Essays on Risk, Religion and Social Preferences



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To the Late Ustad Nusrat Fateh Ali Khan, deep within the nuclei of my heart, I have built a chapel filled with you.

"Phir Charagh-E-Lala Se Roshan Huay Koh-O-Daman
Mujh Ko Phir Naghmon Pe Uqsanay Laga Murgh-E-Chaman
Apne Mann Mein Doob Kar Pa Ja Suragh-E-Zindagi
Tu Agar Mera Nahin, Banta Na Bann, Apna Toh Bann

Mann Ki Duniya, Mann Ki Duniya, Souz-O-Masti, Jazb-O-Shauq
Tann Ki Duniya, Tann Ki Duniya, Sood-O-Sauda, Makr-O-Fann
Mann Ki Daulat, Haath Ati, Hai To Phir, Jaati Nahin
Tann Ki Daulat, Chaon Hai, Ati Hai Dhan, Jata Hai Dhan

Mann Ki Duniya, Mein Na Paya, Mein Ne Afrangi Ka Raaj
Mann Ki Duniya, Mein Na Dekhe, Mein Ne Sheikh-O-Barhaman
Paani Paani, Kar Gayi, Mujh Ko Qalandar Ki Ye Baat
Tu Jhuka, Jab Ghair Ke, Agay Na Mann, Tera Na Tann"

"Bas… Apna Muqaam Paida Kar"

Allama Iqbal
(Bal-E-Jibreel)

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DECLARATION

Chapter two was submitted for publication at the *International Journal of Islamic and Middle-Eastern Finance and Management*. Decision: *Minor Revisions*.

Chapter three was submitted for publication at the *Journal of Behavioural and Experimental Economics.*

Chapters three and four were co-authored with Professor Edward Cartwright.

CHAPTER ONE

1. Introduction

This doctoral thesis consists of three independent chapters, each of which contributes towards a distinct area of research.

Chapter two explores the importance of taking into consideration higher statistical moments for the purposes of portfolio management within the Islamic Finance sector. Chapter three uses incentivised and controlled laboratory experiments to study the role of context in determining agent risk-preferences. Chapter four also employs the experimental approach to investigate whether social-preferences are sensitive to changes in subject choice-sets.

The good fortune of graduate students lies in their exposure to stimulating research, platforms encouraging the exchange of ideas and the ability to interact with erudite academics. Having had the honour of experiencing such an environment over the course of my Ph.D. studies, my curiosity and interests began to develop across diverse areas of research. The encouragement and advice imparted upon me to follow the pursuit of my research interests has culminated into the completion of the three standalone chapters that form this thesis.

Chapter two contributes towards the literature on portfolio management within the Islamic Finance sector. This Islamic Finance sector has attracted considerable attention in recent times due to its impressive performance and phase on expansion since the subprime financial crisis. In particular, since the turn of the millennium, the industry has experienced an annualised growth rate of approximately 15% in global assets, which fell in the region of $200bn in 2003, $2.2tn in 2017 and are forecasted to cross $3.8tn by 2022 (Thomson Reuters (2007) and the City United Kingdom Islamic Finance Report (2015)).

In chapter two, I argue that in spite of its remarkable expansion since inception, the Islamic Finance sector is highly vulnerable to extreme shocks. More precisely, from a theoretical perspective, the stringent restrictions imposed upon Islamic portfolio managers, such as the prohibition of a) trade in derivative contracts b) short-selling strategies c) interest-based contracts and d) the inability of diversifying across what are considered to be unethical markets, collectively act to increase the riskiness of Shariah-compliant portfolios (see Usmani (1998) and Gait and Worthington (2007)). In part, this is due to an inability to efficiently hedge against economic shocks (Hesse et al. 2008). Moreover, the e) underdevelopment and thinness of secondary capital markets alongside f) an acute lack of supply and shortages of liquidity in Islamic Bond markets further exacerbates the vulnerability to extreme events (Hesse et al. (2008), Sole (2008) and Kammer et al. (2015)).

The regulatory constraints necessitated by the Shariah has instigated extensive empirical research into the benefits of both inter and intra asset-class diversification with the Islamic Finance sector, as this offers portfolio managers a relatively simple and compliant form of risk-management (e.g. Madjoub and Mansour (2014), Abbess and Trichilli (2015) and Yilmaz et al. (2015)). However, despite the overt vulnerability to tail-events, chapter two – to the best of my knowledge – provides the first study that takes into consideration the role of higher statistical moments when examining the benefits of portfolio diversification within Islamic Finance.

As such, chapter two demonstrates that ignoring higher statistical moments, such as the skewness and kurtosis of the returns' distribution, can lead to substantially misleading inferences regarding the performance and benefits of diversified Shariah-compliant portfolios. More specifically, I show that evaluating the performance of Islamic securities using the first two moments i.e. mean and standard deviation – as is customary – rather than using the first four moments, which captures a more accurate description of the distribution of returns, can lead to a non-trivial underestimation of portfolio risk during the most extreme market conditions.

A general finding from studies comparing risk-preferences across faith groups is that religious agents tend to display greater levels

of risk-aversion in comparison to the non-religious (e.g. Bartke and Schwarz (2008), Hilary and Hui (2009) and Noussair et al. (2012)). This result has sometimes been explained by the fact that irreligious agents essentially take the riskier option in Pascal's wager. Thus, it has been argued that relative to religious individuals, the irreligious are more likely, in general, to display a greater appetite for risk (Miller and Hoffman 1995).

However, as alluded to above, the Islamic Finance sector has experienced robust rates of growth despite its lack of development, standardisation and its prohibitive stance towards common instruments used for the purposes of risk-mitigation. This observation reveals that the appetite for risk of faith-based agents may be dependent upon whether the channel of investment or the particular action involved is in conflict with the pursuit of satisfying their religious convictions. It is this insight that motivates the third chapter of this thesis.

To be specific, much of the existing experimental research eliciting measures of risk-aversion typically has the decision-task faced by subjects framed in terms of lotteries and gambles (e.g. Gneezy and Potters (1997), Eckel and Grossman (2002) and Benjamin et al. (2010)). Therefore, in chapter three, we argue that the measurement of risk-aversion may in fact interact with religiosity. Given that gambling has seemingly been stigmatised throughout history by the world's major religions (see Binde 2007), it then follows that the use of a gambling frame could potentially create a bias in the measurement of risk-aversion for religious subjects.

Hence, chapter three tests the proposition that the way in which the decision-task is framed can influence risk-taking behaviour. We do this by maintaining an identical numerical problem across treatments whilst manipulating the way in which the decision-task is framed. We implement a gambling frame – which conflicts with religiosity – and an investment frame – which has no apparent conflict with religiosity. Alongside our framing manipulation, we also test whether priming subjects to make religion (or more accurately a broader notion of ethics and morality) salient influences behaviour. Finally, in a novel setup, we conduct an adapted version of our framing experiment within a religious setting. Specifically, we conduct a one-shot version of

our main experiment with Muslim participants within a Mosque immediately following a religious service.

Across our two experimental studies, we find risk-taking in the investment frame to be rather consistent. We do not observe any difference because of prime or setting. In contrast, we observe large differences in subjects' appetite for risk across prime and setting in the gambling frame. Overall, we show that subjects were significantly less risk-tolerant in the gambling frame than in the investment frame.

The results from chapter three corroborate the findings from a broad and growing strand of literature showing that the behaviour of agents displays situational instability. That is, there is ample evidence to suggest that the observed behaviour of individuals is sensitive to, among other things, framing (Schubert et al. (1999)), choice-sets (List (2007) and Bardsley (2008)), gains versus losses (Weber and Hsee 1999), method of endowment determination (Cherry et al. (2002), Carpenter et al. (2010) and Erkal et al. (2011)), context (Zizzo and Oswald (2001), Weber et al. (2002) and Dohmen et al. (2011)) and the number of decision makers i.e. unilateral versus bilateral action (Simunovic et al. (2013)).

The intuition underlying chapter four of this thesis is similar to that of chapter three. Whilst chapter three investigates the context-specificity of risk-preferences, chapter four contributes towards the literature exploring the stability of social-preferences. A plethora of studies have shown the existence of prosocial behaviour in the lab (see Andreoni et al. (2007) and Engel (2011)). However, more recent work has also reported non-negligible evidence of antisocial behaviour in the lab (e.g. Zizzo and Oswald (2001) and Abbink and Sadrieh (2009)). In chapter four, we contribute towards the literature on social-preferences by testing the extent to which altering subject choice-sets influences the level of prosocial and antisocial behaviour between competing individuals.

Prior studies have focussed on the study of whether individuals are willing to give or take from an opponent under various settings. In a novel approach, we extend a baseline choice-set which includes the option to give, take, or do nothing by introducing an option to purchase insurance. This allows us to not

only test the extent to which individuals possess other-regarding preferences, as in previous studies, but also whether subjects are sufficiently concerned about the possibility of others taking money from them and as a result willing to invest resources to avoid this. Furthermore, we test if there is any difference in the observed behaviour of subjects when any amount stolen from their opponent is kept versus when it is simply burned (wasted). Importantly, subjects are asked to make these decisions after having competed for an endowment in a winner-takes-all tournament setting.

Our results show that extending the available choice-set by including the option to insure crowds out voluntary donations by competition winners even when insurance represents a dominated strategy in monetary terms. Moreover, switching the context of the problem from potentially having one's endowment stolen and kept to having it burned by an opponent lowers prosociality in terms of average donation size. In contrast, our data shows considerable evidence of sabotage and antisocial behaviour by contest losers that remains consistent across treatments. We argue that the reduction in prosociality is driven by subjects' unwillingness to steal from their poorer counterparts when there is uncertainty regarding their chosen action whereas the consistent taking by poor subjects is motivated by a strong aversion towards disadvantageous inequality. The findings from chapter four adds further support to the growing consensus on the existence of other-regarding preferences as well as the situational instability of preferences (List (2007), Bardsley (2008) and Dohmen et al. (2011)).

Chapter five provides a brief summary and conclusion of our research findings from chapters two, three and four.

CHAPTER TWO

2. Is Asset-Class Diversification Beneficial for Shariah-Compliant Equity Portfolios?

ABSTRACT

In this chapter, we study a) whether diversifying across asset-classes by including commodities and Sukuk could improve the performance of an equity-only Islamic portfolio b) the benefits of diversification over historically significant bull and bear markets to test the relevance of diversification during volatile and trending markets c) the dynamic conditional correlation between the aforementioned asset-classes to study how the relationship across markets is affected during crisis regimes and d) we employ a convenient tail-risk measure of performance which includes the importance of an assets skewness and kurtosis to study whether taking into account the shape of the returns distribution provides further insight into the potential benefits of diversification. Our findings suggest that the benefit of diversifying beyond an equity-only portfolio is limited during normal times but much greater during crisis periods, with improvement in both risk-return profiles and the probability of extreme losses. Our most important finding relates to the estimation of portfolio tail-risk. In particular, we find that using a standard two-moment Value-at-Risk measure, which assumes normally distributed returns, rather than a four-moment Value-at-Risk, which incorporates an assets skewness and kurtosis, can lead to a substantial underestimation of portfolio risk during the most extreme market conditions. This result is especially important for Islamic portfolio managers as Islamic securities are more likely to deviate from a normal distribution for reasons such as market thinness, market

illiquidity, the lack of product standardization and the inability to diversify across a broader range of markets.

2.1 INTRODUCTION

The Islamic finance sector has attracted considerable attention recently due to its impressive performance and phase of expansion since the subprime financial crisis. In particular, the industry has experienced an annualized growth rate of approximately 15% in global assets over the past decade, which were in the region of $200 billion in 2003, $2.2 trillion in 2017 and are forecasted to cross $3.8 trillion by 2022[1].

Shariah-compliant finance caters primarily for faith-based economic agents whose religious motivation requires them to operate under a dual-regulatory framework. That is, they must incorporate both country-specific and religious-based legislation within their decision-making framework, which seeks to maximize both present and some notion of an afterlife utility. Therefore, whilst the conceptual function of both conventional and Islamic finance is identical i.e. facilitating agents in their desire to smooth consumption patterns across time and space, Shariah-compliance necessitates the imposition of additional constraints, including a) the prohibition of interest b) the prohibition of speculation and contractual ambiguity c) the exclusion of financing and dealing with what the Islamic faith deems socially irresponsible or unethical activities and d) a requirement that all transactions be directly linked to the real underlying economic transaction (Usmani (1998) and Gait and Worthington (2007)).

Islamic finance essentially imposes various screening criterion, based on non-pecuniary value-judgements, to filter out what are considered to be compliant investments out of the broader universe of investable assets. In fact, such screening based on subjective beliefs and value-judgements is what relates Shariah compliant investing to the growing market for Socially-Responsible Investments (SRI). Although there isn't a

[1] See Thomson Reuters (2017) and The City United Kingdom Islamic Finance Report (2015)

unanimously agreed definition of what constitutes a socially-responsible investment, EUROSIF (2014) defines SRI as any type of investment process that combines investors' financial objectives with their concerns about environmental, social and governance (ESG) issues. Hence, this leads to similarities between SRI and Islamic finance as they both restrict or shrink the set of assets, based on subjective values, in which their adherents may invest.

For example, both Islamic and SRI funds typically prohibit investment into tobacco companies. That said, perhaps the key difference between the two is that the filtering criterion may not always be in alignment. This is exemplified by the fact that SRI also involves, for example, screening investments based on environmental issues, company governance structures and engaging with companies that aim to improve social welfare. By contrast, such strategies are typically not deemed necessary and thus not implemented by Shariah compliant investors.

While there has been no empirical consensus in the literature, several authors have argued that the additional constraints imposed by Shariah compliance, which often alters the characteristics and underlying structure of Islamic securities, creates a theoretical heterogeneity between the conventional and Islamic finance sectors that could result in differences in the stability of either sector and their response to economic shocks (Chapra (2008) and Hassan (2009))[2]. For example, Hassan and Dridi (2010) describe how the Islamic banking sector initially absorbed the financial crisis shock better than the conventional sector due to factors attributed to their differing principles, such as greater stringency on leverage ratios and the prohibition of investing in so-called toxic derivative markets. However, Hassan and Dridi (2010) also show that once the ramifications of the crisis penetrated deeper into the real-economy, a combination of poor risk-management and excessive sectoral concentration caused substantial damage to the balance-sheets of Islamic financial institutions.

The regulatory requirements put-forth by the Shariah create several issues for Islamic portfolio managers. For instance, the

[2] For studies finding no significant differences, see Cevik and Charap (2011) and Chong and Lio (2009). For an alternative view, see Rosly et al. (2003), Cakir and Raei (2007), Beck et al. (2013) and Farooq and Zaheer (2015).

prohibition of ambiguity and uncertainty in contracts has generally led Shariah boards and scholars to rule out any trade in derivatives (Jobst and Sole 2012). Although the impermissibility of investing in derivative contracts shielded Islamic portfolios from subprime loans during the financial crisis, this constraint may not be as beneficial in a wider context. That is, derivatives help the economy achieve an efficient allocation of risk, assist in completing markets, provide financial market participants with information and may help reduce or hedge against risks (Sill 1997). This is further exacerbated by the prohibition of strategies such as short-selling which violates the Islamic teaching that one must not sell something that they do not possess or own (Usmani 1998). Therefore, from a theoretical perspective, Islamic portfolios are more vulnerable to large fluctuations in value due to the inability to use such financial instruments to hedge against economic shocks (Hesse et al. 2008).

Secondly, the prohibition of investing in certain markets that are deemed illegitimate e.g. alcohol, concentrates wealth across fewer sectors, thus limiting the potential for diversification and increasing the vulnerability of Shariah compliant portfolios to extreme events and idiosyncratic shocks within particular markets. Furthermore, given the relative infancy of the Islamic finance sector, market participation is still relatively low and there is an absence of mature secondary markets for important securities such as Sukuk. This market thinness makes Shariah compliant portfolios more susceptible to large fluctuations in valuation. Moreover, there is a prevalence of buy-and-hold investors within Sukuk markets. While this has been attributed to an acute lack of supply, the shortage of liquidity this creates not only hampers market growth but makes the valuation of Sukuk more volatile during periods of crises (Hesse et al. (2008), Sole (2008) and Kammer et al. (2015)).

A wider problem facing Islamic securities relates to the process of their approval. That is, securities such as Sukuk must be approved by a Shariah board prior to issuance. While the existence of multiple boards creates issues pertaining to standardization due to differences in the interpretation of Islamic scripture (Ellis (2012) and Godlewski et al. (2014)), a further concern brought to light in recent history is that these rulings aren't immune from being challenged post-issuance. More

precisely, a recent issuance of Islamic bonds was announced as being non-compliant roughly three years after being on the market and prior to the date of maturity. Although the legislative basis for this declaration was contested, such issues within the industry can greatly amplify risk and uncertainty (Ellis (2012) and Jackson (2018)).

Recent evidence shows that Islamic portfolios are highly concentrated within certain geographic regions, asset-classes and market sectors. For example, in 2017, 87% of the Islamic asset-management sector was concentrated within three countries i.e. Iran, Malaysia and Saudi Arabia, where oil dependence is crucial to growth (see Thomson Reuters 2018 report). Furthermore, Islamic investors tend to have substantial equity holdings with minimal diversification across asset-classes (see HSBC Amanah (2011) and Mauro et al. (2013)). The aforementioned issues are further exacerbated by the shrinking of the potential sectors across which Islamic investors may diversify, which leads to greater concentration in some specific sectors, such as Basic Materials, Industrials, Oil, Gas and Technology, thus inducing greater volatility in returns (Hussein and Omran (2005), Dewandaru et al. (2015) and Charles et al. (2015)). For instance, Charles et al. (2015) show that Shariah-screening reduces the number of stocks included in the Islamic index by up to 60-70%. Having access to the composition and sectoral breakdown of the Islamic index, Charles et al. (2015) show that 73% of the Islamic index is concentrated within the Technology, Health-Care, Industrials, Oil, Gas and Basic Material sectors. In comparison, they show that the corresponding figure for the conventional index was only 49%.

In addition to the aforementioned challenges that compliant portfolio managers face, a further and broader issue has been the growing financial integration and interdependence between world economies. That is, it is relatively well-established that greater levels of financial liberalisation and globalisation have resulted in tighter cross-border integration and interdependencies among global equity markets (Kasa (1992), Corhay et al. (1993) and Blackman and Thomas (1994)). A direct corollary of this unprecedented increase in financial globalisation and the subsequent increase in financial interdependence is that global financial systems are now more vulnerable to systematic risk,

thus saturating the potential for cross-border diversification opportunities within asset-classes. The increasing convergence of risk-factors that global equity markets face has led several authors to advocate for diversification across asset-classes.

Roll (2013) highlights the importance of diversifying across asset-classes by arguing that even relatively well-diversified portfolios, such as the S&P 500, are quite volatile during certain periods and could benefit from extending their holdings across asset-classes to diversify across risk-factors. Well-diversified portfolios within an asset-class are highly-correlated, whereas well-diversified portfolios across different asset-classes are less correlated. The first point implies that there is a unique systematic factor that limits diversification within an asset-class and the second implies that each asset-class is mainly driven by its unique factor.

Studies such as Fugazza and Nicodano (2009), Arouri and Nguyen (2010) and Daskalaki and Skiadopolous (2011) show that the returns of securities within a particular asset-class display a much higher correlation than they do with securities from alternative asset-classes. Intuitively, this has to do with heterogeneity in the underlying risk-factors across asset-classes. This point is reinforced by Baur and Lucey (2010), Baur and McDermott and Chan et al. (2011) who find that during periods of higher risk-aversion i.e. economic downturns or crisis regimes, investors attempt to preserve their wealth by shifting their portfolios towards a greater allocation into so-called safe-haven assets such as precious metals and treasuries, which tend to display lower volatility and favourable hedging characteristics.

While the arguments in favour of multi asset-class portfolios have gained considerable traction and support recently (Cheung and Miu (2010), Su and Lau (2010), Hammoudeh et al. (2010), Arouri et al. (2011) and Daskalaki and Skiadopolous (2011)), Chan et al. (2011) argue that the benefits of diversification are highly regime-specific. They find that during crisis regimes, the correlation across asset-classes tends to increase, leaving little benefit from diversification once transaction costs are accounted for.

In light of the regulatory restrictions the Shariah imposes on Islamic securities and investors, in this chapter we study a) whether diversifying across asset-classes by including commodities and Sukuk could improve the performance of an

equity-only Islamic portfolio b) the benefits of diversification over historically significant bull and bear markets to test the relevance of diversification during volatile and trending markets c) the dynamic conditional correlation between the aforementioned asset-classes to study how the relationship across markets is affected during crisis regimes and d) as explained earlier, given that Islamic portfolios are more vulnerable to extreme events, we employ a convenient tail-risk measure of performance which includes the importance of an asset's skewness and kurtosis to study whether taking into account the shape of the returns' distribution provides further insight into the potential benefits of diversification.

An important objective of this study is to provide a *comparative* analysis between the level of risk estimated when we use a measure that assumes normally distributed returns versus a measure that incorporates higher moments, such as an assets skewness and kurtosis. Therefore, given the overall motivation of our study, we use the Value-at-Risk (VaR) model for a few important reasons. First, there is a lack of studies within the Islamic finance literature that employ methods which are directly understood and implementable by industry practitioners. The VaR is beneficial in this regard since it is ubiquitous and thus very well-known among practitioners. The Value-at-Risk was also considered an attractive methodology for our analysis as it can be used for non-normally distributed assets. The four-moment VaR, covered in Section 2.3 (see Favre and Galeano 2002), adjusts the Gaussian quantile function for skewness and kurtosis using the Cornish-Fisher expansion (Cornish and Fisher 1937), thus allowing us to provide a direct comparison between the level of risk estimated by the standard two-moment and higher-moment VaRs.

Hence, not only is the VaR straightforward in terms of implementation, able to measure risk with just one easily understandable number *and* able to incorporate higher-moments, but this approach has a further added advantage of having been embraced by European regulators (see EIOPA 2016). That is, regulators such as the European Securities and Markets Authority (ESMA) has adopted the Cornish-Fisher based VaR as a standardised method to be used in order to report the embedded risk of packaged retail investment and insurance based products

(PRIIPs), which generally include stocks, bonds, insurance policies, structured funds, deposits and products.

However, although our approach does offer the advantages stated above, an important limitation for the general purposes of portfolio management is that the VaR is based upon a univariate distribution. An alternative approach to modelling various risks and the study of extremal events under a multivariate distribution is that of copula analysis. The copula methodology, first introduced by Sklar (1959), has received great attention in the banking industry since it was first used for financial applications by Embrechts et al. (1999). Therefore, although we adopt the VaR for the reasons outlined above, an interesting extension of our work, especially if there is a broader availability of data on various Islamic assets, would be to use copula-analysis to study portfolio management and extreme events within the realm of Islamic finance.

2.2 PRIOR LITERATURE

The literature exploring the potential for diversification in portfolios incorporating both Islamic and conventional equities has increased substantially over the past decade. In particular, much attention has been devoted towards studying the relationship and co-movement between conventional and Islamic equity markets. This is because researchers have primarily been interested in testing whether Islamic stocks represent a unique asset-class or whether they fall within the general class of conventional equities (Hakim and Rashidian (2004), Hassan and Girard (2010), Guyot (2011), Saiti and Masih (2014), Alexakis et al. (2015), Ajmi et al. (2014) and Mensi et al. (2017)).

The empirical research on diversification both within and across asset-classes that are specifically considered Shariah compliant has been less forthcoming. Madjoub and Mansour (2014) study the relationship between the Islamic equity indices of the U.S. and a set of five emerging markets. The authors find evidence of the U.S. market being only weakly correlated with the emerging markets under consideration, which they attribute to the principles of Islamic finance. Madjoub and Mansour (2014) argue that the stringent restrictions on leverage ratios, interest-based transactions and the asset-backed nature of Islamic investments

reduces the exposure of markets to volatility spillovers and thus provides investors with diversification opportunities.

Similar to Madjoub and Mansour (2014), Abbess and Trichilli (2015) investigate the potential benefits of diversifying Islamic portfolios by combining stocks from developed and emerging markets. Using a multivariate cointegration approach, Abbes and Trichilli (2015) find that the degree of interdependence varies depending on the level of economic similarity between the markets under consideration. While markets within a particular economic grouping i.e. developed or emerging display higher levels of integration, there is some evidence that this relationship is a lot weaker for those from opposing groups, suggesting that there may be some scope for cross-border diversification in Islamic equities.

Khan et al. (2015) investigate the time-varying correlation dynamics between the Dow Jones Islamic equity index and various commodity indices to determine the potential for diversification between them. The authors find evidence of instability in correlations which show a general tendency towards increasing during periods of market stress, implying limited diversification during bearish periods. However, Khan et al. (2015) argue that the commodity sector cannot be considered a homogenous asset-class, as the time-varying relationships vary significantly depending on the type of commodity under consideration. In a similar study, Abdullah, Saiti and Masih (2016) find that the degree of interdependence between Islamic equity and commodity markets is country-specific. Their findings suggest that there may be scope for diversification based on differences in risk-factors, which in some instances can have a significant overlap between asset-classes within the realm of Islamic finance. For example, oil prices are likely to be a lot more correlated with equity prices in major oil-producing nations such as Saudi Arabia than they are in those where oil production is less significant, such as Pakistan.

Yilmaz et al. (2015) study the correlation dynamics between ten Islamic equity sector indices i.e. stocks within the healthcare and energy sectors, belonging to the family of Dow Jones Islamic indices. Covering the period from 1999 to 2014, Yilmaz et al. (2015) find an increase in the degree of sectoral integration and interdependence over time, implying limited scope for

diversification within the equity asset-class. The authors argue that a period of increasing global financialization has weakened the importance of fundamentals and real economic factors in determining equity prices which are now instead increasingly driven by factors such as capital flows, risk-appetite, behavioural factors and investment strategies.

Alaoui et al. (2015) explore the co-movement dynamics between various regional equity indices within the Gulf Cooperation Council and a global Sukuk index. They find strong evidence of time-varying correlations, greater contagion between markets in closer proximity and a flight-to-quality during the recent financial crisis whereby investors sought to shift their portfolio weights towards a greater allocation of Sukuk relative to equity holdings.

Nagayev et al. (2016) examine the extent to which commodity markets co-move with Islamic equities. Their findings show that the return correlations between equities and commodities are time-varying and highly volatile, showing a substantial and persistent increase in correlations during the global financial crisis of 2008. Moreover, using a wavelet coherence model, Nagayev et al. (2016) find that the benefit of investing in commodities is dependent on an investor's time-horizon. While some commodities can provide short-term benefits, they may not do so in the longer-run. However, once transaction costs are taken into consideration, these short-term benefits may also be limited.

As described above, the existing literature on portfolio diversification within the realm of Islamic finance primarily focuses on econometric methods aimed at capturing correlations, interdependencies and contagion effects between markets. Higher statistical moments, such as skewness and kurtosis have generally been ignored as a criterion for evaluating portfolio-management decisions. However, it is well established in the literature that financial returns typically display significant skewness and kurtosis. Early researchers such as Rubinstein (1973) argue that skewness and kurtosis cannot be ignored unless asset returns are normally distributed and the investor's utility function is quadratic. If these two conditions were satisfied, the first two moments would be sufficient for maximizing expected utility. This is because a normal distribution implies that the entire distribution of an assets returns could be inferred through its mean and variance, making higher-moments irrelevant.

Likewise, if returns aren't normally distributed but investors have quadratic utility functions, then by construct, this would assume that investors are indifferent to other features of the distribution. However, quadratic utility assumes that investors are equally averse to deviations above the mean as they are to deviations below the mean, and that they sometimes prefer less wealth to more wealth, which isn't borne out by the data (Cremers, Kritzman and Page 2004).

In a seminal paper, Harvey et al. (2010) propose a theoretical model for optimal portfolio allocation that incorporates higher-moments. The authors find that including higher-moments in the decision process alters the optimal portfolio allocation and increases expected utility. This general result has been reinforced by a growing strand of empirical literature. You and Daigler (2010) use a novel approach by exploring whether the inclusion of higher-moments affects the purported benefits of diversifying across international equity markets. Using a four-moment Value-at-Risk methodology, the authors find that ignoring higher-order moments, in particular an assets skewness and kurtosis, can lead to an underestimation of the true level of portfolio risk.

Our main contribution towards the literature is to apply this four-moment Value-at-Risk methodology to investigate whether incorporating a more complete description of the shape of the returns' distribution of Shariah compliant financial securities could provide Islamic portfolio managers with additional information regarding a) the level of tail-risk contained within their portfolios b) the extent to which diversifying across asset-classes could potentially improve tail-risk and c) whether neglecting higher moments affects the interpretation of portfolio tail risk over bearish and bullish markets.

2.3. DATA AND METHODOLOGY

We obtain daily closing prices[3] quoted in US dollars for the S&P 500 Shariah Index, Dow Jones Islamic Developed Market Equity

[3] The issue of selecting an appropriate frequency for the data has been a sensitive topic in the literature. While daily-data could arguably better capture the fast-paced information transmission

Index, Dow Jones Islamic Emerging Market Equity Index, Dow Jones Sukuk Index and the Goldman Sachs Commodity Spot Indices for the Energy, Livestock, Agriculture, Industrial and Precious Metal sectors. While investing in commodity futures isn't permissible under the principles of Shariah, spot trading, of certain commodities, is deemed acceptable under several standards (Usmani 1998). All data was sourced through the Bloomberg Terminal. To perform our analysis, we generate daily returns using the conventional formula:

$$R_t = (\ln(P_t) - \ln(P_{t-1})) * 100 \quad (2.1)$$

Our dataset runs from the 8th of October 2007 to the 15th of March 2015 i.e. the beginning of the subprime financial crisis to the S&P peak in March 2015, for a total of 1919 observations per series. We split our data into two time periods to study the role of diversification over a bear market period i.e. October 2007 to March 2009 and the subsequent expansion or bull-period, albeit with periodic market corrections, running from March 2009 to March 2015. Our rationale for this is particularly to determine the effects of the most extreme market conditions in recent times i.e. the subprime financial crisis, which was the only major crisis within the range of the available data.

