.5225	-194.6872	-13.66229
345	-13.10942	-190.4675	-191.7475	-12.79922
346	-13.76759	-191.3888	-188.8201	-11.94320
347	-14.41853	-192.2863	-185.9052	-11.09422
348	-15.06226	-193.1604	-183.0028	-10.25229
349	-15.69880	-194.0111	-180.1131	-9.417414
350	-16.32816	-194.8385	-177.2362	-8.589582

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Appendix B (Cont.)				
351	-16.95036	-195.6429	-174.3721	-7.768798
352	-17.56542	-196.4244	-171.5211	-6.955059
353	-18.17336	-197.1831	-168.6831	-6.148366
354	-18.77419	-197.9192	-165.8583	-5.348715
355	-19.36793	-198.6328	-163.0468	-4.556104
356	-19.95461	-199.3241	-160.2488	-3.770530
357	-20.53424	-199.9933	-157.4642	-2.991989
358	-21.10685	-200.6405	-154.6932	-2.220477
359	-21.67245	-201.2658	-151.9358	-1.455988
360	-22.23106	-201.8694	-149.1922	-0.698518
361	-22.78271	-202.4516	-146.4625	0.051939
362	-23.32742	-203.0123	-143.7467	0.795390
363	-23.86521	-203.5518	-141.0449	1.531841
364	-24.39609	-204.0702	-138.3573	2.261300
365	-24.92011	-204.5678	-135.6838	2.983774
366	-25.43726	-205.0445	-133.0246	3.699272
367	-25.94759	-205.5007	-130.3797	4.407802
368	-26.45112	-205.9364	-127.7492	5.109374
369	-26.94786	-206.3519	-125.1332	5.803997
370	-27.43784	-206.7472	-122.5317	6.491681
Response of PE				
Period	**PA**	**PB**	**PE**	**PM**
1	9.663438	80.63341	71.52536	0.000000
2	14.71408	79.72661	59.78359	9.060327
3	16.32260	80.50896	58.77497	12.30714
4	16.88277	81.11270	57.70421	13.33984
5	17.04582	81.61749	56.79157	13.34069
6	17.05289	82.07370	55.94609	12.88038
7	17.00008	82.49954	55.12560	12.22300
8	16.92769	82.90320	54.31132	11.48901
9	16.85296	83.28849	53.49502	10.73286
10	16.78321	83.65731	52.67330	9.978851
11	16.72137	84.01071	51.84499	9.237570
12	16.66843	84.34932	51.00987	8.513382
13	16.62451	84.67361	50.16820	7.807851
14	16.58937	84.98393	49.32039	7.121285
15	16.56261	85.28062	48.46692	6.453440
16	16.54378	85.56396	47.60830	5.803837
17	16.53241	85.83425	46.74505	5.171907
18	16.52805	86.09173	45.87764	4.557057
19	16.53024	86.33668	45.00655	3.958696
20	16.53857	86.56932	44.13223	3.376247

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Appendix B (Cont.)				
21	16.55263	86.78991	43.25512	2.809155
22	16.57204	86.99868	42.37563	2.256886
23	16.59644	87.19584	41.49416	1.718929
24	16.62546	87.38161	40.61110	1.194794
25	16.65879	87.55620	39.72681	0.684012
26	16.69611	87.71981	38.84163	0.186133
27	16.73712	87.87264	37.95591	-0.299272
28	16.78154	88.01488	37.06996	-0.772615
29	16.82910	88.14672	36.18409	-1.234291
30	16.87954	88.26833	35.29859	-1.684677
31	16.93262	88.37989	34.41374	-2.124135
32	16.98810	88.48157	33.52981	-2.553010
33	17.04578	88.57353	32.64706	-2.971636
34	17.10544	88.65594	31.76574	-3.380329
35	17.16688	88.72895	30.88607	-3.779395
36	17.22991	88.79272	30.00829	-4.169126
37	17.29436	88.84739	29.13261	-4.549802
38	17.36005	88.89311	28.25924	-4.921691
39	17.42683	88.93002	27.38837	-5.285051
40	17.49455	88.95826	26.52019	-5.640129
41	17.56305	88.97796	25.65489	-5.987161
42	17.63220	88.98926	24.79263	-6.326375
43	17.70186	88.99229	23.93359	-6.657989
44	17.77193	88.98717	23.07792	-6.982212
45	17.84227	88.97402	22.22577	-7.299244
46	17.91277	88.95297	21.37729	-7.609280
47	17.98333	88.92413	20.53262	-7.912503
48	18.05386	88.88763	19.69188	-8.209093
49	18.12425	88.84357	18.85521	-8.499218
50	18.19441	88.79207	18.02272	-8.783045
51	18.26426	88.73323	17.19453	-9.060729
52	18.33372	88.66717	16.37075	-9.332424
53	18.40271	88.59399	15.55149	-9.598274
54	18.47116	88.51379	14.73684	-9.858420
55	18.53901	88.42668	13.92691	-10.11300
56	18.60618	88.33276	13.12178	-10.36213
57	18.67262	88.23212	12.32154	-10.60596
58	18.73826	88.12486	11.52627	-10.84458
59	18.80306	88.01108	10.73606	-11.07813
60	18.86697	87.89087	9.950973	-11.30671

