

Charles University
Faculty of Social Sciences
Institute of Economic Studies



MASTER'S THESIS

Alternative Investment in Art Assets

Author: **Bc. Mirela Kruja**

Study program: **Economics and Finance**

Supervisor: **prof. Roman Horvath**

Academic Year: **2023/2024**

Declaration of Authorship

The author hereby declares that she compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

The author grants to Charles University permission to reproduce and to distribute copies of this thesis document in whole or in part.

Prague, January 2024

Mirela Kruja

Acknowledgments

I would like to express my gratitude to my supervisor for his guidance and support throughout this journey. Additionally, I would like to thank my family for their support during the process of writing this diploma thesis.

Abstract

This thesis investigates the influence of market uncertainty on investments in alternative asset classes, specifically art collectibles, wine, and stamps, over a span of 50 years leading up to the economic downturn of the 2000s, from 1960 to 2007. It explores the premise that such investments can hedge risk during times of financial instability, thus complementing traditional investment strategies. The study aims to provide empirical evidence of the relationship between the price of these alternative asset classes and macroeconomic variables. This paper should serve as an update to the existing body of literature on alternative investments in collectibles, providing valuable insights into how market uncertainty shapes investment behavior. Overall, the results of the study show that macroeconomic variables dynamics play a significant role in shaping the prices in the art market, and by extension, other alternative investment markets, while the analysis of this study emphasizes the role of macroeconomic conditions such as interest rates, inflation rate, and the EPU Index.

JEL Classification	D81, G11, Z11
Keywords	alternative investments, art price index, wine price index, stamp price index, investment, cointegration model, collectibles
Title	Alternative Investment in Art Assets

Abstrakt

Tato práce zkoumá vliv tržní nejistoty na investice do alternativních tříd aktiv, konkrétně uměleckých sběratelských předmětů, vína a známek, v období 50 let, které vedly k hospodářskému útlumu roku 2000, od roku 1960 do roku 2007. Zkoumá předpoklad, že takové investice mohou zajistit riziko v době finanční nestability, a tak doplnit tradiční investiční strategie. Cílem studie je poskytnout empirický důkaz o vztahu mezi cenou těchto alternativních tříd aktiv a makroekonomickými proměnnými. Tato práce by měla sloužit jako aktualizace stávajícího souboru literatury o alternativních investicích do sběratelských předmětů a poskytovat cenné poznatky o tom, jak nejistota na trhu utváří investiční chování. Celkově výsledky studie ukazují, že dynamika makroekonomických proměnných hraje významnou roli při utváření cen na trhu s uměním a potažmo i na dalších alternativních investičních trzích, zatímco analýza této studie zdůrazňuje roli makroekonomických podmínek, jako je úrok sazby, míra inflace a index EPU.

Klasifikace	D81, G11, Z11
Klíčová slova	alternativní investice, index cen umění, index cen vína, index cen známek, investice, kointegrační model, sběratelské předměty
Název práce	Alternativní investice do uměleckého majetku

Table of Contents

Abstract.....	vii
Abstrakt	vii
List of Tables	xi
List of Figures	xii
List of Formulas.....	xiii
Acrynoms.....	xiv
Master's Thesis Proposal	xv
1. Introduction.....	1
2. Literature Review	3
2.1 Investments into collectibles	3
2.2 Factors Influencing the Price of Art	5
2.3 Other collectibles.....	9
2.4 Future point of view on investments in collectibles.....	9
3. Data and Methods	11
3.1 Collectibles Variables.....	11
3.2 Macroeconomic Variables.....	15
3.3 Methodology.....	18
3.3.1 Country Choice.....	18
3.3.2 Variables.....	19
3.3.3 Data Type and Sources.....	21
3.3.4 Methods	22
4. Data Analysis.....	28

4.1	Data Description	28
4.2	Unit-Root Tests	32
4.3	Granger Causality	33
4.4	Cointegration Tests.....	35
4.5	Regression Results.....	37
5.	Discussion and Recommendations.....	45
6.	Conclusion	48
7.	References	51
	List of Appendices.....	56

List of Tables

Table 1, descriptive statistics.....	28
Table 2, correlation matrix	30
Table 3, the results of the first ADF tests	32
Table 4, the results of the second ADF tests	33
Table 5, Granger causality tests for the first model.....	33
Table 6, Granger causality tests for the second model	34
Table 7, Granger causality tests for the third model.....	34
Table 8, Johansen test for ART	35
Table 9, Johansen test for WINE.....	36
Table 10, Johansen test for STAMP	36
Table 11, the first ART model.....	37
Table 12, the second ART model	38
Table 13, the first WINE model	40
Table 14, the second WINE model.....	41
Table 15, the first STAMP model.....	42
Table 16, the second STAMP model.....	43
Table 17, the summary of models.....	45
Table 18, the estimation dataset.....	56

List of Figures

Figure 1, the time series plot of art market index	12
Figure 2, the time series plot of wine market index	13
Figure 3, the time series plot of the stamp market index.....	14
Figure 4, the time series plot of EPU index.....	15
Figure 5, the time series plot of the GDP per capita.....	16
Figure 6, the time series plot of the long-term interest rate.....	17
Figure 7, the time series plot of inflation.....	18

List of Formulas

Formula 1, mean indicator	22
Formula 2, mean indicator	23
Formula 3, standard deviation indicator	23
Formula 4, skewness.....	23
Formula 5, kurtosis	23
Formula 6, Jarque-Bera statistic	24
Formula 7, Pearson correlation coefficient.....	24
Formula 8, t-statistic for Pearson correlation coefficient	24
Formula 9, unit root visualization.....	25
Formula 10, economic models.....	26
Formula 11, models for ART.....	26
Formula 12, models for WINE	26
Formula 13, models for STAMP	27

Acrynomns

WINE	Wine Price Index
STAMP	Stamp Price Index
ART	Art Price Index
VECM	Vector Error Correction Model
VAR	Vector Autoregression
EPU	Economic Policy Uncertainty
GDP	Gross Domestic Product
ADF	Augmented Dickey-Fuller
EU	European Union
UK	United Kingdom
USD	United States Dollar
ECT	Error Correction Term
ML	Maximum Likelihood

Master's Thesis Proposal

Author: Bc. Mirela Kruja
Supervisor: Prof. Roman Horvath
Defense Planned: June 2024

Proposed Topic:

Alternative investment in Art Assets

Motivation:

Art is not only appreciated for the aesthetic value; it has but as a form of investment as well. Recent trends have shown that the prices fetched or commanded by various pieces of art have significantly increased (Frey and Eichenberger, 1995). The art market consists of both main and subsidiary markets. While the main market deals in contemporary art, the secondary market is vested in resales and handles art that is mostly ancient and modern (Baumol, 1986).

As an oligopoly, the sale of art is determined and managed the most influential auction houses. They limit the amount of artists or art that makes its way into the market through the auction route. Artistic works are usually unique. The value one attaches to the product depends on the taste of the dealer (Merrill et al., 2006). The competition in the industry is quite high and intense. The hurdles that ought to be handled before entry into the market, such as fixed costs, are quite high. This significant increase in prices points towards the alluring nature of the investment in art. The industry has witnessed a growth in its worth and annual turnover, i.e., U.S. \$30 billion (ATF, 2007). From its indices, the “Mei Moses All Art Index”, and the “Art Market Research”, it is clear that the returns, when compared to stock markets, are equally as profitable.

The uncertainty that has plunged into the stock markets, as well as an economy that is slowing down, has pushed persons or organizations that are high net worth to seek different investment avenues. Art as an investment stands out ahead of the rest owing to the following significant characteristics (Palmeri, 2007): 1) art has witnessed sustainable demand, 2) there is a limited supply, 3) over time, it has proven to endure or withstand various economic downturns. With regards to primary markets, the cost or value of the art is often uncertain and mostly relies on trying to promote the artists (Taylor, 2007). As such, it is difficult to estimate the potential returns of them.

Concerning cost, the golden rule is that the price attached to an artistic work encompasses the production costs incurred as well as its aesthetic value. Several artistic works are quite expensive because of the production costs incurred (Groysberg et al., 2006). Production costs entail the direct production costs involved, the notional salary owing to the time spent preparing the art, the market costs, and the costs incurred from taxes, insurance, etc. Another concern will be the investments in times of crisis where there could be two effects, one where the price increases because of increase of demand in time of uncertainty but in the same time could be a troubled state because of recession and the other effect would be where it decreases the price so substituted or complements in investment opportunities will dominate.

The risk and returns are high either for alternative investments, and normal traditional alternatives like real estates, hedge funds, private equity etc. There is a \$30 billion international Art market, which is an enormous new area, where because of its global

increasing, the rush of getting into alternative investments have increased especially in alternative asset classes like Art. (Campbell, 2005). Art has become the new attraction regarding investments.

Furthermore, costs are incurred through the commissioning of the artists, making advertisements, offering insurance cover, and the distribution of the art after purchase. The market justifies the high costs since it is hard to liquidate the existing assets (Douglas, 2008). The competition in the industry is based on how unique the artwork is, and not on the price.

Hypotheses:

1. Hypothesis #1: How alternative investment perform vis a vis increased financial uncertainty in different markets?
2. Hypothesis #2: Do collectibles perform as a hedge or not.
3. Hypothesis #3: How uncertainty shapes investments into alternative asset classes such as collectibles.

Methodology:

In order to investigate the impact of alternative investment of art assets in the economy, it is particularly important to observe the relationship of it in the market time series pattern which is going to be done by using Cointegration model. This because the analysis is going to be a of a long run relationship in terms of economic time series data. The model will be created by yearly data of the 20th and 21st century so this way is going to be seen the investment outcomes. The application of Johansen test for cointegration model has feasible advantages among which is the fact that allows us to use large samples.

The analysis would concentrate on the relevant determinants of art prices that are chosen based on previous studies made for this type of topic. Market index would be used to demonstrate that the equity returns of the market that have had a significant impact on the level of price in the art market over the 20th century (Goetzmann and Renneboog, 2011). To build the art price indexes in the long run there will be needed the auction sales data collected by Gerard Reitlinger (1961) and in Christophe Spaenjers website. Some other variables to be included in the model would be GDP per capital, GDP growth, Inflation rate, net personal wealth, house price index, population. As a proxy of resource would be the UK Bureau of Labour Statistics over time on the price indexes of art and Christophe Spaenjers published papers.

Expected Contribution:

The production of art relies on creativity, whereas its consumption relies on the interpretation one attaches to it. The challenge of the thesis is to examine how the uncertainty will shape normal investments into the alternative asset classes such as collectibles. Typically, higher uncertainty in financial markets hampers traditional asset prices.

The study will attempt to provide empirical evidence of the effect of the collectibles serving as a way to hedge the risk. Moreover, updates of the previous research papers related to alternative investments in collectibles will be included.

Outline:

1. Introduction
2. Theory and Literature Review
3. Empirical Investigation on alternative investment in art assets
4. Results
5. Conclusion

Core Bibliography:

1. Art Trading Fund (ATF), 2007, Art Trading Fund Investor Report, August–October, 2007
2. Dimson, E., Rousseau, P. L. and Spaenjers, C. (2015) ‘The price of wine’, *Journal of Financial Economics*, 118(2), pp. 431–449. doi: [10.1016/j.jfineco.2015.08.005](https://doi.org/10.1016/j.jfineco.2015.08.005).

3. Dimson, E. and Spaenjers, C. (2011) 'Ex post: The investment performance of collectible stamps', *Journal of Financial Economics*, 100(2), pp. 443–458. doi: [10.1016/j.jfineco.2010.12.005](https://doi.org/10.1016/j.jfineco.2010.12.005).
4. Art as an Asset: Evidence from Keynes the Collector | The Review of Asset Pricing Studies | Oxford Academic (no date). Available at: <https://academic.oup.com/raps/article/10/3/490/5716334?guestAccessKey=f96774de-5564-41e3-bcb0-9ed47d0f9b1b>
5. Christophe Spaenjers, D. C. (2020). Art as an asset: Evidence from Keynes the collector. *The Review of Asset Pricing Studies*, Volume 10, Issue 3,.
6. Renneboog, L. & C. Spaenjers (2013): "Buying Beauty: On Prices and Returns in the Art Market." *Management Science* 59(1): pp. 36–53.
7. Baumol, W, 1986, "Unnatural Value: Or Art Investment as a Floating Crap Game." *American Economic Review*, 76: 10-14
8. Douglas, S, 2008, Larry Gagosian, *Intelligent Life*, *The Economist*, vol.1, issue 3, Spring, pp. 100-107.
9. Eckstein, J, 2006, "Treating Art as an Asset Class," *Investing in Art*, Jeremy Eckstein, and Associates, London
10. Frey, B, 2003 "Art Markets and Economics: Introduction," University of Zurich, *Journal of Cultural Economics*, Vol. 21, 2003
11. Frey, B. and R. Eichenberger, 1995, "On the Return of Art Investment Return Analyses," *Journal of Cultural Economics*, 19, 207-220
12. Grant, D, 2006, "Art investment companies begin to make a purchase," *Main Antique Digest*, September 20th, 2006
13. Groysberg, B, Podolny, J, Keller, T, 2006, "Fernwood Art Investments: Leading in an imperfect marketplace," Harvard Business School Publishing, Cambridge, M.A., 2006
14. Mei, J.P and Moses, 2002, M, "Art as an Investment and the Underperformance of Masterpieces," *American Economic Review*, December 2002.
15. Merrill Lynch/Cap Gemini and Ernst & Young, 2006 "The World Wealth Report," New York, NY
16. Palmeri, C, 2007, "The Artful Investor. New research calls art a smart investment, but sceptics point to high costs and high risk", *Business Week*, March 12th, 2007
17. William Goetzmann, Luc Renneboog, 2011 "Art and Money". *American Economic Review*, 2011, Vol. 101, No. 3
18. Chanel, O. (1995): "Is art market behaviour predictable?" *European Economic Review* 39(3-4): pp. 519–527.
19. Ursprung, H. & C. Wiermann (2008): "Reputation, Price, and Death: An Empirical Analysis of Art Price Formation." CESifo Working Paper Series 2237, CESifo Group Munich.
20. Chambers, David and Dimson, Elroy and Spaenjers, Christophe, *Art as an Asset: Evidence from Keynes the Collector* (October 5, 2019).

1. Introduction

Arts' popularity has grown over time, and its value has started to be derived not only from its enjoyment but also from wealthy potential buyers. The production of art is based on the artists' creative intention translated to paper or portrait. Its consumption relies on the derivative value attached to the artwork. The valuation and sale process depends on the dealers' investment in ensuring that art prices remain within a particular gap and that the clients get value for their money (Grant, 2006). They also work towards sustaining their credibility and reputation in the market. The dealers do so by reinvesting and buying based on the art valuation and selling the pieces to their clients. Art is usually seen as an alternative business investment. The relationship between the risk and return of other investment opportunities will be examined to explain why many people are interested in and invest in art. Art investment is different from other investment assets, among others, given its attractive characteristics. The art market is an oligopoly, and it consists of the primary and subsidiary markets. An investment in art differs from other investments in the sense that the cost involved, which includes, among others, commissioning and marketing, is significant when compared to the actual investment size (Campbell, 2009). At the same time, art investment is unique from the points of view of both investors, as it attracts different types of demand, and art dealers, as they can apply different investment strategies.

