The Risk of SIN Stocks

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By

ALIREZA REZAEIAN

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OR

Dean
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ABSTRACT

Previous studies suggest that SIN stocks, the stocks issued by firms engaged in socially or morally objectionable operations such as alcohol, tobacco, and gambling, are neglected by the market for a variety of reasons. Most published finance SIN studies proceed under the premise that SIN stocks are riskier than non-SIN stocks; however, in these studies, the risk is not explicitly quantified. Using annual North American data from 1980 to 2017, we investigate the risk of a subset of SIN stocks and compare it to that of a matched sample of non-SIN firms with similar characteristics. We focus on alcohol, tobacco and gambling securities and avoid grey stocks (ambiguous sin classification) in both the sin and non-SIN samples. Our results show that the risk of SIN stocks has declined over time and depends on the SIN category. In general, alcohol stocks have less systematic risk, idiosyncratic volatility, and total volatility relative to their non-SIN counterparts, regardless of time period, while tobacco stocks have significantly reduced systematic and total risk but increased idiosyncratic risk over time. Moreover, the heightened risk reputation associated with SIN stocks can be attributed to gambling stocks, but this volatility has also decreased over time: The impact of being classified as a gambling firm had a significantly positive impact on risk from 1980-1998 but no impact from 1999-2017. Further, the role of Corporate Social Responsibility (CSR) in mitigating the risk of SIN versus non-SIN stocks is also category sensitive. CSR reduces idiosyncratic volatility for alcohol firms but increases total volatility for tobacco firms and has no impact on the risk of gambling companies. These findings support the importance of measuring the changing nature of SIN stock risk by category and over time.

Keywords: SIN stocks, Risk, Corporate Social Responsibility, Propensity Score Matching

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CHAPTER 1. INTRODUCTION

SIN stocks refer to the equity of companies whose primary business is perceived as unethical or undesirable by the public. SIN companies are involved in dubious businesses that fail to meet basic social rules and offer products or services that can harm society. However, there is no unique definition of SIN activities, and studies have categorized businesses differently. In general, there is a consensus on the triumvirate of SIN: alcohol, tobacco, and gambling (Salaber, 2007; Hong and Kacperczyk, 2009; Cai, Jo, and Pan, 2012). Other studies employ broader classifications and may include adult entertainment (Fabozzi et al., 2008; Kim and Venkatachalam, 2011), military (Waxler, 2004; Blitz and Fabozzi, 2017), firearms (Jo and Na, 2012), nuclear power (Guillamón-Saorín et al., 2018), biotech (Fabozzi et al., 2008), and oil and cement (Cai et al., 2012). This thesis focuses on the triumvirate of SIN.

SIN stocks have specific risk-return characteristics that make them an attractive topic for academic research. Most of the finance research into SIN stocks investigates their financial performance. Multiple studies have found that SIN stocks benefit from a sizable excess return (Fabozzi et al., 2008; Hong and Kacperczyk, 2009; Kim and Venkatachalam, 2011). Following these findings, two main explanations have been presented to justify abnormal returns for SIN stock: reputation risk and litigation risk. First, investors, especially institutional investors, such as pension funds and banks, are under social norm pressure and prefer to avoid investing in SIN companies. Also, sell-side analysts ignore SIN firms as institutional investors are their main clients. This avoidance leads to limited risk sharing for holders of SIN stocks and causes these stocks to be traded at lower prices. Such systematic underpricing brings the vice investor a reputation risk premium (Hong and Kacperczyk, 2009; Kim and Venkatachalam 2011; Derwall, Koedijk, and Ter Horst, 2011). Second, SIN stock excess return is attributed to high litigation risk associated with SIN companies' services and products. Hong and Kacperczyk (2009) believe that higher litigation exposure for SIN companies means higher idiosyncratic risk. Therefore, following Merton (1987) who believe that both idiosyncratic and beta matter in asset pricing, Hong and Kacperczyk (2009) assert that SIN stocks can make excess returns. Previous studies show that SIN companies operating in countries with higher litigation risk have higher risk-adjusted returns (Salaber, 2007). Following the findings regarding the excess return of SIN stocks as well as higher litigation exposure and market's widespread avoidance of SIN stocks, some papers assume that SIN stocks are riskier (Hong and Kacperczyk, 2009; Cai et al., 2012; Jo and Na, 2012; Oh et al., 2017). In fact, the overwhelming majority of SIN stocks studies, proceed under the premise that SIN stocks are riskier. Assuming SIN stocks are riskier, they examine different strategies, such as CSR, to see how SIN companies can mitigate their systematic, idiosyncratic, or total risk. To the best of our knowledge, no study focuses specifically on the quantification of risk in SIN stocks.

We investigate the risk of SIN stocks and compare it to that of a matched non-SIN sample of similar firm characteristics. For this purpose, we employ annual North American data from 1980 to 2017. We use three risk measures to compare SIN stocks with their non-SIN peers: systematic risk (beta), idiosyncratic risk, and total risk. Our SIN sample consists of companies involved in alcohol, tobacco, and gambling activities. These are traditional SIN groups that all previous research has classified as SIN industries. Some earlier studies select a broader range of SIN stocks and include military, firearms, cement, oil, and biotech stocks in their sample (Fabozzi et al., 2008; Kim and Venkatachalam, 2011; Guillamón-Saorín, et al., 2018). Firms in these non-unanimous SIN areas are called grey stocks. To make sure that our control sample is unequivocally non-SIN, we exclude these so-called grey stocks. We have 1210 firm-year observations for the SIN sample, consisting of 487, 108, and 615 firm-year observations for alcohol, tobacco, and gambling stocks, respectively. We employ three different approaches to investigate the risks of SIN stocks. First, we use regression analysis to investigate the relationship between our three SIN groups, individually and collectively, and three risk measures (beta, idiosyncratic volatility, and total volatility). Second, we try to find a matched sample for SIN stocks using Propensity Score Matching (PSM) methodology and conduct a univariate test (t-test) on the difference between average risk measures between SIN and non-SIN. Again, matching is done for alcohol, tobacco, and gambling stocks separately, and for a combined SIN sample. Third, we combine PSM and regression analysis.

Our results show that alcohol and tobacco stocks as well as a combined sample of all the triumvirate SIN stocks have less beta, idiosyncratic volatility and total volatility compared to their non-SIN peers over the 1980-2017 period, and these findings are robust to method. This is in sharp contrast to the premise in Hong and Kacperczyk (2009), Cai et al. (2012), Jo and Na (2012), Oh et al. (2017), and Guillamón-Saorín et al. (2018). To explore the time evolution of the risk of SIN stocks, we split our original sample period into two intervals, 1980-1998 and 1999-2017. The results show that the risk of SIN stocks has declined over time and depends on the SIN category. Alcohol has less systematic risk, idiosyncratic volatility, and total volatility relative to their non-sin counterparts, regardless of time period, while tobacco stocks have reduced beta and total risk but increased idiosyncratic risk over time. Moreover, the impact of being classified as a gambling firm had a significantly positive impact on risk from 1980-1998 but no impact from 1999-2017. This is consistent with Hong and Kacperczyk (2009) who illustrate that the gambling industry has gradually become more socially acceptable since the mid-to-late 1990s due to the deregulation of gambling activities in an increasing number of US states. These findings support the importance of separately investigating each SIN category, careful SIN versus non-SIN sample selection, period covered, and controls.

Prior literature has evolved under the assumption that SIN stocks are riskier than non-SIN stocks and considers the role of a firm's Corporate Social responsibility (CSR) activities to reduce risk (Lee and Faff, 2009; Luo and Bhattacharya, 2009; Guiral, 2012). The literature shows that CSR can help reduce idiosyncratic risk (Chen, Hung, and Lee, 2018), systematic risk (Monti, et al., 2019), downside risk (Monti et al. 2019; Diemont, Moore, and Soppe, 2016), future stock price crash risk (Kim, Li, and Li, 2014), value at risk (Monti et al. 2019), and the cost of equity capital (El Ghoul et al., 2011). To test and control for the potential impact of CSR on risk, we include a CSR score in all our models. Using the MSCI KLD database, available between 1991 and 2013, we construct a firm's CSR score as its total strengths minus total concerns in MSCI KLD's six dimensions: Community, Corporate governance, Diversity, Employee relations, Environment, and Product. We find that the role of CSR in mitigating the risk of SIN versus non-SIN stocks is category sensitive. CSR reduces idiosyncratic volatility for alcohol firms but increases total volatility for tobacco firms and has no impact on gambling stocks. This is consistent with the notion in prior studies that the impact of CSR on risk might vary across industries (Dowling, 2004; Jo and Na, 2012).

The rest of this document proceeds as follows. Section two contains background history of SIN stocks, the literature review and hypothesis development. Description of the data, data sources and the composition of the SIN sample are in Section three. Section four includes a brief discussion of propensity score matching and our methodologies. The empirical results are reported and analyzed in Section five with the robustness checks presented in Section six. In the last section, we conclude, with limitations and ideas for future research.

CHAPTER 2. LITERATURE REVIEW

2.1 SIN Companies

SIN companies or companies that conduct business in controversial sectors have always been of interest to academics and practitioners. They are stereotypically considered to have greater risk, greater reward and to be recession proof. The definition of SIN stocks varies but in general, a firm may be tagged as SIN due to industry affiliation, unethical or socially irresponsible operations or harmful products or services. For example, Fabozzi, Ma, and Oliphant (2008, page 85) define SIN companies as “corporations which provide products or services to gratify SIN seeking behavior such as consumption of alcohol, adult services, gaming, tobacco, weapons, and biotech alterations.’’ Oh, Bae and Kim (2017, page 3) state that “sinful firms are understood as the firms that are stigmatized by stakeholders due to their incongruence with social norms, which could harm society”. Therefore, SIN companies typically are defined as the companies that fail to meet basic social rules and are perceived as unethical or illegitimate (Campell, 2007; Byrne, 2010; Jo. et al., 2016). Although there is no consensus on the definition of a SIN stock, previous research tends to include firms involved in tobacco, gambling and alcohol operations as unambiguous cases of SIN firms (Salaber, 2007; Hong and Kacperczyk, 2009; Cai, Jo and Pan, 2012; Jo and Na, 2012). In most cultures, these three business categories compromise “SIN” stocks as they can harm public health, and lead to addicted behaviors (Salaber, 2007). However, there are papers that interpret a broader range of activities as SIN, in addition to the previously mentioned three industries, they include adult entertainment (Fabozzi et al., 2008; Kim and Venkatachalam, 2011), military (Waxler, 2004; Blitz and Fabozzi, 2017; Guillamón-Saorín, et al., 2017), firearms (Jo and Na, 2012), nuclear power (Guillamón-Saorín et al., 2017), biotech (Fabozzi et al., 2008), oil and cement (Cai et al., 2012). Table (2.1) exhibits the definition of SIN and the identified SIN industries in previous studies.

Table 2.1. Definitions of SIN companies in previous studies

Research	Definition of SIN	Industries included in the research	Sample period
Waxler (2004)	‘‘Any company that makes at least 25 % of its revenues from politically incorrect products in one of four sectors: tobacco, gambling, defense/weapons, and liquor’’	Tobacco, gambling, alcohol, weapons	-
Salaber (2007)	‘‘Returns on publicly-traded companies involved in producing tobacco, alcohol, and gaming’’	Alcohol, gambling, tobacco	1975–2006
Fabozzi, Ma, and Oliphant (2008)	‘any company in alcohol, gaming, tobacco, adult entertainment, biotech, and weapons if the revenue obtained from the six SIN product categories exceeded more than 30% of the company’s total revenue’’	Alcohol, gaming, tobacco, Adult entertainment, biotech, and weapons	1970–2007
Hong and Kacperczyk (2009)	‘‘Publicly traded stocks in the gaming, tobacco, alcohol, and adult entertainment’’	alcohol, tobacco, gaming	1965–2006
Kim and Venkatachalam (2011)	“Publicly traded stocks in the gaming, tobacco, alcohol, and adult entertainment (Hong and Kacperczyk, 2009)’’	Tobacco, alcohol, gaming, adult entertainment industry	1988-2006
Jo and Na (2012)	“Publicly traded stocks in the gaming, tobacco, alcohol, and adult entertainment (Hong and Kacperczyk, 2009)’’	Alcohol, tobacco, gambling	1991–2010

Cai, Jo, Pan (2012)	"firms in sinful industries, such as alcohol, tobacco, gambling, as well as those in industries involved with emerging environmental, social, or ethical issues, such as defense-related weapons, nuclear, oil, cement, and biotech	alcohol, tobacco, gambling, weapons, oil, cement, and biotech	1995 to 2009
Liston (2016)	"The SIN portfolio is defined in a similar manner to Hong and Kacperczyk (2009). It includes only equities that are in the tobacco, alcohol and gaming industries"	tobacco, alcohol, and gaming industries	1988 - 2009
Guillamón-Saorín, Guiral and Blanco (2017)	"firms operating or being involved in controversial activities, such as alcohol, tobacco, gambling, firearms, military, and nuclear power"	alcohol, tobacco, gambling, firearms, military, and nuclear power	2004–2008
Blitz and Fabozzi (2017)	"Four industries that are included in almost every study on this topic: alcohol, tobacco, gambling, and weapons."	alcohol, tobacco, gambling, and weapons	1963–2016

The definitions of SIN companies (and the corresponding SIN industries) might differ across various cultures (Waller, Fam, and Erdogan, 2005). Also, the companies which are taken as SIN companies might make a change in their products and services and therefore shift from SIN to non-SIN companies and vice versa. This process requires that the sample of SIN companies be subject to reclassification across cultures and over time (Blitz and Fabozzi, 2017). In this research, we use SIC/NAICS codes, which automatically adjusts for the reclassification of SIN stocks over time.

2.2 SIN companies, Performance, and associated risks

Previous investigations into the financial performance of SIN firms conclude that vice investors benefit from abnormal risk-adjusted returns (Kim and Venkatachalam, 2011; Hong and Kacperczyk, 2009; Fabozzi et al., 2008; Salaber, 2007). For example, Fabozzi, Ma, and Oliphant (2008) study SIN stock performance in 21 different nations from 1970 to 2007 by forming SIN portfolios consisting of stocks in the alcohol, tobacco, defense, biotech, gaming, and adult services industries. They conclude that the SIN portfolio outperforms the market on both a raw and beta adjusted basis by 3% and 6%, respectively. Hong and Kacperczyk (2009) use a time series regression to analyze SIN stock performance during the period of 1965-2006 and conclude that a portfolio consisting of long SIN stocks and short their comparables can make a 26 basis point return per month after controlling for the four-factor Carhart (1997) model.

Reputation, litigation and information risk as well as investor sentiment are used to justify excess returns for SIN companies. A reputation risk premium is relevant to companies that do not conform to social norms and thus many investors, especially institutional investors, avoid them. Shares of SIN stocks are exposed to approximately 18% lower institutional ownership by institutions that are subjected to social norm pressure such as pension funds, universities, banks, and insurance companies (Hong and Kacperczyk, 2009). Consequently, SIN stocks also have less coverage by sell-side analysts who generate financial reports mainly for institutional investors. This means limited risk sharing for those who are willing to hold SIN stocks, causing stocks to be traded at lower prices and to be systematically underpriced. Investors who choose to act against social norms and hold SIN stocks require compensation and expect to earn a reputation risk premium (Fabozzi, Ma, and Oliphant, 2008; Hong and Kacperczyk, 2009; Kim and Venkatachalam 2011; Derwall, Koedijk, and Ter Horst, 2011).

Excess returns for SIN stocks could also stem from the litigation risk associated with the services and products they offer. Due to the nature of their business, SIN companies may encounter higher litigation exposure and consequently costs of legal experts and punitive damage costs of lawsuits. Salaber (2007) utilizes the SIN stocks in 18 European countries over the period 1975-2006 to test whether differences in legal and cultural environments can explain the excess returns of SIN companies. She treats the litigation risk of the country as the determinant of SIN stock excess returns and assesses this risk by measures such as the number of lawyers per capita in a country, and litigation rate per country (number of judicial cases per inhabitants in a year). Her findings confirm that SIN stocks in countries with higher litigation risk have higher risk-adjusted returns but this excess return disappears after controlling for size and book-to-market factors. Salaber (2007) also mentions excise taxation as another determinant of excess returns for SIN stocks and shows that SIN firms operating in a country with higher excise taxation for their products have lower price/earnings, lower price/book ratios, depressed stock prices and thus a higher excess return.

Kim and Venkatachalam (2011) investigate the role of information risk in SIN stocks as a potential factor to explain their excess returns. Kim and Venkatachalam (2011) posit two probable and contrasting behaviors by SIN companies regarding financial reporting quality. Firstly, due to the nature of their business, SIN companies are usually under a high degree of scrutiny, and their deep pockets and significant financial performance may attract potential plaintiffs (Kim, 2007). This heightened public awareness might motivate SIN companies to be less transparent and thus have lower financial reporting quality. Kim and Venkatachalam (2011) maintain that the information risk in the form of inferior earning quality can explain the excess return mentioned in previous studies. On the other hand, it is plausible that SIN firms have an incentive to demonstrate a better self-image to overcome investors' social preferences and thus to prevent neglect by market participants (the neglect effect mentioned by Hong and Kacperczyk, 2009). In this case, SIN firms would exhibit better earning quality in their financial statements. Kim and Venkatachalam (2011) show that the abnormal returns of SIN companies do not arise from this increased information risk, but rather these firms exhibit higher quality information than that of their control firms. They conclude that these companies are neglected by market participants due to the social norm stigma.

Investor sentiment, "a belief about future cash flows and investment risks that are not justified by the facts at hand" (Baker and Wurgler, 2007, page 129), is also considered a potential source of risk that might explain the excess returns of SIN stocks. The evidence suggests that SIN stocks might be affected by investor sentiment-noise trading (Liston, 2016). Previous studies show that SIN stocks are exposed to a lower level of analyst coverage (Hong and Kacperczyk, 2009), leading to stock undervaluation and consequently to more noise trading (Liston, 2016). Liston (2016) studies portfolios of triumvirate SIN stocks, and utilizes sentiments augmented asset pricing models (sentiments-augmented CAPM, three-factor Fama-French model (1992) and four-factor Carhart (1997) model) to see if both individual and institutional investor sentiment can explain over-performance of SIN stocks. He decomposes investor sentiment into rational and irrational sentiments and uses irrational sentiment as a risk factor in the models. The results suggest that after controlling for both individual and institutional investors sentiment, the abnormal return is lost (Jensen's alpha becomes insignificant). Thus, Liston (2016) suggests investor sentiment rather than limited risk sharing or neglect-effect as the driving factor of higher risk-adjusted return of SIN stocks.

However, the existence of abnormal returns, which is hypothesized to reward the vice investors for the risks mentioned above, has been challenged in recent papers (Blitz and Fabozzi, 2017; Lobe and Walkshäusl, 2016). Blitz and Fabozzi (2017) use a global sample consisting of companies involved in alcohol, tobacco, gambling and weapons industries. Their result suggests that although SIN stocks depict a statistically significant CAPM alpha, this excess return disappears when controls for size, value, momentum, as well as the profitability and investment factors introduced in Fama and French (2015), are included. They conclude that there is no premium specific to SIN stocks to compensate for reputation or litigation risks and performance of SIN stocks are completely in line with current asset pricing models.