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Appendix B (Cont.)				
61	18.92993	87.76432	9.171088	-11.53043
62	18.99190	87.63153	8.396470	-11.74939
63	19.05283	87.49259	7.627185	-11.96369
64	19.11270	87.34758	6.863295	-12.17344
65	19.17145	87.19660	6.104857	-12.37871
66	19.22906	87.03972	5.351928	-12.57960
67	19.28548	86.87704	4.604560	-12.77620
68	19.34070	86.70863	3.862803	-12.96859
69	19.39468	86.53459	3.126703	-13.15684
70	19.44740	86.35499	2.396306	-13.34104
71	19.49882	86.16991	1.671653	-13.52127
72	19.54894	85.97944	0.952783	-13.69759
73	19.59771	85.78365	0.239735	-13.87007
74	19.64513	85.58262	-0.467457	-14.03878
75	19.69118	85.37643	-1.168760	-14.20379
76	19.73583	85.16516	-1.864143	-14.36516
77	19.77908	84.94888	-2.553577	-14.52295
78	19.82091	84.72767	-3.237037	-14.67722
79	19.86131	84.50160	-3.914496	-14.82803
80	19.90026	84.27074	-4.585931	-14.97543
81	19.93775	84.03516	-5.251322	-15.11948
82	19.97378	83.79495	-5.910649	-15.26023
83	20.00834	83.55017	-6.563893	-15.39773
84	20.04141	83.30089	-7.211038	-15.53203
85	20.07300	83.04717	-7.852069	-15.66318
86	20.10310	82.78910	-8.486973	-15.79122
87	20.13170	82.52674	-9.115738	-15.91621
88	20.15880	82.26015	-9.738352	-16.03817
89	20.18439	81.98941	-10.35481	-16.15716
90	20.20848	81.71457	-10.96510	-16.27322
91	20.23106	81.43572	-11.56921	-16.38639
92	20.25214	81.15290	-12.16715	-16.49670
93	20.27171	80.86619	-12.75890	-16.60420
94	20.28977	80.57566	-13.34446	-16.70892
95	20.30632	80.28136	-13.92383	-16.81090
96	20.32137	79.98336	-14.49702	-16.91018
97	20.33493	79.68173	-15.06401	-17.00678
98	20.34698	79.37652	-15.62482	-17.10076
99	20.35754	79.06779	-16.17943	-17.19212
100	20.36660	78.75562	-16.72787	-17.28092

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Appendix B (Cont.)				
101	20.37418	78.44005	-17.27012	-17.36718
102	20.38028	78.12116	-17.80619	-17.45093
103	20.38491	77.79899	-18.33610	-17.53220
104	20.38806	77.47362	-18.85984	-17.61102
105	20.38975	77.14509	-19.37743	-17.68743
106	20.38998	76.81347	-19.88886	-17.76144
107	20.38876	76.47882	-20.39416	-17.83309
108	20.38610	76.14119	-20.89332	-17.90241
109	20.38200	75.80064	-21.38637	-17.96941
110	20.37647	75.45723	-21.87330	-18.03414
111	20.36952	75.11102	-22.35414	-18.09661
112	20.36116	74.76206	-22.82889	-18.15684
113	20.35140	74.41040	-23.29757	-18.21488
114	20.34024	74.05610	-23.76019	-18.27073
115	20.32770	73.69922	-24.21677	-18.32442
116	20.31378	73.33982	-24.66731	-18.37598
117	20.29849	72.97793	-25.11184	-18.42543
118	20.28185	72.61363	-25.55037	-18.47280
119	20.26385	72.24696	-25.98292	-18.51810
120	20.24453	71.87797	-26.40950	-18.56136
121	20.22387	71.50672	-26.83013	-18.60259
122	20.20190	71.13327	-27.24483	-18.64183
123	20.17863	70.75765	-27.65362	-18.67910
124	20.15405	70.37992	-28.05651	-18.71441
125	20.12820	70.00014	-28.45353	-18.74778
126	20.10107	69.61835	-28.84470	-18.77924
127	20.07268	69.23461	-29.23003	-18.80881
128	20.04304	68.84896	-29.60954	-18.83651
129	20.01216	68.46146	-29.98327	-18.86235
130	19.98005	68.07215	-30.35122	-18.88635
131	19.94673	67.68108	-30.71342	-18.90855
132	19.91220	67.28830	-31.06990	-18.92895
133	19.87648	66.89386	-31.42067	-18.94757
134	19.83957	66.49780	-31.76576	-18.96444
135	19.80150	66.10018	-32.10518	-18.97957
136	19.76227	65.70104	-32.43898	-18.99297
137	19.72189	65.30042	-32.76716	-19.00468
138	19.68039	64.89838	-33.08975	-19.01471
139	19.63776	64.49495	-33.40678	-19.02306
140	19.59402	64.09019	-33.71828	-19.02978

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Appendix B (Cont.)				
141	19.54918	63.68414	-34.02426	-19.03486
142	19.50326	63.27684	-34.32475	-19.03833
143	19.45626	62.86834	-34.61978	-19.04020
144	19.40821	62.45869	-34.90937	-19.04050
145	19.35911	62.04792	-35.19356	-19.03924
146	19.30897	61.63608	-35.47236	-19.03643
147	19.25781	61.22321	-35.74580	-19.03210
148	19.20564	60.80936	-36.01391	-19.02625
149	19.15247	60.39457	-36.27672	-19.01892
150	19.09831	59.97887	-36.53426	-19.01010
151	19.04318	59.56232	-36.78655	-18.99983
152	18.98709	59.14495	-37.03361	-18.98811
153	18.93005	58.72681	-37.27549	-18.97496
154	18.87208	58.30792	-37.51220	-18.96040
155	18.81318	57.88835	-37.74377	-18.94445
156	18.75336	57.46812	-37.97024	-18.92711
157	18.69265	57.04727	-38.19163	-18.90841
158	18.63106	56.62585	-38.40797	-18.88836
159	18.56858	56.20389	-38.61929	-18.86698
160	18.50525	55.78143	-38.82561	-18.84428
161	18.44106	55.35851	-39.02698	-18.82028
162	18.37604	54.93517	-39.22342	-18.79499
163	18.31020	54.51144	-39.41495	-18.76842
164	18.24354	54.08737	-39.60161	-18.74060
165	18.17607	53.66299	-39.78342	-18.71154
166	18.10783	53.23833	-39.96043	-18.68125
167	18.03880	52.81343	-40.13265	-18.64975
168	17.96901	52.38834	-40.30012	-18.61705
169	17.89847	51.96307	-40.46287	-18.58316
170	17.82719	51.53768	-40.62093	-18.54811
171	17.75518	51.11219	-40.77433	-18.51190
172	17.68245	50.68664	-40.92310	-18.47456
173	17.60902	50.26106	-41.06727	-18.43609
174	17.53490	49.83549	-41.20687	-18.39650
175	17.46010	49.40996	-41.34194	-18.35582
176	17.38463	48.98450	-41.47250	-18.31406
177	17.30850	48.55915	-41.59859	-18.27123
178	17.23173	48.13394	-41.72024	-18.22734
179	17.15433	47.70891	-41.83747	-18.18242
180	17.07630	47.28408	-41.95033	-18.13646

