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RISK-ADJUSTED RETURNS IN THE ALCOHOL AND TOBACCO SECTORS: A COMPARATIVE ANALYSIS (2010–2025)

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ABSTRACT

This thesis examines the risk-adjusted return of alcohol and tobacco companies between 2010 and 2025, comparing them with the S&P 1200 Industrials index. Historically, firms in both sectors have delivered higher returns than the broader market, while being characterized in the literature as carrying elevated regulatory, legal, and reputational risks. While prior literature on sin stocks typically evaluates these firms within broad, aggregated portfolios, this study conducts a disaggregated sectoral analysis to examine alcohol and tobacco separately. This distinction is motivated both by the limited sector-specific evidence in previous research and by the recurrent argument that tobacco should exhibit a higher risk profile than alcohol due to stronger social stigma, stricter regulation, greater uncertainty, and deeper structural rejection. Using annualized returns and volatility, and the Sharpe Ratio for a global sample of 32 firms (7 tobacco and 25 alcohol), this study provides a detailed sector comparison. In terms of returns, alcohol and tobacco followed broadly similar trajectories and both outperformed the benchmark over the full period. Although tobacco displayed better return performance in the most recent years, alcohol achieved a higher average long-term return. Regarding volatility, both sectors consistently exhibited higher risk than the benchmark, confirming their exposure to regulatory pressure and social rejection. However, contrary to expectations, alcohol showed persistently higher volatility than tobacco, challenging the assumption that tobacco's greater structural and institutional risk should translate into a higher risk profile and, consequently, higher required returns. When adjusting for risk, the higher volatility of both sectors results in lower average Sharpe Ratios compared to the benchmark. Nevertheless, alcohol and tobacco display positive, solid, and more stable Sharpe Ratios over time, whereas the benchmark's Sharpe Ratio is higher on average but more volatile. Overall, the findings indicate that while a "sin premium" exists in absolute returns, it does not translate into superior risk-adjusted performance relative to a diversified global industrial benchmark.

KEY WORDS

Alcohol Industry, Tobacco Industry, Sin Stocks, ESG Exclusion, Sharpe Ratio, Risk-Adjusted Return, Financial Performance, Sector Analysis.

RESUMEN

Este trabajo analiza la rentabilidad ajustada al riesgo de empresas de los sectores del alcohol y el tabaco entre 2010 y 2025, comparándolos con el índice S&P 1200 Industrials. Históricamente, ambas industrias han generado mayores retornos que el mercado general, a pesar de que la literatura académica las caracteriza como sectores con elevado riesgo regulatorio, legal y reputacional. Mientras que los estudios previos suelen analizar estas industrias dentro de carteras agregadas de Sin Stocks (o acciones del pecado), este estudio realiza un análisis sectorial desagregado, motivado por la limitada evidencia específica y por el argumento recurrente de que el tabaco debería mostrar un perfil de riesgo mayor al del alcohol, debido a su mayor estigmatización social, regulación más estricta y mayor incertidumbre estructural. Mediante el análisis de los retornos y volatilidades anualizados y el Sharpe ratio de una muestra global de 32 empresas (7 de tabaco y 25 de alcohol), el estudio compara ambos sectores en detalle. En términos de rentabilidad, ambos sectores siguieron trayectorias similares y superaron al benchmark durante el periodo completo. A pesar del mejor desempeño del tabaco en los últimos años, el alcohol presenta una rentabilidad media superior en el largo plazo. En cuanto a la volatilidad, ambas industrias mostraron consistentemente un mayor riesgo que el índice de referencia, reflejando su exposición a presiones regulatorias y rechazo social. No obstante, el alcohol mostró mayor volatilidad que el tabaco, en contra de lo esperado según la literatura. Al ajustar por riesgo, dicha volatilidad elevada conlleva ratios de Sharpe promedio inferiores a los del benchmark. Sin embargo, tanto el alcohol como el tabaco presentan ratios de Sharpe positivos, sólidos y más estables a lo largo del tiempo, mientras que el índice de referencia presenta una media superior pero mayor variabilidad. En conjunto, los resultados indican que, si bien existe un “Sin Premium” en términos de retorno absoluto, esta no se traduce en un mejor desempeño ajustado al riesgo frente a un índice industrial global diversificado.

PALABRAS CLAVE

Industria del Alcohol, Industria del Tabaco, Sin Stocks, Exclusión ESG, Sharpe Ratio, Rentabilidad Ajustada al Riesgo, Desempeño Financiero, Análisis sectorial.

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1. INTRODUCTION

The alcohol and tobacco industries occupy a unique position in global capital markets. Firms operating in these sectors are widely considered controversial due to the health implications of their products and their role in shaping public consumption patterns (Westling et al., 2025). Governments across the world have responded with increasingly strict regulation, including excise taxation, advertising bans, packaging requirements, and usage restrictions (World Health Organization, n.d.; Hawkins et al., 2018; Paraje et al., 2023). These measures aim to curb harmful consumption, but they also create significant compliance burdens and limit operational flexibility for firms operating in these sectors (DeCicca et al., 2022). The stigma associated with these industries further translates into investment consequences: many institutional investors, particularly those committed to ESG principles, actively exclude tobacco and alcohol companies from their portfolios (Berret et al., 2024; Hong & Kacperczyk, 2009). For example, Storebrand Asset Management, an institutional investor with a strong sustainability mandate, explicitly prohibits investment in both sectors (Storebrand Asset Management, 2025). This exclusion can reduce the investor base for these stocks, raising their cost of capital and increasing their exposure to idiosyncratic market risk (Alessandrini & Jondeau, 2019).

Despite these constraints, tobacco and alcohol companies have consistently attracted investor interest. This is largely due to their historical record of high profit margins, cash flow stability, and long-term stock market outperformance (Schürmann, 2024; Jernigan & Ross, 2020; Anderson, 2023). Both industries benefit from more inelastic demand compared to other general industries, driven by addiction, habit, and cultural integration, which allows them to pass higher costs (e.g., from taxation or inflation-driven increases in production costs) onto consumers without a proportional loss in volume (Nelson, 2013; Cotti et al., 2022; Chakkera et al., 2025). Moreover, the market structure in both sectors is concentrated, with a few dominant multinational firms controlling much of the supply, enabling scale economies, strong brand loyalty, and pricing power (Levy et al., 2019; Jernigan & Ross, 2020). This structural and behavioural resilience has translated into robust and relatively stable returns for investors, even in the face of macroeconomic downturns or tightening regulation, making these industries defensive investments (He & Yano, 2009; Lobe & Walkshäusl, 2011).

Academic research has long noted this pattern, grouping tobacco and alcohol, along with other controversial industries such as gambling and weapons, under the category of sin stocks

and observing that they tend to generate higher-than-expected returns (Hong & Kacperczyk, 2009; Statman & Glushkov, 2008; Fabozzi et al., 2008). This phenomenon, often referred to as the "sin premium," is typically explained by the fact that these stocks are underweighted in the portfolios of norm-constrained investors, causing prices to be depressed and expected returns to rise. However, most of this literature aggregates alcohol and tobacco together, failing to distinguish their potentially divergent risk-return profiles. This lack of differentiation represents a meaningful gap, especially given the distinct regulatory trajectories, public perceptions, and structural transitions facing each industry (alcohol and tobacco), particularly the tobacco sector's stronger regulation, exclusion and uncertainty due to its shift toward reduced-risk products (RRPs) amid heightened scrutiny (Hoek et al., 2022; Bialous & Glantz, 2018).

This thesis seeks to address that gap by analysing the alcohol and tobacco sectors separately and evaluating whether their returns adequately compensate investors for the risks associated with investing in socially contested industries. Specifically, it applies the Sharpe Ratio as the key performance metric across a sample of 32 international companies from 2010 to 2025, providing a risk-adjusted assessment of performance in the presence of heightened regulatory, social, and ethical constraints. By disaggregating the analysis, the study contributes to a more granular understanding of the "sin premium" and its sector-specific dynamics.

The findings of this research are relevant for multiple stakeholders. For investors who actively invest in tobacco and alcohol companies, the analysis clarifies whether these investments deliver sufficient reward relative to their risk, informing portfolio construction and risk management decisions. For institutional investors that exclude these sectors, the study helps to quantify the potential financial cost or risk benefit of exclusion, thereby framing ethical screening decisions in terms of opportunity cost. Finally, the research is also pertinent to policymakers and regulators, as it examines whether firms in these industries continue to achieve strong risk-adjusted returns despite regulatory pressure, offering insights into the effectiveness of policy interventions from a market performance perspective. Ultimately, this thesis examines whether alcohol and tobacco companies can deliver consistent outperformance and under what conditions this is true.

2. LITERATURE REVIEW: ALCOHOL AND TOBACCO INDUSTRIES

2.1. REGULATORY FRAMEWORK AND SOCIAL PERCEPTION

The alcohol and tobacco industries are characterized by a highly regulated environment and a complex social perception shaped by their health impacts. Governments across the world impose strict regulations on these sectors considering the well-documented public health risks associated with their products (Hawkins et al., 2018). Such regulations include heavy excise taxes, restrictions or outright bans on advertising and sponsorship, age limits for purchase and use, and mandated health warnings on packaging (World Health Organization, n.d.). These measures aim to curb consumption and mitigate harm, but they also create a challenging operating environment for companies. Regulatory changes and economic measures can directly affect sales; for example, increases in tobacco taxes or tighter marketing rules often lead to price hikes and some reduction in volume as consumers react to higher costs or reduced product visibility (Paraje et al., 2023). Furthermore, periodic health disclosures or scandals can sway public sentiment and policy. Major revelations about the dangers of smoking or excessive drinking have historically prompted tougher regulations and temporarily dampened consumer demand in these industries (Hall, 2022).

Social perception of alcohol and tobacco companies has grown increasingly negative due to the nature of their products. Tobacco use is now widely viewed as a leading preventable cause of death, and alcohol abuse is linked to various social and health problems. As a result, these industries carry a social stigma that more benign sectors do not (Morris & Schomerus, 2023; Cortland et al., 2019). This controversial status translates into reputational risk and has investment implications: many institutional investors choose to avoid alcohol and tobacco stocks on ethical or ESG grounds (Berret et al., 2024). Empirical studies have documented that norm-constrained institutions (such as pension funds or insurance companies with ESG mandates) tend to hold significantly less equity in sin industries like alcohol and tobacco compared to other sectors (Hong & Kacperczyk, 2009). This reduced demand from large investors can translate into a higher cost of capital and lower valuations for the affected companies (Alessandrini & Jondeau, 2019), adding an extra layer of risk for those shareholders who do invest in these stocks. In a recent survey of institutions that signed the Tobacco-Free Finance Pledge, 47% applied a zero-tolerance policy to tobacco investments, and about 24% also excluded alcohol, highlighting the particularly low social acceptance of tobacco relative

to alcohol among global investors (Berret et al., 2024). In sum, alcohol and tobacco firms operate under stringent regulatory scrutiny and face social stigma that together shape their risk profile and market behaviour.

2.2. MARKET STRUCTURE, DEMAND DYNAMICS, AND FINANCIAL PERFORMANCE

Despite their controversial nature and regulatory constraints, the alcohol and tobacco sectors possess market characteristics that have historically made them attractive to many investors. One key factor is the structure of these markets. The tobacco industry is highly concentrated and exhibits oligopolistic traits. A small number of large companies dominate the global cigarette market, benefiting from high barriers to entry and entrenched brand loyalty. For instance, in the United States, decades of mergers and the rise of powerhouse brands (like Marlboro) have elevated market concentration to the point where only a few firms command the majority of market share (Rajani et al., 2023). High concentration, combined with factors such as extensive distribution networks and large marketing budgets, creates formidable entry barriers for potential new competitors. Established firms leverage this environment to maintain pricing power and profitability: In a highly concentrated U.S. cigarette market, the major companies have been able to engage in tacit collusion and coordinated pricing, taking advantage of limited competition to preserve their profit margins. Strong branding in tobacco further reinforces consumer loyalty; customers tend to stick with familiar cigarette brands, making it hard for new entrants to gain ground (Levy et al., 2019). Government regulations can also raise barriers to entry (for example, advertising bans and rigorous product approval processes make it costly for a newcomer to compete), which helps the incumbent firms defend their market position (Levy et al., 2023). Overall, the tobacco industry's structure has allowed the leading companies to achieve considerable market power and stable profits over time.