Although there are multiple studies that investigate the financial performance of SIN stocks, the existing literature is almost silent about quantifying risk in SIN stocks. Following the findings regarding the excess return of SIN stocks as well as the higher litigation exposure and market's widespread avoidance of SIN stocks, all relevant papers make the assumption that SIN stocks are riskier (Hong and Kacperczyk, 2009; Cai et al., 2012; Jo and Na, 2012; Oh et al., 2017). Hong and Kacperczyk (2009) is one of the first studies to adopt this assumption. Using the intuition of

Merton (1987) that both beta and idiosyncratic risk contribute to asset pricing, Hong and Kacperczyk (2009) maintain that, since SIN companies are exposed to higher litigation risk associated with their products and operations, they face more risk. Also, Jo and Na (2012) state that risk is more of an issue for SIN firms compared to conventional firms. These arguments lead to our first hypothesis (H1) to test for risk in SIN stocks:

H1: *SIN stocks have higher risk than non-SIN stocks.*

The literature has evolved under the assumption that SIN stocks have higher risk. As discussed, the risk has not been quantified nor has it been clearly delineated. To better understand SIN stock risk, we separately investigate the total, idiosyncratic and systematic risks of SIN stocks.

Idiosyncratic risk is the main category of risk attributed to the higher litigation exposure of SIN firms (Salaber, 2007; Hong and Kacperczyk, 2009). Idiosyncratic risk is a measure of volatility of stock prices that is firm-specific, and therefore higher litigation risk in SIN stocks increases idiosyncratic risk. Further, idiosyncratic risk is considered the main component of total risk, such that Goyal and Santa-Clara (2003, p. 980) believe "idiosyncratic risk constitutes almost 85% of the average stock variance measure". Thus, total risk is significantly influenced by idiosyncratic risk and both can be expected to be higher for SIN stocks. We formalize this in the following two hypotheses:

H1a*: SIN stocks have higher total risk than non-SIN stocks.*

H1b*: SIN stocks have higher idiosyncratic risk than non-SIN stocks.*

The existing literature is vague about the exact nature of the relative systematic risks (beta) of SIN versus conventional stocks. However, the assumption of higher risk for SIN stocks relative to non-SIN stock (Hong and Kacperczyk, 2009; Cai et al., 2012; Oh et al., 2017) is interpreted as applying to systematic risk as well (Jo and Na, 2012). We test this using hypothesis H1c:

H1c*: SIN stocks have higher systematic risk than non-SIN stocks.*

In contrast, some previous studies maintain that SIN stocks have a defensive nature and are recession proof (Fabozzi et al., 2008; Kim and Venkatachalam, 2011; Blitz and Fabozzi, 2017). In other words, SIN stocks are less volatile than the market and have a beta value less than one. Thus, we also investigate the defensive nature of SIN stocks:

***H1d**: SIN stocks have a beta less than one.*

2.3 Corporate Social Responsibility, firm risk and risk-reduction in SIN companies

Hong and Kacperczyk (2009), Cai et al. (2012), Jo and Na (2012), and Oh et al. (2017) assume that SIN stocks have more risk. Starting from this assumption, these papers attempt to investigate if, and how, SIN companies embrace different strategies to reduce their risk. Prior work considers the ability of CSR activities as a method to reduce risk (Lee and Faff, 2009; Luo and Bhattacharya, 2009; Guiral, 2012, Chen, Hung and Lee, 2018; Monti et al., 2019). CSR acts as moral capital for firms and provides an insurance-like protection for firms' shareholders against negative events (Bansal and Clelland, 2004; Godfrey, 2005). Engagement in CSR activities enhances stakeholders' satisfaction and can lead to a better corporate reputation among stakeholders (Orlitzky, Schmidt, and Rynes, 2003). Further, there is a widely held view that managers use CSR to boost information transparency (Jensen and Meckling, 1976). Accordingly, a higher level of transparency decreases the information asymmetry between firms and investors and thus reduces perceived firm risk (Cai, Cui, and Jo, 2016).

Chen, Hung and Lee (2018) explore CSR and the idiosyncratic risk of listed companies in Taiwan. They take different market conditions into account and separate their sample periods into up-market, down-market and correction conditions (the state between down-markets and up-markets). Using residuals from the CAPM, Fama-French three-factor (1992) and Carhart four-factor models (1997) to calculate idiosyncratic risk, they show that CSR can reduce idiosyncratic risk in all market states.

Monti et al. (2019) examine the association between CSR and systematic, idiosyncratic, downside, and value at risk. They use a sample of firms from 52 countries for the period 2002-2015 and conclude that CSR reduces risk. CSR can be related to downside risk in different ways. CSR can be a signal that non-explicit claims (e.g. product enhancement and job security) of stakeholders are respected. Ignoring these stakeholder claims may lead to lawsuit related outcomes and an increase in company risk (McGuire, Sundgren, and Schneeweis, 1988). Diemont, Moore, and Soppe (2016) also study the relationship between CSR and downside tail risk (extreme negative daily equity return). They use extreme value theory to calculate the value at risk at 1% as the measure of downside tail risk. Different aspects of CSR (community, employees, customers, governance, contractors, and environment) are studied and their sample is divided into three regions: America, Asia, and Europe. Their findings suggest that greater CSR scores in terms of employee and customers rights reduce tail risks.

In summary, these studies support CSR's ability to protect firms from firm-specific adverse shocks and lower the sensitivity of firm's cash flow in crisis or negative events (Luo and Bhattacharya, 2006), and thus reduce systematic risk (Jo and Na, 2012; Monti et al., 2019), idiosyncratic risk (Godfrey, 2005; Lee and Faff, 2009; Luo and Bhattacharya, 2009; Bouslah, Kryzanowski, and M'Zali, 2013; Chen, Hung, and Lee, 2018), and consequently total risk (Jo and Na, 2012; Bouslah et al., 2013; Monti et al., 2019) as well as downside risk (Diemont, Moore and Soppe, 2016; Monti et al., 2019).

This literature motivates CSR as a potential risk moderator in SIN industries. Jo and Na (2012), for example, maintain that since risk for companies involved in SIN activities is more of an issue than for non-SIN companies, they are more willing and likely to engage in CSR based risk-reduction activities. They find a negative relationship between firm total risk and CSR activities after controlling for several firm characteristics such as market to book ratio, firm size, debt ratio, R&D expenses, ROA, capital expenditure to asset ratio, operating cash flow to asset ratio and sales growth. Therefore, they find that SIN companies can improve their corporate image and reputation through CSR programs. In contrast, Guillamón-Saorín, et al. (2018) suggest that there is no risk-reduction effect of being involved in CSR activities for SIN companies. Using 204 US companies in alcohol, tobacco, gambling, firearms, military and nuclear power over 2004 -2008, they show that CSR engagement does not reduce firm market risk after controlling for factors such as potential growth, size, financial distress, and R&D expenses. They also study the role of earning quality (the absolute value of discretionary accruals) in the relationship between CSR and firm market risk. Guillamón-Saorín et al. (2018) conclude that when firms are involved in controversial activities, lower quality of information can lead to higher risk and this negative effect intensifies as companies engage in CSR, implying the market does not trust this CSR involvement and might see it as a means to cover up misconduct and achieve legitimacy (Cai, Hoje, and Carrie, 2012). To test whether CSR can mitigate risk in each triumvirate of SIN, we put forward the following hypotheses:

H2a*: CSR mitigates total risk in SIN stocks*.

H2b*: CSR mitigates idiosyncratic risk in SIN stocks.*

H2c*: CSR mitigates systematic risk (beta) in SIN stocks*

CHAPTER 3. DATA

Our research data is drawn from North American markets. The annual risk measures are collected form Beta Suites by WRDS from 1980 to 2017. The market proxy used for calculating risk measures is the CRSP value-weighted market portfolio. The annual accounting data and firm characteristics come from Compustat and CRSP over the same period. Firms are required to have positive total assets, book and market value of equity. Following previous studies (Hong and Kacperczyk, 2009), we focus on companies with a CRSP share code of 10 or 11 (common equities). Moreover, financial and utility companies are excluded from the sample[1].

Three risk measures are used in this research: market beta, idiosyncratic volatility, and total volatility. These traditional risk measures are estimated from the market model, calculated annually using the 60 monthly returns (5 years) preceding the last month of a given year. Equation (3.1) presents the market model used in Beta Suites to calculate risk measures:

$$r_{it} - rf_t = \alpha_i + \beta_i\,(mktrf_t - rf_t) + \varepsilon_{it} \qquad (3.1)$$

Where r_{it} is firm i's return at time t, rf_t is the one-month Treasury bill rate, and ε_{it} is an idiosyncratic error term of firm i at time t. $mktrf_t$ in equation (3.1) is the excess return on the market (or Rm-rf) and the market return (Rm) is calculated as the value-weight return on all NYSE, AMEX, and NASDAQ stocks (from CRSP). The coefficient on the market variable (β_i) is the beta of an individual stock in the current year. Idiosyncratic risk is measured by the standard deviation of residuals from the market model (Ang, et al., 2006) and is presented in equation (3.2).

$$IVOL_{it} = \sqrt{Var(\varepsilon_{it})} \qquad (3.2)$$

[1] Financial companies and utilities are represented with SIC codes 6000-6799 and 4800-4999, respectively.

Where $IVOL_{it}$ is idiosyncratic risk of firm i at time t, and ε_{it} is the error term from equation (3.1). Total volatility is measured by the standard deviation of monthly stock returns over the previous five years (equation 3.3):

$$TVOL_{it} = \sqrt{Var(r_{it})} \qquad (3.3)$$

To fully characterize the firms in our sample, we also calculate Jensen's alpha, the Sharpe ratio, and higher moments of the returns (skewness and kurtosis). Jensen's alpha and the Sharpe ratio are two common risk-adjusted performance measures. We extract Jensen's alpha from Beta Suites from the market model using 60 monthly returns (over five years), updated annually. α_i in equation (3.1) presents Jensen's alpha. Rearranging equation (3.1), we have:

$$\alpha_i = r_{it} - rf_t - \beta_i\,(mktrf_t - rf_t) - \varepsilon_{it} \qquad (3.4)$$

To calculate the Sharpe ratio, we obtain the excess return and stock volatility (standard deviation) for each stock from the market model using 60 monthly returns (over five years), updated annually. The Sharpe ratio for each stock is calculated as excess return from the market model divided by stock volatility (Sharpe, 1994), and is depicted in equation (3.5).

$$SHARPE = \frac{r_{it} - rf_t}{TVOL_{it}} \qquad (3.5)$$

Moreover, higher moments of returns are calculated as skewness (RET_SKEW) and kurtosis (RET_KURT) of monthly returns in each year, and are presented in equations (3.6) and (3.7) respectively[2].

$$RET\_SKEW = \frac{n}{(n-1)(n-2)} \sum_{i=1}^{n} \left(\frac{r_i - \bar{r}}{s_r}\right)^3 \qquad (3.6)$$

$$RET\_KURT = \frac{n(n+1)}{(n-1)(n-2)(n-3)} \sum_{i=1}^{n} \left(\frac{r_i - \bar{r}}{s_r}\right)^4 - \frac{3(n-1)^2}{(n-2)(n-3)} \qquad (3.7)$$

[2] These are the formulas used by SAS software to measure sample skewness and kurtosis.

Where n is the number of non-missing values for stock returns, r_i is the ith value of the returns, $\bar{r}$ is the sample average of returns, and s_r is the sample standard deviation of returns (SAS documentation, 2010).

3.1 SIN sample

Our SIN sample consists of companies involved in alcohol, tobacco, and gambling activities. These are traditional SIN groups that all previous research has classified as SIN industries. The stocks with Standard Industrial Classification (SIC) codes of 2080-2085 are in the alcohol group, and those with SIC codes of 2100-2199 belong to the tobacco group. For gambling stocks, we employ the North American Industrial Classification System (NAICS) codes of 7132, 71312, 713120, 713210, 71329, 713290, 72112, and 721120. We use NAICS to identify the gambling stocks because the SIC classification unites gambling stocks with hotel and other entertainment.

As mentioned earlier, some previous studies contain a broader range of SIN stocks and include military, firearms, cement, oil, and biotech stocks in their sample (Fabozzi et al., 2008; Kim and Venkatachalam, 2011; Guillamón-Saorín, et al., 2018). To make sure that our control sample is unequivocally non-SIN, we exclude these so called grey stocks from the control group. The list of SIC/NAICS for different SIN categories are presented in table (3.1). Using the list of SIC/NAICS given above, we have 1210 firm-year observations for the SIN sample, consisting of 487 firm-year observations for alcohol stocks, 108 firm-year observations for tobacco stocks, and 615 firm-year observations for gambling securities (table 3.2). Altogether, our SIN sample comprises 9.92% of all SIN firms specified by the list of SIC/NAICS of SIN stocks. The rest are grey stocks. Cement stocks represent the majority of these grey companies at 48.22%, while oil, and military and firearms stocks account for 39.77% and 2.08%, respectively.

Table 3.1. The list of SIC/NAICS for different SIN groups

Industries	SIC	NAICS
Alcohol	2080–2085	325193, 4248, 42481, 424810, 42482, 424820, 7224, 72241, 722410,
Tobacco	2100–2199	424940, 453991, 11191,111910, 312, 3122, 31221, 312210, 31222, 312221, 312229
Gambling	-	7132, 71312, 713120, 713210, 71329, 713290, 72112, 721120
Military	3760-3769, 3795, 3480, 3489	336992
Firearms	-	332992-332994
Cement	2833-2836	-
Oil	1300, 1310-1339, 1370-1382, 1389, 2900-2912, 2990-2999	-
Biotech	3240-3241	-

Table 3.2 SIN stock demographics

	# of firm years	% of firm years	# of firms in each year (range)	# of years
Traditional SIN				
Alcohol	487	3.99	10-25	2-38
Tobacco	108	0.89	4-6	2-38
Gambling	615	5.04	5-33	1-32
Traditional SIN Total	1,210	9.92	23-54	-
Others (Grey)				
Military	254	2.08	5-10	2-38
Firearms	0	0	0	0
Cement	5,881	48.22	38-291	1-38
Biotech	0	0	0	0
Oil	4,850	39.77	94-217	1-38
Others Total	10,985	90.08	190-393	-
Overall	12,195	100	212-422	-

3.2 Variable Construction

Table (3.3) provides a list of the variables used in this study, and the formula for calculating each variable if the database does not provide the variable.

Risk Measures. The quantification of risk is central to many areas of finance. Variance is the primary risk measure in the literature. Markowitz (1952) portfolio selection theory uses variance as a measure of risk. This theory seeks to minimize the risk for a given level of expected return under two assumptions: the distribution of the asset's return is normal, and the utility function is quadratic. The variance considers the entire domain of the return and treats both movements above and below the mean equally. Firm total risk can be decomposed into two elements: systematic risk and idiosyncratic risk. Systematic risk demonstrates how changes in market returns or fundamental news in the market (that affect all firms in the market) can change the firm's return. Idiosyncratic or firm-specific risk stems from firm-specific characteristics (Luo and Bhattacharya, 2009). Idiosyncratic risk has been an area of focus in the literature for several reasons. Firstly, idiosyncratic risk reflects the main component of (total) risk. Goyal and Santa-Clara (2003, p. 980) believe that "idiosyncratic risk constitutes almost 85% of the average stock variance measure, while systematic risk constitutes only 15%". Similarly, Gaspar and Massa (2006, p. 3131) report that "the share of idiosyncratic volatility is about 81%, while that of systematic volatility is only about 19%." Secondly, several studies suggest that idiosyncratic risk can explain the cross-section of expected stock returns and therefore idiosyncratic risk should be priced (Merton, 1987; Malkiel and Xu, 2004). Therefore, idiosyncratic risk has importance in the stock market, and managers and investors pay particular attention to it (Luo and Bhattacharya, 2009). Following the literature, we focus on the most widely adopted risk measures: Total volatility, systematic risk measured by beta, and idiosyncratic risk (Jo and Na, 2012; Bouslah, Kryzanowski, and M'Zali, 2013; Guillamón-Saorín, et al., 2018; Monti, et al., 2019).

Control variables. The prevalent variables used in the literature to capture differences in risk are firm size, firm age, debt, capital expenditure, cash and short-term investments, return on assets (ROA), Tobin's Q, and the Altman Z score. Firm size, measured as the log of total assets, is one of the most common risk control variables. Most papers find that larger companies are less risky

(Jo and Na, 2012; Bouslah, Kryzanowski, and M'Zali, 2013; Guillamón-Saorín, et al., 2018), because larger firms have more opportunities to have risk-mitigation strategies. Older companies are expected to have less risk as they usually possess a more stable revenue stream (Nguyen and Nguyen, 2015; Chen, Hung, and Lee, 2018). In this study, age is calculated as the logarithm of one plus the number of years since the first trading date on CRSP. Leverage is also generally expected to increase risk. Companies with a higher debt ratio (book value of debt divided by total assets) are exposed to more risk because higher debt obligation increases exposure to the risk of bankruptcy and financial distress costs. However, some less risky companies might take advantage of their lower risk stats and use more debt since debt is a less costly source of financing. Therefore, the effect of leverage is ambiguous. Jo and Na (2012), Bouslah, Kryzanowski, and M'Zali (2013), and Diemont, Moore, and Soppe (2016) support a positive association between leverage and risk, while Kim et al. (2014) show that companies with higher leverage have less risk. Jo and Na (2012) point out that SIN stocks with a higher level of profitability, as proxied by ROA, have less risk. Jo and Na (2012), and Nguyen and Nguyen (2015) believe that higher capital expenditure in companies, CapxR (capital expenditure divided by total assets), is associated with higher risk because higher capital expenditure reflects higher investments in new projects or equipment with uncertainty about their payoff in the future. The Altman Z score is a proxy that gauges a company's likelihood of bankruptcy. Bouslah, Kryzanowski, and M'Zali (2013) argue that companies with a higher Altman Z score (1993) are less exposed to financial distress costs and hence involve less risk. Tobin's Q measures the market's valuation of a firm relative to its assets-in-place. It takes into account the market's expectation concerning the firm's potential growth and prospects. A higher Tobin's Q might show that a stock is more likely to be overvalued and thus is associated with higher risk. Guillamón-Saorín, et al. (2018) investigate the relationship between Tobin's Q and market beta and find a positive relationship between them. Finally, Jo and Na (2012) posit that the SIN stocks with a higher operating cash flow (cash and short-term investments divided by total assets) experience less stock volatility. Thus, based on previous literature, we anticipate that Tobin's Q and CapxR will positively affect risk, while Size, Age, ROA, CashR, and Altman Z will have a negative impact on risk, and the debt ratio's impact is ambiguous. By controlling for the potential impact of these variables on risk, we can isolate the impact of SIN on risk.