The challenge of the thesis is to examine how uncertainty shapes investments into alternative asset classes such as collectibles. Typically, higher uncertainty in financial markets hampers traditional asset prices. The study will provide empirical evidence of the effect of collectibles serving as a way to hedge risks and analyze whether investing in them increases or decreases performance during times of financial uncertainty. It can be seen in previous literature how equity returns, and personal income would determine the price of art. This was shown by especially using price indices. However, the income inequality changes have significantly impacted British art pieces, especially in the first half of the twentieth century (Goetzmann, Renneboog and Spaenjers, 2011). Moreover, updates of previous research papers related to alternative investments in collectibles will be included in the thesis. The empirical results of this study will be helpful in shedding light on the topic and bringing more knowledge about how various actors and uncertainty affect investments in alternative assets.

This thesis aims to shed some light on examining how uncertainty in the market shapes standard investments into alternative asset classes, such as art collectibles, wine, and stamps. The scope of the research will cover approximately 50 years, until the Great Recession in the middle of the 2000s. The study will attempt to provide empirical evidence of the effect of art collectibles serving as a way to hedge risk and investigate whether it will increase or decrease the performances during times of financial uncertainties, therefore complementing existing research on the topic. It will also investigate the relationship between the price of collectibles and macroeconomic variables.

The thesis will consist of the following chapters: In Chapter 2, an overview of relevant literature is provided. In Chapter 3, an empirical investigation is provided, whilst also in that chapter, the methodology is outlined. Chapter 4, describes data used in the estimation, as well as the estimation process itself. Chapter 5 presents the comparison of the researcher's findings with the findings of other scholars and formulates relevant recommendations for future research. Chapter 6 concludes the study with a summary of findings and additional recommendations.

2. Literature Review

The fundamental goal is to take a closer look at the importance of collectibles in the investment portfolio and the way alternative investments perform in the market. The role of art has undergone significant transformations in recent years. Previous research on art as an asset has utilized art price indices, which will also be employed as a reference for this thesis to represent art's performance (Chambers, Dimson and Spaenjers, 2019). Additionally, a summary of research on art markets is presented.

2.1 Investments into collectibles

Art has been valued not just for its visual appeal but also as an avenue for investment. Past studies in the art market have utilized a range of datasets, necessitating diverse methodologies. This thesis will focus on the risk of alternative investments, particularly on studying art, stamps, and wine as assets and their behavior in the market. The perspective on risk and return in the art market has evolved due to art being increasingly perceived as a speculative asset (Chanel, 1995). Evidence of this trend can be observed in the significant price appreciation of various art pieces (Frey and Eichenberger, 1995). This considerable surge in prices highlights the appealing investment opportunities in the art market. Over time, the industry has demonstrated growth in both its overall value and annual turnover. According to various indices, notably the "Mei Moses All art Index" as well as the "Art Market Research," it becomes evident that the returns from art investments are approaching, and in some cases even surpassing, the profitability of stock markets, making them a potentially more favorable option (Mei and Moses, 2002, 2005)

Since aesthetic and social benefits cannot be measured in money, Chanel (1995) suggests that one should focus on liquidity and risk as alternative benchmarks instead of returns. As Chanel (1995) investigated the market behavior of alternative investments, it was concluded that art does not possess the characteristics of a liquid asset and cannot be easily divided. Moreover, its value is determined by complex and subjective prices, making it an even riskier investment. In the meantime, financial assets exhibit liquidity and have diversification, consequently reducing their susceptibility to risk. The international alternative investments market, valued at \$30 billion, has emerged as a vast and flourishing sector. The increasing global interest in this market has led to a heightened influx of investors, particularly in alternative asset

classes like art (Campbell, 2005). Art has now become an appealing option for investment.

The art market consists of the main and subsidiary markets. While the main market handles first-time sales and deals with contemporary art, the secondary market is vested in resales and handles art that is primarily ancient and modern. The artists whose art is featured on the secondary market are usually deceased (Baumol, 1985). Furthermore, the creators of contemporary art are mostly still alive, which is another crucial point. One of the main challenges is correctly estimating the potential return on art investments. For secondary markets, frequently, it is tough to find quality art that would be available for sale. For primary markets, the cost or value of the art is often uncertain and mainly relies on the popularity of the artists (Taylor, 2007).

Art as an investment distinguishes itself from others due to the following notable attributes: 1) art has witnessed sustainable demand, 2) there is a limited supply, and 3) over time, it has proven to endure or withstand various economic downturns (Palmeri, 2007).

The sale of art is mainly determined and managed at the most influential auction houses, making the market an oligopoly. They limit the number of artists or Art that makes its way into the market through the auction route. Artistic works are usually unique. The value one attaches to the product depends on the taste of the dealer (Merrill Lynch and E&Y, 2006). The competition in the industry is relatively high and intense. At the same time, the obstacles that ought to be handled before entering the market, such as the fixed costs, are high. These are examples of an oligopolistic market.

Further costs are incurred through commissioning the artists, making advertisements, offering insurance coverage, and distributing the art after its purchase. The market justifies the high costs since it is hard to liquidate the existing assets (Douglas, 2008). The competition in the industry is based on how unique the artwork is and is not based on the price. Related to this comes the financial sanity of the investors, which is driven by their net personal wealth, who convert their wealth into alternative investments or, differently, "investments of passion". However, this financial sanity is also related to the stock market's return, which is a way to measure changes in the buying power of the wealthy society, since equities are held broadly among the wealthy society (Goetzmann, Renneboog and Spaenjers, 2011). Yet, it is important to note that alternative investors are not the only stakeholders in the art market. Traditional art collectors, who view art beyond a mere asset class alongside stocks, bonds, commodities, and real estate, are also concerned about price formation

and the return characteristics specific to art (Goetzmann, Renneboog and Spaenjers, 2011).

Art is gaining popularity and accounts for a non-negligible portion of total wealth. The art's value depends on the enjoyment and the potential owners of the artwork. The duration of work can vary because of the sell-and-buy nature of the artwork. The artwork has a non-tradable use of value, and the auction is costly when an item fails to sell. An individual acquires an art if he or she is willing to pay for it. This way, the bidder enjoys emotional dividends and represents taste and wealth. When the owner is distressed, the dividends turn negative, but it is assumed that the potential buyers are renewed every period (Lovo and Spaenjers, 2018).

2.2 Factors Influencing the Price of Art

Art is a unique and, at the same time, a heterogeneous work, so even the value of each product would depend on the taste of the dealer. With heterogeneity also comes the pressure of competition in this industry, which is followed by difficulties to enter because of high fixed costs and also the difficulty in exiting since art is hard to liquidate (Mamarbachi, Day and Favato, 2008). Factors that could affect the art industry are also characteristics of the paintings, such as colors and the size of the painting, which typically leads to a higher price. Characteristics like those mentioned above always matter without leaving behind the importance of who the author is and whether he is alive.

Wealth affects the prices of art in the market, and therefore the price of art is significantly related to personal income and equity returns. The changes in income equality significantly affect the demand for art and the shifts in preference change to higher quality pieces. The evidence is in the transition of art in Britain over the first half of the twentieth century, which caused the transformation of the demand curve overall (Goetzmann, Renneboog and Spaenjers, 2011).

As a portfolio diversifier, art constitutes a non-negligible proportion of the total household wealth. However, unlike a financial asset whose market price is dictated by its value to well-diversified buyers, various potential owners will value a particular painting or sculpture differently depending on their private pleasure. Secondly, in an infinite-horizon economy, individuals buy and sell artworks, so the period of ownership will vary (Lovo and Spaenjers, 2018).

Artwork cost records, registered before research, ordinarily show massive, long-haul underperformance of art indices in comparison to the stock market.

Interestingly, one of the studies showed that the value of the Keynes artwork assortment increased at a rate equaling that of equities (Chambers, Dimson and Spaenjers, 2019). A top-to-bottom examination of the Keynes assortment's historical backdrop features four drivers of cross-sectional variety in portfolio returns such as 1) the mix of illiquidity and investor heterogeneity determined by time factors in the investment risk portfolio, 2) the presence of clients with diverse preferences, 3) a single item's stellar performance representing a positive skewness in the cross-part of fine art returns, and 4) the high concentration as a characteristic of Keynes collection. The paper also mentions that the Keynes art assortment concentration, meaning that a few of the most expensive artworks represent the vast majority of his expenditure on Art, is a trademark that is also common in other art portfolios. The concentration characteristic intensifies the significance of individual returns of artworks. However, several investors may discover concentrated venture portfolios appealing – particularly in a resource market where individual returns are positively skewed (Chambers, Dimson and Spaenjers, 2019).

The competition in the art industry relies more on its uniqueness than its price, and even the relation of supply and demand will be similar to luxury goods. The difference in the art industry is that there is a limited supply, which increases the artwork's value (Mamarbachi, Day and Favato, 2008b).

The future of the industry is promising everywhere in the world. There has been a rise in the number of markets in Africa and India. As such, there is bound to be progress in the movement of art (Frey and Eichenberger, 1995). Further, the ever-increasing reliance on the Internet promises to open up new avenues for revenue streams (Porter, 1985).

Therefore, art can be quantified as a luxury good, as they have similar supply and demand qualities. Owing to its limited supply and unique nature, art is highly valued. Further, it is viewed as being exclusive, thus resulting in higher prices (Jyrämä, 2002). Consequently, this affects the curve of demand. However, the demand curve for art is worryingly inelastic. The following factors point towards the conclusion of the inelastic demand curve: 1) changes in taste often affect the prices that are attached to the artwork; 2) changes in income determine the interest people have in various pieces of art – higher-income fetches higher prices for art; 3) pricing and accessibility, which is mainly controlled by the oligopolies; 4) threat of substitutes since they are several alternatives to investment other than art, such as equities, bonds, etc. (Eckstein, 2008).

The art industry itself can be categorized as uncertain because the perfect market knowledge does not exist, so imperfections become broader and the

competition higher (Mamarbachi, Day and Favato, 2008b). It is emphasized that examining the alternative investments in collectibles without relating them with other markets is unproductive since they move together even though they could be different industries. Early studies, for example, by Chanel (1995), discuss that the market which reacts fastest to economic shocks is the financial market, and by so, it would appear that the profits gained could be invested in art. Stock exchanges could also be considered an indicator of predicting what will happen in the art market. Some researchers also declare that the illiquid nature of art funds makes art a long-term investment, which is also related to the significance of the transaction costs involved (Campbell, 2005). This significance is essential in art since it is a benefit, especially in extreme market changes.

Art dealers can apply diverse pricing strategies and commission packages described by Velthuis (2013) to meet market demands and sustain production costs. However, some artists may set very high prices with the intention of maximizing profit. The reasoning behind this is that their art is of high quality and provides their consumers with incredible luxury, which meets the rarity and taste. Such art pieces are not easily accessible in the market. As compared to art fairs, galleries and art dealers sell higher volumes of art and therefore demand goods at lower prices because of the large volume numbers.

Concerning cost, the golden rule is that the price attached to an artistic work encompasses the production costs incurred as well as its aesthetic value. Several artistic works are expensive because of the production costs incurred (Groysberg, 2006). Production costs entail the direct production costs involved, the notional salary owing to the time spent preparing the art, the market costs, and the costs incurred from taxes, insurance, etc.

With regards to the uniqueness of the art, the following factors determine it: the quality of the art, the content and attention to detail, the technique used to create it, the size of the work, and the originality of the artist. At the same time, the legitimization and reputation of the artists have an impact on the demand and supply of art (Mei and Moses, 2002). An expert is often required to determine the artistic work's genuineness and the correct valuation. Auction houses profit more from the need of customers for legitimization.

Another research by Chambers, Dimson and Spaenjers (2019) shows that the risk-return characteristics of art collectibles are assessed not only through aggregate price indices but also by tracking a particular collection over time in a broad art portfolio. Nonetheless, there is currently no comparable dataset available for art

portfolios and their components, as the existing datasets primarily comprise aggregated auction prices, which are crucially dependent on the time when the investors decide to release their transaction records and their portfolios' valuations. This kind of information is available in most cases. However, there are some limitations when looking at single art collector-investors, where limitations can be found in such single portfolios.

Several studies also point out that auctions, especially second-price and private-valued ones, include an exogenous participation cost set by the seller (Lovo and Spaenjers, 2018). If the entry cost is strictly positive, the equilibrium afterward is that the seller will choose its reserve price, which will prevent entry for any other buyer. The second price and private-valued auctions are focused on the private-value frameworks, the valuation of which is usually zero. Therefore, the sellers will choose the reserve price to maximize the expected revenue from it. Participation in the auctions comes with free will, which is also how much they want to bid. However, at the same time, the reserve price in equilibrium is high enough so that not all buyers can enter the auction, even though they can anticipate the reserve price in equilibrium in advance.

There is a change in wealth patterns present nowadays. Wealth distribution with the main focus on collectibles is happening. For example, the boom in 1980 in Japan favored Japanese collectors because the price increased. People believe in the investment in different emotional assets, such as stamps, art, musical instruments, and even wine. Investment in the collectible market has its challenges, such as fluctuating prices and vulnerability to fraud (Chambers, Dimson and Spaenjers, 2019). Indirectly the emotional assets market comes with its own set of problems. The financial assets dominate the emotional assets in their risk-return properties. At the same time, it is essential to shed some light on the interaction between the emotional dividends and the financial returns going into the future. The art trading model in the UK market can experience recessions and expansions. During a recession, emotional dividends and the number of bidders tend to decrease. The art market trading model exhibits three types of equilibrium behaviors. The first involves high buyer types, who purchase at high prices when distressed. Secondly, certain low-buyer types acquire art at lower prices and subsequently resell it during the current economic conditions. The third category comprises the investors who purchase artwork at slightly lower prices than the collectors and subsequently sell them during periods of market expansion (Lovo and Spaenjers, 2018).

From the industry's point of view, the change and the creation of a new market is an ongoing area, which provides much interest for studies to be done. At the same

time, frequently, the most essential part is to know how the existing institutions operate with the new products entering and new markets being created.

2.3 Other collectibles

The alternative investment industry is even broader than just art collectibles, as it goes further with collectibles such as wine and stamps, which are also popular investment options.

