Olivier OLLAGNON
Matricule : 20847
Programme Grande Ecole - Majeure Finance

MASTER THESIS

Emotional assets as an alternative financial investment: An efficient portfolio diversification solution during financial crises ?

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Abstract:

This paper investigates whether emotional assets can provide potential hedge or diversification solutions to financial investors, especially when facing economic and financial crises like over the very recent period. In particular, I use data from Dimson and Spaenjers (2011) to analyze correlation of various emotional assets (art, stamps, violins) over the long term with main other asset classes, and stocks in particular. I provide a lagged-CAPM analysis to quantify the exposure of emotional assets to stock returns, and find evidence that there exists a positive correlation between emotional asset and stock returns, but mainly with a lag of 1 or 2 years depending on the asset. In addition, art appears to be the emotional asset, whose correlation with stock markets is the highest at 57.5% with 2 lagged and 1 leading market returns. I also complete a study on diversification based on Mean-Variance optimization, which tends to give evidence that emotional assets do provide diversification benefits for financial investors. Our results for the tangency portfolio imply an allocation of almost a third to emotional assets divided between stamps, violins and wine. Among alternative assets, Real Estate also proves to be interesting from a financial perspective while commodities like gold or silver are much more disregarded.

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Introduction

The world has recently faced two very important financial crises since 2008, the first one due to subprimes and the second one to sovereign debt. Both crises significantly affected stock markets and financial investors. Generally speaking, all financial and economic crises, even though they have different sources and present different features, have similar consequences on poor stock returns and increasing markets' volatility. From this observation, we can wonder whether there exist some other assets that would outperform stocks and could thus help an investor diversify his portfolio and to some extent help him get better returns in time of financial crisis. Main alternative assets that are commonly considered are commodities (investing in gold or silver for instance) or real estate, and emotional assets from a pure financial perspective are often disregarded or forgotten. Some of the reasons are that to invest in such asset classes, you need a certain expertise, markets are much more illiquid than markets for other assets, or that the equilibrium price of emotional assets is unknown and as a result, pricing evaluation is impossible. We could also talk about the low market transparency, high transaction costs, the general expertise discrepancy between sellers and buyers. But anyway, when looking back at financial crises, we can see that traditional alternative assets can be deeply affected by the crisis, like real estate in 2008 during the subprime crisis. Therefore, an investor may find a true rationale for including emotional assets like art, wine, or diamonds in his portfolio diversification strategy, especially if we consider that main concerns of High Net Worth Individuals are capital preservation (97% of people) and Effective portfolio management (94%) according to a survey from the Capgemini World Wealth Report 2010. Thus, investments in emotional assets have been expanding again after the 2008 crisis despite the population of High Net Worth Individuals was strongly affected by the financial crisis. Indeed investments of passion kept on rebounding in 2010 and a large part of wealth invested was made in art (22%) even though it decreased a bit compared to 2008 (25%) while other collectibles investments boomed both in value and relative to other investments of passion (15% of investments of passion in 2010 vs. 12% only in 2008)[1]. As a result, Capgemini World Wealth Report 2010 states about collectibles : « Collectibles such as Art, which are deemed to have a low or negative correlation with mainstream financial investments,

[1] Capgemini World Wealth Report 2011

continued to have portfolio-diversification appeal »[1]. Art market in particular is experiencing a major transformation, among others due to the « increasing recognition of art as an asset class »[2]. This recognition, and increasing interest in art and collectibles in general, notably derives from the current cautious environment for investing (see Clare McAndrew[3]) and from the fact that recent research published (see Deloitte Art & Finance Report 2011, Mei & Moses and AMR indices ; discussed further in Parts I.B and II B)) tends to show that art has outperformed equity since 2000. Good returns are backed by recent strong Asian demand, and the development of art loans and other art investment financing facilities. Today, 83% of private banks « feel that there are strong arguments for including art and collectibles in traditional wealth management »[2].

Thus, the following thesis is aimed to discuss two main subjects : First, as previously stated, the current global economic situation and outlook is unprecedented for several reasons. Indeed, today markets have been bearish for several years. Unlike previous crises, the recovery is very long to arrive and the present situation, given all the concerns about sovereign debt for instance, is likely to last. Therefore, the interest of emotional assets as alternative investments in such a situation may be real. As such, we will research, whether emotional assets can on average be more resilient to crises than other asset classes. Actually, investor behavior is not purely financial as theorized by Belk (1995) or Mandel (2009), what is developed into more details later in the thesis (see Part I C)), and empirically confirmed by recent reports (Deloitte Art & Finance 2011 : only 49% of collectors say to be primarily driven by investment returns). As a result, this may impact prices and returns, even if they still depend on demand (as suggested by Mandel, the main driver of art returns is the « dynamic demand »[4]) and hence on the wealth available[1], or affect correlation with financial markets and the general economic situation, thus providing potential diversification opportunities. This analysis will mainly be based on the review and study of literature and of different ways to calculate returns that were introduced in the past. In fact, some of the main difficulties of these assets are that markets are illiquid, there is no equilibrium price for

[2] Deloitte Art & Finance Report 2011

[3] C. McAndrew, « The international Art market 2007-2009 : Trends in the art trade during global recession », 2010

[4] B. Mandel, « Art as an investment and conspicuous consumption good », 2009

assets as we are commonly used to defining it, so evaluating prices of assets is really tough, and data are rare and hard to find for several reasons (low quantity of transactions, heterogeneity of assets, in art for instance, and difficulties to calculate and compare returns…). We will then compare historical returns of emotional assets to stocks, and try to determine historical correlation between emotional assets and traditional financial assets as well as exposure of emotional assets to market risk through a lagged CAPM analysis.

We will also study whether emotional assets provide diversification opportunities for financial investors. Benefits resulting from diversification have been assessed for quite a long time and, in addition, nowadays traditional assets are more and more correlated thus reducing the impact of such a diversification by investing in stocks from different countries or sectors. In 2007, Richard Bernstein and Kari Pinkernell stated that correlation between the S&P 500 and main other asset classes including stocks, commodities, hedge funds and real estate had increased over the past 10 years to a level sometimes in excess to 90%, and even art was today positively correlated with S&P 500 even though the level of correlation was lower than with most of previously cited assets. Actually, although assets are positively correlated, diversification can still be useful to optimize risk and return of an investor's portfolio. Indeed, « the benefits of diversification across asset classes remain substantial »[5]. As a result, emotional assets individually and altogether may be of interest as alternative investments to achieve a better portfolio diversification. In particular, as emotional assets are numerous and present different features, it might be interesting to combine various emotional assets into a same portfolio. Furthermore, we also need to take into account the standard deviations of assets when estimating the benefits of diversification[5] and so, we will research whether, when considering both the correlation of various emotional assets with other asset classes and their return / standard deviation profiles, based on Markowitz mean-variance optimization, emotional assets are really of interest and should be included in portfolio diversification strategies.

[5] Statman and Scheid, « Correlation, return gaps and the benefits of diversification », 2008

I. Emotional assets : Main features, investment purposes and investor behavior

A. Presentation of emotional assets

There are very different types of emotional assets from art to wine through diamonds, stamps, antiques. However, they all share some common and very particular characteristics that make them comparable between each other and a unique asset class. While other asset classes generate cash flows or have a real and intrinsic use value by being part of an industrial process for instance, it is not the case of emotional assets and besides that is also why it is so hard to value these assets. Most of emotional assets can be *used* like other assets such as commodities but in a different way. They have no industrial use so the only way to benefit from such an asset is for itself (emotional assets are stable over time, they are not aimed to be transformed like commodities and they are not generating any activity like companies or real estate), and from an aesthetic or pleasure perspective. In addition, emotional assets can actually only have a marginal use value for the buyer, from a « social » perspective potentially. If you take the example of art, a painting is just aimed to be watched, potentially to be showed, thus you do not get any value added or cash flows from it except at the resale of course. In the case of wine, it is more or less the same with the major difference that it is a perishable asset so once you consumed it, it has no longer value, but anyway it has no other use than the traditional way to consume it. Moreover, all these assets are unique (art) or at least very limited (fine wine, stamps, antiques) or rare (diamonds) and that is also where their value comes from in addition to a general recognition of quality and luxury[6].

Nevertheless, all these assets are traded like any other, although with less elaborated market, and that is precisely why they can be considered and used from a financial perspective. Indeed they are not just following inflation, they have a real *financial life* with returns, volatility and correlation with other assets that can be used to create optimal portfolios even though they present many drawbacks especially because of the lack of information as we will see into more details in the next part. Though it remains at a very early stage of development, the elaboration of databases, indices with own and various methodologies, and works on these topics, especially for art, have

[6] R. Belk, « Collecting as luxury consumption : Effects on Individuals and Households », 1995

enabled to create an entire and separate asset class. An evidence of this is the current trend for art investors to invest across a range of art sectors to hedge against the risks of market declines for a particular artist or category within their art portfolio[7]. In addition, investment professionals after the crisis of Real Estate, are now talking about SWAG (silver, wine, art and gold) as the new type of successful alternative investment, which implies that art and emotional assets in general are entering the mainstream spectrum of alternative assets. As a result, today the market for art is bigger than ever, even despite the recent global financial crisis and recession, since the global art market size in 2009 (€31.3bn) is higher than ever before 2006 despite a drop by 12% and 26% of the size of the global art market in 2008 and 2009 respectively[7]. Other emotional assets' markets have also been continually increasing over the past decades[8]. The rebound recorded in 2010 and 2011, partly driven by the booming demand in Asia enables to catch up with the level of 2007 : Indeed China already accounted for 14% of the global art market in 2009 while the US and UK were still dominating the market with a combined market share of nearly 60%[7].

Simultaneously, art loans have appeared both on a recourse (traditional banks) and non-recourse (specialist lenders, auction houses) basis helping create liquidity on the art market and helping it grow even faster. Actually art financing has existed for several decades, but what is really a revolution in the art market, is the emergence of non-specialist lenders and new dedicated lending sources from traditional banks. Thus, Deutsche Bank for instance was particularly active in both 2010 and 2011 reporting c.$400 million of art-backed loans on its books[9].

B. Pros and cons of investing in collectibles

Rationales for investing in emotional assets are easily identifiable. It enables an investor to diversify his investments. It offers kind of long-term stability and is as a result often considered as a safer investment because it relies on a « hard » and tangible asset, in addition to the potential passion or pleasure behind the investment. In fact, almost all art investors report that their main motivation for investing in art is focused

[7] C. McAndrew, « The international Art market 2007-2009 : Trends in the art trade during global recession », 2010

[8] Capgemini World Wealth Report 2011

[9] Deloitte Art & Finance Report 2011

on aesthetic and by passion[10]. Then it is also asserted by Deloitte, relying on research by Mei & Moses, that art for instance has outperformed equity over the past ten years and hence that investing in art provides better returns than equity. Indeed, their research shows that 48% of art advisors said their clients and 49% of collectors themselves were primarily driven by investment returns[10]. These assets could therefore have a better resilience to financial crises as they are not linked to any economic activity and that reasons behind investor behavior are primarily non-economic, even if contraction of financial markets logically implies a drop in cash available and therefore in investment in emotional assets as observed in the latest crisis[11]. We will actually study and make empirical research on this particular issue later in the thesis (see Part III). Investing in collectibles like art offers non-negligible taxation advantages to investors as explained by McAndrew and is particularly interesting when most regulators are thinking about a potential taxation on financial transactions.

On the other hand, drawbacks are numerous and actually we already approached some of them previously in this thesis. First of all, the absence of regulated and easily tradable financial markets is a major obstacle. Actually trades involving emotional assets are made through auctions or on OTC (over-the-counter) markets and hence there is no common and standardized (i.e. with valuation standards in particular) market for these assets even for art. Besides it is recognized as such by Deloitte with 73% of private banks seeing it as one of the main hurdles in the expansion of the art market[10].

Then transaction costs are high. In fact, trades are made through intermediaries and experts because of the nature itself of these assets : they are heterogeneous by nature because they are all unique and different, with few similar pieces traded each year, so there is necessarily a need for valuation and certification for instance before each trade. In addition, as further developed by Mamarbachi, Day and Favato in 2006, there usually are large differences in expertise between buyers and sellers so the risk is accrued which makes being cautious even more compulsory before making a trade. That is basically why transaction costs in emotional assets are much higher than for any other

[10] Deloitte Art & Finance Report 2011

[11] C. McAndrew, « The international Art market 2007-2009 : Trends in the art trade during global recession » pg 21, 2010

asset even real estate, and which makes for instance short-term speculation very hard and subsequently slowing the financial development of these asset classes.

Other costs to store these kinds of assets are also high. Indeed, since they are « hard » tangible assets, they need to be stored, restored for some of them like art or stamps in order to be maintained in a good shape and thus keep their value. There is also a need for accrued security around these types of assets because they have a high value, and owning art or diamond requires the implementation of specific security systems for instance. All these arguments explain that storage costs are quite significant for investors in emotional assets and that from a pure financial point of view, as these types of assets are generally expected to be kept during a certain amount of time given the transaction costs, these storage costs cannot be avoided and need to be taken into account when calculating historical or estimating expected returns just like transaction costs.

Other drawbacks add up to the ones previously mentioned, among which the low liquidity of emotional assets' markets, although this issue is well-known and markets players are continually trying to address it. Low liquidity implies an increased spread between buy and sell prices and as much transaction costs and potential loss on your investment. In addition, investments in emotional assets are necessarily large investments – buying a painting or diamonds is expensive - which means that portfolios must be large enough in order to be able to benefit from such a diversification. As a result, altogether this also adds risk to these types of investments because on one hand you buy expensive assets so you can buy only few assets and on the other hand, since markets are illiquid, the risk at the resale is real.

Low transparency of markets is a major concern too. Information on emotional assets is definitely scarce and discrepancies in knowledge and expertise between market players very important. Today it is particularly hard to find the right expertise when investing in emotional assets. In addition, data about return, volatility for instance are not as easy to access and to use as for other asset classes. Actually, one significant issue and bias when making financial investments in emotional assets and calculating returns or risk is that the data you can get are hardly comparable with stocks for instance because you can only get yearly or at best quarterly or monthly data, and because the way to calculate returns and by extension volatility are also different (hedonic approach for example), so you cannot really appreciate to what extent your calculations can be considered as right or biased, but we will discuss this further later in the thesis.