Table 3.3 Variable Descriptions

Variable	Description
Beta	Beta of individual stocks in current year, based on 60 monthly stock returns using the market model (updated annually). The market proxy is the CRSP value-weighted market portfolio.
IVOL	Standard deviation of residuals in the current year from the market model, using monthly stock returns over the previous five years. The market proxy is the CRSP value-weighted market portfolio.
TVOL	Standard deviation of monthly stock returns over the previous five years.
ALPHA	Jensen's alpha based on monthly stock returns over the previous five years using market model. The market proxy is the CRSP value-weighted market portfolio.
SHARPE	Sharpe ratio calculated as excess return divided by stock volatility from the market model using monthly returns over the previous five years, updated annually.
RET_SKEW	Skewness of monthly returns in each year.
RET_KURT	Kurtosis of monthly returns in each year.
D-alcohol (+)	Dummy variable equal to 1 if the firm belongs to the alcohol industry and zero otherwise.
D-tobacco (+)	Dummy variable equal to 1 if the firm belongs to the tobacco industry and zero otherwise.
D-gambling (+)	Dummy variable equal to 1 if the firm belongs to the gambling industry and zero otherwise.
D_SIN (+)	Dummy variable equal to 1 if the firm belongs to the alcohol, tobacco, or gambling industries and zero otherwise.
CSR Z-score (-)	CSR score, by aggregating total strengths minus total concerns for each of the KLD's categories (community, corporate governance, diversity, employee relations, environment, and product) converted into z-scores.
Size (-)	Firm size. The logarithm of total assets.

Age (-)	The logarithm of one plus number of years since the first trading date on CRSP.
Debt ratio (+/-)	Book value of debt divided by total assets.
CapxR (+)	Capital expenditure expense divided by total assets.
ROA (-)	Operating income before depreciation divided by total assets.
CashR (-)	Cash and short-term investments divided by total assets.
Tobin's Q (+)	Market value of common equity plus total assets minus total value of equity divided by total assets.
Altman Z (-)	3.3EBIT + sales + 1.4 retained earnings + 1.2 working capital divided by total assets. Altman Z-score measures the ex-ante probability of distress.

CHAPTER 4. METHODOLOGY

There are three different approaches used in this study to facilitate a comparison between the risk of SIN and conventional stocks. We utilize year fixed effect panel regressions with Newey-West (1987) heteroskedasticity and autocorrelation robust (HAC) standard errors. There are several advantages to panel data analysis. It allows us to get more efficient estimates that use both within and between (group) variations. Panel regression also captures the impact of time-invariant variables and controls for the variables that cannot be observed or measured (Hsiao, 2007). When there is autocorrelation between error terms in the regression or the variance of error terms is not constant, statistical inference that relies on the usual standard errors can be misleading. Although the estimates are still unbiased in this case, the inaccurate standard errors of the estimates make the t-statistics invalid (Wooldridge, 2015). Newey and West (1987) propose a heteroskedasticity and autocorrelation consistent estimators (HAC) of the variance-covariance matrix to remedy this issue. To address any potential issue of autocorrelation in our models' error terms, we employ Newey-West (1987) HAC standard errors with panel regression models in this research. We also conduct a poolability test to see if our panel data is poolable, and we employ a Hausman test to facilitate the choice between random and fixed effect models.

First, we run year fixed effect regressions of market beta, total volatility and idiosyncratic volatility on the control variables and three dummy variables for alcohol, tobacco and gambling stocks. We define separate dummies for the three different SIN categories to investigate how risk is different across different SIN types in addition to comparing the risks of SIN and conventional stocks (equation 4.1). We also create a composite dummy for the 3 SIN categories combined (equation 4.2).

$$Firm\_risk_{it} = \beta_0 + \beta_1 D\_alcohol_{it} + \beta_2 D\_tobacco_{it} + \beta_3 D\_gambling_{it} + \beta_4 Size_{it} + \beta_5 Age_{it} + \beta_6 DebtR_{it} + \beta_7 CapxR_{it} + \beta_8 ROA_{it} + \beta_9 CashR_{it} + \beta_{10} TobinQ_{it} + \beta_{11} AltmanZ_{it} + e_{it} \qquad (4.1)$$

$$Firm\_risk_{it} = \beta_0 + \beta_1 D\_sin_{it} + \beta_2 Size_{it} + \beta_3 Age_{it} + \beta_4 DebtR_{it} + \beta_5 CapxR_{it} + \beta_6 ROA_{it} + \beta_7 CashR_{it} + \beta_8 TobinQ_{it} + \beta_9 AltmanZ_{it} + e_{it} \quad (4.2)$$

The dependent variables, $Firm\_risk_t$, are: i) beta, ii) idiosyncratic volatility, or iii) total volatility. $D\_alcohol_t$ is a dummy variable equal to 1 if the firm belongs to the alcohol industry and zero otherwise, $D\_tobacco_t$ is a dummy variable equal to 1 if the firm belongs to the tobacco industry and zero otherwise, $D\_gambling_t$ is a dummy variable equal to 1 if the firm belongs to the gambling industry and zero otherwise, D_sin_t is dummy variable equal to 1 if the firm belongs to the alcohol, tobacco, or gambling industries and zero otherwise, $Size_t$ is firm size, Age_t is firm age, $DebtR_t$ is the debt ratio, $CapxR_t$ is the capital expenditure ratio, ROA_t is return on assets, $CashR_t$ is the cash and short-term investments ratio, $TobinQ_t$ is the firm's Tobin's Q, and $AltmanZ_t$ is the Altman Z score.

Second, in a different approach, we find a matched sample for the SIN stocks using Propensity Score Matching (PSM) methodology. Matching is done for alcohol, tobacco, and gambling stocks separately, and for a combined SIN sample. Similar to our previous approach, we exclude grey stocks from both the control and SIN groups to increase the rigor of our research. Details of the propensity score matching method is presented in the following section.

4.1 Propensity Score Matching

The propensity score, first introduced by Rosenbaum and Rubin (1983a), is defined as the probability of assigning a treatment conditional on some observed controls: Prob (Y_i =1 |X_i**)**. Propensity score matching balances the distribution of the controls between the treated and untreated subjects, meaning in the subjects with the same propensity scores, the distribution of controls would be the same. The propensity score is used in both randomized experiments and observational studies. In randomized experiments, the true propensity score is defined by the study design and therefore is known. However, the propensity score is not generally known in observational studies and is estimated by study data (Austin, 2011a). In order to determine the propensity score, a logit or probit model is usually used, such that the treatment status is regressed on a set of controls. The propensity score is the predicted probability of treatment derived from the fitted logit/probit regression. The propensity score matching method makes matched sets of treated and control (untreated) subjects that have similar propensity scores (Rosenbaum and Rubin, 1983a, 1985). Balancing the distribution of controls between treated and control subjects allows focus on the treatment and thus the comparison of outcomes between treated and control subjects is conducted more accurately. The treatment effect is obtained by comparing the outcomes between treated and untreated subjects in the matched samples. Rosenbaum and Rubin (1983) propose the test on the difference of the mean outcome between treated and untreated subjects in the matched sample to find the treatment effect.

There are several approaches to match the subjects based on their propensity scores. First, one may choose to do either matching without replacements or matching with replacements. In matching without replacement, once an untreated subject is chosen as the pair for a treated subject, it can no longer be used for another treated subject. In other words, each untreated subject is going to be assigned to at most one treated subject. On the other hand, in matching with replacements, each untreated subject can be attributed to more than one treated subject (Rosenbaum, 2002; Austin, 2011a). Another consideration in propensity score matching is the decision between greedy or nearest neighbor matching and optimal matching. The typical procedure in greedy matching is to randomly choose a treated subject and match it with the untreated subject that has the closest propensity score. This process continues until all treated subjects are assigned to an untreated subject. In case of multiple untreated subjects with the same propensity score for a treated subject, one of them is randomly chosen. Alternatively, the optimal matching method tries to find the untreated subjects, such that the total difference of propensity scores between matched pairs is minimized (Rosenbaum, 2002; Austin, 2011a). There is another method which is utilized widely in this area, called nearest neighbor matching within a specified caliper distance (Rosenbaum and Rubin, 1985). This method puts a restriction on the nearest neighbor method, such that only untreated observations within a certain distance, as measured by difference in propensity scores relative to the treated subjects, are employed. This threshold distance is called caliper. Similar to the nearest neighbor method, the untreated subject with the closest propensity score to the treated one is selected from the set. If there are no subjects in the set to be matched with a treated subject, the treated subject is removed from the sample (Austin, 2011a).

Theoretically, the propensity score matching method can be depicted as follows: Let X denote a vector of control variables, Y denotes the outcome variable, and Z denotes the treatment (Z=1 treated, Z=0 not treated). The propensity score e(X) is defined as:

$$e(X = x) = pr(Z = 1 \mid X = x) \tag{4.3}$$

Each subject in the sample can take one of two potential outcomes: either the outcome under treatment $Y_i(1)$ or the outcome without treatment $Y_i(0)$:

$$Y_i \equiv Y_i(Z_i) = \begin{cases} Y_i(0) & if\ Z_i = 0 \\ Y_i(1) & if\ Z_i = 1 \end{cases} \tag{4.4}$$

And finally, the average treatment effect (ATE) is calculated as the mean of the outcomes under treatment minus the outcomes without treatment:

$$ATE = E[Y(1) - Y(0)] \tag{4.5}$$

In this study, the propensity scores are estimated for SIN and non-SIN stocks using a logistic regression of one of the SIN dummy variables on size, age, and the debt ratio. Specifically, we first run the following logit models to obtain the propensity scores:

$$D\_alcohol_{it} = \beta_0 + \beta_1 Size_{it} + \beta_2 Age_{it} + \beta_3 DebtR_{it} + e_{it} \tag{4.6}$$

$$D\_tobacco_{it} = \beta_0 + \beta_1 Size_{it} + \beta_2 Age_{it} + \beta_3 DebtR_{it} + e_{it} \tag{4.7}$$

$$D\_gambling_{it} = \beta_0 + \beta_1 Size_{it} + \beta_2 Age_{it} + \beta_3 DebtR_{it} + e_{it} \tag{4.8}$$

$$D\_sin_{it} = \beta_0 + \beta_1 Size_{it} + \beta_2 Age_{it} + \beta_3 DebtR_{it} + e_{it} \tag{4.9}$$

$$D\_nonsin_{it} = \beta_0 + \beta_1 Size_{it} + \beta_2 Age_{it} + \beta_3 DebtR_{it} + e_{it} \tag{4.10}$$

Using equations (4.6) to (4.10), we measure propensity scores for alcohol, tobacco, and gambling stocks separately, as well as for a combined SIN and a non-SIN category (control group). We do propensity score matching employing the greedy method without replacement and with caliper 0.2. We use this caliper following Austin (2011b), who finds that the optimal caliper width for estimating the differences in means is 0.2 of the standard deviation of the logit of the propensity score. Moreover, Rosenbaum and Rubin (1985) show that the logit of propensity scores are more likely to be normally distributed, and hence it is better to match on the logit of propensity scores as opposed to merely propensity scores. Following their findings, we match the observations based on the logit of propensity scores extracted from the above models. We also match pairs of stocks in the same year to control for the time factor.

We do t-tests on the three control variables before and after matching to ensure the proper isolation of the impact of treatment. Next, we conduct univariate tests (t-tests) on the mean risk differences of SIN versus the non-SIN matched sample for each grouping (alcohol, tobacco, gambling, and a combined sample). In the robustness section, we repeat this investigation starting with PSM using all eight control variables.

CHAPTER 5. EMPIRICAL RESULTS

5.1 Descriptive Statistics

Table (5.1) provides a statistical summary of the firm characteristics (control variables) for various SIN and non-SIN groupings from 1980 to 2017. The mean size for alcohol (6.26), tobacco (8.25), and gambling stocks (5.94) show that SIN stocks, on average, are larger than non-SINs (5.20) at a 1% level of significance using the difference in means test. Among the SIN groups, tobacco companies are oldest (3.8) and gambling firms are youngest (2.4), on average. We also find that the debt ratio is significantly higher at 1%, on average, for SIN stocks (0.23 for alcohol, 0.29 for tobacco, and 0.40 for gambling) relative to non-SIN firms (0.21). This is consistent with the Hong and Kacperczyk (2009) conclusion that SIN companies raise their capital with more debt than non-SIN firms. Moreover, SIN stocks are more profitable relative to their total assets (ROA) (0.12 for alcohol, 0.28 for tobacco, and 0.12 for gambling), on average, than non-SINs (0.09). Both tobacco (5.69) and gambling (6.55) stocks have, on average, a lower probability of exposure to financial distress relative to the non-SIN group (4.82). All these differences are significant at 1%.

Table 5.1 Statistical summary

Table 5.1 presents the statistical summary of the firm characteristics (control variables) across alcohol, tobacco, gambling, all SINs combined, and non-SIN groups over 1980-2017. We define Size as logarithm of total assets, Age as the logarithm of one plus number of years since the first trading date on CRSP, Debt ratio as the Book value of debt divided by total assets, CapxR as the capital expenditure expenses divided by total assets, ROA as the Operating income before depreciation divided by total assets, CashR as the cash and short-term investments divided by total assets, Tobin's Q as the market value of common equity plus total asset minus total value of equity divided by total assets, and Altman Z as Altman Z score (1993) measured as 3.3EBIT + sales + 1.4 retained earnings + 1.2 working capital divided by total assets. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively.

Industry	**Variable**	**N**	**Mean**	**Median**	**S.D**	**25th**	**75th**	**Max**	**Min**
Alcohol	Size	487	6.2567***	5.8847	2.4012	4.2845	8.4421	11.6301	2.0066
	Age	487	2.8995***	2.8904	0.8825	2.1972	3.5553	4.5433	1.3863
	Debt ratio	486	0.2292***	0.2187	0.1612	0.1053	0.3573	0.6625	0
	CapxR	482	0.0558***	0.0426	0.0477	0.0203	0.0767	0.2717	0
	ROA	487	0.1175***	0.1274	0.1153	0.0703	0.1922	0.3821	-0.5441
	CashR	487	0.1064***	0.0444	0.1807	0.0109	0.1082	0.9945	0
	Tobin's Q	487	1.766***	1.3436	1.1398	1.0610	2.1145	7.2602	0.4054
	Altman Z	476	3.8661***	3.2558	5.6743	2.1952	4.4253	82.3775	-13.2281
Tobacco	Size	108	8.2522***	9.1369	2.3053	6.0065	10.4934	11.5894	3.7940
	Age	108	3.8315***	4.1744	0.8857	4.0604	4.3108	4.5433	1.3863
	Debt ratio	108	0.2850***	0.2775	0.1467	0.1849	0.3923	0.6870	0
	CapxR	108	0.0346***	0.0288	0.0285	0.0126	0.0458	0.1592	0.0014

	ROA	108	0.2767***	0.2082	0.2193	0.1283	0.3322	0.9651	0.0586
	CashR	108	0.078***	0.0527	0.0936	0.0119	0.1122	0.6882	0.0027
	Tobin's Q	108	2.6819***	1.9680	2.1693	1.3881	2.9642	10.7892	0.6557
	Altman Z	96	5.6889***	3.6136	5.3377	2.7401	7.0444	30.3701	0.8728
Gambling	Size	615	5.9434***	5.8629	1.9521	4.7228	7.2327	10.2805	0.0354
	Age	615	2.4077***	2.4849	0.5947	1.9459	2.8904	3.6889	1.3863
	Debt ratio	615	0.4041***	0.4372	0.2343	0.2126	0.5847	0.8929	0
	CapxR	594	0.0927***	0.0636	0.0947	0.0304	0.1161	0.5931	0
	ROA	613	0.1179***	0.1239	0.1049	0.0783	0.1739	0.4850	-0.6837
	CashR	615	0.1259***	0.0872	0.1152	0.0495	0.1682	0.9714	0.0041
	Tobin's Q	615	1.603***	1.3171	1.1819	1.0524	1.7290	15.5136	0.3993
	Altman Z	612	6.5545**	2.0296	66.2290	1.2625	3.2255	34.5236	-8.1603
All SINs	Size	1,210	6.2756***	6.0461	2.2647	4.6632	7.9639	11.6301	0.0354
	Age	1,210	2.7327***	2.7081	0.8573	2.0794	3.2189	4.5433	1.3863
	Debt ratio	1,209	0.3232***	0.3088	0.2174	0.1495	0.4790	0.8929	0
	CapxR	1,184	0.0724***	0.0489	0.0771	0.0241	0.0924	0.5931	0
	ROA	1,208	0.1319***	0.1285	0.1314	0.0792	0.1894	0.9651	-0.6837
	CashR	1,210	0.1137***	0.0687	0.1444	0.0312	0.1429	0.9945	0.0000
	Tobin's Q	1,210	1.7649***	1.3499	1.3178	1.0656	1.9848	15.5136	0.3993
	Altman Z	1,184	5.4035***	2.6406	47.7734	1.5675	4.0052	34.5236	-13.2281
Non-SIN	Size	83,552	5.2041***	5.1002	2.0759	3.6903	6.6161	13.5896	0.0010
	Age	83,552	2.7170***	2.7081	0.6846	2.1972	3.1781	4.5433	1.3863
	Debt ratio	83,251	0.2083***	0.1854	0.1812	0.0385	0.3276	0.9646	0

CapxR	82,659	0.0560***	0.0392	0.0591	0.0199	0.0716	1.5113	-0.1518
ROA	83,324	0.0935***	0.1173	0.1762	0.0561	0.1728	1.9266	-4.7430
CashR	83,536	0.1542***	0.0837	0.1781	0.0251	0.2216	0.9992	-0.0102
Tobin's Q	83,552	1.7710***	1.3396	1.5788	1.0275	1.9442	68.7362	0.1153
Altman Z	80,850	4.8194***	3.5405	12.7757	2.3039	5.3728	79.2314	-18.6549

Table (5.2) exhibits the descriptive statistics for risk and performance measures across the triumvirate of SIN, all three SIN classes combined, and the non-SIN group. Gambling stocks have the highest market beta, idiosyncratic risk, and total risk across all groupings. The average market beta for gambling stocks is 1.18, while this figure for alcohol, tobacco, and conventional stocks is 0.8, 0.67, and 1.17, respectively. Gambling stocks have the highest market risk among SIN stocks, and have similar market risk relative to conventional stocks using the difference in means test[3] and a significance level of 1%. The idiosyncratic and total risks for gambling and non-SIN stocks are also similar using the difference in means test. We test SIN stock betas against one to investigate the hypothesized defensive nature of SIN stocks. The mean betas for alcohol and tobacco stocks are significantly less than one (at 1%) and support the statement that SIN stocks are recession proof (Fabozzi et al., 2008; Kim and Venkatachalam, 2011; Blitz and Fabozzi, 2017). However, the mean beta for gambling stocks and for the sample of all SIN stocks suggest that SIN stocks are not recession proof (insignificant). Therefore, the results support hypothesis H1d for alcohol and tobacco stocks, but not for gambling and the all SIN sample. The idiosyncratic and total volatility averages for alcohol and tobacco are less than for conventional stocks, using a difference in means test and a 1% level of significance. For example, the mean idiosyncratic risk for alcohol and tobacco is 0.099 and 0.0715, respectively, versus 0.138 for conventional stocks. In addition, the average total risk for alcohol and tobacco is 0.1076 and 0.0794, respectively, while it is 0.1509 for conventional stocks. Furthermore, if we compare the all SIN sample with the conventional stock sample, higher average risk measures are observed for conventional stocks at 1%. These results are not consistent with the premise in the existing literature that SIN stocks are risker than non-SIN stocks and thus do not support hypotheses H1a, H1b, and H1c.