The substantial evidence of time-varying correlation dynamics between financial securities is especially relevant when assessing the benefits of diversification (Longin and Solnik (1995), Tse (2000) and Goetzmann et al. (2005)). This is because examining how the behaviour and degree of interdependence between securities changes during volatile periods or in response to economic shocks provides information about the extent to which

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and co-movements in financial-markets, as well as providing a richer data-set in terms of observations, daily-data can also involve greater statistical noise. In contrast, while using lower frequency data could mitigate the problems associated with excessive noise, it may result in biased estimations due to the lower number of observations available. This issue is of great relevance in the Islamic Finance sector as the poor-availability of data exacerbates the trade-off between minimising noise and the number of observations. More precisely, for our sample-interval, using weekly-data would have provided approximately 360 observations whereas monthly-data would have only provided approximately 120. For these reasons, we opted for daily-data.

their underlying risk-factors are aligned. Therefore, we employ the Dynamic Conditional Correlation (DCC) model introduced by Engle (2002). This model builds upon the framework of ARCH/GARCH-type models developed by Engle (1982) and Bollerslev (1986). Assuming that r_t denotes a vector consisting of two return series, $A(L)$ the lag polynomial and ε_t the error term vector, then the return and conditional variance can be represented as:

$$A(L)r_t = \mu + \varepsilon_t, \qquad \varepsilon_t \sim N(0, H_t) \tag{2.2}$$

And,

$$H_t = D_t R_t D_t \tag{2.3}$$

Where $D_t = diag\{\sqrt{h_{1,t}}\sqrt{h_{2,t}}\}$ is the diagonal matrix of time-varying standard deviations estimated from the univariate $GARCH$ (1,1) models and R_t is the time-varying conditional correlation matrix. That is, in the first-stage of the DCC estimation, univariate GARCH models are fit for both return series. In the second-stage, the standardized residuals from the prior stage are used to obtain the conditional correlation coefficients. The $GARCH$ (1,1) variance is represented by:

$$h_t = \omega_i + \alpha_i \varepsilon_{t-1}^2 + \beta_i h_{t-1}, \qquad \omega_i, \alpha_i, \beta_i > 0, \alpha_i + \beta_i < 1 \tag{2.4}$$

Where ω_i represents the weighted long-run variances whilst the α and β coefficients determine the short-term dynamics of the volatility series resulting from the equation.

The time-varying correlation matrix, R_t, can be decomposed into:

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \tag{2.5}$$

Where Q_t is the symmetric positive definite matrix of the conditional variances-covariances and Q_t^{*-1} is an inverted diagonal matrix consisting of the square root of the diagonal elements of Q_t i.e.

$$Q_t^{*-1} = \begin{bmatrix} \frac{1}{\sqrt{q_{11t}}} & 0 \\ 0 & \frac{1}{\sqrt{q_{11t}}} \end{bmatrix} \tag{2.6}$$

And:

$$Q_t = (1 - \theta_1 - \theta_2)\bar{Q} + \theta_1 \varepsilon_{t-1}\varepsilon'_{t-1} + \theta_2 Q_{t-1} \tag{2.7}$$

If both parameter estimates for θ_1, which measures the effect of past shocks on current conditional correlation, and θ_2, which measures the impact of past correlations, are significant, then this would indicate that the conditional correlation between the two series isn't constant.

The dynamic conditional correlation between two assets, 1 and 2, at time t is given by:

$$\rho_{12t} = \frac{q_{12t}}{\sqrt{q_{11t}q_{22t}}} \tag{2.8}$$

The coefficients in the DCC model are estimated by a two-step maximum likelihood method, where the maximum likelihood function is expressed as:

$$L = \frac{1}{2}\sum_{t=1}^{T}(2\log(2\pi) + 2\log|D_t| + \log|R_t| + \varepsilon'_t R_t^{-1}\varepsilon_t) \tag{2.9}$$

Deviations from constant correlations are not the only concern when evaluating diversification benefits. Another common issue is the potential deviation from a normal distribution. It is well known that most financial returns data aren't normally distributed but rather often display non-zero skewness and positive excess kurtosis values. Following the financial crisis, market participants and academics have begun to question the usefulness of standard deviation as a measure of risk. Many financial-agents have begun the adoption of alternative models to quantify portfolio risk, with the standard Value-at-Risk being among the most common. This approach quantifies negative tail-risk by identifying the expected potential loss with a hypothetical fall in the market by a specified number of standard deviations (Uludag and Ezzat 2016).

Coupled with the greater vulnerability of Shariah-compliant assets to extreme events for reasons mentioned earlier, this motivates the need to consider the role of higher statistical moments when determining potential diversification benefits. We

follow You and Daigler (2010) by employing the four-moment Value-at-Risk measure to incorporate skewness and excess kurtosis in measuring tail-risk. We compare this measure both across portfolios and to the more commonly adopted two-moment Value-at-Risk. This approach not only has the benefit of being able to provide insight into whether the inclusion of higher moments affects the perceived benefits of diversification but also its ease of implementation and ability to incorporate important information into a single number makes it an appealing tool for industry practitioners.

Value-at-Risk (VaR) measures combine the relevant statistical moments into one number, allowing us to compare portfolio performance across markets in terms of tail risk. Therefore, the VaR provides straightforward comparisons which is consistent with the interests of portfolio managers in evaluating the downside risks of portfolios. The two-moment VaR, which is currently the more popular measurement of downside risk, is given by:

$$VaR = -\mu_p - z\sigma_p \tag{2.10}$$

Where μ_p is the mean of the daily returns of the portfolio, σ_p is the portfolio's standard deviation and z is the negative of the number of standard deviations that specifies the probability level associated with the tail-risk. The two-moment VaR assumes an underlying normal distribution for the returns by only considering the return and standard deviation of the assets.

The four-moment Modified Value-at-Risk measure given below incorporates all four return moments, providing a method to determine the potential downside risk at a given probability level for a portfolio with a specific set of return, risk, skewness and excess kurtosis values. Favre and Galeano (2002) develop such a four-moment VaR:

$$\begin{aligned} MVaR_z = -\mu_p & \\ & -\left(z_c + \frac{1}{6}(z_c^2 - 1)S_p + \frac{1}{24}(z_c^3 - 3z_c)K_p \right. \\ & \left. -\frac{1}{36}(2z_c^3 - 5z_c)S_p^2\right)\sigma_p \end{aligned} \tag{2.11}$$

Where μ_p, σ_p, S_p and K_p are the first four moments of portfolio P, and z_c is the negative number of standard deviations that specifies the tail probability level associated with the four-moment VaR. the two-moment VaR is a special case of this four-moment VaR when the skewness and excess kurtosis are zero.

2.4. EMPIRICAL RESULTS

Table 2.1 reports the first four moments for each individual asset. With the exception of the Precious Metals sector, each asset displays a lower average return during period 1 (bear market) than in period 2 (bull market) whereas every asset displays a higher standard deviation during period 1. Most of the assets under consideration display negative skewness and positive excess kurtosis which, as evidenced by the Jarque-Bera tests reported in the final column of Table 2.1, implies that returns do not follow a normal distribution and thus motivates the need to include higher moments when assessing the potential benefits of portfolio diversification.

On average, Islamic equity markets outperform commodities and Sukuk in terms of risk-adjusted returns during the bull market. This finding is reversed during the bear market where commodities and Sukuk outperform equities. Shariah compliant equities, on average, display greater positive kurtosis than commodities while Sukuk have the largest kurtosis values. This reinforces our earlier argument regarding the relatively greater vulnerability of Islamic securities to extreme events. The thinner tails and superior performance of commodities during the bear market could make them valuable to compliant portfolio managers for purposes of risk-mitigation.

Tables 2.2 reports the two and four-moment VaRs at one, two and three standard deviations for each of the assets individually. Intuitively, a higher standard deviation implies that we are further into the left-hand tail of the distribution and thus progressively considering higher volatility or more extreme scenarios (Uludag and Ezzat 2016).

Period 2: Bull Market (March 2009-March 2015)							
	Return	Std.Dev	Skew	Kurt	Sharpe[4]	Omega[5]	Jarque-Bera
Precious Metals	4.66	19.87	-0.75	6.19	0.23	1.04	0.00
Agriculture	1.14	21.01	0.08	1.53	0.05	1.01	0.00
Industrial Metals	7.73	22.92	-0.07	1.83	0.34	1.06	0.00
Energy	4.57	26.06	-0.17	3.05	0.18	1.03	0.00
Livestock	8.22	13.05	-0.03	0.54	0.63	1.11	0.00
S&P 500 Shariah	16.88	15.98	-0.17	3.70	1.06	1.21	0.00
Dow Jones Islamic Developed	15.34	15.33	-0.26	3.42	1.00	1.20	0.00
Dow Jones Islamic Emerging	12.21	16.66	-0.15	3.02	0.73	1.14	0.00
Dow Jones Sukuk	5.40	6.91	5.87	153.47	0.78	1.41	0.00
Period 1: Bear Market (October 2007-March 2009)							
Precious Metals	13.55	30.04	0.12	1.65	0.45	1.07	0.00
Agriculture	-13.64	33.62	-0.38	0.98	-0.41	0.93	0.00
Industrial Metals	-56.92	35.74	-0.11	0.63	-1.59	0.76	0.00
Energy	-36.23	47.79	-0.16	1.09	-0.76	0.87	0.00
Livestock	-5.61	16.55	-0.23	0.46	-0.34	0.94	0.00
S&P 500 Shariah	-44.37	34.89	0.18	5.18	-1.27	0.79	0.00
Dow Jones Islamic Developed	-49.65	30.61	-0.16	4.90	-1.62	0.73	0.00
Dow Jones Islamic Emerging	-64.43	35.55	-0.24	3.88	-1.81	0.72	0.00
Dow Jones Sukuk	-9.81	7.79	-5.99	60.20	-1.26	0.44	0.00

Table 2.1. Descriptive Statistics for Individual Assets

Comparing the two and four-moment VaRs across both periods, we find that the latter is smaller than the former at a one standard deviation cut-off value. In other words, the two-moment VaR, which is based upon the assumption of a normal distribution, overestimates portfolio tail risk when one investigates a less extreme scenario and underestimates the level of risk for more extreme events. This finding is consistent with

[4] Given the prohibition of interest in Islamic finance, we calculate the Sharpe Ratio as the assets average return divided by its standard deviation. This provides us with a simple ratio to compare risk-adjusted return.

[5] In calculating the Omega Ratio, we set the threshold to zero. Hence, these figures are equivalent to the Gain-Loss Ratio introduced by Bernardo and Ledoit (2000)

that of You and Daigler (2010). The failure to take into consideration the impact of an asset's skewness and kurtosis can lead to markedly different inferences regarding portfolio risk. For instance, at three standard deviation units, the expected loss in the Sukuk portfolio under the MVaR measure is 8.52 during period 1 and 31.72 during period 2, whereas the corresponding figures are 1.28 and 1.51 according to the VaR measure.

	Bull-Market			*Bear-Market*		
	VaR 1	VaR 2	VaR 3	VaR 1	VaR 2	VaR 3
Precious Metals	1.23	2.49	3.74	1.84	3.73	5.62
Agriculture	1.32	2.64	3.97	2.17	4.29	6.41
Industrial Metals	1.41	2.86	4.30	2.48	4.73	6.98
Energy	1.62	3.27	4.91	3.15	6.16	9.18
Livestock	0.79	1.61	2.43	1.07	2.11	3.15
S&P 500 Shariah	0.94	1.95	2.95	2.37	4.57	6.77
Dow Jones Islamic Developed	0.90	1.87	2.84	2.13	4.05	5.98
Dow Jones Islamic Emerging	1.00	2.05	3.10	2.50	4.73	6.97
Dow Jones Sukuk	0.41	0.85	1.28	0.53	1.02	1.51
	Bull-Market			*Bear-Market*		
	MVaR 1	MVaR 2	MVaR 3	MVaR 1	MVaR 2	MVaR 3
Precious Metals	0.65	3.48	10.03	1.58	3.87	7.63
Agriculture	1.15	2.76	5.33	2.02	4.81	8.71
Industrial Metals	1.19	3.13	6.42	2.36	4.97	8.36
Energy	1.21	3.82	8.99	2.89	6.66	12.17
Livestock	0.75	1.66	2.80	1.03	2.26	3.77
S&P 500 Shariah	0.63	2.34	5.94	1.43	5.31	14.70
Dow Jones Islamic Developed	0.64	2.26	5.58	1.34	4.99	13.43
Dow Jones Islamic Emerging	0.74	2.39	5.67	1.78	5.70	14.06
Dow Jones Sukuk	-3.90	2.64	31.72	-0.47	2.02	8.52

Table 2.2. Two (Top-Half) and Four-Moment (Bottom-Half) VaR for Individual Assets

2.4.1. Dynamic Conditional Correlations

As mentioned earlier, focusing primarily on the unconditional static correlations between the assets that comprise a portfolio can result in suboptimal decision making regarding the allocation of wealth. The results from the dynamic conditional correlation estimations are presented in Figures 2.1-2.8. As shown, there is clear evidence of the correlations between assets fluctuating over time and consistently deviating from their unconditional averages

(dashed lines). The unconditional average correlations are, as expected, highest within the equity asset-class and followed by the industrial metal and energy sectors. This may be attributed to the fact that the industrial metal and energy sectors have a strong relationship with the real-economy, as they serve as inputs to production. Given the tight link between the Islamic finance sector and the real-economy, it is natural to expect a higher correlation among these assets.

The precious-metal and Sukuk sectors display noticeably distinct behaviour. First, neither market shows a clear secular trend in correlations, which implies that they are largely determined by their unique market factors. Although there is some movement during crisis periods, in comparison with other asset-classes these are much more transitory. As shown, both markets display negative correlations during the crisis. This could be due to a flight-to-quality phenomenon as found by Alaoui et al. (2015) where Islamic investors invest in safer sovereign-issued Sukuk. Similarly, precious-metals have traditionally been shown to be refuge instruments during periods of crisis, implying a safe-haven role, as found by Baur and Lucey (2010). However, compared to the relationship found between conventional bond and equity markets, Sukuk display extremely volatile and unstable correlations with respect to the Shariah equity index (Andersson et al. 2008). Given the growing importance of Sukuk within the Islamic finance industry, determining the risk-factors of Sukuk and the relative significance of market and institutional factors in influencing Sukuk prices could be an important avenue for future research and ultimately support practitioners in developing risk-management strategies.

A closer inspection of the diagrams clearly outlines a comparable relationship or characteristics between most pairwise correlations during periods of financial stress. After an initial drop in correlations immediately following the 2008 collapse of Lehman Brothers, which has been attributed to a temporary loosening of conditional links between price returns in the very short-run, a combination of a flight-to-quality phenomenon, herding and macroeconomic factors are likely to have subsequently caused a sharp increase in correlations and their volatilities (Creti et al. (2013), Delatte and Lopez (2013), Silvennoinen and Thorp (2013) and Nagayev et al. (2016)). These results corroborate the findings of previous studies such as Choi and Hammoudeh (2010) who show the existence of regime-induced correlation dynamics between conventional commodity and equity indices.

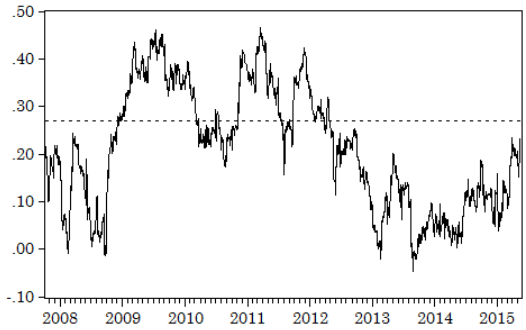


Figure 2.1 Agriculture

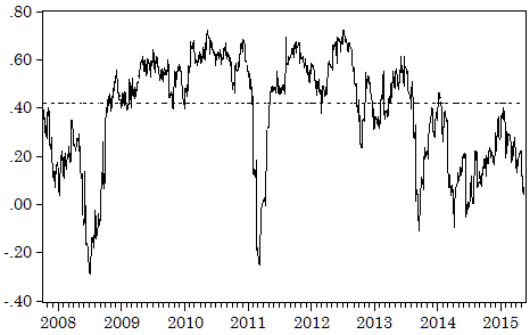


Figure 2.2 Energy

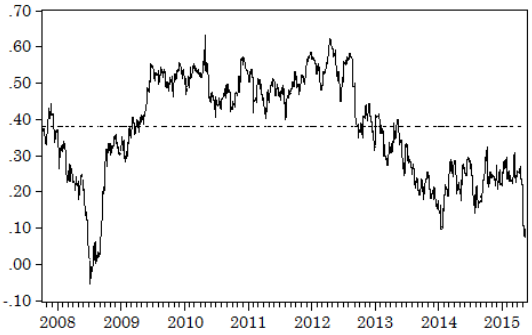


Figure 2.3. Industrial Metals

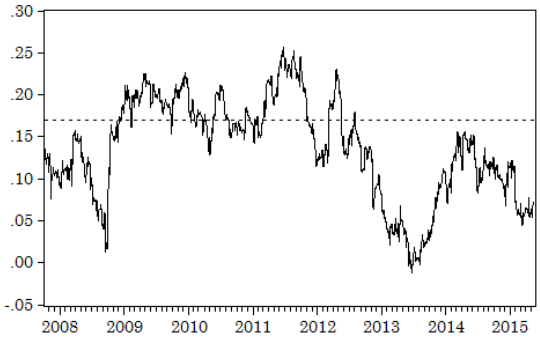


Figure 2.4. Livestock

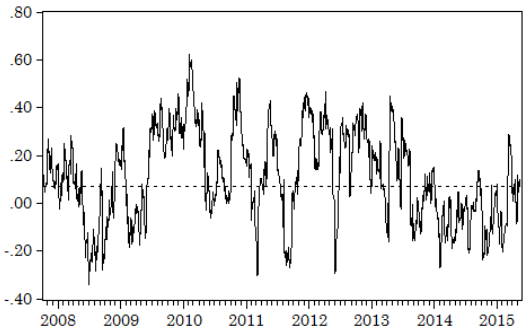


Figure 2.5. Precious Metals

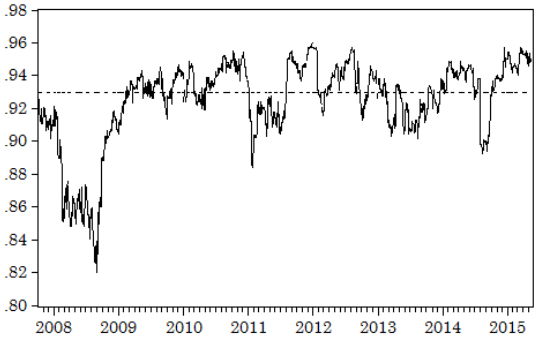


Figure 2.6. Developed Equities

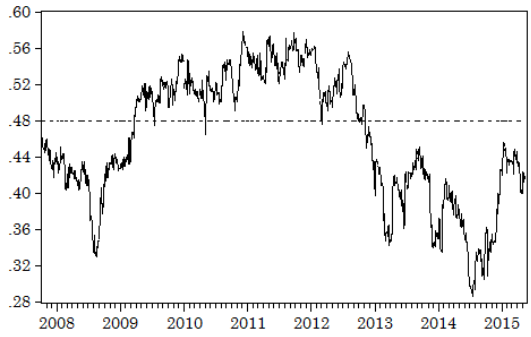


Figure 2.7. Emerging Market Equities

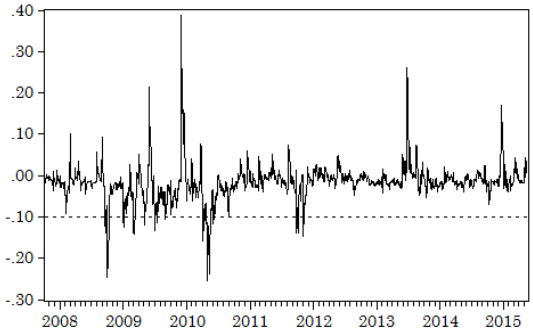


Figure 2.8. Sukuk

Figures 2.1-2.8: Dynamic Conditional Correlations between S&P 500 Shariah and Stated Assets (Dashed Line Represents Static Correlations)

Following the crisis we generally find a persistent correlation dynamic, with correlations remaining high until a dip in 2012. This has been attributed to a combination of macroeconomic, political, financial and behavioural factors over the 2008-2012 period (Nagayev et al. 2016). The systemic nature of the crisis caused widespread panic and negative market sentiment at a global scale that affected most markets in similar ways (Bain 2014). The increased dependence and spill-over between asset-markets was likely due to liquidity constraints faced by investors as sources of borrowing dried up, which forced investors to sell assets at fire-sale prices in order to restore balance-sheets (Delatte and Lopez 2013). In turn, this led to asset prices generally moving in the same direction, which again highlights

the fact that Islamic equities aren't insulated from general market conditions.

More generally, a sharp increase in the popularity of commodity investing over the past decade has triggered an unprecedented inflow of institutional funds into commodity futures markets (Basak and Pavlova 2015). This phenomenon has been referred to as the financialization of commodities. From a theoretical perspective, the fundamental valuation of an asset is determined by its expected discounted cash flows. However, since the financialization of commodities, it has been argued that factors other than the primary supply and demand of commodities, such as the speculation phenomenon often seen in energy markets, which are also susceptible to behavioural biases, now have a significant influence on commodity prices. A direct corollary of the increased financialization has been argued to be greater volatility in commodity markets and correlations between commodity and equity markets (Tang and Xiong 2012). Given the relationship between futures and spot prices, activity in the futures market has a direct feedback into spot markets (Girardi 2012). Coupled with the tight-link between the Islamic sector and the real-economy, which is affected by commodity prices, these factors imply that Islamic portfolios with commodity holdings are not insulated from activity in the conventional sector, as reflected by the fact that the correlation dynamics closely resemble those found between conventional equity and commodity markets[6]. These findings raise additional concerns regarding immunization strategies for Islamic portfolio managers as it further limits their potential to hedge and diversify risk.

However, correlations between Islamic equity and commodity returns have shown a decline since 2012. Various explanations have been put-forth regarding this apparent reversal in correlations. Terazono (2015) argues that according to the physical supply and demand view, commodity markets are now normalizing and will likely return to an era where they are more influenced by individual supply and demand fundamentals. Bain (2014) suggests that commodity valuations have been impacted by uncertainty regarding the economic growth trajectory of countries such as China. Based on the financialization view, the reduction of activity in commodity markets has led to the decrease in

[6] See, for example, Creti et al. (2013).

correlations. A combination of tighter regulation, growing capital requirements and the peaking possibility of the commodity super-cycle has led to large financial institutions lowering their exposure to commodity markets (Sheppard (2014) and Kaminska (2014)).

2.4.2. Portfolio Diversification[7]

Following You and Daigler (2010), You and Nguyen (2013) and Daigler et al. (2017), we compose the desired portfolios by adopting a straightforward risk-return framework in order to identify the Markowitz mean-variance optimal allocations.

For a portfolio P with n assets, the portfolio's return μ_p and risk σ_p^2 characteristics are calculated as:

$$\mu_P = \sum_{i=1}^{n} \mu_i x_i \tag{2.12}$$

$$\sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} \sigma_{i,j} x_i x_j \tag{2.13}$$

Subject to:

$$\sum_{i=1}^{n} x_i = 1 \tag{2.14}$$

$$x_i \geq 0, i = 1,2, \dots n \tag{2.15}$$

Where μ_i, σ_i, and x_i are the mean, standard deviation, and weight of the ith asset in the portfolio. We implement the procedure by composing portfolios that maximise the Sharpe Ratio, so as to calculate the most efficient portfolio weights. Furthermore, to remain compliant with the principles of Islamic Finance, we

impose a constraint that prohibits short-sales. The optimal portfolio weights are presented in Table 2.3[8].

Portfolio	Average	Bear	Bull
Precious Metals	38%	83%	27%
Agriculture	36%	83%	24%
Industrial Metals	26%	33%	24%
Energy	29%	65%	21%
Livestock	41%	67%	35%
Dow Jones Islamic Developed	40%	17%	46%
Dow Jones Islamic Emerging	32%	17%	36%
Dow Jones Sukuk	60%	50%	63%

Table 2.3. Portfolio Weights

Table 2.4 provides the descriptive statistics for all diversified portfolios (that have been combined with our benchmark S&P 500 Shariah Index).

With the exception of the precious metals portfolio, we find no evidence of diversification improving the risk-return profile of the standard equity-only portfolio during period 2 (bull market) but in all cases there is evidence of the diversified portfolios resulting in higher Omega ratios. In contrast, our results show that during period 1 (bear market), in all but one case, diversification improves both the risk-return profile and Omega ratio of the equity-only portfolio. On average, commodities provide the greatest diversification benefits in terms of risk-return and Omega ratios whereas intra asset-class diversification i.e. combining alternative equities, offers the least benefit. Our findings suggest that diversification may have little benefit in terms of improving an equity-only portfolios risk-return ratio during normal times. However, diversification can improve the risk-return ratio during downturns and add stability to the portfolio valuation by mitigating the probability of extreme losses during both bullish and bearish periods.

Tables 2.5 reports the two and four-moment VaRs for the diversified portfolios over both periods. According to the normally

[8] Note that all portfolios consisted of two assets. The benchmark Islamic equity index and the asset listed in Table 2.2. So, for example, the first row of the table illustrates that, on average, the portfolio with precious metals and the Islamic index was comprised of 38% precious metals and consequently 62% S&P 500 Shariah.

distributed VaR measure at three standard-deviation units, precious metals, livestock and Sukuk could lower tail-risk of an equity-only portfolio during period 2 by 8%, 19% and 41%, whereas the industrial metals and energy sectors increase risk by 6% and 13%. During period 1 (bear market), agriculture, livestock and Sukuk reduce tail-risk by 10%, 13% and 15%. In contrast, precious-metals, industrial metals and energy commodities increase tail-risk by 3%, 6% and 16%. Similar to the earlier measures of performance, we find no evidence of intra asset-class diversification i.e. alternative equity markets, providing any significant benefit in terms of lowering tail-risk.

Period 2: Bull Market (March 2009-March 2015)						
	Return	Std.Dev	Skew	Kurtosis	Sharpe	Omega
Precious Metals	17.23	14.68	-0.29	2.71	1.17	1.35
Agriculture	15.65	15.66	-0.02	1.63	1.00	1.32
Industrial Metals	13.27	16.83	-0.20	2.00	0.79	1.26
Energy	13.29	18.00	-0.47	4.69	0.74	1.24
Livestock	13.67	12.92	0.21	3.07	1.06	1.40
Developed Equity	5.68	15.57	-0.31	3.75	0.36	1.24
Emerging Equity	12.69	15.78	-0.22	4.25	0.80	1.30
Sukuk	5.51	9.27	0.29	10.13	0.59	1.46
Period 1: Bear Market (October 2007-March 2009)						
Precious Metals	9.87	37.16	0.22	3.99	0.27	1.06
Agriculture	-3.06	32.04	-0.46	1.41	-0.10	0.98
Industrial Metals	-18.89	37.40	0.12	3.67	-0.51	0.91
Energy	18.69	41.88	-0.06	2.38	0.45	1.08
Livestock	-6.60	31.06	0.33	8.60	-0.21	0.96
Developed Equity	-43.86	34.70	0.17	5.34	-1.26	0.79
Emerging Equity	-34.74	35.27	0.08	5.01	-0.99	0.83
Sukuk	-15.54	30.26	0.34	10.12	-0.51	0.88

Table 2.4. Descriptive Statistics of Optimized Portfolios

The Modified VaR, which takes into account higher statistical moments, provides different conclusions. According to the MVaR at three standard-deviation units, every commodity sector, except for energy, provides sizeable reductions in portfolio tail-risk during period 2, ranging from 17% to 33%. While Sukuk does lower tail-risk substantially at one and two standard deviation units, there is no noticeable reduction at three standard deviation units. During the bear market, all commodities except for energy lower tail-risk at three standard deviation units from between 10% to 39%. However, in contrast to the normally distributed

VaR, which suggests that Sukuk reduces tail-risk by 15% during the bear market at three standard deviation units, the inclusion of higher moments suggests an increase of 30% in downside risk under the same setting. Hence, while Sukuk may offer some benefits during less extreme periods, their distributional properties make them vulnerable to extremely large losses during downturns. Similar to our earlier findings, we find no evidence of alternative equities or energy commodities reducing tail-risk during the most extreme market conditions.

	Bull-Market			*Bear-Market*		
	VaR 1	VaR 2	VaR 3	VaR 1	VaR 2	VaR 3
Precious Metals	0.86	1.78	2.71	2.30	4.64	6.98
Agriculture	0.92	1.91	2.90	2.03	4.05	6.07
Industrial Metals	1.01	2.07	3.13	2.43	4.79	7.14
Energy	1.08	2.22	3.35	2.56	5.20	7.84
Livestock	0.76	1.57	2.39	1.98	3.94	5.90
Developed Equity	0.96	1.94	2.92	2.36	4.55	6.73
Emerging Equity	0.94	1.94	2.93	2.36	4.58	6.80
Sukuk	0.56	1.15	1.73	1.97	3.87	5.78
	Bull-Market			*Bear-Market*		
	MVaR 1	MVaR 2	MVaR 3	MVaR 1	MVaR 2	MVaR 3
Precious Metals	0.65	2.11	4.86	1.53	5.14	13.18
Agriculture	0.79	2.05	4.13	1.83	4.68	8.98
Industrial Metals	0.83	2.34	4.96	1.71	5.36	13.21
Energy	0.66	2.88	7.78	2.04	5.81	17.43
Livestock	0.55	1.69	3.99	0.60	4.98	12.77
Developed Equity	0.66	2.38	5.98	1.39	5.33	14.93
Emerging Equity	0.60	2.39	6.33	1.43	5.41	14.89
Sukuk	0.07	1.55	5.89	0.38	5.11	19.12

Table 2.5. Two and Four-Moment VaRs for Optimized Portfolios

2.5. SUMMARY AND CONCLUSION

The Islamic finance sector has attracted considerable attention recently due to its impressive performance since the turn of the millennium. Despite the substantial growth and expansion of the sector, Islamic portfolio managers face several constraints which limit their ability to diversify and hedge against risk. These include the prohibition of investing in derivative contracts,

engaging in short-selling, investing in markets considered illegitimate by the Shariah and the insufficient liquidity and lack of standardization in Islamic bond markets. This is further exacerbated by the more general finding that the process of financial globalisation has resulted in increasing integration, interdependence and contagion between international equity markets.