Some other drawbacks are put forward by Mamarbachi, Day and Favato (2006) : Markets have a much weaker equilibrium process than other securities, and as the equilibrium price of such assets is unknown, an objective valuation (by discounting future cash flows for instance) is generally impossible. Elasticity of supply is very low and in certain cases even equal to zero (i.e. in art for dead artists, for antiques like violins or rare books for instance). Finally, there exist monopolies especially for owners of art which means that investors are generally in a position of weakness when buying emotional assets.

Eventually, Baumol (1986) describes this lack of equilibrium price for art in particular, as a « floating crap game », since prices of such items « can float more or less aimlessly », and « their unpredictable oscillations are apt to be exacerbated by the activities of those who treat such art items as « investments » and who, according to the data, earn a real rate of return very close to zero on the average ». Indeed, he used data of art prices over a very long period (1650-1960) and took out the effects of inflation to demonstrate that the real rate of return of art investment is close to zero (0.55% per year on the average). Although this analysis points out some major issues of emotional assets like the absence of equilibrium price, it also includes several important biases : first he went back very long in the past when financial markets and investments obviously did not exist instead of focusing only on the very recent period which is very different from what we ever knew before. Then this analysis was made in 1986 at a time when financial markets were much smaller and markets for emotional assets were just nearly inexistent. Therefore, it does not take into account, the fact that an increasing wealth and demand globally, that a much bigger, more liquid and more regulated market can totally change the results for future returns. Eventually he considers art investing just for itself and completely disregards all the benefits to derive from diversification of financial portfolios or from the potential resilience of such assets to economic and financial crises. In addition, the absence of equilibrium price for emotional assets is probably not that worrying from a financial perspective since for other asset classes, change in prices is always stochastic, so nearly unpredictable, which means that investing in financial assets in a way is always a floating game.

C. Investor behavior : consumption vs. financial investment

As previously mentioned, reasons for investing in emotional assets are not only financial. As analyzed by McAndrew (2010), the first reason for investing in emotional assets is by passion. Indeed almost all collectors report that they buy emotional assets by passion first even though they also admit that these investments also have financial purposes since they generally have strict price criteria for instance.

Other authors analyzed more in depth the behavior of investors in emotional assets and the rationale behind the « consumption » of such assets. To begin with, Burton and Jacobsen (1999) discussed what the nature and behavior of investors in emotional assets is, and what consequences it may have on prices and returns of collectibles. They describe the market for emotional asset as being dual to some extent, with a large proportion of people investing in emotional assets for non-pecuniary purposes (i.e. just « to enjoy owning them » - referred as *consumption goods*), so that given the low number of investors and the relative illiquidity of the market, it may be easy for pure financial investors to manipulate this market in order to get very high returns and make a lot of money, all the more than there are no cost fundamentals or production concerns since you are in the resale market. This analysis is probably a bit too simple, because first it is impossible as for any other financial market to predict what the next « hot spot » or bubble is going to be and thus what market or asset is going to outperform others. Then, they probably underestimate the weight of financial rationale when investing in emotional assets because, at the end of the day, any investor is willing to make a good investment and get a positive return even though it is not his main concern, his *primary driver* (51% of investors would be concerned according to Deloitte[12]). However, it might lead to behavioral anomalies like the « endowment effect » (« an art object owned is evaluated higher than one not owned »), the « opportunity cost effect » (« not considering returns from alternative use of funds ») or the « sunk cost effect » (building up a collection) as stated by Frei and Eichenberger (1995).

Belk (1995) introduces the idea of luxury consumption, that emotional assets like collectibles are bought in particular because they are unique and useless objects, and that investors want to acquire « inessential consumer goods that are removed from

[12] Deloitte Art & Finance Report 2011

any functional capacity they may once have », so just because they are unique or very rare. To a certain extent, this is linked to the notion of conspicuous consumption that we will talk about later in this part, because having unique and expensive objects refers in a way to the pleasure to show to other people that you own something special that they cannot afford or simply have. Koford and Tschoegl (1998) took over this analysis to demonstrate that rarity has a positive impact on the value of a consumer good like for emotional assets. They use the example of rare coins to prove that in the case of emotional assets, the fact that these assets are unique or very rare increases the utility function and as a result adds up value to the asset for the investor without increasing the quality of the item.

Campbell, Koedjik and De Roon (2008) extend to emotional assets the multi-attribute utility function defined by Bollen (2007), which models the utility of investors by lower risk-adjusted returns compensated by the additional utility that derives from « investing in financial assets which adhere to their societal or personal objectives »[13]. They include the fact that this additional utility might also be a function of wealth given that people with the greatest incomes are the ones that invest the most in emotional assets. They also put forward the notion of consumption for emotional assets giving them therefore an intrinsic value such as consumption goods and apart from their monetary value. As a result, this intrinsic value corresponds to a form of aesthetic pleasure for instance and thus to the emotional part from the utility function of these assets which can explain why people may buy emotional assets for more than their pure monetary value[13]. Like them, I believe that this emotional utility part is real for investors and that it is logically included into the prices and returns of emotional assets because prices are the quantitative reflection of all the potential utility for investors. Nevertheless, it might be abusive to dissociate the monetary value from the emotive value from a quantitative perspective since it is nearly impossible to quantify each part and indeed they might be different from one investor to another.

To go further into the analysis of emotional assets as a consumption good, Corneo and Jeanne (1994) define conspicuous goods as « goods that are mainly purchased because of the demonstration effects that their consumption exerts on others ». It is kind of a social consumption and enables indeed its owner to signal and

[13] Campbell, Koedjik and De Roon, « Emotional Assets and Investment Behavior », 2008

raise his social status and thus « the amount of deference shown by others » and his « approval by the society ». They model this form of consumption as a « signaling game » depending on your wealth (both what you can afford and what you want to show as being your social status). It is particularly true for certain emotional assets like art or diamonds for instance. Thus, Scott and Yelowitz (2010) take the example of diamonds and claim that such goods can be consumed as conspicuous assets, « not just for their intrinsic utility but also for the impression their consumption has on others ». They find that people are willing to pay quite significant premia on average just to marginally increase the quality of the diamond they buy and reach the next threshold.

Finally, Mandel (2009) took the example of art to explain that the « determinants » of the value of such an asset are different from other financial assets. Indeed, on one side « art offers no claim on an underlying stream of payments », and on the other side the elasticity of supply is nil because the market is « dominated by the masterstrokes of dead artists » and « many living artists are relegated to the domain of fad, avocation, or financial ruin » so that at the end the only driver of art returns is the « dynamic demand » for art what is of course very different from other financial assets. Then, he further develops the notion of conspicuous consumption by defining it as a « consumption that is unrelated to the intrinsic value of a good », and which is applicable to all assets that are *consumed*, for aesthetic pleasure for instance, but that are not *used*, so with a very low rate of depreciation (i.e. mainly objects that you consume by the pleasure of owning, watching, showing them – « non-pecuniary benefits »). He explains and models the fact that art, and by extension all emotional assets, tend to have low or even negative risk premia (through a simulated consumption-based CAPM) and therefore underperform equity consequently to an utility that is not only financial. I agree with the fact that investors in emotional assets can be likely to accept the risk of getting lower returns because of this additional utility. Nevertheless, the relation between consumption and returns is probably even more complex and that it cannot fully explain lower returns for art or other emotional assets since it is not because investors may have another rationale for investing in emotional assets, may have non-pecuniary benefits and an additional utility, that they automatically get low returns or disregard their investment return. In addition, in Mandel's experiment, the correlation

between art real returns and equity remains low[14] and likely to be still very interesting from a financial perspective especially in prevision of bearish markets and high volatility of other asset classes, all the more than on an historical basis, partly due to the booming demand for art, it is said to have outperformed equity over the 2000-2011 period[15]. Anyway, we will investigate this later in the thesis.

D. Summary and classification

To sum up, we can acknowledge that emotional assets are very different from traditional investments on many points, and especially because unlike other asset classes they do not generate cash flows apart from their sale nor are consumed for their intrinsic value. They are consumed as conspicuous goods and therefore their valuation is first variable (no equilibrium price) and linked to demand only, and secondly very hard since it's really tough to estimate their utility function at least for the emotive part. However, they can still be considered as financial assets because they are traded like any other assets though on OTC-like markets, and have indeed each very interesting features from a financial perspective, all the more than demand in particular from Asian emerging countries is booming.

[14] B. Mandel, « Art as an investment and conspicuous consumption good », 2009 : Table 3

[15] Deloitte Art & Finance Report 2011

Table 1 - Characteristics of main emotional assets

	Art	**Wine**	**Stamps**	**Diamonds**	**Other Antiques**
Level of development of the market	High	Medium	Limited	Medium	Limited / Very limited
Elasticity of supply	Almost nil	Low	Nil	Low	Nil
Liquidity of the market	Limited	Limited	Very limited	Limited	Very limited
Data & information available	Good	Medium	Limited	Limited	Very rare
Degree of uniqueness	Unique	Limited	Very limited	Limited	Very Limited
Degree of conspicuous consumption	Very high	Limited (you cannot consume it without loosing its value)	Medium	Very high	Medium
Perishable?	No	Yes	No	No	No
Level of transaction costs (degree of expertise, intermediaries)	Very high	Medium	Very high	High	Very high
Level of storage costs	High	Medium	High	Medium	High
Cyclicality of demand (subject to hot spot and risk at the resale)	Medium in general (depends more on the type of art)	Low	High	Low	High
Misvaluation/Fake risk	High	Medium	High	Medium	High

II. Performance of emotional assets and portfolio optimization in literature

A. Methodology used : hedonic vs. repeat sales, and the emergence of the hybrid approach

There exist several methods to calculate historical returns for emotional assets. Basically, given the specificity and heterogeneity of these assets and the relative lack of information and transactions, you cannot use the same methods as for other assets like stocks. Indeed, since each emotional asset is unique like for art for instance, and is traded only rarely contrary to stocks which are traded several million times each day, you are forced to mix comparable assets, make regression, construct indices… We must in particular « address the heterogeneity issue » as well as « distinguish many different collecting categories since returns may vary dramatically » from one to another [Ginsburgh, Mei & Moses (2006)]. As a result, there are of course several methodologies for calculating returns based on historical data that have been developed in existing literature.

Burton and Jacobsen (1999) present and analyze the three main methodologies that are commonly used. The first one is to construct composite indices based on selected sample sets of objects that vary over time: it is largely used by non-economists because easier to implement. The main drawback is that it is not very accurate because rely on several strong assumptions. Indeed it presupposes that all the assets of the asset class are very comparable and thus have exactly the same performance on average since only a few number of assets are generally going to be traded over each period of time and that you even change the sample over time. Then, depending on your sample selection, your results can be very different and be biased depending on which assets inside the sample were traded over the period analyzed. Therefore, it appears not to be an appropriate method to evaluate returns for emotional asset markets.

The second method to construct a price index presented by Burton and Jacobsen (1999) is to run a *hedonic* regression. This kind of model is frequently used in real estate. In this method, you regress the price of selected items in order to adjust and solve issues deriving from having heterogeneous assets. This is the case for emotional assets, since for instance all works of art are considered as unique, and thus you can regress prices relative to several features like age (particularly important in the case of

wine for instance), purchase price, provenance, size, name of the artist/producer, sale location.... This method can in particular be aimed to evaluate the capital gain attributable to ageing in a certain asset class like wine. This is a very powerful method which enables to take into account a very large number of factors and all transactions (not only repeat sales as we will see in the next subpart). However, first you cannot take into account every factor and therefore it is very hard to justify which ones you choose to adjust prices and why not other factors. In addition, it is also very hard to estimate the impact of a qualitative feature from a quantitative perspective, so that you can easily claim that the assumptions made to calculate returns with the hedonic methodology are unrealistic for instance. Indeed, according to Triplett (2004), « its major liability (i.e. of the hedonic method) is the difficulty in introducing weights » into the hedonic function. Then, as stated by Collins, Scorcu and Zanola (2007), the hedonic regression includes drivers that are not time-varying and therefore implies some very strong assumptions regarding the structure and stability of the market over time. Finally, to implement such a methodology, you need to have a lot of information on each individual sale and goods' attributes so eventually as for the repeat sales method you will need to take out many transactions on which you do not have enough information. This method is applied today by Artprice Artist index for example whose hedonic regression function takes into account most of the characteristics of an art work, and serves as a reference among art analysts willing to use this methodology.

So the third methodology is the *repeat sales* approach. It records the changes in price for the same asset over time across a fixed selection. Thus, contrary to composite indices, the sample set does not vary over time. However it has the strong disadvantage to include in the set only assets that are often traded and at least twice over the sample period so it implies a certain bias and disregarding a very large part of transactions. This issue is identified as the « sample selection bias » by Collins, Scorcu and Zanola (2007). It is for instance widely used in art (Mei & Moses Art Price index) and generally considered as « the most consistent and reliable method » to calculate returns since it « averts the need to deal with the many issues associated with the heterogeneous nature of art »[16] or other emotional assets in general. It is also adapted to some other emotional assets that are frequently traded like wine but on the contrary, pretty much unadapted to some other emotional assets like most antiques or rare books for instance.