The existing literature tests and finds higher risk-adjusted performance measures for SIN stocks (Salaber, 2007; Fabozzi et al., 2008; Hong and Kacperczyk, 2009; Kim and Venkatachalam, 2011). For our sample and the period 1980 to 2017, the mean ALPHA for each SIN category is statistically significant at 1%, except for alcohol, which is significant at 5%, indicating SIN outperforms the market, especially for tobacco. Among the triumvirate of SIN, only the tobacco group has a

[3] This test assumes the observations are independent. As a robustness check, we regressed each risk measure on a constant with Newey-West (1987) HAC standard errors for each SIN and non-SIN group and used the estimated constant as the estimated mean. We conducted t-test on the difference of these estimated means between the SIN categories versus the non-SIN samples. The results are like the ones based on the descriptive statistics measures in table (5.2) and the differences are significant at 1%.

significant mean Sharpe ratio (0.3034). The non-SIN sample has a mean Sharpe ratio of -0.0137, which is significant at 1%, but the sample of all SIN stocks has an insignificant mean Sharpe ratio (0.0021). Altogether, the tobacco group has the highest mean ALPHA and SHARPE measures across all categories, suggesting tobacco stocks can make significantly higher risk-adjusted returns. This is consistent with Hong and Kacperczyck (2009), who argue that tobacco stocks are exposed to more litigation risk compared to other SIN groups and that higher litigation risk might drive some of its higher excess return.

Asset returns distributions are asymmetric and leptokurtic (Longin, 1996; Peiro, 1999). Except for tobacco, the distributions for SIN stocks are significantly positively skewed at 1% between 1980 and 2017. Among SIN groups, gambling has the highest mean return skewness (0.4273) followed by alcohol (0.2949). Positive skewness reflects a small chance of large gains and it is similar for the SIN and non-SIN samples (0.3425, 0.3410 respectively). The mean RET_KURT is positive and significant at 1% for all groups, indicating fat tails (higher frequencies of outcomes) at the extreme negative and positive ends of the distribution. Among the SIN categories, alcohol has the highest mean return kurtosis (0.7979), then gambling (0.7558) and tobacco (0.4639). However, SIN stocks generally have a significantly (at 1%) lower mean return kurtosis (0.7466 versus 0.7638) than non-SIN stocks, suggesting a lower chance of extreme negative and positive events for SIN stocks relative to non-SIN stocks.

Thus, alcohol and tobacco stocks have less market, idiosyncratic, and total risk than conventional stocks, while gambling stocks have higher market risk and similar idiosyncratic and total risk compared to non-SIN stocks. The risk-adjusted return is significant and positive for tobacco, but not for other SIN groups. Further, SIN stocks have thinner tails than non-SIN stocks in their return distributions, indicating a lower chance of extreme negative and positive events compared to non-SIN stocks.

Table 5.2 Statistical summary for risk measures across different SIN classes

Table 5.2 represents the summary statistics of risk measures between 1980 and 2017 across four different groups: alcohol stocks, tobacco stocks, gambling stocks, the aggregated sample of the three SIN stocks, and non-SIN stocks. We define Beta as the beta of individual stocks in the current year, based on monthly stock returns over the previous five years using the market model, IVOL is standard deviation of residuals in the current year from the market model, using monthly stock returns over the previous five years, TVOL is the standard deviation of monthly stock returns over the previous five years, ALPHA is Jensen’s alpha based on monthly stock returns over five years using the market model, Sharpe is the Sharpe ratio calculated as excess return divided by stock volatility from market model using monthly returns over five years, updated annually, and RET_SKEW and RET_KURT are the skewness and kurtosis of monthly returns in each year, respectively. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively.

Industry	**Variable**	**N**	**Mean**	**Median**	**S.E**	**25th**	**75th**	**Max**	**Min**
	Beta	487	0.7981***	0.7386	0.5665	0.4207	1.0920	3.2984	-0.7624
	IVOL	487	0.0990***	0.0865	0.0512	0.0636	0.1152	0.4240	0.0283
	TVOL	487	0.1076***	0.0949	0.0528	0.0732	0.1239	0.4357	0.0323
Alcohol	ALPHA	487	0.0018**	0.0043	0.0178	-0.0045	0.0114	0.0508	-0.0882
	SHARPE	485	-0.0043	-0.0215	0.8870	-0.5348	0.5240	2.8571	-3.3919
	RET_SKEW	487	0.2949***	0.2112	0.8882	-0.3292	0.8538	3.3391	-2.1137
	RET_KURT	486	0.7979***	0.1783	1.9879	-0.5232	1.5209	11.3686	-1.8763
	Beta	108	0.6717***	0.6525	0.3341	0.4553	0.9128	1.7134	-0.3239
	IVOL	108	0.0715***	0.0640	0.0255	0.0509	0.0917	0.1508	0.0397
Tobacco	TVOL	108	0.0794***	0.0742	0.0240	0.0625	0.0956	0.1728	0.0434
	ALPHA	108	0.0093***	0.0103	0.0119	0.0052	0.0155	0.0369	-0.0475
	SHARPE	107	0.3034***	0.2689	0.8656	-0.2598	0.9008	3.0467	-1.7330

	RET_SKEW	108	0.0764	0.0507	0.7650	-0.4463	0.5278	2.2294	-1.5589
	RET_KURT	108	0.4637***	0.1451	1.4960	-0.6567	1.1251	6.0538	-1.7822
	Beta	615	1.1842***	1.1130	0.8361	0.6613	1.6362	5.4717	-1.9497
	IVOL	615	0.1462***	0.1343	0.0582	0.1019	0.1764	0.3875	0.0480
	TVOL	615	0.1578***	0.1442	0.0596	0.1147	0.1885	0.3921	0.0509
Gambling	ALPHA	615	0.0043***	0.0034	0.0225	-0.0093	0.0167	0.1015	-0.0914
	SHARPE	606	-0.0459	-0.0915	0.8785	-0.5258	0.3829	4.8079	-2.7468
	RET_SKEW	612	0.4273***	0.3809	0.8405	-0.1691	0.9343	3.0079	-1.8527
	RET_KURT	612	0.7558***	0.1928	1.9731	-0.5912	1.4875	9.7350	-1.9527
	Beta	1,210	0.9830***	0.8889	0.7328	0.5250	1.3420	5.4717	-1.9497
	IVOL	1,210	0.1205***	0.1076	0.0597	0.0783	0.1549	0.4240	0.0283
	TVOL	1,210	0.1306***	0.1176	0.0616	0.0866	0.1635	0.4357	0.0323
All SIN	ALPHA	1,210	0.0037***	0.0047	0.0201	-0.0059	0.0141	0.1015	-0.0914
	SHARPE	1,198	0.0021	-0.0447	0.8853	-0.5103	0.4719	4.8079	-3.3919
	RET_SKEW	1,207	0.3425***	0.2852	0.8594	-0.2386	0.8654	3.3391	-2.1137
	RET_KURT	1,206	0.7466***	0.1870	1.9421	-0.5853	1.4755	11.3686	-1.9527
	Beta	83,508	1.1658***	1.0936	0.7585	0.6993	1.5311	5.5837	-3.1270
	IVOL	83,508	0.1383***	0.1199	0.0793	0.0863	0.1688	0.9366	0.0165
	TVOL	83,508	0.1509***	0.1324	0.0811	0.0978	0.1815	0.9541	0.0175
Non_SIN	ALPHA	83,508	0.0042***	0.0036	0.0202	-0.0068	0.0144	0.3818	-0.1715
	SHARPE	83,019	-0.0137***	-0.0712	0.9505	-0.5507	0.4578	3.4849	-3.8698
	RET_SKEW	83,105	0.3410***	0.2979	0.8752	-0.2233	0.8650	3.4641	-2.4455
	RET_KURT	83,026	0.7638***	0.2002	2.0152	-0.6042	1.4959	12.0000	-2.9843

To examine the collinearity properties of the variables in preparation for regression analysis, we calculate Pearson correlations. The Pearson correlation matrix for the risk measures and the control variables is presented in table (5.3). Unless otherwise noted, all correlations are significant at 1%. Size, age, and the debt ratio are significantly negatively associated with most of the risk measures, with an exception for the significantly positive relationship between size and Beta (+0.076). The negative correlations of size and age with the risk measures range from -0.469 (size and IVOL) to -0.125 (age and beta) and are all larger than the correlations between the risk measures and the debt ratio (range from -0.076 to -0.026). This is consistent with the Nguyen and Nguyen (2015) result that bigger or older companies usually have less idiosyncratic and total volatility. Tobin's Q and the cash and short-term investments ratio (CashR) are also significant and positively related to all risk measures with magnitudes of approximately 0.1 and 0.2, respectively. On the other hand, an increase in capital expenditure and ROA contributes to less risk, regardless of risk measure. The correlations between CapxR and the three risk measures are small, ranging from -0.018 (Beta) to -0.068 (IVOL and TVOL) and the correlation of ROA with Beta is small (-0.11) but stronger than with TVOL (-0.358) and IVOL (-0.364). Most of the correlations between control variables are statistically significant, except for relationships with the Altman Z score. However, none of the control variables have particularly strong correlations with each other. The largest correlation is between the debt ratio and CashR (-0.456) followed by the correlation between Age and Size (0.41), while the majority of the correlations (22/28) are below 0.2. This mitigates multi-collinearity concerns for regression analysis.

We continue our investigation into risk and SIN versus non-SIN categories by doing multivariate regressions, which allows us to control for firm features that might also impact risk.

Table 5.3 The Pearson Correlation Coefficients matrix

Table 5.3 presents the correlations for risk measures and control variables for the entire sample from 1980 to 2017. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Beta	1										
(2) IVOL	0.307***	1									
(3) TVOL	0.417***	0.989***	1								
(4) Size	0.076***	-0.469***	-0.426***	1							
(5) Age	-0.125***	-0.364***	-0.358***	0.410***	1						
(6) Debt ratio	-0.076***	-0.026***	-0.033***	0.132***	0.005	1					
(7) CapxR	-0.018***	-0.068***	-0.068***	0.010***	-0.074***	0.090***	1				
(8) ROA	-0.114***	-0.370***	-0.363***	0.300***	0.160***	0.017***	0.149***	1			
(9) CashR	0.207***	0.200***	0.216***	-0.149**	-0.158***	-0.456***	-0.159***	-0.212***	1		
(10) Tobin's Q	0.100***	0.125***	0.127***	-0.028***	-0.099***	-0.198***	0.046***	-0.094***	0.302***	1	
(11) Altman Z	0.009**	-0.002	-0.003	-0.040***	-0.031***	-0.177***	-0.004	0.090***	0.175***	0.360***	1

5.2 Regression Analysis

To proceed, we separately regress each risk measure on the dummies for alcohol, tobacco and gambling stocks, controlling for size, age, debt, Tobin's Q, cash and short-term investments, capital expenditure, ROA, and Altman Z score (see equation 4.1). We also create a composite dummy for the three SIN categories combined (equation 4.2). To begin, we explore the hypothesis that SIN stocks have different risks than non-SIN stocks by separately estimating equation (4.1) for each of beta, idiosyncratic volatility, and total volatility.

To determine an appropriate estimation method for our panel data, we conduct the poolability test. The poolability test examines if the slopes are the same across groups or over time (Baltagi, 2001). The null hypothesis states that the sensitivity of the dependent variable to an explanatory variable is the same for all cross section units and that this is true for each regressor. We reject the null hypothesis of poolability and conclude that each firm has its own slope for each regressor and therefore, it is better to use a fixed or random effects model. The Hausman test is used to choose the correct specification. The results, table (5.4), show that the null hypothesis of random effects is rejected at all levels. Thus, we include year fixed effects in the regression and re-run the model. The results of "F-test for no fixed effects" (reported in table 5.5) confirms the presence of fixed effects in the model. The fixed effects model controls for all time-invariant differences between the individuals. Thus, the estimated coefficients of the fixed effects models cannot be biased because of omitted time-invariant characteristics and we can control for any potential correlation in unobserved variables across time (Wooldridge, 2015).

Table 5.4 Hausman Test for the investigation of random vs fixed effect specification

Variables	(1) Beta	(2) IVOL	(3) TVOL
D-alcohol	-0.33396***	-0.0276***	-0.03085***
	(0.089)	(0.00839)	(0.00872)
D-tobacco	-0.50337**	-0.03513*	-0.03809*
	(0.2025)	(0.0191)	(0.0198)
D-gambling	-0.07333	0.015558**	0.011719
	(0.0751)	(0.00707)	(0.00735)
Size	0.070692***	-0.01266**	-0.01115***
	(0.0026)	(0.000232)	(0.000242)
Age	-0.18203***	-0.00809**	-0.0114***
	(0.00584)	(0.000508)	(0.000531)
Debt ratio	-0.07739***	0.023333**	0.021459***
	(0.0181)	(0.00155)	(0.00162)
CapxR	0.152364***	-0.06368***	-0.06212***
	(0.0477)	(0.00405)	(0.00423)
ROA	-0.25628***	-0.03758***	-0.04083***
	(0.0169)	(0.00144)	(0.00151)
CashR	0.458809***	0.021103***	0.028708***
	(0.0191)	(0.00163)	(0.00171)
Tobin's Q	0.010818***	0.003592***	0.003284***
	(0.00177)	(0.00015)	(0.000157)
Altman z	0.000454**	-0.00003*	-0.00003
	(0.000184)	(0.000016)	(0.000016)
_Cons	1.244629***	0.225248***	0.238414***
	(0.0168)	(0.00145)	(0.00152)
Random effects included	Yes	Yes	Yes
Hausman Test P-value for random effects	<.0001	<.0001	<.0001
Observations	87437	87437	87437

Table 5.5 Regression Analysis for different SIN groups

Variables	(1) Beta	(2) IVOL	(3) TVOL
D-alcohol	-0.35528***	-0.01907***	-0.02396***
	(0.0408)	(0.00352)	(0.00364)
D-tobacco	-0.45046***	0.013227***	0.004689
	(0.0899)	(0.00421)	(0.00441)
D-gambling	-0.03053	0.003367	0.002328
	(0.0499)	(0.00331)	(0.00363)
Size	0.073835***	-0.01611***	-0.01404***
	(0.00241)	(0.000231)	(0.000241)
Age	-0.19185***	-0.01799***	-0.02004***
	(0.00625)	(0.000518)	(0.00055)
Debt ratio	-0.03901	0.046506***	0.044287***
	(0.0254)	(0.00221)	(0.00232)
CapxR	0.17293***	-0.00124	0.001007
	(0.0636)	(0.00567)	(0.00586)
ROA	-0.47991***	-0.0786***	-0.08398***
	(0.0337)	(0.00378)	(0.00395)
CashR	0.706642***	0.026636***	0.036197***
	(0.03)	(0.0025)	(0.00267)
Tobin's Q	0.024328***	0.003407***	0.003613***
	(0.00391)	(0.00039)	(0.000413)
Altman z	-0.00127*	-0.00014*	-0.00016*
	(0.000753)	(0.000075)	(0.000084)
_Cons	1.101888***	0.252826***	0.251055***
	(0.0306)	(0.00251)	(0.0026)
Year fixed effect	Yes	Yes	Yes
P-value for fixed effect F-test	<.0001	<.0001	<.0001
R-Squared	0.1195***	0.4117***	0.3776***
Observations	87400	87400	87400

Table (5.5) presents the estimates from the year[4] fixed effects estimation of equation (4.1). The fixed effects regression results for market beta confirm that the average beta for alcohol and tobacco stocks are statistically significantly lower (-.3553 and -.4505, respectively) while the beta for gambling stocks is statistically indistinguishable compared to the beta of non-SIN firms. These amounts are statistically (at 1%) as well as economically significant. Thus, contrary to H1c, we do not find a stronger systematic risk for SIN stocks relative to non-SIN stocks.

Alcohol stocks have on average 0.01907 and 0.02396 significantly less idiosyncratic risk and total risk compared to non-SIN stocks (at 1%), yet for gambling stocks, both measures are statistically insignificant, suggesting gambling and non-SIN stocks possess, on average, the same level of idiosyncratic and total risk. Tobacco stocks, on the other hand, have statistically significantly (at 1%) more idiosyncratic risk (0.0132) which supports H1b, but show no difference in total risk compared to non-SIN stocks. The control variables generally have the expected signs. An increase in cash ratio and Tobin's Q leads to a significant increase in all risk measures, which is consistent with Guillamón-Saorín et al. (2018), while return on assets and age are significantly negatively associated with risk (at 1%). Size is negatively related to beta, but positively related to idiosyncratic and total risk, all significant at 1%. In addition, the debt ratio does not significantly impact beta, but it has significantly positive association (at 1%) with idiosyncratic and total risk.

Thus, we have only one instance, tobacco and idiosyncratic risk, where our data supports any of hypotheses H1a-H1c and the generally cited statement in the existing literature that SIN stocks are riskier than non-SIN stocks (Hong and Kacperczyck 2009; Cai et al., 2012; Jo and Na, 2012; Oh et al., 2017). Our sharply contrasting findings may reflect the explicit quantification of risk, importance of period coverage, controls, separate investigation of each SIN category, careful SIN versus non-SIN sample selection or a combination of these factors.

[4] We assume that heterogeneity across units is not an issue as we control for SIN versus non-SIN using industry dummies and a broad set of controls.