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Appendix B (Cont.)				
181	16.99767	46.85948	-42.05884	-18.08950
182	16.91844	46.43515	-42.16303	-18.04153
183	16.83862	46.01112	-42.26294	-17.99258
184	16.75822	45.58742	-42.35859	-17.94265
185	16.67727	45.16407	-42.45003	-17.89177
186	16.59576	44.74112	-42.53727	-17.83994
187	16.51371	44.31859	-42.62036	-17.78718
188	16.43113	43.89650	-42.69932	-17.73350
189	16.34803	43.47490	-42.77419	-17.67891
190	16.26442	43.05380	-42.84500	-17.62344
191	16.18032	42.63323	-42.91178	-17.56708
192	16.09573	42.21323	-42.97456	-17.50985
193	16.01067	41.79383	-43.03338	-17.45178
194	15.92515	41.37504	-43.08827	-17.39286
195	15.83917	40.95690	-43.13925	-17.33311
196	15.75276	40.53943	-43.18636	-17.27255
197	15.66591	40.12266	-43.22964	-17.21119
198	15.57864	39.70662	-43.26912	-17.14903
199	15.49096	39.29133	-43.30482	-17.08610
200	15.40289	38.87682	-43.33678	-17.02240
201	15.31443	38.46311	-43.36504	-16.95796
202	15.22558	38.05023	-43.38962	-16.89277
203	15.13638	37.63821	-43.41055	-16.82685
204	15.04681	37.22707	-43.42788	-16.76022
205	14.95690	36.81682	-43.44163	-16.69288
206	14.86665	36.40751	-43.45183	-16.62486
207	14.77608	35.99914	-43.45851	-16.55615
208	14.68518	35.59175	-43.46171	-16.48678
209	14.59399	35.18536	-43.46147	-16.41675
210	14.50249	34.77998	-43.45780	-16.34607
211	14.41071	34.37565	-43.45075	-16.27477
212	14.31866	33.97238	-43.44034	-16.20284
213	14.22633	33.57020	-43.42662	-16.13030
214	14.13375	33.16912	-43.40960	-16.05717
215	14.04092	32.76917	-43.38932	-15.98345
216	13.94786	32.37038	-43.36582	-15.90916
217	13.85456	31.97275	-43.33912	-15.83431
218	13.76105	31.57632	-43.30927	-15.75890
219	13.66733	31.18109	-43.27628	-15.68295
220	13.57340	30.78710	-43.24019	-15.60647

Appendices

Appendix B (Cont.)				
221	13.47929	30.39436	-43.20103	-15.52948
222	13.38499	30.00289	-43.15884	-15.45198
223	13.29052	29.61270	-43.11364	-15.37398
224	13.19588	29.22383	-43.06547	-15.29549
225	13.10109	28.83628	-43.01436	-15.21653
226	13.00616	28.45007	-42.96034	-15.13711
227	12.91108	28.06523	-42.90345	-15.05723
228	12.81588	27.68177	-42.84370	-14.97691
229	12.72056	27.29970	-42.78114	-14.89616
230	12.62513	26.91905	-42.71579	-14.81499
231	12.52959	26.53983	-42.64769	-14.73340
232	12.43396	26.16206	-42.57687	-14.65142
233	12.33824	25.78575	-42.50336	-14.56904
234	12.24245	25.41092	-42.42718	-14.48628
235	12.14658	25.03759	-42.34838	-14.40316
236	12.05065	24.66576	-42.26697	-14.31967
237	11.95467	24.29547	-42.18300	-14.23583
238	11.85865	23.92671	-42.09649	-14.15165
239	11.76259	23.55952	-42.00747	-14.06714
240	11.66650	23.19389	-41.91597	-13.98231
241	11.57038	22.82984	-41.82203	-13.89717
242	11.47425	22.46740	-41.72567	-13.81173
243	11.37812	22.10656	-41.62692	-13.72600
244	11.28199	21.74736	-41.52581	-13.63998
245	11.18587	21.38979	-41.42238	-13.55369
246	11.08976	21.03387	-41.31665	-13.46714
247	10.99368	20.67962	-41.20866	-13.38033
248	10.89762	20.32704	-41.09843	-13.29328
249	10.80161	19.97615	-40.98598	-13.20600
250	10.70564	19.62696	-40.87137	-13.11848
251	10.60973	19.27949	-40.75460	-13.03075
252	10.51387	18.93373	-40.63571	-12.94281
253	10.41808	18.58972	-40.51473	-12.85467
254	10.32237	18.24744	-40.39168	-12.76634
255	10.22673	17.90693	-40.26661	-12.67783
256	10.13118	17.56818	-40.13953	-12.58915
257	10.03573	17.23121	-40.01047	-12.50030
258	9.940376	16.89602	-39.87947	-12.41129
259	9.845130	16.56264	-39.74655	-12.32214
260	9.749997	16.23105	-39.61174	-12.23285