In light of these issues, in this chapter we studied a) whether diversifying across asset-classes by including particular compliant commodities and Sukuk could improve the performance of equity-only Islamic portfolios b) the benefits of diversification over historically significant bull and bear markets to test the relevance of diversification during volatile and trending markets c) the dynamic nature of correlations between the aforementioned asset-classes and d) given that Islamic portfolios are more vulnerable to extreme events, we employed a convenient tail-risk measure of performance which includes the importance of an assets skewness and kurtosis to study whether taking into account the shape of the returns distribution provides further insight into the potential benefits of diversification.

Our findings show that the benefit of diversifying beyond an equity-only portfolio is minimal during normal times in terms of improvement in risk-return profiles but there is some evidence that diversification can lower the chances of extreme losses during such periods. In contrast, we find that the benefits of diversification are much greater during crisis periods, with improvement in both risk return profiles and Omega ratios. However, our most important finding relates to the estimation of portfolio tail-risk. In particular, we find that using a standard two-moment Value-at-Risk measure, which assumes normally distributed returns, rather than a four-moment Value-at-Risk, which incorporates an assets skewness and kurtosis, can lead to a substantial underestimation of portfolio risk during the most extreme market conditions. This result is especially important for Islamic portfolio managers as Islamic securities are more likely to deviate from a normal distribution for reasons such as market thinness, market illiquidity, the lack of product standardization and the inability to diversify across a broader range of markets.

While these findings could motivate several strands of future research, such as extending our analysis to cover additional

markets and securities as well as studying the risk-factors of Islamic securities, the challenges facing the Islamic finance industry, such as the lack of market liquidity, insufficient hedging instruments, inadequate secondary markets and the lack of product standardization perhaps require the greatest attention.

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CHAPTER THREE

3. Does Religious Priming and Decision-Task Framing Influence Individual Risk-Preferences?

ABSTRACT

We report the results of two experiments in which we explore the extent to which elicited risk attitudes are influenced by framing and religious priming. We find that risk-taking is significantly higher when an identical task is framed in terms of investment rather than gambling. We also find that a religious prime or setting (a Mosque) significantly lowers risk-taking in the gambling frame. One implication of our results is that risk elicitation methods should avoid a gambling frame. In the gambling frame we find that elicited risk-aversion is influenced by a range of factors, including gender, ethical standards and the setting, while in the investment frame we observe no such effects.

3.1. INTRODUCTION

Risk-aversion constitutes one of the most fundamental properties of human behaviour. The seminal and pioneering work of Bernoulli[9] on gambling and the St. Petersburg Paradox in the 17th century instigated substantial academic discourse and research devoted towards developing a greater understanding of the human decision-making process in situations involving risk. A significant focus of this research has been on measuring risk-aversion at the individual level and exploring factors, such as gender, that may influence the extent of risk-aversion (Weber et al. 2002).

Estimates and measures of risk-aversion have been studied and developed in various settings (see Harrison and Röstrom (2008) and Holt and Laury (2014) for a review). These include lab experiments and surveys (Gneezy and Potters (1997), Eckel and Grossman (2002), Lejuez et al. (2002), Holt and Laury (2002), Weber, Blais and Betz (2002), Charness and Gneezy (2010) and Dohmen et al. (2011)), labor-supply behaviour (Chetty 2006), portfolio choices among financial investors (Mehra and Prescott (1985) and Guiso and Paiella (2008)), option prices (Ait-Sahalia and Lo 2000), deductive choices in insurance contracts (Szpiro (1986) and Cohen and Einav (2007)), auction behaviour (Lu and Perrigne 2008) and even contestant behaviour on game shows (Post, Van Den Assem, Baltussen and Thaler (2008) and Andersen, Harrison, Lau and Rustrom (2008)).

While the catalogue of studies providing methods of estimating risk-preferences is clearly voluminous, considerable research has documented evidence that measured risk-attitudes often vary within individuals across elicitation techniques (See Johnson and Rojas 2007). Importantly, it is not the case of there being a scaling effect in that a particular method simply makes everyone seem more or less risk-averse by a given proportion. Rather, there seems to be a significant reordering of individuals in terms of the ranking of their implied risk-parameters (Isaac and James 2000). These results are consistent with the findings from a vast literature within psychology showing that risk-preferences are domain-specific (MacCrimmon and Wehrung (1986) and Weber et

[9] See Bernoulli (1954)

al. (2002)). More precisely, individual risk-preferences do not display cross-situational stability, which implies that even if the objective numerical risk-return profiles are identical across two domains, individuals may actually prefer or be less-willing to take risks in one of those domains.

A leading explanation for why we may observe differences in risk-taking across domains has been the individual's perception and trade-off between an activity's benefits and risk. That is, analogous to risk-return models in finance, such as the Capital Asset Pricing Model, researchers have argued that risk-attitude may be more usefully conceptualized in a psychological risk-return framework. Psychological risk-return models treat perceived riskiness as a variable that can differ between individuals and as a function of content and context (Deck et al. 2010). This provides for multiple ways in which characteristics of the decision maker and/or situation can affect choices under risk. Apparent risk-taking by the same decision-maker may differ if they perceive the risks and benefits to differ in magnitude across the two domains e.g. in a recreational versus a financial decision, while their attitude towards perceived risk essentially remains identical across both domains.

Therefore, if an individual is faced with two opportunities that offer identical objective risk-return profiles but they consider one activity as either being less beneficial or riskier to engage in, perhaps for some wider subjective reasons, then we may observe differences in behaviour across those two domains. In other words, it is conceivable that there exist deeper considerations, such as the content-specificity of the action, which individuals take into account during their decision-making process, rather than purely basing their actions on quoted monetary values.

The existing evidence relating to the significance of the content and domain specificity of risk-preferences could have important ramifications for research eliciting measures of risk aversion. This is because much of the experimental research eliciting risk-preferences has the decision-task framed or presented in terms of lotteries and gambling. For example, in the well-known Gneezy and Potters (1997) experiment, participants are asked to decide the portion of their endowment they "wish to bet in the following lottery", Eckel and Grossman (2002) measure risk attitudes by presenting participants with six possible "gambles" and asking

them to choose the one they would most prefer to play. Similarly, Benjamin et al. (2010) study how social identity affects risk-preferences by presenting participants with 18 binary choices between a safe option and a gamble, with their instructions stating that "gambles would be resolved by drawing from a bag of red and blue marbles."

Frames like the three examples above suggest a *gambling* connotation which could be influencing results. Intuition behind this claim stems from the observation that gambling ostensibly seems to be stigmatized across multiple cultures. While there have been various explanations for why this may be, one possible explanation is that the world's major religions don't look upon gambling favourably (Binde 2007). Although there are varying degrees of ambiguity in the condemnation of gambling across religions[10], the consensus among most sects across religious ideologies considers gambling as being morally objectionable[11]. Therefore, this argument postulates that due to the historically influential role religion has had on the human race, the aversion towards gambling may possibly have been ingrained into us over the centuries.

If there is indeed a negative aura surrounding gambling, then using lottery-type tasks to elicit risk-preferences could be inadvertently priming subjects in a way that leads to an underestimation of overall risk-preferences, with this effect being more pronounced for particular demographics, such as the religious. Moreover, using results from abstract gambling tasks as proxies for risk attitudes to be applied in any context may lead to misleading inferences. In other words, previous studies that have been based on gambling frames have used their results to argue that religious agents display higher levels of risk-aversion than the irreligious. In this chapter, we argue that the religious may *appear* more risk-averse in these studies since the task is framed as a gamble (religious subjects are more likely to dislike

[10] For instance, in Hinduism, Karma plays a central role and so the precise motives behind why exactly it is that someone is gambling will often have to be taken into consideration before determining whether or not such actions are deemed acceptable.
[11] Christianity: Exodus 20:17, Timothy 6:10. Luke 12:15, Matthew 6:24 and Hebrews 13:15, Judaism: Talmud (Sanhedrin: 24), Islam: Quran (5:90), Hinduism: Rigveda Mandala 10, Sukta 34, Buddhism: Sigalovada Sutta.

gambling). Hence, if one interprets the results from such studies as religious people displaying greater levels of risk-aversion in general, then this wouldn't be correct as gambling frames may be biasing the results.

In this study, we contribute towards the literature in three ways. First, we test the proposition that the way in which the decision-task is framed can influence risk-taking behaviour. We do this by maintaining an identical numerical problem and manipulating the framing of the decision-task to see whether this influences the risk-appetite of participants in an incentivised lab experiment. The two frames we use are an investment frame and a gambling frame. Across two experiments, we observe significantly less risky behaviour in gambling than in investing. This is consistent with the notion that a gambling frame overestimates risk aversion.

Second, alongside employing a framing manipulation, we also test whether priming subjects to make religion, or perhaps more accurately some broader notion of ethics and morality, salient influences behaviour. The purpose of priming one's religious identity is that it can temporarily increase the strength of one's affiliation with that identity category, causing their behaviour to shift towards the category's norms (Benjamin et al. 2016). Our motivation in using the priming task was to see if the investment versus gambling framing effect is more pronounced when subjects are given a religious prime. This would be evidence that ethics and morality are factors behind an aversion to gambling. Our results point to an interesting dynamic effect in which those given the religious prime react differently to a loss. This ultimately means that those given a religious prime gamble less.

Finally, in a novel setup, we conduct a framing experiment within a religious setting. More precisely, we ran an experiment with Muslim participants, within the Mosque, immediately following a religious service. The purpose of doing so was to test whether greater religious intensity leads to a more pronounced difference in risk-taking across the gambling and investment frames. The framing effect we observed was extreme with hardly any risk taking in the gambling frame. This finding reinforces results from across our experimental studies that the framing effect varies predictably with situation and individual characteristics.

Across our two experimental studies risk taking in the investment frame was remarkably constant. We did not observe any difference because of prime (religious or neutral) or setting (Mosque, computer lab or classroom). Moreover, there was no gender difference. By contrast, in the gambling frame we observe big variations across prime, setting and gender. We would suggest, therefore, that studies looking to elicit an individual's general attitude to risk should not use a frame that alludes to gambling. Instead more neutral frames should be employed.

Whilst evidence of a significant framing effect has clear implications in terms of experimental research on risk-preferences, such religious or ethical framing may also have real-world applications. In general, the relevance of framing can be deduced by how ubiquitous the emphasis and advertisement of the ethical and moral aspects of businesses has become. For instance, firms commonly utilise marketing campaigns to promote and differentiate themselves from competitors through emphasising fair-trade policies, ethically-raised and free-from produce, employee pay and working conditions, environmental sustainability, charitable activities, gender equality and various other ethical or moral features of their business. The importance of framing or promoting such aspects of a business is clearly importance since a recent report found that 92% of millennials are more likely to purchase from what they consider an ethical company and 66% are likely to invest in a company well-known for its corporate social responsibility program (Aflac 2015).

In addition, to provide an example that perhaps more directly relates to our research, consider a simple loan contract. Lenders provide borrowers with funding in exchange for an overall repayment that exceeds the amount initially lent. This excess demanded over the original amount borrowed typically contains compensation for the level of risk assumed by the lender and is commonly referred to as an interest rate. However, under Islamic law, interest is strictly prohibited. Modern Islamic banking circumvents this issue by essentially rephrasing or repackaging such compensation as a "profit-rate". In other words, assuming two identical loan contracts, simply manipulating or reframing the compensation for risk as profit rather than interest can alter whether certain agents consider the contract permissible or not. Although there is little research in this area, evidence of a

significant framing effect in our experiment suggests that it may be of interest to test how altering the framing of interest rates for mortgage contracts or student-loans influences participation and enrolment by Islamic agents in such productive investments.

3.2. PRIOR LITERATURE

There are two strands of literature related to our study. The first strand compares risk-preferences between different faith-groups and between religious and non-religious. The second looks at framing effects on risky behaviour.

A general finding from studies comparing risk-preferences across faith groups is that the religious appear (weakly) more risk-averse than the irreligious (e.g. Bartke and Schwarz 2008, Hilary and Hui 2009, Noussair et al. 2012). This result has sometimes been explained through the fact that irreligious individuals essentially take the riskier option in Pascal's wager[12] and are thus in general more likely to display a greater appetite for risk than religious individuals. The basic theme of our study, however, is that *measurement* of risk aversion may interact with religiosity. It is important, therefore, to consider how risk aversion is measured and whether this may bias results.

An interesting comparison is that between Barsky et al. (1997) and Halek and Eisenhaur (2001). Measuring risk aversion using hypothetical questions about whether the person would take a job that could improve or worsen family income, Barsky et al. (1997) find evidence that Protestants are more risk averse than Catholics who are more risk averse than Jewish.[13] By contrast, Halek and Eisenhaur (2001) using life-insurance data, find that

[12] See Miller and Hoffman (1995)

[13] It's interesting to note that the sample used by Barsky et al. (1997) was restricted to adults aged between 51 and 61. Some authors have argued that religion becomes more salient during older ages as individuals approach the later stages of their lifecycle and could thus be more inclined to play the safer option in Pascal's wager. In this case using lottery-based tasks seems undesirable since the conflict between gambling and religion could be influencing the behaviour of participants and thus not providing a true reflection of risk-aversion in other domains.

Catholics are marginally more risk averse than Protestants.[14] They also, though, are able to measure risk aversion using the same hypothetical questions as Barsky et al. (1997). Here they find, consistent with Barsky et al. (1997) that Protestants are more risk averse than Catholics.

Halek and Eisenhaur (2001) put this 'flipping' of risk attitudes down to different preferences for speculative risk. For instance, they point out that Protestants are more likely to view gambling as sinful (see also Kumar et al. (2011) and Benjamin et al. (2016)). If so, this would illustrate that attitudes to risk are sensitive to context. There is the additional concern that choices made in hypothetical situations may not reflect actual behaviours when real money is at stake. Furthermore, evidence from experimental economics suggests that respondent's reports of their own attitudes don't always reflect their actual behaviours (e.g. Glaesers et al. 2000). In emotive contexts such as religion, questionnaire responses may be particularly subject to conformity, self-image or desirability biases.

A further illustration of the way risk preferences can be influenced by the interaction between religion and context is provided by Leon and Pfeifer (2013). They use a German survey data to investigate whether religiosity explains a household's willingness to take financial risks. Compared to the irreligious, Christians were more willing to take financial risks through holding larger positions in equities whereas Muslims were less risk-taking with relatively larger investments in real-estate compared to equities. However, Leon and Pfeifer (2013) also find that Muslims are less likely to invest in life insurance compared to the irreligious whereas Christians were more likely to do so. Given that these results seem contradictory, as we would expect risk-averse individuals to be more likely to purchase life-insurance, one potential explanation of these findings could be that the Islamic faiths prohibition on certain types of investment are driving the decisions to abstain from equity and insurance market investments.

Another study related to our work is that of Benjamin et al. (2016). In their study, an unscrambling exercise was used to make

[14] The sample size for Jewish is small but in terms of the raw coefficient they display more risk aversion than Catholics.

religion salient for some participants. The sentences varied depending on whether the subject was part of the religion-salient condition or the control group.[15] Benjamin et al. (2016) then use a multiple price type lottery experiment to elicit risk attitudes. The authors find that religious identity salience causes both Catholics and the irreligious to become *less* risk-averse, but has no significant effect for Protestants and Jews. The authors argue that the strength of the identity salience manipulation could vary by religious group, making them more likely to find null effects in some groups than in others. Even so, it is a surprise to see less risk-aversion with the religious prime. We obtain different results as we shall discuss more below.

We will highlight one further study on risk aversion and religion as it is one of the studies that has data on Muslims. Bartke and Schwarz (2008) use self-reported survey data to examine the relationship between religion and risk-aversion among German immigrants. Muslim migrants were found to be more risk-averse than their Christian counterparts, which was attributed to the degree of strictness or comprehensiveness of the behavioural rules embedded within a particular religion.

The preceding discussion has highlighted how risk preferences may depend on an interaction between religion and context or framing. The more general notion that elicited risk preferences depend on context and framing of choice is well known. Indeed, research has shown that there is little situational stability in preferences (Deck et al. 2010). That is, there is little consistency in people's risk-taking attitudes across decision domains, including gains versus losses (Weber and Hsee 1999), money versus time domains (Weber and Milliman 1997), and gambling, financial investing, business decisions and personal decisions (MacCrimmon and Wehrung 1986, 1990).

Schubert et al. (1999) provide a particularly interesting example of how the context and framing of a question can influence

[15] Five of the ten sentences unscrambled by religion-salient subjects contained religious content. The possible unscrambled sentences for this group were as follows 1) she felt the spirit 2) the desert was divine 3) her presence was appreciated 4) do it once more 5) I mailed it over 6) give thanks to God 7) he finished it yesterday 8) the book was sacred 9) prophets reveal the future and 10) I was somewhat prepared.

findings and the subsequent policy prescriptions derived from them. Several studies have found evidence of strong gender-effects whereby women display significantly greater levels of risk-aversion than their male counterparts (e.g. Croson and Gneezy (2009) and Booth and Nolen (2012)). However, Schubert et al. (1999) argue that such studies are strongly dependent on the framing of the decision task. That is, while gender specific risk propensities do arise in abstract gambling tasks, with males showing a greater appetite for risky behaviour, the authors argue that such differences in risk-attitudes are eliminated when the decision task is reframed as an investment decision. Hence, they suggest that abstract gambling experiments may be inadequate for the analysis of gender-specific risk attitudes towards financial decisions as in practice risky financial decisions are inherently contextual (Schubert et al. 1999). Our results will reinforce this conclusion.

In an influential paper, Weber et al. (2002) introduce the so-called Domain Specific Risk Taking (DOSPERT) Scale. This simple psychometric scale assesses individual risk-attitudes by asking respondents to rate the likelihood that they would engage in domain-specific risky activities, as well as their perceptions of the magnitude of the risks and expected benefits of engaging in each domain. This data is then used to generate domain-specific risk-taking propensities that are then used as a predictor of risk-taking behaviour. Covering five content domains i.e. ethical, financial, health, social and recreational in their original study, Weber et al. (2002) find that risk-taking varied across domains. However, perceived, rather than apparent, risk and benefits jointly explained a significant proportion of the variability in risk-taking across domains.[16]

In a more recent paper, Dohmen et al. (2011) find that a general survey-based question on risk-propensity, where participants are asked to rank how risk-taking they consider themselves in

[16] Several studies have both adapted and tested the construct validity of the original DOSPERT scale. For instance, Zuniga and Bouzas (2006) found that scores on both the recreational and health and safety risk-taking subscales significantly predicted estimated blood alcohol concentrations in Mexican high-school students. Similarly, Hanoch et al. (2006) find that smokers were significantly more likely to have a higher risk-taking propensity score in the health and safety subscale.

general on a scale from 1-10, provides a good all-round explanatory variable for risk-taking across many domains. However, although less successful across particular domains, they find that the single best risk measure in any given context is the measure incorporating the corresponding specific context, which is akin to the DOSPERT Scale developed by Weber et al. (2002). For instance, the best predictor of smoking is the question about willingness to take risks in health matters, rather than the general risk question. This again, reinforces the need for measurement of risk preferences to be specific to the context. On the flip side, it suggests we should avoid contexts that are unlikely to be representative of general risk preferences. We argue that a gambling frame is such a context.

3.3. EXPERIMENT 1

3.3.1. Methods

Our first experimental study employs a 2x2 design, crossing prime – religious or neutral – with frame – gamble or investment – to give us four treatments, as outlined in Table 3.1. The experiment consists of three stages.

First, participants are asked to answer five questions, at their own speed. These questions, listed in Table 3.2, were used to prime subjects and therefore differed in content depending on whether the participant was part of the primed or control group. As can be seen, the religious prime questions are intended to capture a broad notion of ethics and morality. This has the benefit of adding subtlety in the sense that we were not obviously targeting religion.[17] We also anticipated that our sample may not contain too many fervently religious participants.

In the first three questions subjects were asked to provide short written answers. This was intentional as research in cognitive neuroscience suggests that recognition type questions i.e. multiple choice or matching, such as that used by Benjamin et al. (2016), stimulate less activity in the brain than recall questions i.e. essay

[17] Wheeler and Petty (2001) argue that subtle primes more reliably cause behaviour to conform to norms.

or short-written answer questions (Cabeza et al. 1997). Therefore, we hoped this would create a stronger prime. For the final two questions, participants were asked to choose their answers from a five-point Likert scale i.e. strongly agree, agree, neither agree nor disagree, disagree or strongly disagree. The neutral prime was designed to replicate the religious prime as closely as possible while focussing on neutral topics.

	Frame	
Prime	Investment	Gambling
Religious	Religious Investment (RI)	Religious Gambling (RG)
Neutral	Neutral Investment (NI)	Neutral Gambling (NG)

Table 3.1. Treatments

Once participants completed the first stage of the experiment, they moved onto the second stage, which was the main decision-task. The decision-task we use was based on the seminal work of Gneezy and Potters (1997). We use the Gneezy and Potters (1997) framework not only due to its simplicity, which makes it more readily understood by subjects, but also the ease with which the framing could be changed. The decision-task consisted of eight identical rounds. In each round, participants are given an endowment of 100 tokens and are asked to decide, depending on the framing, how many tokens, with a minimum of 0 and a maximum of 100, they would like to *bet* or *invest*. We shall refer to the choice as the amount *allocated* to the risky option. The probability of winning in any round was 33% and the probability of losing was 67%. If participants won a particular round, they would earn a 250% return on the amount allocated. In the case of a loss, participants simply lost the number of tokens allocated. Whatever sum wasn't allocated was kept by the participants. Subjects received feedback on whether they had won at the end of each round.

As alluded to earlier, the decision problem remains identical across frames. The only difference between the investment and gambling frame, as shown in Figures 3.1A and 3.1B, is the graphic participants see as well as a slight manipulation of wording. In the investment frame participants were told 'For instance, you might imagine that you can make a business investment into the Research and Development programme of one

of the fastest tech start-ups specialising in Artificial Intelligence (AI).' The instructions then talk of investment throughout. By contrast, in the gambling frame participants were asked how many tokens they would like to bet. The instructions to both frames are available in the appendix.

	Prime	
	Religious	Neutral
1)	Do humans serve a greater purpose beyond the pleasures or satisfaction derived from engaging in our daily activities?	What features of social media sites, such as Facebook, do you believe have caused them to resonate with so many people?
2)	Are humans born with morality embedded within them or is it socially constructed? In other words, is morality intrinsic i.e. present within us from birth, or learned from our environment?	Is there a difference between the sport you enjoy playing most and that which you enjoy watching most?
3)	Would the promise of eternal immortality cause you to alter your day-to-day behaviour?	What aspect(s) of travelling do you find most enjoyable?
4)	Whether a lie is judged to be moral or immoral depends upon the circumstances surrounding the action.	I rely on some form of caffeine in the morning.
5)	One shouldn't perform an action that could harm or threaten the welfare of an innocent other.	I think it is better to watch than to participate in sport.

Table 3.2. Priming Questions

Payoffs were calculated as the cumulative earnings over each of the eight rounds, plus a £2 participation fee. As the number of tokens allocated was bounded by 0-100 in any single round, and they simply lost the amount allocated if the round was lost, there was no situation in which subjects could have negative earnings.

Participants received feedback on the outcome of a round before going to the next round. Following the completion of the second stage of the experiment i.e. the decision-task, subjects then moved onto the final stage which involved answering a questionnaire that was intended to gather information on demographic and other control variables. The experiment was programmed and run using Z-Tree (Fischbacher 2007). Our sample consisted of 85 undergraduate and postgraduate students studying at the Canterbury campus of the University of Kent.



Figure 3.1A. Graphic Shown in Investment Frame



Figure 3.1B. Graphic Shown in Gambling Frame

3.3.2. Hypotheses

In the Gneezy and Potters (1997) task there is a positive return from allocating tokens to the risky option and so a risk neutral

individual should allocate all 100 tokens in each round. Specifically, if an individual allocates 100 tokens then his expected payoff is a third of 350, or 115 tokens, which is more than a sure 100 tokens. In reality, few individuals invest 100 tokens. The average number of tokens a participant allocates can, therefore, be used as a measure of risk-taking. This is the main outcome measure we shall focus on.

Our main hypothesis concerns the comparison between the investment and gambling frame.

Hypothesis One: Allocations to the risky option will be higher in the investment frame than in the gambling frame.

There are least two plausible mechanisms that motivate this hypothesis. First, gambling is stigmatized across multiple cultures and religious faiths as morally objectionable. Investment, or having an entrepreneurial spirit, by contrast, is typically looked upon favourably. This, of itself, would lead to less risk-taking in the gambling frame and is the main effect we are interested in studying. Second, loss-aversion is known to be domain specific (Li et al. 2012) and a gambling frame may make someone focus more on losses. In essence it may feel worse to lose in a gambling frame than investment frame. Hence, an individual may be more reluctant to gamble than invest. Note that, if true, this bias is likely a consequence of the different cultural norms around gambling. Hence we obtain a direct moral effect from a gambling frame and an indirect loss aversion effect.

Recall that our work is motivated by the idea that a gambling-investment framing effect may bias measures of risk aversion. This is a particular concern if the effect systematically differs depending on personal characteristics. Prior work suggests the framing effects are partly mediated by gender. We would expect the gambling-investment framing effect would also be mediated by the level of religiosity.

Hypothesis Two: The gambling-investment framing effect will be more pronounced in females than males and the religious than irreligious.

If the stigmatization of gambling is due to issues of religion and morality then priming participants to think about morality should lower allocations in the gambling frame. So, risk taking should be

lowest among participants who were both religiously primed and faced a gambling task. Whilst there is evidence to suggest that religion and gambling are potentially in conflict, there is no indication of any mainstream religion discouraging investment. So, we expect the religious prime to have less effect in the investment frame.

Hypothesis Three: The gambling-investment framing effect will be larger with the religious prime.

Hypotheses 1 to 3 focus on the overall amount allocated to the risky option. A further consideration is that the frame or prime could have a dynamic effect. Specifically, primed participants in the gambling frame may react differently to losses from previous rounds than those that face a neutral prime. This is because making religion salient could intensify the regret or guilt participants feel when engaging in and subsequently losing a gamble.

Hypothesis Four: Allocations to the risky option are more sensitive to loss in the gambling frame than investment frame and religious prime than neutral prime.

3.3.3. Results

Following Gneezy and Potters (1997), we use the non-parametric Mann-Whitney test to analyse treatment effects[18]. Furthermore, as some authors have argued that non-parametric tests may have relatively low power, we additionally report results from the

[18] While the Gneezy and Potters (1997) task offers a clean method of studying framing effects in terms of statistically testing for differences in the levels of investment across treatments, a disadvantage of this method is that it cannot distinguish between risk-seeking and risk-neutral preferences (Charness et al. 2013). That is, data from the Gneezy and Potters (1997) experiment cannot be readily used to calculate the range of the parameter of risk-aversion. Recent studies such as Kortajarene et al. (2015) use more elaborate methodologies such as finite mixture models to extract measures of risk-aversion from the Gneezy and Potters (1997) data based on a CRRA specification, which has, however, been argued to be inadequate at explaining the behaviour observed in the Gneezy and Potters (1997) study (Harrison and Rustrom 2008). We leave further exploration of this point for future work.

bootstrapped t-test to provide greater robustness to our findings (see Moffatt 2015). The null-hypothesis across all tests is that the number of tokens allocated to the risky option is equal across groups. We summarize our findings in six key results.

Result 1: Allocations to the risky option are significantly higher in the investment frame than in the gambling frame.

To ease comparison, we take the average percentage of endowment allocated to the risky option in blocks of two rounds. These averages and the corresponding standard deviations are presented in Table 3.3. The final column of Table 3.3 gives the average percentage of endowment allocated over all rounds. We find that the average allocation is significantly higher in the investment than gambling frame. Indeed, the average allocation is between 37% and 49% higher in the investment frame. Therefore, we find strong evidence in favour of our first hypothesis.

	Rounds 1-2	Rounds 3-4	Rounds 5-6	Rounds 7-8	Rounds 1-8
Avg. Gamble (n = 38)	15.34	17.18	19.61	22.00	18.53
Avg. Investment (n = 47)	21.46	25.50	29.13	30.05	26.53
Std.Dev (Gamble)	16.76	16.92	23.55	24.94	18.08
Std.Dev (Investment)	14.16	22.60	24.41	26.73	18.15
Mann-Whitney	0.00	0.05	0.02	0.10	0.01
Bootstrapped T-Test	0.07	0.06	0.08	0.15	0.04

Table 3.3. Average Allocation to the Risky Option across Frames

Result 2: Investment is lowest in the treatment with a religious prime and gambling frame.

Table 3.4 reports the average allocation to the risky option by treatment. Overall (Rounds 1-8), allocations are lowest in the RG treatment. Consistent with Hypothesis 3 we find that the framing effect is more pronounced with a religious prime (statistically significant increase in amount invested of 49% compared to statistically insignificant increase of 37%). Even so, over rounds 1-4, risk-taking is higher in the RG treatment than for the NG treatment. It is in Rounds 5 to 8 that the RG treatment really

stands out as having lower investment. This points towards a dynamic effect of the prime.

	Rounds 1-2	Rounds 3-4	Rounds 5-6	Rounds 7-8	Rounds 1-8
			Avg. Tokens Invested		
RI (n = 22)	21.48	21.16	28.75	32.91	26.07
RG (n = 20)	16.48	18.45	16.93	18.23	17.52
NI (n = 25)	21.44	29.32	29.46	27.54	26.94
NG (n = 18)	14.08	15.78	22.58	26.19	19.66
			Mann-Whitney P-Values		
RI = RG	0.02	0.08	0.01	0.10	0.01
NI = NG	0.05	0.19	0.35	0.48	0.24
			Bootstrapped T-Test P-Values		
RI = RG	0.28	0.64	0.07	0.04	0.09
NI = NG	0.12	0.03	0.38	0.88	0.21

Table 3.4. Evidence for Result 2 and Hypothesis 3

Result 3: The change in allocation following a loss is negative in the treatment with a religious prime and gambling frame while positive in all other treatments.