Table 5.6 Regression Analysis results for the sample of all SIN stocks

Variables	(1) Beta	(2) IVOL	(3) TVOL
D-SIN	-0.19799***	-0.00501**	-0.00824***
	(0.0324)	(0.00233)	(0.0025)
Size	0.073644***	-0.01611***	-0.01404***
	(0.00241)	(0.000231)	(0.000241)
Age	-0.19349***	-0.018***	-0.02008***
	(0.00624)	(0.000516)	(0.000549)
Debt ratio	-0.03062	0.047021***	0.044906***
	(0.0254)	(0.0022)	(0.00232)
CapxR	0.191976***	-0.0007	0.00183
	(0.0635)	(0.00566)	(0.00585)
ROA	-0.48041***	-0.07844***	-0.08384***
	(0.0336)	(0.00377)	(0.00395)
CashR	0.710837***	0.026904***	0.036517***
	(0.0299)	(0.00249)	(0.00267)
Tobin's Q	0.023821***	0.003407***	0.003605***
	(0.00391)	(0.00039)	(0.000413)
Altman z	-0.00122	-0.00014*	-0.00016*
	(0.000756)	(0.000075)	(0.000084)
_Cons	1.106459***	0.252688***	0.251001***
	(0.0306)	(0.0025)	(0.0026)
Year fixed effect	Yes	Yes	Yes
P-value for fixed effect F-test	<.0001	<.0001	<.0001
R-Squared	0.1188***	0.4114***	0.3772***
Observations	87400	87400	87400

We also run the model for all three SIN stocks combined (alcohol, tobacco, gambling) by defining D_sin_t as a dummy variable equal to 1 if the firm belongs to the alcohol, tobacco, or gambling industries and zero otherwise. We test the model specification using the Hausman test and find the presence of fixed effects. Consequently, we conduct year fixed effects panel regression analysis and exhibit the results in table (5.6). The control variables are mostly significant at 1% and have the anticipated signs. The coefficient for the SIN dummy is negative and significant for all three risk measures with estimates of -.198, -0.005, and -0.008 for beta, idiosyncratic risk, and total risk respectively. Thus, these results are contrary to the premise in Hong and Kacperczyck (2009), Cai et al. (2012), Jo and Na (2012), and Oh et al. (2017), and show that risk of SIN stocks is not greater than that of non-SIN stocks and actually less, regardless of risk measures. The results for our aggregated SIN group also do not support hypotheses H1a, H1b, and H1c.

5.3 Propensity Score Matching

We have compared SIN to non-SIN stocks using conventional approaches but in order to isolate the treatment effect more carefully and thoroughly we will also use propensity score matching (PSM). Propensity score matching eliminates the "curse of dimensionality" when one wishes to match on several characteristics and increases the measurement accuracy of the treatment effect (Bartram, Brown, and Conrad, 2011). This method ensures that the two groups of subjects are matched equally on all factors (except for treatment), and thus the comparison between two groups is done more carefully and reliably.

We first match each SIN stock with a similar non-SIN stock based on three characteristics or control variables and do a t-test on the mean difference of each risk measure between SIN and its matched non-SIN. In addition, we estimate equation (4.1) on the matched sample employing dummies for different SIN types and all the control variables. We choose size, age, and the debt ratio to match the stocks, as these are the variables that show the highest level of overlap between our treated and untreated samples. By doing that, we aim to get better matching quality, as matching on only three variables can be done more tightly than on all eight control variables with different levels of overlap.

Table 5.7 The Propensity Score Matching on Size, Age, and the Debt ratio, t-test on the difference of the control variables

Alcohol	Sample	Treated	Control	Difference	S.E	P-value
Size	Unmatched	6.2567	5.2041	1.0526***	2.0779	<.0001
	Matched	6.2566	6.2435	0.013	2.4373	0.9336
Age	Unmatched	2.8995	2.717	0.1826***	0.6859	<.0001
	Matched	2.899	2.9661	-0.0671	0.8234	0.204
Debt ratio	Unmatched	0.2292	0.2083	0.0209***	0.181	0.0046
	Matched	0.2292	0.2214	-0.00778	0.1679	0.4704
Tobacco	**Sample**	**Treated**	**Control**	**Difference**	**S.E**	**P-value**
Size	Unmatched	8.2522	5.2041	3.048***	2.0762	<.0001
	Matched	8.2961	8.3759	-0.0799	2.3111	0.8034
Age	Unmatched	3.8315	2.717	1.1146***	0.6849	<.0001
	Matched	3.9256	3.9232	0.00235	0.6561	0.9794
Debt ratio	Unmatched	0.285	0.2083	0.0767***	0.1811	<.0001
	Matched	0.287	0.2658	0.0212	0.1566	0.3307
Gambling	**Sample**	**Treated**	**Control**	**Difference**	**S.E**	**P-value**
Size	Unmatched	5.9434	5.2041	0.7393***	2.075	<.0001
	Matched	5.933	6.0521	-0.119	1.9898	0.2955
Age	Unmatched	2.4077	2.717	-0.3093***	0.684	<.0001
	Matched	2.4123	2.3825	0.0298	0.6241	0.404
Debt ratio	Unmatched	0.4041	0.2083	0.1958***	0.1816	<.0001
	Matched	0.4025	0.3893	0.0132	0.2366	0.3284
All SINs	**Sample**	**Treated**	**Control**	**Difference**	**S.E**	**P-value**
Size	Unmatched	6.2756	5.2041	1.0715***	2.0787	<.0001
	Matched	6.2744	6.1404	0.134	2.2403	0.1417
Age	Unmatched	2.7327	2.717	0.0158	0.6874	0.5246
	Matched	2.7333	2.681	0.0523	0.7946	0.106
Debt ratio	Unmatched	0.3232	0.2083	0.1149***	0.1817	<.0001
	Matched	0.3227	0.3295	-0.00682	0.2232	0.4524

Table (5.7) reports the difference of the mean size, age, and debt ratio between SIN stocks and non-SIN stocks before and after PSM. Other than age in the all SIN sample, the differences in the three control variables between each SIN and non-SIN grouping are statistically significant at 1% before matching, but this quantity is statistically insignificant after matching. This shows that propensity score matching worked well: The matched pairs have a similar distribution of size, age, and debt ratio after matching.

Once we know we have a good matched sample, we do a t-test on the mean difference of each risk measure between SIN and its matched non-SIN. The results are in table (5.8). The mean risk measures for alcohol and tobacco are always statistically significantly less than for their matched non-SIN sample. For alcohol the difference in the mean beta, idiosyncratic risk, and total risk are respectively 0.3832, 0.0288 and 0.0341 less than those of non-SIN stocks. All differences are significant at all levels. Similarly, the mean beta for tobacco stocks is 0.4784 less than that of non-SIN peers, and they have 0.0159 and 0.0241 less idiosyncratic and total volatility, all significant at 1%. On the other hand, there is no significant difference in the mean beta for gambling stocks between SIN and its matched non-SIN, but gambling stocks have a significantly higher IVOL (0.00796, significant at 5%) and TVOL (0.00686, significant at 10%) relative to their non-SIN matched sample. However, the magnitude of these differences is small and not economically significant. Finally, for the all SIN grouping, beta, IVOL, and TVOL are each significantly less (at 1%) than their matched counterpart. These results are similar to the SIN vs non-SIN comparisons without benefit of PSM (table 5.2) and the regression analysis on the sample of all SINs combined (table 5.6). Based on these findings, we can conclude that alcohol and tobacco stocks are generally less risky, while gambling stocks have almost the same levels of risk as conventional stocks, on average. These findings do not support hypotheses H1a, H1b, and H1c.

We also run a panel regression on the matched sample to investigate differences in risk measures after controlling for Size, Age, Debt, CapxR, ROA, CashR, Tobin's Q and Altman Z score. PSM used size, age, and debt for matching but to capture any potential information left in size, age, and debt, we also include them in the regression. We use fixed effect panel regression since the Hausman test (unreported) reflects the presence of fixed effects. The estimates for each SIN group can be found in table (5.9), and for the all SIN sample in table (5.10).

Table 5.8 Propensity Score Matching, t-test on the differences of risk measures

Table 5.8 exhibits the test of differences in mean of Beta, IVOL, and TVOL between matched samples resulting from propensity score matching on Size, Age, and the Debt ratio over the period 1980-2017. The results are presented in four sections: alcohol stocks, tobacco stocks, gambling stocks, and the sample of all SIN stocks. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively.

Alcohol	**Obs**	**Mean**	**Difference (Alcohol- Non)**	**P-value of diff**
Beta (Alcohol)	486	0.7986	-0.3832***	<.0001
Beta (non-SIN)		1.1817		
Idiosyncratic volatility (Alcohol)	486	0.099	-0.0288***	<.0001
Idiosyncratic volatility (non-SIN)		0.1279		
Total volatility (Alcohol)	486	0.1077	-0.0341***	<.0001
Total volatility(non-SIN)		0.1418		
Tobacco	**Obs**	**Mean**	**Difference (Tobacco - non)**	**P-value of diff**
Beta (Tobacco)	104	0.6733	-0.4784***	<.0001
Beta (non-SIN)		1.1517		
Idiosyncratic volatility (Tobacco)	104	0.0858	-0.0159***	0.0017
Idiosyncratic volatility (non-SIN)		0.0698		
Total volatility (Tobacco)	104	0.0777	-0.0241***	<.0001
Total volatility(non-SIN)		0.1017		
Gambling	**Obs**	**Mean**	**Difference (Gambling - non)**	**P-value of diff**
Beta (Gambling)	612	1.1758	-0.0264	0.5783
Beta (non-SIN)		1.2023		
Idiosyncratic volatility (Gambling)	612	0.1463	0.00796**	0.0304
Idiosyncratic volatility (non-SIN)		0.1383		
Total volatility (Gambling)	612	0.1578	0.00686*	0.0722
Total volatility(non-SIN)		0.151		
All sins (Alcohol,Tobacco, Gambling)	**Obs**	**Mean**	**Difference (SIN - non)**	**P-value of diff**

Beta (SIN)	1208	0.9824	-0.1811***	<.0001
Beta (non-SIN)		1.1635		
Idiosyncratic volatility (SIN)	1208	0.1205	-0.0124***	<.0001
Idiosyncratic volatility (non-SIN)		0.133		
Total volatility (SIN)	1208	0.1306	-0.0151***	<.0001
Total volatility(non-SIN)		0.1457		

Table 5.9 Panel regression analysis on matched sample of different SIN groups (matched on Size, Age, and the Debt ratio)

Table 5.9 presents the Panel regression analysis with Newey-West (1987) autocorrelation robust standard errors on the matched samples from Propensity Score Matching on Size, Age, and Debt ratio over the period 1980-2017. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively. Standard errors are presented in brackets below the estimated coefficients.

	Beta			IVOL			TVOL		
	Alcohol	**Tobacco**	**Gambling**	**Alcohol**	**Tobacco**	**Gambling**	**Alcohol**	**Tobacco**	**Gambling**
D-SIN	-0.58188***	-0.5078***	0.206655	-0.03822**	0.008619	0.019485*	-0.04676***	-0.00112	0.020618
	(0.1531)	(0.1371)	(0.1896)	(0.0172)	(0.00523)	(0.0114)	(0.0181)	(0.00417)	(0.0125)
Size	-0.03027	-0.03985	0.15399***	-0.0142***	-0.0072***	-0.0102***	-0.0141***	-0.0073***	-0.0073***
	(0.0266)	(0.0286)	(0.0295)	(0.00314)	(0.00180)	(0.00226)	(0.00331)	(0.00139)	(0.00258)
Age	0.039388	0.03563	-0.17736*	0.0017	0.00287**	-0.0089	0.00186	0.00262**	-0.0122**
	(0.0666)	(0.0367)	(0.0935)	(0.00532)	(0.00139)	(0.00534)	(0.00562)	(0.00127)	(0.00587)
Debt ratio	0.02864	0.18762	0.260616	0.01566	-0.0506***	0.077024***	0.015226	-0.0461***	0.078119***
	(0.2780)	(0.3585)	(0.1956)	(0.0271)	(0.0187)	(0.0128)	(0.0287)	(0.0146)	(0.0130)
CapxR	0.513034	-0.76814	-0.1646	0.01497	-0.02819	-0.02377	0.014394	-0.04048	-0.02954
	(0.7243)	(0.9521)	(0.5286)	(0.0496)	(0.0852)	(0.0273)	(0.0524)	(0.0730)	(0.0266)
ROA	-0.26426	-0.25965	-0.40194*	-0.0904**	-0.0932***	-0.18609***	-0.08754**	-0.0951***	-0.1876***
	(0.4409)	(0.4286)	(0.4272)	(0.0379)	(0.0320)	(0.0272)	(0.0397)	(0.0251)	(0.0285)
CashR	0.631562*	-0.68596	-0.33999***	0.022679	0.01875	0.07236***	0.025376	0.00537	0.067781**
	(0.3572)	(0.4895)	(0.3728)	(0.0220)	(0.0304)	(0.0271)	(0.0247)	(0.0219)	(0.0275)
Tobin's Q	0.004379	-0.02696	0.107101**	0.001585*	0.0092	0.00534***	0.001446	0.008948*	0.00694**
	(0.0356)	(0.0745)	(0.0451)	(0.00266)	(0.00621)	(0.00205)	(0.00282)	(0.00487)	(0.00211)
Altman Z	-0.00633	0.032677	0.0008***	-0.00098**	-0.0036*	0.000019	-0.00105**	-0.00294**	0.00003*
	(0.00499)	(0.0248)	(0.000278)	(0.000456)	(0.00180)	(0.000018)	(0.000453)	(0.00140)	(0.00002)

_Cons	1.22589***	1.1889***	0.053983	0.2285***	0.1239***	0.14299***	0.23835***	0.13463***	0.135988***
	(0.2711)	(0.3784)	(0.3935)	(0.0219)	(0.0204)	(0.0253)	(0.0226)	(0.0161)	(0.0269)
Year fixed effect included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P-value F-test for no fixed effect	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
R-squared	0.2148***	0.6561***	0.3781***	0.536***	0.8543***	0.4968***	0.5052***	0.8844***	0.4695***
Obs	726	174	896	726	174	896	726	174	896

Table 5.10 Panel regression analysis on matched sample of all SIN stocks (matched on Size, Age, and the Debt ratio)

Table 5.10 presents the Panel regression analysis with Newey-West (1987) autocorrelation robust standard errors on the matched samples resulted from Propensity Score Matching on Size, Age, and the Debt ratio over the period 1980-2017. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively. Standard errors are presented in brackets below the estimated coefficients.

	Beta	**IVOL**	**TVOL**
	All SIN	**All SIN**	**All SIN**
D-SIN	-0.56549***	-0.02188	-0.03171*
	(0.2066)	(0.0155)	(0.0184)
size	0.040158**	-0.01126***	-0.01016***
	(0.0203)	(0.00142)	(0.00160)
age	-0.16153***	-0.01005***	-0.01234***
	(0.0510)	(0.00296)	(0.00334)
debt ratio	0.6998***	0.076532***	0.084026***
	(0.1402)	(0.00920)	(0.00964)
CapxR	0.391452	0.026014	0.028776
	(0.4933)	(0.0261)	(0.0260)
ROA	-0.37185	-0.12048***	-0.11975***
	(0.2434)	(0.0175)	(0.0183)
cashR	0.596347***	0.038662***	0.042587***
	(0.2212)	(0.0149)	(0.0163)
Tobin's Q	0.048222**	0.0053***	0.005613***
	(0.0240)	(0.0015)	(0.00162)
Altman Z	0.00103***	0.000044***	0.000056***
	(0.00023)	(0.000012)	(0.000014)
_Cons	1.186724***	0.193997***	0.203759***
	(0.2798)	(0.0198)	(0.0225)
Year fixed effect included	Yes	Yes	Yes

P-value F-test for no fixed effect	<.0001	<.0001	<.0001
R-squared	0.2762***	0.4977***	0.4724***
Obs	1788	1788	1788

Table (5.9) shows that alcohol and tobacco shares have statistically lower (at 1%) market betas than non-SIN matched pairs with coefficients of -0.5819 and -0.5078, respectively and the beta for gambling stocks is not statistically different. The idiosyncratic volatility for alcohol stocks is significantly less (-0.03822, significant at 5%) than that of the matched non-SIN firms, but the relevant difference is positive for gambling stocks (0.01949, significant at 10%) and insignificant for tobacco. Total volatility for alcohol stocks are on average 0.0468 less than their non-SIN counterparts, yet the estimates for tobacco and gambling are insignificant, suggesting that there is no difference in their total risk compared with matched conventional stocks. Thus, when we refine our non-SIN comparator group and do fixed effects estimation, we continue to find a lack of support for the first three hypotheses (H1a, H1b, and H1c) with one weak exception (idiosyncratic risk of gambling firms). Although we do match the SIN stocks based on size, age, and debt and observe that the quality of matching is appropriate, we still witness instances of significant coefficient estimates on these three variables in the regression. The PSM outcomes for SIN versus non-SIN stocks are comparable to the results in table (5.5), except, in general, the coefficient estimates are larger in the case of the matched samples.

For the all SIN stock sample (table 5.10), the estimates of the SIN dummy for beta and total volatility are -0.5655 (significant at 1%) and -0.03171 (significant at 10%), respectively. Being a SIN stock has no significant impact on idiosyncratic volatility for the matched sample. Once more, we conclude that SIN stocks involve less systematic risk, while other risk measures are not different, or very close to those for conventional stocks. This contradicts Jo and Na (2012), Cai et al. (2012), Oh et al. (2017), and Guillamón-Saorín et al. (2018) who assume that the SIN stocks are riskier due to the nature of their business. Thus, regardless of method, our data supports less systematic risk for SIN stocks. Further, in isolated instances where IVOL or TVOL is greater, the magnitudes are not economically significant.

5.4 Regression analysis in different periods

The existing literature assumes SIN stocks are riskier than non-SIN, but our results do not support this assumption for the 1980-2017 period. To examine how the risk of SIN stocks has changed over time, we split our original sample period into two intervals: 1980-1998 and 1999-2017. Similar to the previous sections, we do a fixed effects panel regression analysis on the matched sample of SIN groups from propensity score matching on Size, Age, and the Debt ratio.

Table 5.11 Regression analysis on different sample periods for the sample of all SINs

Table 5.11 presents the panel regression analysis with Newey-West (1987) autocorrelation robust standard errors for the matched sample of the all SIN combined group over two periods: 1980-1998 and 1999-2017. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively. Standard errors are presented in brackets below the estimated coefficients.

All SINs	Beta		IVOL		TVOL	
	1980-1998	**1999-2017**	**1980-1998**	**1999-2017**	**1980-1998**	**1999-2017**
D-SIN	0.077972	-0.25068***	0.011985***	-0.01813**	0.011818**	-0.02086***
	(0.0653)	(0.0932)	(0.00447)	(0.00733)	(0.00467)	(0.0078)
Size	0.064338***	0.014838	-0.01199***	-0.01116***	-0.01058***	-0.01034***
	(0.0188)	(0.0227)	(0.00123)	(0.00169)	(0.00125)	(0.00187)
Age	-0.15093***	-0.10687	-0.00944***	-0.01035***	-0.01146***	-0.01196***
	(0.0436)	(0.065)	(0.00264)	(0.00398)	(0.00265)	(0.00435)
Debt ratio	0.174362	1.05738***	0.065794***	0.067241***	0.066017***	0.081321***
	(0.1849)	(0.1905)	(0.0126)	(0.0141)	(0.0126)	(0.0149)
CapxR	0.39197	1.350424**	0.035342	0.04043	0.036342	0.055032
	(0.5708)	(0.5779)	(0.0283)	(0.038)	(0.0263)	(0.0407)
ROA	-0.223	-1.01489**	-0.11107***	-0.08589***	-0.1094***	-0.09877***
	(0.3266)	(0.4422)	(0.0159)	(0.0325)	(0.0146)	(0.0352)
CashR	0.44866	0.637982**	0.06597***	0.044773**	0.069028***	0.051812**
	(0.3358)	(0.2964)	(0.019)	(0.0219)	(0.0202)	(0.0224)
Tobin's Q	0.051634	-0.00975	0.006546***	0.002962	0.00747***	0.002268
	(0.0379)	(0.032)	(0.00154)	(0.00249)	(0.00139)	(0.0026)

Altman Z	0.000809***	0.027*	0.000044***	-0.00224*	0.000052***	-0.00167
	(0.000234)	(0.0158)	(0.000013)	(0.00123)	(0.000013)	(0.00133)
_Cons	0.585669***	0.823413***	0.181515***	0.198944***	0.182956***	0.199751***
	(0.1744)	(0.2372)	(0.0102)	(0.0172)	(0.0103)	(0.0179)
Year fixed effects included	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.0995***	0.3147***	0.5898***	0.4098***	0.565***	0.404***
Obs	702	906	702	906	702	906

We begin our investigation with the sample of all SINs and report the outcomes in table (5.11). The results for beta indicate that the systematic risk of SIN stocks is less relative to the matched non-SIN in the second half of our period. For example, we find that the SIN dummy is insignificant and positive (0.078) for 1980-1998, but it is significant (at 1%) and negatively related to beta (-0.251) from 1999 to 2017. The results for IVOL and TVOL show that SIN stocks were riskier in 1980-1998 (0.012 and 0.012, respectively), but they become less risky than the non-SIN matched sample in the second period (-0.018 and -0.021, respectively). Each of these coefficients is significant at 5% or 10%. Thus, the impact of SIN on risk measures is sensitive to time and risk metric. This may partially reconcile our findings with those concentrating on earlier time periods. Although the impact of SIN on risk is less, the controls do not display any shift in their impact on risk over time.