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Appendix B (Cont.)				
261	9.654984	15.90129	-39.47507	-12.14342
262	9.560098	15.57335	-39.33656	-12.05388
263	9.465344	15.24724	-39.19625	-11.96421
264	9.370729	14.92297	-39.05416	-11.87445
265	9.276259	14.60055	-38.91032	-11.78458
266	9.181941	14.28000	-38.76476	-11.69463
267	9.087779	13.96130	-38.61750	-11.60459
268	8.993780	13.64449	-38.46858	-11.51448
269	8.899951	13.32955	-38.31801	-11.42430
270	8.806295	13.01650	-38.16583	-11.33406
271	8.712821	12.70535	-38.01207	-11.24377
272	8.619532	12.39610	-37.85674	-11.15344
273	8.526436	12.08876	-37.69989	-11.06307
274	8.433536	11.78334	-37.54153	-10.97268
275	8.340839	11.47983	-37.38169	-10.88226
276	8.248351	11.17826	-37.22039	-10.79183
277	8.156076	10.87862	-37.05767	-10.70139
278	8.064019	10.58092	-36.89355	-10.61095
279	7.972187	10.28516	-36.72806	-10.52053
280	7.880583	9.991351	-36.56121	-10.43011
281	7.789214	9.699497	-36.39305	-10.33972
282	7.698084	9.409603	-36.22358	-10.24936
283	7.607198	9.121673	-36.05285	-10.15903
284	7.516561	8.835711	-35.88086	-10.06874
285	7.426178	8.551721	-35.70766	-9.978506
286	7.336054	8.269708	-35.53326	-9.888325
287	7.246192	7.989674	-35.35769	-9.798207
288	7.156599	7.711625	-35.18097	-9.708158
289	7.067278	7.435563	-35.00313	-9.618185
290	6.978234	7.161490	-34.82419	-9.528293
291	6.889471	6.889412	-34.64418	-9.438489
292	6.800993	6.619329	-34.46312	-9.348779
293	6.712806	6.351245	-34.28103	-9.259171
294	6.624913	6.085163	-34.09795	-9.169668
295	6.537319	5.821084	-33.91388	-9.080279
296	6.450026	5.559011	-33.72887	-8.991008
297	6.363041	5.298945	-33.54292	-8.901862
298	6.276366	5.040889	-33.35606	-8.812847
299	6.190005	4.784844	-33.16833	-8.723968
300	6.103963	4.530811	-32.97973	-8.635231

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Appendix B (Cont.)				
301	6.018243	4.278791	-32.79029	-8.546641
302	5.932849	4.028786	-32.60004	-8.458205
303	5.847784	3.780797	-32.40899	-8.369928
304	5.763053	3.534824	-32.21718	-8.281815
305	5.678658	3.290868	-32.02461	-8.193872
306	5.594604	3.048929	-31.83133	-8.106105
307	5.510893	2.809008	-31.63733	-8.018517
308	5.427529	2.571104	-31.44266	-7.931115
309	5.344516	2.335217	-31.24733	-7.843904
310	5.261857	2.101348	-31.05135	-7.756889
311	5.179554	1.869495	-30.85476	-7.670075
312	5.097612	1.639659	-30.65758	-7.583466
313	5.016032	1.411838	-30.45982	-7.497068
314	4.934819	1.186032	-30.26150	-7.410886
315	4.853975	0.962240	-30.06266	-7.324924
316	4.773503	0.740460	-29.86329	-7.239188
317	4.693406	0.520691	-29.66344	-7.153681
318	4.613686	0.302932	-29.46312	-7.068408
319	4.534347	0.087181	-29.26234	-6.983375
320	4.455392	-0.126563	-29.06114	-6.898584
321	4.376822	-0.338303	-28.85952	-6.814042
322	4.298641	-0.548040	-28.65751	-6.729751
323	4.220850	-0.755778	-28.45513	-6.645717
324	4.143453	-0.961517	-28.25239	-6.561944
325	4.066452	-1.165260	-28.04932	-6.478435
326	3.989849	-1.367011	-27.84594	-6.395196
327	3.913647	-1.566771	-27.64226	-6.312229
328	3.837847	-1.764544	-27.43830	-6.229539
329	3.762453	-1.960332	-27.23409	-6.147130
330	3.687466	-2.154139	-27.02964	-6.065006
331	3.612888	-2.345968	-26.82496	-5.983171
332	3.538721	-2.535822	-26.62008	-5.901627
333	3.464968	-2.723704	-26.41502	-5.820380
334	3.391630	-2.909619	-26.20979	-5.739432
335	3.318709	-3.093570	-26.00441	-5.658788
336	3.246207	-3.275560	-25.79890	-5.578450
337	3.174126	-3.455594	-25.59327	-5.498423
338	3.102468	-3.633676	-25.38755	-5.418709
339	3.031234	-3.809811	-25.18175	-5.339312
340	2.960426	-3.984001	-24.97588	-5.260236