Figure 3.2 displays the average percentage change in allocation to the risky option in round t following a loss in round $t-1$. As illustrated, while those who faced a religious prime seemed to be more cautious following a loss than those with a neutral prime, we find a substantially greater contraction for those in the religious gambling treatment. The reaction to a loss is significantly different between the RG and NG treatments (p = 0.03 Mann Whitney, 0.01 T-test). This is consistent with Hypothesis 4. This effect is even more pronounced by the fact that in three treatments we observe an increase in allocation following a loss, possibly in an attempt to recover losses, while in the RG treatment we observe a decrease. As hypothesized this suggests the prime has an effect on how losses are interpreted.

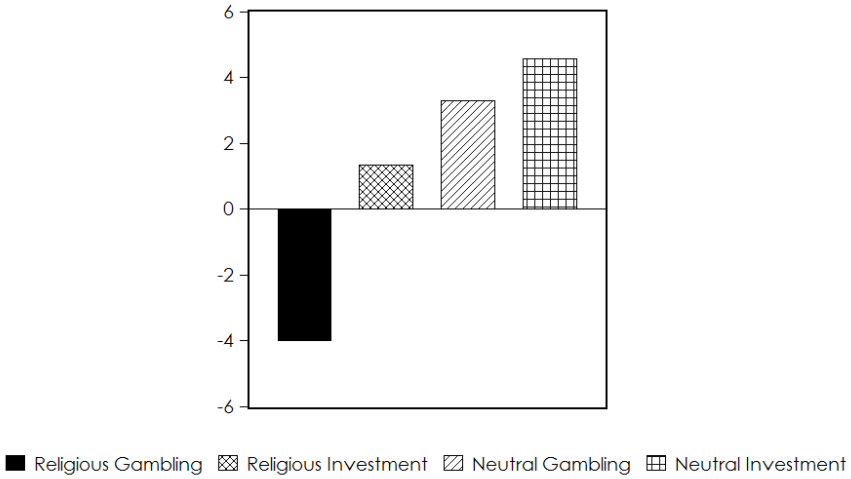


Figure 3. 1. Average Percentage Change in Allocation to the Risky Option Following Loss in Previous Round

Result 4: The gambling-investment framing effect is stronger in females than males.

	Rounds 1-2	Rounds 3-4	Rounds 5-6	Rounds 7-8	Rounds 1-8
			Female		
Avg. Gamble (n = 23)	15.93	13.33	15.09	17.37	15.43
Avg. Investment (n = 29)	24.26	24.90	27.59	29.84	26.65
Std.Dev (Gamble)	19.72	14.61	20.84	18.38	17.56
Std.Dev (Investment)	14.11	23.49	19.37	27.74	18.17
Mann-Whitney	0.00	0.01	0.00	0.07	0.00
Bootstrapped T-Test	0.09	0.03	0.03	0.05	0.02
			Male		
Avg. Gamble (n = 15)	14.43	23.10	26.53	29.10	23.29
Avg. Investment (n = 18)	16.94	26.47	31.61	30.39	26.35
Std.Dev (Gamble)	11.38	18.95	26.43	31.99	18.42
Std.Dev (Investment)	13.39	21.72	31.37	25.81	18.65
Mann-Whitney	0.73	0.80	0.66	0.56	0.72
Bootstrapped T-Test	0.55	0.63	0.61	0.90	0.62

Table 3.5. Average Allocation to the Risky Option by Gender

Table 3.5 reports the average allocation to the risky option across frames by females and males. For female participants we observe a strong gambling-investment framing effect with allocations significantly higher in the investment frame. For males we observe a much smaller and statistically insignificant effect. This

is consistent with Hypothesis 2 and corroborates the findings of Schubert et al. (1999) regarding the content-specificity of the decision-task and the apparent aversion towards gambling among female participants.

Result 5: The gambling-investment framing effect is stronger in subjects who are religious and ethical.

We classify a religious participant as someone who identifies as being part of a particular religious faith-group whilst on average not attending any church service(s) in any given month. An actively religious participant not only identifies as being part of a particular religious faith-group but also attends at-least one church service a month, on average. While the economic effect is somewhat larger for the actively religious, we find that both groups are less-willing to take risks in the gambling frame than in the investment frame. Specifically, we observe a significant framing effect for both actively religious (17.49 versus 29.54, p = 0.05 Mann Whitney, n = 12 Gambling, n = 21 Investment) and religious (19.52 versus 27.82, p = 0.02 Mann Whitney, n = 24 Gambling, n = 40 Investment). We do not find a significant effect for the non-religious (16.85 versus 19.21, Mann-Whitney 0.55, n = 14 Gambling, 7 Investment).

However, what seems to have a stronger effect than religion is whether an individual identifies as being ethical. We define a participant as being ethical if they either agreed or strongly agreed that ethical and moral decisions influence their decisions on where or how to spend their money. Ethical participants allocated almost 130% less to the risky option in the gambling frame than in the investment frame (11.87 versus 27.15, p = 0.01 Mann Whitney, n = 19 Gambling, n = 28 Investment) In contrast, no significant framing effect was found for non-ethical participants (25.20 versus 25.63, p = 0.38, Mann-Whitney, n = 19 Gambling, n = 19 Investment).

Participants were also asked whether they strongly agreed, agreed, neither agreed nor disagreed, disagreed or strongly disagreed, with the statement that they would generally be willing to accept a lower return on socially responsible investments. Categorising participants who responded that they agreed or strongly agreed with the above statement as socially-responsible, we find that the average allocation is almost 95%

higher in the investment frame (12.53 versus 24.39, p = 0.05 Mann Whitney, n = 12 Gambling, n = 20 Investment). For those not classified as socially-responsible, the average allocation was around 76% higher in the investment frame (21.3 versus 28.13, p = 0.05, n = 26 Gambling, n = 27 Investment).

Result 6: There is marginal evidence that the gambling-investment framing effect is stronger in subjects who self-report being loss-averse.

In the questionnaire participants were asked whether they strongly agreed, agreed, neither agreed nor disagreed, disagreed or strongly disagreed, with the statement that they were more concerned about the probable losses than probable gains when making a financial decision. We categorise anyone who either agreed or strongly agreed with the above statement as being loss-averse and subsequently test for any framing effect among this group of participants. We find that loss-averse participants on average allocated 37.2% more tokens to the risky option in the investment frame than in the gambling frame (25.06 versus 18.27) although the effect is only marginally significant (p = 0.06 Mann Whitney, n = 28 Gambling, n = 30 Investment). No significant framing effect was found for non-loss averse participants although the absolute effect is still large (29.14 versus 19.28, p = 0.13 Mann Whitney, n = 10 Gambling, n = 17 Investment).

To corroborate the findings reported above, Table 3.6 presents the results from a simple regression analysis. From Table 3.6, we find that a gambling frame significantly lowers the amount of tokens invested, as illustrated earlier. Moreover, while we do not find any significant effect of moral priming on the amount of tokens invested, we do find further evidence of a dynamic priming effect. As shown, on average, subjects that had experienced a loss in the previous round $(t-1)$, increased the amount, though insignificantly, of tokens invested in the subsequent round (t). By contrast, subjects that faced the moral, rather than neutral, priming questions, significantly lowered the amount of tokens invested in round (t) following a loss in round $(t-1)$.

Amount Invested in Risky Option	
Gambling Frame	-7.40***
	(1.97)
Moral Prime	3.66
	(3.60)
Moral Prime * Loss Previous Round	-8.74**
	(4.28)
Female	-2.95
	(2.35)
Ethical	-5.52***
	(2.02)
Loss Previous Round	3.94
	(3.26)
Religious	3.70
	(2.32)
Constant	39.68***
	(5.79)
No. of Observations	595

Table 3.6. Regression Analysis[19]

3.3.4. Discussion

We observe a large gambling-investment framing effect. Specifically allocations to the risky option were around 40% higher when the task was framed in terms of investment. So, framing matters. More important for our purposes is that we see this framing effect systematically varies according to the characteristics of the participant. In particular, males and those who are irreligious or not ethical seem to be largely unaffected by the frame. By contrast, we see that women, the religious and those classified as being ethical are significantly affected. This is important because it means that risk preference elicitation methods framed in a way that brings to mind gambling may produce biased estimates of general risk preferences.

We conjectured that the gambling frame would decrease risk taking because of the cultural norms around gambling. That we

[19] (Note: Robust standard errors in parentheses. Marginal effects are reported. * $p < 0.10$, ** $p < 0.05$ and *** $p < 0.01$).

observe a bigger framing effect amongst the religious is consistent with this. It is clear, however, that being religious is not the only factor. First, we have the gender divide. Second, the correlation between being ethical and religious among our sample was only 0.14.[20] Therefore, it seems as though gambling is deemed unethical by people beyond those belonging to a particular religious faith group. This could be because of norms, which have been shaped by religion, influencing those who are not actively religious.

We saw that the religious prime primarily had a dynamic effect. In particular participants exposed to the religious prime decreased allocation to the risky option if they were exposed to a loss. This meant that allocations in the treatment where subjects were exposed to a religious prime and gambling frame was ultimately significantly lower than in the other three treatments. Put another way, participants exposed to a neutral prime and gambling frame increased risk-taking over time. This suggests that the effects of the frame wore off over time if participants were not exposed to the religious prime. The prime, therefore, had a long run impact, potentially by shaping how participants reacted to outcomes.

3.4. EXPERIMENT 2

Although we find a strong treatment effect for religious participants in our main experiment, the average gamble is still positive. If religion *prohibits* gambling, then it is reasonable to question why religious participants still decided to bet some portion of their endowments rather than simply refusing to bet anything at all. One explanation could be people identify as being part of a religious faith without actually having too deep an understanding about the principles or tenets of their chosen religious ideology. Simply put, religion may serve more as a label than something which is strictly abided by. This is arguably more likely to be the case among a sample of university students given the common finding in the literature that the fervency of religious

[20] This falls to 0.10 between those who are ethical and actively religious.

belief declines with education (Inglehart and Baker 2000, Glaeser and Sacerdote 2008).

Another related explanation is the environment in which individuals act. That is, behaviour could vary, where individuals act in a way that is more closely aligned to religious teachings when they are in a religious or more natural environment. For instance, university students may decide to gamble when faced with the task in a laboratory setting but wouldn't actively decide to gamble outside of the laboratory. This again could vary depending on religious intensity. For example, given the possibility that university students are likely to be less stringent in their following of religion, they may decide to take a small risk in the moment whereas those with stricter religious inclinations may be less willing to do so.

The broader point here is that elicited risk preferences may not only be subject to the frame and individual characteristics, as shown in Experiment 1, but also the environment where the preferences are elicited. To test for such an effect we conducted a follow-up experiment inside a Mosque, with a control group in a classroom. Conducting the experiment within the premises of the Mosque essentially offers a much stronger priming effect as participants are surrounded by a religious atmosphere. Our main hypothesis is that we will observe a large framing effect in this setting.

3.4.1. Methods

To conduct the experiment within the Mosque we condensed Experiment 1 into a simple one-shot version without the initial priming questions. Participants simply read the instructions, made their choice, pulled a number out of a bag to determine whether they won or not, and then were paid accordingly. This took around 5 minutes.

The main part of the experiment was conducted inside a Mosque situated nearby the Canterbury campus of the University of Kent. Following congregational prayers, an announcement was made that a research experiment was being conducted in a designated area of the Mosque. The experiment was conducted in both the male and female areas of the Mosque to obtain a balanced sample. We were able to recruit 43 participants.

As a control we recruited a further 20 subjects from the general student population. These participants were exposed to the same one-shot version of the experiment as those in the Mosque. The control was carried out in a small lecture theatre at the university. In both the Mosque and classroom we were careful to make sure that participants were only exposed to their frame and could not see the alternative frame.

3.4.2. Hypotheses

Our main hypothesis remains,

Hypothesis One: Risk-taking will be higher in the investment frame than in the gambling frame.

Here, however, we expect a stronger effect caused by the particular religious setting and the fact that Islam explicitly prohibits aleatory transactions such as gambling, wagering or betting (Schacht 1982). Note that investment is not prohibited and is positively encouraged in Islam.

Hypothesis five: We will observe a larger framing effect in the Mosque than in the classroom or Experiment 1.

3.4.3. Results

We summarize our findings in two main results.

Result 7: We observe a very large gambling-investment framing effect with virtually no gambling in the Mosque.

Table 3.7 presents the average allocation to the risky option by treatment for participants in the Mosque. Consistent with Hypothesis 5 we see a very large framing effect. The observed increase of allocations in the investment frame of 785% compares to 43.2% in Experiment 1. Moreover, 71.4% of subjects in the Mosque did not allocate anything to the risky option in the gambling frame (and 86% gambled with less than three tokens of their endowment). In contrast, every participant who faced the investment task allocated a positive amount to the risky option. Moreover, we observe a large gambling-investment framing effect for both males and females.

	Complete Sample	Females	Males	Loss-Averse	Ethical	SRI
Avg. Gamble	4.95	5.55	4.30	4.25	4.44	11.33
Avg. Investment	38.86	46.50	32.50	41.25	33.67	37.08
Std. Dev Gambling	11.86	11.77	12.56	11.62	11.33	16.46
Std. Dev Investment	24.49	27.49	20.73	22.88	21.00	22.71
Mann-Whitney	0.00	0.00	0.00	0.00	0.00	0.01
Bootstrapped T-Test	0.00	0.00	0.00	0.00	0.00	0.00
Observations	43	21	22	20	31	21

Table 3.7. Average Allocation to the Risky Option by Participants in the Mosque

Result 8: We observe a significant but less pronounced gambling-investment framing in the classroom compared to Mosque.

Figure 3.3 shows average allocations to the risky option in the control group compared to the Mosque. We see that, for the control group, the average allocation is lower in the gambling frame (22.73 versus 40.0, Mann-Whitney 0.11, T-Test 0.07, n = 11 Gambling, n = 9 Investment). This is further evidence in support of Hypothesis 1. The framing effect is, however, notably lower in our control than in the Mosque, lending further support to Hypothesis 5. This is consistent with the mediating effect of religion and moral views as well as the importance of the setting.

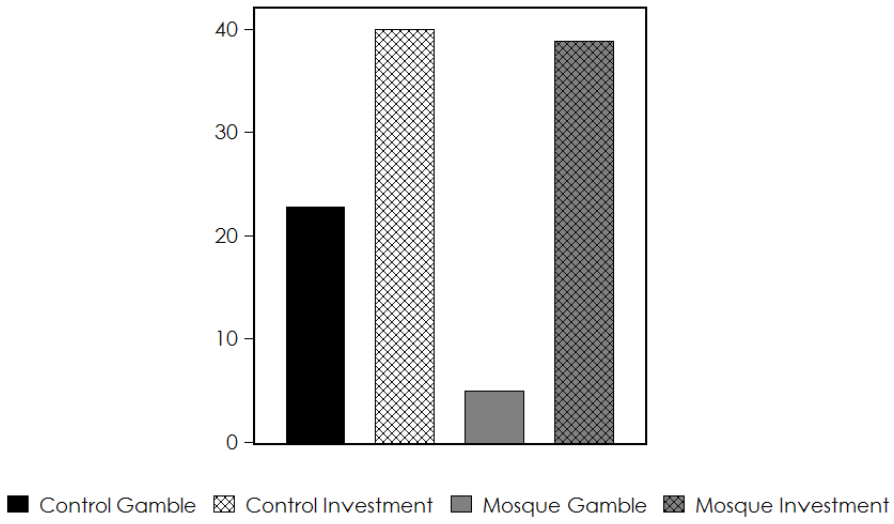


Figure 3. 2. Risk-Taking across Frames and Locations

3.4.4. Discussion

This experiment reinforces the general point that behaviour is influenced by the frame, this time in a one-shot setting. The experiment also powerfully shows that the situational context can influence the gambling-investment framing effect. Clearly, the Mosque is a very particular setting with a strong religious priming effect. Even so, the very large framing effect we observe illustrates that we can, more generally, expect the setting to matter. It is particularly noteworthy that we observe a large framing effect for men as well as women. This compares to Experiment 1 where the effect was small for men. This nicely demonstrates that both personal characteristics (male and female in Experiment 1) and setting (Mosque or lab) influence the magnitude of the framing effect.

3.5. GENERAL DISCUSSION

Through implementing a simple framing manipulation, we show that an individual's propensity to bear risk varies depending on the framing of the choice they face. This result corroborates the findings of several earlier studies that provide evidence of the domain and context-specificity of risk-preferences (MacCrimmon and Wehrung (1986), Schubert et al. (1999), Weber et al. (2002), Hanoch et al. (2006), Dohmen et al. (2011)). The significance of this framing effect varied across demographic groups. Most notably, female and religious participants displayed a significant aversion towards gambling, relative to investment. It also varied across situational settings. For instance, both men and women showed an aversion to gambling in a Mosque.

Our results add to the literature exploring the often observed gender disparities across economic domains such as the labor market (see Blau and Kahn 2000 for a review), and saving, investment and consumption behaviour (Croson and Gneezy (2009) and Fisher (2010)). These differences have been hypothesized to have been driven by gender-specific differences in preferences (Croson and Gneezy 2009). Several experimental studies using both real and hypothetical payoffs with either an explicit or implicit lottery-based framing have consistently found

males as being more risk-prone than females (Schubert et al. (1999), Holt and Laury (2002), Hartog et al. (2002), Eckel and Grossman (2002) and Charness and Gneezy (2012)). However, if females are inherently more averse to gambling tasks than males, as our results indicate, then the results from the aforementioned studies may not be generalizable beyond the domain of gambling.

Eckel and Grossman (2008), in reviewing the evidence for risk aversion, conclude that there is no consistent evidence of gender differences in contextual environments (as opposed to gambling environments where the evidence is clear). Schubert et al. (1999), for instance, find that reframing the decision-task as an investment eliminates the gender-effect that is found when the problem is presented as an abstract gamble. Similarly, (see Table 3.5) we observe no difference between men and women in an investment frame but find a significant difference in the gambling frame. Moreover, in the setting of the Mosque, we find no difference between men and women in either the investment or gambling frame. There are contextual frames where females are more risk averse than men (e.g. Eckel and Grossman 2008b). Overall, however, we would suggest that the evidence for greater risk taking in males may well be an artefact of how risk preferences are elicited.

Evidence of a significant framing effect for religious, ethical and socially-responsible participants suggests that people take into account deeper considerations beyond monetary payoffs during their decision-making process. Understanding differences in risk-preferences that are derived from cultural or religious heterogeneity could contribute towards our understanding of individual differences in socio-economic outcomes (Iannaccone (1998) and Hoffmann (2013)) such as entrepreneurship decisions (Audretsch et al. 2007), wealth accumulation (Keister 2003), savings behaviour (Renneboog and Spaenjers 2012) and labor market outcomes (Giavazzi et al. 2009). Moreover, if such differences in individual risk-attitudes are responsible for distinct economic choices, then they may further provide a microeconomic foundation for divergent aggregate outcomes[21].

[21] This has been an area of growing interest, with studies on the macroeconomic consequences of religion and culture on economic growth (Barro and McCleary 2003), economic development

The existing literature comparing risk-preferences between religious groups has typically found that Catholics are more risk-prone than Protestants and that the religious are more risk-averse than the irreligious (Barsky et al. (1997), Hilary and Hui (2009), Kumar et al. (2011), Noussair et al. (2012) and Benjamin et al. (2016)). However, the existing experimental studies have typically been based around lottery-type tasks. As our findings show, religious participants are likely to be more sensitive to framing which resembles gambling. This could explain the common finding of Protestants being more risk-averse than Catholics, given the stronger anti-gambling norm among Protestants, and the religious being more risk-averse than the irreligious. If participants from particular religious backgrounds have an unfavourable bias towards gambling whereas non-religious participants don't, then similar to the case with gender, such results may not be reliably generalized to domains beyond gambling.

In addition to studying framing effects, we also study whether making religion salient through priming would influence behaviour. We do not find evidence of the religious prime causing any difference in risk-taking in terms of the initial investments made. However, we find that primed participants were more sensitive to losses i.e. a loss in the previous round led to a sharper contraction of investment in the subsequent round in comparison to those with a neutral prime. This effect was strongest for those given the religious frame which suggests an important dynamic priming effect. To the best of our knowledge such dynamic effects have not been considered before. But they are potentially an important mechanism through which religion can influence aggregate outcomes.

Let us finish the discussion by clarifying that we are not arguing gender and religion have no influence on risk attitudes. In our second experiment we saw a dramatic decrease in the amount gambled in the Mosque and so religion and religious context clearly matter. The point we want to make is more that eliciting risk preferences using a frame involving gambles and lotteries may give a biased picture. The broader point is that risk preferences systematically vary depending on individual

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(Alesina et al. 2003), governmental systems (La Porta et al. 1999) and savings and investment ratios (Guiso et al. 2006).

characteristics and the setting (Isenberg (1986), Lopes (1987), Eckel et al. (2009) and Bougheas et al. (2013)). Hence, some groups, such as the religious, are more sensitive to the frame and context than others. This can have important repercussions, not only in the lab, but in 'real life'. For instance, women or the religious may be more reluctant to take on a risky financial investment if it is framed as a gamble.

To summarize, Figure 3.4 plots the average allocation to the risky task over the two experiments and frames including gender and ethical beliefs. In the investment frame we see remarkable consistency across different groups and settings. With the gambling frame by contrast we see huge variation depending on individual beliefs and the setting. This illustrates that attitudes to gambling do appear to vary widely and that eliciting risk preferences using a gambling frame may lead to systematic bias.

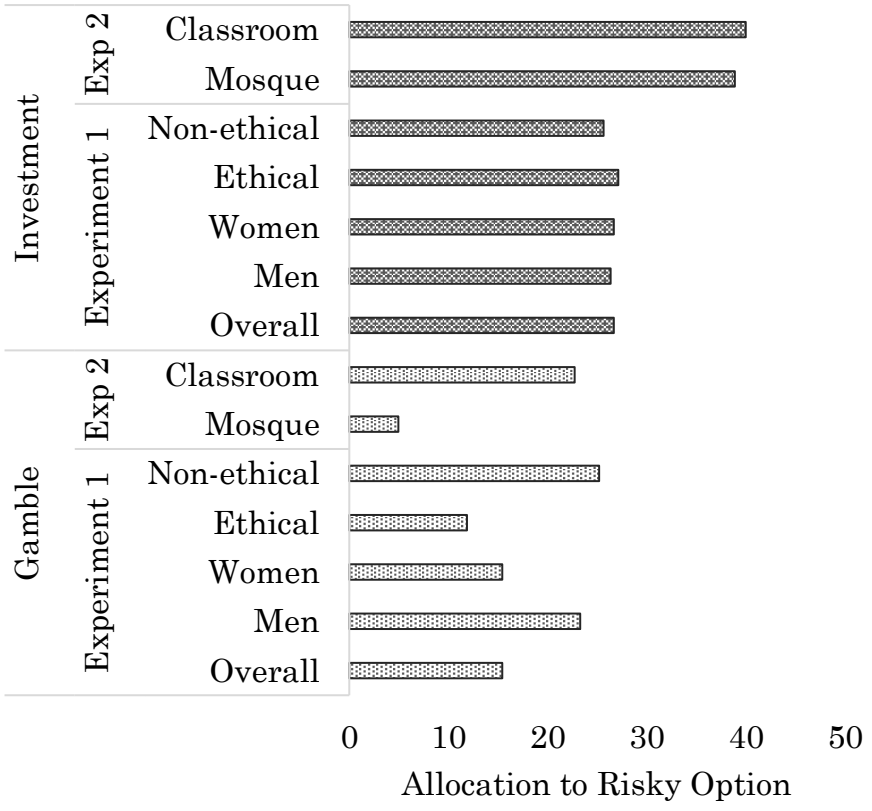


Figure 3. 3. Average Allocation to the Risky Option across Experiments

3.6. SUMMARY AND CONCLUSION

In this study, we ran simple incentivised laboratory experiments using the seminal Gneezy and Potters (1997) framework to test whether religious, or ethical, priming and decision-task framing could influence the appetite for risk among participants. We find evidence to suggest that reframing an identical numerical problem into an investment decision results in greater risk-taking than when it is presented as a gamble. We also find that priming participants about religion and ethics causes a dynamic effect where the reaction to losses was stronger for those that were primed. In our second experiment we find that risk-taking drops dramatically in the Mosque for those exposed to the gambling frame.

Overall, our findings corroborate the results of previous studies that show context is an important determinant of risk-taking (Schubert et al. (1999), Weber et al. (2002) and Dohmen et al. (2010)). More specifically, we highlight two conclusions that can be drawn from our work. First, we find that choices in the investment frame are relatively stable across personal characteristics (most notably gender), beliefs (ethical and religious) and setting (Mosque, lab or classroom) while those in the gambling frame are not. This suggests that individuals are particularly sensitive to a gambling frame, potentially because of the social and religious norms around gambling. Second, we argue that risk preference elicitation tasks that are framed in terms of gambling, as many are, likely lead to systematic bias. We should, therefore, look to test and develop methods that avoid a gambling frame.

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3.8. APPENDIX

3.8.1. Instructions for Investment Frame (Experiment 1)



This experiment on decision making consists of eight rounds. At the beginning of each round, you are to be endowed with 100 tokens. You then have the opportunity to invest in a project. For instance, you might imagine that you can make a business investment into the Research and Development programme of one of the fastest tech start-ups specialising in Artificial Intelligence (AI). You are asked to choose a portion of your endowment (between 0 and 100 tokens) to invest with. There is a 33% chance of success and 67% chance of failure in the project. If the project is a success, you receive 2.5 times the amount you invested, which amounts to a 250% return on investment. In contrast, if the programme fails, you lose the entire amount invested. Whatever sum you decide not to invest with is safely stored and for yours to keep. At the end of each round you will be told whether the project was a success or failure as well as your consequent returns from investment. The earnings from each round will be added together to determine your final payment.

How many tokens would you like to invest?

.....

3.8.2. Instructions for Gambling Frame (Experiment 1)



This experiment on decision making consists of eight rounds. At the beginning of each round, you are to be endowed with 100 tokens. You then have the opportunity to gamble by betting on a lottery. You are asked to choose a portion of your endowment (between 0 and 100 tokens) to gamble with. There is a 33% chance of winning and 67% chance of losing the bet. If the bet is won, you receive 2.5 times the amount you gambled with, which amounts to a 250% return. In contrast, if the bet is lost, you lose the entire amount gambled. Whatever sum you decide not to gamble with is safely stored and for yours to keep. At the end of each round you will be told whether the bet was won or lost as well as your consequent returns from gambling. The earnings from each round will be added together to determine your final payment.

How many tokens would you like to bet?

……

3.8.3. Instructions for Investment Frame (Experiment 2)



This experiment consists of one decision. You are endowed with 100 tokens (worth £5). You then have the opportunity to invest in a project. For instance, you might imagine that you can make a business investment into the Research and Development programme of one of the fastest tech start-ups specialising in Artificial Intelligence (AI). You are asked to choose a portion of your endowment (between 0 and 100 tokens) to invest with. There is a 33% chance of success and 67% chance of failure in the project. If the project is a success, you receive 2.5 times the amount you invested, which amounts to a 250% return. In contrast, if the programme fails, you lose the entire amount invested. For example, if you decide to invest 10 tokens and the project is successful, your earnings would be calculated as the return on investment i.e. 25, plus your endowment of 100, totalling 125. If the project fails, you would lose the 10 tokens you invested and thus your total earnings would be 90. Whatever sum you decide not to invest is yours to keep.

How many tokens would you like to invest?

.....

3.8.4. Instructions for Gambling Frame (Experiment 2)



This experiment consists of one decision. You are endowed with 100 tokens (worth £5). You have the opportunity to gamble by betting on a lottery. You are asked to choose a portion of your endowment (between 0 and 100 tokens) to gamble with. There is a 33% chance of winning and 67% chance of losing the bet. If the bet is won, you receive 2.5 times the amount you gambled with, which amounts to a 250% return. In contrast, if the bet is lost, you lose the entire amount gambled. For example, if you decide to bet 10 tokens and the gamble is successful, your earnings would be calculated as the amount won i.e. 25, plus your endowment of 100, totalling 125. If the gamble is lost, you would lose the 10 tokens you bet and thus your total earnings would be 90. Whatever sum you decide not to gamble with is yours to keep.

How many tokens would you like to bet?

……

CHAPTER FOUR

4. Does Insurance and the Prospect of Sabotage Crowd Out Prosocial Behaviour?

ABSTRACT

We report the results of a simple laboratory experiment in which we explore the extent to which altering subject choice-sets and the context in which the decision is made influences the level of prosocial and anti-social behaviour among competing individuals. We find that extending the available choice-set by including the option to insure crowds out voluntary donations by winners even when insurance constitutes a dominated strategy. Furthermore, switching the context of the problem from potentially having one's endowment stolen to having it burned by an opponent lowers prosociality in terms of average donation size. Our data shows considerable evidence of both sabotage and antisocial behaviour by contest losers that is consistent across treatments. One implication of our results is that behaviour can be susceptible to changes in choice-sets even when the added options do not represent monetarily advantageous strategies. This provides further support to the growing consensus on the situational-instability of preferences.

4.1. INTRODUCTION

The economics literature has traditionally focused on the study of agents with relatively simple self-interested material motivations. The findings of Smith (1962) illustrated that if subjects trade a homogenous good of which all aspects are fully contractible then experimental markets are quick to converge to the competitive equilibrium. As the equilibrium was computed based on the assumption that all players were exclusively self-interested, and the fact that numerous studies successfully corroborated this result, the findings of Smith (1962) were used to support the notion that self-interest provided a good description of behaviour (see Davis and Holt 1993). However, an extensive body of research based on laboratory experiments has subsequently documented considerable evidence showing the significance of interdependent utility, or so-called other-regarding preferences, during the decision-making process of individuals under various situations, for purposes such as inequity aversion (Bolton and Ockenfels (1998), Fehr and Gachter (2000) and Charness and Rabin (2002))[22], altruism (Andreoni and Miller 2002), fairness, reciprocity (Fehr and Gachter 2000), relative standing (Kirchsteiger (1994) and Charness and Rabin (2002)), norm-breaking (Lopez-Perez 2008), social reputation, egocentrism (Cox et al. 2002) or even spite and envy (Zizzo and Oswald (2001), Herrmann et al. (2008) Abbink and Sadrieh (2009) and Abbink and Herrmann (2011)).