We also investigate the time sensitivity of each SIN group separately. Table (5.12) exhibits the fixed effects panel regression estimates of the alcohol versus matched non-SIN sample. We observe that alcohol stocks have significantly less Beta, IVOL, and TVOL relative to their non-SIN matched pairs, regardless of the time period. Further, the absolute value of the alcohol impact for all risk measures has become higher in the more recent subsample, suggesting that the alcohol group has become less risky in 1999-2017 relative to 1980-1998. For example, estimates change from -0.48618 to -0.56622 for Beta, from -0.011 to -0.05507 for IVOL, and from -0.01975 to -0.06434 for TVOL.

Table (5.13) presents the results for the tobacco group. In the first sub-period the risk is not statistically different between the tobacco and non-tobacco matched firms regardless of the risk measurement. In sharp contrast, all tobacco risk measures are significant in the second half. The estimates for Beta (-0.87382), IVOL (0.017194), and TVOL (-0.00884) show that being a tobacco stock significantly reduced systematic and total risk but increased idiosyncratic risk in the second subperiod. Finally, table (5.14) demonstrates that the impact of being in the gambling sector is positive and significant at 5% or better from 1980-1998 for all risk measures (0.451 for Beta, 0.028 for IVOL, and 0.032 for TVOL), yet it has no significant relationship with the three risk measures from 1999-2017. Thus, being a gambling stock significantly increased risk, relative to the matched sample, before 1998 but not in the second subperiod. This finding is consistent with the Hong and Kacperczyk (2009) observation that the gambling industry has gradually become more socially acceptable since the late 1990s due to the deregulation of gambling activities in an increasing number of US states.

Table 5.12 Regression analysis on different sample periods for matched sample of the alcohol group

Table 5.12 presents the panel regression analysis with Newey-West (1987) autocorrelation robust standard errors for the matched sample of the alcohol group over two periods: 1980-1998 and 1999-2017. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively. Standard errors are presented in brackets below the estimated coefficients.

Alcohol	**Beta**		**IVOL**		**TVOL**	
	1980-1998	**1999-2017**	**1980-1998**	**1999-2017**	**1980-1998**	**1999-2017**
D-alcohol	-0.48618***	-0.56622***	-0.011**	-0.05507***	-0.01975***	-0.06434***
	(0.0986)	(0.152)	(0.00531)	(0.0158)	(0.00587)	(0.0168)
Size	0.018502	-0.08809**	-0.01014***	-0.01328***	-0.0096***	-0.01385***
	(0.0297)	(0.0377)	(0.00133)	(0.00474)	(0.0015)	(0.00501)
Age	-0.06976	0.297527***	-0.00152	-0.00264	-0.00285	0.001345
	(0.072)	(0.1108)	(0.0028)	(0.0114)	(0.00325)	(0.012)
Debt ratio	-0.19947	0.706554*	0.019601	-0.0323	0.013073	-0.01816
	(0.2633)	(0.4)	(0.014)	(0.0496)	(0.0152)	(0.0515)
CapxR	-0.10069	0.885145	0.04784	-0.06102	0.04237	-0.04489
	(1.0355)	(0.9786)	(0.0346)	(0.0846)	(0.0419)	(0.0902)
ROA	0.11962	-2.19532***	-0.14104***	-0.1167***	-0.13373***	-0.14902***
	(0.612)	(0.5864)	(0.0366)	(0.0409)	(0.0343)	(0.0445)
CashR	0.970113**	0.626747*	0.057894***	-0.05947**	0.066611***	-0.05463*
	(0.4786)	(0.3297)	(0.0165)	(0.0288)	(0.022)	(0.0293)
Tobin's Q	0.116019	-0.05064	0.00439	0.010181***	0.008342**	0.008642**
	(0.0873)	(0.037)	(0.00393)	(0.00347)	(0.00375)	(0.00367)

Altman Z	-0.0105	0.05624***	-0.00088***	-0.00307**	-0.00104***	-0.00208
	(0.00683)	(0.0188)	(0.000227)	(0.00119)	(0.000314)	(0.00132)
_Cons	1.207347***	0.680535**	0.185908***	0.264336***	0.19767***	0.265642***
	(0.2351)	(0.3322)	(0.0113)	(0.0259)	(0.0122)	(0.0265)
Year fixed effects included	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.1909***	0.3431***	0.6922***	0.5152***	0.6243***	0.5***
Obs	301	341	301	341	301	341

Table 5.13 Regression analysis on different sample periods for matched sample of the tobacco group

Table 5.13 presents the panel regression analysis with Newey-West (1987) autocorrelation robust standard errors for the matched sample of the tobacco group over two periods: 1980-1998 and 1999-2017. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively. Standard errors are presented in brackets below the estimated coefficients.

Tobacco	**Beta**		**IVOL**		**TVOL**	
	1980-1998	**1999-2017**	**1980-1998**	**1999-2017**	**1980-1998**	**1999-2017**
D-tobacco	-0.08189	-0.87382***	0.005406	0.017194***	0.004805	-0.00884*
	(0.1772)	(0.0991)	(0.0074)	(0.00336)	(0.00771)	(0.00475)
Size	-0.02564	0.121342***	-0.00821***	-0.00499***	-0.00811***	-0.00047
	(0.0249)	(0.0299)	(0.00147)	(0.00134)	(0.00143)	(0.00169)
Age	-0.70181*	0.000433	0.009469	-0.00081	-0.0115	-0.0022
	(0.3702)	(0.0236)	(0.02)	(0.00116)	(0.0213)	(0.00182)
Debt ratio	-0.01275	-0.64673**	-0.04159	-0.00539	-0.04141	-0.02653
	(0.6368)	(0.2686)	(0.0299)	(0.0129)	(0.0287)	(0.0194)
CapxR	2.745708***	-0.80892	0.026013	0.146534	0.083181*	0.064888
	(0.8035)	(2.7059)	(0.0484)	(0.097)	(0.048)	(0.1473)
ROA	-0.40912	3.245701***	-0.11583***	-0.03299*	-0.12186***	0.072311**
	(0.4206)	(0.5374)	(0.0272)	(0.0181)	(0.0228)	(0.0307)
CashR	-0.48485*	0.476452	0.007456	0.012113	0.005523	0.028474
	(0.287)	(0.3108)	(0.0206)	(0.0194)	(0.0175)	(0.0196)
Tobin's Q	-0.04887	0.145576**	0.00977*	-0.00575**	0.009958**	-0.00269
	(0.096)	(0.064)	(0.00497)	(0.00272)	(0.00405)	(0.00418)

Altman Z	0.037409	-0.26636***	-0.00262	0.001887	-0.00226	-0.00481
	(0.0376)	(0.0626)	(0.00163)	(0.00202)	(0.00142)	(0.00371)
_Cons	3.879569**	0.374867	0.144052*	0.106558***	0.233407***	0.099318***
	(1.5086)	(0.3134)	(0.0774)	(0.0145)	(0.0834)	(0.0163)
Year fixed effects included	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.5995***	0.7407***	0.7633***	0.5542***	0.6571***	0.5703***
Obs	81	70	81	70	81	70

Table 5.14 Regression analysis on different sample periods for matched sample of the gambling group

Table 5.14 presents the panel regression analysis with Newey-West (1987) autocorrelation robust standard errors for the matched sample of the tobacco group over two periods: 1980-1998 and 1999-2017. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively. Standard errors are presented in brackets below the estimated coefficients.

Gambling	**Beta**		**IVOL**		**TVOL**	
	1980-1998	**1999-2017**	**1980-1998**	**1999-2017**	**1980-1998**	**1999-2017**
D-gambling	0.450749**	-0.01177	0.028408***	0.004384	0.031708***	0.005423
	(0.191)	(0.1547)	(0.0108)	(0.00886)	(0.0107)	(0.0105)
Size	0.127958***	0.135105***	-0.01447***	-0.00888***	-0.01276***	-0.00595*
	(0.0388)	(0.036)	(0.00271)	(0.00291)	(0.00266)	(0.00334)
Age	-0.05805	-0.18456*	-0.00823	-0.00072	-0.00799	-0.00448
	(0.1171)	(0.1019)	(0.0066)	(0.00858)	(0.0065)	(0.00929)
Debt ratio	0.144209	0.691353***	0.057553***	0.087246***	0.059562***	0.090941***
	(0.2946)	(0.2275)	(0.0177)	(0.0178)	(0.0173)	(0.0191)
CapxR	-0.15053	-0.19824	-0.01523	-0.05908	-0.0188	-0.06252
	(0.6167)	(0.6523)	(0.0318)	(0.0384)	(0.0288)	(0.0435)
ROA	-0.20641	-1.4925**	-0.15656***	-0.2118***	-0.14911***	-0.23087***
	(0.5797)	(0.6095)	(0.0332)	(0.0447)	(0.032)	(0.0494)
CashR	-0.63462	0.07408	0.064068*	0.112886***	0.057818*	0.110838***
	(0.5442)	(0.4369)	(0.034)	(0.0325)	(0.033)	(0.0363)
Tobin's Q	0.098326*	0.144498**	0.002159	0.014627***	0.00371*	0.016661***
	(0.0528)	(0.0663)	(0.00221)	(0.00382)	(0.00199)	(0.00439)

Altman Z	0.000816***	0.02621	0.000022	-0.00275	0.000032*	-0.00243
	(0.000269)	(0.0224)	(0.00002)	(0.00179)	(0.000019)	(0.00193)
_cons	-0.26106	0.006827	0.206742***	0.116953***	0.19641***	0.107351***
	(0.4374)	(0.4245)	(0.0229)	(0.0367)	(0.0228)	(0.0399)
Year fixed effects included	Yes	Yes	Yes	Yes	Yes	Yes
R-square	0.1413***	0.5404***	0.5291***	0.4824***	0.5143***	0.4629***
Obs	322	425	322	425	322	425

These outcomes illustrate the importance of disaggregating the SIN categories and examining the time sensitivity of their risks. Alcohol has less systematic, idiosyncratic, and total risk relative to their non-SIN counterparts, regardless of time period. Tobacco stocks have reduced beta and total risk but increased idiosyncratic risk over time. Further, the elevated risk reputation associated with SIN stocks can be largely attributed to gambling stocks and this has also changed over time: The impact of being classified as a gambling firm had a significantly positive impact on risk from 1980-1998 but no impact from 1999-2017.

5.5 Discussion

Many studies argue that inherent business characteristics cause SIN stocks to be riskier than non-SIN stocks. Hong and Kacperczyck (2009) state that companies involved in alcohol, tobacco, and gambling are widely neglected by investors due to social norms, are more exposed to litigation risk, and hence have higher idiosyncratic risk and a higher risk-adjusted return. Based on Hong and Kacperczyck (2009), a series of papers also assume that SIN stocks are riskier but none of these studies explicitly quantifies and analyzes risk (Cai et al., 2012; Jo and Na, 2012; Oh et al., 2017; and Guillamón-Saorín et al., 2018). Our study calculates beta, idiosyncratic and total risks and finds that alcohol and tobacco stocks have less beta, idiosyncratic volatility and total volatility while gambling stocks have similar risk levels compared to their non-SIN pairs. Hong and Kacperczyk (2009) state that the gambling industry has gradually become more socially acceptable since mid-to-late 1990s as more US-states have started deregulating gambling activities. Therefore, it is not surprising that gambling stocks do not show different risks relative to conventional stocks. Finally, the sample of all SIN stocks demonstrates that, regardless of risk measure, risk is not greater for SIN stocks relative to their matched non-SIN sample. This contrasts with the prevailing assumption that SIN companies are riskier than non-SIN firms (Hong and Kacperczyk, 2009; Cai et al., 2012; Jo and Na, 2012; Oh et al., 2017; Guillamón-Saorín et al., 2018). Therefore, we reject hypotheses H1a, H1b, and H1c. Our results are robust to using different approaches including regression analysis on an unmatched sample, Propensity Score Matching, and regression analysis on the matched sample of SIN stocks.

The existing literature maintains that SIN companies are more prone to litigation risk relative to their non-SIN counterparts (Salaber, 2007; Hong and Kacperczyk, 2009). Due to the nature of their business, SIN companies may encounter higher litigation exposure and consequently costs of legal experts and punitive damage costs of lawsuits. This higher litigation risk might imply higher risk for SIN stocks, which is contrary to our results. On the other hand, Kim and Venkatachalam (2011) argue that SIN companies benefit from higher earning quality and lower information risk compared to their control firms because SIN companies have an incentive to present a better self-image to prevent being neglected by the market. It has been shown that information risk has a positive association with stock risk and stocks with higher information risk (poor earning quality) have higher volatility (Chen, Huang, and Jha, 2012). Alam, et al. (2015) support this idea and belief that as earning quality increases, idiosyncratic and total volatility decrease. Our results are consistent with the information risk hypothesis. We suspect that the impact of information risk on SIN stocks dominates the effect of higher litigation risk.

There are several additional explanations to reconcile the differences between our results and those in the existing literature. First, to the best of our knowledge, this research is the first one in the SIN area to use propensity score matching to more carefully isolate the impact of being classified as a SIN firm on risk. Second, this study is also the first one that excludes grey stocks. Previous studies included grey stocks in their SIN or conventional stock samples, but we maintain that grey stocks should be excluded from both because they are not necessarily universally accepted as SIN and are only circumstantially considered unethical by investors (Byrne, 2010). This necessitates a careful SIN versus non-SIN selection, especially when we observed from table (3.2) that grey stocks contain approximately 90% of the total SIN sample.

Third, unlike previous studies that investigate SIN companies collectively, we study each SIN category separately to fully understand how the risk of each SIN grouping is different relative to its non-SIN matched sample. Gambling stocks have gradually attracted more social acceptance over the time, while the tobacco and alcohol industries are still considered to be in conflict with the goals of public health policies. We observed from table (3.2) that gambling stocks account for 51% of our (triumvirate) SIN sample, while tobacco stocks comprise only 9% of the sample. This implies that the gambling group might drive the results and thus studying SIN stocks collectively could give us a misleading picture of SIN risk.

Fourth, the time period covered in the research has a key role to play as illustrated by our results in section 5.4 and tables 5.11 to 5.14. For example, for the sample of All SIN stocks, which is the aggregated category used by prior studies, we find that SIN stocks were riskier (IVOL and TVOL) in 1980-1998 but they became less risky than the non-SIN matched sample in the second period. Therefore, if the time period studied corresponds to the first sub-period (1980-1998), such as Hong and Kacperczyk (2009) and Kim and Venkatachalam (2011), it is not surprising that they find SIN stocks to be riskier. In addition, by disaggregating the SIN types, we see that gambling stocks, as the largest component of the SIN sample, may account for these results.

5.6 CSR inclusion in the regression analysis of matched samples

The existing literature treats CSR as a practical approach to reduce risk for all stocks (Lee and Faff, 2009; Luo and Bhattacharya, 2009; Guiral, 2012). Bansal and Clelland (2004) and Godfrey (2005) believe that CSR acts as moral capital and provides protection for companies in an adverse event. Engagement in CSR activities enhances stakeholders' satisfaction and can lead to a better corporate reputation among stakeholders (Orlitzky et al., 2003), decrease volatility in firm's future cash flows (Luo and Bhattacharya, 2006), decrease systematic risk (Jo and Na, 2012; Monti, et al., 2019), idiosyncratic risk (Godfrey, 2005; Lee and Faff, 2009; Luo and Bhattacharya, 2009; Bouslah et al., 2013; Chen et al., 2018), and total risk (Jo and Na, 2012; Bouslah et al., 2013; Monti et al., 2019).

To investigate the role of CSR in mitigating risk in SIN versus non-SIN stocks, we include the MSCI KLD CSR scores in our model. For each company, MSCI KLD assigns several strengths and concerns along different dimensions to assess its social performance. Since the MSCI KLD information is only available from 1991 to 2013, we narrow our sample from 1980-2017 to 1991-2013. We calculate the CSR score as total strengths minus total concerns in MSCI KLD's six dimensions: Community, Corporate governance, Diversity, Employee relations, Environment, and Product. Each strength adds one point to the CSR score and each concern subtracts one point. Following Giuli and Kostovetsky (2014) and Guillamón-Saorín, et al. (2018), we standardize all scores to have a mean of zero and a standard deviation of one across each year to simplify the interpretation of coefficients (CSR z-score). We do regression analysis on the matched samples (from propensity score matching on Size, Age, and the Debt ratio) with the lagged CSR z-score and the interaction of the SIN dummy with the lagged CSR z-score included. Following Bouslah et al. (2013) and Kim et al. (2014), we impose a one-year lag between the CSR z-score (in year t-1) and risk measure (in year t) to ensure that the impact of CSR is properly absorbed. To test our hypotheses H2a, H2b, and H2c, we rely on multivariate regression analysis of equation (5.1):

$$Firm\_risk_{it} = \beta_0 + \beta_1 D\_SIN_{it} + +\beta_2 CSR\_Z_{it-1} + \beta_3 D\_SIN_{it} * CSR_{Z_{it-1}} + \beta_4 Size_{it} + \beta_5 Age_{it} + \beta_6 DebtR_{it} + \beta_7 CapxR_{it} + \beta_8 ROA_{it} + \beta_9 CashR_{it} + \beta_{10} TobinQ_{it} + \beta_{11} AltmanZ_{it} + e_{it} \qquad (5.1)$$

Where the dependent variables ($Firm\_risk_t$) are i) beta, ii) idiosyncratic volatility, or iii) total volatility , D_sin_t is dummy variable equal to 1 if the firm belongs to the alcohol, tobacco, or gambling industries (depending on the category it could be D-alcohol, D-tobacco, D-gambling, or D-SIN) and zero otherwise, CSR_Z_{t-1} is the lagged CSR z-score, $Size_t$ is firm size, Age_t is the firm age, $DebtR_t$ is the debt ratio, $CapxR_t$ is capital expenditure ratio, ROA_t is return on assets, $CashR_t$ is Cash and short-term investments ratio, $TobinQ_t$ is firm's Tobin's Q, and $AltmanZ_t$ is the Altman Z score.