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Appendix B (Cont.)				
341	2.890045	-4.156252	-24.76997	-5.181483
342	2.820094	-4.326568	-24.56403	-5.103057
343	2.750573	-4.494955	-24.35807	-5.024960
344	2.681485	-4.661416	-24.15212	-4.947197
345	2.612830	-4.825956	-23.94619	-4.869769
346	2.544609	-4.988581	-23.74029	-4.792680
347	2.476825	-5.149295	-23.53444	-4.715934
348	2.409478	-5.308104	-23.32866	-4.639531
349	2.342570	-5.465013	-23.12297	-4.563477
350	2.276102	-5.620028	-22.91737	-4.487772
351	2.210075	-5.773153	-22.71188	-4.412420
352	2.144489	-5.924394	-22.50652	-4.337424
353	2.079347	-6.073758	-22.30131	-4.262786
354	2.014649	-6.221249	-22.09626	-4.188509
355	1.950396	-6.366874	-21.89137	-4.114595
356	1.886589	-6.510639	-21.68668	-4.041047
357	1.823229	-6.652549	-21.48219	-3.967866
358	1.760316	-6.792611	-21.27791	-3.895056
359	1.697852	-6.930831	-21.07386	-3.822619
360	1.635837	-7.067215	-20.87006	-3.750556
361	1.574272	-7.201770	-20.66652	-3.678870
362	1.513157	-7.334502	-20.46324	-3.607564
363	1.452494	-7.465417	-20.26025	-3.536638
364	1.392282	-7.594523	-20.05756	-3.466096
365	1.332522	-7.721826	-19.85518	-3.395939
366	1.273215	-7.847333	-19.65313	-3.326170
367	1.214361	-7.971050	-19.45141	-3.256789
368	1.155960	-8.092985	-19.25005	-3.187799
369	1.098014	-8.213145	-19.04904	-3.119202
370	1.040522	-8.331536	-18.84841	-3.050999
Response of PM				
Period	**PA**	**PB**	**PE**	**PM**
1	2.291474	-4.463026	3.254088	306.9481
2	27.18527	6.596947	-12.58153	429.9846
3	45.28414	14.27255	-15.73037	475.4184
4	56.30879	20.48180	-13.17441	487.1312
5	63.06305	25.86648	-8.331444	484.0601
6	67.48008	30.82286	-2.593665	474.5418
7	70.60025	35.54888	3.421939	462.3045
8	72.94527	40.13693	9.439566	449.0274
9	74.77500	44.62824	15.33539	435.4684
10	76.22365	49.04025	21.05413	421.9697

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Appendix B (Cont.)				
11	77.36603	53.37965	26.57169	408.6844
12	78.24869	57.64836	31.87831	395.6799
13	78.90437	61.84631	36.97093	382.9846
14	79.35864	65.97268	41.84966	370.6086
15	79.63299	70.02644	46.51625	358.5539
16	79.74631	74.00661	50.97327	346.8186
17	79.71560	77.91235	55.22380	335.3987
18	79.55634	81.74296	59.27126	324.2894
19	79.28271	85.49795	63.11927	313.4854
20	78.90773	89.17699	66.77165	302.9809
21	78.44337	92.77990	70.23233	292.7700
22	77.90063	96.30664	73.50537	282.8469
23	77.28959	99.75733	76.59492	273.2052
24	76.61950	103.1322	79.50518	263.8389
25	75.89886	106.4315	82.24040	254.7418
26	75.13543	109.6558	84.80489	245.9077
27	74.33629	112.8056	87.20296	237.3302
28	73.50794	115.8813	89.43895	229.0032
29	72.65626	118.8838	91.51717	220.9206
30	71.78664	121.8138	93.44194	213.0760
31	70.90394	124.6719	95.21756	205.4636
32	70.01258	127.4592	96.84829	198.0771
33	69.11656	130.1763	98.33838	190.9107
34	68.21947	132.8244	99.69200	183.9585
35	67.32457	135.4042	100.9133	177.2145
36	66.43476	137.9167	102.0064	170.6732
37	65.55262	140.3630	102.9753	164.3289
38	64.68049	142.7440	103.8239	158.1759
39	63.82039	145.0608	104.5563	152.2090
40	62.97415	147.3144	105.1762	146.4227
41	62.14333	149.5058	105.6874	140.8119
42	61.32933	151.6361	106.0936	135.3713
43	60.53333	153.7063	106.3984	130.0961
44	59.75635	155.7175	106.6054	124.9813
45	58.99925	157.6707	106.7181	120.0221
46	58.26274	159.5668	106.7398	115.2138
47	57.54740	161.4071	106.6739	110.5520
48	56.85369	163.1924	106.5236	106.0320
49	56.18196	164.9239	106.2921	101.6497
50	55.53247	166.6024	105.9825	97.40068

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Appendix B (Cont.)				
51	54.90537	168.2291	105.5979	93.28094
52	54.30073	169.8048	105.1410	89.28644
53	53.71856	171.3305	104.6149	85.41329
54	53.15878	172.8073	104.0222	81.65768
55	52.62129	174.2360	103.3657	78.01594
56	52.10588	175.6176	102.6480	74.48447
57	51.61233	176.9530	101.8718	71.05979
58	51.14037	178.2430	101.0394	67.73853
59	50.68969	179.4886	100.1533	64.51740
60	50.25994	180.6907	99.21591	61.39322
61	49.85074	181.8500	98.22944	58.36289
62	49.46169	182.9675	97.19612	55.42341
63	49.09238	184.0439	96.11811	52.57189
64	48.74235	185.0800	94.99750	49.80549
65	48.41115	186.0766	93.83630	47.12150
66	48.09831	187.0345	92.63648	44.51726
67	47.80334	187.9545	91.39994	41.99020
68	47.52576	188.8373	90.12852	39.53786
69	47.26506	189.6836	88.82400	37.15781
70	47.02074	190.4940	87.48812	34.84774
71	46.79230	191.2694	86.12255	32.60540
72	46.57922	192.0104	84.72890	30.42859
73	46.38101	192.7177	83.30875	28.31523
74	46.19716	193.3918	81.86361	26.26325
75	46.02716	194.0335	80.39494	24.27070
76	45.87052	194.6433	78.90417	22.33565
77	45.72673	195.2218	77.39267	20.45628
78	45.59532	195.7698	75.86176	18.63079
79	45.47579	196.2876	74.31273	16.85746
80	45.36767	196.7759	72.74681	15.13463
81	45.27049	197.2353	71.16521	13.46068
82	45.18378	197.6663	69.56908	11.83406
83	45.10709	198.0694	67.95953	10.25327
84	45.03998	198.4451	66.33765	8.716851
85	44.98201	198.7939	64.70447	7.223404
86	44.93275	199.1164	63.06100	5.771574
87	44.89178	199.4130	61.40822	4.360053
88	44.85870	199.6842	59.74705	2.987579
89	44.83310	199.9304	58.07840	1.652931
90	44.81459	200.1521	56.40314	0.354933