The aging effects on the price and therefore returns in the wine market is still an ongoing process even when they have lost their gastronomic appeal because even then, they provide delight to the owner. Therefore, the examination of ownership dividends and codetermining their price levels can be done by estimating life-cycle price patterns (Dimson, Rousseau and Spaenjers, 2013). Dimson, Rousseau and Spaenjers (2013) analyzed the attractiveness of wine as a collectible over time with price dynamics, which interpret the fluctuations in its consumption value and how the price changes over low-quality and high-quality wines. The difference between the life-cycle patterns in wine is the appreciation of the quality related to price over time. Furthermore, it was confirmed that in the periods when the financial markets were overvalued, there was a spillover effect on the wine price index (Dimson, Rousseau and Spaenjers, 2013).

Another study by Dimson and Spaenjers (2010) investigated the performance of the returns on British collectible stamps in the long run, which are seen as a safe investment asset and quite attractive as well. Firstly, the authors concluded that the returns of the stamps are affected by the equity market and that the risk of stamps is at low levels. However, they still expect some part of inflation to be reflected in the price of the stamps. Empirical results showed that stamps do not increase cash flows since the reason behind the returns on collectibles still needs to be determined. It was also concluded that they hedge against expected and unanticipated inflation. Among the empirical results, there is also a similarity between British art and stamps regarding long-term returns since both move in wave patterns of the financial market.

2.4 Future point of view on investments in collectibles

According to research conducted by Mamarbachi, Day and Favato (2008) art is an alternative investment asset. Many investments fall for several reasons like, for example, the need for more institutional backing and management issues. Many people who want to invest in the art market have issues with the need for more transparency

in the market, lack of liquidity, ease of existence, and the misunderstood risk-return ratio. To succeed in investing in art, one needs robust significant bank backing. The bank makes its commission from the transaction cost and locks the funds for 5 to 9 years. The art fund management is a combination of professional investment skills and artwork professionals. Other parties in the art market are the advisors who do not control much. The more significant contributors are professionals engaged in buying and selling art on their behalf. Finally, the art fund should focus more on the challenges they encounter and their operational methods.

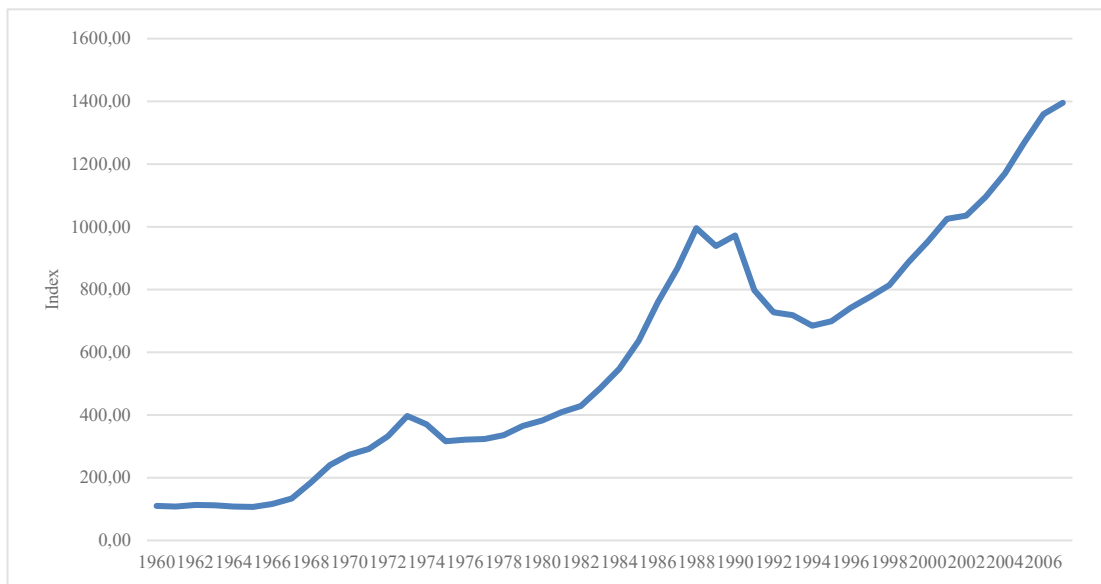
3. Data and Methods

This chapter is dedicated to two fundamental components of the empirical analysis carried out in the further chapter. The first two chapters are dedicated to the time series analysis and description of the performance of the selected indicators related to the domain of alternative investments and macroeconomic variables that will both be fitted into linear regression models estimated further.

The other three sub-chapters are mainly related to the description of data, variables, and methods used for the analysis. At last, the sources of data are specified for further clarification purposes.

3.1 Collectibles Variables

Effectively, the thesis concerns three individual selected alternative investment options and their markets, notably the wine index, the stamp index, and the art index. Following the specification of the markets addressed in the thesis, it is important to address the development of those variables over the selected period of time covering 48 years – from 1960 until 2007, which is mainly explained by the data availability constraint and the nature of those indices. The dataset containing all variables is presented in the list of appendices in Table 18. Figure 1 presents the time series plot of the art market index variable.

Figure 1, the time series plot of art market index

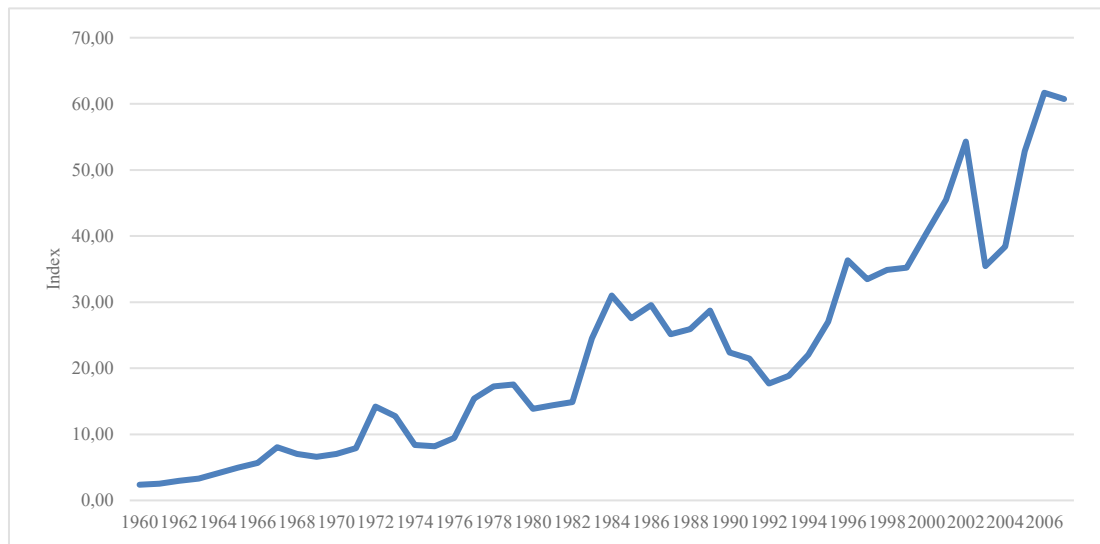
Source: own processing based on data from Chambers, Dimson and Spaenjers 2019

In essence, the first half of the '60s was a very stable and static time for the art market, which can be concluded based on almost no change recorded in the index for the mentioned period. However, in the late 60s, the situation changed and the market saw a huge expansion that lasted until approximately the year 1973 eventually losing a few points. This might to some extent be related to 2 specific events that took place in the early 70s – the first oil shock that happened in 1973 and impacted specifically selected countries representing the Western block, and the first European enlargement that took place the same year and resulted in the UK joining the European Community (Bini, Garavini and Romero, 2016). Effectively, the first phenomenon is likely to be the real reason behind the recession of the market since luxury goods were not something about which people were thinking during the times when there was a huge shortage of much more basic goods.

Yet, the market did manage to recover, but it happened in the early 80s when the period prior to the recovery was accompanied by a slow annual increment in the value of the index. The market saw the biggest expansion in the late 80s, which might itself be tied to the overall improvement of the economic situation in the world followed by the wave of liberalization and the ongoing collapse of the Eastern block (Steiner, 2014). The expansionary period briefly finished in 1989 until once again coming back in the mid-90s and remaining there until a brief recession in 2001-2002. Overall, the development of the market over the analyzed period of time is classified as a positive dynamic, which is pretty logical from the socio-economic perspective –

based on various reports, every further generation of people lives better than their predecessors due to the expansionary nature of economic growth and improvement in wealth; as generations become wealthier and wealthier, they will shift more focus towards luxury goods and goods that do not belong to the category of primary necessity. The art market is a perfect depiction of the phenomenon described by some of the authors dedicated to the study of luxury goods (Kräussl, Lehnert and Martelin, 2016). After addressing the development of the art market variable, it is downright essential to continue with the second selected market – the wine market, where the time series plot is presented in Figure 2.

Figure 2, the time series plot of wine market index



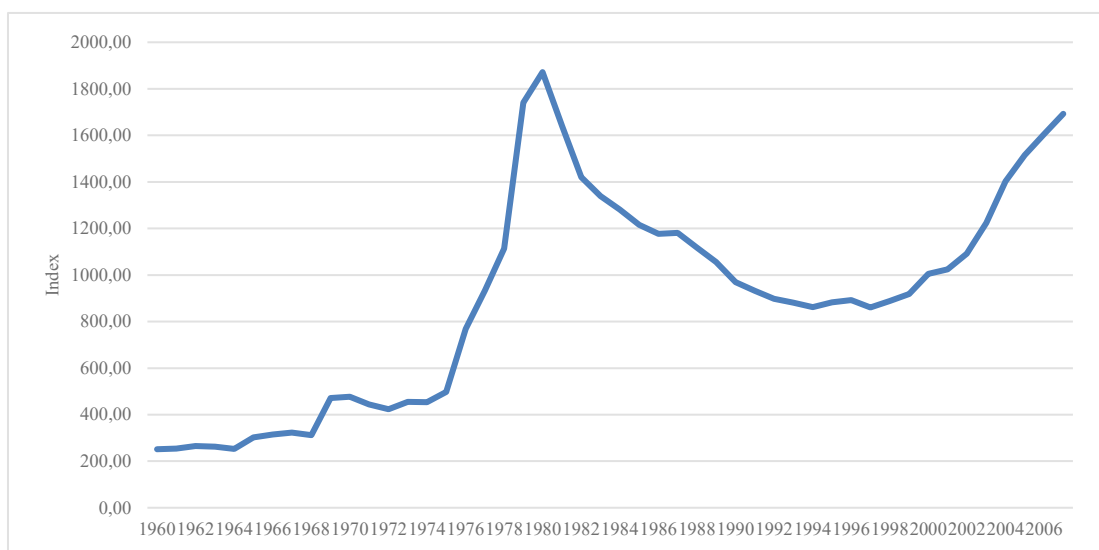
Source: own processing based on data from Chambers, Dimson and Spaenjers 2019

The breakdown of the second variable follows the same logic as the art market index variable, where apart from the time series plot itself, a pertinent linear trend function was estimated. Compared to the first index, the first years of the 60s were much more dynamic and there was no visible stagnation of the market, which was, on the contrary, slowly expanding until reaching its peak in 1967 and partially dropping and slowly expanding once again until reaching its local maximum in 1972. Yet, the drop that happened in 1973 in the index is highly likely to be explained by the very same reason – the oil crisis of 1973 (Blanchard and Gali, 2007). On the other hand, the effect of the crisis on the second variable is expected to be higher since wine itself is a product of the primary sector – any production within the sector and within the industry

needs to be transported, which itself is extremely dependent on logistics that became extremely expensive due to the oil embargo of Arab countries.

Following the unfortunate period, the late 70s were positive for the market as a whole, which began the 80s on a very good note eventually reaching its historical peak in 1984 and somewhat remaining on the same level until the early 90s, when there was a huge drop that brought the market to the level of 1980-1981, which might be related to the series of reasons specific to the market itself. After this major drop, there were no particular issues nor obstacles for the market which peaked first in 2002 but dropped in 2003-2004 and peaked once more in 2006, which resulted in the all-time historical high of the index. The third variable deals with the stamp market and the time series plot is presented in Figure 3.

Figure 3, the time series plot of the stamp market index



Source: own processing based on data from Chambers, Dimson and Spaenjers 2019

The development of the third market is somewhat less volatile since the development of the market can mostly be explained by three individual behaviors – a gradual increase until approximately the year 1980; a subsequent drop that lasted until approximately the year 1997, and an expansionary stage that kicked off in 1998 and lasted until the last recorded year in the dataset – 2007. Overall, the development of this specific niche market is much different from the first two since the market has not really managed to reach the all-time historic high by the end of the analyzed time period – the peak from the 1980s is still slightly higher than the one experienced by the variable in the mid-00s. Based on the nature of the indicator, fitting a particular trend

function does not seem to be a sensible move since neither exponential, logarithmic, or linear type of the function is likely to provide any viable results suitable for the interpretation since the indicator is a cyclical one with 3 cycles identified.

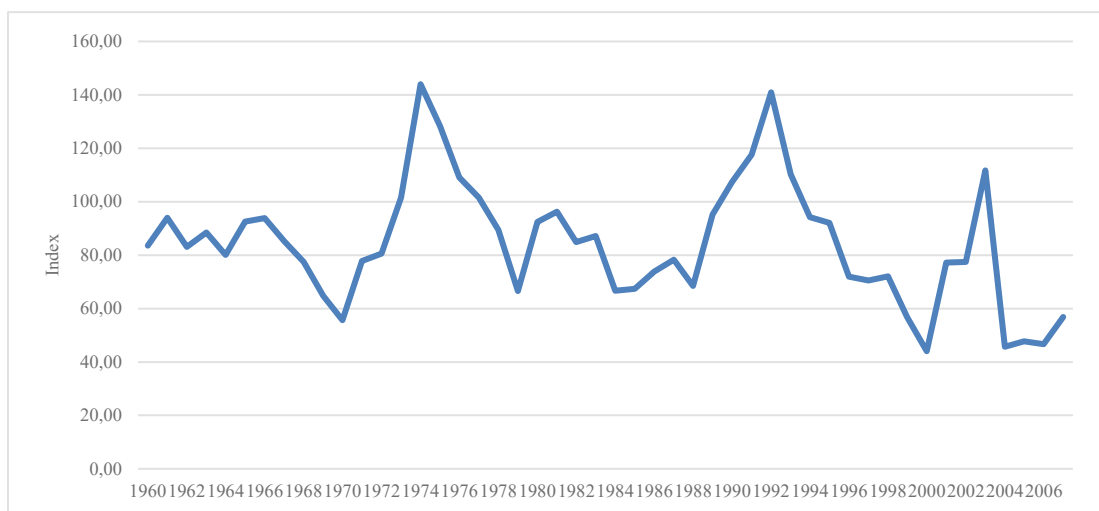
Overall, after addressing the development of all three collectibles markets, it is time to proceed to the next sub-chapter focuses explicitly on macroeconomic variables that are incorporated into the empirical part of the diploma thesis.

3.2 Macroeconomic Variables

The domain of macroeconomic indicators for this specific study is represented by 3 crucial indicators that each address a specific pillar of macroeconomics and state economics – the EPU (economic policy uncertainty index for the case of the United Kingdom), GDP (real) per capita, and long-term interest rate. Further comments about the reason for selecting particular variables and their implications for different macroeconomic domains will be addressed later in the chapter dedicated to the variable specification.