The alcohol industry likewise features a long history of consolidation and the dominance of large multinationals. Over the past few decades, mergers and acquisitions have created a landscape where a handful of corporations control a substantial share of global alcohol production and sales. For example, in 2016 Anheuser-Busch InBev completed a mega-merger with SABMiller, consolidating its position as the world's largest beer company, getting to brew and market more than a quarter of the world's commercial beer. In the spirits sector, companies

like Diageo and Pernod Ricard rank among the top producers worldwide, with extensive portfolios of well-known liquor brands (Jernigan & Ross, 2020). This consolidation grants the leading firms significant market power. They benefit from economies of scale in production and distribution, as well as the ability to build and market global brands, which in turn yields strong pricing power (Anderson, 2023). As a result, leading alcohol companies often report high profit margins (Albulescu, 2020; Jernigan & Ross, 2020).

Another critical aspect of both industries is the nature of consumer demand, which tends to be relatively inelastic (but not perfectly inelastic). Because tobacco and alcohol products are addictive or habit-forming, consumers are less sensitive to changes in price than they might be for other goods (Blecher & Bertram, 2019). Empirical research consistently finds that the price elasticity of demand for these substances is low. For instance, Nelson (2013) found alcohol price elasticities of approximately –0.3 for beer and around –0.5 to –0.6 for wine and spirits, implying that a 10% increase in alcohol prices is associated with an average reduction in consumption of roughly 3–6%. By comparison, Colchero et al. (2015) report substantially higher own-price elasticities for non-alcoholic beverages, estimating –1.06 for soft drinks and –1.16 for sugar-sweetened beverages, which implies that a similar price increase would reduce consumption by approximately 10.6–11.6%. Similarly, cigarette demand is notoriously inelastic; recent studies in the United States confirm that sizable tax or price hikes lead to proportionally smaller declines in cigarette sales (Cotti et al., 2022). For example, one analysis found that substantial increases in cigarette prices driven by tax changes were associated with price elasticities well below –1, often around –0.3 to –0.4 for higher-income consumers, indicating that despite higher prices, a large share of smokers continued purchasing cigarettes (Guindon et al., 2014). This inelastic demand is partly a function of addiction, nicotine and alcohol create physical and psychological dependence, and partly cultural. In many societies, drinking (and to a certain extent smoking) is embedded in social rituals and lifestyles, so consumption patterns change slowly even when costs rise (Chakkera et al., 2025; Hoek et al., 2022). The implication for companies is that they can often pass increased costs on to consumers to a significant extent, though not with complete freedom, without a devastating loss of volume, which helps to stabilize revenues. However, demand is not perfectly inelastic, so firms cannot fully pass through higher costs without some impact on volumes or margins (Nelson, 2013), meaning that cost increases, while mitigated by inelastic demand, still affect profitability. Indeed, these industries are sometimes described as defensive because during

economic downturns or periods of rising input costs, their sales tend to hold up better than those of more cyclical industries (Richey, 2020).

The combination of market power and inelastic demand contributes to strong and relatively stable financial performance for alcohol and tobacco companies. Schürmann (2024) stated that tobacco and alcohol stocks have historically delivered very strong long-term stock market performance, with particularly striking evidence for tobacco: drawing on long-run data, the article notes that from 1900 to 2015 the U.S. tobacco industry generated annualized total returns of around 14.6%, making it the best-performing industry over that period, even ahead of many technology-driven sectors. The study also highlights that since 2001, the MSCI World Tobacco Net Total Return Index, which tracks the performance of listed global tobacco companies, has clearly outperformed the STOXX Sustainability ex Alcohol, Gambling, Tobacco, Armaments & Firearms, Adult Entertainment Net Return USD Index, a broad global equity index that excludes companies involved in these sectors based on sustainability criteria, illustrating the opportunity cost of excluding tobacco companies. Additionally, in the UK, the alcohol industry ranked at the top in terms of long-term performance, where an investment of one pound sterling in breweries and distilleries in 1900 increased to roughly £243,000 by 2015 (Schürmann, 2024). These figures illustrate that both tobacco and alcohol have historically delivered extraordinary, compounded returns over more than a century, despite increasing regulation and social opposition, underscoring the persistent profitability and resilience of these industries in capital markets.

2.3. DIFFERENTIAL RISK PROFILE: REGULATION, INVESTOR EXCLUSION AND STRUCTURAL UNCERTAINTY

While alcohol and tobacco share common challenges as controversial, regulated industries, there are important differences in their risk profiles. Primary among these is the degree of social stigma and regulatory pressure faced by tobacco in contrast to alcohol. Both industries are subject to government oversight, but tobacco has been targeted by public health authorities worldwide with more severe control measures (McCambridge & Morris, 2019). Over the past few decades, tobacco companies have experienced increasing restrictions: comprehensive bans on advertising and sponsorship in many countries, graphic warning labels and plain packaging requirements, public smoking bans in workplaces and restaurants, and continual excise tax

hikes aimed at reducing smoking rates (DeCicca et al., 2022). The social perception of smoking has shifted dramatically: it is no longer acceptable in many public settings, and smoking prevalence has declined significantly in numerous regions due to aggressive tobacco control campaigns (Hoek et al., 2022). Alcohol, on the other hand, while certainly regulated (with laws on minimum drinking age, drunk-driving penalties, licensing of sales, etc.), still enjoys a greater degree of social acceptance when consumed in moderation. In many cultures, drinking is integrated into social traditions and is viewed as a normal part of life for most adults. Moderate alcohol use does not carry the same social opprobrium that smoking a cigarette does in today's society (Buss et al., 2025). This difference means that the political and legal risks for the tobacco industry are arguably more severe than for the alcohol industry. Policymakers in some countries now openly talk about "endgame" strategies for tobacco (Hoek et al., 2022).

This difference in social stigma can be seen in Figure 1, which illustrates the evolution of traditional cigarette sales over time (excluding e-cigarettes, vapers, and other alternative nicotine products) and alcohol consumption in the United States over time. It shows that, over recent decades, alcohol consumption has remained relatively stable, whereas traditional cigarette consumption began to decline between the 1980s and 1990s, as observed in the chart, well before the emergence of e-cigarettes and RRPs in the USA in the early 2010s (King et al., 2015), meaning this decline is not related to them.

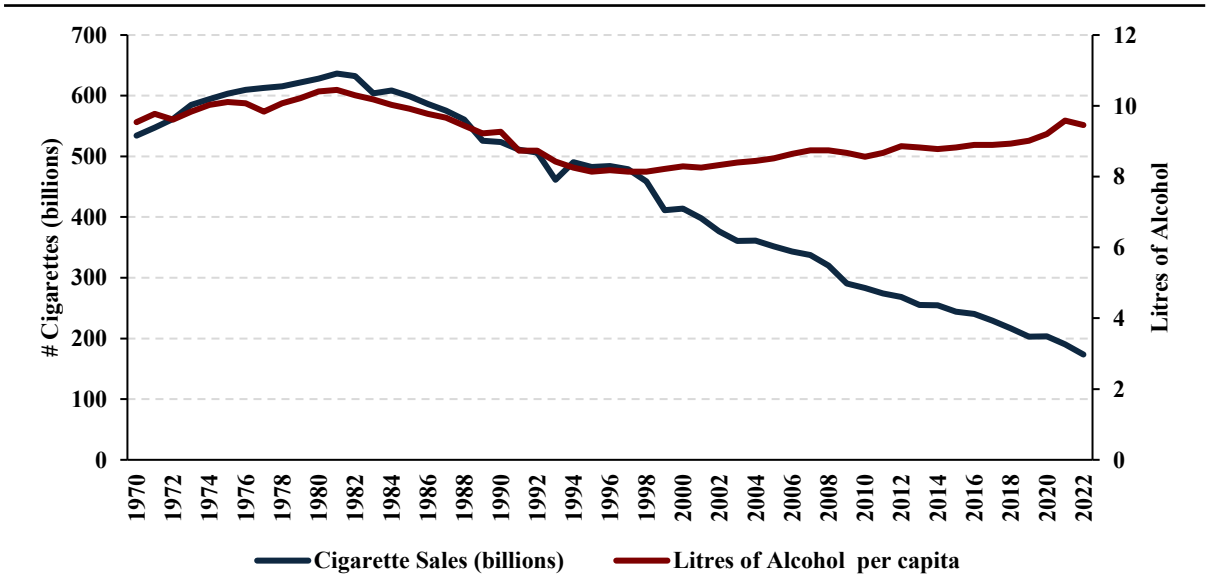


Figure 1. U.S. Cigarette (Traditional Only) Sales vs. Alcohol Consumption, 1970–2022 (Source: U.S. Federal Trade Commission, 2023; Slater & Alpert, 2024; Own elaboration)

The disparity in social stigma is also reflected in investor behaviour and exclusion policies. As noted in Section 2.1, many institutional investors avoid both industries, but avoidance of tobacco is more prevalent and absolute. Berret et al. (2024) found that among the financial institutions that were signatories to the Tobacco-Free Finance Pledge (e.g., banks, asset managers, insurers, and pension funds), exclusion of tobacco investments was significantly more common than exclusion of alcohol. Nearly half of those institutions would not invest in tobacco at all, whereas only about one-quarter refused to invest in alcohol companies. Part of the reason is historical: the tobacco industry's reputation was severely damaged by revelations that emerged in the 1990s, for example, it was shown that companies had long been aware of smoking's harms and had deliberately misled consumers and regulators (Brandt, 2012). Due to this, the tobacco industry faced a landmark legal settlement (the 1998 Master Settlement Agreement in the United States) through which major tobacco companies agreed to pay states billions of dollars and accept significant advertising and marketing restrictions (McKinney & Gottlieb, 2010). Furthermore, from an ESG perspective, tobacco is often singled out as uninvestable in a way alcohol is not. Many socially responsible funds will allow alcohol holdings but draw the line at tobacco (Hong & Kacperczyk, 2009).

Another critical difference in the risk profile comes from the structural changes and uncertainties affecting each industry. The tobacco industry is currently in the midst of a transformative period as it attempts to transition from traditional combustible cigarettes to RRPs, such as e-cigarettes, vaping devices, and heated tobacco products. Faced with declining smoking rates in many markets, including a 32% decrease in the US between 2000 and 2010 (Federal Trade Commission, 2023), prior to the emergence of e-cigarettes and other RRPs in the country (King et al., 2015), and mounting regulatory pressure, the major tobacco companies have invested heavily in these new product categories to secure their future. This strategic pivot is an effort to offer alternatives that potentially carry lower health risks than smoking, thereby appealing to health-conscious consumers or those who might otherwise quit nicotine altogether (Bialous & Glantz, 2018). However, the move into RRPs brings substantial uncertainty. The technologies are relatively new, and the long-term health outcomes of using e-cigarettes or heated tobacco are still being studied. Regulators have adopted varying approaches to these products: some countries have banned certain vaping products outright (due to concerns about youth uptake or unknown health effects), while others are treating them as tools for harm reduction and integrating them into tobacco control strategies. The scientific consensus on the safety of RRPs is not fully established, which means future regulations could tighten if new

evidence of harms emerges (Braznell et al., 2025). Additionally, consumer acceptance of these products is not guaranteed. While some smokers have switched to e-cigarettes or heated devices, many others remain resistant or have tried and reverted to smoking (Tran et al., 2025). The tobacco companies thus face a risk that RRPs might not grow quickly enough to offset the continuing decline in cigarette sales. They are effectively betting on unproven products to reinvent their business. For example, if a particular vaping product is later found to pose unexpected health risks, it could be pulled from the market, stranding the company's investment (Gaca et al., 2022). Or if governments decide to subject nicotine alternatives to the same taxes and marketing restrictions as cigarettes, the economic advantage of selling RRPs could diminish (Oxford Economics, 2023). In short, the tobacco industry's future is marked by a pivotal change with many contingent risks, making its long-term outlook more uncertain and volatile.

In contrast, the alcohol industry is not undergoing a comparably dramatic transition in its core product offerings. There is innovation in the alcohol sector, such as the rise of low-alcohol or alcohol-free beverages, craft beers, and flavored spirits, but these developments are more about diversifying product lines and catering to changing consumer tastes, rather than replacing the fundamental product. There is no equivalent to the "e-cigarette" in alcohol that threatens to upend the traditional consumption of beer, wine, or spirits (Anderson, 2023). As a result, the alcohol industry faces less structural uncertainty in terms of product viability. Thus, from an investor's perspective, tobacco stocks might carry a higher long-term risk premium due to the possibility of their main product category diminishing or being heavily disrupted, as well as the constant threat of stricter regulations. Alcohol stocks, while certainly subject to regulatory and social pressures, are anchored in a more stable market demand and face less risk of a paradigm shift in their business.