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Appendix B (Cont.)				
91	44.80280	200.3497	54.72212	-0.907553
92	44.79735	200.5237	53.03614	-2.135624
93	44.79788	200.6745	51.34598	-3.330339
94	44.80404	200.8025	49.65240	-4.492721
95	44.81550	200.9081	47.95612	-5.623756
96	44.83191	200.9917	46.25784	-6.724398
97	44.85296	201.0536	44.55824	-7.795564
98	44.87834	201.0944	42.85797	-8.838142
99	44.90774	201.1142	41.15764	-9.852988
100	44.94087	201.1136	39.45787	-10.84093
101	44.97745	201.0928	37.75923	-11.80276
102	45.01719	201.0522	36.06228	-12.73925
103	45.05984	200.9921	34.36755	-13.65115
104	45.10514	200.9129	32.67557	-14.53916
105	45.15283	200.8149	30.98683	-15.40398
106	45.20268	200.6984	29.30180	-16.24628
107	45.25446	200.5637	27.62095	-17.06670
108	45.30794	200.4112	25.94472	-17.86585
109	45.36291	200.2411	24.27353	-18.64435
110	45.41915	200.0537	22.60779	-19.40276
111	45.47647	199.8494	20.94789	-20.14165
112	45.53467	199.6283	19.29421	-20.86155
113	45.59357	199.3909	17.64711	-21.56298
114	45.65298	199.1373	16.00693	-22.24645
115	45.71275	198.8678	14.37401	-22.91243
116	45.77269	198.5828	12.74867	-23.56140
117	45.83266	198.2824	11.13120	-24.19380
118	45.89249	197.9669	9.521915	-24.81006
119	45.95205	197.6365	7.921081	-25.41062
120	46.01119	197.2916	6.328972	-25.99587
121	46.06978	196.9323	4.745844	-26.56620
122	46.12769	196.5589	3.171943	-27.12200
123	46.18480	196.1717	1.607505	-27.66362
124	46.24098	195.7708	0.052756	-28.19142
125	46.29614	195.3564	-1.492090	-28.70574
126	46.35015	194.9289	-3.026827	-29.20691
127	46.40291	194.4884	-4.551258	-29.69524
128	46.45434	194.0351	-6.065197	-30.17104
129	46.50433	193.5693	-7.568466	-30.63461
130	46.55279	193.0912	-9.060894	-31.08623

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Appendix B (Cont.)				
131	46.59965	192.6009	-10.54232	-31.52618
132	46.64482	192.0988	-12.01259	-31.95473
133	46.68822	191.5848	-13.47155	-32.37213
134	46.72978	191.0594	-14.91908	-32.77864
135	46.76944	190.5227	-16.35503	-33.17449
136	46.80713	189.9748	-17.77928	-33.55992
137	46.84278	189.4159	-19.19171	-33.93516
138	46.87634	188.8463	-20.59222	-34.30042
139	46.90776	188.2662	-21.98069	-34.65591
140	46.93698	187.6756	-23.35702	-35.00184
141	46.96396	187.0749	-24.72113	-35.33842
142	46.98864	186.4641	-26.07292	-35.66581
143	47.01100	185.8435	-27.41231	-35.98423
144	47.03098	185.2132	-28.73922	-36.29384
145	47.04855	184.5733	-30.05359	-36.59481
146	47.06368	183.9242	-31.35533	-36.88733
147	47.07633	183.2659	-32.64440	-37.17154
148	47.08648	182.5985	-33.92072	-37.44761
149	47.09410	181.9224	-35.18426	-37.71570
150	47.09916	181.2375	-36.43495	-37.97595
151	47.10164	180.5442	-37.67275	-38.22850
152	47.10153	179.8424	-38.89763	-38.47350
153	47.09879	179.1325	-40.10953	-38.71109
154	47.09342	178.4146	-41.30844	-38.94138
155	47.08540	177.6887	-42.49431	-39.16453
156	47.07472	176.9551	-43.66713	-39.38064
157	47.06137	176.2139	-44.82687	-39.58984
158	47.04533	175.4653	-45.97350	-39.79225
159	47.02660	174.7093	-47.10702	-39.98798
160	47.00518	173.9463	-48.22741	-40.17714
161	46.98105	173.1762	-49.33465	-40.35985
162	46.95422	172.3992	-50.42874	-40.53620
163	46.92468	171.6155	-51.50968	-40.70631
164	46.89244	170.8253	-52.57746	-40.87026
165	46.85748	170.0286	-53.63208	-41.02816
166	46.81982	169.2256	-54.67355	-41.18011
167	46.77946	168.4164	-55.70186	-41.32619
168	46.73640	167.6012	-56.71704	-41.46649
169	46.69065	166.7801	-57.71908	-41.60111
170	46.64221	165.9532	-58.70800	-41.73013