First, it is essential to address the development of variables, where the first analyzed variable from the macroeconomic domain is the EPU index, whose time series plot can be found in Figure 4.

Figure 4, the time series plot of EPU index



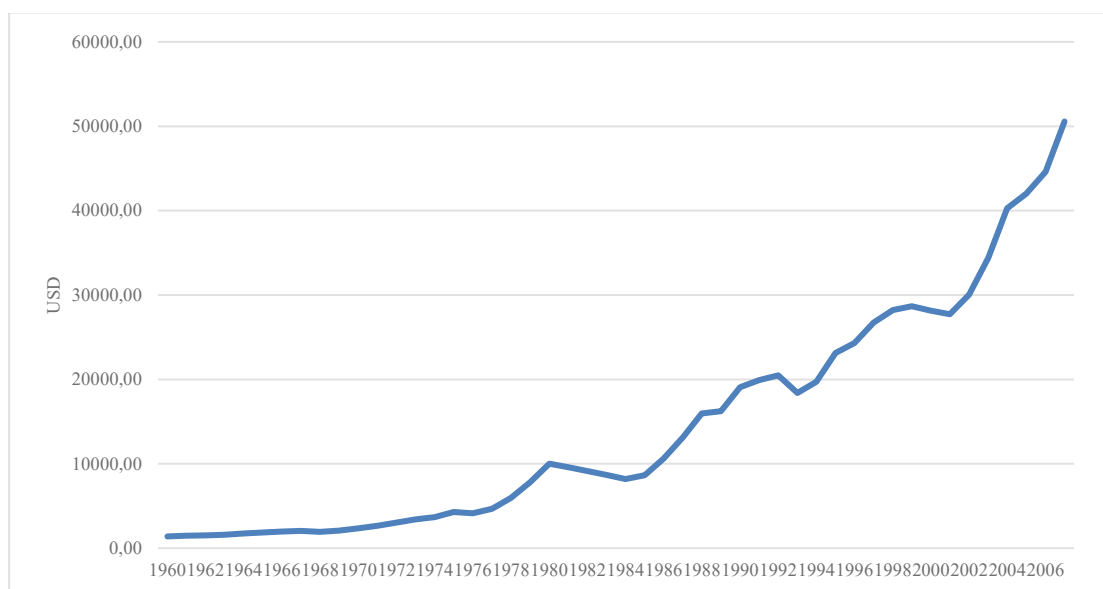
Source: own processing based on data from The World Bank, 2023

Compared to the previous three variables representing collectibles markets, the first macroeconomic variable's development is not likely to be influenced by any kind of trend, which itself is pretty logical since the political environment in the United

Kingdom was not exacerbating constantly. However, it is important to mention that the most unstable period of time was in the mid-70s, which was followed by the accession of the country to the European Community (Bulmer and Burch, 2009). However, as reforms and integration went well, the anxiety in society eased down and there were seemingly pretty stable times during the 80s even despite the Falklands War in 1982, which clearly increased the index just a bit.

Another complicated period in the British political environment happened in the mid-90s as a consequence of the economic recession of the early years of the decade and the Black Wednesday (also known as the 1992 sterling crisis) that was supposedly caused by massive speculation with the British currency that resulted in a massive financial crisis and forced the UK out of the European monetary system (Budd, 2005). At last, the last years of the political environment in the UK were far from being categorized as stable, as the index suggests. As a matter of the fact, even though the UK is often regarded as one of the world's most advanced economies and societies around the world, the level of stability within the country's political environment is subject to serious debate that might likely indicate that the country experiences periods of political turmoil too often for such a highly appraised society. The next variable concerns the GDP per capita, which itself is a complex index consisting of the real GDP variable and the population, whose time series plot is presented in Figure 5.

Figure 5, the time series plot of the GDP per capita

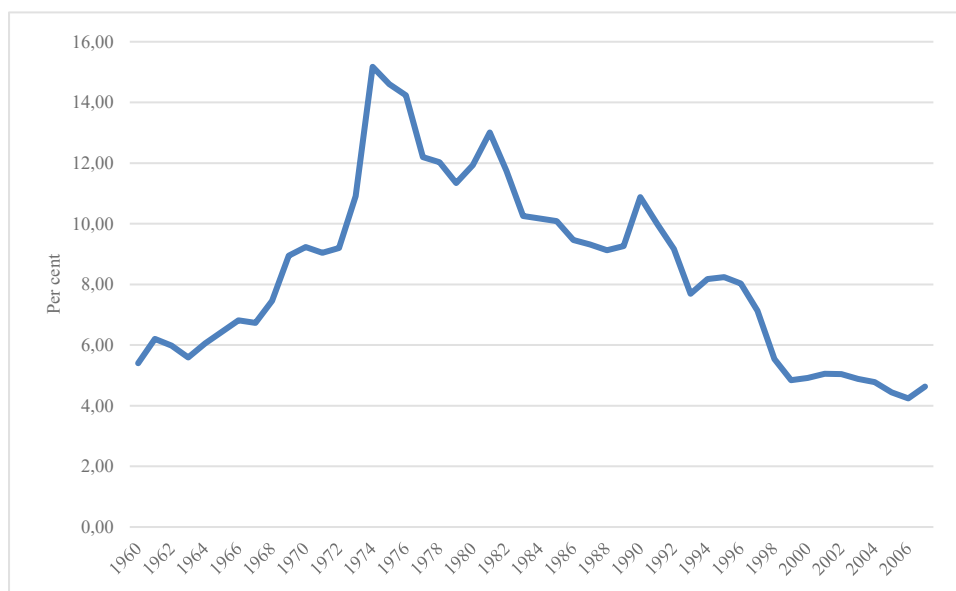


Source: own processing based on data from The World Bank, 2023

The GDP per capita variable, contrary to the rest of the earlier introduced variables, does evidently experience a different pattern of growth. In essence, the nature of economic growth is often treated as an exponential one and the case of the British GDP per capita is a clear confirmation of this assumption. There was an almost constant growth of the GDP per capita in the United Kingdom with just a few exceptions, such as the period between 1980-1984; 1992-1993, and 2000-2002.

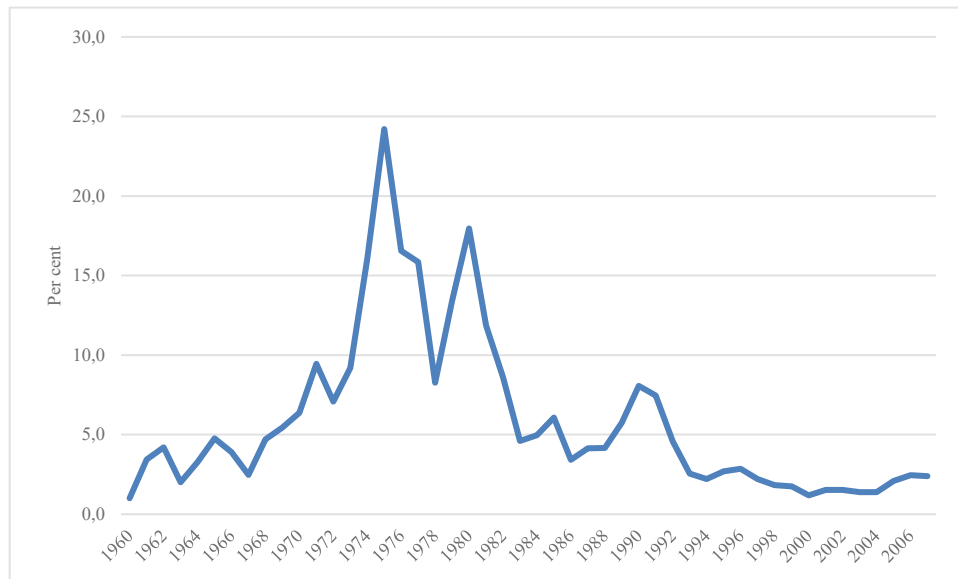
On the other hand, the exponential nature of the GDP might one day result in the inability of the country to properly mitigate negative externalities of the growth of the indicator, but it is surely something that is not directly related to the topic of financial and collectibles markets. At last, the very final variable addressed in the diploma thesis is the long-term interest rate of the United Kingdom, whose average yearly values are presented in the time series plot of the variable in Figure 6.

Figure 6, the time series plot of the long-term interest rate



Source: own processing based on data from The World Bank, 2023

At last, the very final variable included in the study is another one for which generating a specific trend function is not fully possible because of the fact that there were two fundamental cycles – an increasing pattern until roughly the end of the 70s, and a diminishing pattern until the very last observed year of 2007. Overall, this specific indicator suggests that the period of low-interest rates did change the period of economic uncertainty and potentially high inflation in the 60s and 70s. The final variable addressed in the study is the inflation rate, whose time series plot is presented in Figure 7.

Figure 7, the time series plot of inflation

Source: own processing based on data from The World Bank, 2023

Based on the time series plot, it is possible to identify that the development of inflation in the UK was somewhat under the control of the government during the late studied period, whilst during the first half of the period analyzed, the rates of inflation were somewhat blown out of proportion, notably in 1976 when it almost reached the value of 25 percent. Undeniably, the development of inflation was worsened by the series of oil shocks that were happening in the 70s, where one of the first repercussions of the crises was an increase in the overall price level of the country due to the need for transportation for literally anything. A visual improvement came in the 80s, which was significantly influenced by Margaret Thatcher's adoption of Friedman's model of economy (Ip and Whitehouse, 2006). The next sub-chapter addresses the methodology used in the diploma thesis.

3.3 Methodology

This chapter focuses on the overview of variables, market of interest, data sources, and exact techniques used for the estimation of the three models for three individual markets.

3.3.1 Country Choice

The study is based on data dedicated to the United Kingdom. Three models are created based on annual time series data covering both the 20th and 21st centuries -

from 1960 to 2007, covering the economic downturn from the beginning of the 2000s and other unstable periods of times in British history, such as the 70s and the early 90s. The study considered data from the UK to substitute equity and bond investment with alternatives such as collectibles, despite the knowledge that they are illiquid. The reasons that motivate investors to invest in alternative assets, such as collectibles, were discussed in the literature review.

At last, the choice of the UK as the main country of interest is underpinned by the fact that the country, compared to the rest of the world, belongs to the group of the most developed countries following its quick economic expansion after its accession to the European Community in 1973 (Crafts, 2017). Furthermore, this specific development throughout the last couple of decades resulted in a substantial increase in the value of disposable income and savings, which are traditionally invested somewhere. Based on the aforementioned series of reasons, the study focuses on this specific country.

3.3.2 Variables

The phrase "uncertainty surrounding economic policy" may allude to apprehension regarding monetary or fiscal policies, the tax or regulatory environment, or concern regarding the outcomes of elections that will change political leadership. A check for economic risk that happens when it is unknown what direction government policy will take in the future should be carried out. Such uncertainties increase risk, which causes individuals and businesses to delay making decisions regarding spending and investments until it has been resolved.

To calculate policy-related economic uncertainty in the UK, this study uses an indicator called the Economic Uncertainty Index (in short, the EPU Index), which is based on various annual data regarding policy uncertainty. The index is based on the UK's yearly data (Davis, 2016).

The EPU index in Europe has emerged as a significant issue in recent years. This is primarily attributable to the European Sovereign Debt Crisis and the lack of transparency surrounding its possible results (Degiannakis and Filis, 2019). The uncertainty of the economy's future can be attributable to the unpredictability of the political and economic climate of the member states in the European Union. Thus, the inference of predicting significant and possible destabilizing decisions proposed by the union arises in the market. Typically, investors assess the chances of unfavorable monetary developments in markets they want to put their funds for financial growth and security. When the union adopts resolutions that motivate investors to grow their

capital in the European market and amends such proposals periodically, it causes an increase in the EPU index of the region. The index rises when investors anticipate the region's economic policy to be highly unascertainable. In evaluating whether European policies, such as taxes and uncertainty, have a close connection with collectibles, it is required to analyze the influence that European policies, like taxes and tension, have on debt. Consequently, there is an urgent requirement to study the effect that an increase in investment in collectibles has on the amount of risk uncertainty associated with acquisitions and the tax burden (Davis, 2016).

Additionally, tariffs and taxation are vast indicators of regulating the markets for the EU and the UK governments. An example of an event that can heavily influence the markets is Brexit (Brexit did not take place in the period chosen for this study; however, it is still possible to refer to it). The market is already experiencing the consequences of a post-Brexit reality that has caused the stock market and foreign exchange rates to become volatile. This continuous volatility has resulted in uncertainty, causing the pound's value to be unpredictable with the changing negotiations and prolonged negotiations with the EU. The EPU arising from the Brexit debate has seen a spike over the last couple of years, with the highest being in 2016. As such, this specific index focuses on the political stability within the country mainly because the very nature of the index is inevitably connected to the degree of political stability and extent of uncertainty (Davis, 2016).

The GDP per capita is a measure of a nation's economic output with regard to the population, thus modifying the original indicator and shedding a brighter light on economic development. The measure determines the economic output respective to the number of people living in the country. Wealthy states like the United Kingdom typically have greater GDPs per capita, indicating a higher level of economic development. Thus, this suggests that the higher the GDP per capita, the higher the number of investments each person can potentially make (Dyanan and Sheiner, 2018). Therefore, the study's objective is to analyze the connection between collectibles and GDP per capita.

Financial flexibility would make it easy to assess the collectibles as a way of storing value, investing for future returns, and as a status symbol. In developed economies, more people are interested in portfolio diversification, and having collectibles breaks the monopoly making it a self-imposed need that needs to be satisfied (Dyanan and Sheiner, 2018). The opposite would apply in developing economies where the GDP per capita is significantly smaller thus theoretically constraining populations. They are more likely to invest in highly liquid assets that can

easily be converted into physical money. This study aims to explore the relationship between GDP per capita and investments in collectibles and investigate whether the two have a positive or negative relationship. As such, this specific indicator represents the dimension of economic performance and development at the same time.

The persistent rise in long-term interest rates has emerged as one of the critical reasons for concern regarding the status of the global economic system (Del Negro *et al.*, 2019). Therefore, a surge would be predicted due to the market's anticipated occurrence of financial instability. However, other factors, such as investors' concerns about the fiscal position and uncertainties about the economic and policy prospects, may also be playing a role and helping to explain the sudden jump in the long-term interest rate early on. As a result, studying the connection between the long-term interest rate and the values of various collectibles, including stamps, wine, and artwork, is essential. A quick and persistent increase in interest rates might lead to a repricing of risk and a more comprehensive tightening of financial conditions, both of which can cause upheaval in developing economies and undermine the value of collectible investments.