Other-regarding preferences have therefore been recognised as being important for a range of social and economic outcomes, such as public life and politics (Fehr and Fischbacher 2002), tax-compliance (Alm et al. 1995), income redistribution (Fong et al. 2005), law enforcement (Lind and Tyler 1988) and workplace relations (Krueger and Mas 2004).

[22] A number of influential economists such as Adam Smith (1759), Gary Becker (1974), Kenneth Arrow (1981), Paul Samuelson (1993) and Amartya Sen (1995) had mentioned that individuals may in fact care about the well-being of others and that this could potentially have important economic implications.

Given the substantial evidence on the existence of interdependent utility, much of the academic research has now shifted focus towards developing a deeper understanding of the determinants and conditions under which these preferences could have important economic and social implications. For example, despite the common finding of positive contributions in various public goods experiments or evidence of sharing in the classical dictator game, a series of papers have shown that adapting the choice-set available to subjects can significantly alter their behaviour. List (2007) and Bardsley (2008) show that extending the dictator game by allowing dictators to take money from receivers considerably lowers giving. More generally, differences in the type and extent of other-regarding behaviour across studies have also been attributed to issues such as monitoring and anonymity considerations (Hoffman and McCabe (1994) and Eckel and Grossman (1996), Bandiera et al. (2005) and Benz and Meier (2008)), the decision context, self-selection of participants, stake-sizes, the artificial restriction of choice sets that the lab imposes and experimenter scrutiny or demand effects (Levitt and List (2007), Orne (1962), List (2007), Bardsley (2008), Smith (2010), Oechssler (2010) and Zizzo (2010)), the process that generates the initial distribution of wealth in these experiments (Cherry et al. (2002), Rotemberg (2006) and Erkal et al. (2011)), reputational concerns (List 2006) and the number of decision makers i.e. unilateral versus bilateral action (Simunovic et al. (2013)).

A particular other-regarding preference that has attracted growing attention recently is that relating to antisocial behaviour, which is based upon negative utility interdependence. Antisocial behaviour is now being recognized as an important social and economic problem in the real world. There is an abundance of examples that showcase the existence of such behaviour within everyday life, such as littering, graffiti, vandalism, damaging private properties, theft, bullying, harassment, cyber-crime, viruses and malware. According to the British Crime Survey (2016), around 1.8m incidents of antisocial behaviour were recorded by police between 2012 and 2013. Since data on antisocial behaviour is restricted to those incidents that have been reported, the *actual* number of incidents is likely to be higher than what has been reported.

These actions impose not only private costs upon those that are directly affected, but also external or third-party costs to society. In an attempt to quantify such costs, Cohen (1998) estimated that a typical career criminal causes around $1.3m to $1.5m in external costs to society. The corresponding figure for heavy drug-users was between $370,000 and $970,000. Overall, Cohen's (1998) calculations suggest that the monetary value of saving a high-risk youth from such lifestyle would be in the region of $1.7m to $2.3m.

To provide a more concrete perspective of the costs associated with antisocial behaviour, data from the UK shows that government agencies in England and Wales spend around £3.4m a year in responding to reports of antisocial behaviour. In 2003, the Home Office formed the antisocial behavioural unit with an annual budget of £25m to design and implement the Government's policy on antisocial behaviour (HoC 2007). Clearly then, understanding what drives individuals to carry out such actions has serious real-world applications.

This chapter contributes towards the literature on social-preferences and other-regarding utility in the following ways. First, while previous studies focus on studying whether individuals are willing to give or take money under various settings, we further test whether people are sufficiently concerned about the possibility of others taking or sabotaging their earnings and as a result willing to invest resources to avoid this. More specifically, in our no insurance treatments we allow subjects to simultaneously transfer i.e. give or take money from an opponent at a fixed cost, or do nothing. We then introduce a treatment whereby the available choice-set is extended to include the option of purchasing insurance against the risk of subjects having money taken away from them. This allows us to test how changes in the available choice-set influences behaviour.

Secondly, given the recent growth in interest regarding anti-social behaviour within the lab, we study whether the decision to take from an opponent is influenced by whether the amount taken is kept or burned. Zizzo and Oswald (2001) found that 62.5% of participants chose to burn their opponents' money in an incentivised experiment despite the fact that such a decision implied a net monetary cost to them. Importantly, Zizzo and Oswald (2001) created the initial allocation of funds across

subjects through a betting stage, which was followed by the random endowment of arbitrary gifts to some participants in order to provide them with an unfair advantage. As this was common knowledge, the authors argue that the fundamental driver of burning was inequity aversion and subjects' dislike for the unfairness involved in the process.

Given that there is a robust finding within the experimental literature showing that behaviour varies depending on the way in which the initial distribution of wealth is generated (e.g. Durante et al. (2014) and Akbas et al. (2014)), our experimental design further involves subjects initially participating in a winner-takes-all competition in order to earn their endowments. The competition was set up so that half of the subjects received 'easier' questions, which means that the allocation of endowments was essentially exogenous. Even so, subjects may have felt as though they 'earned' their endowment. If individuals believe that inequality reflects differences in effort as opposed to luck or privilege, this may affect their willingness to redistribute (Durante et al. 2014). Prior literature has shown that other-regarding behaviour is mitigated when participants earn their endowments (see Hoffman and Spitzer (1985), Hoffman et al. (1994), Ruffle (1998), Cherry et al. (2002) and Carpenter et al. (2010)). For instance, Erkal et al. (2011) show that after competing in an experimental tournament, those ranked first are significantly less likely to redistribute their earnings compared to those of any other rank.

Furthermore, by allowing subjects in our experiment to give, take, do-nothing and, in a particular treatment, purchase insurance, we arguably provide subjects with a more complete choice-set to choose from. This could aid in our understanding of how individual's behave when they are faced with a more realistic scenario that consists of multiple possible options rather than a simple binary choice, which may be relatively more prone to experimenter demand effects.

Therefore, the combination of offering subjects a broader choice-set, the existence of an effort stage and the strategic concerns created by the bilateral design of our experiment i.e. simultaneous action by subjects, could offer valuable insights into the stability or dynamics of social preferences under a setting that is different from what has been covered in the earlier literature.

4.2. FURTHER RELATED LITERATURE

As alluded to above, a plethora of studies have found evidence in support of the existence of other-regarding preferences. The literature on social-preferences has traditionally placed greater emphasis on studying pro-social behaviour. That is, voluntary behaviour intended to benefit others through actions such as sharing, donating and co-operating for reasons such as warm glow, prestige, fairness, social pressure and philanthropy (see Brown, Meer and Williams 2012). For example, it has been found that in the classical dictator game, where an individual decides what proportion of a monetary endowment they would like to share with an anonymous person, people often violate traditional assumptions of self-interest by making positive transfers to the other player. This is despite the fact that the other player is simply a passive participant who cannot punish the dictator for not sharing the endowment (see Engel 2011 for a review). Several extensions have been made to the traditional dictator game to find evidence of how reducing dictator-recipient social distance and increasing emotional feelings towards the recipient can increase giving (see Eckel and Grossman (1996), Hoffman et al. (1996), Bohnet and Frey (1999) and Branas-Garza et al. (2012)).

More recently, there has been a growing interest in exploring the so-called darker or negative departures from the customary assumption of rational self-interest. Research on anti-social preferences looks into the willingness of individuals to make others worse off for reasons such as inequality-aversion, envy, spite and even pure nastiness. The established literature shows that subjects are in fact willing to behave antisocially even if this implies that they must incur a net monetary cost in doing so (e.g. Zizzo and Oswald (2001) and Abbink and Sadrieh (2009)).

While the experimental research on anti-social behaviour is very limited, researchers have argued that a supposed "*homo-rivalis*" or "*homo-maliciosus*" (Herrmann and Orzen 2008) may provide better explanations for various social dilemmas in comparison to the standard homo-economicus. For example, if attitudes towards income redistribution were purely based on rational self-interest, then anyone earning less than the average level of income should

favour redistribution, since they would benefit from such a policy. That is, an increase in income inequality skews the distribution of income rightwards. Therefore, as inequality increases, a larger share of the population has income beneath the mean, which implies that the support for redistribution should rise. However, empirically this hasn't been the case. For instance, Kuziemko et al. (2014) find that agents exhibit last place aversion. This result holds across both laboratory settings and in everyday social environments. People near the bottom of the income distribution oppose redistribution due to fears that it could result in people below them catching up or even overtaking them and thus leave them at the bottom of the status hierarchy.

Muller et al. (2016) argue that antisocial preferences appear to be linked to resource scarcity and competition pressures. In other words, antisocial preferences follow an evolutionary logic similar to that found across nature. That is, by harming others, one may be able to reduce competition and therefore such behaviour should co-vary with competition intensity. This would be analogous to bacteria that release toxins to kill closely-related species (Muller et al. 2016). If this is indeed the case then trends in wage stagnation and anaemic long-term economic growth in certain parts of the world could increase competition pressures and make antisocial preferences a lot more important to understand.

The research on anti-social preferences within the realm of experimental economics was initiated in a seminal paper by Zizzo and Oswald (2001). In their study, Zizzo and Oswald (2001) introduce a one-shot version of the money burning game, which follows a simple two-stage process. In the first stage, the authors create a wealth distribution among participants through having them engage in a betting game. However, some subjects receive an arbitrary gift, which provides them with an unfair advantage over other participants. These gifts, which boost their recipients' endowment, were public knowledge in that all participants were both aware of this feature of the game and the exact amounts allocated or given to these more fortunate players.

Subsequent to this initial betting stage, subjects were then allowed to burn i.e. reduce the money-holdings of other subjects, under complete anonymity, for a given price. Zizzo and Oswald (2001) vary this price or cost of burning to gauge the extent of negative utility interdependence between subjects. In other

words, to assess how the amount of burning varies with the cost of burning.

Given the set-up of their experiment, standard economic assumptions would predict there to be no burning given that burning here incurs an own cost for no material benefit in return. However, the authors find substantial evidence of burning. More precisely, they report that 62.5% of participants chose to burn despite the fact that such a decision implied a net monetary cost to them. Furthermore, on average each subject had 48.7% of their earnings burnt.

While Zizzo and Oswald (2001) don't find any significant correlation between the price of burning and the decision to burn, they do find evidence suggesting that the rationale behind most of the burning was driven by whether or not the money had been received deservedly or otherwise. Therefore, rather than the burning being driven purely by spite or envy, they argue that money was burned primarily due to concerns for fairness as participants appeared to use the information regarding unearned gifts in making their decisions on whether or not to burn.

In a subsequent paper, Zizzo (2004) extends the design of Zizzo and Oswald (2001) to provide a more focused analysis on whether agents indeed take into consideration distributional and procedural fairness when making decisions on burning the money-holdings of other participants, as indicated in Zizzo and Oswald (2001). In the new set-up, Zizzo (2004) gives agents the ability to change the wealth distribution by paying to reduce and redistribute the money of other participants. Furthermore, half of the sessions included the possibility of stealing from others. Standard economic assumptions would suggest that self-interested agents should do nothing in the non-stealing condition, since this would imply a net-cost to them, and that they should steal everything from everybody in the stealing condition. Zizzo (2004) reports substantial evidence of stealing when it is allowed but notes that this is always much lower than 100%. However, Zizzo (2004) argues that this is unlikely to be purely motivated by self-interest as moving from the stealing to non-stealing condition increases burning rates. More precisely, the burning ratio is only 8% when stealing is allowed compared to an average of 20% in the non-stealing setting. Therefore, since burning appears to be an imperfect substitute for stealing, some stealing is likely to have

been motivated by negative utility interdependence but some burning may have stemmed from a good motive, namely the aversion to unfairness.

In order to isolate anti-social behaviour stemming from pure envy and spite rather than any pecuniary, fairness or reciprocity type motives, Abbink and Sadrieh (2009) introduce the joy-of-destruction game. The game has two stages. First, two players earn an endowment, which is equal in expectation, through the completion of some tasks. Subsequent to this, both players can then mutually and simultaneously destroy each other's endowments. Destruction is costless and entails no material benefit for the destroying party, and thus the presence of destruction would provide stronger evidence of pure spite and nastiness among participants. Abbink and Sadrieh (2009) use a repeated interaction framework to observe the dynamics of play. For example, whether the opportunity to retaliate could trigger the escalation into an ongoing vendetta or perhaps have a deterrent effect. Furthermore, the authors use two variants of the game. In the "open" treatment, destruction is perfectly observable after the completion of each round. In the "hidden" treatment, the destruction is veiled by an additional random destruction. That is, in the hidden setting, there is some positive probability that the endowment of agents is destroyed by "nature." However, the targeted individual can only observe the total damage to their endowment and cannot identify its source. Hence, in this treatment it became possible to damage someone's endowment under anonymity.

Similar to the experiments by Zizzo and Oswald (2001) and Zizzo (2004), standard economic assumptions would predict there to be no destruction. The authors find that the overall frequency of destruction is on average 8.5% of all decisions made under the open treatment. Furthermore, they observe that destruction rates are higher in the earlier rounds but are quick to fade away. However, in the hidden treatment, an average of 39.4% of all decisions involved destruction. Also, unlike the open treatment, they find no evidence of destruction rates falling over subsequent periods.

Abbink and Herrmann (2011) use a one-shot version of the joy-of-destruction game whereby two players are given equal endowments and subsequently engage in the simultaneous

decision on whether or not to reduce the payoff of the other player by incurring an own cost. Similar to Abbink and Sadrieh (2009) the authors use an open and hidden treatment where there exists some positive probability that nature would partly destroy the opponent's endowment.

Abbink and Herrmann (2011) argue that the hidden feature should increase burning rates. This is because if nature were to destroy part of the opponent's income, then it could perhaps lower the moral costs of burning. In other words, if there is a chance that the target loses their money anyway, and the source of this loss isn't identifiable, then the scruples subjects have to harm other subjects are reduced, and thus they could become considerably nastier. While the findings do show that burning rates are higher in the hidden treatment, at 10.8%, their explanation seems debatable. More precisely, if one knows that another person could be inflicted with punishment, this could actually elicit feelings of greater sympathy towards such an individual and thus increase the moral costs of imposing further harm upon them.

Karakostas and Zizzo (2016) extended the joy-of-destruction game used by Abbink and Herrmann (2011) to study the role of experimenter demand effects. Karakostas and Zizzo (2016) found that 60% of subjects chose to reduce their opponent's earnings when an indirect yet unequivocal cue to destroy was given to them. The authors argue that compliance norms and social image towards the authority can be influential in determining the choices individuals decide to make.

Abbink and Herrmann (2009) design the vendetta game to investigate antisocial preferences and conflict. In this game, two groups of four players interact with each other over ten identical rounds. In every round, each player receives an equal endowment and subsequently decides on whether or not they would like to pay to reduce the payoff of members of the other group. Lowering the other group's payoff would entail no material benefit for the destroyer or their group but would in fact lower their own monetary earnings. Therefore, any evidence of burning could be interpreted as purely representing antisocial behaviour. The authors also add an additional treatment whereby they include an incentive to destroy money. This takes the form of a prize draw where one out of however many members of a particular group

that decided to burn could win a prize of five points. However, this prize is lower than the fixed cost of burning and thus still implies a net cost to the participant in monetary terms. Abbink and Herrmann (2009) argue that this treatment could mirror symbolic rewards from committing destructive acts such as social prestige or honour, and could perhaps incentivise or nudge those more inclined but hesitant to destroy towards doing so. The authors find that the introduction of a symbolic reward increases the frequency of hostile acts to an average of 40% over the ten rounds compared with 13% in their baseline treatment. However, both treatments displayed similar dynamics of play. Specifically, although destruction rates remained significantly higher in the prize treatment throughout the experiment, these rates seemed to drop across both treatments after the first two periods, which could be attributed to the fear of retaliation.

Abbink, Masclet and Van-Veelen (2011) provide the first study on the role of framing when studying anti-social preferences. That is, to explore the influence of context, the authors reframe the simple money-burning task by altering the domain from that of gains to that of losses. For example, in the treatment representing losses, the question was framed as an option of paying to reduce the opponent's payoff whereas in the second treatment, the same task was framed as an option of being paid to increase the opponent's payoff.

Furthermore, Abbink, Masclet and Van-Veelen (2011) adjust the initial endowments of the participants to study whether starting from a point of advantageous or disadvantageous inequality had any impact on the decision to burn. While the authors find similar destruction rates overall, with burning taking place on average in 25.2% of cases within the negative framing framework and 24% in the positive framework, they find differences in the behavioural patterns of participants. More precisely, within the negative framing setting, they find that subjects exhibit equity aversion rather than inequity aversion, while in the positive setting, the relationship between advantageous and disadvantageous inequality is reversed. That is, while antisocial behaviour in the negative setting is seemingly being driven by what the authors argue is aggressive competitiveness i.e. the wish to enhance an already advantageous position; they find that in the positive

frame, antisocial behaviour is driven by the desire to close an unfavourable income gap.

Kessler, Ruiz-Martos and Skuse (2012) conduct a one-shot experiment with the destructor game. In this game, subjects first earn an endowment based on the completion of some tasks. Following this, participants are randomly paired and assigned the roles of a destructor and a passive subject. Each destructor then decides the percentage of their passive partner's earnings to destroy, with destruction being costless and hidden. In order to exclude inequity and equity aversion motives for destruction, only 1000 tokens earned from the initial tasks were vulnerable for destruction, with the total earnings of the passive subject remaining hidden. Each destructor could choose to destroy either 0%, 20% or 40% of the passive players endowment of 1000 tokens. Furthermore, for 20% of all passive players, "nature" destroys either 20% or 40% of the endowment, with equal probability. However, with the maximum destruction inflicted upon any passive participant capped at 40%, if both destructor and nature chose to destroy 40% of the passive player's earnings, then nature's destruction would be ineffective.

Using a large sample of 1212 students, the authors find that 15.5% of destructors chose to destroy their passive partner's endowment. Specifically, 8.7% of destructors destroyed 20% and 6.8% destroyed the maximum possible 40% of their partner's endowment. Following the experiment, participants were asked to complete various personality-related questionnaires on neuroticism and psychopathy. From this data, Kessler, Ruiz-Martos and Skuse (2012) find that destructive behaviour isn't significantly associated to any particular personality or psychopathic characteristics.

In a seminal study, Herrmann et al. (2008) document the widespread existence of antisocial punishment, which they define as the sanctioning of people who behave pro-socially. Using a public goods experiment with the added possibility of punishing group members, they investigate how an individual who has contributed a given amount to the public good punishes group members who either contributed less, the same amount or more than them. Importantly, the authors also study how this decision varies across cultural settings. Using a large sample of 1120 undergraduate students who then act in an identical environment

i.e. a laboratory setting, the authors find considerable and significant cross-societal heterogeneity in terms of differences in cooperation levels and anti-social punishment. For instance, while some participant pools showed little evidence of antisocial punishment, others seemed to punish those behaving more pro-socially than themselves as harshly as they did free-riders. Furthermore, contributions were highly and significantly different across pools, with the most co-operative pool contributing on average 90% of their endowment, which was 3.1 times higher than the least co-operative pool, with an average of 29%. Moreover, not only do Herrmann et al. (2008) find differences in punishment, but they also find differences in how participants react to punishment. That is, while punishment had an efficiency enhancing property in certain pools, in that it induced free-riders to increase contributions, participants from some pools took punishment a lot more negatively, which resulted in an increase in anti-social punishment. The authors argue that this is likely due to the way in which punishment is perceived across different cultures, with some reacting positively by increasing contributions and others seeking out revenge.

Fehr (2018) studies whether increasing inequality causes an increase in antisocial behaviour towards others. Subjects were randomly matched into groups of four and subsequently took part in a task to earn money. Fehr (2018) implements two treatments which involve paying a bonus to the highest performing member and allowing members to cheat by paying to artificially increase their performance before their scores are revealed. Following the completion of this task, subjects were given information regarding their performance relative to other group members and were given the opportunity to pay to burn up to half of the income of another group member. Only the decision of one randomly selected group member was implemented. Fehr (2018) finds evidence to suggest that the extent of antisocial behaviour depends upon whether the increase in inequality can be attributed to effort and how transparent the cause of the inequality was.

To summarise, previous studies have found evidence of both prosocial and anti-social behaviour within a lab-setting. As described above, the existence of such preferences has typically been tested by presenting subjects with narrow choice-sets such

as the binary choice of either doing nothing or burning an opponent's endowment. Under such a setting, evidence of burning would then be used in support of the proposition that agents do exhibit antisocial preferences. Moreover, a growing strand of literature has shown that the preferences and decisions of agents are in general sensitive to changes in the context and situation in which they are made. Our study contributes to the existing literature in a few ways.

First, we attempt to mitigate any potential experimenter demand effects by offering subjects a broader choice-set which includes the option to give, take, do nothing and insure. In other words, if the decision to be made by subjects involves two options i.e. to steal money or do nothing, then this could act as a cue as to what constitutes appropriate behaviour within the experimental setting and thus influence the behaviour of subjects (see Zizzo 2010). Therefore, framing the question more naturally by allowing subjects the option to give, take, do nothing, insure, as well as implementing an initial effort stage whereby subjects may feel as though the endowment is earned rather than arbitrarily allocated, could arguably bring behaviour into closer alignment with a subject's true preferences.

The main area of novelty in our experiment lies in the introduction of an option for subject's to purchase insurance. Allowing subjects to insure could provide insight not only into whether there is a shift towards insuring and the determinants of insurance demand, particularly when insurance is a dominated strategy in monetary terms, but also how this impacts the extent to which subjects choose the other three options available to them. More precisely, as subjects in our experiment can only choose one option i.e. give, take, do nothing or insure (in the insurance treatment), it is of interest to examine whether the shift towards insurance is driven by a reduction in taking, the choice to do nothing or the crowding out of prosocial giving.

Additionally, by incorporating both a take-and-keep treatment where subjects can keep any money they take from their opponent and a take-and-burn treatment whereby the endowment is simply burned, we are able to provide insight into whether the switch from take-and-keep to take-and-burn impacts the degree of antisocial and prosocial behaviour symmetrically. This would also enable us to explore if subjects are willing to trust their opponent

to not engage in burning (as this always implies a net monetary loss for both parties) and jointly maximize payoffs through doing nothing, or whether insurance serves an important and justified role under such circumstances.

4.3. EXPERIMENT DESIGN

Our experimental study employs a 2 x 2 design, crossing the type of taking i.e. take-and-keep or take-and-burn, with the ability to insure i.e. insurance or no insurance. This gives us four treatments, as outlined in Table 4.1.

	Insurance vs No Insurance	
Keep vs Burn	No Insurance	Insurance
Take-and-Keep	Give-Take (GT)	Give-Take-Insure (GTI)
Take-and-Burn	Give-Burn (GB)	Give-Burn-Insure (GBI)

Table 4.1. Treatments

The experiment consisted of three stages. In the first stage of our experiment, we generate an initial distribution of earnings by asking subjects to complete a cyber-security themed multiple-choice problem set consisting of fifteen questions. Subjects were randomly assigned an opponent from within the experimental session. One member of the pair was randomly allocated Quiz A while the other was given Quiz B, with the difference between the two being that the questions in Quiz A were intended to be more difficult than those in Quiz B[23]. The endowment earned was therefore exogenously determined by random allocation to Quiz A or Quiz B, hence, there is no endogeneity problem. After each pair had completed their respective question sets, their payoffs were determined based on a winner-takes-all tournament model whereby the player within each pair that had answered the most questions correctly was allocated £10 and their opponent was

[23] The instructions explicitly said that the other person may have different questions to you and so there was no deception

given nothing[24]. However, each subject was also allocated a £5 participation fee which was added to their earnings from this round to determine the player's endowment for the subsequent round.

Once all participants had completed the first stage of the experiment, we moved onto the second stage. In the second stage, subjects were again randomly paired up with another individual from within the experimental session and were made aware that their opponent in the second stage differed from their opponent in the first stage of the experiment. Each pair intentionally consisted of one winner from the first stage, who we refer to as the "rich" subjects or players and one loser from the first stage, who we label as being the "poor" subjects or players. Both players were then told the payoff they had earned from the first stage as well as the payoff of their opponent.

It is important to note that in stage 1, subjects that were randomly allocated the easier questions i.e. Quiz B, always won the initial competition. As such, these subjects were always the "rich" players in stage 2, whilst those allocated the more difficult questions i.e. Quiz A, were invariably the "poorer" players. Additionally, whilst subjects were told the payoff of their opponent at the beginning of stage 2, they were not informed about the varying levels of difficulty of to the problem sets that both they and their opponent had completed. To be more specific, the information set of each subject solely consisted of a) their own payoff and b) their opponent's payoff. That said, given the instructions from stage 1, subjects would have also known that the rich player was a winner in the stage 1 competition whilst the poorer player must've lost against their opponent in stage 1.

Given that we are introducing a novel experiment through incorporating a blocking or insurance strategy, our primary objective for this particular study was to provide a simple setup in order to test whether blocking is indeed an important component of the give, take and do nothing mix. However, there are several interesting future extensions of our benchmark setup. For instance, changing the information set could provide us with important insights. In our experiment, subjects don't have

[24] The instructions indicated that in the case of a tie one subject would randomly be chosen to receive the £15.

information regarding the cause of inequality i.e. effort or luck. With a large enough sample, one could easily adapt our design so as to test whether providing subjects with such information at the beginning of stage 2 has any significant effect on behaviour. Moreover, another interesting extension would be to provide information on the opponent's personal characteristics, such as social group e.g. gender or religion. This could contribute to the literature exploring whether subjects behave differently or in a discriminatory way when interacting with in-group versus out-group members i.e. interaction between people within the same, versus different, social groups[25].

Subjects were subsequently asked to choose *one* option from the choice-set presented to them. In the no insurance treatments, subjects were given the option to a) take up to £2.50 from their opponent at a cost of 10p for every 50p taken b) give up to £2.50 to their opponent at a cost of 10p for every 50p given or c) do nothing. In the insurance treatments, subjects had a further choice of d) paying £1.00 to insure themselves by blocking their opponent from being able to take their money. That is, as the choices of subjects were not revealed to their opponents, if a player chose to purchase insurance, any attempt to take their money would still incur the fixed cost of taking i.e. 10p per 50p taken, however, the subject trying to take would be blocked from being able to access the insured player's endowment.

Importantly, in the burning treatments, the amounts taken (option (a)) were not transferred to or kept by the taker. Rather, subjects were given the option to pay, under the same price structure as in the no-burning treatments, to simply reduce, or "burn", up to £2.50 of their opponent's endowment.

It is worth noting that the label of insurance on our additional strategy is derived from the underlying motivation of our study. However, given our design, this strategy doesn't involve many aspects of insurance that are found in the real-world economy, such as risk-pooling. Therefore, although we refer to our additional strategy as insurance throughout this chapter, one may consider the label of blocking more accurate, as subjects are essentially given the ability to use a prevention mechanism

[25] See, for example, Chakravarty et al. (2019).

(perfect prevention in our case) that allows them to unilaterally block their opponent from accessing their endowment.

To reinforce the discussion above, let e_i denote the endowment of the two subjects. Let g_i and t_i denote the amount subject i gives and takes, respectively. Finally, let s_i be an indicator variable that says whether or not subject i paid for insurance. In the Give-Take treatment the payoff of subject 1 matched with subject 2 (in pounds sterling) is

$$u_A = e_A - 1.2g_A + g_B + 0.8t_A - t_B \tag{4.1}$$

In the Give-Burn treatment the payoff of subject 1 is

$$u_A = e_A - 1.2g_A + g_B - 0.2t_A - t_B \tag{4.2}$$

In the Give-Take-Insure treatment the payoff of subject 1 is

$$u_A = e_A - 1.2g_A + g_B - 0.2t_A + t_A(1 - s_B) - t_B(1 - s_A) - s_A \tag{4.3}$$

In the Give-Burn-Insure treatment the payoff of subject 1 is

$$u_A = e_A - 1.2g_A + g_B - 0.2t_A - t_B(1 - s_A) - s_A \tag{4.4}$$

It is worth noting that whilst subjects can engage in transfers so as to equalise their payoffs in the Give-Take treatment, the richer player will always earn more than the poorer player in the Give-Burn treatment. Specifically, assuming that the rich player decides to give the maximum amount of £2.50 to their poorer opponent and that the poor player takes the maximum amount of £2.50 from their richer counterpart, then from equation (4.1) above, their respective payoffs in the Give-Take treatment can be calculated as:

$$u_{Rich} = 15 - 1.2(2.50) - 2.50 = 9.50 \tag{4.5}$$

$$u_{Poor} = 5 + 2.50 + 0.8(2.50) = 9.50 \tag{4.6}$$

Since subjects cannot take and keep money in the Give-Burn treatment, any amount taken by the poor player would reduce inequality by less than it would have in the Give-Take treatment. It is clear from equation (4.2) that under the assumption that the rich player gives £2.50 and the poor player takes £2.50 in the

Give-Burn treatment, the former's payoff function would be identical to that in equation (4.5) whilst the poor player's payoff would now be calculated as:

$$u_{Poor} = 5 + 2.50 - 0.2(2.50) = 7.00 \quad (4.7)$$

It is important to reiterate that subjects could only choose *one* of the options available and therefore couldn't simultaneously give, take or insure. The instructions are made available in the appendix.

Following the completion of the second stage of the experiment, subjects moved onto the final stage in which they answered a questionnaire that was intended to gather information on demographic and other control variables. The experiment was run using pen and paper on the campus of the University of Kent in Canterbury, United Kingdom. We were able to recruit 78 participants who consisted of both undergraduate and postgraduate students from within the university. The sample size breakdown is reported in Table 4.2. The final earnings were calculated as the initial endowment the players had earned in Stage 1 plus a £5 participation fee and the net transfer from the second stage.

Treatment	Sample Size
Give-Take	22
Give-Burn	20
Give-Take-Insure	20
Give-Burn-Insure	16
Total	78

Table 4.2. Sample Size Breakdown

4.4. THEORETICAL RESULTS

Four models of social-preferences are particularly relevant to the experimental design of our study. First, the model of narrow self-interest, which serves as a useful benchmark against other models of social-preferences in terms of expected behaviour, is based upon the assumption that agents are solely concerned with

the maximization of their personal monetary payoffs. In accordance with this model, the preferences of agents can be represented by the following straightforward utility function:

$$U_A = u_A \tag{4.8}$$

Where u_A indicates the monetary payoff of the agent. As described, the utility of agents is increasing in only their own monetary payoff. In other words, the higher an individual's monetary payoff, the higher is their utility.