[16] Deloitte Art & Finance Report 2011

According to a study from Chanel, Gérard-Varet and Ginsburgh (1994), over long periods results deriving from various methodologies are closely correlated. Therefore, they suggest that, at the end of the day, « returns can be computed using all sales and not resales only » as generally made by authors on art and thus defend in a way the hedonic approach for long-term returns at least. At a similar level, Fogarty and Jones (2010) compare hedonic, repeat sales and *hybrid* approaches for calculating returns to Australian wine over the period 1988-2000 using 14,102 auction sales. They suggest from their results that the repeat sales approach leads to « significantly higher return estimates » than other methods, what had already been pointed out by Ashenfelter and Graddy (2003) based on their results. Fogarty and Jones also suggest that the hybrid approach, first established by Case and Quigley (1991), by regressing prices according to hedonic criteria while identifying repeat sales as such, though rarely used in existing literature, is the most efficient one. In fact, when looking at their results, returns from the repeat sales approach are slightly higher than with other methods in particular due to a better performance at the beginning of the period. In addition, evolution over time tends to be smoothed especially relative to the hedonic approach. Then, still according to Fogarty and Jones (2010), the hybrid approach provides estimates that are indeed more precise (lower standard error). This conclusion is confirmed by the analysis on Picasso prints completed by Locatelli and Zanola (2005), since they empirically find that the hybrid model provides the most precise estimates by reducing price volatility. However, this relative gain is likely to be largely compensated by the significant additional issues and workload implied by combining both methods especially because of the difficulty to identify time-varying variables – as noticed by Chanel, Gérard-Varet and Ginsburgh (1996), what necessarily leads to further strong assumptions and imprecision – and when elaborating databases, all the more than you might need to ignore some repeat sales data because of missing information and required in order to apply the hedonic function. On the other hand, the Art Market Research (AMR) for instance also uses a slightly different approach, with an index based on a fixed basket of artists for each specific art market (over 500 indices – to address the heterogeneity issue) to show trends in average returns on a monthly basis.

To conclude on return calculation methodologies for emotional assets, one of the main drawbacks of all these methods is that you always need to constitute very large samples and have a large quantity of transactions in order to be accurate, so there is a

large amount of work associated to such methods and you need to have access to very large sets of data what in general is hardly the case for emotional assets over short periods at least. Also, given the need of having a large quantity of transactions, you can only get quarterly or semi-annual returns what makes the comparison with returns from other asset classes quite tough. In addition, as stated by Deloitte, such index-based return calculation approach has some other limitations and biases[17] : First, you consider only a part of the transactions on the market (c.50% for art) since other transactions are either private or primary sales and therefore not taken into account. Then, you only take into account successful transactions (when the sale has been completed) and totally ignore unsold items. This is identified as the *survivorship* bias, stressing winners (successful transactions) over losers, and may lead to fairly optimistic results. Moreover, samples are generally built up from auction data which means that transactions retained are the ones which had enough demand to attract competitive bidders that is to say that samples generally include items with strongest demand and ignore those with lower demand. These kinds of indices also ignore transaction costs, which as we saw previously are quite significant in the case of emotional assets. Finally, it lacks predictive power as such indices only reflect historical prices and give no clue for estimating expected returns[17]. Nevertheless, it remains the best methods to calculate historical returns across a particular emotional asset class.

B. Historical risk-return performance of various emotional assets

Many authors have calculated and analyzed rate of returns for specific emotional assets. They use various methods, time periods and adjustments, for transaction or storage costs for instance, so that at the end they get sometimes very different results. Papers like Burton and Jacobsen (1999) summarize these results and try to find tendencies on the long run. They also analyze the risk profiles of emotional assets and in particular, in addition to volatility, their correlation both between each other and with stock markets in order to find out whether emotional assets can be considered as a potential hedge against stock markets' volatility or against inflation for instance. Indeed, they present ideas from Kane (1984 : coins), Ibbotson and Brinson (1987 : coins, stamps, Chinese ceramics, art) or Cardell et al. (1995 : stamps) according to

[17] Deloitte Art & Finance Report 2011

which collectibles can provide « hedges against stock market risk » thanks to negative correlation or negative sensitivities to inflation for instance. Other studies suggest on the contrary positive correlation between emotional assets and financial asset markets like Goetzmann (1993) and Chanel (1995) in the case of art.

We will now discuss into more details the rate of returns and volatility for each main emotional asset over the past decades based on literature.

1) Art

Art (i.e. paintings) is definitely the emotional asset on which the largest amount of work has been done so far to calculate historical returns and volatility. It is in addition a very heterogeneous asset class so depending on the approach, data sets considered, and assumptions made, you can potentially obtain very different results.

We can go back to the 1970's to find the first calculations of rate of returns in art and to Anderson (1974) in particular. He first noticed that art might have had very interesting returns over the past 2 decades, and that art, as previously wrote in this thesis, is a very heterogeneous asset class so that returns could sharply vary depending on many factors like the artist, « the artistic merit of the particular work », or school. He went back very far in the past, until 1780, and up to 1970, to try and establish art long-term returns, which for him are indeed much lower than the most recent returns at that time. In his calculations, he quantified and included certain additional costs and factors to get the real rates of return and eventually found out « that paintings are not very attractive investments unless one also includes the consumption value of art ». He used both hedonic and repeat sales approaches and found a nominal rate of return for art of 3.3% per year on average (until 1960 only - real return of 2.6%) and 3.7% (1780-1970 – real return of 3.0%) respectively for each approach, while more modern works (impressionists, 2Oth century paintings) have generally higher returns than old masterpieces, and returns over the last twenty years (1950-1970) were significantly in excess to the long term average. He also estimated the standard deviation (volatility) in annual returns to be 56% (for both 10 and 20 years holding periods) before concluding that considering the low risk-adjusted performance of art that the primary motivation for investing in art must be its consumption value and not financial. As previously stated in this paper, although it is helpful to have calculations of long term rate of returns, we should notice that the most recent and expected returns for art are absolutely not the

same as long term historical returns over the past two or three centuries. Indeed, art prices and returns are notably linked to demand, or to the level of development of the art market, which is today definitely not comparable to what we ever knew in the past (especially because of the increasing wealth worldwide, the booming demand in emerging countries, or the appearance of speculators on the art market), and what as a result can for instance lead to different conclusions on the interest of art from a financial perspective.

Baumol (1986) made a comparable work by analyzing, through the repeat sales approach, a sample of 642 transactions from 1642 to 1961. This study seems to include strong biases, first because, as for Anderson, it goes very far in the past in order to find several transactions on the same art work and thus can only deliver long term returns that are, according to me, totally disconnected to the reality of today's returns, which are actually the ones of interest for potential financial investors (actually the further back you go in the past, the lower average returns are). This is even amplified by the fact that he excludes all transactions that were made within an interval of twenty years because too close to each other in his view, what actually tends to remove from the sample all best performing art works that were frequently traded during the 20th century, to eventually retain a quite small sample (640 transactions vs. more than 1,500 artworks retained, i.e. more than 3,000 transactions, for Anderson and more than 2,800 works for Goetzmann over shorter periods) with mainly underperforming pieces of art. Thus, he finally gets an average real rate of return of 0.55% per year for art (with a median slightly higher at 0.85% - 1.25% and 1.55% respectively for nominal rates of return) and compares art returns to returns from other asset classes like government bonds to see that there is an « opportunity loss upon the holder of the painting of close to 2% per year ». However, his calculation of government securities' return is somehow unclear (« Probably about 3.25% was a representative nominal rate of return for the period ») and in particular it seems to disregard the fact that for instance over the period analyzed, some historical events, like revolutions, depressions, World Wars, communism, could have actually made governments securities much riskier than what we could imagine. So although investing in emotional assets alone may not be interesting from a pure financial perspective especially because of its higher risk profile, results from Baumol are probably underestimating the financial potential of these emotional assets.

Goetzmann (1993) uses a similar methodology as Anderson over the period 1715-1986 and constructs an art return index from art works traded at least twice over the period. He evaluates the risk-return performance of art investment in comparison to stock markets in particular. He finds out that since 1850, since the index has been « well estimated » (before 1850 estimations are proved to be poorly accurate according to his results), art returns outperform stocks and bonds with a rate of return at 6.2% per year but volatility is high at 65%. He also finds evidence of a strong positive correlation between art demand and increase in global wealth, thus proving what we intuitively stated previously in this thesis. He also infers the high positive correlation between art and stock and bond markets that from a financial perspective, art might not be « an attractive purchase for investment purposes alone » especially for a risk-averse investor despite « returns in the second half of the 20th century have rivaled the stock market ». Nevertheless, one cannot ignore the very high rates of return found since 1900 (17.5% per year on average), all the more than volatility is lower over the period 1900-1986 (52.8%) than ever before and is particularly high actually because of the strong underperformance and bearish market during the global recession in the 30's or wars as proved by other authors (standard deviation found by Mei and Moses (2002) since 1950 is much lower at 21.3% for instance while it is at 35.5% since 1900 for instance[18]). In addition, correlation between art and other financial markets, though significantly positive, is at the end not that high (54% with bonds, 78% with LSE since 1900), given that economic and political troubles over the first half of the century is likely to make it increase and given what Bernstein and Pinkernell stated in 2007 about the very strong correlation across all financial asset classes. Furthermore, results from other studies tend to show that actual volatility and correlation between art or other emotional assets and stocks are in fact lower than what stated by Goetzmann (i.e. Mei & Moses or Rachel Campbell for instance).

Pesando (1993) analyzed the market for modern prints with a semi-annual index built up through repeat sales methodology over the period 1977-1992. Like peers, he observes that the risk-adjusted performance of art is lower than for other financial assets and thus art compares « unfavorably » to other asset classes. From his print price index, he states that between 1977 and 1992 art prices and nominal returns reach their

[18] Mei and Moses, « Art as an investment and the underperformance of masterpieces », 2002

historical high in 1990 (5x higher than in 1977) before falling at the beginning of the 1990's to 3x the level of 1977. Therefore, the annualized average nominal rate of return over the whole period is 7.6% per year while annual real return is 1.5% only, below real returns of other financial assets like stocks or bonds. However, it is interesting to notice that until 1990 only, its highest level over the period, the nominal return is 13.7% per year and that standard deviation of art is more or less in line with other financial assets (19.9% for art in general and 23.4% for Picasso prints vs. 22.5% and 21.8% for stocks and US government bonds respectively) while correlation is significantly lower with stocks (30%) than what observed by previous authors (i.e. Goetzmann) and even negative with bonds (-10%). He is also among the firsts to argue that masterpieces underperform the market for art with the lowest cumulative return between 1980 and 1992, what will be then reformulated by Mei and Moses in particular.

Mei and Moses (2002) constructed a price index for the period 1875-2000 based on the repeat sales methodology, and which is today widely used among art analysts because it tries and addresses the issues linked to heterogeneity of artworks and infrequency of trading. In addition, this index is more « exhaustive », on the American market at least, since it takes into account a much higher number of transactions than previous studies from Goetzmann, Baumol or Anderson for instance. They find that return for art is on average slightly lower than stocks in particular over the more recent period (1950-1999) and significantly higher than government bonds which are much less risky assets. Indeed art provides a nominal rate of return of 4.9% per year over 1875-1999 and of 8.2% over 1950-1999. Standard deviation for art is slightly higher than for stocks over 1950-1999, which means that art compares unfavorably to stocks, but records a very important fall in volatility over the more recent period from 42.8% over 1875-1999 to 21.3% over 1950-1999. Furthermore, correlation between and other assets appear to be very interesting from a financial perspective (4% with S&P 500 and -15% with government bonds). From their CAPM analysis, they find that art beta (relative to S&P 500) is 0.719. Then, like Pesando they observe the sharp drop in art prices at the beginning of the 1990's after the 1990 bubble. They also present some more evidence, further to Pesando analysis, of relative underperformance of masterpieces.

Campbell (2005, 2007, 2009) first based her analysis on the two main art indices that are the Mei & Moses and the AMR indices. As noticed earlier in this thesis, the repeat sales approach used by Mei & Moses leads to higher returns (10.1% per year

between 1976 and 2001) than the AMR index for instance (5.3% per year). She then desmoothes the returns for art in order to capture the « true » return and volatility of the market and in particular to get rid of the « appraisal-induced biases » and also includes additional and necessary costs linked to art investment. She ends up with an average annual return for art of 6.76% between 1980 and 2008 and a standard deviation of 17.30% (significantly higher than bonds at 7.25% and slightly higher than stocks and gold at 14.61% and 14.53% respectively). Correlation with all asset classes (stocks, bonds, commodities and real estate) is found to be very interesting for portfolio diversification strategies, often negative and in any case no higher than 10% (Commodity index).

Some other authors like Chanel, Gérard-Varet and Ginsburgh (1994) use the hedonic approach enabling them to consider all sales and not only resales which is aimed to give wider and more accurate results. They also decided to take into account all other costs to calculate real returns from nominal returns and in particular, in addition to transaction costs, all storage and insurance costs, but excluding inflation. For their well-known 32 painters hedonic index, they obtain an annual average nominal rate of return of 13.3% and a real rate of return significantly lower at 7.0% over the period 1962-1988, while inflation rate is estimated to be at 5.9% per year. It is also interesting to notice the great performance of art during the 1980's (real return of 19.6% per year between 1980 and 1988).

Richard Agnello (2002) also proposes a hedonic approach to calculate art returns and volatility. He uses a significant number of features to build up his hedonic function and applies this model to a very large number of transactions (25,217), what altogether tends to give reliability and accuracy to his results. He obtains an overall return of 4.2% per year between 1971 and 1996 with significant discrepancies between various submarkets (school, subject of the painting in particular) and an annualized standard deviation of 23.1% (vs. 11.6% return and 12.1% volatility for S&P 500). Correlation with S&P 500 and government bonds is relatively low at 23% and 7% respectively for the overall art market.

This approach was favored by Renneboog and Spaenjers (2011) as well, over a 50-year period, between 1957 and 2007. They provide an extensive and robust model, resulting in a quite low annual return at 3.97% per year, probably suffering from the fact that they go back as far as 1957 to calculate art returns. Indeed, over the last 25 years only, the annual mean return is significantly higher at 5.19% per year. Standard

deviation over the whole period is high at 19.05%, which implies a Sharpe ratio at 0.2, quite lower than the ones of traditional financial asset classes (i.e. stocks and corporate or government bonds) but higher than US government bonds alone, commodities and real estate. In addition, correlation is found to be negative with S&P 500 and bonds while positive but still low with global stocks, commodities and real estate.

Kraussl and Van Elsland (2008) use a 2-step hedonic model, which enables to estimate the regression coefficients on a sub-sample of artists and which will then be used into the regression function to calculate returns for the whole sample. This is aimed to provide more accurate returns by enhancing the robustness of the hedonic equation. This methodology is thus applied to the German art market over the period 1985-2007 and provides an average annual rate of return of 7.3% for an annualized standard deviation of 17.9%. With this model, correlation of art with other asset classes appears to be lower than all other assets between each other and therefore the most interesting for investors (-6.8% with commodities, 15.4% with Real Estate, 16.4% and 25.3% with corporate and government bonds respectively, 18.9% with stocks). At the end of the day, results obtained from the 2-step hedonic model are very closed to the ones derived from the traditional methodology, so that the utility of such an enhancement of the hedonic approach seems to be very limited.