Economic and political government actions would significantly impact the market and the long-term interest rates by default. In times of increased inflation, there would have been an unanticipated collapse in production and, by extension, all other factors of the economy. Most of the aftermaths would have a long-term effect resulting in an exponential increase in the long-term interest rate (Del Negro *et al.*, 2019). The Bank of England would follow the precedence set by its fellow central banks. The central banks would keep revising the interest rates to cool inflationary constraints. As such, this specific variable represents the banking sector and can also indicate a particular behavior within a country about the anticipation of inflation, so it is included in the study for those reasons in addition to the earlier mentioned ones.

At last, in one case, notably in the stamp model, the original variable used – interest rate is substituted by the inflation rate, which itself is based on the CPI index for the United Kingdom.

3.3.3 Data Type and Sources

The data of the dependent variables, which are the art price index, wine price index, and stamp price index, were based on Christophe Spaenjers' published papers that introduced indicators developed by the author. GDP per capita and long-term interest rates are obtained from the World Bank platform. The EPU Index data was taken directly from the Economic Policy Uncertainty website and database. The data

from the EPU Index was necessary to demystify relations among the various collectibles and provide proper and well-defined guidelines and processes. In essence, the quality of the data traditionally defines the quality of the econometric estimate, according to Gujarati and Porter (2009), so relying on government-published data is a good way to properly address this issue. At the same time, the only possible constraint that can occur is the fact that collectible markets are represented by an indicator proposed by one author, thus indicating a lack of centralized control for those markets and an inability to take a look at the performance of those markets from a different angle. Yet, this specific constraint is not likely to influence the quality of the models since the considered values and indicators for those markets are the only available pieces of information.

3.3.4 Methods

The exact list of methods and techniques used for the diploma thesis consists almost entirely of quantitative techniques, notably the ones coming from a very distinctive branch of economics – econometrics. This specific chapter deals with the introduction of exact methods used for the econometric estimation of the three models, as well as with the specification of each of the models in detail.

To begin with, it is important to specify that before data is used for the estimation, there is an evident need for processing this data and identifying the main tendencies associated with it. For this purpose, three specific techniques are used.

The very first technique that has already been applied is basic time series analysis, where the development of variables over the selected period of time is addressed (Gujarati and Porter, 2009).

The second technique used for describing data is descriptive statistics. Descriptive statistical analysis is a useful tool to gain fundamental insights into the data used in econometric estimation. The study uses Eviews as the main software tool, so the pool of descriptive measures is explained mainly by the default series of methods offered by the application. The first indicator used in this type of analysis is mean, which indicates the average value for a variable, which itself is calculated as:

Formula 1, mean indicator

$$\hat{X} = \frac{\sum x_1, x_n}{n}$$

Following the utilization of the mean indicator, the median is also used, which is used for identifying the value that corresponds to the second quartile. There are two formulas for the median, depending on whether the total number of observations is even or odd. The formulas for both cases are:

Formula 1, mean indicator

$$\bar{X} = \begin{cases} X \left[\frac{n+1}{2} \right], & \text{if } n \text{ is odd} \\ \frac{X \left[\frac{N}{2} \right] + X \left[\frac{N}{2} + 1 \right]}{2}, & \text{if } n \text{ is even} \end{cases}$$

Then, the descriptive analysis also covers 2 specific indicators that represent ranks – maximum (the highest value) and minimum (the lowest value). Both indicators are based on the classification of variables according to their numeric values. In addition to the measures of the central tendency, the study also includes an indicator representing measures of variation – the standard deviation. The standard deviation indicates the variation of values around the mean and it is calculated as:

Formula 2, standard deviation indicator

$$s = \sqrt{\frac{\sum (X_i - \hat{X})^2}{N - 1}}$$

Following the standard deviation, three specific measures are considered for the analysis, which are somewhat associated with the way how variables are distributed. Skewness and kurtosis are both calculated for a better description of the distribution that is observed for a given variable and both are calculated according to the following formulas:

Formula 3, skewness

$$Sk = \frac{\sum (X_i - \hat{X})^3}{(N - 1)s^3}$$

Formula 4, kurtosis

$$Kt = \frac{\sum (X_i - \hat{X})^4}{(N - 1)s^4}$$

Based on these two indicators, Jarque Bera test statistic is calculated, which is traditionally used for the identification of whether a particular variables follows the normal distribution that has figures close to 0 for skewness and figures close to 3 for

kurtosis (Thadewald and Büning, 2007). The test statistic is calculated according to the following formula:

Formula 5, Jarque-Bera statistic

$$JB = N \left[\frac{Sk^2}{6} + \frac{(Kt - 3)^2}{24} \right]$$

The very final technique used for the description of data is the correlation coefficient, which traditionally describes the degree of linear association between two variables, taking the value between negative one and positive one, where extremes indicate that the strength of the relationship is extremely high. The nature of the relationship depends entirely on the sign, where negative figures indicate a negative association and positive figures indicate vice versa (Asuero, Sayago and González, 2006). The correlation coefficient used in the study is the Pearson correlation coefficient, which is calculated according to the following formula:

Formula 6, Pearson correlation coefficient

$$R = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum(X_i - \bar{X})^2 \sum(Y_i - \bar{Y})^2}}$$

Following the estimation of the correlation coefficient, pertinent t-statistic is calculated for the purpose of identifying if a given relationship is statistically significant or not. The t-statistic for correlation coefficient is calculated as:

Formula 7, t-statistic for Pearson correlation coefficient

$$t - statistic = \frac{R_{xy} \sqrt{N-2}}{\sqrt{1-R^2}}$$

At last, after processing data and capturing all essential insights reflecting the development of variables, the econometric estimation is performed. Yet, it is important to understand that utilizing the VECM estimation method on non-stationary data is likely to result in the problem of the so-called spurious regression or nonsense regression. Based on the time series analysis that was already performed, it is highly likely that the majority of introduced variables do exhibit a particular trend that results in non-constant variance over time and increasing mean. For this purpose, the so-called unit-root tests are introduced to the thesis that will help to understand if the data used for the estimation is stationary or not. The kind of test used in the diploma thesis is the ADF test which helps to understand if the coefficient associated with the lagged version of the endogenous variable is equal to one, indicating the presence of the so-called unit root and absence of stationarity (Lopez, 1997). Visual representation of the controlled phenomenon has the following structure:

Formula 8, unit root visualization

$$Y_t = \alpha Y_{t-1} + \beta X_e + \varepsilon$$

If the value of the alpha coefficient is equal to one, the null hypothesis is not rejected and the time series is not stationary. Apart from using unit-root tests for the identification of stationarity, the study also incorporates Granger's Causality Test which is used to understand if one variable can be used for the prediction of another one (Shojaie and Fox, 2022).

Following the identification of stationarity, which, for all three models is quite likely not to be the case, it is important to understand that using the ML (maximum likelihood) method based on such data requires the presence of the cointegration between variables. Cointegration refers to the existence of a long-run equilibrium between two or more non-stationary time series. The existence of such a relationship is characterized by the fact that the residuals of such a model are non-stationary as well. There are a few ways how this can be identified, including the Engle-Granger test which is often regarded as the most commonly used one. Yet, the study considers another test that offers a more sophisticated outcome and is used in cases when more than 2 different time series are involved. This test is the Johanson cointegration test that is expressed in two main forms – Trace tests and Maximum Eigenvalue tests. Furthermore, it is downright crucial to specify that all tests use the significance level of 5 percent, including the other earlier mentioned testing procedures (Dwyer and Wallace, 1992).

At last, it is crucial to proceed to the specification of models and the exact technique of linear estimation used for each case. Based on the fact that the time series used in the thesis are not likely to be stationary, the utilization of the VAR (vector autoregression) is not the best choice. Yet, on the other hand, the potential presence of cointegration offers the researcher an opportunity to go for the VECM (vector error correction model) instead, for which the assumption of cointegration is a must. However, such models traditionally require not just one equation describing the long-term relationship expressed by the variables in their original forms, but also an equation describing the short-term development, including the vector correction term always taking the values between the negative one and zero and being statistically significant (Pesaran, 2004). The need for the second equation results in the fact that variables have to be integrated of the same order, practically meaning that if they are non-stationary,

their first differences have to be stationary, which, in turn, will be included in the model with the error correction term.

Continuing to the essence of the work, three models are estimated. Based on the fact that the VECM estimation is used, the total number of models is equal to 6. Each of the three collectibles (art, wine, and stamps) are estimated based on the three selected variables – the EPU (representing the political environment and policy uncertainty), the long-term interest rate (representing the financial stability), and the GDP per capita (represents the economic development and the wealth of individuals within the country). First, before identifying the econometric models, it is downright crucial to estimate the economic models, which are presented below:

Formula 9, economic models

$$\begin{cases} ART = f(EPU, GDP, r) \\ WINE = f(EPU, GDP, r) \\ STAMP = f(EPU, GDP, r) \end{cases}$$

As a matter of fact, the formulation of the econometric models requires making a series of particular assumptions. One of the most crucial assumptions is related to the signs of variables, where the sign of the EPU is expected to be negative (as the political instability rises, people are less willing to make alternative investments); the sign of the GDP per capita is expected to be positive (as the wealth grows, people are more willing to make investments), and the sign of the long-term interest rate is positive (as rates are higher, people are more willing to make investments and escape higher rates of inflation). Furthermore, each of the models contains an error term, which traditionally describes all variables not included in the model for a given reason. Additionally, the error term in both models (the long-term and the short-term ones) is different. The art models have the following structure:

Formula 10, models for ART

$$\begin{cases} ART = \beta_{11} + \beta_{12}EPU_t + \beta_{13}GDP_t + \beta_{14}r_t + \varepsilon_1 \\ \Delta ART = \beta_{21} + \beta_{22}\Delta EPU_t + \beta_{23}\Delta GDP_t + \beta_{24}\Delta r_t + \beta_{25}\varepsilon_{1t-1} + v_1 \end{cases}$$

The next two models are dedicated to the wine market index:

Formula 11, models for WINE

$$\begin{cases} WINE = \beta_{31} + \beta_{32}EPU_t + \beta_{33}GDP_t + \beta_{34}r_t + \varepsilon_2 \\ \Delta WINE = \beta_{41} + \beta_{42}\Delta EPU_t + \beta_{43}\Delta GDP_t + \beta_{44}\Delta r_t + \beta_{45}\varepsilon_{2t-1} + v_2 \end{cases}$$

The last two models are focused on stamps:

Formula 12, models for STAMP

$$\begin{cases} STAMP = \beta_{51} + \beta_{52}EPU_t + \beta_{53}GDP_t + \beta_{54}I_t + \varepsilon_3 \\ \Delta STAMP = \beta_{61} + \beta_{62}\Delta EPU_t + \beta_{63}\Delta GDP_t + \beta_{64}\Delta I_t + \beta_{65}\varepsilon_{3t-1} + v_3 \end{cases}$$

In the case of the STAMP model, the variable of the interest rate is substituted by inflation due to the absence of cointegration between the original list of variables and the stamp variable. Before proceeding to the estimation itself, it is downright crucial to specify that it is highly anticipated that either of the estimated models will experience problems during the diagnostic process, where the presence of autocorrelation is seen as the most anticipated scenario due to the time series type of data and a high number of potentially omitted variables. For not getting biased standard errors, the HAC robust standard errors are used in cases where problems of either homoscedasticity or autocorrelation are encountered so that the t-testing can be done without any distortions (Croux, Dhaene and Hoorelbeke, 2004).

4. Data Analysis

This chapter contains the study's data description and results. It starts with an overview of diagnostic tests and descriptive statistics before moving on to investigating the relationship between variables, which are the EPU Index, GDP per capita and the long-term interest rates and inflation in one case, and the price indexes of the collectibles, followed by an interpretation of the findings. This chapter reveals information about the analysis while inspecting the properties of variables. The steps mentioned in the preceding chapter are implemented in this chapter.

4.1 Data Description

Descriptive statistics is the first step of the data analysis part of the diploma thesis, where a deeper look at quantitative figures for variables presented in the study is taken. Eviews was used to calculate all statistical measures described earlier, the overview of which for all variables is presented in Table 1.

Table 1, descriptive statistics

Indicator	ART	WINE	STAMP	EPU	GDP	r	I
<i>Mean</i>	588.15	22.08	899.23	84.36	14510.83	8.45	5.90
<i>Median</i>	515.47	18.25	908.41	83.36	9372.69	8.59	4.17
<i>Maximum</i>	1395.46	61.67	1871.75	143.99	50566.83	15.17	24.20
<i>Minimum</i>	106.80	2.37	251.48	44.03	1397.60	4.24	1.00
<i>Std.Dev.</i>	373.10	15.82	459.64	22.77	13350.02	2.93	5.16
<i>Skewness</i>	0.39	0.80	0.18	0.49	0.95	0.41	1.65
<i>Kurtosis</i>	2.08	2.94	2.10	3.30	2.95	2.33	5.37
<i>Jarque-Bera</i>	2.93	5.17	1.91	2.09	7.16	2.24	33.32
<i>Probability</i>	0.23	0.08	0.39	0.35	0.03	0.33	0.00
<i>Sum</i>	28230.99	1059.74	43163.18	4049.34	696519.60	405.58	1255.10
<i>Observations</i>	48.00	48.00	48.00	48.00	48.00	48.00	48.00

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

To begin with, one of the most important aspects that are worth mentioning is the fact that for the majority of the selected variables, the figures for mean and median are somewhat close, which inevitably suggests that the distribution of those variables is symmetrical and the value of skewness approaches zero. This is the case for the overwhelming majority of selected variables – ART, WINE, STAMP, EPU, and r. On the other hand, there are two variables whose distribution cannot be categorized as a symmetrical one, notably the GDP and inflation variables.

Effectively, the Jarque-Bera statistic is a useful tool that will help to understand if a given variable follows the normal distribution or not, where the null hypothesis for the relevant test is “variable is distributed normally”. Instead of using the raw value of Jarque-Bera, the focus is paid to the probability associated with the indicator, thus concluding that for 5 variables out of 7, it is possible to conclude the presence of normal distribution. On the other hand, GDP and inflation are not distributed normally, which is concluded from the fact that the probability is lower than the selected level of significance of five percent for the hypothesis testing.

When it comes to the rest of the indicators, it is important to specify that understanding and properly interpreting figures of descriptive statistics is mostly possible when seeing the situation in the context, which is the case for the variables representing individual markets. On the other hand, it is possible to interpret macroeconomic indicators and comment on the performance of the country over the long run.

The average GDP of the United Kingdom is equal to 14510.83 USD, which itself is not a big value when realizing that the United Kingdom has already exceeded this figure a while ago. The median for the indicator is equal to 9372.69 USD. The maximum value of the GDP per capita is equal to 50566.83, which is a tremendous amount indicating a very high level of economic development in the country. On the other hand, the minimum value confirms that the country’s situation was not so outstanding at the beginning and the country took a long journey to eventually end up where they are right now. The value of standard deviation has almost the same magnitude as the average, which suggests that the coefficient of variation is close to 100%, indicating a very high variability originating from the fact that the country’s GDP per capita development can be categorized as an exponential trend.