While the model of narrow self-interest is commonly applied throughout the economic literature, numerous studies have found the assumption of agents being entirely self-regarding to be overly simplistic and inaccurate across a multiplicity of contexts. As mentioned earlier, prior literature has provided strong evidence for the existence of so-called other regarding preferences. The seminal model of inequality aversion (Fehr and Schmidt 1999) provides an extension to the model of narrow self-interest by postulating that individuals are not only positively concerned about their own monetary payoffs but are also negatively affected by the difference between their own payoff and that of the other.

Therefore, if agents display inequality aversion i.e. they dislike inequality, then they may be willing to sacrifice a percentage of their own wealth or endowment for the purpose of reaching a more egalitarian distribution of outcomes through reallocation. Under a simple two-person setting, the utility function of agents within the model of inequality-aversion can be written as:

$$U_A(u_A, u_B) = u_A - a_A \max\{u_B - u_A, 0\} - \beta_A max\{u_A - u_B, 0\} \tag{4.9}$$

Where u_A indicates the monetary payoff to Person A and u_B denotes the payoff to Person B. The second term on the right hand side of the equation measures the loss of utility from disadvantageous inequality. The larger the parameter a_A, which is sometimes referred to as a measure of envy, the more Person A dislikes disadvantageous inequality. Similarly, the third term measures the loss of utility from advantageous inequality. The larger the parameter β_A, also described as a parameter measuring the degree of guilt, the more Person A dislikes advantageous inequality. In their original study, Fehr and Schmidt (1999) assume that $0 \leq \beta < 1$, which not only implies that agents do not enjoy advantageous inequality but that they also wouldn't be

willing to burn their own money to mitigate an advantageous position. An additional assumption made by Fehr and Schmidt (1999) is that $a_A \geq \beta_A$. In other words, individuals dislike disadvantageous inequality i.e. being poorer than the other, more than they dislike advantageous inequality i.e. being richer than the other.

While the assumption that agents hold a greater aversion towards disadvantageous inequality in comparison to advantageous inequality has a strong intuitive appeal and is also supported by prior findings in social psychology (Messick and Sentis (1985) and Loewenstein et al. (1989)), more recent studies have found this assumption to be regularly violated empirically (Dannenberg et al. (2007), Bellemare et al. (2008), Blanco et al. (2011) and Yang et al. (2016)).

A further important form of other-regarding preferences that has received widespread empirical support is that of altruism. The model of altruism posits that agents are not only concerned about their own wealth or payoffs but that they also care positively about the payoff of others. In this study, we consider a model of altruism based upon a restricted version of the Fehr and Schmidt (1999) model presented above. Under the simple two-individual setting in this model, the utility function of agents is written as:

$$U_A(u_A, u_B) = u_A - \theta_A max\{u_A - u_B, 0\} \tag{4.10}$$

Where the parameter θ measures, and is increasing in, the degree of altruism. It is assumed that $0 < \theta_A \leq 1$. Hence, the larger the parameter of altruism the more the subject cares about the monetary payoff of the other. If $\theta = 1$ then the subject cares about the monetary payoff of the other as much their own payoff. As shown in (4.10), the utility of agents is decreasing in the amount of advantageous inequality whilst being unaffected by disadvantageous inequality, which differentiates this model of altruism from the model of inequality-aversion described above. That is, if Person A is richer than Person B, then the second term on the right hand side of equation (4.10) is positive. In contrast, if Person A is poorer than Person B, this term then becomes irrelevant.

The final model of social-preferences we take into consideration is that of spite (or envy)[26]. This model assumes that an agent's utility is a positive function of their personal monetary payoff but, as spiteful or envious agents dislike being worse off than others, their utility is decreasing in the size of any disadvantageous inequality. Similar to the model of altruism presented above, the model of envy constitutes a restricted form of the Fehr and Schmidt (1999) model of inequality-aversion. In the two-person case, the utility function of agents is expressed as:

$$U_A(u_A, u_B) = u_A - \lambda_A max\{u_B - u_A, 0\} \quad (4.11)$$

Where the parameter $0 < \lambda \leq 1$ provides a measure of the degree of envy. If $\lambda = 1$, the subject cares about disadvantageous inequality as much as their own monetary payoff. As described, an envious agent's utility is decreasing in both the degree of envy and the extent of disadvantageous inequality. If the subject has a higher payoff than their opponent i.e. $u_B - u_A < 0$, then the second term on the right hand side of the equation becomes irrelevant and the utility function becomes identical to that in the model of narrow self-interest as in (4.8).

4.4.1. Theoretical Results for Self-Motivated

We take it as given that there will be heterogeneity across the population in terms of social-preferences. Therefore, some people behave as if maximising their personal monetary payoff, others inequality averse and so on. In the following, we derive results regarding the possible behaviour of subjects in our experiment based on the four models of social-preferences. These results are also summarised in Table 4.3. We begin with a result that requires no proof.

Proposition 1: An individual who is concerned with maximizing their personal monetary payoff should take the maximum £2.50 in the Give-Take treatment and do nothing in the Give-Burn treatment.

You can see that in the treatments without insurance, the optimal behaviour of a selfish individual does not depend on the behaviour of their opponent. Once we add insurance this changes. Now

[26] Note that for the purposes of this study we use the terms spite and envy interchangeably.

optimal behaviour depends upon an individual's belief about the likelihood that their opponent will take or insure. To formally capture this, let p_a denote the probability individual A puts on their opponent choosing to take £2.50.[27] Let q_a denote the probability they assign to their opponent insuring. The expected payoff of person A if they decide to take £2.50 in the GTI treatment is then given by:

$$u_A = e_A + g_B - 0.5 + 2.50(1 - q_A) - 2.50p_A \tag{4.12}$$

Since any amount taken wouldn't be transferred to person A in the GBI treatment but would still incur the cost of burning, the expected payoff from choosing to take in the GBI treatment would then be:

$$u_A = e_A + g_B - 0.5 - 2.50p_A \tag{4.13}$$

The expected payoff from choosing to insure remains constant across both the GTI and GBI treatment:

$$u_A = e_A + g_B - 1 \tag{4.14}$$

As does that from doing nothing:

$$u_A = e_A + g_B - 2.50p_A \tag{4.15}$$

Consider, first, the GTI treatment. Comparing equations (4.12) and (4.14) we see that take is preferred to insure if

$$e_A + g_B - 0.5 + 2.50(1 - q_A - p_A) > e_A + g_B - 1 \tag{4.16}$$

Which must the case (because $1 \geq q_A + p_A$). Hence it is never optimal for a self-regarding player to insure. It then follows that a self-regarding subject would take if the expected payoff from doing so is higher than the expected payoff of doing nothing i.e.

$$e_A + g_B - 0.5 + 2.50(1 - q_A) - 2.50p_A > e_A + g_B - 2.50p_A \tag{4.17}$$

This simplifies to $q_A < 0.8$. Hence, if the self-regarding subject expects that there is less than 80% chance of their opponent insuring, then they should take. If they believe that there is over 80% chance of their opponent insuring they should do nothing.

[27] For simplicity we assume that the opponent either takes the maximum £2.50 or nothing.

This result implies that selfish subjects have a strong incentive to take.

Proposition 2: An individual who is concerned with maximizing their personal monetary payoff should not insure in the Give-Take-Insure treatment. They should take unless they believe the probability their opponent will insure is 80% or more.

Consider now the GBI treatment. In this case, comparing equations (4.13) and (4.15) we see that doing nothing is better than take. From equations (4.13) and (4.14) we see that a selfish subject does best to do nothing if

$$e_A + g_B - 2.50p_A > e_A + g_B - 1 \tag{4.18}$$

Which simplifies to $p_A < 0.4$. In other words, as long as the selfish player attaches a probability of less than 40% to their opponent choosing to take, they should do nothing. If they assign a probability higher than 40%, they should insure.

Proposition 3: An individual who is concerned with maximizing their personal monetary payoff should not take in the Give-Burn-Insure treatment. They should insure if they believe the probability their opponent will take is more than 40%.

4.4.2. Theoretical Results for Social-Preferences

The results for selfish subjects already tell us a lot about subjects with social-preferences. For instance, for a poor altruistic subject, since $max\{u_A - u_B, 0\} = 0$ (see (4.10)), the utility function and thus optimal strategy always coincides with that of a selfish subject. Likewise, for a rich, envious subject, since $max\{u_B - u_A, 0\} = 0$, the optimal strategy coincides with that of a selfish subject.

For a first consequence of inequality aversion and envy consider a poor inequality averse (or envious) individual in the Give-Burn treatment. If they do nothing their payoff is

$$U_A = 5 + g_B - t_B - a_A(15 - 1.2g_B - 0.2t_B - 5 - g_B + t_B) \tag{4.19}$$

If they burn the £2.50 their payoff is

$$U_A = 4.5 + g_B - t_B - a_A(12.5 - 1.2g_B - 0.2t_B - 4.5 - g_B + t_B) \tag{4.20}$$

Comparing equations (4.19) and (4.20) we get that it is optimal to burn if

$$4.5 - a_A(8 - 2.2g_B + 0.8t_B) > 5 - a_A(10 - 2.2g_B + 0.8t_B) \qquad (4.21)$$

This simplifies to $a_A > 0.25$. A value of $a_A = 0.25$ would be interpreted as a relatively low level of inequality aversion. We see, therefore, that a poor subject who is inequality averse or envious should burn. Recall that a selfish or altruistic subject would not.

Proposition 4: A poor individual who is inequality averse or envious should burn in the Give-Burn treatment.

Consider next a rich inequality averse individual in the Give-Take treatment. If they give £2.50 their payoff is

$$U_A = 12 + g_B - t_B - \beta_A(12 + g_B - t_B - 7.5 + 1.2g_B - 0.8t_B) \qquad (4.22)$$

If they take £2.50 their payoff is

$$U_A = 17 + g_B - t_B - \beta_A(17 + g_B - t_B - 2.5 + 1.2g_B - 0.8t_B) \qquad (4.23)$$

If they do nothing their payoff is

$$U_A = 15 + g_B - t_B - \beta_A(15 + g_B - t_B - 5 + 1.2g_B - 0.8t_B) \qquad (4.24)$$

Comparing equations (4.22), (4.23) and (4.24) we get that it is optimal to give if

$$12 - \beta_A(4.5 + 2.2g_B - 1.8t_B) > 15 - \beta_A(10 + 2.2g_B - 1.8t_B) \qquad (4.25)$$

This simplifies to $\beta_A > 6/11$. It is optimal to do nothing if $6/11 > \beta_A > 4/9$ and to take if $4/9 > \beta_A$. Depending on the level of altruism a rich inequality averse individual may, therefore, decide to do nothing or give. Repeating this exercise for the Give-Burn treatment you can see that it is optimal for the rich individual to give if $\beta_A > 6/11$ and to do nothing otherwise.

In interpretation, a value of β_A around 0.5 would be relatively high and so subjects with a low level of inequality aversion or altruism would still take in the GT treatment and do nothing in the GB treatment. Only those with a high level of inequality aversion or altruism would give.

Proposition 5: A rich individual who is sufficiently inequality averse ($\beta_A > 6/11$) or altruistic ($\theta_A > 6/11$), should give in the Give-Take and Give-Burn treatments.

It remains to consider the effect of insurance on those with social preferences. If a rich inequality averse individual is willing to give money to their opponent then it follows that they gain utility from their opponent taking money (see equation (4.22)). It is, therefore, clearly not in their interests to insure. This holds in both the GTI and GBI treatments.

Proposition 6: A rich individual who is sufficiently inequality averse ($\beta_A > 6/11$) or altruistic ($\theta_A > 6/11$), should never insure.

The logic of Proposition 2 applies in the case of inequality aversion. So, in the GTI treatment a poor individual would never insure. A poor individual would consider insurance in the GBI treatment. To illustrate, consider an individual with $a_A > 0.25$, meaning that burn is preferred to doing nothing. Again, let p_a denote the probability individual A puts on their opponent choosing to take £2.50. Let q_a denote the probability they assign to their opponent insuring. Let h_a denote probability of giving £2.50. If individual A burns the £2.50 their expected payoff is

$$U_A = 4.5 + 2.5h_a - 2.5p_a - a_A(12.5 - 3h_a - 0.5p_a + 1.5q_a - 4.5 - 2.5h_a + 2.5p_a) \quad (4.26)$$

If they insure their expected payoff is

$$U_A = 4 + 2.5h_a - a_A(15 - 3h_a - 0.5p_a - q_a - 4 - 2.5h_a) \quad (4.27)$$

Comparing equations (4.26) and (4.27) we get that it is optimal to insure if

$$4 - a_A(11 - 0.5p_a - q_a) > 4.5 - 2.5p_a - a_A(8 + 1.5q_a + 2p_a) \quad (4.28)$$

This simplifies to $2.5p_a(1 + a_A) > 0.5 + a_A(3 - 2.5q_a)$. Suppose, for example, that $a_A = 0.5$, then, it would be optimal to insure if $p_a > 0.53 - 0.33q_a$.

Proposition 7: A poor individual will never insure in the Give-Take-Insure treatment. They may insure in the Give-Burn-Insure treatment if they consider the probability their opponent will take is sufficiently large.

4.4.3. Hypotheses

The 7 propositions above are summarised in Table 4.3. Building on these propositions we suggest the following testable hypotheses. Our first hypothesis is based upon what we would expect if subjects are selfish:

		Treatment			
Preferences	Player	GT	GB	GTI	GBI
Selfish	Rich	Take	Nothing	Take or Nothing	Nothing or Insure
	Poor	Take	Nothing	Take or Nothing	Nothing or Insure
Inequality-Averse	Rich	Give	Give	Give	Give
	Poor	Take	Burn	Take	Burn
Altruism	Rich	Give	Give	Give	Give
	Poor	Take	Nothing	Take or Nothing	Nothing or Insure
Spite	Rich	Take	Nothing	Take or Nothing	Nothing or Insure
	Poor	Take	Burn	Take	Burn

Table 4.3. Summary of Propositions

Hypothesis 1: Subjects will take in the GT and GTI treatments and do nothing in the GB and GBI treatments.

Since it is never optimal for selfish subjects to give or burn, evidence of either would imply that subjects hold other-regarding preferences. The only caveat is the GBI treatment where it can be optimal for a selfish subject to insure if they believe their opponent will burn.

Hypothesis 2: Subjects will not insure in the GTI treatment. And will only insure in the GBI treatment if they expect their opponent to burn.

We have shown that it is never optimal for selfish, inequality-averse, altruistic or spiteful agents to insure in the GTI treatment. This is a clear prediction from our theoretical analysis. Another clear prediction of our analysis concerns rich subjects.

Hypothesis 3: Rich subjects should never burn their opponent's money.

Evidence of burning by the rich would add support to the so-called "nastiness hypothesis" (Abbink and Sadrieh 2009) which

postulates that antisocial behaviour is driven by an intrinsic pleasure derived from lowering the well-being of others rather than purposes such as eliminating inequality (Zizzo and Oswald 2001).

Our final hypothesis is based on the original assumption made by Fehr and Schmidt (1999) and earlier studies finding that subjects tend to show a general tendency towards holding a greater aversion towards disadvantageous inequality than to advantageous inequality (Messick and Sentis (1985) and Loewenstein et al. (1989)).

Hypothesis 4: Overall, subjects will give less than they will take.

As explained earlier, the more recent literature has found evidence that individuals may holder a stronger aversion to advantageous inequality. If so, then we could see higher levels of giving than taking.

4.5. RESULTS

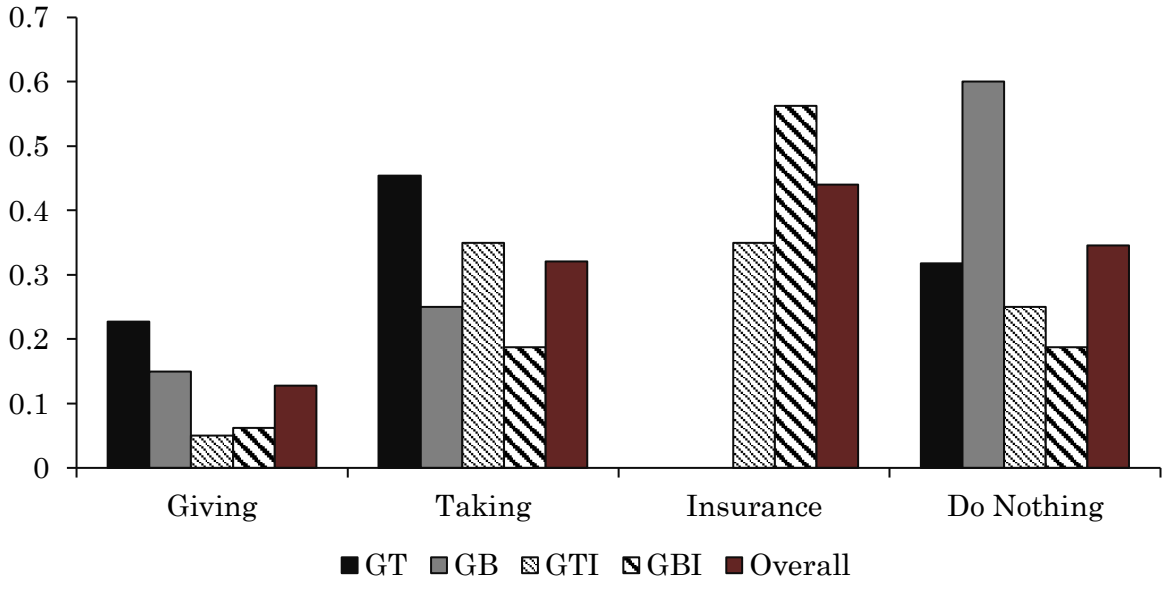


Figure 4.1. Observed Choices across Treatments

Figure 4.1 reports the distribution of choices i.e. the fraction of subject's who chose to give, take, do nothing or insure across treatments. You can see that around 50% of subjects choose to insure. So, insurance is a far more popular choice than our

theoretical analysis would predict. To explore this and other findings, we consider, in turn, giving, taking and insurance.

4.5.1. Giving

Finding 1: We observe that, on average, around one in ten subjects decided to give money to their opponent.

Our results show that approximately 13% of subjects, on average, decided to transfer money to their opponents ($p = 0.00$, T-Test on giving being above 0). This finding indicates the existence of some form of altruistic or inequality-averse preferences and provides support against the model of narrow self-interest (see Hypothesis 1) according to which subjects should have never voluntarily transferred money towards their opponent (see Table 4.3).

Figure 4.2 shows the fraction of rich and poor subjects that chose to give across treatments. Giving was, as expected, overwhelmingly driven by rich players. 9% of poor subjects chose to give in the GT treatment ($p = 0.32$, T-Test) whereas there was no giving by poor subjects in any other treatment. By comparison, 36% of rich players gave money to their opponents in the GT treatment ($p = 0.04$, T-Test) and 30% of rich subjects gave in the GB treatment ($p = 0.08$, T-Test). Giving by the rich fell to 10% in the GTI treatment ($p = 0.34$, T-Test) and 13% in the GBI treatment ($p = 0.35$, T-Test).

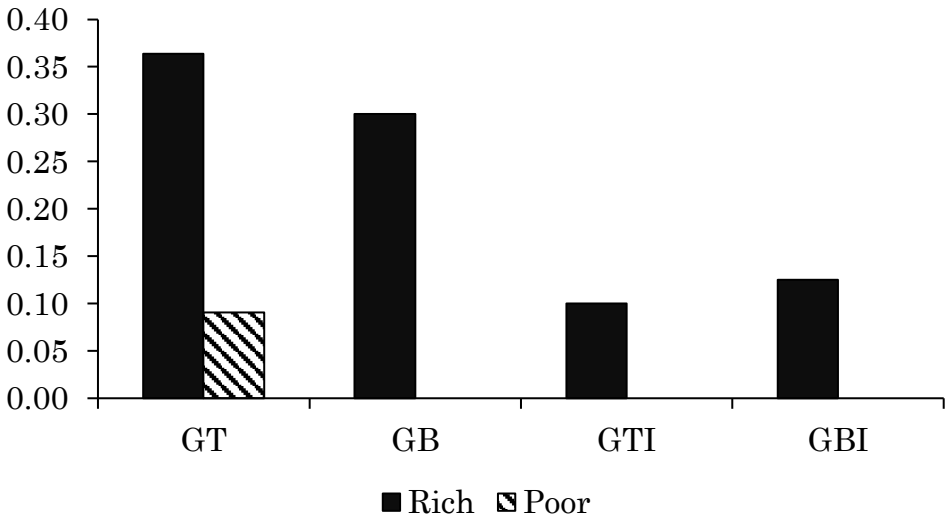


Figure 4.2. Giving by Rich and Poor across Treatments

Finding 2: Extending the choice-set to include the option to insure lowers giving.

The fraction of subjects that decided to give money to their opponents fell from 23% in the GT treatment to 5% in the GTI treatment (giving in the GT versus GTI treatment, p = 0.10 Proportions Test, p = 0.08 T-Test) and from 15% in the GB treatment to 6.25% in the GBI treatment (p = 0.41 Proportions Test, p = 0.38 T-Test). If we compare the proportion of subjects willing to give in the no insurance treatment i.e. GT plus GB with the proportion of subjects willing to give in the insurance treatment i.e. GTI plus GBI, we find that extending the choice-set to include the option to insure significantly lowers the fraction of subject's willing to give from 19% to 6% (p = 0.08 Proportions Test, p = 0.06 T-Test). Our results show a marginally significant reduction in the fraction of rich subjects willing to give from 33% in the no insurance treatment to 11% in the insurance treatment (p = 0.10 Proportions Test, 0.07 T-Test).

Our theoretical analysis suggested that the introduction of an insurance option, ceteris paribus, shouldn't influence subjects' willingness to give. Basically, if a subject is willing to give then they should also be willing to let their opponent take. The apparent reversal in generosity observed in our experiment is consistent with the so-called contextual preference reversal and reference dependence of preferences (see Easterlin (1995), Clark and Oswald (1996), Kahneman et al. (2000), Laynard (2003), List (2007) and Bardsley (2008)). In particular, the choice set may have served as an indicator of appropriate behaviour and social norms. For instance, the option of insurance may have led to subjects to put more weight on their opponent taking, which then crowds out a desire to give.

Finding 3: There is no statistically significant difference in giving between the taking and burning treatments.

Overall, we find that 11% of subjects gave in the burn treatment whereas 14% of subjects chose to give in the taking treatment (giving in the taking versus burn treatment, p = 0.68 Proportions Test, p = 0.11 T-Test). Similarly, 24% of rich subjects chose to give in the take-and-keep treatment whereas 22% gave in the burn treatment (p = 0.91 Proportions Test, p = 0.91 T-Test).

Thus, while expanding the available choice-set by offering the option to insure crowds out giving, we find no evidence to suggest that the switch from take-and-keep to take-and-burn influences the choice to give.

4.5.2. Taking

Finding 4: Extending the choice-set to include the option to insure has no significant effect on taking.

On average, 32% of subjects decided to take money from their opponents ($p = 0.01$, T-Test on taking being above 0). Overall, we find no significant difference in the proportion of subjects that decided to take in the insurance and no insurance treatments ($p = 0.45$ Proportions Test, 0.46 T-Test). This result holds across rich and poor subjects. In particular, although the fraction of rich players that took fell from 24% in the no insurance treatment to 11% in the insurance treatment, we do not find evidence of a statistically significant difference across treatments (taking by the rich in the insurance versus no insurance treatment, $p = 0.30$ Proportions Test, $p = 0.30$ T-Test). The fraction of poor subjects that took also fell insignificantly from 48% in the no-insurance treatment to 44% in the insurance treatment ($p = 0.84$ Proportions Test, $p = 0.84$ T-Test).

Finding 5: Taking was significantly lower in the burning treatment relative to the take-and-keep treatment.

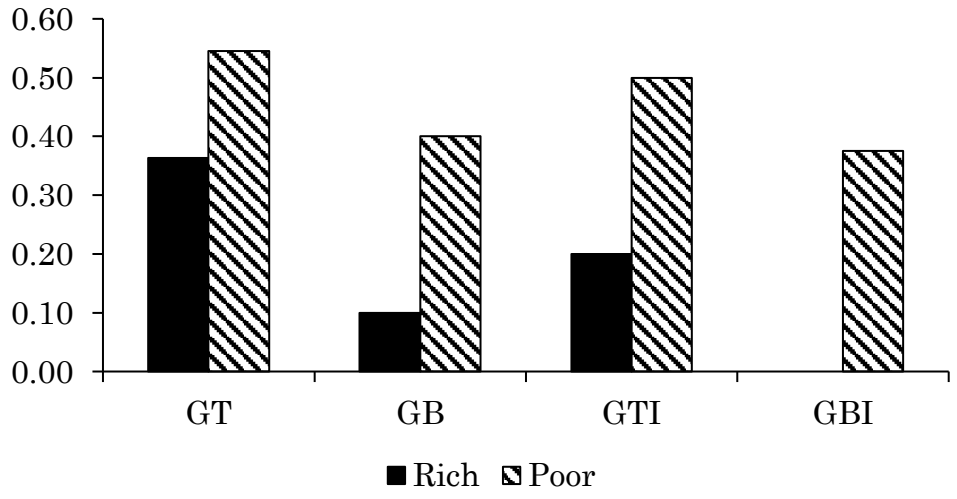


Figure 4.3. Taking by Rich and Poor Subjects

We find evidence of a reduction in the fraction of subjects that decided to take from 40% in the taking treatment to 22% in the burning treatment (taking in the taking versus burn treatment, $p = 0.09$ Proportions Test, $p = 0.07$ T-Test). Interestingly, this result doesn't hold when we compare the behaviour of rich and poor players. In particular, as shown in Figure 4.3, we find that the fraction of rich subjects that took fell from 29% in the taking treatment to 6% in the burning treatment ($p = 0.06$ Proportions Test, $p = 0.05$ T-Test) while the fraction of poor subjects that took fell insignificantly from 52% in the taking treatment to 39% in the burning treatment ($p = 0.40$ Proportions-Test, $p = 0.40$ T-Test). Moreover, while taking by the poor is individually significant in every treatment ($p = 0.01$ (GT), $p = 0.04$ (GB), $p = 0.02$ (GTI), $p = 0.08$ (GBI)), our results suggest that taking by the rich is only significant in the GT treatment ($p = 0.04$).

Our finding of there being no statistical difference in the fraction of poor subjects that took across the taking and burning treatments lends support to the notion that burning is primarily driven out of an aversion towards disadvantageous inequality (Zizzo and Oswald 2001) rather than pure nastiness (Abbink and Sadrieh 2009). That is, the absence of any significant burning by rich subjects implies that we do not find evidence in support of the so-called nastiness hypothesis which postulates that observed antisocial behaviour is triggered by an intrinsic pleasure derived from lowering the well-being of others. Rather, the decrease in the fraction of rich subjects that took in the burn treatment relative to the take-and-keep treatment suggests that taking by the rich was primarily motivated by self-interest rather than pure nastiness, which adds support towards Hypothesis 3.

The fact that we do not observe any significant difference in taking across the take-and-keep and burn treatments among poor subjects raises an interesting question regarding the external validity and thus real-world implications of our findings. That is, we show that in a lab setting, subjects were willing to incur a net personal cost in order to counter disadvantageous inequality. This finding is in line with a number of studies that have shown that individuals derive utility from relative status (Frank (1985), Robson (1992), Solnick and Hemenway (2007) and Grolleau and Said (2009)), that they dislike being of a lower rank than others

(Bault et al. (2008) and Ferrer-i-Carbonnel (2005)) and that they are willing to invest resources to prevent themselves from being beneath others (Beckman et al. (2002) and Zizzo and Oswald (2001)).

However, while taking money in the take-and-keep treatment involved a reallocation of wealth and possible net advantage in monetary terms for the taker, evidence of burning implies that agents were willing to waste resources and lower the level of tangible welfare in order to improve their relative position in the income hierarchy. At a more practical level, there are numerous documented accounts of hostility towards individuals that are more successful than the perpetrators (Smith 1990, Mui 1995 and Fehr 2015).

Several authors have argued that such sabotaging behaviour targeted at better-off individuals can discourage entrepreneurship, innovation, economic growth and development (Schoeck (1966), Mui (1995), Caplan et al. (2005) and Fehr (2018)). The ramifications of such behaviour are therefore likely to have a negative feedback effect on saboteurs in the longer-run. In combination with the common finding within the empirical literature showing that poorer households tend to depict a higher degree of impatience in terms of their time-preferences (see Carvalho 2010), if poorer agents don't place a high enough weight on future prospects, then this result may further suggest that poorer agents are more willing to directly inflict punishment upon others and inadvertently promote self-sabotage in the longer-term as a consequence.

Moreover, this result could also be relevant for discussions on organizational settings. For instance, several organizations commonly implement tournament or competition-type compensation schemes whereby earnings and promotions are dependent upon relative performance comparisons (Bognanno 2001, Bothner, Kang and Stuart 2007 and Casas-Arce and Martinez-Jerez 2009). However, in combination with earlier studies, our results suggest that such setups could elicit negative emotions and interactions which may ultimately hamper cooperation between agents.

4.5.3. Transfer Amounts

Finding 6: Subjects that chose to give transferred less money in the burning treatments in comparison to the taking treatments whereas there is no significant difference in the amounts taken across the taking and burning treatments.

Figure 4.4 reports the distribution of the amounts taken across treatments. The data shows a strong negative distribution for the amounts taken. 82% of subjects that took decided to take the full amount in the take-and-keep treatment and 75% took the full amount in the burning treatment. We find no significant difference in the proportion of subjects taking the maximum amount possible in the burning and taking treatments ($p = 0.67$ Proportions Test, $p = 0.68$ T-Test).

Figure 4.5 highlights the distribution of the amounts given across treatments. As shown, the distribution of the amount given is substantially less skewed in comparison to the distribution of the amounts taken. While our results showed no significant difference in the proportion of subjects that decided to take the full amount across the take-and-keep and burning treatments, we find a significant reduction in the fraction of subjects that *gave* the full amount, from 67% in the take-and-keep treatments, to no subject transferring the maximum amount of £2.50 in the burning treatments (giving in the taking versus burn treatments, $p = 0.04$ Proportions Test, $p = 0.00$ T-Test).