Therefore, given the stronger social and institutional rejection of tobacco, together with its higher regulatory risk and the additional uncertainty faced by the tobacco industry due to its transition toward RRPs, it is hypothesized that investors require a higher expected return from tobacco firms. This higher required return compensates for the industry's elevated regulatory, legal, and reputational risks, resulting in risk-adjusted profitability that is comparable to that of alcohol firms. This hypothesis is empirically tested in this thesis.

3. DEFINITION OF THE HYPOTHESIS AND OBJECTIVES OF THE STUDY

The tobacco and alcohol sectors have historically delivered robust returns despite facing substantial regulatory, social, and structural risks. This situation raises a fundamental question: do these industries provide superior risk-adjusted returns that truly compensate for their elevated risk profiles? In other words, when we measure returns relative to volatility (for example, using the Sharpe ratio), are tobacco and alcohol stocks' performance on par with or better than the broader markets? If financial markets are efficient and investors fully understand the additional risks (litigation, regulation, social stigma), those risks should be reflected in lower stock prices and thus higher expected returns, yielding normal risk-adjusted performance. However, if either industry systematically outperforms the market on a risk-adjusted basis, it could indicate a mispricing anomaly, potentially caused by some investors shunning "sin" stocks and driving their returns higher. Conversely, underperformance after adjusting for risk would suggest that the extra risks are not being fully compensated for by returns.

Prior studies on sin stocks (the broad category encompassing alcohol, tobacco, gambling, etc.) have consistently found that these industries earn superior risk-adjusted returns relative to the market. Hong and Kacperczyk (2009), in their seminal study The Price of Sin, documented that a composite sin stock portfolio outperformed otherwise comparable stocks by roughly 2%-3% per year on average. They attributed this excess return to the effects of social norms: because many institutional and ethically constrained investors avoid sin stocks, these shunned stocks trade at depressed prices, leading to higher expected returns for the investors willing to hold them. Statman and Glushkov (2008) similarly found that excluding sin stocks from an investment portfolio (as socially responsible funds often do) incurs a performance penalty. In their analysis, "virtuous" portfolios that screened out sin industries slightly lagged unconstrained portfolios, implying that sin stocks provided a modest return advantage that socially responsible investors forewent. This sin premium has been observed across different markets and samples. For example, Fabozzi, et al. (2008) report that a global sin stock portfolio earned an average annual return of about 19%, significantly higher than common market benchmarks. In Europe, Salaber (2007) showed that sin stocks tend to outperform other stocks even after controlling for standard risk factors (like size and book-to-market), with their risk-adjusted returns especially high in countries enforcing strong normative pressures, such as nations with stricter religious norms against vice or with higher excise taxes on products like

alcohol and tobacco. Taken together, previous literature strongly suggests that vice-related stocks deliver abnormal risk-adjusted returns (a "sin stock premium"), likely as compensation for being under-held due to ethical constraints or for bearing certain regulatory and legal risks.

Crucially, the existing literature usually lumps tobacco and alcohol companies together, so it remains unclear whether one industry is primarily responsible for the sin stock premium or if both contribute equally. The tobacco industry faces greater challenges, such as stricter regulations, litigation costs, and declining smoking rates, and has been more widely shunned by ESG-focused investors (Nandwani & Japee, 2025) than the alcohol industry. One might expect, therefore, that tobacco stocks would offer higher expected returns to compensate for these heightened risks, potentially giving them an even stronger risk-adjusted performance. On the other hand, tobacco's unique difficulties, such as the uncertainty regarding the industry trend toward RRPs, might have suppressed its returns, meaning alcohol stocks could exhibit the better risk-adjusted performance. Because prior research did not differentiate between these sectors, this point remains unresolved.

Furthermore, most earlier analyses ended in the mid-2000s, before the recent surge in ESG-oriented investing (Nandwani & Japee, 2025) and before tobacco companies began shifting toward RRPs (Bialous & Glantz, 2018). Thus, an updated examination is warranted. This study addresses these gaps by analyzing the two sectors separately and using more recent data to capture contemporary market conditions.

Based on the above reasoning, we propose two main hypotheses:

- H1: The tobacco sector is hypothesized to exhibit higher risk than the alcohol sector, reflected in greater return volatility, due to its stronger regulatory, uncertainty and social pressures.
- H2: Tobacco's higher volatility is compensated by higher returns, resulting in a risk-adjusted return broadly comparable to that of the alcohol sector.
- H3: Tobacco and alcohol stocks deliver risk-adjusted returns (Sharpe ratios) that are comparable to or higher than those of the overall market. In other words, their historically high returns are commensurate with their higher risks.

Accordingly, this research pursues two key objectives. Firstly, we will compare the tobacco and alcohol sectors by analysing their volatility, returns, and Sharpe ratios side by

side to assess whether tobacco indeed exhibits higher risk (addressing H1) and whether this additional risk is fully compensated by correspondingly higher returns (addressing H2). Secondly, we will evaluate the risk-adjusted returns of tobacco and alcohol industry stocks relative to the market to determine whether their returns have indeed compensated for their risks (addressing H3).

4. METHODOLOGY

4.1. DATA

Following (Chu et al., 2022; Kircher & Rösch, 2021; Valadkhani & Moradi-Motlagh, 2023) the selected risk-adjusted measure for the analysis is the Sharpe Ratio. The rationale for selecting this measure is explained in Section 4.1.3. In order to calculate the Sharpe Ratio for each company and perform the sector analysis, several key financial variables were defined and computed. These include measures of return and risk for each stock, as well as the appropriate risk-free rate corresponding to each company's market. From a methodological standpoint, all computations, including the calculation of daily returns, annual daily return averages, the standard deviations for each year, annualizations and later the Sharpe Ratio itself, were carried out using a Python script (provided in **Annex 4**). This approach was chosen to ensure accuracy and efficiency in handling the large dataset of daily prices. The use of Python also enhances reproducibility of the results, as the exact procedures and formulae applied are documented in the script. The following subsections describe how these variables were obtained.

4.1.1. Return and Risk

To compute the Sharpe Ratio, we first derive annual returns and annualized risk for each company-year:

- **Return calculation:** We obtain the daily return for each company based on their historical daily closing prices, using discrete returns for such calculation, that is, applying the following formula to each closing price on each day:

$$r_{\text{daily}} = \frac{P_{\text{t}} - P_{\text{t-1}}}{P_{\text{t-1}}}$$

then, for each company in each year, we calculate the mean of its daily returns. Denote this average daily return as $\bar{r}_{\text{daily}}$. We then annualize this mean return using the formula:

$$R_{\text{annual}} = (1 + \bar{r}_{\text{daily}})^{252} - 1$$

where 252 is the approximate number of trading days in a year. This yields the annualized return R_{annual} for the company in that year. Annualizing the return in this

way (from the average daily return) produces a measure that is directly comparable on an annual basis, as commonly used in Sharpe Ratio calculations (Sharpe, 1994).

- **Risk (volatility) calculation:** For each company-year, we compute the standard deviation of the daily returns (σ_{daily}) as the daily return volatility. We then annualize this volatility by scaling with the square root of 252:

$$\sigma_{\text{annual}} = \sigma_{\text{daily}} \times \sqrt{252}$$

The resulting σ_{annual} is the annualized risk (volatility) for the company in that year.

By using annualized return and volatility for each company-year, we ensure the Sharpe Ratios are based on annualized daily data, facilitating straightforward comparison with other sectors and standard benchmarks.

4.1.2. Risk-Free Rate

The computation of the Sharpe Ratio requires the specification of an appropriate proxy for the risk-free rate. In this study, the 5-year sovereign government security is selected as the benchmark risk-free asset.

The choice of the 5-year sovereign government bond as the proxy for the risk-free rate is motivated by its closer alignment with the medium- to long-term investment horizon typically associated with equity investments (Lan et al., 2024). Unlike short-term instruments, the 5-year yield better reflects investors' expectations regarding inflation, monetary policy, and economic conditions over a longer horizon, which is more consistent with the risk profile of corporate equities. Moreover, long-term sovereign bonds issued by stable economies are generally regarded as virtually free of default risk (Dittmar et al., 2026), making them an appropriate benchmark for the minimum return required in a no-risk scenario. This choice is also consistent with standard practice in empirical macro-finance, where the 5-year yield is conventionally used as the closest practical proxy for a default-free and liquid asset (Hasan et al., 2015).

Based on this criterion, this study uses the annual yield of a 5-year sovereign government security, observed on a daily basis, as the proxy for the risk-free rate for each company, selecting the instrument corresponding to the country in which the company operates.

Specifically, for companies based in the United States, the 5-Year Treasury Note is used. For European countries, the risk-free rate is proxied by the Belgium 5-Year Government Bond, France 5-Year Government Bond, Italy 5-Year Government Bond, Netherlands 5-Year Government Bond, Denmark 5-Year Government Bond, and the 5-Year Gilt in the case of the United Kingdom. For Asian markets, the instruments considered are the China 5-Year Government Bond, Japan 5-Year Government Bond, South Korea 5-Year Government Bond, Hong Kong 5-Year Government Bond, and India 5-Year Government Bond. Finally, for Australia, the Australia 5-Year Government Bond is employed. Although these instruments may differ in their specific structures, such as coupon-bearing versus zero-coupon securities, the yields used are consistently reported as yield-to-maturity values. This standardization ensures that coupon payments are fully incorporated into the yield measure, making the annual 5-year yields directly comparable across countries. All data on the daily annual yields of these sovereign government securities were obtained from Investing.com (n.d.).

We then calculated the annual risk-free rate by averaging the daily yields over each calendar year. Because bond yields are already expressed in annual terms (as percentage rates), this annual average can be used directly as the risk-free rate R_f. Finally, for each company-year, we assign the risk-free rate corresponding to the company's country or region and year.

For computing the Sharpe Ratio of the S&P 1200 Industrials Index (benchmark), the risk-free rate is constructed as a market-cap-weighted average of each constituent country's sovereign yield, in order to properly reflect the international composition of the index and avoid geographic bias. The country weights and corresponding risk-free instruments used are: U.S. 53.7% (5-Year Treasury Note), Japan 14.0% (Japan 5-Year Government Bond), France 7.0% (France 5-Year Government Bond), Germany 6.0% (Germany 5-Year Government Bond), UK 4.6% (5-Year Gilt), Sweden 3.6% (Sweden 5-Year Government Bond), Switzerland 2.5% (Switzerland 5-Year Government Bond), Canada 2.3% (Canada 5-Year Government Bond), Denmark 1.1% (Denmark 5-Year Government Bond), Spain 0.8% (Spain 5-Year Government Bond), Italy 0.7% (Italy 5-Year Government Bond), Finland 0.7% (Finland 5-Year Government Bond), South Korea 0.6% (South Korea 5-Year Government Bond), Hong Kong 0.4% (Hong Kong 5-Year Government Bond), Ireland 0.4% (Ireland 5-Year Government Bond), Netherlands 0.3% (Netherlands 5-Year Government Bond), Brazil 0.2% (Brazil 5-Year Government Bond), Norway 0.22% (Norway 5-Year Government Bond), Mexico 0.2% (Mexico 5-Year Government Bond), and Chile 0.1% (Chile 5-Year Government Bond) (S&P

Dow Jones Indices, 2026). The weighted daily risk-free series is then aggregated and annualised following the same procedure described above for individual companies.

4.1.3. Risk-Adjusted Performance Metric: Sharpe Ratio

The Sharpe Ratio evaluates an investment's performance by measuring how much excess return (return above the risk-free rate) is earned per unit of risk (volatility). Formally, it is defined as the portfolio's return minus the risk-free rate, divided by the standard deviation of the portfolio's returns (Sharpe, 1966). In formula form, if R_p is the portfolio return, R_f is the risk-free rate, and $\sigma_p$is the standard deviation of returns, then the Sharpe Ratio is:

$$Sharpe = \frac{R_p - R_f}{\sigma_p}.$$

Therefore, a higher Sharpe Ratio indicates more return per unit of risk. Because we compute returns and volatility on an annual basis in this analysis, the resulting Sharpe Ratios will also be expressed on an annualized basis.

There are several reasons for choosing the Sharpe Ratio as our risk-adjusted performance metric. First, it is easy to understand and interpret: the ratio condenses risk and return into a single number, indicating how much excess return is obtained per unit of risk. This simplicity has made the Sharpe Ratio one of the most popular and widely used measures of performance in finance. Despite the many alternative metrics proposed by academics, it remains a standard tool for ranking (Kourtis, 2016). Another advantage is that the Sharpe Ratio does not require a specialized benchmark or market index for each company, as it uses the risk-free rate as a universal baseline and the asset's own total volatility as the risk measure (Sharpe, 1966). This means we can evaluate each company's performance without needing to determine its beta or pick an appropriate comparison index, greatly simplifying the analysis.