To sum up, most of results show that art risk-adjusted returns tend to compare unfavorably with other asset classes, with bonds in particular. Nevertheless, despite what some of them may claim (i.e. Baumol, Goetzmann), it seems that art provides returns that may be of interest for financial investors, especially thanks to their attractive correlation with other financial assets. Then, returns obtained in various papers can differ significantly because of many reasons like the period chosen. This includes how far you go in the past, and also how you include the significant art bubble that occurred at the end of the 1980's, and burst at the beginning of the 1990's. Indeed, articles that analyze the 1990's period (Locatelli and Zanola (2005) for instance) can present relatively poor returns while other papers focused on the 1980's or on the 2000's would tend to show more bullish returns. Other issues are the methodology used (repeat sales returns tend to outperform hedonic returns), the way it is applied, the selected sample, adjustments to calculate real returns (actually, definition of what nominal and real returns are, can vary significantly from one author to another, whether they include transaction, storage or insurance costs, inflation etc.)… Finally, two

indices are widely used today among art analysts : the Mei & Moses index, as established in 2002 and based on the repeat sales approach, and the second one, the AMR index, whose methodology refers more to the hedonic approach.

Table 2 - Summary table on literature on art returns and volatility

Author(s)	Period analysed	Methodology	Annual return	Annualized volatility	Correlation with other asset classes
Robert Anderson (1974)	1780-1970	Repeat sales	3.7% (nominal) 3.0% (real)	n.a.	n.a.
	1780-1960	Hedonic	3.3% (nominal) 2.6% (real)		
William Baumol (1986)	1642-1961	Repeat sales	1.25% (nominal) 0.55% (real)	n.a.	n.a.
William Goetzmann (1993)	1850-1986	Repeat sales	6.2% (nominal)	65%	54% with bonds, 78% with LSE since 1900
	1900-1986		17.5% (nominal)	52.8%	
James Pesando (1993)	1977-1992	Repeat sales	7.6% (nominal) 1.5% (real)	19.9% (23.4% for Picasso prints)	30% with stocks, -10% with bonds
Chanel/Gérard-Varet/Ginsburgh (1994)	1962-1988	Hedonic	13.3% (nominal) 7.0% (real)	n.a.	n.a.
Mei/Moses (2002)	1875-1999	Repeat sales	4.9% (nominal)	42.8%	4% with S&P 500
	1950-1999		8.2% (nominal)	21.3%	-15% with gov. bonds
Richard Agnello (2002)	1971-1996	Hedonic	4.2%	23.1%	23% with S&P 500 7% with gov. bonds
Rachel Campbell (2005-2009)	1980-2008	Moving average - Desmoothed AMR	6.76% (real)	17.3%	Negative with corp. and gov. bonds, lower than 10% for stocks and commodities
Kraussl/Van Elsland (2008)	1985-2007	2-step hedonic	7.3%	17.9%	Negative with commodities and hedge funds, lower than 25% for other assets
Renneboog/Spaenjers (2011)	1957-2007	Hedonic	3.97% (real)	19.05%	Negative with S&P 500 and bonds, lower than 50% with Real Estate and commodities
	1982-2007		5.19% (real)	18.04%	

2) Wine

Wine is one of the emotional assets, after art, on which most work has been done so far. Wine is also a very specific emotional asset with particular features. Indeed, the quality of wine is probably much more concrete than for art for instance where you

have basically no idea what the next hot spot of the market is going to be in terms of school or artist. In particular, wine quality depends on several factors like the year of production (relates to weather, rainfall…), label and location for instance, so that at the end it removes some of the uncertainty associated to investment in emotional assets in general. This also explains why the hedonic approach can be very relevant to estimate the future price of wine and has been widely used historically (see Ashenfelter[19], Combris/Lecocq /Visser[20], Jones and Storchmann[21]). Hedonic regression can therefore be also very helpful to calculate historical rates of return on wine investment, since wine is a very heterogeneous asset class and quality does not only depend on age but also on a lot of other drivers particularly during the production process. Nevertheless, this approach was not used until very recently to regress and calculate returns to wine investment and earlier authors on the subject tended to favor other approaches as we will discuss now. In addition, while collectibles as a whole are generally recognized as comparing unfavorably with financial assets, wine has been often considered as an exception and can constitute « a possible exception to this negative assessment »[22].

The first working papers on wine as a financial investment date from the end of the 1970's. William Krasker (1979) made indeed the first significant analysis on wine returns and calculated the financial return for an investor that would store wine and resell it over the period 1973-1977 (repeat sales approach). He concludes that storing wine for financial purposes yields a real return that is close to the risk free rate. However, this conclusion definitely contains some biases and approximations, as stated by Jaeger (1981). Actually, Krasker performed his analysis over a very short period of time and over a very limited sample (137 observations only) so his results are, as a result, strongly linked to this period, to the selected sample and to the particular economic situation (i.e. oil crisis). Indeed, prices in the wine industry declined quite sharply during this timeframe. In addition, Krasker calculated real returns and used way

[19] Ashenfelter, Ashmore and Lalonde, « Wine vintage quality and the weather : Bordeaux », 1995

O. Ashenfelter, « Predicting the Quality and Prices of Bordeaux Wines », 2005

[20] Combris, Lecocq and Visser, « Estimation of a Hedonic Price Equation for Bordeaux Wine: Does Quality Matter ? », 1997

[21] Jones and Storchmann, « Wine market prices and investment under uncertainty : an econometric model for Bordeaux Crus Classés », 2001

[22] P. Graeser, « Rate of Return to Investment in American Antique Furniture », 1993

too high and unrealistic storage costs to adjust returns (c.16$ annually per case). Jaeger applies the same methodology as Krasker while reducing drastically the storage costs, extending the sample timeframe by going further back in the past until 1969 (8-year period) and expanding the number of observations. He estimates that storing wine thus provides a real return of over 12% per year which is much more interesting from the perspective of a financial investor.

Weil (1993) is the first to consider a wine « portfolio », including mainly Bordeaux and Burgundy wines, and calculate nominal returns over a 15-year holding period from 1977 to 1992. The approach employed is thus close to the repeat sales methodology given that he consider purchase and sale price of wine held and also includes all storage and transaction costs. His findings suggest that the return for holding wine in general is 9.5% per year on average, which tends to compare unfavorably with other financial assets, and stocks in particular. He also suggests that Bordeaux wines significantly outperform other types of wine since return is estimated to be higher at 11% per year while volatility is strongly lower than for wine in general. As for Krasker, the number of observations remains very limited (68) so we can wonder whether his results can be generalized, and the way Weil chose his sample portfolio is unclear and seems at least not to be optimal. Furthermore, he calculates nominal returns but actually includes adjustments for transaction, delivery and storage costs as well as tax effects, so that at the end these returns are indeed closer to realized returns than to nominal returns.

Burton and Jacobsen (2001) analyzed the return for investing in red Bordeaux wine by using the repeat sales methodology over the period 1986-1996. They are the first ones to construct a price index for the wine industry despite the repeat sales methodology and elaborating price indices is a well-adapted approach to calculating rate of return for wine (more homogeneity exists – ranges of similar assets with same label, vineyard and vintage –, frequently traded). They include wines that had been produces since 1960 to eliminate the « antique effect » and get rid of time-varying factors that bring some noise in the return estimations. They end up with a sample of 315 chateaux and over 10,500 transactions which is likely to be much more accurate and general than previous studies achieved on wine. They find an average nominal rate of return of 7.9% per year over the period, with an important depression affecting the wine industry at the beginning of the 1990's (which started during the first semester of 1989) and which is very similar to what we could observe for the art market. The corresponding real return,

including transaction and storage costs, is 3.1% per year on average. So although wine would have outperformed bonds, Burton and Jacobsen claim that it significantly underperformed stocks. In addition, standard deviation is quite high at a semi-annual rate of 13.3% (vs. 8% for Dow Jones), which implies an annualized volatility of 18.8%. Nevertheless, the 1990's were a favorable period for stocks, with high returns, much more than the 2000's for instance which include two very important financial crises (internet bubble and subprime crisis). In addition, this tends to prove that wine would have a lower correlation with financial assets than them between each other and for instance could have been very interesting during the 2000's to diversify financial portfolios.

Some other authors during the 2000's provide us with some estimates of rates of return for wine like Sanning, Shaffer and Sharratt (2006). They try to establish monthly returns between 1996 and 2003 from repeat transactions for each wine producer and vintage across their sample, before establishing an average return (similar approach to the AMR index for art for instance). They also analyze volatility and correlation with usual financial assets in order to evaluate the financial interest of wine. Their sample includes c.90 producers and over 13,000 wine returns. At the end, the general average monthly return is 0.51% for a standard deviation of 6%, leading to an annual nominal return of 6.3% and a volatility of approximately 21%. In addition to positive returns, they show that investment grade wines have a minimal covariance « with market returns and other commonly accepted risk factors ». Thus, they derive from their comparison with the CAPM that wine yields a rate of return « in excess of risk-adjusted returns » and wines « have effectively zero betas ». Therefore wine appears to be a very interesting asset class to diversify financial portfolios.

James Fogarty (2006, 2010) first use the hedonic methodology in 2006 to estimate quarterly rates of return for wine between 1990 and 2000, by distinguishing 4 wine classes and constructing four indices (« exceptional wine », « outstanding wine », « excellent wine » and « distinguished wine ») according to the relative quality of wine, as recognized by professionals of the industry[23]. He concludes from his analysis that on average the best performing wine class is the outstanding one at 4.1% per quarter (hence yielding a rate of 17.4% per year) but is also the more volatile with an annualized volatility of 24.6%. On the other hand, the worst performing category is the excellent

[23] J. Fogarty, « A mean-variance approach to wine investment », 2006

one at 8.7% per year on average. Distinguished wines (i.e. lowest quality) are the less volatile category with an annual standard deviation of only 13.4%, which tends to refute what Sanning, Shaffer and Sharratt assessed on the low exposure of investment grades wine to market risks even though it proves that investment grade wines (here exceptional and outstanding) tend to outperform other types of wine. As a whole, wine is estimated to generate annual nominal returns of 11.9% on average for an estimated volatility of 17.8% over the 1990's when taking into account all 4 wine categories with their total respective number of observations. In addition, it provides a very low correlation with other asset classes. However, we can wonder whether these results are really consistent, given that discrepancies between results for various wine categories are very important, and that Fogarty even finds a negative correlation between exceptional and outstanding wines and very low correlation between all wine categories in general. It seems not totally clear that although results make sense separately, these results are close to the true return and volatility to holding wine. This is besides one of the troubles of the hedonic method, because depending on which coefficient and drivers you select to make the regression, results for volatility and correlation in particular can vary very significantly. Fogarty then made an extensive work, together with Jones (2010), to compare the three mainly recognized methodologies to calculate rate of returns of emotional assets (hedonic, repeat sales and hybrid), applied to the particular case of Australian wine over the period 1988-2000 and on a quarterly basis[24]. As previously stated, they notice that the hybrid approach provides more accurate estimates and that the repeat sales methodology leads to significantly higher returns, or at least higher risk-adjusted returns since as I previously mentioned, the price index tends to be smoothed with the repeat sales approach relative to the hedonic approach (lower volatility – not quantified by the authors though) even if the outperformance is probably not that significant because it is mainly linked to an outperformance of the repeat sales index just at the beginning of the period (when markets were bearish and volatility was high – probably linked to the sample selection bias of selecting only repeat sales) and not consistently over the whole period. They conclude from their 14,102 auction sale observations that the mean return for wine, with the hybrid approach (considered as being the most accurate), is 4.9% per year, including the depression of the wine market

[24] Fogarty and Jones, « Return to wine : A comparison of the hedonic, repeat sales and hybrid approaches », 2010

during the late 1980's and early 1990's. In addition, correlation of wine with Australian stocks and bonds is low and interesting (at 5.8% and 3.1% respectively) and tends to demonstrate that diversification through alternative assets is, first really useful in the particular case of wine, and then, more interesting and efficient than pure geographic diversification (relative to correlation between Australian and US stocks at 40% or Australian and US bonds at 47.1%)[24].

Masset, Henderson and Weisskopf (2009) made the most recent analysis on rate of returns for wine by calculating the mean return from 1996 to 2009 showing that fine wine tends to be an attractive investment especially during economic downturns. They consider only wines that are traded on a regular basis in order to address any liquidity and inconsistency problem and use the repeat sales methodology to construct indices for various regions. They find that over the period, wine yields a higher mean rate of return and a lower volatility than stocks at 7.3% and 8.23% respectively both on an annual basis. However, given the sample selection criteria (only often traded wines, windsorize by taking out extreme outliers, deflating all prices to obtain constant USD amounts), it is likely that returns tend to be smoothed over time and volatility to be understated. In addition, wine appears to « improve portfolio diversification when it is most needed », that is to say during financial crisis by reducing risk for investors while correlation between traditional assets on the contrary tends to increase. They make a conditional CAPM analysis with time-varying alphas and betas depending on the economic environment, and show that fine wine has significantly positive alphas and low betas so that wine returns are « primarily related to economic conditions and not to the market risk » and thus wine provides attractive portfolio diversification opportunities. During the 2008 financial crisis in particular, the general wine drops by 17% only while the stock index decreases by 47% over the same period.