Appendices

Appendix B (Cont.)				
171	46.59109	165.1206	-59.68381	-41.85363
172	46.53730	164.2826	-60.64654	-41.97169
173	46.48085	163.4391	-61.59619	-42.08441
174	46.42175	162.5904	-62.53279	-42.19184
175	46.36000	161.7366	-63.45636	-42.29407
176	46.29563	160.8778	-64.36693	-42.39118
177	46.22864	160.0141	-65.26451	-42.48324
178	46.15904	159.1456	-66.14914	-42.57031
179	46.08686	158.2725	-67.02085	-42.65248
180	46.01210	157.3948	-67.87967	-42.72980
181	45.93477	156.5128	-68.72563	-42.80234
182	45.85491	155.6265	-69.55875	-42.87018
183	45.77251	154.7360	-70.37909	-42.93337
184	45.68761	153.8414	-71.18667	-42.99198
185	45.60021	152.9430	-71.98154	-43.04607
186	45.51034	152.0407	-72.76373	-43.09571
187	45.41801	151.1347	-73.53328	-43.14094
188	45.32324	150.2251	-74.29023	-43.18183
189	45.22605	149.3120	-75.03464	-43.21844
190	45.12646	148.3955	-75.76653	-43.25083
191	45.02450	147.4758	-76.48597	-43.27904
192	44.92018	146.5529	-77.19298	-43.30314
193	44.81352	145.6270	-77.88763	-43.32318
194	44.70454	144.6981	-78.56996	-43.33921
195	44.59328	143.7664	-79.24002	-43.35128
196	44.47974	142.8320	-79.89786	-43.35945
197	44.36395	141.8949	-80.54353	-43.36377
198	44.24593	140.9553	-81.17708	-43.36428
199	44.12571	140.0132	-81.79857	-43.36104
200	44.00331	139.0688	-82.40805	-43.35409
201	43.87875	138.1222	-83.00558	-43.34348
202	43.75206	137.1735	-83.59121	-43.32926
203	43.62325	136.2227	-84.16500	-43.31147
204	43.49236	135.2700	-84.72700	-43.29016
205	43.35941	134.3155	-85.27727	-43.26538
206	43.22441	133.3592	-85.81588	-43.23718
207	43.08741	132.4013	-86.34288	-43.20558
208	42.94841	131.4418	-86.85833	-43.17065
209	42.80745	130.4808	-87.36228	-43.13241
210	42.66455	129.5185	-87.85482	-43.09092

Appendices

Appendix B (Cont.)				
211	42.51973	128.5549	-88.33598	-43.04622
212	42.37302	127.5901	-88.80584	-42.99834
213	42.22445	126.6242	-89.26446	-42.94734
214	42.07403	125.6573	-89.71190	-42.89324
215	41.92180	124.6895	-90.14823	-42.83609
216	41.76778	123.7208	-90.57351	-42.77594
217	41.61199	122.7514	-90.98780	-42.71281
218	41.45447	121.7813	-91.39118	-42.64675
219	41.29523	120.8106	-91.78370	-42.57780
220	41.13430	119.8395	-92.16543	-42.50599
221	40.97171	118.8679	-92.53644	-42.43137
222	40.80748	117.8960	-92.89679	-42.35397
223	40.64164	116.9238	-93.24656	-42.27383
224	40.47420	115.9515	-93.58581	-42.19098
225	40.30521	114.9790	-93.91461	-42.10547
226	40.13468	114.0066	-94.23302	-42.01732
227	39.96264	113.0342	-94.54112	-41.92658
228	39.78912	112.0619	-94.83897	-41.83328
229	39.61413	111.0899	-95.12664	-41.73745
230	39.43771	110.1181	-95.40421	-41.63914
231	39.25987	109.1468	-95.67174	-41.53836
232	39.08066	108.1758	-95.92930	-41.43517
233	38.90008	107.2054	-96.17696	-41.32959
234	38.71817	106.2356	-96.41480	-41.22166
235	38.53495	105.2664	-96.64288	-41.11141
236	38.35044	104.2980	-96.86127	-40.99888
237	38.16468	103.3304	-97.07005	-40.88409
238	37.97768	102.3636	-97.26928	-40.76709
239	37.78947	101.3978	-97.45905	-40.64790
240	37.60007	100.4330	-97.63941	-40.52655
241	37.40951	99.46921	-97.81044	-40.40308
242	37.21782	98.50661	-97.97221	-40.27753
243	37.02502	97.54522	-98.12480	-40.14991
244	36.83112	96.58509	-98.26828	-40.02027
245	36.63617	95.62630	-98.40271	-39.88863
246	36.44017	94.66892	-98.52818	-39.75503
247	36.24316	93.71299	-98.64475	-39.61950
248	36.04516	92.75859	-98.75249	-39.48206
249	35.84619	91.80578	-98.85148	-39.34275
250	35.64628	90.85462	-98.94180	-39.20160

Appendices

Appendix B (Cont.)				
251	35.44545	89.90516	-99.02351	-39.05863
252	35.24372	88.95747	-99.09668	-38.91389
253	35.04112	88.01160	-99.16139	-38.76739
254	34.83767	87.06762	-99.21772	-38.61916
255	34.63339	86.12558	-99.26572	-38.46925
256	34.42831	85.18554	-99.30549	-38.31767
257	34.22245	84.24754	-99.33709	-38.16445
258	34.01583	83.31166	-99.36059	-38.00962
259	33.80848	82.37794	-99.37606	-37.85322
260	33.60041	81.44643	-99.38358	-37.69526
261	33.39165	80.51720	-99.38323	-37.53578
262	33.18223	79.59028	-99.37507	-37.37481
263	32.97216	78.66574	-99.35917	-37.21237
264	32.76146	77.74362	-99.33562	-37.04849
265	32.55017	76.82397	-99.30448	-36.88319
266	32.33829	75.90685	-99.26582	-36.71652
267	32.12586	74.99230	-99.21972	-36.54848
268	31.91289	74.08038	-99.16625	-36.37911
269	31.69940	73.17112	-99.10548	-36.20843
270	31.48542	72.26458	-99.03748	-36.03648
271	31.27097	71.36079	-98.96234	-35.86328
272	31.05606	70.45982	-98.88011	-35.68884
273	30.84072	69.56170	-98.79087	-35.51321
274	30.62497	68.66647	-98.69469	-35.33640
275	30.40883	67.77419	-98.59165	-35.15845
276	30.19232	66.88489	-98.48182	-34.97937
277	29.97546	65.99861	-98.36526	-34.79919
278	29.75827	65.11541	-98.24205	-34.61793
279	29.54077	64.23531	-98.11227	-34.43563
280	29.32298	63.35836	-97.97597	-34.25230
281	29.10492	62.48460	-97.83324	-34.06798
282	28.88661	61.61407	-97.68414	-33.88268
283	28.66807	60.74680	-97.52875	-33.69642
284	28.44931	59.88284	-97.36714	-33.50924
285	28.23036	59.02222	-97.19937	-33.32116
286	28.01123	58.16498	-97.02551	-33.13220
287	27.79195	57.31116	-96.84564	-32.94238
288	27.57253	56.46078	-96.65983	-32.75173
289	27.35299	55.61389	-96.46815	-32.56026
290	27.13335	54.77052	-96.27066	-32.36802