For each company, using each of their annualized values (annualized return and volatility), we compute each company's Sharpe Ratio. This yields one Sharpe value per company per year. Next, to compare across sectors, we aggregate these company-level Sharpe Ratios by sector. For each year and each sector (alcohol or tobacco), we compute the sector's average Sharpe Ratio by taking the arithmetic mean of the Sharpe Ratios of all companies operating in that sector in that year. Thus, we obtain an annual Sharpe Ratio for the alcohol sector and another for the tobacco sector. Because all values are on an annual basis, these sector Sharpe Ratios are

directly comparable with each other and with Sharpe Ratios reported for other industries, as these kinds of metrics are usually expressed in annual terms (Amédée-Manesme & Barthélémy, 2022).

In addition to the cross-sector comparison, we conduct a temporal analysis of risk-adjusted returns, which consists of examining how the Sharpe Ratio of each sector evolves from 2010 to 2025, identifying trends, patterns, or structural changes.

4.2. SAMPLE SELECTION AND DESCRIPTION

The selection of the tobacco and alcohol firms that will be used for the study was guided by the 2Q 2025 exclusion list of Storebrand Asset Management, a leading Norwegian investment manager known for its strict ESG criteria and exclusion policies. Storebrand's exclusion list identifies companies that engage in certain industries or practices deemed unsustainable or unethical, including companies in the alcohol and tobacco sectors (Storebrand Asset Management, 2025). From this list, the companies operating in the alcohol and tobacco industries were considered for inclusion. To ensure consistency, comparability and relevance of the financial analysis, the sample was further refined to include only alcohol and tobacco companies whose main revenue stream derives from alcohol or tobacco products, respectively, and those companies with international operations. Focusing on multinational firms allows the analysis to rely on companies with diversified revenue streams, greater exposure to global capital markets and more homogeneous disclosure standards, which reduces country-specific distortions and improves the comparability of risk-adjusted performance measures across firms. Furthermore, prior literature shows that multinational firms exhibit distinct financial characteristics, such as internationally diversified cash flows and greater access to global capital markets, which are particularly relevant for comparative analyses of risk and performance (Erel et al., 2020). As a result of applying these criteria, the final sample comprises 32 companies (7 in tobacco and 25 in alcohol) that meet the above conditions.

For each company in the sample, historical daily closing stock price data were collected for the period from 2010 through 2025 in order to provide an updated analysis relative to the largely outdated sin stock literature (Hong and Kacperczyk, 2009; Statman and Glushkov, 2008; Fabozzi et al., 2008; Salaber, 2007), while taking into account the structural changes that

currently characterize the alcohol and tobacco industries, including the growing importance of ESG-oriented investment (Nandwani & Japee, 2025) and the shift within the tobacco sector toward RRPs (Bialous & Glantz, 2018), thereby ensuring greater relevance and precision in the analysis.

The price data were obtained using the FactSet financial data platform (FactSet, 2025). For companies that went public (IPO) after 2010, data was included starting from the exact date at which the company began trading, so that all available and actual trading information was fully reflected. No data prior to the IPO date was considered, as it was not available.

Daily historical closing prices of the S&P Global 1200 Industrials index were also collected. This index is a global equity benchmark that tracks large- and mid-capitalization industrial companies drawn from the broader S&P Global 1200, covering both developed and emerging markets (S&P Dow Jones Indices, 2026). In our analysis, it will be used as a market benchmark to compare the performance of the tobacco and alcohol industries, as the firms in the sample are likewise global industrial companies. Accordingly, the same variables and calculations applied to the tobacco and alcohol firms are also computed for the S&P Global 1200 Industrials to ensure full comparability across analyses.

Table 1 presents the main descriptive characteristics of the sample in terms of geographical distribution, sectoral classification, and data availability. The sample comprises 32 listed firms operating in the alcohol and tobacco industries, with a broad international coverage. Chinese firms represent the largest share of the sample, accounting for approximately 31% of the total, reflecting the prominence of China's alcoholic beverages industry in global equity markets. The United States follows with around 16% of the firms, while the United Kingdom and Japan each contribute close to 9%. The remaining companies are distributed across several countries in Europe, Asia-Pacific and emerging markets, including Denmark, Australia, France, Italy, the Netherlands, South Korea, Hong Kong and India, ensuring substantial geographical diversification. For a description of each company's operations, see **Annex 1**.

Table 1. Sample Companies and Benchmark: Country, Sector and Data Availability (Source: Own elaboration; historical data collected up to the last trading day of 2025; for companies listed after 2010, data are considered from their respective IPO dates)

Company Name	Country	Sector	Start Date
Altria Group	USA	Tobacco	4 Jan. 2010
Anheuser-Busch InBev SA/NV	Belgium	Alcohol	4 Jan. 2010
Anhui Gujing Distillery Co Ltd	China	Alcohol	4 Jan. 2010
Anhui Yingjia Distillery Co Ltd	China	Alcohol	28 May. 2015
Asahi Group Holdings Ltd	Japan	Alcohol	4 Jan. 2010
Beijing Yanjing Brewery	China	Alcohol	4 Jan. 2010
British American Tobacco Plc	UK	Tobacco	4 Jan. 2010
Brown-Forman Corp	USA	Alcohol	4 Jan. 2010
Carlsberg AS	Denmark	Alcohol	4 Jan. 2010
China Resources Beer Holdings Co Ltd	China	Alcohol	4 Jan. 2010
Constellation Brands Inc	USA	Alcohol	4 Jan. 2010
Davide Campari-Milano	Italy	Alcohol	4 Jan. 2010
Diageo plc	UK	Alcohol	4 Jan. 2010
Endeavour Group Ltd	Australia	Alcohol	24 Jun. 2021
Heineken NV	Netherlands	Alcohol	4 Jan. 2010
Imperial Brands	UK	Tobacco	4 Jan. 2010
Japan Tobacco	Japan	Tobacco	4 Jan. 2010
Jiangsu King's Luck Brewery Ltd	China	Alcohol	3 Jul. 2014
Jiangsu Yanghe Brewery JSC Ltd	China	Alcohol	4 Jan. 2010
Kirin Holdings Co Ltd	Japan	Alcohol	4 Jan. 2010
KT&G Corp.	S. Korea	Tobacco	4 Jan. 2010
Kweichow Moutai Co Ltd	China	Alcohol	4 Jan. 2010
Luzhou Laojiao Co Ltd	China	Alcohol	4 Jan. 2010
Molson Coors Beverage	USA	Alcohol	4 Jan. 2010
Pernod Ricard SA	France	Alcohol	4 Jan. 2010
Philip Morris International	USA	Tobacco	4 Jan. 2010
Royal Unibrew A/S	Denmark	Alcohol	4 Jan. 2010
Smoore International Holdings	Hong Kong	Tobacco	10 Jul. 2020
Treasury Wine Estates	Australia	Alcohol	4 Jan. 2010
Tsingtao Brewery Co Ltd	China	Alcohol	4 Jan. 2010
United Spirits Ltd	India	Alcohol	4 Jan. 2010
Wuliangye Yibin Co Ltd	China	Alcohol	4 Jan. 2010
S&P 1200 Industrials	N/A	N/A	4 Jan. 2010

5. RESULTS AND ANALYSIS

5.1. RETURN AND VOLATILITY

Table 2 reports the average annualized returns and volatilities of the firms in the sample, together with those of the S&P 1200 Industrials benchmark, over the period 2010–2025. The results reveal substantial heterogeneity in stock performance across companies. Average annualized returns range from −3.8% for Endeavour Group Ltd to 76.0% for Smoore International Holdings, indicating pronounced differences in long-term profitability within the alcohol and tobacco sectors. Several firms record particularly high average returns, notably Chinese distillers such as Anhui Gujing Distillery Co Ltd and Anhui Yingjia Distillery Co Ltd, as well as United Spirits Ltd and Smoore International Holdings. Volatility also varies markedly across firms, with average annualized values ranging from approximately 19.8% for Diageo plc to 66.4% for Smoore International Holdings. In comparison, the S&P 1200 Industrials benchmark exhibits a lower average return of 11.4% and a volatility of 15.0%. Overall, the firms in the sample tend to display higher risk–return profiles than the broad market index.

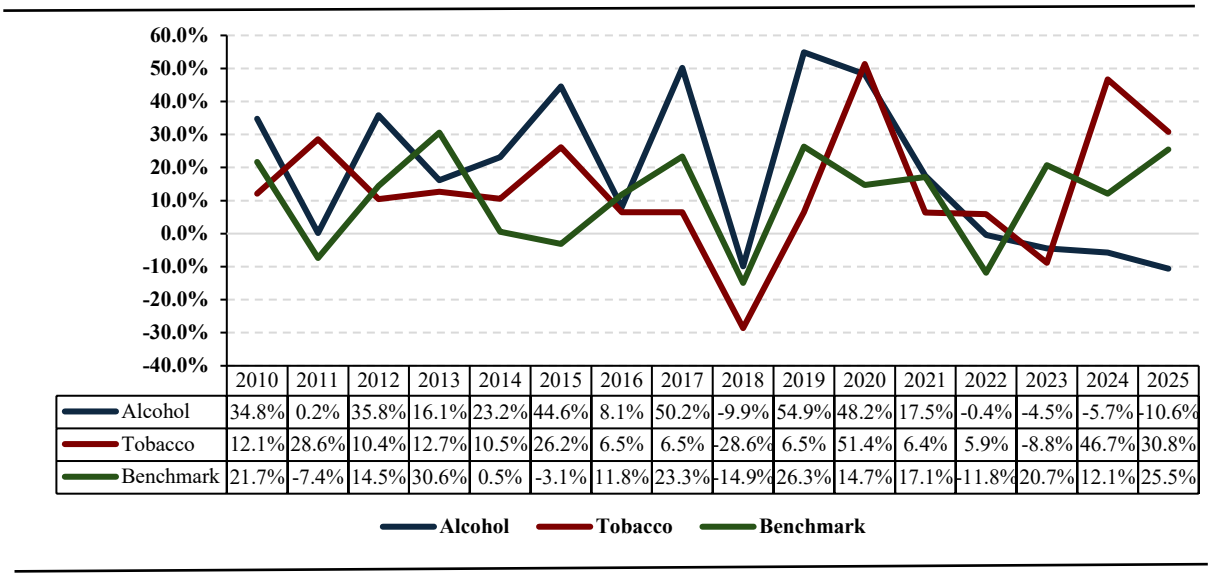
Table 2. Sample Companies and Benchmark: Average Returns and Volatility (Source: Own elaboration; historical data collected up to the last trading day of 2025; for companies listed after 2010, data are considered from their respective IPO dates)

Company Name	Country	Sector	Start Date	Avg. Return	Avg. σ
Altria Group	USA	Tobacco	4 Jan. 2010	10.6%	19.8%
Anheuser-Busch InBev SA/NV	Belgium	Alcohol	4 Jan. 2010	7.7%	24.2%
Anhui Gujing Distillery Co Ltd	China	Alcohol	4 Jan. 2010	38.4%	43.3%
Anhui Yingjia Distillery Co Ltd	China	Alcohol	28 May. 2015	47.1%	46.5%
Asahi Group Holdings Ltd	Japan	Alcohol	4 Jan. 2010	12.7%	24.9%
Beijing Yanjing Brewery	China	Alcohol	4 Jan. 2010	9.8%	32.0%
British American Tobacco Plc	UK	Tobacco	4 Jan. 2010	10.2%	21.1%
Brown-Forman Corp	USA	Alcohol	4 Jan. 2010	9.6%	23.2%
Carlsberg AS	Denmark	Alcohol	4 Jan. 2010	10.3%	23.2%
China Resources Beer Holdings Co Ltd	China	Alcohol	4 Jan. 2010	19.7%	37.7%
Constellation Brands Inc	USA	Alcohol	4 Jan. 2010	24.8%	27.2%
Davide Campari-Milano	Italy	Alcohol	4 Jan. 2010	13.5%	25.1%
Diageo plc	UK	Alcohol	4 Jan. 2010	6.5%	19.8%
Endeavour Group Ltd	Australia	Alcohol	24 Jun. 2021	-3.8%	23.0%
Heineken NV	Netherlands	Alcohol	4 Jan. 2010	8.2%	20.4%
Imperial Brands	UK	Tobacco	4 Jan. 2010	7.3%	21.3%
Japan Tobacco	Japan	Tobacco	4 Jan. 2010	14.1%	24.0%
Jiangsu King's Luck Brewery Ltd	China	Alcohol	3 Jul. 2014	30.4%	41.6%
Jiangsu Yanghe Brewery JSC Ltd	China	Alcohol	4 Jan. 2010	23.4%	36.3%
Kirin Holdings Co Ltd	Japan	Alcohol	4 Jan. 2010	9.6%	23.3%
KT&G Corp.	S. Korea	Tobacco	4 Jan. 2010	8.2%	23.9%
Kweichow Moutai Co Ltd	China	Alcohol	4 Jan. 2010	29.3%	29.4%
Luzhou Laojiao Co Ltd	China	Alcohol	4 Jan. 2010	28.9%	38.4%
Molson Coors Beverage	USA	Alcohol	4 Jan. 2010	5.2%	25.4%
Pernod Ricard SA	France	Alcohol	4 Jan. 2010	5.2%	20.9%
Philip Morris International	USA	Tobacco	4 Jan. 2010	11.9%	21.0%
Royal Unibrew A/S	Denmark	Alcohol	4 Jan. 2010	30.6%	27.0%
Smoore International Holdings	Hong Kong	Tobacco	10 Jul. 2020	76.0%	66.4%
Treasury Wine Estates	Australia	Alcohol	4 Jan. 2010	14.1%	30.9%
Tsingtao Brewery Co Ltd	China	Alcohol	4 Jan. 2010	11.4%	33.8%
United Spirits Ltd	India	Alcohol	4 Jan. 2010	39.1%	34.3%
Wuliangye Yibin Co Ltd	China	Alcohol	4 Jan. 2010	29.2%	33.7%
S&P 1200 Industrials	N/A	N/A	4 Jan. 2010	11.4%	15.0%