Table 3 - Summary table on literature on wine returns and volatility

Author(s)	Period analysed	Methodology	Annual return	Annualized volatility	Correlation with other asset classes
William Krasker (1979)	1973-1977	Repeat sales	Close to risk-free rate (real)	n.a.	n.a.
Elizabeth Jaeger (1981)	1969-1977	Same as Krasker	12% (real)	n.a.	n.a.
Roman Weil (1993)	1977-1992	Return of a wine portfolio	9.5% (nominal but incl. various costs)	Higher than equity	n.a.
Burton/Jacobsen (2001)	1986-1996	Repeat sales (index)	7.9% (nominal) 3.1% (real)	18.8%	Lower than between traditional financial assets
Sanning/Shaffer/ Sharratt (2006)	1996-2003	Repeat sales	6.3% (nominal)	21%	Minimal covariance ("effectively zero betas")
James Fogarty (2006)	1990-2000	Hedonic	11.9% (nominal)	17.8%	17.7% with stocks -15.9% with bonds
Masset/Henderson/ Weisskopf (2009)	1996-2009	Repeat sales	7.3% (nominal, constant USD)	8.23%	Wine has a low beta (i.e. low correlation with market risk)
James Fogarty (2010)	1988-2000	Hybrid (Aus. wine only)	4.9% (incl. the depression of the late 1980's)	n.a.	5.8% with stocks 3.1% with bonds

3) Stamps

Stamps can also be classified as emotional assets but present in a certain way different features than art or wine. Indeed, stamps can be referred as part of the antique asset class, because the collectable nature and the value of stamps are tightly linked to their age and rarity. Indeed, stamps are not completely unique like art, but elasticity of supply is nil like for all antiques. It implies that all the considerations related to the collector behavior, as seen in the first part of this thesis, are particularly important here. In addition, since we are talking about old and very rare assets, just like for art, transaction costs (need for expertise), storage and insurance costs, restoring costs are very high, and lower by as much the real return of such assets.

Literature on stamps is rarer than on art or wine. William Taylor (1983), however, estimates the quality-adjusted return for stamps, that is to say the rate of return of stamps with the same quality, since he claims that « quality variation among the

items offered is a dominant feature » (such as for bonds with different ratings, or for non-financial assets like stamps but what is not the case for wine for instance, or for art since each artwork is unique). In particular, according to him the hedonic and repeat sales approaches may be unadapted, because the first one requires extensive and sometimes hardly quantifiable knowledge on each asset, while the significant infrequency of trading makes the other one inadequate all the more than it does not take into account quality variation over time. Therefore, he uses a moving average estimator over various samples between 1963 and 1977 and creates a quality-adjusted index, which yields a mean rate of return of 12.2% per year, higher than stocks over the period, and a very low volatility, actually thanks to the quality adjustment, and which is probably less realistic for an individual investor though. He then makes a CAPM analysis but finds no evidence either of a significant correlation or non-correlation between stamps and stocks (NYSE returns).

Cardell, Kling and Petry (1995) makes a repeat sales regression on over 20,000 transactions concerning more frequently traded stamps only, and including a dummy variable « to eliminate any problem of the mean quality changing across time or stamps », in order to estimate the rate of return of stamps over the period 1947-1988. They find that stamps provided an average nominal return of 7.6% per year. They also identify that there was a significant « bubble » in stamp prices at the beginning of the 1980's (prices multiplied by more than 3 between 1976 and 1980 before a sharp drop and depression of the stamp market over the few next years) leading to an increased volatility. However, the research tends to show that stamps are a good hedge to stock investment because « stamps are related in an opposite way to many of the important systemic factors that influence stock and bond returns ».

Chris Veld (2007) uses the SG 100 index, a stamp index introduced in 2002 by Stanley Gibbons, according to the repeat sales methodology on higher value and most frequently traded stamps, in order to determine what the benefits for a financial investor to invest in stamps are. He concludes from his research that stamps monthly mean return is 0.58% (vs. 1.11% for FTSE 100) leading to annualized rate of return of 7.2% between 2002 and 2007 (vs. 14.2% for FTSE 100). However, over the same period, volatility of stamps is proved to be lower than stocks at 0.77% on a monthly basis (annual standard deviation of 2.67%) while FTSE 100 has an annual volatility of 10.18%. However, these estimations exclude the two significant crises of the 2000's that occur in 2001 (internet) and 2008 (subprimes) which in particular strongly impact

volatility, which as a result is much lower than over the whole decade. He also runs a CAPM regression of the excess returns of stamps relative to stocks. He finds out that stamps yields monthly returns of c.0.23% in excess to those derived from the CAPM, and provide significantly positive alphas, while « betas are not significantly different from zero » relative to both UK or American equity, offering thus very interesting diversification opportunities. Indeed, the Capital Market Line (CML) including stamps stands well above than the one excluding stamps, which proves that stamps provide benefits for financial investors by potentially increasing returns and reducing risk. However, as previously said, this study is conducted over a bullish period for financial markets only, while it is probably more interesting to assess the diversification opportunity offered by alternative investments when markets are bearish.

Finally, Dimson and Spaenjers (2010) calculate long-term average nominal and real returns for stamps (1900-2008) through a repeat-sales regression, over a time-varying sample (by including into the sample stamps that become highly valuable within the timeframe). Mean nominal return is found to be 7.0% per year and real return 2.9% (vs. annual real returns of 1.5% for bonds and 5.1% for stocks). In addition, the paper confirms the emergence of a stamp bubble at the beginning of the 1980's, which burst in 1982, with the only depreciation in prices of more than 2% over the whole period (-8.8%). This tends to give evidence of a lower volatility of stamps, since financial crises were much more frequent for traditional financial assets across the 20th century. The paper also shows evidence of a low correlation between stamps and other financial assets, stocks in particular, through both the calculation of historical sample correlation and by adapting the CAPM model to stamps and estimating Betas and lagged betas (to address the non-synchroneity of returns issue). This low correlation, especially during financial crises, « is consistent with the observation that the financial crisis did not stop stamp prices from rising during the 2008 bear market ». Indeed, stamps volatility for unsmoothed return is of 18.0% over the entire period and 19.7% since 1952, which is lower than for equity but significantly higher than for bonds. Correlation between stamps and equity or bonds is very low at 0.5% and 8.6% respectively, while it is much higher with commodities like gold for instance at 45.1%.

Table 4 - Summary table on literature on stamps returns and volatility

Author(s)	Period analysed	Methodology	Annual return	Annualized volatility	Correlation with other asset classes
William Taylor (1983)	1963-1977	Quality-adj. index (moving avg estimator)	12.2% (nominal)	n.m.	No evidence of either correlation or non-correlation with stocks
Cardell/Kling/Petry (1995)	1947-1988	Repeat sales (adj. for quality variations)	7.6% (nominal)	Relatively high because of the early 1980's bubble	Negative with many systemic factors affecting stock and bond returns
Chris Veld (2007)	2002-2007	Repeat sales	7.2% (nominal)	2.7%	Positive alpha, Beta not significantly different from 0
Dimson/Spaenjers (2010)	1900-2008	Repeat sales	7.0% (nominal) 2.9% (real)	18.0% (for unsmoothed returns)	0.5% with stocks 8.6% with bonds 45.1% with gold

4) Diamonds

Diamonds are an emotional asset because their value is linked to conspicuous consumption (cf. Scott/Yelowitz (2010)) and to their rarity, but they have characteristics however that are very close to commodities like gold. Indeed, unlike antiques or wine, their value is totally decorrelated from age or time, and depends solely on both their quality (color, clarity) and size/weight. As a result, calculating return is likely to be easier than for other emotional assets, since transaction prices are regressed depending on the number of carats of the gem. Renneboog and Spaenjers (2011) find average annual real returns of 6.4% for white diamonds and of 2.9% for colored diamonds over the period 1999-2010 (vs. -0.1% and 3.3% for stocks and bonds respectively). Since 2003 only, the annual returns go up to 10% and 5.5% per year respectively. Considering the underperformance of equity over this period, diamonds outperform stocks during the 2000's even though they underperform gold. Authors also notice that in the case of diamonds, high quality gems (« masterpieces ») historically outperform other diamonds, which tends to be contrary to what most authors notice in the case of art. On the volatility side, white diamonds have a lower volatility than stocks at 16.7%, while colored diamonds slightly higher at 24.1% (vs. 22.5% for stocks). Given the low standard deviation of gold (11.9%), diamonds compare unfavorably to gold and are similar to bonds in the case of white diamonds. Correlations with stocks remains quite

low (31% and 27% respectively), but still higher than bonds and gold so that on this very particular historical period, gold might have been a better hedge to stock investment for instance, but one should not forget that gold recorded outstanding and never equaled returns during the 2000's decade. In addition, today performance of diamonds is absolutely outstanding with an increase by 35% in polished diamonds prices over the first half of 2011, while rough diamond prices jumped by 49% over the same period[25] (strengthening besides the idea of low correlation with stock markets). Alrosa CEO says that such an increase in rough diamond prices « may signal bubble », while De Beers CEO « sees diamond price steadying after rising »[25].

5) Violins and other antiques

As assessed earlier in the part on stamps, antiques definitely belong to the category of collectibles, and one can observe collector behavior among these asset classes. They also have the features of collectibles (i.e. rarity, no supply elasticity) and in addition always include a notion of age (antiques are often defined as being more than 100 years old) and very important transaction and storage costs. In fact, if you take the example of Stradivari, fakes are numerous and real Stradivari are very rare, old and fragile so transaction and storage costs are huge (expertise, insurance, restoring…). Some literature exists on these assets, and especially on fine violins like Stradivarius. The first analysis was made by Ross and Zondervan (1989). They first use a hedonic regression to show that although prices could be different among Stradivaris depending on quality and the violin was made, it had nearly no impact on rate of return. Thus, they make a repeat sales study on 17 individual Stradivaris between 1803 and 1982. They find that the nominal rate of return over the whole period is 2.2% per year, and the real rate of return adjusted for insurance and storage costs is 1.5% per year. However, these are only long-term returns and are very approximate results, since they observe a total of only 29 transactions over the whole period.

Then two major recent studies are made on returns for fine violins. Rachel Campbell (2008) estimates the annual rate of return for violins through the repeat sales methodology over 1986-2006, and by desmoothing returns (smoothed returns representing a major concern because of the market illiquidity and low frequency of trading). Her general violin index gives a mean annual rate of return of 8.34% per year

[25] Bloomberg articles, 2011 & www.polishedprices.com

for a corresponding standard deviation of 8.66%, Correlation of violin return is negative with both stocks and Real Estate (-2.9% and -11.5% respectively) while close to zero for commodities and government bonds (9.4% and 7.7%). Graddy and Margolis (2011) makes a slightly more extensive analysis of fine violin returns by comparing returns derived from both repeat sales (337 observations) and hedonic regressions (over 2,500 transactions). The time interval is very similar to the one used by Campbell, since they selected the period 1980-2009. The repeat sales approach provides an annual mean nominal return of 6.28% per year, and the hedonic regression a mean return of 7.5% per year for a corresponding volatility of 9.2%. It is besides interesting to notice that unlike many studies on the matter, the hedonic approach provides here an higher rate of return than the repeat sales approach. At the end, real rate of return for investing in fine violins is estimated to be around 3.3% since 1980 and volatility of 7.8%. Correlation is negative with both stocks and bonds (-13.6% and -15%) and positive only with art (18.4%).

Table 5 - Summary table on literature on violins returns and volatility

Author(s)	Period analysed	Methodology	Annual return	Annualized volatility	Correlation with other asset classes
Ross/Zondervan (1989)	1803-1982	Repeat sales	2.2% (nominal) 1.5% (real)	n.a.	n.a.
Rachel Campbell (2007)	1986-2006	Repeat sales - Desmoothed returns	8.34% (nominal)	8.66%	Negative with stocks and Real Estate, lower than 10% with bonds and commodities
Graddy/Margolis (2008)	1980-2009	Repeat sales Hedonic	6.3% (nominal) 7.5% (nominal) 3.3% (real)	n.a. 9.2% 7.8%	Negative with stocks and bonds, 18.4% with art

C. Portfolio Optimization in existing literature

As extensively stated in the previous part, while opinions differ whether emotional assets compare favorably or unfavorably to traditional financial assets, literature tends to prove that emotional assets may be of interest when considering portfolio diversification. Burton and Jacobsen (1999) in particular state that correlation of collectibles with stock market returns are negative or at least very low so that they could be use as hedges or as part of diversification strategies. The *true* correlation of

emotional assets with stocks is likely to positive as suggested by Goetzmann (1993) or Chanel (1995), since investments in emotional assets are made by High Net Worth Investors, who are likely to invest more in emotional assets when stock markets are bullish because they have money available and reciprocally. However, we can also argue like Burton and Jacobsen, that if emotional assets are used as hedges against bearish stock markets and as safe haven because these are tangible assets with logically more stable long-term prices, then we could observe a negative correlation with stocks. In any case, empirical research shows that correlation with stock markets is low, and indeed James Fogarty (2010) for instance find evidence that cross-sectional is much more efficient than international diversification, with correlation between emotional assets like wine and other asset classes like stocks that are much lower than correlation between returns of a same asset class across several countries. This tends to be confirmed by what Bernstein and Pinkernell (2007) claim, on the fact that correlation between traditional financial assets tends to be higher and higher today, and often in excess to 90%, while alternative asset classes tend to keep a lower correlation though positive with traditional assets, so that diversification opportunities are real.

Several suggestions of optimal portfolio allocation were made during the 2000's. Most authors use Markowitz mean-variance optimization to determine the optimal strategic allocation including art, wine or other emotional assets. In particular, Rachel Campbell (2009) suggests an allocation to art of 7.6%, while portfolio remains logically concentrated on stocks (70.3%) and bonds (21.7%)[26]. When incorporating violins, she suggests an allocation of 7.1% while still allocating 5.9% to art, to get an optimal portfolio[27]. Kraussl and Van Elsland (2008) set up restriction on asset class allocation to fully benefit from diversification opportunities (no more than 25% or 18.5% on a single asset class), what result in an allocation to art of either 3.25% or 5.72% of the portfolio respectively, and is shown to substantially reduce the volatility of the related portfolio compared to the allocation without art. Regarding wine, Fogarty (2006) provides us with an optimal portfolio allocation analysis based on Markowitz optimization, which allocates 19.6% of the portfolio to wine, in order to maximize the Sharpe ratio of the related portfolio. This is obtained while also optimizing the strategic

[26] R. Campbell, « Is art an investable asset class ? », 2009

[27] R. Campbell, « Fine violins as an alternative investment : Strings attached », 2007

allocation inside wine between the four main categories that he identifies (i.e. exceptional, outstanding, excellent and distinguished wines) over the retained time interval, which is totally optimal, on the contrary to stocks and bonds, for which he uses usual benchmarks, and besides quite unrealistic because based on an historical analysis while it is impossible to predict in advance what the returns for each category will be so that you can apply an optimal allocation to your wine investment. Finally, we can retain that for a particular emotional asset, the optimal allocation must be and vary between 0 and 15% of the total portfolio, depending on assumptions made and results obtained from the risk-return analysis.