The average value of the interest rate equal to 8.45 percent, as well as the median of 8.59 both indicate that the government was more focused on contractionary monetary policy with high interest rates traditionally used to restrict inflation. On the other hand, as it was revealed during the time series analysis, the overall level of interest rates in the UK started to drop by the end of the 20th century. The absolute maximum value of the variable was 15.17 percent, while the lowest value was 4.24 percent. Standard deviation accounts for nearly 30% of the average, which indicates a relatively augmented volatility and variability of the indicator.

At last, the average inflation rate in the United Kingdom was 5.9 percent, while the median was 4.17 percent. This is not a high figure but it is almost entirely certain that this average figure is higher than the target value of inflation that is traditionally set by the majority of governments at the level of 2-3 percent. The highest inflation is recorded at the level of 24.2, while the lowest one was just 1. In essence, the fact that the lowest inflation is positive indicates that there was no single deflationary year for the British economy, which is somewhat good for producers. At last, the value of standard deviation almost entirely replicates the average, which indicates that the variability of the indicator is extremely high.

After addressing some insights about the selected variables, primarily macroeconomic ones, it is vital to focus on the relationship that exists between different variables. To describe relationships, a correlation matrix will be used, where special symbols next to correlation coefficients indicate the significance. The correlation matrix is presented in Table 2.

Table 2, correlation matrix

	ART	WINE	STAMP	EPU	GDP	r	I
ART	1						
WINE	0.93***	1					
STAMP	0.65***	0.67***	1				
EPU	0.33**	0.48***	0.29**	1			
GDP	0.93***	0.92***	0.6***	0.38***	1		
r	0.36**	0.44***	0.09	0.56***	0.52***	1	
I	-0.36***	-0.40***	0.06	0.49***	-0.43***	0.85***	1

Source: own processing based on data from Chambers, Dimson and Spaenjers

2019 and The World Bank, 2023

At first glance, it is fair to indicate that the overwhelming majority of correlation coefficients are statistically significant at the level of 5 percent. Starting with the ART variable, it is possible to indicate that the variable is correlated significantly with every single variable in a positive way with just one exception of inflation. The highest correlation is identified between the ART variable and WINE, and between the GDP and ART.

When it comes to WINE, the situation is somewhat similar to the ART variable with all relationships being statistically significant and positive with just an exception of inflation, which is also correlated with WINE negatively. In essence, this picture is a direct consequence of an almost perfectly linear relationship between ART and WINE that results in both variables having similar relations with the rest.

STAMP, on the other hand, has an entirely different situation, where all correlations are positive, but few are statistically significant at all. As such, the STAMP variable is in particular not correlated with either interest or inflation, which is an interesting point.

The EPU index is positively correlated with literally all variables from the list, where in addition to the positive correlation, all of those relationships are statistically significant for literally all variables.

GDP, on the other hand, is also statistically correlated with every single variable, but it has a negative relationship with inflation. This specific notice is pretty common in the world of macroeconomics, where inflation is seen as a major obstacle to economic growth and development.

At last, the correlation between the interest rate and inflation is positive and statistically significant, which might be a sign that the United Kingdom was suffering from the phenomenon of stagflation, where inflation is high and unemployment is also high resulting in attempts of the government to tackle it through contractionary monetary policy. The next chapter continues the analysis by presenting individual results for unit-root tests.

4.2 Unit-Root Tests

Before proceeding to the estimation of cointegration models, it is downright crucial to ensure two individual aspects – that all variables are non-stationary and that they are integrated of the same order, which practically means that if they are not stationary in the first level, differencing them will result in making entirely stationary variables. A series of unit-root tests (ADF) was carried out and the overview of the results for the original level of variables is presented in Table 3.

Table 3, the results of the first ADF tests

	ADF	P	Result
ART	0.045	0.95	Unit Root
WINE	-0.07	0.94	Unit Root
STAMP	-1.55	0.49	Unit Root
EPU	-2.92	0.051	Unit Root
GDP	4.53	1.00	Unit Root
r	-1.04	0.72	Unit Root
I	-2.09	0.24	Unit Root

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

Based on the tests performed, it is possible to indicate that for the majority of variables, their non-stationary was out of the question, notably for the ART, WINE, STAMP, interest, and GDP variables. On the other hand, the development of two particular variables raised serious questions of whether they are non-stationary or not – inflation and the EPU index. The hypothesis testing revealed that even those two dubious cases can be categorized as non-stationary processes, which is a good sign that allows the researcher to use the aforementioned set of variables for the estimation of a potential cointegration relationship.

Yet, before doing so and running other essential tests, it is important to perform unit-root tests once again to identify if the variables are non-stationary in their first differences. The overview of the second stage of ADF tests is presented in Table 4.

Table 4, the results of the second ADF tests

	ADF	P	Result
d(ART)	-3.96	0.00	No Unit Root
d(WINE)	-6.56	0.00	No Unit Root
d(STAMP)	-3.82	0.00	No Unit Root
d(EPU)	-7.53	0.00	No Unit Root
d(GDP)	-2.96	0.04	No Unit Root
d(r)	-5.17	0.00	No Unit Root
d(I)	-6.64	0.00	No Unit Root

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

Based on the results of the second wave of ADF testing, it is possible to identify that all variables are stationary in their first differences, which is a good sign that will allow the use of the VECM for future estimation. The next chapter addresses Granger causality tests that are used for additional descriptions of the data implemented in the analysis.

4.3 Granger Causality

Granger causality tests, when applied to the case of non-stationary variables, require the utilization of their first differences. Consequently, the causality between the dependent variables and the set of selected independent variables for each model will be checked. The results for the first model (ART) are presented in Table 5.

Table 5, Granger causality tests for the first model

Pair	Null	P
1	d(EPU) causes d(ART)	0.12
	d(ART) causes d(EPU)	0.01
2	d(GDP) causes d(ART)	0.94
	d(ART) causes d(GDP)	0.04
3	d(r) causes d(ART)	0.01
	d(ART) causes d(r)	0.32

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

Based on the results of the hypothesis testing, it is possible to confirm that the EPU does not cause the ART variable, while the ART does cause the EPU. When it comes to the second pair, GDP does not cause the ART, but the ART does cause the

GDP. At last, the interest rate does cause ART, but ART does not cause the interest rate. Following the results for the first model, it is essential to proceed to the second model dedicated to WINE whose results are presented in Table 6.

Table 6, Granger causality tests for the second model

Pair	Null	P
1	d(EPU) causes d(WINE)	0.00
	d(WINE) causes d(EPU)	0.06
2	d(GDP) causes d(WINE)	0.86
	d(WINE) causes d(GDP)	0.00
3	d(r) causes d(WINE)	0.44
	d(WINE) causes d(r)	0.67

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

Based on the results for the second model, it is possible to suggest that the EPU causes WINE, but WINE, in turn, does not cause the EPU. GDP does not cause WINE, but WINE does cause the GDP. At last, the interest rate does not cause WINE, and WINE does not cause the interest rate. The last model's results are presented in Table 7.

Table 7, Granger causality tests for the third model

Pair	Null	P
1	d(EPU) causes d(STAMP)	0.72
	d(STAMP) causes d(EPU)	0.99
2	d(GDP) causes d(STAMP)	0.53
	d(STAMP) causes d(GDP)	0.49
3	d(I) causes d(STAMP)	0.12
	d(STAMP) causes d(I)	0.08

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

At last, the EPU does not cause STAMP, and neither does STAMP cause the EPU. GDP does not cause STAMP, and STAMP does also not cause the GDP. Finally, the inflation rate does not cause STAMP and STAMP does not cause the inflation rate. Following the results of Granger causality tests, the next chapter deals with Johansen's cointegration tests.

4.4 Cointegration Tests

Johansen tests are applied to each of the models to identify if there is a presence of a cointegration relationship between the variables. The first model for which the tests are applied is the ART model with the result of the tests introduced in Table 8.

Table 8, Johansen test for ART

ART				
Type	No. of CE(s)	Eigenvalue	Statistic	P
<i>Trace</i>	None	0.595	61.43	0.0016
	At most 1	0.213	19.83	0.4344
	At most 2	0.121	8.75	0.3883
	At most 3	0.05	2.77	0.0956
<i>Maximum Eigenvalue</i>	None	0.59	41.6	0.0004
	At most 1	0.21	11.07	0.64
	At most 2	0.12	5.98	0.6158
	At most 3	0.058	2.77	0.0956

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

The null hypothesis of the test originally suggests that there is no cointegrating equation or relationship between the variables. Yet, as the P value suggests, this null hypothesis is rejected for both cases, suggesting that there is indeed a cointegrating relationship present in the model. Furthermore, the results of the hypothesis testing for both cases – Trace and Maximum Eigenvalue indicate that there are at most 3 cointegrating equations possible to be constructed for this case. Henceforth, the results of the test indicate that there is a strong presence of cointegration between the ART and the selected set of independent variables. The next model for which the Johansen test is considered is WINE, whose results are presented in Table 9.

Table 9, Johansen test for WINE

WINE				
Type	No. of CE(s)	Eigenvalue	Statistic	P
<i>Trace</i>	None	0.46	56.23	0.0067
	At most 1	0.28	27.81	0.0833
	At most 2	0.17	12.33	0.14
	At most 3	0.07	3.72	0.0536
<i>Maximum Eigenvalue</i>	None	0.46	28.42	0.039
	At most 1	0.285	15.48	0.2567
	At most 2	0.17	8.6	0.3203
	At most 3	0.077	3.72	0.0536

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

Based on the same logic as the one introduced in the earlier paragraph, it is possible to conclude that the hypothesis about no cointegration is rejected for this case as well, which is a good sign. According to the results of the testing procedure, there is enough evidence to suggest that there are at most 3 cointegrating equations once again. At last, the final results for the STAMP model are introduced in Table 10.

Table 10, Johansen test for STAMP

STAMP				
Type	No. of CE(s)	Eigenvalue	Statistic	P
<i>Trace</i>	None	0.37	49.26	0.03
	At most 1	0.25	27.33	0.09
	At most 2	0.17	14.001	0.08
	At most 3	0.11	5.37	0.02
<i>Maximum Eigenvalue</i>	None	0.37	27.58	0.22
	At most 1	0.25	21.13	0.42
	At most 2	0.17	14.26	0.31
	At most 3	0.11	3.84	0.02

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

Based on the very last results, it is possible to suggest that there is a disagreement between the two approaches. Maximum Eigenvalue indicates that there is no cointegration, while the Trace approach suggests the opposite. Furthermore, there are at most two cointegrating equations for this case. Nevertheless, the tests will continue, as well as the estimation since one would stick to the Trace approach for the

identification of cointegration. The first model's results are introduced in the next chapter.

4.5 Regression Results

4.5.1 Art Price Index

Following the completion of all prerequisite conditions and steps that eventually boiled down to the confirmation of cointegration between the art price index and the selected set of three exogenous variables, it is finally possible to focus on the development of a relevant econometric model. The first model that is estimated for the index indicates a long-term equilibrium, whereas the second model will show a short-term development of the index. The model is estimated with robust standard errors to tackle the problem of serial correlation that persisted during the first tests of running the model. The results for the short and long-term development are presented separately in order to address individual situations in more detail. Table 11 contains the results for the long-term equilibrium of the art price index.

Table 11, the first ART model

Variable	β	St.Error	t	P
<i>C</i>	37.5	84.42	0.44	0.66
<i>EPU</i>	-0.88	1.04	-0.84	0.4
<i>GDP</i>	0.028	0.001	18.08	0.00
<i>r</i>	25.18	11.35	2.21	0.03
R square				0.89
Adjusted R Square				0.88
F Statistic				125.62
P				0
Akaike				12.56
Schwarz				12.72
Hannan-Quinn				12.62

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

Based on the results of the estimation, the following linear regression model displaying the long-term equilibrium of the art price index can be created:

$$ART = 37.5 - 0.88EPU_t + 0.028GDP_t + 25.18r_t + \varepsilon_1$$

Following the formulation of the model, it is vital to proceed to the interpretation of individual coefficients:

- If the EPU index in the UK increases by 1 point, the value of the art market index goes down by 0.88 points, *ceteris paribus*.
- If the real GDP per capita in the UK increases by 1 USD, the art market index increases by 0.028, *ceteris paribus*.
- If the interest rate in the UK increases by 1 percentage point, the art market index increases by 25.18, *ceteris paribus*.

When it comes to the estimated properties of the model and the diagnostics, it is essential to highlight that robust standard errors were considered, which tackle the issue of serial correlation and heteroscedasticity at once. On the other hand, the model suffers from the lack of normality of residuals. The share of explained variation in the art market index is 0.88 or 88%, according to the adjusted coefficient of determination, which is a good sign. The whole model is significant, as both the F test and the probability associated with it suggest. On the other hand, it is crucial to specify that out of 4 regressors, just 2 are statistically significant at a 5 percent level – the real GDP per capita and the interest rate. Then, following the creation of the long-term equilibrium model, it is essential to focus on the short term and also identify the error correction term that ensures that the original model's results will be constantly and unconditionally increasing. The output for the short-term model is presented in Table 12.

Table 12, the second ART model

Variable	β	St.Error	t	P
<i>C</i>	17.64	84.42	1.31	0.19
$\Delta(EPU)$	-0.42	1.04	-1.005	0.32
$\Delta(GDP)$	0.009	0.001	2.23	0.03
$\Delta(r)$	4.04	11.35	0.39	0.69
<i>ECT</i>	-0.038	0.0095	-4	0.00
R square				0.15
Adjusted R Square				0.11
F Statistic				4.35
P				0.00
Akaike				10.88
Schwarz				11.07
Hannan-Quinn				10.95

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

Based on the output, the following model for the short-term process with the art price index can be formulated:

$$\Delta ART = 17.64 - 0.42\Delta EPU_t + 0.009\Delta GDP_t + 4.04\Delta r_t - 0.038\varepsilon_{1,t-1} + v_1$$

Thus, the following interpretation can be provided for the aforementioned short-term model:

- If the EPU increases by 1 point relative to the previous year, the art market index decreases by 0.42, *ceteris paribus*.
- If the real GDP per capita increases by 1 USD relative to the previous year, the art market index increases by 0.009, *ceteris paribus*.
- If the interest rate increases by 1 percentage point relative to the previous year, the art market index increases by 4.04 points, *ceteris paribus*.
- The speed of adjustment that is needed for the art market index to return to the long-term equilibrium is 0.038, according to the error correction term.

When it comes to the statistical and econometric properties of the estimated model, it is vital to specify that the variation explained by the variables in their first differences is extremely small – just 0.11 or 11%. On the other hand, there is just one variable that affects the art market index in a significant way in the short-term perspective – the real GDP per capita. The fact that the error correction term is negative and significant fully aligns with the principle of the VECM.

4.5.2 Wine Price Index

After estimating the first two models dedicated to the art market index, it is vital to proceed to the estimation of the first model dedicated to the wine price index with the long-term equilibrium model being the first one estimated. Table 13 contains the results of the estimation for the model.