Table 5.15 CSR inclusion in regression analysis on the matched sample of the alcohol group

Table 5.15 presents the panel regression analysis with Newey-West (1987) autocorrelation robust standard errors for the matched sample of the alcohol group over the period 1991-2013. We use three different risk measures as the dependent variable: Beta as the beta of individual stocks in the current year, based on monthly stock returns over five years using market model, IVOL as the standard deviation of residuals in the current year from market model, using monthly stock returns over five years, and TVOL as the standard deviation of monthly stock returns in current year. D_alcohol is the dummy variable equal to 1 if the firm belongs to the alcohol group and zero otherwise. We define CSR z-score as the CSR score, by aggregating total strengths minus total concerns for each of the MSCI's six social rating categories (community, corporate governance, diversity, employee relations, environment, and product) converted into z-scores, Size as logarithm of total assets, Age as the logarithm of one plus number of years since the first trading date on CRSP, Debt ratio as the Book value of debt divided by total assets, CapxR as the capital expenditure expenses divided by total assets, ROA as the Operating income before depreciation divided by total assets, CashR as the cash and short-term investments divided by total assets, Tobin's Q as the market value of common equity plus total assets minus total value of equity divided by total assets, and Altman Z as Altman Z score (1993) measured as 3.3EBIT + sales + 1.4 retained earnings + 1.2 working capital divided by total assets. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively. Standard errors are presented in brackets below the estimated coefficients.

	Beta		**IVOL**		**TVOL**	
	(1) Alcohol	**(2) Alcohol**	**(1) Alcohol**	**(2) Alcohol**	**(1) Alcohol**	**(2) Alcohol**
D-alcohol	-0.09246	-0.08792	-0.0133***	-0.00954**	-0.01521**	-0.0117*
	(0.1109)	(0.1195)	(0.0048)	(0.00464)	(0.0061)	(0.00599)
CSR	-0.06445**	-0.05824	-0.00136	0.003799	-0.00306**	0.001736
	(0.0286)	(0.0594)	(0.00111)	(0.00237)	(0.00152)	(0.0031)

D-alcohol *CSR		-0.00707		-0.00587**		-0.00546
		(0.0673)		(0.00274)		(0.00364)
Size	-0.15571**	-0.15575**	-0.0196***	-0.01962***	-0.02254***	-0.02258***
	(0.0751)	(0.0751)	(0.0031)	(0.00301)	(0.00422)	(0.00414)
Age	0.363686***	0.36434***	0.008756*	'0.009298**	0.017793***	0.018298***
	(0.1308)	(0.1319)	(0.00462)	(0.00455)	(0.00669)	(0.00665)
Debt ratio	0.003257	0.005026	-0.03924**	-0.03777**	-0.02919	-0.02783
	(0.4581)	(0.4597)	(0.0175)	(0.0172)	(0.0231)	(0.023)
CapxR	-1.89924*	-1.8952*	-0.01209	-0.00874	-0.04556	-0.04244
	(1.0987)	(1.0992)	(0.0444)	(0.0438)	(0.0571)	(0.057)
ROA	-2.48335***	-2.4889***	-0.06712**	-0.07176**	-0.09715***	-0.10146***
	(0.5114)	(0.5174)	(0.0299)	(0.0294)	(0.0348)	(0.0344)
CashR	-0.35012	-0.35163	-0.0693***	-0.07054***	-0.0736**	-0.07477**
	(0.5268)	(0.5275)	(0.0246)	(0.0237)	(0.0312)	(0.0305)
Tobin's Q	-0.04066	-0.04066	0.005481*	0.005487*	0.004143	0.004148
	(0.0758)	(0.0757)	(0.00329)	(0.00324)	(0.00433)	(0.0043)
Altman Z	0.060479**	0.060572**	-0.00414**	-0.00406**	-0.00309*	-0.00302
	(0.0303)	(0.0304)	(0.00165)	(0.00164)	(0.00185)	(0.00184)
_Cons	1.522295***	1.51756***	1.51756***	0.261945***	0.281483***	0.277826***
	(0.5548)	(0.5496)	(0.5496)	(0.0255)	(0.0301)	(0.0299)
Year fixed effects included	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.5765***	0.5766***	0.8582***	0.8615***	0.815***	0.8172***
Obs	170	170	170	170	170	170

Table 5.16 CSR inclusion in regression analysis on the matched sample of the tobacco group

Table 5.16 presents the panel regression analysis with Newey-West (1987) autocorrelation robust standard errors for the matched sample of the tobacco group over the period 1991-2013. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively. Standard errors are presented in brackets below the estimated coefficients.

	Beta		IVOL		TVOL	
	(1) Tobacco	**(2) Tobacco**	**(1) Tobacco**	**(2) Tobacco**	**(1) Tobacco**	**(2) Tobacco**
D-tobacco	-0.68051***	-0.63313***	0.02279	0.024129	0.006445	0.008777
	(0.1771)	(0.1518)	(0.0148)	(0.0146)	(0.0137)	(0.013)
CSR	-0.02988	-0.1561***	0.001156	-0.00241	0.000648	-0.00557*
	(0.0247)	(0.0438)	(0.00186)	(0.00285)	(0.00175)	(0.00283)
D-tobacco *CSR		0.154673***		0.004374		0.007617**
		(0.0484)		(0.00345)		(0.00344)
Size	0.14726***	0.102649***	-0.00404	-0.0053	0.000075	-0.00212
	(0.0347)	(0.0311)	(0.00394)	(0.00444)	(0.00397)	(0.00445)
Age	-0.03398	-0.04305	-0.00103	-0.00129	-0.00425	-0.0047
	(0.0395)	(0.0396)	(0.00435)	(0.00421)	(0.00406)	(0.0038)
Debt ratio	-0.13142	-0.08672	-0.02014	-0.01887	-0.01498	-0.01278
	(0.2643)	(0.2572)	(0.0229)	(0.023)	(0.0205)	(0.0203)
CapxR	-0.55964	-0.84533	0.783007***	0.774928***	0.756417***	0.742347***
	(3.4225)	(2.7845)	(0.2817)	(0.2861)	(0.2576)	(0.2569)
ROA	-0.09509	-0.2916	-0.01858	-0.02414	-0.02573	-0.03541
	(0.5179)	(0.4398)	(0.0419)	(0.0445)	(0.0368)	(0.0393)

CashR	0.972517	0.786194	0.023972	0.018703	0.038404	0.029228
	(0.6359)	(0.5605)	(0.0563)	(0.0557)	(0.0518)	(0.0497)
Tobin's Q	0.208547***	0.220733***	-0.00816*	-0.00781	-0.00348	-0.00288
	(0.0633)	(0.059)	(0.00472)	(0.00484)	(0.00387)	(0.00388)
Altman Z	-0.02131	-0.02485	-0.00008	-0.00018	-0.00015	-0.00033
	(0.0177)	(0.0166)	(0.00128)	(0.00133)	(0.00101)	(0.00105)
_Cons	-0.68517	-0.25184	0.112049**	0.124304**	0.091053*	0.112393**
	(0.4579)	(0.4164)	(0.0456)	(0.0502)	(0.0453)	(0.0495)
Year fixed effects included	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.7378***	0.7674***	0.3275***	0.3359***	0.3351***	0.3648***
Obs	90	90	90	90	90	90

Table 5.17 CSR inclusion in regression analysis on the matched sample of the gambling group

Table 5.17 presents the panel regression analysis with Newey-West (1987) autocorrelation robust standard errors for the matched sample of the gambling group over the period 1991-2013. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively. Standard errors are presented in brackets below the estimated coefficients.

	Beta		**IVOL**		**TVOL**	
	(1) Gambling	**(2) Gambling**	**(1) Gambling**	**(2) Gambling**	**(1) Gambling**	**(2) Gambling**
D-gambling	0.080003	0.102819	0.002499	0.005217	0.002785	0.005739
	(0.2455)	(0.2525)	(0.0143)	(0.0135)	(0.0173)	(0.0166)
CSR	-0.0429	-0.10819	-0.00351	-0.01129	-0.00376	-0.01221
	(0.0423)	(0.1631)	(0.003)	(0.0119)	(0.00349)	(0.0127)
D-gambling *CSR		0.071017		0.00846		0.009197
		(0.1652)		(0.0122)		(0.013)
Size	0.118448*	0.120159*	-0.00624	-0.00604	-0.00227	-0.00204
	(0.0662)	(0.066)	(0.00649)	(0.0064)	(0.00718)	(0.00709)
Age	-0.24322	-0.24618	0.012708	0.012356	0.007241	0.006858
	(0.172)	(0.1708)	(0.0129)	(0.0127)	(0.015)	(0.0149)
Debt ratio	1.042926***	1.044305***	0.13477***	0.134934***	0.142119***	0.142298***
	(0.3168)	(0.3197)	(0.0269)	(0.0271)	(0.0302)	(0.0304)
CapxR	0.154841	0.15144	-0.07927	-0.07967	-0.07475	-0.07519
	(0.892)	(0.8911)	(0.0654)	(0.0653)	(0.0738)	(0.0737)
ROA	-3.04332*	-3.03271*	-0.32494**	-0.32367**	-0.3425**	-0.34112**
	(1.8205)	(1.8179)	(0.1389)	(0.1379)	(0.1566)	(0.1557)

CashR	2.471002*	2.406875	0.217465**	0.209826**	0.263481**	0.255176**
	(1.4828)	(1.4759)	(0.0982)	(0.0957)	(0.1178)	(0.1154)
Tobin's Q	0.098521	0.094874	0.011276	0.010842	0.010908	0.010436
	(0.1217)	(0.1215)	(0.0131)	(0.0128)	(0.0141)	(0.0138)
Altman Z	0.029654	0.031467	0.001718	0.001934	0.002176	0.002411
	(0.0369)	(0.0367)	(0.00456)	(0.00448)	(0.00485)	(0.00477)
_Cons	1.182992	1.160538	0.10396*	0.101286	0.108977	0.10607
	(0.8108)	(0.8134)	(0.062)	(0.0614)	(0.0713)	(0.0707)
Year fixed effects included	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.495***	0.4953***	0.3417***	0.3428***	0.3864***	0.3874***
Obs	221	221	221	221	221	221

Table 5.18 CSR inclusion in regression analysis on the matched sample of the all SIN group

Table 5.18 presents the panel regression analysis with Newey-West (1987) autocorrelation robust standard errors for the matched sample of the all SIN combined group over the period 1991-2013. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively. Standard errors are presented in brackets below the estimated coefficients.

	Beta		**IVOL**		**TVOL**	
	(1) All SINs	**(2) All SINs**	**(1) All SINs**	**(2) All SINs**	**(1) All SINs**	**(2) All SINs**
D-SIN	-0.03198	-0.02321	0.003109	0.003232	0.002096	0.002286
	(0.1106)	(0.1114)	(0.00623)	(0.00635)	(0.00767)	(0.00781)
CSR	-0.03425	-0.11305	-0.00287*	-0.00397	-0.00334*	-0.00505
	(0.0249)	(0.1178)	(0.00159)	(0.00729)	(0.00187)	(0.00886)
D_SIN *CSR		0.092087		0.001295		0.001995
		(0.12)		(0.00748)		(0.00907)
Size	-0.04689	-0.04617	-0.00906***	-0.00905***	-0.00869***	-0.00867***
	(0.0464)	(0.0464)	(0.00248)	(0.00248)	(0.0032)	(0.0032)
Age	-0.03093	-0.02943	-0.00683*	-0.00681*	-0.0074	-0.00737
	(0.0773)	(0.0773)	(0.00408)	(0.00407)	(0.00514)	(0.00513)
Debt ratio	1.765672***	1.772563***	0.090699***	0.090796***	0.117897***	0.118046***
	(0.2766)	(0.276)	(0.0185)	(0.0183)	(0.0213)	(0.0212)
CapxR	0.432041	0.484158	-0.00943	-0.0087	-0.00507	-0.00394
	(0.803)	(0.8004)	(0.0351)	(0.0353)	(0.0436)	(0.0439)
ROA	-1.38042**	-1.39902**	-0.05711**	-0.05737**	-0.07011*	-0.07051**
	(0.5557)	(0.5517)	(0.0287)	(0.0284)	(0.0358)	(0.0355)

CashR	1.450414**	1.444084**	0.070771**	0.070682**	0.09554**	0.095403**
	(0.6547)	(0.6556)	(0.0323)	(0.0324)	(0.0424)	(0.0424)
Tobin's Q	-0.07547	-0.07519	-0.00712**	-0.00712**	-0.00931**	-0.0093**
	(0.0705)	(0.0699)	(0.00313)	(0.00313)	(0.00382)	(0.00382)
Altman Z	0.0606***	0.060954***	0.002571*	0.002576*	0.00378**	0.003787**
	(0.0224)	(0.0224)	(0.00138)	(0.00137)	(0.00161)	(0.00161)
_Cons	1.279975**	1.25887**	0.18501***	0.184713***	0.193612***	0.193155***
	(0.4954)	(0.4943)	(0.0296)	(0.0295)	(0.0356)	(0.0355)
Year fixed effects included	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.427***	0.4288***	0.4518***	0.4519***	0.4531***	0.4533***
Obs	495	495	495	495	495	495

Tables 5.15 to 5.18 report the estimation of equation (5.1) for alcohol, tobacco, gambling, and the sample of all SINs, respectively, using panel regression with fixed effects. The results for the alcohol group (table 5.15) show that if only CSR is added to the models of each risk measure (all columns labelled (1)), the market risk and total risk can be significantly reduced at a 5% level of significance. This is consistent with the risk-reduction role of CSR (Lee and Faff, 2009; Chen, Hung, and Lee, 2018; Monti, et al., 2019). To determine if the alcohol category changes risk sensitivity to CSR, we add the interaction term D-alcohol*CSR. With the addition of this term, the CSR variable is not significant for any risk measure and the interaction term is only significant (negative and significant at 5%) for IVOL (-0.00587). This suggests that CSR benefits alcohol firms by reducing IVOL relative to their non-SIN matches, which supports hypothesis H2b. On the other hand, the outcomes are not consistent with hypotheses H2a and H2c for alcohol stocks. Also, with the addition of the interaction term, the alcohol dummy is still significant and negative for IVOL (-0.00954) and TVOL (-0.0117) and remains insignificant for beta. These results continue to back our earlier findings that SIN stocks are not riskier than non-SIN stocks.

The estimates for the tobacco and matched non-SIN firms (table 5.16) show that CSR reduces risk for beta (-0.1561, significant at 1%) and TVOL (-0.00557, significant at 10%) but has an insignificant impact on IVOL. However, the estimate for TVOL is not economically significant. For beta, the interaction coefficient is 0.1547 and significant at 1%. This tells us that the impact of CSR on beta for a tobacco firm is less than for its non-SIN match. Similarly, the coefficient of the interaction term for TVOL is 0.0077 and significant at 5%, suggesting that CSR affects total risk in a tobacco firm less than its non-SIN match. In other words, CSR is less effective in mitigating beta and total risk for tobacco firms. This finding is consistent with World Health Organization (2004), which states that "The CSR of the tobacco industry is an inherent contradiction, as industry's core functions are in conflict with the goals of public health policies with respect to tobacco control". There are other studies that show CSR cannot help, and in fact irritates, stakeholders in some industries as it is seen as whitewashing (Hill, 2001; Palazzo and Richard, 2005). Thus, these findings do not support hypotheses H2a, H2b, and H2c for tobacco stocks. Further, including CSR does not change our earlier outcomes that tobacco risk is, in general, not greater than the risk of its non-SIN matched sample.

CSR does not mitigate risk for the gambling group (table 5.17) and none of the interaction terms are significant. Other studies also find the impact of CSR on risk is industry specific (Dowling, 2004). Gambling investor indifference toward corporate socially responsible actions perhaps also reflects the more lenient investor attitudes toward gambling.

Finally, we find that being categorized as a SIN company does not impact the sensitivity of any risk measure to CSR, and CSR does not reduce (or increase) risk for the sample of all SINs (table 5.18, columns (2)). Thus, hypotheses H2a, H2b, and H2c and H1a, H1b and H1c are not supported for the sample of all SINs.

In general, we find that the role of CSR in mitigating the risk of SIN versus non-SIN stocks is category sensitive. This is consistent with the premise that CSR-risk potency varies across industries (Dowling, 2004; Jo and Na, 2012). CSR reduces idiosyncratic risk for alcohol firms but increases total risk in tobacco stocks. Further, the impact of CSR on systematic risk and total risk for a tobacco firm is less than for its non-SIN match, while CSR has no impact on the risks of the gambling group and the all SINs sample. Our results contradict Jo and Na (2012) for total risk in SIN stocks and Guillamón-Saorín et al. (2018) for market risk (beta) in SIN stocks.

Further, after controlling for CSR, our findings continue to confirm that alcohol and tobacco stocks are not riskier and often less risky than their non-SIN counterparts. Similarly, gambling stocks still do not display any significant difference in risk measures relative to conventional stocks. Thus, our results continue to contradict the premise of Hong and Kacperczyck (2009), Cai et al. (2012), Jo and Na (2012), Oh et al. (2017), and Guillamón-Saorín et al. (2018) that SIN companies are riskier than non-SIN firms.

CHAPTER 6. ROBUSTNESS CHECKS

We conducted propensity score matching on the three variables with the highest overlap between SIN and non-SIN (size, age, and the debt ratio), because matching is done more tightly with fewer controls. To check the sensitivity of our results to this matched sample, we match the SIN samples with non-SIN groups using the full set of controls in our research, except for the Altman Z score. In other words, the propensity scores are estimated for SIN and non-SIN stocks using logistic regression of one of the SIN dummy variables on size, age, debt ratio, Tobin's Q, cash and short-term investments ratio, capital expenditure ratio, and ROA. We drop Altman Z score from the regression, as there is little overlap between SIN and non-SIN stocks for this variable.

Table (6.1) represents the mean difference of SIN stocks and conventional stocks for all control variables in the logistic models before and after matching. A good match should balance the distribution of control variables between the treated and the untreated group. For tobacco and gambling stocks, there are statistically significant differences in all the control variables between SIN and non-SIN stocks before matching, while the differences are insignificant after matching, suggesting tobacco and gambling stocks have the same characteristics with their non-SIN counterparts except for the treatment. For the alcohol sample, except for age and the cash ratio, the differences shift from significant to insignificant as we move from an unmatched to a matched sample and the differences are not significant in either scenario for CapxR and Tobin's Q. Similarly, for the all SIN sample, most of the control variables are balanced between SIN and non-SIN stocks, which ensures the isolation of the treatment effect and thus a more robust investigation into the impact of SIN versus non-SIN on risk.