As evidenced in Figure 2, the alcohol sector's annual returns remained positive through 2021 (aside from 2018's -9.9% drop), but each year from 2022 onward showed negative returns. In contrast, the tobacco sector enjoyed solid positive returns in nearly every year except 2018 and 2023. Up to 2021 the two sectors tracked similarly, but they diverged thereafter:

alcohol returns turned negative, whereas tobacco (with the single exception of 2023) continued a strong uptrend. This results in a higher long-run average return for alcohol (18.9%) versus tobacco (14.0%), since alcohol outperformed during the extended 2010–2021 bull market of both sectors. This contradicts our initial hypothesis that tobacco's higher expected risk would translate into higher returns for the sector compared to that of alcohol. Over the full period, both sectors outperformed the S&P 1200 Industrials benchmark, which had an average return of 11.4%, with more stable growth paths and shallower drawdowns during crises. For example, during stress episodes like 2011 and especially the COVID crash in 2020 these sectors fell less than the market. Indeed, in 2020 both sectors delivered extraordinary returns compared to the benchmark 14.7% total return. This defensive nature of the alcohol and tobacco sectors is consistent with the idea highlighted in the literature review, which suggests that these industries tend to behave defensively due to characteristics such as their relatively inelastic demand compared to other sectors, the high degree of industry consolidation in both alcohol and tobacco, and the presence of significant barriers to entry. By comparison, the broad market's 2018 decline has been linked to external shocks (a restrictive Fed and trade-war tensions) (Columbia Threadneedle Investments, 2019). Furthermore, the divergence between alcohol and tobacco showed in recent years has been driven by secular trends: global alcohol consumption has actually fallen (US alcohol volumes were down ~2.6% in 2023), whereas tobacco companies benefited from steady demand (Dent, 2025). For a detailed breakdown of the annualized return by company and year, see **Annex 2**.

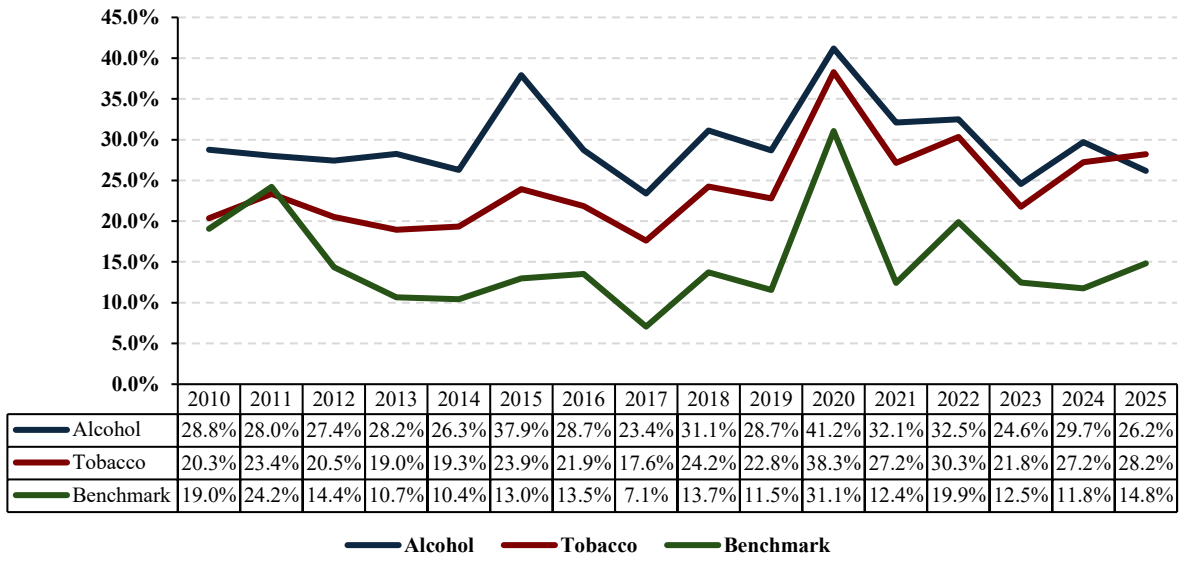
The empirical results largely reinforce the conclusions drawn in the existing sin stock literature. The long-term outperformance of alcohol and tobacco relative to the benchmark is consistent with the return premium documented by Statman and Glushkov (2008), who show that excluding sin stocks leads to a performance penalty, and by Fabozzi et al. (2008), who report average annual returns of 19% for sin stocks, close to those observed for the alcohol and tobacco sectors in this study. The defensive behaviour identified during market stress episodes further supports the idea that sin stocks combine relatively stable demand with higher expected returns, helping explain their persistent outperformance over broad market benchmarks despite regulatory and reputational risks.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Alcohol	34.8%	0.2%	35.8%	16.1%	23.2%	44.6%	8.1%	50.2%	-9.9%	54.9%	48.2%	17.5%	-0.4%	-4.5%	-5.7%	-10.6%
Tobacco	12.1%	28.6%	10.4%	12.7%	10.5%	26.2%	6.5%	6.5%	-28.6%	6.5%	51.4%	6.4%	5.9%	-8.8%	46.7%	30.8%
Benchmark	21.7%	-7.4%	14.5%	30.6%	0.5%	-3.1%	11.8%	23.3%	-14.9%	26.3%	14.7%	17.1%	-11.8%	20.7%	12.1%	25.5%

Figure 2. Annualized Return by Sector (Alcohol vs. Tobacco), 2010-2025 (Source: Own Elaboration)

Regarding volatility, as shown in Figure 3, the alcohol and tobacco sectors have similar volatility patterns, though alcohol's volatility is generally higher, contradicting the idea we had previously established that tobacco is exposed to greater risk than alcohol. Notably, alcohol volatility spiked in 2015 during a period of global market instability, linked to China's market crash and Fed rate-hike uncertainty (Carew, 2015). Volatility jumped again across all sectors in 2022 amid inflationary and geopolitical shocks (Imam & Poghosyan, 2025; OECD, 2022). Afterwards, the benchmark's volatility declined as markets stabilized, but alcohol and tobacco remained comparatively more volatile, likely reflecting ongoing industry-specific uncertainties. In every year, both sectors exhibited higher volatility (risk) than the benchmark, consistent with their historically larger swings. In summary, the alcohol and tobacco sectors exhibited significantly higher risk throughout the period of analysis compared to the benchmark (Average volatility of 15.0% for the benchmark, compared with 29.7% for the alcohol sector and 24.1% for the tobacco sector). This is consistent with the existing literature, which suggests that the alcohol and tobacco sectors are exposed to higher risk than the broader market due to the regulatory constraints they face, their exclusion from institutional investment portfolios, and the social stigma associated with their products. For a detailed breakdown of the annualized volatility by company and year, see **Annex 3**.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Alcohol	28.8%	28.0%	27.4%	28.2%	26.3%	37.9%	28.7%	23.4%	31.1%	28.7%	41.2%	32.1%	32.5%	24.6%	29.7%	26.2%
Tobacco	20.3%	23.4%	20.5%	19.0%	19.3%	23.9%	21.9%	17.6%	24.2%	22.8%	38.3%	27.2%	30.3%	21.8%	27.2%	28.2%
Benchmark	19.0%	24.2%	14.4%	10.7%	10.4%	13.0%	13.5%	7.1%	13.7%	11.5%	31.1%	12.4%	19.9%	12.5%	11.8%	14.8%

Figure 3. Annualized Volatility by Sector (Alcohol vs. Tobacco), 2010-2025 (Source: Own Elaboration)

5.2. SHARPE RATIO

Table 3 shows the annual Sharpe Ratio by company and year. It shows substantial heterogeneity in risk-adjusted performance across firms and over time, despite all companies belonging to the alcohol and tobacco universe. Several large, mature players (such as Altria, British American Tobacco, Philip Morris International, Diageo, and Heineken) display mostly positive but moderate Sharpe ratios. In contrast, a number of Chinese spirits producers (Kweichow Moutai, Wuliangye Yibin, Luzhou Laojiao) exhibit very high Sharpe ratios in specific years (notably 2017, 2019, and 2020), attributed to their high annualized returns (see **Annex 2**), reflecting periods of exceptional returns combined with contained volatility, but also show sharp reversals in downturn years, highlighting higher cyclicality. Negative Sharpe ratios cluster in stress years such as 2018 and 2022–2023, confirming that even defensive sectors are not immune to global shocks. Overall, the table illustrates that sector-level stability masks significant firm-level dispersion.

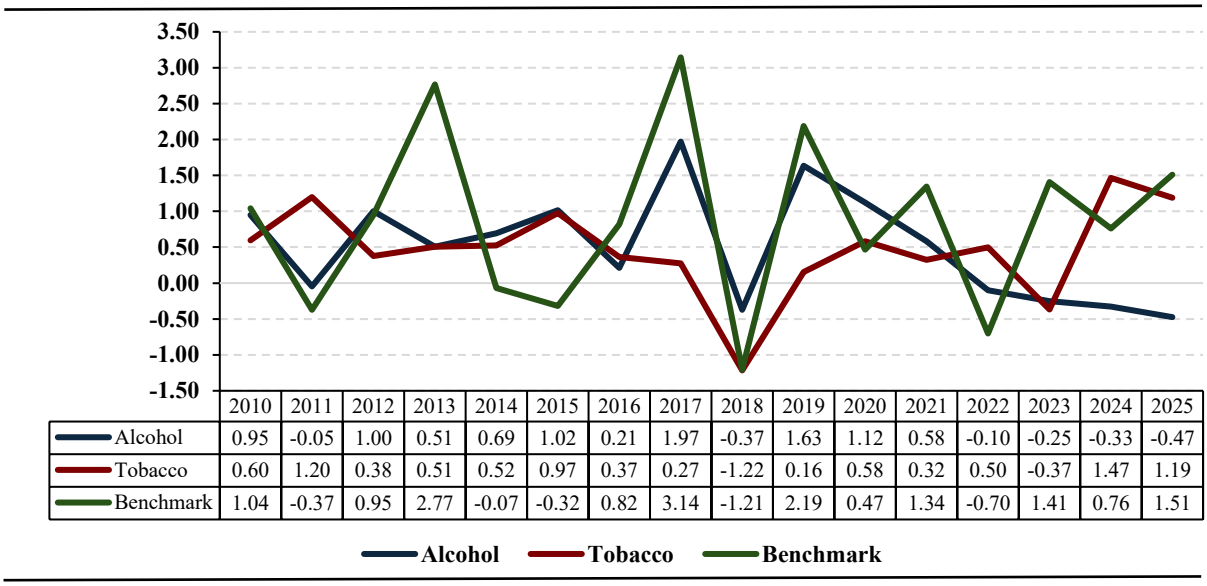
Table 3. Annual Sharpe Ratio by Company and Year (2010-2025) (Source: Own Elaboration)