Table 13, the first WINE model

Variable	β	St.Error	t	P
<i>C</i>	12.04	3.8	3.16	0.002
<i>EPU</i>	-0.16	0.05	-2.94	0.0052
<i>GDP</i>	0.001	0	18.29	0
<i>r</i>	0.91	0.38	2.39	0.02
R square				0.88
Adjusted R Square				0.87
F Statistic				112.57
P				0.00
Akaike				6.34
Schwarz				6.5
Hannan-Quinn				6.4

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

Following the introduction of the results, it is possible to formulate the model for the long-term equilibrium of the wine market index:

$$WINE = 12.04 - 0.16EPU_t + 0.001GDP_t + 0.91r_t + \varepsilon_2$$

Based on the results of the estimation, it is possible to proceed to the following interpretation of parameters of exogenous variables:

- If the EPU index in the UK increases by 1 point, the value of the wine market index goes down by 0.16 points, ceteris paribus.
- If the real GDP per capita in the UK increases by 1 USD, the wine market index increases by 0.001, ceteris paribus.
- If the interest rate in the UK increases by 1 percentage point, the wine market index increases by 0.91, ceteris paribus.

The share of explained variation in the wine market index is equal to 0.87 or 87%, according to the adjusted coefficient of determination. Furthermore, the model is significant, as the F statistic and probability both reveal. In addition to that, literally all regressors included in the model are significant, which is an extremely good sign especially when considering that standard errors are not biased due to the utilization of robust standard errors. After creating and addressing the first model associated with the wine market, it is time to proceed to the model depicting the short-term development of the index, which is based on the output from Table 14.

Table 14, the second WINE model

Variable	β	St.Error	t	P
<i>C</i>	1.38	0.82	1.67	0.1
$\Delta(EPU)$	-0.06	0.02	-2.86	0.006
$\Delta(GDP)$	-0.000164	0.0004	-0.377	0.7
$\Delta(r)$	-0.43	0.48	-0.9	0.37
<i>ECT</i>	-0.44	0.18	-2.4	0.02
R square				0.37
Adjusted R Square				0.31
F Statistic				6.28
P				0.00
Akaike				5.82
Schwarz				6.02
Hannan-Quinn				5.89

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

Following the depiction of the estimation results, it is possible to proceed to the interpretation of individual coefficients of independent variables over the short-term perspective:

- If the EPU increases by 1 point relative to the previous year, the wine market index decreases by 0.06, *ceteris paribus*.
- If the real GDP per capita increases by 1 USD relative to the previous year, the wine market index decreases by 0.000164, *ceteris paribus*.
- If the interest rate increases by 1 percentage point relative to the previous year, the wine market index decreases by 0.43 points, *ceteris paribus*.
- The speed of adjustment that is needed for the wine market index to return to the long-term equilibrium is 0.44, according to the error correction term.

Overall, the results of the second model indicate that independent variables have a negative effect on the wine market over the short-term perspective. Additionally, just one predictor is significant – the EPU index. On the other hand, the whole model is significant according to the F value and the probability associated with it. The final chapter of the analytical part concerns the stamp price index, whose model is introduced shortly in the narrative.

4.5.3 Stamp Price Index

The results for the final model related to the stamp price index is presented in Table 15.

Table 15, the first STAMP model

Variable	β	St.Error	t	P
<i>C</i>	727.21	324.32	2.24	0.03
<i>EPU</i>	-5.46	2.93	-1.86	0.06
<i>GDP</i>	0.02	0.004	5.67	0.00
<i>I</i>	45.89	22.35	2.05	0.04
R square				0.54
Adjusted R Square				0.51
F Statistic				17.64
P				0.00
Akaike				14.45
Schwarz				14.61
Hannan-Quinn				14.51

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

The model dedicated to the stamp index has the following structure:

$$STAMP = 727.21 - 5.46EPU_t + 0.02GDP_t + 45.89I_t + \varepsilon_3$$

The final model depicts the results for the stamp price index, based on which, the following interpretation can be formulated:

- If the EPU index in the UK increases by 1 point, the value of the stamp market index goes down by 5.46 points, *ceteris paribus*.
- If the real GDP per capita in the UK increases by 1 USD, the stamp market index increases by 0.02, *ceteris paribus*.
- If the inflation rate in the UK increases by 1 percentage point, the stamp market index increases by 45.89, *ceteris paribus*.

When it comes to the coefficient of determination of the estimated model, it is possible to conclude that the model has the lowest figure out of the three dedicated to the long-term equilibrium – just 0.51 or 51% of the variation was explained. On the other hand, the model is significant based on the F value and the probability associated with it. Furthermore, the model does not suffer from problems of heteroscedasticity and serial correlation due to the introduction of robust standard errors. Out of the three

exogenous variables, there is just one that is not significant – the EPU index, while both the GDP and interest rate are significant predictors of the stamp price index over the long-term horizon. After estimating the first model, it is crucial to proceed to the estimation of the very last model of this diploma thesis – the short-term stamp price index model, whose output is presented in Table 16.

Table 16, the second STAMP model

Variable	β	St.Error	t	P
<i>C</i>	6.53	19.89	0.32	0.74
$\Delta(EPU)$	-2.1	0.9	-2.31	0.02
$\Delta(GDP)$	0.02	0.01	2.08	0.04
$\Delta(I)$	8.28	5.77	1.43	0.15
<i>ECT</i>	-0.13	0.05	-2.53	0.01
R square				0.28
Adjusted R Square				0.21
F Statistic				4.21
P				0.00
Akaike				12.4
Schwarz				12.6
Hannan-Quinn				12.48

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

After presenting the results of the last model, it is possible to formulate the following model:

$$\Delta STAMP = 6.53 - 2.1\Delta EPU_t + 0.02\Delta GDP_t + 8.28\Delta I_t - 0.13\varepsilon_{3t-1} + v_3$$

Consequently, the created equation's interpretation is:

- If the EPU increases by 1 point relative to the previous year, the stamp market index decreases by 2.1, ceteris paribus.
- If the real GDP per capita increases by 1 USD relative to the previous year, the stamp market index increases by 0.02, ceteris paribus.
- If the inflation rate increases by 1 percentage point relative to the previous year, the stamp market index increases by 8.28 points, ceteris paribus.
- The speed of adjustment that is needed for the stamp market index to return to the long-term equilibrium is 0.13, according to the error correction term.

The short-term stamp model has one of the best coefficients of determination out of the short-term models – 0.21 or 21% of the variation in the dependent variable was explained. The whole model is significant with just the inflation rate having an insignificant effect on the stamp price in the short-term horizon. The error correction term is negative and its value is located between 0 and 1, which, alongside its significance, indicates that the model is properly constructed. Further elaboration on the results and comparison of the findings with other scholars and scientists will be provided in the next chapter dedicated to the discussion.

5. Discussion and Recommendations

Before proceeding to the discussion itself, it is downright crucial to recall the main findings of the diploma thesis. Given the presence of a total of 6 models, a pertinent table containing the summary of results is introduced in this chapter. Table 17 offers a complete overview of the findings of the diploma thesis.

Table 17, the summary of models

Horizon	Variable	ART	WINE	STAMP
<i>Short-Term</i>	<i>EPU</i>	-0.42	-0.06	-2.1
	<i>GDP</i>	0.009	0.0001	0.02
	<i>r</i>	4.04	-0.43	-
	<i>I</i>	-	-	8.28
	<i>ECT</i>	-0.038	-0.44	-0.13
<i>Long-Term</i>	<i>EPU</i>	-0.88	-0.16	-5.46
	<i>GDP</i>	0.028	0.001	0.02
	<i>r</i>	25.18	0.91	-
	<i>I</i>	-	-	45.89

Source: own processing based on data from Chambers, Dimson and Spaenjers 2019 and The World Bank, 2023

What is interesting to note here is the fact that all collectible markets are extremely sensitive towards changes in the political environment and policy stability in the country, which is visible due to the negative sign for the EPU variable for all cases. Furthermore, the most vulnerable market to political instability and policy uncertainty is the stamp market, where the magnitude of the negative effect is the highest – negative 2.1 compared to 0.42 and 0.06 for art and wine, respectively. Furthermore, it is interesting to specify that the market that is less prone to negative fluctuations associated with changes in the political environment and government-related agendas is the wine one due to the lowest magnitude of the decrease. On the other hand, it is possible to suggest that the markets are somewhat correlated and this correlation extends beyond just high values for the correlation coefficient but also to the way how individual collectible markets experience shocks associated with political instability and uncertainty. Based on this very piece of evidence, it is more likely that ongoing recessions and political issues do damage the market to some extent, which partially indicates that those markets are not suitable for escaping risks prevailing in more traditional markets entirely. The same is suggested by Burton and Jacobsen,

(1999). In that regard, the stamp market is the most vulnerable one to potential uncertainties, which is not shared by Grable and Watkins (2016), while the wine market is somewhat different, which might be inevitably connected to the connection that the market has to agriculture that rarely sees any considerable changes and problems due to a longer cycle of agrarian policies oriented more on a medium and long-term horizons.

On the other hand, another piece of evidence for the fact that the collectibles market behaves in a normal way not much different from traditional financial and commodity markets are signs for the GDP per capita variable, which are positive in every single instance. Furthermore, it is vital to indicate that the market that is more positively affected by the increment in the GDP per capita, i.e., the wealth of the nation, is the stamp market. Alternatively, it is fair to assume that whenever a particular recession happens, the value of the GDP per capita inevitably falls, thus leading to the chain reaction in all of the three markets represented in the form of a logical recession, which is entirely against the assumption of those market being an ideal hedge against financial and economic uncertainty. A similar assumption is made by Burton and Jacobsen (1999). On the other hand, those assumptions contradict the study mentioned earlier in the theoretical part of the work - Mamarbachi, Day and Favato (2008), who believed in the potential of the art market to be an alternative. The market itself might serve as a quasi-alternative to traditional markets, but its very mechanism is not much different from traditional markets, as the analysis reveals.

Yet, what is different from traditional markets in the case of collectibles is their relationship with the interest rate, which is traditionally negative in the case of financial markets. For the case of the art market, the relationship is positive, which itself might indicate the willingness of individuals to find shelter in that market during the times of contractionary monetary policy mainly expressed in higher rates of interest imposed by central banks. On the other hand, this is not observed in the case of the wine market, the phenomenon of which must be surely tied to the fact that wine is a commodity produced by businesses and firms. During times of higher interest rates, it is quite natural for businesses to experience problems with expansion, which must inevitably affect the whole market, as is seen by the estimated sign. Overall, this particular phenomenon observed partially confirms that collectibles markets offer a haven for investors during times of recession and higher interest, but this is not the case for the wine market. Furthermore, the interest rate variable is omitted from the last case due to the absence of cointegration as a whole. For this reason, it is vital to conclude that collectible markets, despite being somewhat similar, do still differ in specific cases and the interest rate is one of them.

Finally, another important finding that was made in the thesis was the formulation of the error correction term which is a useful tool shedding a brighter light on the speed of adjustment of each market. Based on the error correction term, it is possible to say that the market that adjusts the fastest to the change in variables is the wine market, followed by the stamp and the art markets.

Apart from summarizing the main findings of the work and comparing them to the relevant scientific framework, it is downright crucial to also formulate relevant recommendations that can be useful for future research and analysis of the collectibles market. One of the first and the most important recommendations that a potential researcher should consider would be expanding the original sample size by theoretically including quarterly observations instead of annual ones. Furthermore, another recommendation concerns the period used for the analysis, where the recent decade can also be included in the analysis, which was not done in this analysis due to data unavailability. Undeniably, in the near future, it is highly likely that the original study of Spaenjers could be expanded further which will allow researchers to consider not just the period until the year 2007 but beyond that date as well.

Another recommendation that is formulated concerns the estimation process itself, where it can be potentially interesting and useful to perform Chow tests that can shed a brighter light on whether there were any structural changes within the three considered markets. In addition to that, focusing on other countries and potentially comparing them to the United Kingdom can be a useful and sophisticated expansion to the diploma thesis. One of the biggest limitations of the work was the fact that the main estimation was based on very limited amount of data, so it is suggested to expand the research through focusing on a larger sample size or using alternative methods.

6. Conclusion

This study was focused on analyzing alternative investments, represented by Art, wine, and stamps, i.e., collectibles markets, and investigating their performance during unstable financial times while potentially being able to say whether they can act as a hedge or not. To depict uncertainty and political instability, a series of macroeconomic indicators were introduced, where special focus was paid to the relationship between the three markets and the EPU index.

This thesis was focused on the UK, and it is worth noting that the results can be different when analyzing other countries or regions, which leads to the formulation of relevant recommendations suggesting that the analysis should further be expanded to other regions and countries, and the results can be compared with the United Kingdom.

Alternative investments' popularity has seen a rapid rise in the past decades, alongside their value, which is why this topic offered an interesting base for a more detailed study. This thesis has been designed to investigate the relationship between the chosen variables and Art, wine, and stamp price indexes in the UK between 1960 and 2007. The Johansen test, Granger causality, and the VECM were applied all together.

Consequently, several different analyses were carried out. Firstly, the relationship between the art price index and three independent variables, the EPU Index, long-term interest rates, and the GDP per capita was analyzed. The findings showed a statistically significant relationship between just two independent variables and the art price index – GDP per capita and the interest rate. Secondly, the relationship between the stamp price index and three independent variables, the EPU Index, GDP per capita, and inflation rate, was analyzed. The findings showed a statistically significant relationship with just two variables – the GDP and the inflation rate. Lastly, the relationship between the wine price index and three independent variables, the EPU Index, the GDP per capita, and the interest rate was investigated. Based on the results, it can be seen that all three variables had a statistically significant relationship with the wine price index, thus indicating that this market is the one that has a larger number of

factors triggering changes there. In addition to that, the wine market is the fastest one where the market adjusts to changes in the determinants, according to the error correction term that was highest out of the three collectibles markets.

The findings of the study are in line with previous literature on this topic. The relationship between various factors and pricing of art and other alternative investments was also investigated by Dimson and Spaenjers (2010); Lovo and Spaenjers (2018); Chambers, Dimson and Spaenjers (2019). Despite the differences in methodologies and variables considered, their study converged on the same central idea that wealth and income dynamics play a significant role in shaping the prices in the art market, and by extension, other alternative investment markets. It was found that the wealth of the wealthy drives art prices, and art booms can be expected whenever income inequality rises quickly, which is in line with the results of this study, demonstrating a significant relationship between wealth and the price of wine. Both academic works also underscore the relevance of population size in influencing the price of art. Even though both studies acknowledge the role of macroeconomic conditions in determining the price of alternative investments, other studies' findings suggest a more direct link between income equality and art prices, while the analysis of this study emphasizes the role of macroeconomic conditions such as interest rates, inflation rate, and the EPU Index more.