However, they all use historical mean returns as expected returns in their Markowitz portfolio optimization model, which is commonly seen as a poor way to estimate expected returns (cf. Thomas Philips (2003)), since future performance is never equal or predictable thanks to historical performance. Indeed, in the case of stocks, one would need huge datasets of daily returns (over two or three centuries), just to estimate expected returns with a 95%-confidence interval through the sample mean estimator[28], what is of course already totally inapplicable for stocks, so even more impossible to do in the case of emotional assets.

Another drawback of these analysis is that, apart from Rachel Campbell to a certain extent (with art and violins/antiques), none of the authors previously cited provides us with an optimal strategic asset allocation considering various emotional assets or shows how much to allocate to emotional assets both altogether and individually, what could really be of interest, since as previously discussed in this paper, emotional assets can have quite a low correlation between each other, as it tends to be proved for instance by the non-simultaneity of various bubbles that affected emotional assets in the past (early 1980's for stamps, late 1980's for wine, and rather early 1990's in the case of art).

[28] Olivier Ledoit, HEC Quantitative Asset Allocation class, Majeure Finance 2011

III. Modeling exposure of emotional assets to market risk and portfolio diversification

A. Data

To perform this empirical research, I will use two different datasets : the first one is based on long-term real returns for various emotional assets (i.e. art, stamps and violins), stocks, bonds, bills and gold. These data come from various studies, as we will detail including Dimson and Spaenjers (2011) for stamps, Renneboog and Spaenjers (2011) for art, Graddy and Margolis for violins (2011) and Dimson, Marsh and Staunton (2010) for other asset classes. Then, they have all been gathered, deflated (based on GBP prices) and furnished by Dimson and Spaenjers. It will be aimed in a first time to assess historical correlation of emotional assets with other financial assets and then to estimate the exposure of emotional assets to market risk through a CAPM analysis and by taking into account the non-synchroneity of emotional asset and traditional financial asset returns. The second dataset contains short-term nominal returns for several emotional assets (art, wine, stamps and violins), and all other main investable asset classes including equity, bonds, commodities and Real Estate, in order to determine optimal strategic asset allocation according to Markowitz mean-variance optimization model.

Long-term returns data

This dataset includes real annual returns for emotional assets and main financial asset classes over a 110-year time frame, between 1900 and 2010. Returns are calculated by Dimson and Spaenjers (2011) from indices deflated on a yearly basis in order to get real returns. They are based on the repeat sales approach and catalogues published by British stamp dealer Stanley Gibbons. Dimson and Spaenjers first identify the 50 most valuable British stamps in January 1900 and then use a time-varying basket of fine stamps by updating their list of most valuable stamps every nine years until 1998. The index is constructed until 2008 through a value-weighted arithmetic repeat-sales methodology as defined by Shiller (1991), and expanded until end 2009 with Stanley Gibbons' Great Britain 30 Rarities Index. The annual mean deflated rate of return is 2.9% for an annualized volatility of 12.4%. Art returns are provided by Goetzmann, Renneboog and Spaenjers (2011) and based on Bayesian repeat sales

methodology. It is extended from 2008 to 2010 through the UK art index from Artprice.com. Mean real return is slightly lower than for stamps at 2.5% and standard deviation very similar at 12.5%. Auction and dealer data on repeat sales for violins come from Graddy and Margolis (2011) and are utilized by Renneboog and Spaenjers (2011) to construct a repeat sales index through the Bayesian regression approach. Violins yield an average annual real rate of return of 2.9%, equal to stamps, but with a lower volatility at 8.0%, which is probably due to the relatively small number of transactions. Data for stocks, bonds and bills come from Dimson, Marsh and Staunton (2010) and gold returns are downloaded from Global Financial Data and Datastream and then deflated in order to get real returns. All returns are deflated according to British Pound inflation data. Stocks are the only asset class that performs better than emotional assets over the entire period at 5.3% per year on average and compare favorably to both art and stamps with a volatility of 20.1%, what corresponds to a Sharpe ratio of 0,26. Bonds, bills and gold underperform emotional assets with mean real return of 1.4%, 1.0% and 0.8% and standard deviation at 13.7%, 6.3% and 17.4% respectively.

	STAMPS	ART	VIOLINS	STOCKS	BONDS	BILLS	GOLD
Mean real return	2,9%	2,5%	2,9%	5,3%	1,4%	1,0%	0,8%
Volatility	12,4%	12,5%	8,0%	20,1%	13,7%	6,3%	17,4%
Sharpe ratio	**0,24**	**0,20**	**0,36**	**0,26**	**0,10**	**0,17**	**0,04**

Table 6 – Long-term returns and volatility of emotional assets vs. other asset classes

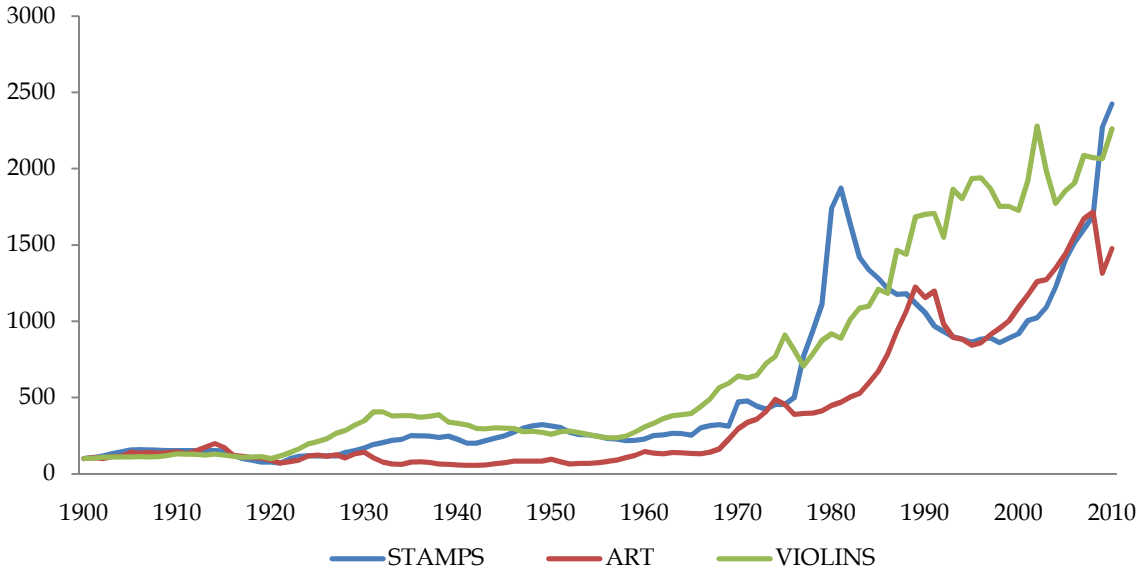

Figure 1 - Real price indices of selected emotional assets since 1900

It is interesting to notice that apart from the stamps bubble during the 1980's and the recent financial crisis (stamps perform well, art on the contrary is significantly affected by the global crisis), art and stamps perform quite similarly over the period, while violins seem to consistently beat art and stamps returns. In addition, the strong performance of stamps over the 2nd half of the 2000's and especially since the beginning of the financial crisis may signal a new bubble, such as at the end of the 1970's.

Short-term returns data

Regarding short-term data, we use nominal returns, on an yearly basis over a 20-year period from 1991 to 2011, for emotional assets and all usual asset classes including stocks, bonds, commodities and Real Estate. Under emotional assets, we include stamps, art and violins, whose data are derived from long-term returns and *re-inflated* in order to obtain nominal returns. We also include data on wine that are obtained from Liv-Ex Fine Wine Investable index. Then we use traditional indices to calculate performance of main asset classes, all downloaded from Datastream except for Real Estate. For stocks, we select S&P 500, FTSE 100 and CAC 40 total returns, including both price returns and dividends by assuming that dividends are reinvested in the index. This enables in particular to include equity geographic diversification in our research. Regarding bonds, we include both corporate and government bonds. We use the Citigroup US BIG Corporate 1-10Y bond total return index to estimate corporate bond returns, while government bonds are represented by both a 6-month Treasury Bills total return index (from Citi) and Citigroup 1-10Y treasury bond index. Concerning commodities, we select gold and silver as investable assets from a pure financial perspective. Finally, we use US and UK House Price Indices, from Federal Housing Finance Agency (www.fhfa.gov) and Nationwide (www.nationwide.co.uk/hpi/), as representative of Real Estate performance. As a result, we obtain a total sample of 14 assets and benchmarks, including 4 emotional assets, 3 stock indices, 3 bond indices, 2 commodities and 2 real estate indices. Individual returns and volatility are presented in the following tables :

	ART	WINE	STAMPS	VIOLINS	S&P 500	FTSE 100	CAC 40
Mean real return	4,7%	13,2%	7,5%	4,2%	8,8%	8,5%	6,8%
Volatility	9,5%	22,4%	8,3%	8,7%	19,1%	16,8%	23,5%
Sharpe ratio	**0,49**	**0,59**	**0,91**	**0,48**	**0,46**	**0,50**	**0,29**

	US Corp BONDS	T-BILLS	US Gov BONDS	GOLD	SILVER	US REAL ESTATE	UK REAL ESTATE
Mean real return	7,2%	3,6%	6,1%	6,9%	9,5%	3,2%	5,4%
Volatility	5,9%	2,0%	4,6%	14,7%	26,8%	4,5%	8,7%
Sharpe ratio	**1,22**	**1,75**	**1,32**	**0,46**	**0,35**	**0,70**	**0,62**

Table 7 - Short-term returns and volatility of emotional assets vs. other asset classes

B. Methodology

Methodology of our research is based first on a study of correlation with traditional financial asset classes and exposure to market risk through a lagged CAPM analysis over the long term. Then, we apply Markowitz mean-variance optimization to our short-term dataset in order to estimate various optimal asset allocations. We will use assumptions regarding maximum allocation to a particular asset class in order to fully benefit from portfolio diversification and regarding expected returns too. In particular, historical mean return is an inaccurate estimator of expected returns and it sometimes needs to be adapted to match the current global economic outlook or adjusted for additional parameters like transaction or storage costs in the case of emotional assets.

Methodology to analyze long-term correlation and risk exposure

We start by determining the correlation matrix for our long-term returns dataset. Let first introduce the following notations:

- T is the total number of return observations in our long-term dataset (here T =110 years of returns between 1900 and 2011)
- $(A_{i,j}) \in \mathcal{M}_{[1:110]x[1;7]}$ is the matrix containing all demeaned returns over the time frame. Thus, $\forall(i,j) \in [1;110]x[1;7]$, $a_{i,j}$ is the demeaned return of the j^{th} asset (with assets being in the following order: stamps, art, violins, stocks, bonds, bills and gold) for the i^{th} year of the sample
- $\forall\ i \in [1;7]$ σ_i is the historical standard deviation of the i^{th} asset over the sample time frame

Hence the covariance matrix $(\Sigma_{i,j}) = (\sigma_{i,j})_{(i,j)\in[1;7]}^2$ is given by the following equation:

$$\Sigma = \frac{1}{(T-1)}\,{}^{\tau}AA \quad (1)$$

Thus, the historical correlation $\rho_{i,j}$ between the i^{th} and j^{th} assets is calculated as follows:

$$\forall(i,j) \in [1;7]^2 \quad \rho_{i,j} = \sigma_{i,j} / \sigma_i\sigma_j \quad (2)$$

Secondly, we apply a lagged Capital Asset Pricing Model (CAPM) to the emotional assets from our dataset (vs. stock returns) in order to determine the exposure of each emotional asset to market risk, while taking into account the issue of non-synchroneity of returns between emotional assets and stocks. Indeed, the relatively low correlation observed in Part III.C between emotional asset and stock returns may be linked to this non-synchroneity issue, that we address by applying the aggregated coefficients methodology from Dimson (1979). Non-synchroneity in returns can be explained by assumptions made when calculating emotional asset returns like using catalogue prices, which actually reflect prices for the previous period, such as for stamps[29]. It is also linked to the fact that emotional asset prices may adjust more slowly than stocks to changes in the financial and economic global outlook. Thus, it is likely to create a lag in returns so that it may be useful to take into account the stock returns on previous and following years when estimating the Beta of emotional assets.

Therefore, in order to estimate the *true* exposure of emotional assets to equity returns, in addition to the matching market return (same year return for stocks) the market model β of each emotional asset is adjusted for lagged equity returns (i.e. prior year returns) and leading equity returns (i.e. following year returns). In fact, we assume that correlation between emotional assets and equity is complex so that there is an interaction between stock and emotional asset returns : Stock returns can affect the outlook of emotional asset markets and therefore their returns and reciprocally. The model is defined as follows :

$$R_t = \alpha_t + \sum_{i=-a}^{b} \beta_i R_{t+i}^m \quad (3)$$

where R_t is the return of the considered emotional asset on year t and R_t^m the return of the market on year t. Then, *a* is the number of lagged market returns (number of prior market returns taken into account) and *b* the number of leading market returns (number of following market returns). The returns are regressed and individual slopes β_i are

[29] Dimson and Spaenjers, « Ex post : The investment performance of collectible stamps », 2010

estimated thanks to an Ordinary Least Squares (OLS) estimator applied to the whole sample.

We obtain an unbiased estimation of the market model β for the considered emotional asset by adding up all the individual slope coefficients :

$$\beta = \sum_{i=-a}^{b} \beta_i \quad (4)$$

Methodology to study portfolio optimization based on short-term returns

This study will rely on Markowitz mean-variance optimization methodology[30] and be based on our short-term returns dataset. We choose to use the short-term dataset because it will enable us to consider recent returns and correlation only, to be more realistic by including widely used indices and benchmarks (i.e. S&P 500…) that can be replicated, and it will also enables us to be more exhaustive by using all main asset classes (equity, bonds, commodities and Real Estate) and by incorporating country diversification for stocks.