Entity	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Altria Group	1.58	1.23	0.44	1.50	1.93	0.99	1.03	0.31	-1.30	0.09	-0.36	0.81	-0.13	-0.79	1.48	0.43
Anheuser-Busch InBev SA/NV	0.67	0.43	2.00	0.82	1.23	0.99	-0.40	-0.38	-1.67	1.19	-0.16	-0.11	0.31	0.15	-0.97	0.60
Anhui Gujing Distillery Co Ltd	3.59	0.30	-0.36	-0.65	1.82	0.26	0.81	1.43	-0.27	4.27	2.70	0.02	0.42	-0.42	-0.50	-0.70
Anhui Yingjia Distillery Co Ltd	NaN	NaN	NaN	NaN	NaN	3.19	-0.54	-0.70	-0.45	1.34	1.92	2.32	-0.06	0.28	-0.28	-0.81
Asahi Group Holdings Ltd	-0.38	0.42	0.68	2.35	1.26	0.18	0.05	3.12	-0.78	0.95	-0.21	0.36	-0.15	1.51	-0.11	0.01
Beijing Yanjing Brewery	0.24	-1.34	-0.62	1.71	-0.10	0.31	-0.58	-0.23	-0.37	0.59	1.00	0.03	0.85	-0.57	1.46	-0.24
British American Tobacco Plc	1.18	1.24	0.16	0.24	0.48	0.42	1.27	0.52	-1.72	1.20	-0.33	0.13	0.94	-1.60	1.30	2.07
Brown-Forman Corp	1.50	0.70	1.10	1.20	0.97	0.74	-0.49	2.77	-0.55	2.14	0.67	-0.36	-0.39	-0.62	-1.34	-0.79
Carlsberg AS	1.58	-0.75	1.55	0.48	-0.84	1.28	0.10	1.77	-0.40	2.32	0.11	0.95	-0.56	-0.54	-0.78	1.00
China Resources Beer Holdings Co Ltd	0.38	-0.48	0.23	-0.28	-1.46	2.06	0.15	3.12	0.04	1.90	2.01	-0.20	-0.12	-1.01	-0.34	0.26
Constellation Brands Inc	1.62	-0.10	2.18	2.53	1.97	2.32	0.40	2.79	-1.37	0.75	0.60	0.81	-0.35	0.12	-0.56	-1.19
Davide Campari-Milano	1.54	0.17	0.49	0.19	-0.70	2.30	0.74	2.11	0.71	0.56	0.60	2.07	-0.78	0.30	-1.20	-0.14
Diageo plc	0.52	0.94	1.72	0.70	-0.48	0.06	0.82	2.00	0.18	0.91	-0.11	2.53	-0.41	-1.16	-0.69	-1.43
Endeavour Group Ltd	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	1.09	-0.16	-0.95	-1.05	-0.67
Heineken NV	0.44	-0.12	2.08	-0.07	1.14	1.51	-0.41	1.89	-0.56	1.44	0.05	0.53	-0.38	0.20	-1.35	0.09
Imperial Brands	0.06	1.16	-0.10	-0.07	1.11	1.28	0.01	-0.55	-1.06	-0.66	-0.34	0.34	1.28	-0.84	2.27	1.05
Japan Tobacco	-0.14	0.82	1.35	1.57	0.01	1.36	-0.33	-0.34	-1.29	-0.40	-0.49	0.71	0.85	2.63	0.61	2.04
Jiangsu King's Luck Brewery Ltd	NaN	NaN	NaN	NaN	0.96	0.69	0.12	0.66	0.02	3.54	2.05	0.08	-0.09	-0.06	-0.04	-0.88
Jiangsu Yanghe Brewery JSC Ltd	2.74	0.58	-0.33	-1.56	2.76	0.70	0.17	2.20	-0.26	0.62	3.21	-0.52	0.03	-1.30	-0.71	-1.53
KT&G Corp.	-0.07	0.99	-0.02	-0.47	0.11	1.36	-0.03	0.68	-0.61	-0.51	-0.33	-0.49	1.03	-0.42	0.87	1.36
Kirin Holdings Co Ltd	-0.99	-0.52	0.53	1.87	0.06	0.54	0.70	2.87	-0.57	0.31	0.24	-1.13	0.57	0.25	0.01	0.86
Kweichow Moutai Co Ltd	0.36	0.66	0.35	-1.39	2.19	0.87	2.18	4.37	-0.39	3.67	2.64	0.19	-0.49	-0.02	-0.39	-0.60
Luzhou Laojiao Co Ltd	0.37	-0.31	-0.09	-1.39	0.08	0.96	0.80	3.42	-0.86	3.33	4.42	0.52	-0.15	-0.64	-0.65	-0.17
Molson Coors Beverage	0.49	-0.48	-0.05	1.47	1.53	1.06	0.22	-0.97	-1.02	-0.11	-0.16	0.21	0.45	0.79	-0.34	-0.74
Pernod Ricard SA	0.73	0.11	1.16	-0.26	0.76	0.70	0.02	2.27	0.60	0.74	0.10	2.22	-0.43	-0.69	-1.40	-1.21
Philip Morris International	0.97	1.74	0.43	0.27	-0.49	0.44	0.25	1.03	-1.32	1.21	0.12	0.89	0.28	-0.57	1.31	1.29
Royal Unibrew A/S	3.91	-0.07	2.67	2.28	2.15	1.20	0.03	2.04	1.05	1.79	0.65	0.33	-0.81	-0.29	0.50	0.66
Smoore International Holdings	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	5.79	-0.13	-0.75	-0.98	2.43	0.10
Treasury Wine Estates	NaN	0.51	1.20	0.15	0.11	2.63	1.03	2.26	-0.15	0.45	-0.58	1.19	0.43	-0.84	0.18	-1.77
Tsingtao Brewery Co Ltd	-0.12	0.25	0.27	1.72	-0.96	-1.22	-0.54	1.29	-0.51	2.15	1.55	-0.14	0.32	-1.06	0.40	-0.48
United Spirits Ltd	0.29	-1.71	5.70	1.04	0.11	0.20	-1.22	2.60	-0.46	-0.34	-0.01	2.00	-0.15	1.11	1.84	-0.65
Wuliangye Yibin Co Ltd	0.42	-0.25	-0.40	-1.78	1.39	0.84	1.00	4.60	-0.87	4.70	3.68	-0.40	-0.45	-0.84	0.11	-1.32

When it comes to sector comparison, as evidenced in Figure 4, the alcohol and tobacco sectors have had broadly similar Sharpe-ratio trajectories. In the pre-2022 period alcohol generally had the higher Sharpe, but after 2022 tobacco's Sharpe led (reflecting their return trends). On average alcohol's Sharpe (0.51) modestly exceeds tobacco's (0.47). However, the benchmark's Sharpe profile is higher and more variable: the Industrials index averages about 0.86 Sharpe with a much larger standard deviation (1.18) than alcohol (0.72) or tobacco (0.61). The benchmark's higher Sharpe ratio is consistent with the lower volatility it exhibits throughout the analysis period. This reflects the fact that while these sectors cushion declines (being defensive), they still underperform the broad market on a risk-adjusted basis over the full cycle because of their higher volatility.

The Sharpe ratio results are broadly aligned with the predictions of the sin stock literature, though they also introduce important nuances. While prior studies argue that sin stocks tend to deliver superior risk-adjusted returns due to exclusion by ethically constrained investors (Hong & Kacperczyk, 2009; Salaber, 2007), the evidence here shows that alcohol and tobacco only partially exhibit this premium. Although both sectors display relatively stable Sharpe ratio trajectories and positive averages over the sample period, they underperform the benchmark average on a risk-adjusted basis due to their structurally higher volatility. This suggests that, in this context (when analysing the alcohol and tobacco sectors independently,

rather than including them in a broad, aggregated group of sin stocks), the sin stock premium documented in the literature materializes more clearly in terms of absolute returns rather than superior Sharpe ratios, indicating that the compensation for social stigma and regulatory risk may not be sufficient to offset their higher risk when compared to a broadly diversified market index.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Alcohol	0.95	-0.05	1.00	0.51	0.69	1.02	0.21	1.97	-0.37	1.63	1.12	0.58	-0.10	-0.25	-0.33	-0.47
Tobacco	0.60	1.20	0.38	0.51	0.52	0.97	0.37	0.27	-1.22	0.16	0.58	0.32	0.50	-0.37	1.47	1.19
Benchmark	1.04	-0.37	0.95	2.77	-0.07	-0.32	0.82	3.14	-1.21	2.19	0.47	1.34	-0.70	1.41	0.76	1.51

Figure 4. Annual Sharpe Ratio by Sector (Alcohol vs. Tobacco), 2010-2025 (Source: Own Elaboration)

6. CONCLUSIONS

Our analysis shows that both alcohol and tobacco equities delivered strong absolute returns over 2010–2025, outpacing the S&P 1200 Industrials benchmark. In fact, the alcohol sector achieved the highest long-term average return, although tobacco stocks led the way in the most recent years. Both sectors' returns exceeded the Industrials index average, and they tended to rebound more quickly following crises. This pattern confirms the defensive character often ascribed to sin stocks. At the same time, these return advantages come with elevated volatility. Throughout our sample, both alcohol and tobacco indices were consistently more volatile than the benchmark. This is consistent with the notion stated by previous literature that these sectors carry extra risk due to heightened litigation, regulatory, and reputational uncertainty, for which investors demand a premium. Moreover, we found that alcohol stocks were more volatile than tobacco stocks over the period, which is contrary to the expectation that tobacco, with its stricter legal constraints and social stigma and its higher uncertainty due to its tendency towards RRPs, might be riskier (H1 and H2 are rejected). In any case, the high volatility erodes the sin sectors' returns advantage: both alcohol and tobacco exhibit higher risk, and this extra volatility outweighs their higher raw returns when viewed against the benchmark.

Reflecting their consistent higher volatility, risk-adjusted returns in the alcohol, and tobacco sectors were weaker than the ones of the benchmark (H3 is rejected). Despite higher absolute gains, the average Sharpe ratio of alcohol and tobacco stocks was lower than that of the S&P 1200 Industrials index over 2010–2025. In other words, alcohol and tobacco investors earned less return per unit of risk. Although some prior studies report sin portfolios have higher risk-adjusted returns than the broad market, our results highlight that this does not hold in our specific sample period against the Industrials index. One notable feature, however, is that the Sharpe ratios of the alcohol and tobacco portfolios were more stable over time, than the ones of the S&P 1200 Industrials index. This suggests that although sin portfolios did not deliver superior risk-adjusted returns, their performance per risk unit was comparatively more predictable.

These findings have clear implications for investors and policymakers. Active investors who concentrate on alcohol and tobacco may be attracted by the strong returns but must recognize that this "sin premium" is not fully earned in compensation for volatility. By contrast, institutional that exclude alcohol and tobacco for ethical reasons give up some return potential but also sidestep the extra volatility and uncertainty.

For policymakers, this study shows that regulatory and policy measures do in fact affect the alcohol and tobacco sectors in terms of risk, in line with the existing literature. These interventions increase volatility and uncertainty for investors, which ultimately deteriorates the risk-adjusted return of alcohol and tobacco relative to the broader market.

Finally, this study presents several limitations that should be acknowledged. First, the sample is limited to 32 publicly listed multinational firms, which may not fully capture the diversity of risk and performance profiles across smaller or regionally focused companies. Second, the analysis relies exclusively on the Sharpe Ratio as the measure of risk-adjusted return, which does not account for downside risk or non-normal return distributions. Lastly, the study focuses on historical performance and does not incorporate forward-looking market expectations or macroeconomic variables, which may affect the generalizability of the findings in future periods.

7. STATEMENT OF USE OF GENERATIVE AI TOOLS

ADVERTENCIA: Desde la Universidad consideramos que ChatGPT u otras herramientas similares son herramientas muy útiles en la vida académica, aunque su uso queda siempre bajo la responsabilidad del alumno, puesto que las respuestas que proporciona pueden no ser veraces. En este sentido, NO está permitido su uso en la elaboración del Trabajo fin de Grado para generar código porque estas herramientas no son fiables en esa tarea. Aunque el código funcione, no hay garantías de que metodológicamente sea correcto, y es altamente probable que no lo sea.