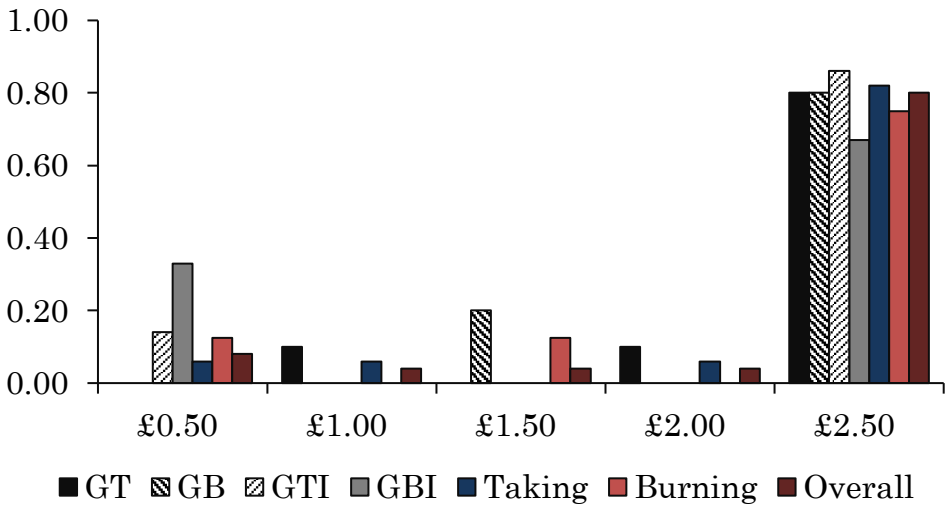


Figure 4.4. Amount Taken across Treatments

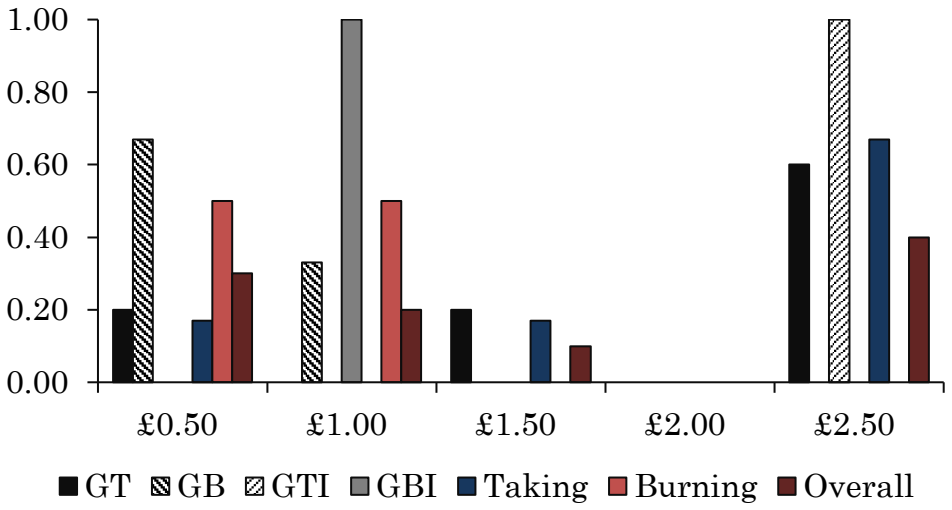


Figure 4.5. Amount Given across Treatments

Figures 4.6 and 4.7 display the distribution of the amounts given and taken by rich players across the take-and-keep and burning treatments. Similar to above, we find that the distribution of the amounts taken displays greater skewness in comparison to the distribution of the amounts given. 67% of rich subjects who took decided to take the full amount in the taking treatment whereas there was only a single rich player that took in the burning treatment (taking maximum £2.50 (by rich) in taking versus burning treatment, $p = 0.49$ Proportions Test, $p = 0.49$ T-Test). 80% of rich subjects that gave decided to transfer the full amount in the take-and-keep treatment whereas no rich player decided to transfer the full amount in the burning treatment (giving full-amount in taking versus burning treatments, $p = 0.02$ Proportions Test, $p = 0.00$ T-Test). 91% of poor subjects who took decided to take the maximum amount in the taking treatment whereas 71% did so in the burning treatment ($p = 0.28$ Proportions Test, $p = 0.31$ T-Test).

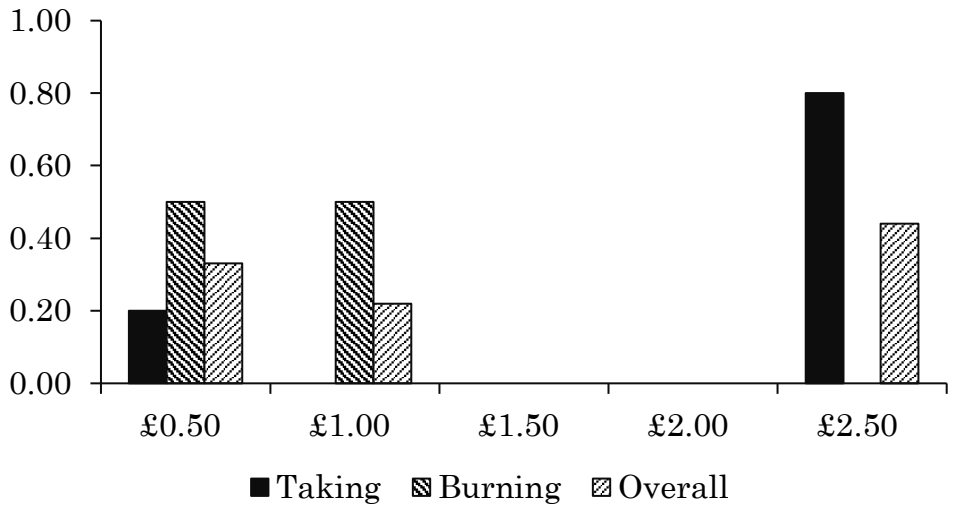


Figure 4.6. Amount Given by Rich across Treatments

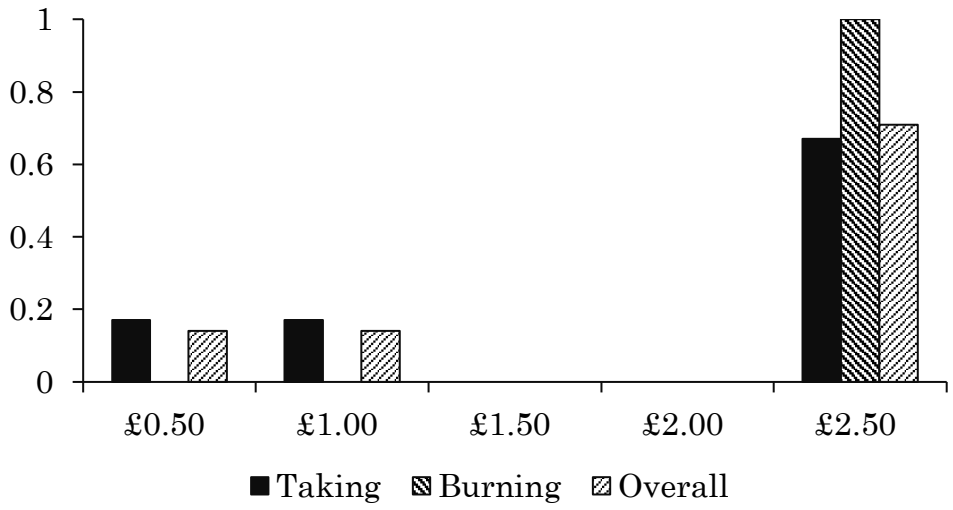


Figure 4.7. Amount Taken by Rich across Treatments

Analogous to our observation under Finding 2, the reduction in the amount voluntarily transferred towards the opponent in the burning treatments relative to the taking treatments highlights how a change in the context of the experiment can influence the level of prosociality. That is, the perception of benevolence or fairness may indeed be context-specific in which case the switch to burning could influence one's perception of generosity. More specifically, one possible example of this could be that if burning has a framing effect whereby subjects feel more vulnerable or as if the situation involves greater risk, then transferring £1.00 in such an environment may be perceived as being equally as kind as transferring £2.50 in the take-and-keep treatment (see Deck et al. 2010).

Finding 7: We observe that on average subjects take/burn a larger amount of money than they give.

Overall, we find that 55% of rich subjects that chose to give transferred £1.00 or less and 45% gave the maximum amount of £2.50. In contrast, 28% of rich subjects who took, took £1.00 or less whereas 72% took the full amount. Similarly, 83% of poor subjects that decided to take, took the maximum amount of £2.50 and 6% took £1.00 or less[28]. This result provides support towards Hypothesis 4 and earlier literature regarding the assumption of agents finding disadvantageous inequality more problematic than advantageous inequality (Messick and Sentis (1985), Loewenstein et al. (1989) and Fehr and Schmidt (1999)).

Given that 55% of rich subjects that chose to give in our experiment only transferred £1.00 or less, this amounts to 6.7% of their wealth. 45% of rich subjects transferred £2.50 i.e. 16.7% of their initial wealth. In comparison, Engel (2011) conducts a meta-analysis of over 100 experiments finding that within the dictator game, on average, dictators choose to transfer 28.35% of the endowment. Although we set an upper-limit on giving, 55% of those that gave transferred over four times less than the average amount observed in the dictator game. This finding is in line with studies showing that changes to the available choice-set and the context in which the decision is made can cause significant differences in behaviour and distributional outcomes (List (2007), Bardsley (2008) and Dohmen et al. (2011)).

4.5.4. Insurance

Finding 8: We observe that the fraction of subjects that purchased insurance was high and insignificantly different across the GTI and GBI treatments.

Overall, we find that 44% of subjects purchased insurance ($p = 0.00$, T-Test on overall significance of insurance) when it was made available. The purchase of insurance was higher, though insignificantly, at 56.25% in the GBI treatment compared to 35% in the GTI treatment (insurance in GTI versus GBI treatment, $p = 0.20$ Proportions Test, $p = 0.19$ T-Test). As Figure 4.8 reports,

[28] There was only one case of a poor subject giving money to their opponent and this was a transfer of £1.50.

no poor subject purchased insurance in the GTI treatment whereas 38% did so in the GBI treatment. In contrast, the purchase of insurance was stable across the taking and burning treatments for rich players. 70% of rich subjects purchased insurance in the GTI treatment and 75% did so in the GBI treatment. Hence, our findings suggest that poor players were significantly more likely to purchase insurance in the burning treatment i.e. GTI versus GBI ($p = 0.04$ Proportions Test, $p = 0.03$ T-Test) whereas we find no significant difference in the proportion of rich subjects purchasing insurance across the taking and burning treatment ($p = 0.81$ Proportions Test, $p = 0.81$ T-Test).

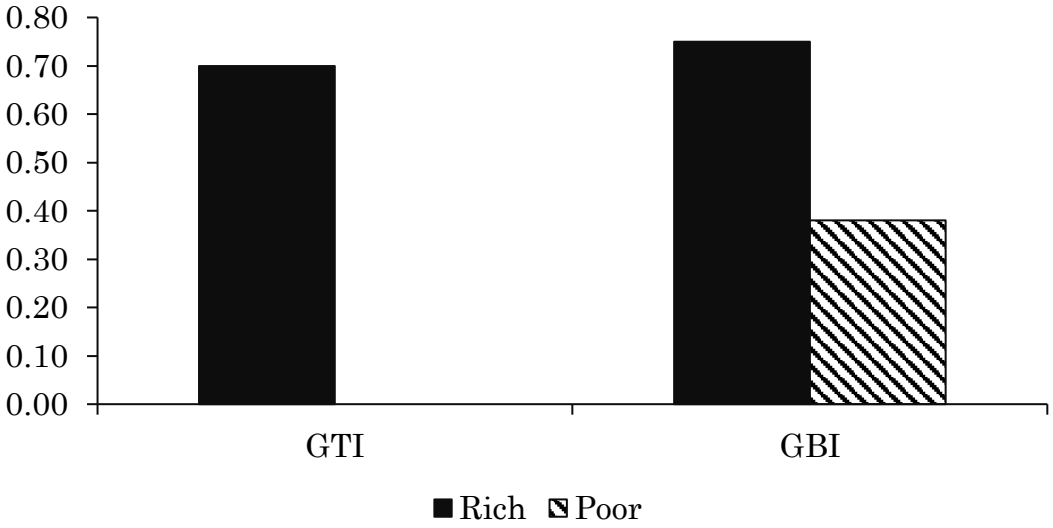


Figure 4.8. Insurance by Rich and Poor

The high level of observed insurance purchases by the rich in the GTI treatment provides an interesting refutation of Hypothesis 2. That is, based on the four models of social preferences covered earlier, we showed that it was never optimal for subjects to purchase insurance in the GTI treatment. For subjects that are purely concerned with their personal monetary earnings, taking the maximum amount from the opponent provides a superior 'alternative' strategy to insuring for £1.00, as the net-loss from doing so cannot exceed £0.50.

One possible interpretation of this result is that in reality subjects perceive there to be a difference between taking and insuring. While insurance involves the protection of one's own earnings, taking implies the theft of an other's property. Therefore, from a

psychological perspective, there is an important distinction between these two options. Moreover, as subjects don't know with any certainty the strategy of their opponent, insurance provides them with the ability to completely eliminate uncertainty. This is important not only from a financial standpoint i.e. by removing uncertainty regarding final payoffs, but is also important for behavioural reasons.

Specifically, if the subject expects their opponent to take with some positive probability and chooses take as an alternative strategy to insuring, then there is still a possibility that their expectation was incorrect, in which case taking from a poor subject who in fact hadn't decided to take may lead to feelings of guilt and regret for the richer player. Hence, although the four models of social preferences presented earlier may not capture such motives, the high levels of observed insurance may have been driven by a combination of emotional and property-right based reasoning.

4.5.5. Do Nothing

Finding 9: We observe a significant increase in the fraction of subjects that chose to do nothing and a simultaneous reduction in the fraction of subjects that took in the GB treatment relative to the GT treatment.

The proportion of subjects that decided to do nothing rose from 32% in the GT treatment to 60% in the GB treatment ($p = 0.07$ Proportions Test, $p = 0.06$ T-Test). In contrast, the fraction of subjects that decided to take fell from 45% in the GT treatment to 25% in the GB treatment (taking in the GT versus GB treatment, $p = 0.17$ Proportions Test, $p = 0.17$ T-Test) while the difference in the level of giving was far less pronounced as 15% of subjects gave in the GB treatment compared to 23% in the GT treatment ($p = 0.52$ Proportions-Test, $p = 0.53$ T-Test).

Since burning money under all circumstances implied a net monetary cost to the taker, this finding suggests that part of our subject pool was indeed motivated purely by self-interest. This provides some support towards Hypothesis 1 and the predictions derived from the model of narrow self-interest.

Finding 10: Extending the choice-set to include the option to insure significantly lowers the fraction of subjects that choose to do nothing.

Comparing the incidence of choosing to do nothing across the insurance and no insurance treatments, we find a significant reduction from 45% of subjects in the no insurance treatment to 22% of subjects choosing to do nothing in the insurance treatment ($p = 0.03$ Proportions Test, $p = 0.03$ T-Test). Moreover, the fraction of rich subjects that chose to do nothing fell substantially from 43% in the no insurance treatment to 6% in the insurance treatment ($p = 0.01$ Proportions Test, $p = 0.00$ T-Test) whilst the fraction of poor subjects that chose to do nothing fell insignificantly from 48% in the no insurance treatment to 39% in the insurance treatment ($p = 0.58$ Proportions Test, $p = 0.57$ T-Test).

Findings 2, 4 and 10 jointly show that expanding the available choice-set by including the option to insure resulted in a significant reduction in the fraction of subjects that chose to give and do nothing but had no effect on the proportion of subjects that decided to take. One possible interpretation of this result is that the shift towards insurance was primarily driven by a reduction in the proportion of subjects that decided to do nothing coupled with the crowding out of giving, and so a reduction in prosocial behaviour, whilst having no impact on taking. Given that we also found a decrease in the fraction of subjects that gave the maximum amount to their opponents in the burning treatment relative to the taking treatment whilst finding no significant difference in the fraction of subjects that took the maximum amount (see Finding 6), these results imply that the preference for altruism or acting upon advantageous inequality-aversion is relatively weaker and less stable than the desire to mitigate disadvantageous inequality (Messick and Sentis (1985), Loewenstein et al. (1989) and Fehr and Schmidt (1999)). More broadly, this result highlights the fact that altering the choice-set available to subjects can have an impact on the degree of altruism, as shown in several previous studies (List (2007), Bardsley (2008)).

The data in Figure 4.1 shows that overall, around 35% of subjects decided to do nothing. While doing nothing can certainly represent selfishness or reciprocity motives, another potentially

relevant explanation for this option being chosen so frequently could be related to the perception of fairness regarding the way in which the endowment was earned. For example, Akbas, Ariely and Yuksel (2014) argue that the perceived fairness of income distributions depends on the beliefs about the process that generated the inequality. Specifically, they outline two crucial factors of the process that affect fairness views. These are procedural justice i.e. equal treatment of all participants and agency i.e. one's ability to make their own choices. If people feel they were treated fairly and received compensation for what they earned, then they may choose to do nothing. In other words, the inequality in our experiment, unlike several previous studies, could be considered a fair and natural outcome in which rewards were distributed according to differences in performance. This could potentially affect the incentive of subjects to counter such inequality.

4.5.6. Gender

There is considerable experimental evidence to suggest that gender is an important determinant of a variety of economic and strategic decisions (Eckel and Grossman 1998, Croson and Gneezy 2009), and on subjects' beliefs about the altruistic behaviour of men and women (Aguiar et al. 2009). Chowdhury et al. (2016) run a dictator game with both give and take frames finding that females allocate significantly more under the taking frame than in the giving frame whereas males display the exact opposite behaviour. The authors argue that using a taking frame makes male subjects significantly more selfish while making females more egalitarian, in comparison to the giving frame. More generally, females have been found to display greater altruism than their male counterparts in dictator games (see Engel 2011 for a review).

Findings from the literature cited above could translate into gender differences between a take-and-keep and take-and-burn treatment. Experimental studies on gender differences in anti-social behaviour are limited. Abbink and Hermann (2011) and Kessler et al. (2012) find no evidence of a gender-effect in antisocial behaviour. However, Ghiglieri (1999) showed in a non-experimental study that males tend to display more aggression in comparison to females. Hence, we test whether the context of the

experiment i.e. taking versus burning has an asymmetric effect on males and females.

Finding 11: Overall, there is no significant gender-effect in terms of differences in the fraction of males and females that chose to give, take, insure or do nothing.

Figure 4.9 reports the overall distribution of choices made by males and females across treatments. We find no significant difference in the fraction of males and females that decided to give (overall fraction women that gave versus men, p = 0.93 Proportions Test, p = 0.93 T-Test), take (p = 0.93 Proportions Test, p = 0.93 T-Test), insure (p = 0.50 Proportions Test, p = 0.49 T-Test) or do-nothing (p = 0.58 Proportions Test, p = 0.58 T-Test).

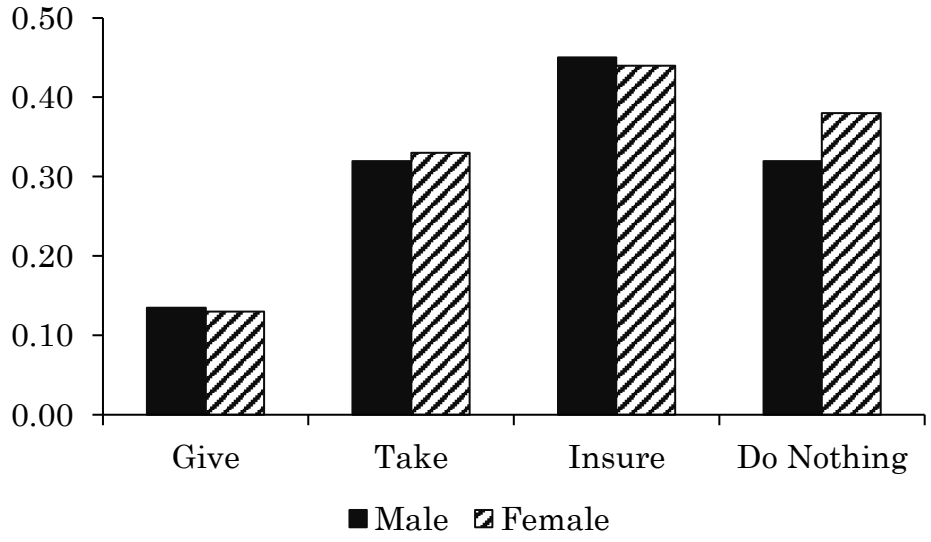


Figure 4.9. Overall Choices by Gender

This result holds in most cases when we compare behaviour within particular treatments. As reported in Table 4.4, we are only able to find a significant difference in behaviour in the GBI treatment. Specifically, 30% of women decided to take in the GBI treatment whereas no male chose to take. Likewise, 30% of females chose to insure in the GBI treatment whereas the corresponding figure for males was 100%.

Male vs. Female								
	Proportions Test				*Bootstrapped T-Test*			
	Give	Take	Do Nothing	Insure	Give	Take	Do Nothing	Insure
GB	0.21	0.42	0.85	-	0.26	0.37	0.85	-
GT	0.32	0.34	0.89	-	0.33	0.32	0.90	-
GBI	0.42	0.14	0.14	0.01	0.30	0.03	0.04	0.00
GTI	0.30	0.16	0.12	0.64	0.29	0.14	0.10	0.64

Table 4.4. Gender Differences

4.5.7. Ethics

Several studies have found there to be a relationship between an individual's belief-system, such as their religiosity, and prosociality. For example, it has been shown that the use of a religious prime increases allocations in the anonymous dictator game (Shariff and Norenzayan 2007), promotes the willingness to volunteer (Sasaki et al. (2013) and Batara (2016)), increases honesty (Randolph-Seng and Nielsen 2007) and the intention to help others (Pichon, Boccato and Saroglou 2007) as well as improve willingness to help and helping behaviours in general (Pichon and Saroglou (2009), Ruffle and Sosis (2010) and Ahmed and Salas (2013)).

In an attempt to understand the motivation behind some of the decisions made by subjects in our experiment, we use a more general measure of an individual's values. Specifically, participants were asked a series of questions after the completion of the main experiment and from this data, we define "ethical" subjects as those who either disagreed or strongly disagreed with the statement that ethical or moral issues do not influence where or how they decide to spend their money.

Finding 12: We observe that ethical subjects were significantly less likely to burn and more likely to give than not-ethical subjects. Furthermore, there is a significant reduction in taking from ethical subjects between the taking and burning treatment whereas there is no significant difference in taking for not-ethical subjects. There is no significant difference in giving by ethical subjects between the taking and burning treatments whilst giving is insignificant for not-ethical subjects across both treatments.

As shown in Figure 4.10, on average, 20% of ethical subjects chose to give money to their opponents, whereas the corresponding figure was 5% for those who didn't identify as being ethical (ethical versus not-ethical giving p = 0.06 Proportions Test, p = 0.05 T-Test). 24% of ethical subjects decided to take from their opponents which is lower than the 41% of not-ethical subjects that decided to take (ethical versus not-ethical taking p = 0.13 Proportions Test, p = 0.13 T-Test).

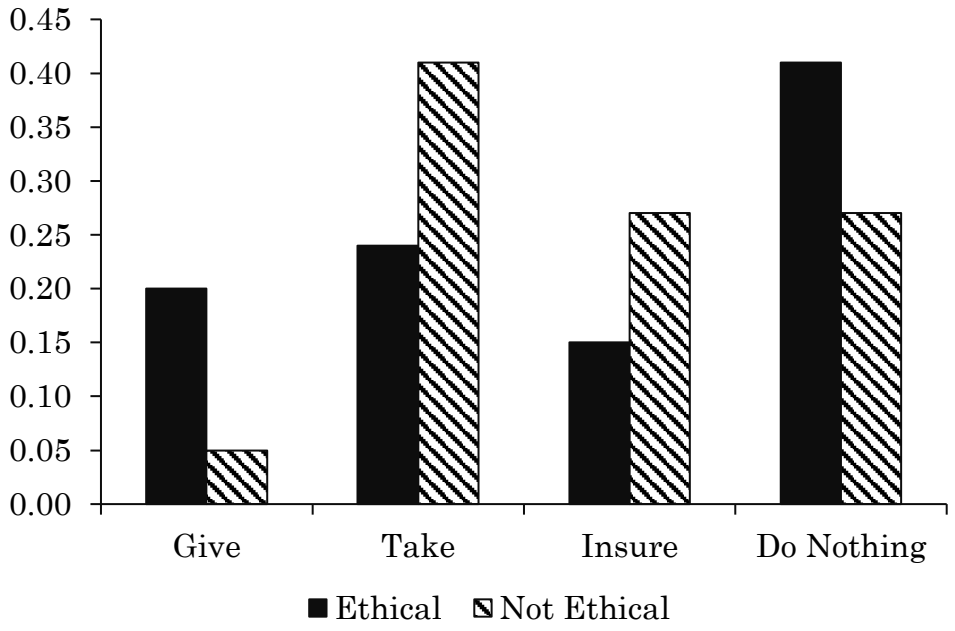


Figure 4.10. Choices by Ethical Participants

From Table 4.5, when comparing behaviour between the burning and take-and-keep treatments, we find no significant difference in the fraction of ethical subjects that chose to give (p = 0.82 Proportions Test, p = 0.81 T-Test). However, we do find that the fraction of ethical subjects that took fell from 36% in the take-and-keep treatment to 11% in the burning treatment (p = 0.05 Proportions Test, p = 0.04 T-Test). In contrast, for not-ethical subjects, we find no significant difference in the fraction of subjects that gave (p = 0.18 Proportions Test, p = 0.13 T-Test) or took (p = 0.55 Proportions Test, p = 0.54 T-Test) across the take-and-keep and burning treatments.

	Take-and-Keep		*Take-and-Burn*	
	Ethical	Not-Ethical	Ethical	Not-Ethical
Give	0.18	0.10	0.21	0.00
Take	0.36	0.45	0.11	0.35

Table 4.5. Choices by Ethical and Not-Ethical Subjects (*Fraction*)

In the burning treatments, on average, 21% of ethical subjects chose to transfer money to their opponents whereas no not-ethical subject gave during this treatment ($p = 0.05$ Proportions Test, $p = 0.03$ T-Test). In contrast, only 11% of ethical subjects took during the burning treatments whilst 35% of not-ethical subjects decided to burn their opponents endowment ($p = 0.07$ Proportions Test, $p = 0.07$ T-Test). In the take-and-keep treatments, we find no evidence of any difference in either the fraction of taking ($p = 0.57$ Proportions Test, $p = 0.56$ T-Test) or giving ($p = 0.45$ Proportions Test, $p = 0.45$ T-Test) between ethical and not-ethical subjects).

Therefore, Finding 12 corroborates the literature cited above by illustrating a positive relationship between an individual's value-system and the level of prosociality.

4.5.8. Regression Analysis

Table 4.6 reports the results from a simple regression analysis. As shown, giving and doing nothing are significantly lower in the insurance treatment whilst there is no significant effect on the level of taking. This adds support to our earlier assertion that the shift towards insurance was driven by a reduction in doing nothing and the crowding out of giving (see Under Finding 10).

Moreover, taking was lower whilst insurance purchases and choosing to do nothing were higher in the burning treatment. As explained earlier, insurance was only optimal in the GBI treatment according to the model of self-interest (conditional upon subjects expecting their opponents to take). The reduction in taking and increase in doing nothing and insurance implies that some subjects had indeed acted based on self-interest. Interestingly, the higher insurance purchases in the burning treatment implies that subjects had a sufficiently high level of distrust in their opponent that they had expected them to

willingly incur a net personal cost in order to sabotage their earnings. From the perspective of a rich player, ex-post, the purchase of insurance during the GBI treatment seems justified based on our findings on the behaviour of poor subjects in the burn treatment.

Our results show that poor subjects were significantly less likely to have purchased insurance and give money but more likely to have taken in comparison to rich subjects. Finding 5 showed that there was no significant difference in taking by the poor between the take and burn treatments. Hence, from our earlier predictions (see Table 4.3), these results suggest that the models of inequality-aversion and envy provide a more accurate description of the observed behaviour of poorer subjects in comparison to the model of narrow self-interest. In combination with Findings 1 and 5, we observe evidence of both altruism and selfishness from rich players.

Risk-aversion is an important determinant of the demand for insurance (see Outreville 2013). Risk-averse agents agree to pay an insurance premium that is in excess of the mathematical expectation of loss[29]. Numerous studies have documented evidence of agents displaying some positive degree of risk-aversion (Gneezy and Potters (1997), Eckel and Grossman (2002) and Holt and Laury (2002)). Table 4.6 shows that the purchase of insurance was higher for those that self-reported a higher degree of risk-aversion[30] as well as for those that had expected to be taken from. This result indicates that a key determinant of insurance demand was the desire for greater certainty regarding the final allocation of subject endowments.

[29] The maximum amount of money that can be taken from any subject is £2.50. If a player anticipates this, they would be better off (in the GTI treatment) taking an equal amount from their opponent which would leave both 50p worse off. However, the purchase of insurance at £1.00 would be indicative of risk-aversion as it would suggest that subjects were willing to pay a premium in order to ensure they have certainty regarding their final payoff.

[30] Risk-aversion here is based on a self-reported measure where subjects were asked to rank their appetite for risk on a scale ranging from 1-10 with 1 being fully risk-averse and 10 representing a risk-lover.