We first define the following additional notations :

- $\mu = (\mu_i)_{i \in [1;14]}$ is the column matrix containing expected returns for all assets (in the following order : Art, Wine, Stamps, Violins, S&P 500, FTSE 100, CAC 40, US Corporate bonds, T-Bills, US government bonds, Gold, Silver, US Real Estate and UK Real Estate)
- $w = (w_i)_{i \in [1;14]}$ is the weight vector and $e = \begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix}$ is the unit vector
- The covariance matrix $\sum \in \mathcal{M}_{[1:14]}{}^2$ and in this particular case T = 21

The efficient frontier represents the range of mean-variance optimal portfolios. In particular, we will focus on Global Mean-Variance Portfolio (GMVP – Portfolio with lowest volatility) and Tangency portfolio (Portfolio with maximal Sharpe Ratio). The GMVP is determined as follows :

- We minimize portfolio variance ${}^{\tau}w \sum w$
- Under the following constraints on portfolio weights :

  Portfolio weights sum up to 100% : ${}^{\tau}we = 1$

  No short-selling : $w >> 0$

[30] H. Markowitz, « Portfolio selection », 1952

Then, we will also calculate the Tangency Portfolio, which is defined as follows :

- We maximize the Sharpe Ratio $\frac{{}^{\tau}w\mu}{\sqrt{{}^{\tau}w\Sigma w}}$
- Under the following constraints on portfolio weights :

  Portfolio weights sum up to 100% : ${}^{\tau}we = 1$

  No short-selling : $w >> 0$

We can also add some constraints on maximum weights on a particular asset class in the portfolio in order to fully benefit from diversification (i.e. $w_i < x\%$). By doing this, we may obtain apparently *inefficient* portfolio (i.e. that are not on the efficient frontier), but which would actually enable us to diversify our risk and help us reduce risk from a qualitative perspective. Indeed, by well diversifying our portfolio, we can for instance hedge against extreme risks like financial crises or huge drops in prices of a particular asset class.

Finally, there only remains to establish expected returns. Mean returns, as calculated earlier in the data section, can often be considered as a good proxy of future returns but remains an inaccurate estimation of expected returns. Therefore, we need to set up expected returns depending on both historical performance and personal analysis and assumptions on what future returns may be. In addition, we also adjust emotional asset returns for several additional costs (transaction and storage costs) in our forecasts. As a result we will use the following expected returns throughout this analysis on portfolio optimization :

	Exp. Return		Exp. Return
ART	2,2%	US CORP BONDS	6,0%
WINE	10,7%	T-BILLS	1,0%
STAMPS	2,2%	US GOV BONDS	4,0%
VIOLINS	2,2%	GOLD	3,5%
S&P 500	8,8%	SILVER	5,0%
FTSE 100	8,5%	US RE	1,7%
CAC 40	6,8%	UK RE	3,9%

Table 8 – Retained expected returns for mean-variance portfolio optimization

As a whole, we chose to retain quite conservative expected returns given the recent economic situation. We put in black expected returns that we kept equal to mean

returns. In blue are the expected returns that we adjusted in order to match the current economic and financial outlook, to get rid of some sample biases, or to include transaction and storage costs into returns. We used mean returns for stocks and Real Estate (minus transaction and holding costs) while other asset classes have adjusted expected returns. Indeed, we set T-Bills expected return at 1%, in line with current economic situation and probably still a bit optimistic on the very short term. Similarly, bond returns have a low volatility, consequently we can set expected returns at 6% and 4% respectively, according to recent yields over the past few years. Gold and silver are affected by a sample selection bias (very high return during the 2000's – approximately 20% per year for both) so that we should also take lower rates of return to reflect more their much lower performance over the long term and the relative premium offered by equity for instance. As a result, we establish their expected returns at 3.5% and 5.0% respectively to maintain the same proportion of excess return of silver over gold.

We determine all art, stamps and violins nominal expected returns at 5%, thus significantly lowering stamps historical mean return and slightly raising both art and violins mean returns because of a sample selection bias. Actually, our sample starts in 1991 just during the art bubble which burst at the beginning of the 1990's, what explains the quite low art mean return, and after the stamps crisis of the 1980's, what helps stamps yield a higher return over the last two decades. In addition, stamps perform extremely well during the 2000's and are unlikely to keep a similar level of performance in the future. At the end, our data show that art, stamps and violins yield sensibly comparable returns over the long term independently from their performance over short periods, so that it seems impossible to forecast which one is likely to outperform others in the future. That is why we assume equal expected returns, at 5% on a nominal basis, what is in line with long-term returns (1900-2010) considering that today inflation given recent rates can reasonably be estimated to be around 2-2.5% per year. Wine on the other hand, historically tends to outperform other emotional assets as noticed by Graeser (1993) or Burton and Jacobsen (2001) for instance. In addition, there is a cumulative effect in storing wine, because after several years you can basically renew you portfolio with younger and less expensive wines. This is consistent with the nominal mean return of 13.2% observed from our short-term dataset and therefore we use this historical mean return in the case of wine.

Then, we adjust all emotional asset nominal expected returns for both transaction and storage costs. We cut returns by 0.5% for storage costs since the amount

of storage costs depends on the portfolio value (estimated to be about 0.5% per year) and can be directly removed from the rate of return. Regarding transaction costs, it is slightly more complicated because the impact of such high transaction costs on returns clearly depends on the investor horizon. The longer the holding time, the less the rate of return is affected by transaction costs. We assume that financial investors that would diversify their portfolio thanks to emotional assets are likely to be willing to invest over mid-term periods (i.e. about 5-15 years), which implies that transaction costs would quite significantly affect the investment return. By referring to Dimson and Spaenjers (2010), transaction costs for stamps are estimated to be between 20% and 25% and, for a 10-year holding period to reduce the rate of return by 2.3% (from 6.2% to 3.9% per year). Transaction costs are quite similar for violins and art and slightly lower for wine, around 15% according to Burton and Jacobsen (2001). As a result, we decide to cut nominal expected returns for transaction costs by 2.3% (2.8% when adding storage costs) for art, stamps and violins and by only 2.0% (2.5% overall) in the case of wine. The resulting expected returns are shown in the table above.

Concerning other asset classes, transaction and storage costs are negligible, except for Real Estate where transaction costs corresponds more or less to about 5-10% of the transaction price (i.e. c.-1.0% per year) and holding costs to a cut in return by c.0.5% per year (tax, works…)

C. Results

1) Long-term historical correlation and exposure to stock returns

First, as exposed in the data section, it appears that over the long term, emotional assets clearly underperform stocks (real returns between 2.5% and 2.9% per year vs. 5.3% for equity), but outperform bonds, bills and gold. In addition, these returns do not take into account potential additional costs, which are high in the case of emotional assets (transaction and storage costs) and therefore reduce the relative performance of emotional assets and force investors to hold such assets over longer time periods (i.e. during several years).

Volatility of emotional assets appears to be particularly low between 8% and 12.5%. Actually, results suggest that only bills would be less volatile than emotional assets. Nevertheless, we will not focus on this particular point since these results are likely to significantly underestimate *true* standard deviations of emotional assets

because of both appraisal bias and spurious first-order autocorrelation affecting emotional asset returns. Indeed, such illiquid assets that are infrequently traded may suffer from « appraisal smoothing »[31] because valuation is logically influenced by prices of previous transactions, and calculating returns based on yearly averages also tends to *smooth* these returns, thus reducing their volatility, and we would need to desmooth the returns in order to get rid of the underlying bias and autocorrelation[32]. As a result, volatility of emotional assets would probably be more in line with gold or stocks.

Then, the following matrix presents sample historical correlation between assets. Here smoothing in returns does not affect results or only marginally since standard deviation is removed from covariance in order to get correlation (cf. equation (2)). The following correlations take into account returns for all assets between 1900 and 2010 :

1900-2010	STAMPS	ART	VIOLINS	STOCKS	BONDS	BILLS	GOLD
STAMPS	**100%**						
ART	13,9%	**100%**					
VIOLINS	7,3%	24,0%	**100%**				
STOCKS	0,7%	22,3%	(0,5%)	**100%**			
BONDS	24,7%	8,7%	7,4%	52,3%	**100%**		
BILLS	36,2%	22,4%	34,5%	26,1%	64,6%	**100%**	
GOLD	39,8%	6,4%	12,6%	(17,3%)	(2,7%)	14,7%	**100%**

Table 9 – Correlation matrix of long-term returns (1900-2010)

We can first notice that correlation between the three emotional assets from our sample is quite low (lower than 25%), which implies that each emotional asset can individually potentially provide a diversification opportunity for a financial investor. In addition, correlation between emotional assets and other asset classes as a whole are positive but remains below 40% while it is significantly higher between some other assets like between bonds and bills (64.4%) or between stocks and bonds (52.3%). Gold on the other hand seems interesting because has a negative correlation with both bonds and stocks. However, this needs to be balanced with the fact that gold yields a very low mean return over the whole period (even lower than bills), especially when considering

[31] D. Geltner, « Smoothing in appraisal-based returns », 1991

[32] see : R. Campbell, « Art as a financial investment », 2007
Dimson and Spaenjers, « Ex post : the investment performance of collectible stamps », 2010
Renneboog and Spaenjers, « Buying beauty : on prices and returns in the Art market », 2011

its standard deviation. It is besides normal that correlation is negative considering this relative underperformance. This tends to give evidence that emotional assets can therefore be very useful for diversification purposes, but this will be investigated into more depth later in this part, over a shorter time frame in order to match more closely the current market situation. Correlation of emotional assets with stocks in particular is very close to zero for both stamps and violins (0.7% and -0.5% respectively) and still low in the case of art (22.3%). However, this might be severely underestimated because of the non-synchroneity of returns issue that we discussed earlier in this part. That is why we will now present results from our CAPM analysis on emotional assets including lagged and leading equity market returns.

The tables below report the results of our lagged CAPM analysis based on the estimation of Betas through the Ordinary Least Square (OLS) methodology :

ART vs. STOCKS	β_{-2}	β_{-1}	β_0	β_{+1}	$\boldsymbol{\beta}$	R^2	Adj. R^2
Model 1 (a=0 and b=0)	-	-	0.139*	-	**0.139***	0.050	-
Model 2 (a=1 and b=1)	-	0.226*	0.149*	0.017	**0.392***	0.173	0.149
Model 3 (a=2 and b=1)	0.148*	0.234*	0.162*	0.029	**0.575***	0.224	0.193

Table 10 – Estimation of Art market model regression coefficients

STAMPS vs. STOCKS	β_{-2}	β_{-1}	β_0	β_{+1}	$\boldsymbol{\beta}$	R^2	Adj. R^2
Model 1 (a=0 and b=0)	-	-	0.004	-	**0.004**	$4x10^{-5}$	-
Model 2 (a=1 and b=1)	-	0.136*	0.014	0.054	**0.204***	0.050	0.022
Model 3 (a=2 and b=1)	0.080	0.143*	0.024	0.062	**0.309***	0.067	0.030

Table 11 – Estimation of Stamps market model regression coefficients

VIOLINS vs. STOCKS	β_{-2}	β_{-1}	β_0	β_{+1}	$\boldsymbol{\beta}$	R^2	Adj. R^2
Model 1 (a=0 and b=0)	-	-	(0.002)	-	**(0.002)**	$3x10^{-5}$	-
Model 2 (a=1 and b=1)	-	0.071	0.003	0.067	**0.141***	0.053	0.026
Model 3 (a=2 and b=1)	0.105*	0.079	0.014	0.077	**0.275***	0.118	0.084

Table 12 – Estimation of Violins market model regression coefficients

* Slope coefficient is significantly different from zero at the 5% level

Model 1 is a classical CAPM measuring the correlation between the considered emotional asset and stock returns based on 110 observations (from 1900 to 2010). Model 2 includes 1 lagged and 1 leading market returns and therefore coefficients are measured over 108 return observations (from 1901 to 2009). Finally, Model 3 is a 4-factor model with 2 lagged and 1 leading market returns, and contains 107 return observations from 1902 and 2009.

We can notice that all the aggregated β remain significantly below 1, what confirms that correlation between emotional assets and equity is relatively low and that diversification opportunities are real. We can also notice that art is the emotional asset that presents the highest correlation with stock returns. In the case of art, all β_0, β_{-1} and β_{-2} are significantly positive, meaning that art has a important exposure to stock returns both on a same-year basis and with a certain lag. Basically, all emotional assets show to a certain extent a meaningful positive correlation with lagged stock market returns while both stamps and violins have a very low exposure to same-year stock returns. Indeed, for stamps, β_{-1} estimations are 0.136 and 0.143 (from Model 2 and 3 respectively), and are significantly different from zero at the 5% level since the 95%-confidence interval is each time well above zero. In the case of violins, returns are mainly exposed to stock returns with a 2-year lag. Consequently we can infer from our results that stock returns may affect returns of all emotional assets though to different extent and with various lags. This seems to be consistent with theoretical framework exposed earlier in this thesis, especially with assertion that the main driver of emotional asset prices is the « dynamic demand »[33] and that this demand is closely linked to wealth of High Net Worth Investors and as a consequence to market outlook and returns[34].

In addition, the unequalled level of development of the art market and the fact that art is the most considered emotional asset from a financial perspective[34], may explain that correlation with stock returns is higher than for other emotional assets, which remain more pure collectibles. Relatedly, the level of development of the market seems to have a consequence on the exposure and reactivity to changes in stock returns. Actually markets that are more developed like the art market and to a smaller extent the stamps market seem to be more reactive to changes in stock returns than the market for

[33] B. Mandel, « Art as an investment and conspicuous consumption good », 2009

[34] Capgemini World Wealth Report 2011

violins for instance. Art in particular is the emotional asset, which is the most correlated with stocks and correlation is already significantly different from zero for same-year returns. Then, stamps record mainly a 1-year lag in their exposure to market returns, while for violins it is the slope coefficient of the 2-year lagged returns which is the most significantly positive.

On the other side, there is no evidence of correlation between emotional asset returns and leading market returns. Actually, estimations of β_{+1} are all close to zero, what suggests that performance of emotional assets has a very little impact and even probably no impact on performance of equity.