Por la presente, yo, Ignacio Ruesta Llorente, estudiante de ADE y Business Analytics (E-2 + Analytics) de la Universidad Pontificia Comillas al presentar mi Trabajo Fin de Grado titulado "*Risk-Adjusted Returns in the Alcohol and Tobacco Sectors: a Comparative Analysis (2010-2025)*", declaro que he utilizado la herramienta de Inteligencia Artificial Generativa ChatGPT u otras similares de IAG de código sólo en el contexto de las actividades descritas a continuación:

1. **Referencias:** Usado conjuntamente con otras herramientas, como Science, para identificar referencias preliminares que luego he contrastado y validado.
2. **Interpretador de código:** Para realizar análisis de datos preliminares.
3. **Corrector de estilo literario y de lenguaje:** Para mejorar la calidad lingüística y estilística del texto.
4. **Sintetizador y divulgador de libros complicados:** Para resumir y comprender literatura compleja.
5. **Traductor:** Para traducir textos de un lenguaje a otro.

Afirmo que toda la información y contenido presentados en este trabajo son producto de mi investigación y esfuerzo individual, excepto donde se ha indicado lo contrario y se han dado los créditos correspondientes (he incluido las referencias adecuadas en el TFG y he explicitado para que se ha usado ChatGPT u otras herramientas similares). Soy consciente de las implicaciones académicas y éticas de presentar un trabajo no original y acepto las consecuencias de cualquier violación a esta declaración.

Fecha: 18/11/2025

Firma: 

Ignacio Ruesta Llorente

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9. ANNEXES

ANNEX 1 - COMPANY DESCRIPTIONS

- **Altria Group (MO)** – U.S. tobacco company best known for cigarettes and smoke-free nicotine products.
- **Anheuser-Busch InBev SA/NV (ABI)** – World's largest brewer, producing global beer brands like Budweiser and Stella Artois.
- **Anhui Gujing Distillery Co Ltd (000596)** – Chinese producer of traditional baijiu spirits.
- **Anhui Yingjia Distillery Co Ltd (603198)** – Chinese baijiu distiller focused on regional premium spirits.
- **Asahi Group Holdings Ltd (2502)** – Japanese beverage group producing beer, soft drinks, and food products.
- **Beijing Yanjing Brewery (000729)** – Chinese state-linked brewery known for Yanjing Beer.
- **British American Tobacco Plc (BATS)** – Global tobacco company producing cigarettes, vaping and nicotine products.
- **Brown-Forman Corp (BF.B)** – U.S. spirits company famous for Jack Daniel's and other premium liquor brands.
- **Carlsberg AS (CARL-B)** – Danish multinational brewer with large European and Asian operations.
- **China Resources Beer Holdings Co Ltd (291)** – Major Chinese brewery, owner of the Snow Beer brand.
- **Constellation Brands Inc (STZ)** – U.S. producer of beer, wine, and spirits, including Corona (U.S. rights).
- **Davide Campari-Milano (CPR)** – Italian spirits company behind Campari, Aperol, and other iconic beverages.
- **Diageo plc (DGE)** – UK-based global leader in spirits and beer, owning Johnnie Walker and Guinness.
- **Endeavour Group Ltd (EDV)** – Australian retailer and operator of liquor stores, pubs, and beverage services.
- **Heineken NV (HEIA)** – Dutch multinational brewing company known for Heineken and over 300 local brands.
- **Imperial Brands (IMB)** – UK tobacco company producing cigarettes, rolling tobacco, and vaping products.
- **Japan Tobacco (2914)** – Japanese tobacco and food conglomerate selling cigarettes and reduced-risk products.
- **Jiangsu King's Luck Brewery Ltd (603369)** – Chinese baijiu producer focused on premium and mid-range spirits.
- **Jiangsu Yanghe Brewery JSC Ltd (002304)** – Leading Chinese baijiu distiller with strong national presence.
- **Kirin Holdings Co Ltd (2503)** – Japanese beverage and food company producing beer, soft drinks, and biotech products.

- **KT&G Corp. (033780)** – South Korean tobacco company manufacturing cigarettes and ginseng products.
- **Kweichow Moutai Co Ltd (600519)** – China's most valuable distiller, producing the premium Moutai baijiu.
- **Luzhou Laojiao Co Ltd (000568)** – One of China's oldest baijiu distilleries, specializing in strong-aroma spirits.
- **Molson Coors Beverage (TAP)** – North American brewer producing brands like Coors, Miller, and Blue Moon.
- **Pernod Ricard SA (RI)** – French multinational spirits group behind Absolut, Chivas, and Jameson.
- **Philip Morris International (PM)** – Global tobacco company focused on smoke-free products like IQOS.
- **Royal Unibrew A/S (RBREW)** – Danish beverage company producing beer, soft drinks, and malt beverages.
- **Smoore International Holdings (6969)** – Chinese manufacturer of vaping devices and e-cigarette technology.
- **Tsingtao Brewery Co Ltd (168)** – One of China's largest breweries, known for Tsingtao Beer.
- **Treasury Wine Estates (TWE)** – Australian wine company producing Penfolds and other global wine brands.
- **United Spirits Ltd (532432)** – India's largest spirits producer, majority-owned by Diageo.
- **Wuliangye Yibin Co Ltd (000858)** – Chinese premium baijiu distiller famous for Wuliangye spirits.

ANNEX 2 - ANNUALIZED AVERAGE DAILY RETURNS BY COMPANY AND YEAR (2010-2025)

Entity	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Altria Group	26.0%	22.1%	7.2%	23.5%	29.7%	20.2%	17.6%	7.1%	-28.9%	4.3%	-12.3%	18.4%	-0.4%	-10.3%	31.9%	12.6%
Anheuser-Busch InBev SA/NV	18.5%	13.0%	40.9%	20.6%	23.3%	25.6%	-9.5%	-6.1%	-36.2%	29.8%	-9.2%	-3.3%	9.8%	5.5%	-15.7%	16.9%
Anhui Gujing Distillery Co Ltd	167.8%	13.1%	-12.8%	-28.3%	83.8%	19.1%	37.6%	56.0%	-9.0%	183.2%	128.7%	3.7%	20.9%	-9.6%	-19.5%	-20.0%
Anhui Yingjia Distillery Co Ltd	NaN	NaN	NaN	NaN	NaN	284.3%	-21.2%	-15.8%	-14.2%	53.0%	107.4%	146.8%	-0.2%	12.8%	-10.7%	-23.8%
Asahi Group Holdings Ltd	-7.5%	11.3%	10.0%	71.1%	31.3%	4.7%	1.3%	55.2%	-21.4%	20.4%	-8.6%	9.3%	-4.3%	31.1%	-2.4%	1.2%
Beijing Yanjing Brewery	11.3%	-27.8%	-13.8%	53.5%	1.5%	19.9%	-13.0%	-1.2%	-10.6%	22.7%	43.5%	3.6%	37.7%	-15.4%	48.7%	-4.2%
British American Tobacco Plc	23.1%	26.6%	3.5%	5.1%	9.4%	10.0%	24.7%	10.7%	-48.0%	34.2%	-11.2%	3.1%	23.3%	-28.7%	27.2%	49.7%
Brown-Forman Corp	32.2%	19.5%	19.7%	21.1%	17.9%	14.8%	-7.9%	56.1%	-10.8%	45.0%	27.0%	-6.4%	-6.9%	-10.6%	-31.1%	-26.3%
Carlsberg AS	47.2%	-23.2%	42.4%	10.8%	-18.5%	32.5%	2.0%	23.4%	-6.1%	47.3%	2.9%	18.1%	-14.8%	-6.9%	-16.3%	24.4%
China Resources Beer Holdings Co Ltd	14.4%	-12.1%	10.4%	-4.4%	-35.2%	134.4%	8.3%	92.3%	5.2%	69.1%	79.4%	-4.4%	-3.3%	-34.2%	-16.1%	10.9%
Constellation Brands Inc	41.8%	-1.6%	84.2%	118.9%	42.4%	48.0%	10.7%	51.7%	-28.0%	22.7%	28.2%	16.8%	-5.2%	6.6%	-6.8%	-34.4%
Davide Campari-Milano	35.7%	8.6%	15.7%	7.1%	-13.2%	59.6%	19.9%	40.9%	17.5%	12.5%	23.2%	39.4%	-22.1%	10.0%	-37.3%	-2.2%
Diageo plc	11.0%	21.4%	28.7%	13.7%	-6.2%	2.5%	15.5%	30.6%	3.8%	16.1%	-4.0%	41.9%	-7.2%	-20.1%	-9.4%	-34.4%
Endeavour Group Ltd	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	27.4%	-1.3%	-16.9%	-17.6%	-10.7%
Heineken NV	10.2%	-0.4%	43.2%	-0.7%	22.0%	37.0%	-7.8%	22.6%	-9.8%	24.5%	0.9%	10.6%	-8.2%	6.3%	-23.5%	4.6%
Imperial Brands	3.4%	26.7%	-1.0%	0.0%	23.5%	29.4%	0.9%	-9.2%	-22.9%	-18.0%	-12.2%	7.8%	31.9%	-11.4%	43.0%	24.4%
Japan Tobacco	-3.5%	28.1%	42.0%	48.2%	0.4%	42.3%	-10.3%	-4.8%	-27.0%	-6.3%	-11.7%	12.6%	17.5%	39.6%	16.3%	42.8%
Jiangsu King's Luck Brewery Ltd	NaN	NaN	NaN	NaN	42.1%	44.7%	8.1%	25.7%	4.3%	153.4%	100.7%	6.7%	-0.6%	0.6%	0.2%	-21.3%
Jiangsu Yanghe Brewery JSC Ltd	124.1%	20.9%	-8.4%	-55.3%	113.1%	38.5%	7.6%	74.2%	-8.8%	24.3%	140.5%	-22.4%	3.6%	-30.4%	-20.9%	-26.9%
KT&G Corp.	2.7%	31.2%	2.7%	-6.2%	5.7%	45.1%	0.6%	18.2%	-10.6%	-6.6%	-8.0%	-4.3%	17.3%	-3.7%	30.2%	39.1%
Kirin Holdings Co Ltd	-22.7%	-14.7%	10.2%	58.8%	1.5%	14.3%	21.7%	53.2%	-16.2%	7.4%	8.1%	-23.1%	11.4%	3.9%	0.8%	17.2%
Kweichow Moutai Co Ltd	13.9%	19.7%	13.9%	-37.6%	73.0%	38.0%	60.9%	121.6%	-10.4%	114.7%	79.6%	10.1%	-12.4%	2.1%	-8.8%	-8.7%
Luzhou Laojiao Co Ltd	16.9%	-5.3%	0.1%	-41.9%	6.4%	57.6%	29.6%	115.8%	-33.6%	136.4%	197.7%	31.4%	-3.8%	-17.0%	-25.1%	-3.5%
Molson Coors Beverage	11.4%	-10.5%	-0.1%	34.6%	36.1%	30.8%	6.1%	-14.5%	-28.4%	-0.9%	-6.7%	7.3%	15.9%	22.1%	-3.8%	-15.8%
Pernod Ricard SA	18.2%	5.3%	24.0%	-3.7%	12.7%	17.3%	0.1%	28.8%	10.0%	12.9%	2.3%	35.7%	-9.9%	-11.1%	-29.5%	-30.1%
Philip Morris International	21.0%	36.9%	8.2%	5.5%	-5.5%	9.9%	5.5%	16.8%	-34.3%	31.3%	5.4%	16.6%	10.0%	-5.7%	30.5%	38.4%
Royal Unibrew A/S	153.2%	0.2%	57.3%	54.8%	53.0%	34.7%	0.5%	39.1%	24.5%	40.0%	26.3%	7.1%	-28.2%	-5.3%	16.8%	16.5%
Smoore International Holdings	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	409.4%	-9.4%	-58.5%	-41.7%	147.6%	8.6%
Treasury Wine Estates	NaN	20.8%	30.8%	7.7%	7.4%	84.9%	35.0%	53.2%	-2.4%	14.9%	-31.6%	37.6%	12.9%	-17.4%	8.2%	-51.2%
Tsingtao Brewery Co Ltd	-1.4%	12.4%	9.8%	50.4%	-18.0%	-31.2%	-13.3%	46.2%	-16.2%	77.9%	72.3%	-2.8%	17.2%	-29.8%	19.7%	-11.4%
United Spirits Ltd	16.7%	-64.0%	391.5%	48.4%	11.9%	15.2%	-32.3%	104.5%	-8.5%	-2.3%	5.0%	63.1%	2.3%	31.3%	51.0%	-8.9%
Wuliangye Yibin Co Ltd	16.9%	-2.6%	-9.8%	-44.4%	44.5%	42.6%	33.6%	150.4%	-31.9%	192.1%	142.8%	-15.8%	-13.9%	-20.3%	6.0%	-23.3%

Source: Own Elaboration

ANNEX 3 - ANNUALIZED VOLATILITY BY COMPANY AND YEAR (2010-2025)