To summarize the findings, all three price indexes, art, wine, and stamps, had a negative relationship with the EPU Index, which means that it cannot be stated that they perform well during times of increased political and financial uncertainty. Furthermore, the relationship that all three markets have with the selected macroeconomic variables indicates that their performance is not much different from traditional markets such as the commodity and financial ones. On the other hand, the only major difference is the relationship between some selected markets and the interest rate, which was identified to be positive compared to the traditionally observed negative relationship for the case of other more conservative markets.

At the same time, it is worth noting that alternative investments can be riskier due to the value of the collectible falling if the interest in the particular item suddenly declines, as alternative investments are frequently focused on specific individual items of interest to the investor(s). Due to the same reason, they can offer a good portfolio

diversified to certain investor types as these individual items of interest can be less correlated with the overall market movements. However, this does not prompt the researcher to accept the hypothesis that collectible markets can serve as a hedge.

One of the possible areas of further expansion of the study is to focus on more than one geographic region (in this case, the United Kingdom) to investigate the differences based on different economies, monetary policies, levels of income or wealth, and other investment characteristics of the population. Another interesting area of further research includes comparing alternative investments to more common investment opportunities, such as stocks or bonds, to analyze whether there is any correlation between these and to understand further how they affect each other if they do. Lastly, one could also expand the findings by including more macroeconomic factors that can influence investment decisions, as well as introducing the Chow test to identify potential structural changes. Additionally, quarterly time series data can be viewed as a more robust alternative to the data implemented in the study.

7. References

Asuero, A.G., Sayago, A. and González, A.G. (2006) 'The Correlation Coefficient: An Overview', *Critical Reviews in Analytical Chemistry*, 36(1), pp. 41–59. Available at: <https://doi.org/10.1080/10408340500526766>.

Baumol, W.J. (1985) 'Unnatural Value: Or Art Investment as Floating Crap Game', *Journal of Arts Management and Law*, 15(3), pp. 47–60. Available at: <https://doi.org/10.1080/07335113.1985.9942162>.

Bini, E., Garavini, G. and Romero, F. (eds) (2016) *Oil shock: the 1973 crisis and its economic legacy*. London: I.B. Tauris (International library of twentieth century history, 88).

Blanchard, O. and Gali, J. (2007) *The Macroeconomic Effects of Oil Shocks: Why are the 2000s So Different from the 1970s?* w13368. Cambridge, MA: National Bureau of Economic Research, p. w13368. Available at: <https://doi.org/10.3386/w13368>.

Budd, A. (2005) 'Black Wednesday - A Re-examination of Britain's Experience in the Exchange Rate Mechanism', *SSRN Electronic Journal* [Preprint]. Available at: <https://doi.org/10.2139/ssrn.734203>.

Bulmer, S. and Burch, M. (2009) *The Europeanisation of Whitehall: UK central government and the European Union*. Manchester, UK ; New York : New York: Manchester University Press ; Distributed in the USA by Palgrave Macmillan (European Policy Research Unit series).

Burton, B.J. and Jacobsen, J.P. (1999) 'Measuring Returns on Investments in Collectibles', *Journal of Economic Perspectives*, 13(4), pp. 193–212. Available at: <https://doi.org/10.1257/jep.13.4.193>.

Campbell, R. (2005) 'The art of portfolio diversification'.

Campbell, R.J. (2009) 'Art as a Financial Investment', in *Collectible Investments for the High Net Worth Investor*. Elsevier, pp. 119–150. Available at: <https://doi.org/10.1016/B978-0-12-374522-4.00006-8>.

Chambers, D., Dimson, E. and Spaenjers, C. (2019) 'Art as an Asset: Evidence from Keynes the Collector'. Rochester, NY. Available at: <https://doi.org/10.2139/ssrn.2657741>.

Chanel, O. (1995) 'Is art market behaviour predictable?', *European Economic Review*, 39(3–4), pp. 519–527. Available at: [https://doi.org/10.1016/0014-2921\(94\)00058-8](https://doi.org/10.1016/0014-2921(94)00058-8).

Crafts, N. (2017) 'UK Economic Growth Performance in a European Context: Has EU Membership Made Much Difference?', in N.F. Campos and F. Coricelli (eds) *The Economics of UK-EU Relations*. Cham: Springer International Publishing, pp. 9–45. Available at: https://doi.org/10.1007/978-3-319-55495-2_2.

Croux, C., Dhaene, G. and Hoorelbeke, D. (2004) 'Robust Standard Errors for Robust Estimators', *Katholieke Universiteit Leuven, Open Access publications from Katholieke Universiteit Leuven* [Preprint].

Davis, S. (2016) *An Index of Global Economic Policy Uncertainty*. w22740. Cambridge, MA: National Bureau of Economic Research, p. w22740. Available at: <https://doi.org/10.3386/w22740>.

Degiannakis, S. and Filis, G. (2019) 'Forecasting European economic policy uncertainty', *Scottish Journal of Political Economy*, 66(1), pp. 94–114. Available at: <https://doi.org/10.1111/sjpe.12174>.

Del Negro, M. *et al.* (2019) 'Global trends in interest rates', *Journal of International Economics*, 118, pp. 248–262. Available at: <https://doi.org/10.1016/j.jinteco.2019.01.010>.

Dimson, E., Rousseau, P.L. and Spaenjers, C. (2013) 'The Price of Wine', *SSRN Electronic Journal* [Preprint]. Available at: <https://doi.org/10.2139/ssrn.2321573>.

Dimson, E. and Spaenjers, C. (2010) 'Ex Post: The Investment Performance of Collectible Stamps'. Rochester, NY. Available at: <https://papers.ssrn.com/abstract=1444341> (Accessed: 3 January 2024).

Douglas, S. (2008) 'Larry Gagosian, Intelligent Life', *The Economist*.

Dwyer, G.P. and Wallace, M.S. (1992) 'Cointegration and market efficiency', *Journal of International Money and Finance*, 11(4), pp. 318–327. Available at: [https://doi.org/10.1016/0261-5606\(92\)90027-U](https://doi.org/10.1016/0261-5606(92)90027-U).

-
- Dynan, K. and Sheiner, L. (2018) ‘GDP as a Measure of Economic Well-being’.
- Eckstein, J. (2008) *Investing in Art*. London: Routledge.
- Frey, B.S. and Eichenberger, R. (1995) ‘On the Return of Art Investment Return Analyses’, *Journal of Cultural Economics*, 19(3), pp. 207–220.
- Goetzmann, W.N., Renneboog, L. and Spaenjers, C. (2011) ‘Art and Money’, *The American Economic Review*, 101(3), pp. 222–226.
- Grable, J.E. and Watkins, K. (2016) ‘Quantifying the Value of Collecting: Implications for Financial Advisers’, *Journal of Family and Economic Issues*, 37(4), pp. 639–648. Available at: <https://doi.org/10.1007/s10834-015-9471-2>.
- Grant, D. (2006) ‘Art investment companies begin to make purchase’, *Main Antique Digest*.
- Groysberg, B. (2006) *Fernwood Art Investments: Leading in an Imperfect Marketplace - Case - Faculty & Research - Harvard Business School*. Available at: <https://www.hbs.edu/faculty/Pages/item.aspx?num=31548> (Accessed: 3 January 2024).
- Gujarati, D.N. and Porter, D.C. (2009) *Basic econometrics*. 5th ed. Boston: McGraw-Hill Irwin.
- Ip, G. and Whitehouse, M. (2006) ‘How Milton Friedman Changed Economics, Policy and Markets’, *The Wall Street Journal*. Available at: <https://www.columbia.edu/~esp2/WSJ%20Whitehouse%20Article.pdf>.
- Jyrämä, A. (2002) ‘Contemporary Art Markets — Structure and Actors: A Study of Art Galleries in Finland, Sweden, France and Great Britain’, *International Journal of Arts Management*, 4(2), pp. 50–65.
- Kräussl, R., Lehnert, T. and Martelin, N. (2016) ‘Is there a bubble in the art market?’, *Journal of Empirical Finance*, 35, pp. 99–109. Available at: <https://doi.org/10.1016/j.jempfin.2015.10.010>.
- Lopez, J.H. (1997) ‘The power of the ADF test’, *Economics Letters*, 57(1), pp. 5–10. Available at: [https://doi.org/10.1016/S0165-1765\(97\)81872-1](https://doi.org/10.1016/S0165-1765(97)81872-1).

Lovo, S. and Spaenjers, C. (2018) 'A Model of Trading in the Art Market', *American Economic Review*, 108(3), pp. 744–774. Available at: <https://doi.org/10.1257/aer.20160522>.

Mamabachi, R., Day, M. and Favato, G. (2008a) 'Art as an Alternative Investment Asset', *SSRN Electronic Journal* [Preprint]. Available at: <https://doi.org/10.2139/ssrn.1112630>.

Mamabachi, R., Day, M. and Favato, G. (2008b) 'Evaluating art as an alternative investment asset', *Journal of Financial Transformation*, 24, pp. 63–71.

Mei, J. and Moses, M. (2002) 'Art as an Investment and the Underperformance of Masterpieces', *The American Economic Review*, 92(5), pp. 1656–1668.

Mei, J. and Moses, M. (2005) 'Beautiful Asset: Art as Investment'.

Merrill Lynch and E&Y (2006) *The World Wealth Report*. New York.

Palmeri, C. (2007) 'The Artful Investor. New research calls art a smart investment, but skeptics point to high costs and high risk', *Business Week*.

Pesaran, M.H. (2004) 'General Diagnostic Tests for Cross Section Dependence in Panels', *SSRN Electronic Journal* [Preprint]. Available at: <https://doi.org/10.2139/ssrn.572504>.

Porter, M.E. (1985) *Competitive advantage: creating and sustaining superior performance*. 4. printing. New York: Free Pr. [u.a.].

Shojaie, A. and Fox, E.B. (2022) 'Granger Causality: A Review and Recent Advances', *Annual Review of Statistics and Its Application*, 9(1), pp. 289–319. Available at: <https://doi.org/10.1146/annurev-statistics-040120-010930>.

Steiner, A. (2014) 'The globalisation process and the Eastern bloc countries in the 1970s and 1980s', *European Review of History: Revue européenne d'histoire*, 21(2), pp. 165–181. Available at: <https://doi.org/10.1080/13507486.2014.888704>.

Taylor, K. (2007) *Seeking A Hedge For Art*, *The New York Sun*. Available at: <https://www.nysun.com/article/arts-seeking-a-hedge-for-art> (Accessed: 3 January 2024).

Thadewald, T. and Büning, H. (2007) ‘Jarque–Bera Test and its Competitors for Testing Normality – A Power Comparison’, *Journal of Applied Statistics*, 34(1), pp. 87–105. Available at: <https://doi.org/10.1080/02664760600994539>.

The World Bank. (2023). Indicators. [online]. Available from <https://data.worldbank.org/indicator>.

Velthuis, O. (2013) *Talking Prices: Symbolic Meanings of Prices on the Market for Contemporary Art*. Princeton University Press. Available at: <https://doi.org/10.2307/j.ctt4cgd14>.

List of Appendices

Table 18, the estimation dataset

Year	ART	WINE	STAMP	EPU	GDP	r	I
1960	110.48	2.37	251.48	83.60	1397.59	5.40	1.0
1961	107.59	2.51	254.57	93.95	1472.39	6.20	3.4
1962	113.54	2.95	265.25	83.13	1525.78	5.98	4.2
1963	112.01	3.29	262.81	88.43	1613.46	5.59	2.0
1964	108.26	4.11	253.43	80.06	1748.29	6.06	3.3
1965	106.80	4.95	301.70	92.51	1873.57	6.43	4.8
1966	115.97	5.67	315.12	93.89	1986.75	6.82	3.9
1967	133.05	8.05	323.13	85.28	2058.78	6.73	2.5
1968	184.10	7.02	311.77	77.43	1951.76	7.46	4.7
1969	240.54	6.61	472.05	64.74	2100.67	8.94	5.4
1970	273.54	7.03	477.16	55.62	2347.54	9.23	6.4
1971	291.77	7.89	444.33	77.78	2649.80	9.04	9.4
1972	332.92	14.20	423.12	80.57	3030.43	9.20	7.1
1973	397.17	12.76	455.19	101.57	3426.28	10.91	9.2
1974	370.44	8.38	453.66	143.99	3665.86	15.17	16.0
1975	316.63	8.17	498.09	128.28	4299.75	14.60	24.2
1976	321.47	9.47	769.00	109.06	4138.17	14.23	16.6
1977	322.87	15.42	933.42	101.55	4681.44	12.19	15.8
1978	335.45	17.25	1113.64	89.48	5976.94	12.03	8.3
1979	364.82	17.56	1740.07	66.55	7804.76	11.35	13.4
1980	382.38	13.84	1871.75	92.47	10032.06	11.93	18.0
1981	408.88	14.39	1640.56	96.32	9599.31	13.01	11.9
1982	428.19	14.88	1419.78	84.89	9146.08	11.74	8.6
1983	484.49	24.50	1338.63	87.17	8691.52	10.25	4.6
1984	546.45	31.02	1281.55	66.67	8179.19	10.17	5.0
1985	637.02	27.58	1215.05	67.41	8652.22	10.09	6.1
1986	760.34	29.56	1176.33	73.90	10611.11	9.46	3.4
1987	866.68	25.14	1180.59	78.25	13118.59	9.32	4.1
1988	995.50	25.91	1118.18	68.51	15987.17	9.12	4.2
1989	938.88	28.71	1056.19	95.19	16239.28	9.26	5.8
1990	972.86	22.39	969.55	107.38	19095.47	10.88	8.1
1991	797.90	21.44	932.72	117.62	19900.73	9.99	7.5
1992	727.35	17.67	897.95	140.91	20487.17	9.16	4.6
1993	718.14	18.82	881.76	110.27	18389.02	7.69	2.6
1994	684.97	22.06	862.53	94.17	19709.24	8.18	2.2
1995	698.56	27.02	882.42	92.08	23123.18	8.24	2.7
1996	742.21	36.32	891.65	71.95	24332.70	8.03	2.9
1997	776.19	33.48	860.42	70.45	26734.56	7.13	2.2
1998	814.40	34.85	888.44	72.09	28214.27	5.53	1.8
1999	887.72	35.22	918.87	56.72	28669.54	4.85	1.8
2000	952.53	40.44	1004.87	44.03	28149.87	4.91	1.2
2001	1025.19	45.47	1024.01	77.27	27744.51	5.05	1.5
2002	1035.19	54.31	1091.80	77.47	30056.59	5.05	1.5
2003	1096.31	35.45	1223.53	111.73	34419.15	4.88	1.4
2004	1170.43	38.39	1401.93	45.67	40290.31	4.77	1.4
2005	1268.52	52.83	1515.51	47.79	42030.29	4.44	2.1
2006	1358.87	61.67	1604.52	46.69	44599.70	4.24	2.5
2007	1395.46	60.71	1693.09	56.83	50566.83	4.63	2.4

Source: The World Bank, 2023