2) Research on portfolio asset allocation

This analysis relies on the short-term dataset which covers the last two decades and all main asset classes with widely used indices. As exposed in the data section, emotional assets have very different features. Wine for instance presents both high mean return and high volatility with only silver being more volatile over the period. From the risk-adjusted performance perspective, stamps are the most interesting with a Sharpe Ratio of 0.91, thanks to a very good performance in particular over the past decade. First, we calculate the sample covariance and correlation matrices :

1991-2011	ART	WINE	STAMPS	VIOLINS	S&P500	FTSE100	CAC40	US Corp BONDS	T-BILLS	US Gov BONDS	GOLD	SILVER	US RE	UK RE
ART	**0,90%**													
WINE	0,75%	**5,01%**												
STAMPS	(0,21%)	(0,51%)	**0,68%**											
VIOLINS	0,09%	0,31%	(0,10%)	**0,75%**										
S&P 500	0,66%	1,30%	(0,83%)	(0,30%)	**3,64%**									
FTSE 100	0,51%	1,01%	(0,72%)	(0,12%)	2,91%	**2,82%**								
CAC 40	0,90%	0,68%	(0,80%)	(0,25%)	3,53%	3,46%	**5,54%**							
US Corp BONDS	0,08%	0,10%	(0,21%)	(0,02%)	0,55%	0,43%	0,26%	**0,35%**						
T-BILLS	(0,04%)	0,11%	(0,06%)	0,02%	0,09%	0,06%	0,13%	0,01%	**0,04%**					
US Gov BONDS	(0,20%)	(0,16%)	0,02%	(0,07%)	(0,11%)	(0,15%)	(0,35%)	0,11%	0,04%	**0,21%**				
GOLD	0,49%	0,74%	0,26%	(0,15%)	(0,39%)	(0,14%)	(0,40%)	0,03%	(0,18%)	(0,19%)	**2,17%**			
SILVER	1,39%	2,41%	(0,45%)	(0,07%)	1,83%	2,11%	2,10%	0,42%	(0,24%)	(0,50%)	2,45%	**7,18%**		
US RE	0,15%	(0,06%)	(0,05%)	0,01%	0,13%	0,12%	0,30%	0,01%	0,03%	(0,01%)	(0,13%)	(0,06%)	**0,21%**	
UK RE	0,50%	(0,10%)	(0,10%)	(0,18%)	0,12%	(0,07%)	0,35%	0,03%	(0,00%)	(0,11%)	0,20%	0,31%	0,24%	**0,76%**

Table 13 – Covariance matrix of short-term returns (1991-2011)

1991-2011	ART	WINE	STAMPS	VIOLINS	S&P500	FTSE100	CAC40	US Corp BONDS	T-BILLS	US Gov BONDS	GOLD	SILVER	US RE	UK RE
ART	**100%**													
WINE	35,2%	**100%**												
STAMPS	(27,0%)	(27,5%)	**100%**											
VIOLINS	10,7%	15,8%	(13,4%)	**100%**										
S&P 500	36,8%	30,5%	(52,9%)	(18,1%)	**100%**									
FTSE 100	32,0%	26,8%	(51,5%)	(8,5%)	90,8%	**100%**								
CAC 40	40,5%	12,9%	(41,0%)	(12,3%)	78,6%	87,5%	**100%**							
US Corp BONDS	14,2%	7,9%	(42,8%)	(3,6%)	49,5%	43,1%	18,5%	**100%**						
T-BILLS	(19,7%)	24,8%	(32,8%)	11,1%	23,6%	16,6%	26,0%	9,0%	**100%**					
US Gov BONDS	(46,8%)	(15,2%)	6,1%	(17,3%)	(12,7%)	(18,8%)	(32,6%)	39,2%	42,1%	**100%**				
GOLD	35,2%	22,5%	21,7%	(11,4%)	(13,8%)	(5,7%)	(11,6%)	3,4%	(60,3%)	(28,5%)	**100%**			
SILVER	54,8%	40,2%	(20,3%)	(2,9%)	35,8%	46,8%	33,3%	26,5%	(44,5%)	(40,2%)	62,1%	**100%**		
US RE	34,0%	(6,0%)	(14,2%)	1,6%	14,7%	15,3%	27,9%	3,4%	29,5%	(6,6%)	(19,2%)	(4,9%)	**100%**	
UK RE	60,5%	(5,0%)	(14,0%)	(24,5%)	7,0%	(4,9%)	16,9%	5,6%	(1,6%)	(26,6%)	15,4%	13,4%	61,0%	**100%**

Table 14 – Correlation matrix of short-term returns (1991-2011)

Results from the shorter dataset show that unlike other emotional assets, in particular stamps and violins, art is positively and quite significantly correlated with other financial asset classes (i.e. stocks, bonds). This tends to confirm the empirical observation from our lagged CAPM analysis and give evidence that the higher level of development of the art market and the existence of pure financial investors among art buyers is likely to lead to a higher correlation with pure financial assets. It is however interesting to notice that stamps and violins have a negative historical correlation with stocks and most of main other asset classes over the last two decades.

We now determine the asset allocation of various portfolios : first, the Global Mean-Variance Portfolio (GMVP), which yields the lowest volatility. It is besides the only efficient portfolio if you consider that you cannot forecast expected returns and assume that all expected returns are equal. In such a situation, the Markowitz efficient frontier would be a straight horizontal line and all possible portfolios would be on this line. Then, the tangency portfolio, which maximizes the Sharpe Ratio with no other constraint than no short-selling. Then, we also incorporate some additional constraints in portfolios C and D. Portfolio C is the portfolio that maximizes Sharpe Ratio (with no short-selling) under the constraint that weight of each individual asset class (emotional

assets, equity, bonds, commodities and Real Estate) is lower than 25%. Eventually, Portfolio D also maximizes Sharpe Ratio excluding short-selling but under different constraints on allocation to various asset classes : weights of financial asset classes (equity and bonds), which include usual investable assets, are individually lower than 40%, while weights of each alternative asset class (emotional assets, commodities and Real Estate) must be lower than 20%. This last portfolio is aimed to favor traditional asset classes, which are likely for instance to be more liquid and transparent, or to provide more diversification opportunities inside the asset class itself (especially for stocks). The optimization of portfolio weights gives the following results :

	Optimal portfolio weighting			
	GMVP	Tangency portfolio	Portfolio C	Portfolio D
ART	1,3%	-	-	-
WINE	-	2,3%	0,1%	0,2%
STAMPS	10,7%	17,6%	14,1%	9,8%
VIOLINS	2,7%	13,4%	10,8%	10,0%
S&P 500	-	-	2,1%	-
FTSE 100	-	8,9%	13,1%	12,1%
CAC 40	-	-	-	-
US CORP BONDS	6,1%	3,8%	-	-
T-BILLS	72,6%	-	-	-
US GOV BONDS	-	36,0%	25,0%	40,0%
GOLD	3,4%	1,8%	9,8%	7,9%
SILVER	1,5%	-	-	-
US RE	-	-	9,5%	3,5%
UK RE	1,8%	16,2%	15,5%	16,5%
Total	**100%**	**100%**	**100%**	**100%**

Table 15 – Asset allocation in various selected portfolios

	Portfolio key metrics			
	GMVP	Tangency portfolio	Portfolio C	Portfolio D
Expected return	1,7%	4,0%	4,0%	4,1%
Volatility	1,2%	2,0%	2,7%	2,3%
Sharpe ratio	**1,36**	**2,05**	**1,48**	**1,77**

Table 16 – Key results of various selected portfolios

With respect to the GMVP, the total weight allocated to emotional assets is 14.7% and split between stamps in majority (10.7%), violins (2.7%) and art (1.3%). Most of the portfolio is invested in Treasury Bills (72.6%), which by definition have a very low standard deviation. The expected return of the portfolio is low at 1.7%, slightly lower than historical inflation, but volatility is very low too at 1.2% for a total Sharpe Ratio of 1.36.

For portfolios based on maximization of the Sharpe ratio, regarding emotional assets, the tangency portfolio privilegiates stamps and violins, with a small proportion of the portfolio (2.3%) invested in wine when there is no constraint on maximum weight allocated to emotional assets. In this case, emotional assets as a whole account for 33.3% of the tangency portfolio, while this weight logically drops to 25% and 20% when adding constraints on maximum weight allocated to this particular asset class. In these cases, the proportion of the portfolio allocated to stamps in particular decreases sharply. Other assets present in the tangency portfolio are US government bonds, UK Real Estate, FTSE 100, US Corporate bonds and gold. Then, when incorporating additional constraints on maximum proportion of the portfolio invested in a single asset class (i.e. emotional assets, stocks, bonds, commodities or Real Estate), we notice a significant increase in wealth allocated to S&P 500, gold and US Real Estate while UK Real Estate for instance tends to be slightly more disregarded, what is besides probably due to correlation and standard deviation matters. Indeed, UK Real Estate, which has a lower correlation than US Real Estate with US government bonds, is likely to become less interesting when allocation to this particular asset decreases all the more than US Real Estate presents a lower standard deviation and enables to offset the decrease in US treasury bonds weight. It is also interesting to notice that at comparable or even lower Sharpe ratio, assets with the lowest volatility tend to be favored over other assets (i.e. gold over silver, stamps and violins over wine). The tangency portfolio reaches an interesting Sharpe Ratio of 2.05 with an expected annual return of 4.0%. Other portfolios have roughly similar expected returns but higher volatility because of additional constraints that are aimed to diversify risk and improve it from a *qualitative* perspective.

Finally, if we plot the efficient frontier of Markowitz mean-variance optimization for the selected dataset, we obtain the following chart :

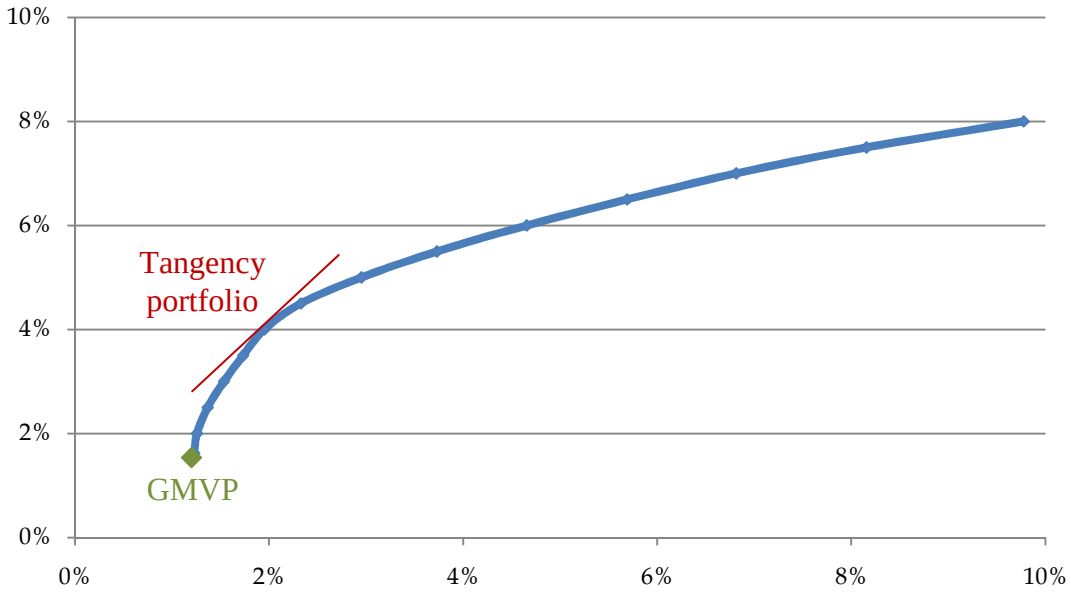

Figure 2 – Mean-Variance efficient frontier for diversified investments

Conclusion

We first made a review of existing literature on emotional assets and especially on the financial dimension, which is getting more important than ever since simultaneously collectible markets have reached an unequalled level of development (art in particular) and rates of return got higher than ever especially relative to equity because of recent financial crises, and indeed, became attractive for investing purposes. This analysis has shown that despite emotional assets still tend to compare unfavorably with traditional financial assets from a risk-return perspective, the additional utility of such asset, like conspicuous consumption, may offset this relative underperformance and that in addition, their correlation features might make from them interesting diversification solutions. Authors like Rachel Campbell (2007, 2009) or Fogarty (2006, 2010) for instance show that emotional assets like art, violins or wine can definitely be included in optimal portfolios. In particular, these assets may be better diversification solutions than other alternative asset classes like gold for instance, which got a very attractive performance during recent financial crises but actually yields a very low long-term real return.

Then, our empirical research shows first that emotional assets have returns (excluding additional costs) in excess to other alternative assets like gold, and are beaten only by stocks over long-term periods. It also tends to give evidence that there does exist a positive correlation between emotional assets and stock markets over the long-term but mainly with a lag of 1 or 2 years, especially for emotional assets, whose markets are less developed like violins or stamps. This lag exists even for art, what tends to prove that emotional asset returns have a positive exposure to market returns, which actually affect the High Net Worth Investors general wealth. Finally, our analysis on portfolio optimization shows that under the methodology used (Markowitz mean-variance optimization) and for the selected assets and dataset, emotional assets are definitely of interest to lower financial risk and diversify portfolios even when taking into account storage and transaction costs. In particular, we make personal assumptions on expected returns, and thus emphasize that first mean returns are relatively poor estimators of assets future performance, and then, that some assets, which record very high returns over the past few years, are actually far from their historical long-term performance and should therefore have much lower expected returns (i.e. commodities,

stamps to a lower extent), while equity keeps a significant premium over other asset classes.

Eventually, the lack of easily accessible data is obviously a major hurdle when making research on emotional assets. These assets are numerous and can present very different features. Besides, the example of wine is striking : Actually, this asset behaves very differently from other emotional assets from a financial perspective and has return and volatility characteristics that are closer to equity for instance. But very little has been done so far on most of emotional assets, like coins or old books for instance, and this would probably be a logical avenue for further research.

Then, lagged correlation between emotional assets and other asset classes (not only stocks) could be further investigated as well. One could also build up a model to incorporate this lag when studying portfolio diversification, since at the moment our analysis, according to Markowitz Mean-Variance optimization methodology, takes into account same-year correlation only.

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