Entity	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Altria Group	15.3%	16.8%	14.8%	14.9%	14.6%	18.8%	15.9%	16.5%	24.3%	25.1%	36.0%	21.7%	25.2%	18.3%	18.7%	20.2%
Anheuser-Busch InBev SA/NV	24.2%	22.1%	19.6%	23.5%	18.5%	25.8%	22.9%	15.8%	21.7%	25.3%	53.1%	26.4%	27.8%	18.3%	18.8%	23.9%
Anhui Gujing Distillery Co Ltd	45.9%	31.9%	44.3%	48.8%	43.8%	61.0%	43.1%	36.7%	46.9%	42.2%	46.7%	54.8%	44.1%	29.0%	42.9%	31.0%
Anhui Yingjia Distillery Co Ltd	NaN	NaN	NaN	NaN	NaN	88.1%	43.8%	27.6%	38.9%	37.4%	54.7%	62.0%	45.7%	35.9%	45.6%	31.4%
Asahi Group Holdings Ltd	20.7%	25.8%	14.3%	30.1%	24.6%	25.2%	29.3%	17.7%	27.2%	21.8%	39.4%	26.5%	28.7%	20.5%	25.7%	21.7%
Beijing Yanjing Brewery	35.7%	23.5%	27.3%	29.1%	24.3%	54.7%	26.8%	20.1%	38.2%	33.4%	41.0%	29.0%	41.5%	31.4%	32.0%	24.1%
British American Tobacco Plc	17.8%	20.0%	16.1%	16.0%	15.9%	20.6%	19.0%	19.5%	28.5%	27.9%	33.7%	20.3%	22.6%	20.4%	17.9%	22.0%
Brown-Forman Corp	20.2%	25.8%	17.2%	16.7%	16.8%	17.9%	18.9%	19.6%	24.6%	20.1%	39.8%	20.1%	25.6%	23.8%	26.4%	38.2%
Carlsberg AS	28.5%	33.4%	27.1%	20.6%	22.5%	25.3%	22.1%	13.4%	15.1%	20.6%	30.8%	19.5%	28.6%	17.6%	23.6%	22.3%
China Resources Beer Holdings Co Ltd	30.6%	32.8%	31.8%	28.2%	26.8%	63.7%	36.9%	28.5%	39.4%	34.8%	38.1%	37.1%	50.6%	36.4%	52.3%	35.9%
Constellation Brands Inc	24.5%	32.6%	38.2%	46.5%	20.7%	20.0%	23.7%	17.9%	22.4%	27.8%	46.0%	19.6%	23.2%	20.7%	19.5%	32.3%
Davide Campari-Milano	21.3%	24.0%	23.0%	20.8%	21.2%	25.5%	26.4%	19.0%	22.4%	20.4%	38.1%	19.0%	31.4%	20.9%	33.8%	35.1%
Diageo plc	16.9%	20.9%	16.2%	17.8%	16.7%	20.4%	18.1%	15.0%	15.3%	17.0%	36.1%	16.4%	23.1%	20.8%	19.4%	26.9%
Endeavour Group Ltd	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	24.4%	26.7%	21.7%	20.3%	21.9%
Heineken NV	18.7%	20.6%	20.4%	20.5%	18.9%	24.4%	18.3%	12.1%	17.1%	17.3%	31.2%	21.0%	24.6%	18.0%	19.3%	24.9%
Imperial Brands	18.1%	21.4%	18.0%	16.9%	19.6%	22.0%	20.6%	17.8%	22.7%	28.4%	36.2%	21.6%	23.2%	18.2%	17.2%	19.4%
Japan Tobacco	28.2%	33.8%	30.9%	30.6%	25.2%	31.0%	30.6%	13.7%	20.9%	15.2%	23.5%	17.7%	20.6%	15.0%	26.0%	20.4%
Jiangsu King's Luck Brewery Ltd	NaN	NaN	NaN	NaN	39.6%	59.9%	44.8%	33.6%	47.7%	42.5%	47.9%	49.2%	35.8%	32.1%	40.4%	25.9%
Jiangsu Yanghe Brewery JSC Ltd	44.3%	29.8%	34.2%	37.7%	39.5%	50.2%	29.3%	32.2%	46.7%	34.5%	43.0%	48.8%	35.3%	25.3%	32.1%	18.6%
KT&G Corp.	23.1%	27.7%	26.1%	19.6%	26.1%	31.8%	28.6%	23.8%	20.9%	16.0%	28.3%	12.2%	13.6%	17.4%	31.1%	26.8%
Kirin Holdings Co Ltd	23.4%	29.1%	18.9%	31.3%	22.6%	26.5%	31.4%	18.6%	28.5%	25.0%	34.5%	20.4%	20.0%	14.7%	17.9%	18.9%
Kweichow Moutai Co Ltd	30.8%	24.6%	31.3%	29.7%	31.5%	39.9%	26.7%	27.0%	35.6%	30.4%	29.1%	37.4%	30.4%	20.6%	27.7%	17.1%
Luzhou Laojiao Co Ltd	38.0%	28.7%	33.1%	32.7%	31.5%	56.7%	33.8%	32.8%	43.3%	40.1%	44.2%	55.5%	42.6%	30.6%	41.8%	29.1%
Molson Coors Beverage	19.5%	24.9%	18.0%	22.7%	22.5%	27.7%	21.8%	16.9%	30.4%	25.3%	46.2%	30.0%	28.6%	22.8%	23.2%	26.6%
Pernod Ricard SA	22.2%	26.0%	19.6%	17.9%	15.9%	24.6%	21.1%	12.7%	16.5%	17.9%	27.9%	16.3%	25.8%	20.2%	23.0%	27.1%
Philip Morris International	19.7%	20.4%	17.2%	15.7%	14.6%	19.3%	16.4%	14.5%	28.1%	24.3%	39.6%	17.7%	25.2%	17.1%	20.2%	26.7%
Royal Unibrew A/S	38.7%	26.0%	21.3%	23.5%	24.3%	29.0%	25.1%	19.3%	23.5%	22.6%	41.1%	22.9%	36.1%	27.9%	29.2%	21.7%
Smoore International Holdings	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	70.6%	78.8%	81.8%	46.0%	59.4%	62.0%
Treasury Wine Estates	NaN	31.9%	23.3%	30.6%	40.2%	31.4%	32.2%	22.5%	31.8%	30.2%	55.1%	31.0%	23.2%	25.1%	24.4%	31.2%
Tsingtao Brewery Co Ltd	34.7%	35.0%	24.5%	27.2%	22.9%	28.2%	29.5%	33.0%	38.4%	34.8%	44.8%	40.1%	45.5%	30.7%	44.1%	27.1%
United Spirits Ltd	31.6%	42.4%	67.3%	38.5%	30.4%	37.4%	32.3%	37.6%	35.0%	26.8%	41.5%	28.8%	30.6%	21.8%	23.9%	23.3%
Wuliangye Yibin Co Ltd	33.5%	24.5%	32.2%	27.0%	29.1%	46.8%	31.1%	32.0%	40.8%	40.3%	38.1%	46.5%	36.9%	27.1%	35.0%	18.8%

Source: Own Elaboration

ANNEX 4 - PYTHON SCRIPT

I. Libraries

```
import pandas as pd
import numpy as np
```

II. Load Datasets

```
companies = pd.read_excel("/content/Companies Historical Prices (Antiguo).xlsx", parse_dates=["Date"])
rf = pd.read_excel("/content/Risk-Free Data.xlsx", parse_dates=["Date"])
```

III. Initial Adjustments

```
# Add Year column
companies["Year"] = companies["Date"].dt.year
rf["Year"] = rf["Date"].dt.year

# Convert the risk-free rate to decimal form by dividing by 100
rf["Rate"] = rf["Rate"] / 100

# Label the benchmark so it is included in the groupby and pivot operations (Conutry and Sector fields ar "N/A" in the database for the benchmark)
BENCHMARK_NAME = "S&P 1200 Industrials"
companies.loc[companies["Entity"] == BENCHMARK_NAME, "Country"] = "Benchmark"
companies.loc[companies["Entity"] == BENCHMARK_NAME, "Sector"] = "Benchmark"
```

IV. Compute daily returns per entity (companies + S&P 1200 Industrials)

```
companies = companies.sort_values(["Entity", "Date"])
companies["daily_return"] = companies.groupby("Entity")["Metric"].pct_change()

# Remove first observation per company (NaN from pct_change)
companies = companies.dropna(subset=["daily_return"])
```

V. Compute mean and std of daily returns

```
stats_emp_year = (
    companies
    .groupby(["Entity", "Country", "Sector", "Year"])["daily_return"]
    .agg(["mean", "std"])
    .reset_index()
    .rename(columns={"mean": "mean_daily_ret", "std": "std_daily_ret"})
)
```

VI. Annualize returns and volatility

```
TRADING_DAYS = 252

stats_emp_year["ann_return"] = (1 + stats_emp_year["mean_daily_ret"])**TRADING_DAYS - 1
stats_emp_year["ann_vol"] = stats_emp_year["std_daily_ret"] * np.sqrt(TRADING_DAYS)
```

VII. Request Tables (annualized return and volatility)

```python
# 5.1 Annualized return per company-year (includes the Benchmark)
table_ret_emp_year = stats_emp_year.pivot_table(
    index="Entity", columns="Year", values="ann_return"
)

# 5.2 Mean annualized return per sector-year (includes the Benchmark)
table_ret_sector_year = (
    stats_emp_year
    .groupby(["Sector", "Year"])["ann_return"]
    .mean()
    .reset_index()
    .pivot(index="Sector", columns="Year", values="ann_return")
)

# 5.3 Annualized volatility per company-year (includes the Benchmark)
table_vol_emp_year = stats_emp_year.pivot_table(
    index="Entity", columns="Year", values="ann_vol"
)

# 5.4 Mean annualized volatility per sector-year (includes the Benchmark)
table_vol_sector_year = (
    stats_emp_year
    .groupby(["Sector", "Year"])["ann_vol"]
    .mean()
    .reset_index()
    .pivot(index="Sector", columns="Year", values="ann_vol")
)
```

VIII. Compute annual risk-free rate per country-year

```python
rf_annual = (
    rf
    .groupby(["Country", "Year"])["Rate"]
    .mean()
    .reset_index()
    .rename(columns={"Rate": "rf_annual"})
)
```

IX. Compute the benchmark's annual risk-free rate as a country-weighted average

```python
weights = {
    "USA": 0.537,
    "Japan": 0.140,
    "France": 0.070,
    "Germany": 0.060,
    "UK": 0.046,
    "Sweden": 0.036,
    "Switzerland": 0.025,
    "Canada": 0.023,
    "Denmark": 0.011,
    "Spain": 0.008,
    "Australia": 0.008,
    "Italy": 0.007,
    "Finland": 0.007,
    "South Korea": 0.006,
    "Hong Kong": 0.004,
    "Ireland": 0.004,
    "Netherlands": 0.003,
    "Norway": 0.002,
    "Mexico": 0.002
    "Brazil": 0.002,
    "Chile": 0.001,
}

rf_benchmark_annual = (
    rf_annual[rf_annual["Country"].isin(weights.keys())]
    .assign(weight=lambda d: d["Country"].map(weights))
)
```

```
rf_benchmark_annual = (
    rf_benchmark_annual
    .groupby("Year")
    .apply(lambda g: (g["rf_annual"] * g["weight"]).sum())
    .reset_index(name="rf_annual")
)

rf_benchmark_annual["Country"] = "Benchmark"

# Append the benchmark's weighted risk-free series to rf_annual so it is included in the Country-Year merge
rf_annual = pd.concat([rf_annual, rf_benchmark_annual], ignore_index=True)
```

X. Merge risk-free rate into company dataset by country-year

```
stats_emp_year = stats_emp_year.merge(
    rf_annual, on=["Country", "Year"], how="left"
)
```

XI. Compute Sharpe Ratio per entity-year (including the benchmark)

```
stats_emp_year["sharpe"] = (
    (stats_emp_year["ann_return"] - stats_emp_year["rf_annual"]) /
    stats_emp_year["ann_vol"]
)
```

XII. Build Sharpe Ratio tables

```
# 9.1 Sharpe ratio per entity-year (including the S&P 1200 Industrials)
table_sharpe_emp_year = stats_emp_year.pivot_table(
    index="Entity", columns="Year", values="sharpe"
)

# 9.2 Mean Sharpe Ratio per entity-year (including the S&P 1200 Industrials)
table_sharpe_sector_year = (
    stats_emp_year
    .groupby(["Sector", "Year"])["sharpe"]
    .mean()
    .reset_index()
    .pivot(index="Sector", columns="Year", values="sharpe")
)
```