Appendices

Appendix B (Cont.)				
291	26.91362	53.93070	-96.06744	-32.17500
292	26.69383	53.09447	-95.85855	-31.98125
293	26.47399	52.26186	-95.64406	-31.78678
294	26.25413	51.43290	-95.42405	-31.59161
295	26.03425	50.60762	-95.19858	-31.39576
296	25.81437	49.78606	-94.96772	-31.19927
297	25.59452	48.96823	-94.73154	-31.00214
298	25.37470	48.15418	-94.49010	-30.80441
299	25.15494	47.34393	-94.24348	-30.60609
300	24.93526	46.53751	-93.99174	-30.40720
301	24.71566	45.73495	-93.73495	-30.20776
302	24.49617	44.93627	-93.47318	-30.00781
303	24.27679	44.14151	-93.20649	-29.80735
304	24.05756	43.35068	-92.93495	-29.60641
305	23.83848	42.56382	-92.65862	-29.40500
306	23.61957	41.78094	-92.37758	-29.20316
307	23.40084	41.00208	-92.09189	-29.00089
308	23.18231	40.22726	-91.80161	-28.79822
309	22.96400	39.45649	-91.50682	-28.59518
310	22.74592	38.68981	-91.20757	-28.39177
311	22.52809	37.92723	-90.90393	-28.18801
312	22.31051	37.16879	-90.59596	-27.98394
313	22.09321	36.41449	-90.28374	-27.77956
314	21.87620	35.66436	-89.96732	-27.57490
315	21.65949	34.91842	-89.64676	-27.36997
316	21.44310	34.17668	-89.32214	-27.16479
317	21.22704	33.43918	-88.99352	-26.95939
318	21.01133	32.70593	-88.66095	-26.75378
319	20.79597	31.97693	-88.32450	-26.54798
320	20.58099	31.25223	-87.98424	-26.34200
321	20.36640	30.53182	-87.64023	-26.13587
322	20.15220	29.81573	-87.29252	-25.92960
323	19.93842	29.10397	-86.94118	-25.72321
324	19.72506	28.39656	-86.58628	-25.51671
325	19.51214	27.69352	-86.22786	-25.31014
326	19.29967	26.99485	-85.86601	-25.10349
327	19.08767	26.30058	-85.50076	-24.89679
328	18.87614	25.61071	-85.13219	-24.69006
329	18.66510	24.92526	-84.76036	-24.48331
330	18.45456	24.24424	-84.38532	-24.27656

Appendices

Appendix B (Cont.)				
331	18.24453	23.56767	-84.00713	-24.06983
332	18.03502	22.89556	-83.62585	-23.86313
333	17.82605	22.22791	-83.24155	-23.65647
334	17.61763	21.56474	-82.85428	-23.44988
335	17.40976	20.90606	-82.46409	-23.24337
336	17.20247	20.25189	-82.07106	-23.03695
337	16.99575	19.60221	-81.67522	-22.83064
338	16.78962	18.95706	-81.27665	-22.62446
339	16.58410	18.31644	-80.87539	-22.41842
340	16.37919	17.68034	-80.47151	-22.21253
341	16.17490	17.04880	-80.06506	-22.00682
342	15.97124	16.42180	-79.65610	-21.80129
343	15.76823	15.79936	-79.24468	-21.59596
344	15.56587	15.18148	-78.83086	-21.39084
345	15.36417	14.56817	-78.41468	-21.18595
346	15.16314	13.95944	-77.99622	-20.98131
347	14.96280	13.35528	-77.57552	-20.77692
348	14.76315	12.75572	-77.15263	-20.57280
349	14.56419	12.16074	-76.72762	-20.36896
350	14.36595	11.57036	-76.30052	-20.16542
351	14.16843	10.98457	-75.87141	-19.96219
352	13.97163	10.40338	-75.44032	-19.75928
353	13.77557	9.826803	-75.00731	-19.55671
354	13.58026	9.254827	-74.57243	-19.35449
355	13.38569	8.687460	-74.13574	-19.15263
356	13.19189	8.124702	-73.69728	-18.95115
357	12.99886	7.566556	-73.25711	-18.75005
358	12.80661	7.013022	-72.81528	-18.54935
359	12.61514	6.464101	-72.37183	-18.34906
360	12.42447	5.919792	-71.92683	-18.14920
361	12.23459	5.380096	-71.48031	-17.94977
362	12.04553	4.845013	-71.03232	-17.75078
363	11.85728	4.314541	-70.58292	-17.55226
364	11.66985	3.788679	-70.13216	-17.35420
365	11.48325	3.267425	-69.68008	-17.15663
366	11.29749	2.750778	-69.22672	-16.95954
367	11.11258	2.238736	-68.77215	-16.76296
368	10.92851	1.731295	-68.31640	-16.56690
369	10.74530	1.228452	-67.85952	-16.37135
370	10.56296	0.730206	-67.40156	-16.17635

Note: Cholesky One S.D. (d.f. adjusted); Cholesky ordering: *PA, PB, PE, PM*.

Cite this article as: Suliman Alshahmy, Arnaz Binsardi and Padmi Nagirikandalage (2024). Relationship between the Pricing and Trading of Cryptocurrencies and the Collectible, Metaverse, and Art Non-Fungible Token Subcategories. *International Journal of Cryptocurrency Research,* 4(2), 12-66. doi: 10.51483/IJCCR.4.2.2024.12-66.