Table 6.1 Propensity Score Matching, t-test on the differences of control variables

Table 6.1 shows the t-test on the differences of all control variables, including Size, Age, Debt ratio, CapxR, ROA, CashR, and Tobin's Q before and after Propensity Score Matching over the period of 1980-2017. The results are presented in four sections: alcohol stocks, tobacco stocks, gambling stocks, and the sample of all SIN stocks. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively.

Alcohol	**Size**		**Age**		**Debt ratio**		**CapxR**	
	Unmatched	Match	Unmatched	Match	Unmatched	Match	Unmatched	Match
Treated	6.2567	6.2452	2.8995	2.8952	0.2292	0.2307	0.0558	0.0558
Control	5.2041	6.4607	2.717	3.0015	0.2083	0.217	0.056	0.0568
Difference	1.0526***	-0.2155	0.1826***	-0.1062**	0.0209***	0.0137	-0.000205	-0.001
S.E	2.0779	2.4428	0.6859	0.8367	0.181	0.1641	0.0591	0.0504
P-value	<.0001	0.1716	<.0001	0.0492	0.0046	0.1952	0.9252	0.7603
Tobacco	**Size**		**Age**		**Debt ratio**		**CapxR**	
	Unmatched	Match	Unmatched	Match	Unmatched	Match	Unmatched	Match
Treated	8.2522	8.3541	3.8315	3.7132	0.285	0.2947	0.0346	0.0325
Control	5.2041	7.8888	2.717	3.697	0.2083	0.2736	0.056	0.0395
Difference	3.048***	0.4653	1.1146***	0.0162	0.0767***	0.0211	-0.0215***	-0.00703
S.E	2.0762	2.2813	0.6849	0.8119	0.1811	0.1532	0.0591	0.0295
P-value	<.0001	0.2167	<.0001	0.9034	<.0001	0.4036	<.0001	0.1497
Gambling	**Size**		**Age**		**Debt ratio**		**CapxR**	
	Unmatched	Match	Unmatched	Match	Unmatched	Match	Unmatched	Match
Treated	5.9434	5.9877	2.4077	2.42	0.4041	0.404	0.0927	0.093

Control	5.2041	5.8992	2.717	2.395	0.2083	0.4074	0.056	0.0871
Difference	0.7393***	0.0885	-0.3093***	0.025	0.1958***	-0.0034	0.0367***	0.0059
S.E	2.075	1.9564	0.684	0.6047	0.1816	0.2413	0.0594	0.1076
P-value	<.0001	0.4367	<.0001	0.4781	<.0001	0.8071	<.0001	0.3386

All SINs	**Size**		**Age**		**Debt ratio**		**CapxR**	
	Unmatched	Match	Unmatched	Match	Unmatched	Match	Unmatched	Match
Treated	6.2756	6.2953	2.7327	2.7459	0.3232	0.3216	0.0724	0.0717
Control	5.2041	6.2726	2.717	2.7559	0.2083	0.3275	0.056	0.0714
Difference	1.0715***	0.0227	0.0158	-0.01	0.1149***	-0.00583	0.0164***	0.0004
S.E	2.0787	2.2539	0.6874	0.8003	0.1817	0.2223	0.0594	0.0812
P-value	<.0001	0.8069	0.5246	0.7609	<.0001	0.5242	<.0001	0.9098

Table 6.1 (Continued). Propensity Score Matching, t-test on the differences of control variables

Table 6.1 shows the t-test on the differences of all control variables, including Size, Age, Debt ratio, CapxR, ROA, CashR, and Tobin's Q before and after Propensity Score Matching over the period of 1980-2017. The results are presented in four sections: alcohol stocks, tobacco stocks, gambling stocks, and the sample of all SIN stocks. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively.

Alcohol	**ROA**		**CashR**		**Tobin's Q**	
	Unmatched	Match	Unmatched	Match	Unmatched	Match
Treated	0.1175	0.1166	0.1064	0.1058	1.766	1.7612
Control	0.0935	0.1072	0.1542	0.1303	1.771	1.7104
Difference	0.024***	0.0094	-0.0478***	-0.0246**	-0.00498	0.0508
S.E	0.1759	0.1416	0.1781	0.1729	1.5766	1.1675
P-value	<.0001	0.3035	<.0001	0.0279	0.9237	0.5001
Tobacco	**ROA**		**CashR**		**Tobin's Q**	
	Unmatched	Match	Unmatched	Match	Unmatched	Match
Treated	0.2767	0.1962	0.0779	0.0713	2.6819	1.9015
Control	0.0935	0.2357	0.1542	0.0691	1.771	1.8595
Difference	0.1832***	-0.0395	-0.0763***	0.00228	0.9109***	0.042
S.E	0.1763	0.1806	0.178	0.0744	1.5797	1.1187
P-value	<.0001	0.1859	<.0001	0.8524	<.0001	0.8196
Gambling	**ROA**		**CashR**		**Tobin's Q**	
	Unmatched	Match	Unmatched	Match	Unmatched	Match
Treated	0.1179	0.1152	0.1259	0.1276	1.603	1.5995

Control	0.0935	0.1087	0.1542	0.1351	1.771	1.6431
Difference	0.0244***	0.0065	-0.0283***	-0.0075	-0.168***	-0.0436
S.E	0.1758	0.1236	0.1777	0.1496	1.5763	1.1982
P-value	<.0001	0.3664	<.0001	0.3911	<.0001	0.532

All SINs	**ROA**		**CashR**		**Tobin's Q**	
	Unmatched	Match	Unmatched	Match	Unmatched	Match
Treated	0.1319	0.1307	0.1137	0.1142	1.7649	1.76
Control	0.0935	0.119	0.1542	0.1257	1.771	1.7811
Difference	0.0384***	0.0116**	-0.0405***	-0.0114*	-0.00608	-0.0211
S.E	0.1757	0.1216	0.1776	0.1549	1.5754	2.1369
P-value	<.0001	0.0202	<.0001	0.0735	0.8737	0.8105

Table 6.2 Propensity Score Matching, t-test on the differences of risk measures

Table 6.2 exhibits the test of differences in the mean of Beta, IVOL, and TVOL between matched samples over the period of 1980-2017. The results are presented in four sections: alcohol stocks, tobacco stocks, gambling stocks, and the sample of all SIN stocks. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively.

Alcohol	**Obs**	**Mean**	**Difference (Alcohol- non)**	**P-value of diff**
Beta (Alcohol)	481	0.8042	-0.3396***	<.0001
Beta (non-SIN)		1.1498		
IVOL (Alcohol)	481	0.0992	-0.0233***	<.0001
IVOL (non-SIN)		0.1175		
TVOL (Alcohol)	481	0.1079	-0.0464***	<.0001
TVOL(non-SIN)		0.1313		

Tobacco	**Obs**	**Mean**	**Difference (Tobacco - non)**	**P-value of diff**
Beta (Tobacco)	74	0.6514	-0.4007***	0.0014
Beta (non-SIN)		1.0521		
IVOL (Tobacco)	74	0.0739	-0.0131*	0.0831
IVOL (non-SIN)		0.087		
TVOL (Tobacco)	74	0.0813	-0.0204***	0.0075
TVOL (non-SIN)		0.1017		

Gambling	**Obs**	**Mean**	**Difference (Gambling - non)**	**P-value of diff**
Beta (Gambling)	591	1.1895	-0.0587	0.231
Beta (non-SIN)		1.2482		
IVOL (Gambling)	591	0.1454	0.00079	0.841
IVOL (non-SIN)		0.1446		

TVOL (Gambling)	591	0.1572	-0.00124	0.7601
TVOL (non-SIN)		0.1584		

All SINs (Alcohol,Tobacco, Gambling)	**Obs**	**Mean**	**Difference (SIN - non)**	**P-value of diff**
Beta (SIN)	1178	0.9824	-0.1784***	<.0001
Beta (non-SIN)		1.1608		
IVOL (SIN)	1178	0.1199	-0.0061**	0.0202
IVOL (non-SIN)		0.126		
TVOL (SIN)	1178	0.1301	-0.00898***	0.0009
TVOL (non-SIN)		0.1391		

Table (6.2) demonstrates that the mean risk measures for alcohol are always statistically significantly less than for its matched non-SIN sample using the difference in means t-test. For example, the difference in the mean beta, idiosyncratic risk, and total risk are respectively 0.3396, 0.0233 and 0.0464 less than those of non-SIN stocks, with all differences significant at all levels. Similarly, tobacco stocks have 0.4007 less mean beta than that of its non-SIN peers, 0.0131 less mean idiosyncratic (significant at 10%) and 0.0204 less mean total volatility (significant at 1%). There are no significant differences for gambling stocks and its matched non-SIN sample. When the triumvirate of SIN stocks are taken together, the difference in the mean beta for matched pairs is -0.1784 and significant at 1%. The differences are also negative and significant for IVOL and TVOL but with smaller magnitudes. We also conducted fixed effects panel regression on the eight control matched samples (table 6.3). The results are similar to the regression analysis on the matched sample using PSM on three controls (age, size and debt) except gambling now has an insignificant impact on IVOL. We can conclude that alcohol and tobacco stocks are generally less risky, while gambling stocks have the same level of risks with conventional stocks, on average. This is contrary to the premise in the literature that SIN stocks are risker than non-SIN stocks (Hong and Kacperczyck, 2009; Cai et al., 2012; Jo and Na, 2012; Oh et al., 2017). Thus, the results do not support hypotheses H1a, H1b, and H1c and we are confident that they are robust to PSM.

Finally, we consider the dividend yield (dividend payout per share price) as a potential explanatory variable for risk and add it to the set of controls. We do not expect this to impact our outcomes because dividend payout is theoretically and empirically related to several of the existing control variables, especially cash holdings (CashR). Al-Najjar and Belghitar (2011) assert that cash holdings and dividend policy share the same determinants, and find that size, debt ratio, and profitability ratio can explain dividend policy. Also, Drobetz and Grüninger (2007) conclude that dividend payments are positively associated with cash holdings. They state that dividend paying firms are concerned with reducing or omitting the dividend and therefore they tend to hold more cash. As a robustness check, we include dividend yield in our analyses. The multivariate regression results show a significant impact of dividend yield on risk if CashR, size and ROA are excluded but an insignificant impact otherwise. In either case, the implications for our three risk measures and four SIN categories are unchanged: SIN stocks are not risker than non-Sin stocks. Propensity score matching is problematic when we add dividend yield to the other seven controls in our logistic models. However, by excluding size, ROA, and CashR, matching is done properly, and, most importantly, the conclusions are the same: Alcohol and tobacco are less risky, and gambling has the same risk as its non-SIN matches. Therefore, we believe that our set of controls capture the impact of dividend yield on the risk of SIN versus non-SIN matched samples.

Table 6.3 Panel regression analysis on matched sample of different SIN groups

Table 6.3 presents the panel regression analysis with Newey-West (1987) autocorrelation robust standard errors on the matched samples from Propensity Score Matching on eight control variables over the period 1980-2017. ***, **, and * stand for the statistical significance level at 1%, 5%, and 10%, respectively. Standard errors are presented in brackets below the estimated coefficients.

	Market Beta			Idiosyncratic volatility			Total volatility		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
	Alcohol	**Tobacco**	**Gambling**	**Alcohol**	**Tobacco**	**Gambling**	**Alcohol**	**Tobacco**	**Gambling**
D_SIN	-0.2913***	-0.2755**	0.0210	-0.0196***	-0.00049	0.002851	-0.0249***	0.00547	0.001942
	(0.0666)	(0.1108)	(0.126)	(0.0057)	(0.00661)	(0.00789)	(0.00594)	(0.00692)	(0.00871)
Size	0.003781	-0.04327	0.14435***	-0.0116***	-0.00681**	-0.0089***	-0.0111***	-0.00625**	-0.00631***
	(0.0209)	(0.0374)	(0.0264)	(0.00193)	(0.00279)	(0.0021)	(0.00202)	(0.00279)	(0.00231)
Age	-0.00331	-0.0072	-0.14361*	-0.00261	0.001329	-0.01605***	-0.0024	-0.00184	-0.01784***
	(0.058)	(0.0512)	(0.0816)	(0.00409)	(0.00404)	(0.00502)	(0.00435)	(0.00413)	(0.00533)
Debt ratio	-0.33243	0.367957	0.271406	-0.01206	-0.06191**	0.06555***	-0.01688	-0.03248	0.067408***
	(0.2218)	(0.5539)	(0.1695)	(0.014)	(0.0303)	(0.0131)	(0.015)	(0.029)	(0.0133)
CapxR	0.520946	1.99198**	0.057601	0.052441	-0.3140***	-0.02578	0.051896	-0.24236***	-0.02805
	(0.6591)	(0.9319)	(0.408)	(0.044)	(0.0964)	(0.021)	(0.0464)	(0.0911)	(0.0205)
ROA	-0.5501	-1.43655**	-0.33367	-0.1458***	0.032434	-0.1714***	-0.1489***	0.009549	-0.17276***
	(0.3871)	(0.5694)	(0.3902)	(0.0384)	(0.0599)	(0.0241)	(0.0388)	(0.0522)	(0.0249)
cashR	0.410772	-0.15122	-0.12169	-0.00131	-0.05586	0.06974***	-0.0012	-0.05087	0.06831**
	(0.3504)	(0.603)	(0.369)	(0.0196)	(0.0569)	(0.0253)	(0.0227)	(0.0578)	(0.0267)
Tobin's Q	0.002962	0.080407	0.113105**	0.001147	-0.00234	0.004268**	0.001112	-0.00288	0.005943***
	(0.0293)	(0.0927)	(0.047)	(0.00227)	(0.00648)	(0.00208)	(0.00235)	(0.00653)	(0.00212)

Altman Z	-0.00647	0.06689*	0.00084***	-0.00035	-0.0061**	0.000032*	-0.00046	-0.0033	0.000042**
	(0.00493)	(0.0386)	(0.000276)	(0.000254)	(0.0024)	(0.000018)	(0.000297)	(0.00229)	(0.000018)
_Cons	0.99737***	0.421937	-0.07039	0.22074***	0.17983***	0.18127***	0.22630***	0.17111***	0.170492***
	(0.2193)	(0.5052)	(0.3485)	(0.0171)	(0.0338)	(0.0234)	(0.0177)	(0.0327)	(0.0246)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P-value F-test for no Fixed	0.016	<.0001	<.0001	0.0245	<.0001	<.0001	0.0088	<.0001	<.0001
R-squared	0.1879	0.3808	0.3224	0.5842	0.4103	0.4317	0.5465	0.4212	0.4062
Obs	515	122	762	515	122	762	515	122	762

CHAPTER 7. CONCLUSION

The goal of this research is to investigate the risk of SIN stocks. We use systematic (beta), idiosyncratic, and total risk to compare SIN stocks to their non-SIN peers. We focus on alcohol, tobacco, and gambling securities and avoid grey stocks (ambiguous sin classification) in both the sin and non-SIN samples. Three different methodologies are used: First, we separately regress each risk measure on dummies for alcohol, tobacco and gambling stocks and a set of controls. Second, we utilize propensity score matching to find a group of non-SIN companies that match the SIN categories on three criteria (size, age, and the debt ratio). This allows us to more carefully isolate the role of SIN versus non-SIN on risk. After forming the matched pairs, we do t-tests on the mean difference of the risk measures between matched samples. Third, we run a regression on the matched samples from propensity score matching, including SIN dummies and all controls. We repeat each approach for the aggregated sample of all SINs. Our results show that the collective triumvirate ALL sin, alcohol, tobacco and gambling stocks have significantly less, or no significance difference, in beta, idiosyncratic and total volatility compared to their non-SIN pairs with one (weak) exception: Gambling has a significant impact (.02, significant at 10%) on IVOL. However, the significant impact of gambling on IVOL disappears when we include all eight control variables. This contrasts with the widely held premise in the SIN stock literature that SIN stocks are riskier (Hong and Kacperczyck, 2009; Cai et al., 2012; Jo and Na 2012; Oh et al., 2017; and Guillamón-Saorín et al., 2018).

Our contributions to the literature are numerous and supported by a variety of factors. In contrast to the existing literature, we explicitly quantified and investigated risk instead of simply assuming SIN risk exceeds the risk of non-SIN firms. Further, unlike the current studies, we analyzed each SIN category separately as well as collectively. In addition, we made a careful selection of the SIN and non-SIN samples by excluding so-called grey stocks from both samples. We also study an extended period and include a broad set of controls. To allow for period sensitivity, we split our original sample period into two intervals: 1980-1998 and 1999-2017. The outcomes show that the risk of SIN stocks has declined over time and depends on the SIN category. Alcohol has less systematic risk, idiosyncratic volatility, and total volatility relative to their non-SIN counterparts, regardless of time period, while tobacco stocks have reduced beta and total risk but increased idiosyncratic risk over time. On the other hand, gambling stocks are riskier than their matched non-SIN sample from 1980-1998 but have the same risk with non-SIN from 1999-2017.

For robustness, we repeat the propensity score matching using all control variables (except Altman Z score) and conduct t-tests on the matched samples. In general, regardless of the controls used in matching, the SIN sample has less risk regardless of risk measure. However, gambling stocks do not differ from their non-SIN matches, across the three risk measures.

We examine the impact of CSR on risk and find that the role of CSR in mitigating the risk of SIN versus non-SIN stocks is category sensitive. CSR reduces idiosyncratic risk for alcohol firms but increases beta and total risk for tobacco stocks. Also, CSR has no impact on the risks of the gambling group and the all SINs sample. Our CSR model findings also verify that alcohol and tobacco stocks are generally less risky, while gambling stocks do not differ from non-SIN stocks.

Our results have practical implications for investors' stock selection and attitudes toward SIN stocks. The existing literature states that SIN stocks usually earn higher risk-adjusted returns. However, by disaggregating into SIN components, we show that only the tobacco group has significantly higher risk-adjusted performance. In addition, our results demonstrate that SIN stocks, specifically alcohol and tobacco stocks, are less risky than their non-SIN counterparts. This implies that, if an investor is not concerned about social norms, tobacco stocks are good candidates to be placed in the investor's portfolio, as they can make higher risk-adjusted returns and have less risk relative to conventional stocks. Further, we find that alcohol and tobacco stocks have a defensive nature and therefore they could be good investment choices in recessions.

Another implication of our work is the possibility of a changing attitude toward SIN stocks. We found that SIN stocks have generally become less risky with time and this may reflect a shift in the way North Americans view vice investing. Accordingly, further research can investigate how social norms and different investors' perceptions are changing. This will require development of an appropriate metric to measure investor perception (attitude) toward SIN groups. In addition, the definitions of SIN companies might differ across various cultures (Waller, Fam, and Erdogan, 2005). For example, people in different North American states might have dissimilar opinions about the constituents of vice stocks. Another possibility for future study is to expand the domain of the current research to different regions (Europe, Africa, and Asia) to explore the riskiness of SIN stocks worldwide. Finally, additional risk measures, such as downside risk, can be added to increase our understanding of the impact of SIN on risk.

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