	Give	Take	Do Nothing	Insure
Burning	-0.035	-0.22**	0.176*	0.272*
	(0.065)	(0.094)	(0.104)	(0.141)
Insurance	-0.14**	-0.08	-0.245***	
	(0.065)	(0.093)	(0.094)	
Poor	-0.131**	0.377***	-0.012	-0.42***
	(0.067)	(0.110)	(0.123)	(0.134)
Female	-0.011	0.057	-0.001	-0.121
	(0.070)	(0.097)	(0.102)	(0.129)
Ethical	0.072	-0.04	0.116	-0.278**
	(0.063)	(0.098)	(0.109)	(0.128)
Risk-Aversion	0.001	0.032	0.004	-0.077*
	(0.020)	(0.023)	(0.028)	(0.045)
Expected Taking	0.015	0.03***	-0.409***	0.269**
	(0.063)	(0.110)	(0.131)	(0.124)
Reciprocal Takers	-0.305***	0.22**	0.076	0.144
	(0.091)	(0.110)	(0.120)	(0.141)
Loss-Averse	-0.13	-0.01	0.212**	0.05
	(0.089)	(0.101)	(0.108)	(0.192)
Self-Regarding	-0.005	0.059	-0.035	-0.338*
	(0.049)	(0.128)	(0.143)	(0.171)
Constant	0.522***	-0.22	0.396*	0.932**
	(0.019)	(0.196)	(0.225)	(0.384)
No. of Observations	78	78	78	36

Table 4.6. OLS Regression Results[31]

Several studies have found that females display a lower level of risk-tolerance in comparison to their male counterparts (Booth and Nolen (2012) and Croson and Gneezy (2009)). As an individual's degree of risk-aversion is a positive determinant of insurance demand, it then follows that the demand for insurance should be greater among females than males. However, our findings do not support this view as we do not find any evidence of females being more likely to purchase insurance than their male counterparts. This result does however support a growing strand of literature showing that gender-specific differences, as well as general differences in preferences, are domain-specific (See Dohmen et al. 2011).

[31] (Note: Robust standard errors in parentheses. Marginal effects are reported. * $p < 0.10$, ** $p < 0.05$ and *** $p < 0.01$).

Traditional economic theory posits that immoral behaviour, such as lying and stealing, is a product of both income effects and the probability of being caught and punished (Becker 1968). More recently, this standard theory has been questioned with the concept of non-pecuniary moral costs associated with lying and stealing being incorporated into the decision model (Gneezy (2005), Levitt and List (2007), Fischbacher and Heusi (2008), Mazar et al. (2008) and Lundquist et al. (2009)). In a sense, the standard assumption can be thought of as being based on the assumption that agents are self-regarding. In an attempt to capture agents who behave in such a manner, we asked subjects in our post-experiment questionnaire whether they felt that it was justified to do anything in the pursuit of success as long as they could get away with their actions. Subjects that either agreed or strongly agreed with this statement were labelled as being "self-regarding".

We consider the variable "ethical" introduced earlier a proxy for those that are more likely to take into consideration the non-pecuniary costs of stealing. From Table 4.6, we see that both ethical and self-regarding participants were significantly less likely to purchase insurance. Although we are unable to find statistical significance in any other regression for these two variables, it is interesting to note that our results show a negative coefficient on giving and doing nothing but a positive coefficient on taking for self-regarding subjects. In contrast, we find the complete opposite for ethical subjects whereby the coefficients on giving and doing nothing are positive whilst the coefficient on taking is negative.

As in Finding 12, this result suggests that part of the observed heterogeneity in preferences is likely to be based upon an individual's ethical and moral code. Ethical subjects are more likely to behave altruistically by donating a portion of their endowments to their poorer opponents and less likely to steal from their opponent. Based on self-reported responses, self-regarding subjects are willing to behave antisocially by engaging in activities, albeit illicit, in order to improve their own situation.

Subjects were also asked in the post-experiment questionnaire how they would have responded if they were told with complete certainty that their opponent had chosen to take money from them. Participants that either agreed or strongly agreed that they

would have also chosen to take money from their opponent were categorised as "reciprocal takers". Note that there is a distinction between those that had expected to be taken from and those that would reciprocate taking. While the former may have also responded by taking during the experiment, their decision was based on an expectation regarding their opponent's strategy. In comparison, reciprocal taking is based upon a hypothetical scenario in which there is complete certainty regarding the opponent's actions. Therefore, whilst those that were categorised as reciprocal takers may have also expected their opponent to have taken during the experiment, the probability they had assigned to their opponent choosing to take may have been sufficiently low so as to have prevented them from taking during the experiment.

Table 4.6 shows that those expecting to be taken from were significantly less likely to do nothing and more likely to take and purchase insurance Reciprocal takers were significantly less likely to give and more likely to take. We do not find a significant insurance effect for reciprocal takers. However, we find that the coefficient for reciprocal takers in the taking regression is over seven times higher than that on those that expected to be taken from.

This result reinforces our assertion under Finding 8 that the high levels of insurance purchases observed in the GTI game may have been a consequence of uncertainty regarding the opponent's choice. In order to avoid the regret or guilt of taking from an opponent that didn't take, subjects may have opted for insurance. In other words, at least some subjects that had an expectation of being taken from didn't have an expectation that was sufficiently high to trigger taking i.e. the optimal strategy in monetary terms. Hence, such subjects may have rather opted to purchase insurance.

4.5.9. Insurance and Welfare

Comparing the average payoffs across treatments for rich and poor subjects (see Table 4.7), our results show an insignificant increase in the average payoff for rich subjects from £13.68 in the no insurance treatment to £13.90 in the insurance treatment ($p = 0.40$ Mann-Whitney, $p = 0.64$ T-Test), an increase from £13.56 in

the GT treatment to £13.74 GTI treatment (p = 0.43 Mann-Whitney, p = 0.83 T-Test) and an increase from £13.81 in the GB treatment to £14.10 in the GBI treatment (p = 0.44 Mann-Whitney, p = 0.78 T-Test). However, we do find weak evidence that the availability of insurance influences the average payoff for poor subjects. Specifically, the average payoff fell from £5.33 in the no insurance treatment to £4.94 in the insurance treatment (p = 0.10 Mann-Whitney, p = 0.39 T-Test), from £5.85 in the GT treatment to £5.20 in the GTI treatment (p = 0.20 Mann-Whitney, p = 0.39 T-Test) and fell from £4.77 in the GB treatment to £4.61 in the GBI treatment (p = 0.27 Mann-Whitney, p = 0.60 T-Test).

There is weak evidence to support the notion that the availability of insurance worsens inequality. From earlier results, we found that the availability of insurance had no significant impact on taking but led to a reduction in the fraction of rich players that chose to give and do nothing. Moreover, we reported a high and significant uptake of insurance by the rich. This implies that the shift towards insurance was partially driven by a reduction in the fraction of rich subjects that chose to do nothing and the crowding out of giving. Coupled with the inability of poor players to access the endowment of the insured rich and the fact that we find no difference in taking by the poor across the insurance and no insurance treatments, these factors may provide an explanation for the observed fall in the average payoff of poor subjects and the, albeit insignificant, increase in the average payoff of richer subjects.

	Avg. Payoff		
Treatment	Overall	Rich	Poor
Insurance	9.42	13.90	4.94
No Insurance	9.51	13.68	5.33
Burning	9.32	13.94	4.70
Taking	9.59	13.65	5.54
GT	9.70	13.56	5.85
GB	9.29	13.81	4.77
GTI	9.47	13.74	5.20
GBI	9.36	14.10	4.61
	Variance of Payoff		
Insurance	22.00	1.37	1.42
No Insurance	20.79	3.13	2.96
Burning	22.59	0.80	0.53
Taking	20.27	3.59	3.45
GT	20.15	4.98	4.57
GB	22.55	1.36	0.84
GTI	21.45	2.42	2.34
GBI	24.15	0.14	0.19

Table 4.7. Average Payoff across Treatments

The results above suggest that the inclusion of insurance doesn't improve welfare. That is, we do not find strong evidence of changes in the average payoff across the insurance and no insurance treatment. However, the welfare of agents isn't solely a function of their average payoff. Rather, for risk-averse agents, the second moment i.e. the variance of their payoff is also a critical component of welfare. Although there is little evidence of any significant difference in the overall payoff variance, which was 20.79 in the no insurance treatment and 22.00 in the insurance treatment ($p = 0.35$ Levene's Test)[32], at a more disaggregated level, we do find evidence of a significant reduction in the variance of payoffs for both rich and poor subjects. Specifically, the average variance of the payoff for rich players fell by 229% from 3.13 in the no insurance treatment to 1.37 in the insurance treatment ($p = 0.02$ Levene's Test) and by 209%, from 2.96 in the no insurance treatment to 1.42 in the insurance treatment for poor players ($p = 0.07$ Levene's Test). Therefore,

[32] Testing for the equality of variances based on Levene (1960). The null-hypothesis is that the two variances are equal.

despite there being no significant change in average payoffs, if the payoff variance is used as a measure of risk, then the average payoff per unit of risk i.e. average payoff divided by average variance increased from 7.73 in the no insurance treatment to 11.88 in the insurance treatment for rich subjects and from 3.10 to 4.15 for poor subjects.

4.6. SUMMARY AND CONCLUSION

Theories of other-regarding preferences typically predict that giving increases with an individual's income. This has been attributed to various factors such as relative earnings (Bolton 1991), inequality-aversion (Fehr and Schmidt (1999), Bolton and Ockenfels (2000) and Alesina and Angeltos (2005)) and warm glow (Andreoni 1990). There exists a voluminous literature reinforcing the idea of positive other-regarding preferences by showing the existence of prosocial behaviour in the lab (Andreoni et al. (2007) and Engel (2011)). The more recent literature has found conflicting evidence of antisocial behaviour in the lab e.g. theft and sabotage of an opponent's earnings. It has been argued that this so-called dark-side of human behaviour is motivated by inequality-aversion, envy and pure nastiness (Zizzo and Oswald (2001) and Abbink and Sadrieh (2009)).

Developing a better understanding of antisocial preferences can provide valuable insights[33]. This is because the forces of spite and envy have been argued to have both socially destructive and constructive ramifications. If agents are willing to expend resources to undermine the performance and success of others

[33] A potentially interesting extension of our work, that is not explored here, could be to provide insight into the weight of θ on the opponent's monetary gain and the range of its parameter value. For example, perhaps a separable preference that nests both an other-regarding and stealing aversion component such as:

$$U(C_{own}) - \theta U(C_{other}) + \gamma 1_{steal}$$

Assuming an arbitrarily large dataset, one should be able to reveal the parameter values of both θ and γ.

(Smith and Kim (2007) and Van de Ven, Zeelenberg and Pieters (2009)), then such behaviour could negatively impact societal cohesion and welfare as well as discouraging investment and productivity (Kebede and Zizzo 2015). On the other hand, envy has the potential to serve as a motivator for the envious to work harder in order to progress in the income and status hierarchies (Grolleau et al. 2009).

Evidence regarding the impact of income inequality (which has been argued to be a major driver of spite and envy) on behaviour has been mixed. For instance, while it has been found that low-income subjects are relatively more co-operative than their high-income counterparts (Buckley and Croson 2006), other studies have shown there to be little difference between the willingness to harm others among low and high income subjects (Grossman and Komai 2016). With the growing levels of inequality across several countries (Piketty 2014), it has been argued that the social and economic consequences have become more pertinent to understand.

More broadly, it has been shown that competitive environments can encourage sabotage (Charness et al. (2011), Balafoutas et al. (2012) and Jauernig and Uhl (2019)). For example, Harbring and Irlenbusch (2011) use an experimental tournament setting to show that wage differences between subjects increases sabotage. Gurr (1970) argues that the opportunity costs of the relatively disadvantaged decreases while their inclination to engage in violent demands for redistribution increases following an increase in inequality. Given that people may in general have some tendency to envy those that are in a better position than themselves (Tullock 2013), it is of interest to study the role of inequality derived from differences in performance on the behaviour of agents.

In this study, we ran a simple incentivised laboratory experiment to test whether altering subject choice-sets and the context in which the decision is made (i.e. take-and-keep versus take-and-burn) influences the level of prosociality after subjects have competed in a tournament setting. Consistent with previous findings, our results suggest that some agents do display other-regarding preferences. However, we not only observe heterogeneity in preferences across subjects but also find that behaviour can be sensitive to changes in the exact context and

choice-set presented to subjects (List (2007), Bardsley (2008) and Dohmen et al. (2011)).

We report evidence showing that altering subject choice-sets had an asymmetric effect on attitudes. Our data shows that an expansion of the available choice-set to include the option of insurance crowds out donations from competition winners (rich subjects) and shifting from the take-and-keep to the take-and-burn treatment lowered the average size of donations. We find a high and significant uptake of insurance by tournament winners even in cases in which insuring was a dominated strategy in monetary terms. One interpretation of this finding is that rich subjects avoided stealing from poorer opponents due to uncertainty regarding their chosen action. Specifically, rich subjects may have preferred to incur an additional £0.50 cost to purchase insurance in order to avoid the ex-post regret or guilt of having taken from a poor opponent that didn't choose to take.

In contrast, our results show that neither an expansion of the choice-set nor a switch from the take-and-keep treatment to the take-and-burn treatment impacted taking by competition losers (poor subjects). This was both in terms of the fraction of poor subjects that took and the size of the amounts taken. Hence, we found that the aforementioned changes to the decision-task were more effective at lowering prosocial behaviour by competition winners whilst being less effective at having any impact on the antisocial behaviour of competition losers.

In combination with the prior literature, an important overarching implication of our findings is that the situational instability of preferences observed in the lab is likely responsible for the lack of external validity of experimental studies. While the experimental literature has provided valuable insights through theory-testing, in order to address concrete real-world problems there is a need for greater emphasis on context-specific studies, the results of which may only have limited scope in terms of generalizability (see Guala and Mittone 2005).

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4.8. APPENDIX

4.8.1. Instructions in Give-Take (GT) Treatment

Part 3

In this part of the experiment you will be randomly paired with one other person in the experimental session. Below we have the payoff that you received in part 1 and the payoff that this other person received.

You received _____ The other person received _____

Both of you now have the option to transfer or take money from the other person. Specifically:

For a payment of £0.10 you can take £0.50 of your money and **give it to the other person**. If you chose this option then your payoff goes down by £0.60 (the £0.10 payment and £0.50 transfer) and the payoff of the other person goes up by £0.50. If you pay £0.20 then you give £1.00 to the other person, and so on. The most you can pay is £0.50 in which case you give £2.50.

For a payment of £0.10 you can take £0.50 of the money the other person has and **move it to you**. If you chose this option then your payoff goes up by £0.40 (the £0.50 minus the £0.10 payment) and the payoff of the other person goes down by £0.50. If you pay £0.20 then you can take £1.00 from the other person, and so on. The most you can pay is £0.50 in which case you take £2.50.

The other person has the same options as you. Your final payoff will be determined by your respective choices.

Do you want to give, take or do nothing? (Please tick **one** option):

☐ Give ☐ Take ☐ Do Nothing

If you chose **Give/Take**, then how much do you want to Give/Take? (Please tick **one** option):

☐ £0.00 ☐ £0.50 ☐ £1.00 ☐ £1.50 ☐ £2.00 ☐ £2.50

4.8.2. Instructions in Give-Burn (GB) Treatment

Part 3

In this part of the experiment you will be randomly paired with one other person in the experimental session. Below we have the payoff that you received in part 1 and the payoff that this other person received.

You received _____ The other person received _____

Both of you now have the option to transfer or take money from the other person. Specifically:

For a payment of £0.10 you can take £0.50 of your money and **give it to the other person**. If you chose this option then your payoff goes down by £0.60 (the £0.10 payment and £0.50 transfer) and the payoff of the other person goes up by £0.50. If you pay £0.20 then you give £1.00 to the other person, and so on. The most you can pay is £0.50 in which case you give £2.50.

For a payment of £0.10 you can **take** £0.50 of the money the other person has and **reduce their payoff**. If you chose this option then your payoff goes down by £0.10 and the payoff of the other person goes down by £0.50. If you pay £0.20 then you can take £1.00 from the other person, and so on. The most you can pay is £0.50 in which case you take £2.50.

The other person has the same options as you. Your final payoff will be determined by your respective choices.

Do you want to give, take or do nothing? (Please tick **one** option):

☐ Give ☐ Take ☐ Do Nothing

If you chose **Give/Take**, then how much do you want to Give/Take? (Please tick **one** option):

☐ £0.00 ☐ £0.50 ☐ £1.00 ☐ £1.50 ☐ £2.00 ☐ £2.50

4.8.3. Instructions in Give-Take-Insure (GTI) Treatment

Part 3

In this part of the experiment you will be randomly paired with one other person in the experimental session. Below we have the payoff that you received in part 1 and the payoff that this other person received.

You received _____ The other person received _____

Both of you now have the option to transfer or take money from the other person. Specifically:

For a payment of £0.10 you can take £0.50 of your money and **give it to the other person**. If you chose this option then your payoff goes down by £0.60 (the £0.10 payment and £0.50 transfer) and the payoff of the other person goes up by £0.50. If you pay £0.20 then you give £1.00 to the other person, and so on. The most you can pay is £0.50 in which case you give £2.50.

For a payment of £0.10 you can take £0.50 of the money the other person has and **move it to you**. If you chose this option and it is not blocked (see below) then your payoff goes up by £0.40 (the £0.50 minus the £0.10 payment) and the payoff of the other person goes down by £0.50. If you pay £0.20 then you can try to take £1.00 from the other person, and so on. The most you can pay is £0.50 in which case you can take £2.50

For a payment of £1.00 **you can block the other person taking money from you**. Specifically, if you pay £1.00 then even if the other person chooses to take money from you then this is blocked. Similarly, if the other person pays £1.00 then you are blocked from taking money from them.

The other person has the same options as you. Your final payoff will be determined by your respective choices.

Do you want to give, take, insure or do nothing? (Please tick **one** option):

☐ Give ☐ Take ☐ Insure ☐ Do Nothing

If you chose **Give/Take**, then how much do you want to Give/Take? (Please tick **one** option):

☐ £0.00 ☐ £0.50 ☐ £1.00 ☐ £1.50 ☐ £2.00 ☐ £2.50

4.8.4. Instructions in Give-Burn-Insure (GBI) Treatment

Part 3

In this part of the experiment you will be randomly paired with one other person in the experimental session. Below we have the payoff that you received in part 1 and the payoff that this other person received.

You received _____ The other person received _____

Both of you now have the option to transfer or take money from the other person. Specifically:

For a payment of £0.10 you can take £0.50 of your money and **give it to the other person**. If you chose this option then your payoff goes down by £0.60 (the £0.10 payment and £0.50 transfer) and the payoff of the other person goes up by £0.50. If you pay £0.20 then you give £1.00 to the other person, and so on. The most you can pay is £0.50 in which case you give £2.50.

For a payment of £0.10 you can **take** £0.50 of the money the other person has and **reduce their payoff**. If you chose this option then your payoff goes down by £0.10 and the payoff of the other person goes down by £0.50. If you pay £0.20 then you can take £1.00 from the other person, and so on. The most you can pay is £0.50 in which case you take £2.50.

For a payment of £1.00 **you can block the other person taking money from you**. Specifically, if you pay £1.00 then even if the other person chooses to take money from you then this is blocked. Similarly, if the other person pays £1.00 then you are blocked from taking money from them.

The other person has the same options as you. Your final payoff will be determined by your respective choices.

Do you want to give, take, insure or do nothing? (Please tick **one** option):

☐ Give ☐ Take ☐ Insure ☐ Do Nothing

If you chose **Give/Take**, then how much do you want to Give/Take? (Please tick **one** option):

☐ £0.00 ☐ £0.50 ☐ £1.00 ☐ £1.50 ☐ £2.00 ☐ £2.50

4.8.5. Post-Experiment Questionnaire

For the final part of this experiment, please answer the following questions to the best of your knowledge.

1. Gender
   - ☐ Male
   - ☐ Female

2. Religious Affiliation
   - ☐ Christian (Protestant)
   - ☐ Christian (Catholic)
   - ☐ Hindu
   - ☐ Jewish
   - ☐ Sikh
   - ☐ Muslim
   - ☐ Atheist
   - ☐ Agnostic
   - ☐ Buddhist
   - ☐ Other

3. Ethical or moral issues do not influence where or how I decide to spend my money:
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Neither Agree nor Disagree
   - ☐ Disagree
   - ☐ Strongly Disagree

4. When I am faced with a financial decision, I am generally more concerned about the possible losses than probable gains.
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Neither Agree nor Disagree
   - ☐ Disagree
   - ☐ Strongly Disagree

5. I feel it is justified to do anything I can get away with in order to succeed.
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Neither Agree nor Disagree
   - ☐ Disagree
   - ☐ Strongly Disagree

6. It is morally justifiable to hurt others in pursuit of my own goals.
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Neither Agree nor Disagree
   - ☐ Disagree
   - ☐ Strongly Disagree

7. It is morally justifiable to steal from others in pursuit of my own goals.
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Neither Agree nor Disagree
   - ☐ Disagree
   - ☐ Strongly Disagree

8. Exploiting others to achieve success and improve one's social situation is justifiable.
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Neither Agree nor Disagree
   - ☐ Disagree
   - ☐ Strongly Disagree

9. Cheating isn't justified because it is unfair to others.

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neither Agree nor Disagree
- ☐ Disagree
- ☐ Strongly Disagree

10. Whether cheating is judged to be moral or immoral depends upon the circumstances surrounding the action.
    - ☐ Strongly Agree
    - ☐ Agree
    - ☐ Neither Agree nor Disagree
    - ☐ Disagree
    - ☐ Strongly Disagree

11. In Part 2 of the experiment, did you expect the other person to:
    - A. Give
    - B. Take

12. Which of the following objectives is most important for you?
    - ☐ Maximizing my own outcomes regardless of others.
    - ☐ Maximizing my own outcomes relative to others.
    - ☐ Maximizing joint outcomes.

13. In Part 2 of the experiment, I was worried about the possibility of the other person taking my money.
    - ☐ Strongly Agree
    - ☐ Agree
    - ☐ Neither Agree nor Disagree
    - ☐ Disagree
    - ☐ Strongly Disagree

14. In Part 2 of the experiment, I felt envious towards the other person.
    - ☐ Strongly Agree
    - ☐ Agree
    - ☐ Neither Agree nor Disagree
    - ☐ Disagree
    - ☐ Strongly Disagree

15. If given the option, I would be willing to pay to reduce someone else's income out of spite/envy.
    - ☐ Strongly Agree
    - ☐ Agree
    - ☐ Neither Agree nor Disagree
    - ☐ Disagree
    - ☐ Strongly Disagree

16. If income inequality reflected differences in effort as opposed to luck or privilege, this would affect my willingness to redistribute or donate money.
    - ☐ Strongly Agree
    - ☐ Agree
    - ☐ Neither Agree nor Disagree
    - ☐ Disagree
    - ☐ Strongly Disagree

17. If given the option, I would be willing to pay to reduce someone else's income for issues relating to fairness.
    - ☐ Strongly Agree
    - ☐ Agree
    - ☐ Neither Agree nor Disagree
    - ☐ Disagree
    - ☐ Strongly Disagree

	Give	Take	Insure	Do Nothing
Q1 [Female]	(-)	(+)	(-)	(+)
Q2 [Religious]	(-)	(+)	(+)	(-)
Q3 [Strongly Agree and Agree]	(+)	(-)	(-)	(+)
Q4 [Strongly Agree and Agree]	(-)	(-)	(+)	(+)
Q5 [Strongly Agree and Agree]	(-)	(+)	(-)	(+)
Q6 [Strongly Agree and Agree]	(+)	(-)	(+)	(+)
Q7 [Strongly Agree and Agree]	(-)	(-)	(-)	(+)
Q8 [Strongly Agree and Agree]	(+)	(-)	(+)	(-)
Q9 [Strongly Agree and Agree]	(+)	(+)	(-)	(-)
Q10 [Strongly Agree and Agree]	(+)	(-)	(+)	(-)
Q11 [Take]	(+)	(+)	(+)	(-)
Q12 [Own Outcomes]	(-)	(-)	(+)	(-)
Q12 [Relative Outcomes]	(+)	(+)	(-)	(+)
Q12 [Joint Outcomes]	(+)	(-)	(-)	(-)
Q13 [Strongly Agree and Agree]	(-)	(-)	(+)	(+)
Q14 [Strongly Agree and Agree]	(-)	(+)	(-)	(+)
Q15 [Strongly Agree and Agree]	(-)	(-)	(+)	(-)
Q16 [Strongly Agree and Agree]	(+)	(-)	(+)	(+)
Q17 [Strongly Agree and Agree]	(-)	(+)	(+)	(+)

Table A1. Correlations between Post-Experiment Questionnaire Responses and Choices during Experiment

Note: Table A1 provides the direction of correlation between giving, taking, insuring and doing nothing with responses to our post-experiment questionnaire. The table is to be read as follows. Question 17 asks, "If given the option, I would be willing to pay to reduce someone else's income for issues relating to fairness". Subjects were then asked to respond based on a Likert scale i.e. strongly agree to disagree. The correlations shown for this question are for those that had either strongly agreed or agreed with the above statement. In other words, the correlation between giving with those that strongly agreed or agreed with the statement was negative, whilst it was positive for those that hadn't strongly agreed or agreed with the statement.

CHAPTER FIVE

5. CONCLUSION

This thesis covered three independent research questions.

Chapter two argued that the regulatory constraints imposed by the Shariah on Islamic securities and investors, such as the prohibition of trade in derivative contracts, impedes the ability of Islamic portfolio managers to utilise important risk-management strategies. In light of this, chapter two studied a) whether diversifying across asset-classes by including commodities and Sukuk (Islamic Bonds) could improve the performance of an equity-only Islamic portfolio b) the benefits of diversification over historically significant bull and bear markets to test the relevance of diversification during volatile and trending markets c) the dynamic conditional correlation between the aforementioned asset-classes to study how the relationship across markets is affected during crisis regimes and d) given that Islamic portfolios are vulnerable to extreme events, I employed a convenient tail-risk measure of performance which includes the importance of an assets skewness and kurtosis to study whether taking into account the shape of the returns' distribution provides further insight into the potential benefits of diversification.

The results from chapter two showed that in terms of improving risk-return profiles, the benefit of diversifying beyond an equity-only portfolio is limited during normal times but advantageous during crisis periods. The most important finding from chapter two relates to the estimation of portfolio tail-risk. In particular, I demonstrated that using a standard two-moment Value-at-Risk measure, which assumes normally distributed returns, rather than a four-moment Value-at-Risk measure, which incorporates an assets skewness and kurtosis, can lead to a substantial underestimation of portfolio risk during the most extreme market conditions.

The aforementioned results have important practical implications for portfolio managers and practitioners within the Islamic Finance sector. As argued in chapter two, Shariah-compliant

securities are likely to deviate from a normal distribution as well as being vulnerable to extreme shocks for reasons such as market thinness, shortages of liquidity, the lack of product standardisation, underdeveloped secondary markets and the inability to diversify across a more comprehensive range of market sectors. Hence, our results provide important insights into the benefits of asset-class diversification and highlight the importance of taking into consideration a more complete description of the distribution of returns.

Given the distinctive characteristics and requirements of Shariah-compliant assets, an interesting avenue for future research, which has so far received little attention, is the study and development of risk-factor models specific to Shariah-based securities. With the growing relevance of assets such as Sukuk, it has become increasingly important to determine the risk-factors and relative importance of market and institutional factors in influencing the prices of niche Islamic securities. Such research could further support practitioners in improving the management of risk in their portfolios.

In chapter three, we explored the extent to which elicited measures of risk-aversion are influenced by religious priming and the way in which the decision-task is framed. Using the seminal Gneezy and Potters (1997) framework, we found that risk-taking is significantly higher when an identical task is framed in terms of an investment rather than a gamble. Furthermore, our results suggest that using a religious prime or setting (a Mosque) significantly lowers risk-taking in the gambling frame whilst having no effect in the investment frame. The elicited measures of risk-aversion were influenced by a range of factors including gender, ethical standards and setting in the gambling frame whereas we observed no such effect in the investment frame. We argue that this sensitivity towards a gambling frame is due to social and religious norms around gambling. This is an important result as it suggests that risk-preference elicitation tasks that are framed in terms of gambling, as many are, likely lead to systematic bias. Hence, an important implication derived from our experiments in chapter three is that we should look to test and develop methods of measuring risk-preferences that avoid a gambling frame. Overall, our findings corroborate the results of previous studies that show the fundamental importance of context

in determining individual risk-taking (Weber 2012, Dohmen et al. 2011, Schubert et al. 1999).

Chapter four presented the results from a simple incentivised laboratory experiment that tested whether altering subject choice-sets influences the level of prosociality. Subsequent to an effort-stage where subjects competed in a winner-takes-all tournament to earn their endowment, subjects had the opportunity to do nothing, give or take money from their opponent or in the insurance treatment, insure. We additionally tested for any differences in the observed behaviour of subjects when any amount stolen from their opponent was kept versus when it was burned (wasted).

We report several interesting findings. First, consistent with previous studies, we find strong evidence of agents displaying both positive and negative other-regarding preferences, which contradicts the model of narrow self-interest (e.g. Zizzo and Oswald (2001), Andreoni et al. (2007), Abbink and Sadrieh (2009) and Engel (2011)). Second, we observe that the behaviour of subjects can be sensitive to changes in the choice-set they are presented with, even when the options added onto the choice-set constitute monetarily dominated strategies. Moreover, our results suggest that altering choice-sets had an asymmetric effect on the attitudes of competition winners and losers. Particularly, expanding the available choice-set to include the option of insurance crowded out donations from competition winners and shifting from the take-and-keep to take-and-burn treatment lowered the average size of donations. In contrast, neither the expansion of the choice-set nor the switch from the take-and-keep treatment to the take-and-burn treatment had any impact on stealing by competition losers. This was both in terms of the fraction of subjects that decided to steal and the size of the amounts stolen. Hence, we found that the aforementioned changes to the decision-task were more effective at lowering prosocial behaviour by competition winners whilst being less effective at having any impact on the antisocial behaviour of competition losers.

Similar to chapter three, the results from chapter four corroborate the findings from previous studies showing that behaviour can be sensitive to changes in the exact context and choice-set presented to subjects (List (2007), Bardsley (2008) and Dohmen et al.

(2011)). More broadly, in combination with the prior literature, an important overarching implication of our findings from chapters three and four is that the situational instability of preferences observed in the lab is likely responsible for the lack of external validity of experimental studies. While the experimental literature has provided valuable insights through theory-testing, in order to address concrete real-world problems there is a need for greater emphasis on context-specific studies, the results of which may only have limited scope in terms of generalizability (see Guala and Mittone 2005).