



# **Illuminating the Benefits and Costs of Trade Internalisation: Liquidity, Volatility, Price Discovery, and the Regulation Challenges**

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# Abstract

This paper investigates the impact of trade internalisation, often referred to as dark trading, on market liquidity, volatility, and price discovery. Drawing on insights from an AI augmented literature review of 11,000+ research papers, including from key regulators and authorities, the study explores the benefits and challenges of trade internalisation and proxies, particularly for small capitalisation stocks and emerging market exchanges where literature is more limited compared with developed markets. Focusing on the Brazilian market and situating it within an international framework—drawing comparisons with the United States, Canada, Australia, the U.K. and South Africa—the research delivers a comprehensive analysis of the welfare benefits and costs associated with trade internalisation. The study employs a mixed-methods approach, combining quantitative analysis on primary sourced data including panel regressions and causality tests as well as qualitative semi-structured interviews to address the hypotheses. These include the hypotheses that trade internalisation improves liquidity (H1), reduces volatility during market stress (H2), enhances price discovery (H3), and that improved market quality (liquidity and price discovery) indicates integration rather than market fragmentation (H4). By examining the regulatory frameworks and empirical evidence from these regions our findings suggest that dark trading can enhance liquidity and facilitate price discovery, especially during times of market stress. Moreover, concerns about transparency and potential market fragmentation are also addressed. The results offer valuable insights for policymakers and market participants, highlighting the need for balanced regulatory measures to maximise the benefits of dark trading while mitigating its potential risks.

Keywords: Trade internalisation, dark trading, alternative trading systems, liquidity, volatility, price formation, regulation, stock exchanges.

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# 1. Executive Summary

The evolution of financial markets, driven by technological advancements and regulatory changes, has led to increased interest in trade internalisation, particularly in developed markets like the United States, Australia, and Canada. Trade Internalisation, often synonymous with dark trading, allows broker-dealers to match buy and sell orders internally rather than routing them to public exchanges. In Brazil, the Comissão de Valores Mobiliários (CVM) has expressed concerns about trade internalisation's potential impact on market liquidity, volatility, price discovery, and the cost of regulatory oversight ([CVM, 2024](#)). This report, commissioned by BTG Pactual and XP Inc., assesses the implications of introducing trade internalisation in Brazil, providing a comprehensive analysis based on international benchmarks and quantitative analysis.

The study draws on empirical evidence from more other markets (both larger and comparable in size to Brazil's stock market) to assess whether the Brazilian market could benefit from trade internalisation, addressing potential welfare benefits, costs, and regulatory concerns.

## **Hypotheses and research questions**

The research was guided by three core questions, each developed from a systematic literature review and adapted from existing studies on market liquidity, volatility, and price discovery. These questions aimed to explore a range of topics, from identifying the key metrics used to assess the impact of

trade internalisation, to understanding the differences in how internalisation operates versus lit markets (public stock exchange venues) across various countries where the practice is permitted. Additionally, the research sought to define the benchmarks that would allow us to quantify the potential benefits or costs of adopting trade internalisation in Brazil.

Building on these research questions, the report studied hypotheses that trade internalisation would lead to improved market liquidity, with narrower bid-ask spreads and higher liquidity ratios. It was also expected that internalisation could mitigate market volatility, particularly during periods of stress, while enhancing price discovery by contributing to more accurate and efficient price formation. Furthermore, the research explored whether these improvements in liquidity and price discovery would ultimately foster market integration, countering concerns about potential fragmentation.

These hypotheses were rigorously tested using a variety of quantitative methods, including panel regressions and Granger causality tests, to assess internalisation's effects on liquidity, volatility, and price discovery.

## **1.1. Trade internalisation in other markets**

Trade internalisation has long been a feature of major developed financial markets. The United States led this development, with the implementation of Securities and Exchange Commission (SEC) rules enabling off-exchange trading as early as 1975 ([U.S. SEC, 2021](#)). Over the decades, internalisation has become integral to financial markets, driven by demand from institutional investors seeking anonymity and better trade execution. Alternative Trading

Systems (ATS), including dark pools, have provided these investors with the ability to execute large trades without revealing their intentions to the broader market, improving liquidity and price stability. Similar trends are observed in other markets, such as Canada and Australia, where regulatory frameworks have adapted to accommodate the growth of internalisation.

In these jurisdictions, internalisation coexists with traditional exchanges, and its evolution has been marked by ongoing regulatory adjustments. This report delves into these developments, focusing on their relevance to Brazil and the potential for adopting similar frameworks.

## **1.2. Empirical findings on liquidity, volatility, and price discovery**

### **1.2.1. Liquidity improvements in internalised markets**

Trade internalisation has been shown to improve liquidity, particularly in small capitalisation stocks. This effect is evident in the Russell 2000 index (small capitalisation index in the U.S. market), where internalisation has resulted in tighter bid-ask spreads and increased trading volumes. Our analysis, using panel regression models, demonstrates that as internalised trading volumes increase, liquidity improves significantly. This pattern is not limited to large markets like the U.S.; South Africa's Johannesburg Stock Exchange (JSE) has experienced similar liquidity improvements during periods of market stress, driven by dark trading.

In Brazil, the introduction of internalisation through mechanisms like the Retail Liquidity Provider (RLP) system for mini-contracts and for limited set of

equities – 20 stocks separated in two groups with open and both open closed spreads – has already improved liquidity in certain asset classes.

### **1.2.2. The role of internalisation in market volatility**

Contrary to concerns that internalisation could exacerbate volatility, our analysis finds that internalised markets can act as stabilisers, particularly during times of market stress. The experience of the U.S. and South Africa during the 2008 financial crisis and the COVID-19 pandemic demonstrates that dark trading contributed to dampening volatility. Using Granger causality tests, we show that internalisation is negatively correlated with short-term volatility, suggesting that internalised trading can absorb market shocks more efficiently than fully lit venues.

For instance, data from the U.S. Russell 2000 and South Africa's JSE indices show that during periods of heightened uncertainty, the share of trades executed internally increased, contributing to lower overall volatility. This finding challenges the assumption that internalisation would lead to more significant price swings, suggesting instead that it provides a stabilising mechanism by allowing large trades to occur without moving the market.

### **1.2.3. Impact on price discovery and market integrity**

One of the most debated aspects of trade internalisation is its potential effect on price discovery. Our study indicates that while internalisation reduces pre-trade transparency, it does not necessarily harm price formation. In fact, empirical data from markets such as the New York Stock Exchange (NYSE)

show that price discovery remains intact even in the presence of significant internalised trading ([Chapter 5](#)).

The introduction of dark trading has provided institutional investors with the ability to execute large orders discreetly, avoiding adverse price impacts while still contributing to price discovery post-trade. This is particularly evident in Canada and Australia ([Foley and Putniņš 2016](#)), where dark trading has been shown to improve price accuracy by enabling large trades without moving the public order book.

## **1.3. Market participant welfare benefits**

### **1.3.1. Operational benefits for broker-dealers**

For broker-dealers, trade internalisation offers several advantages, particularly in terms of operational efficiency. By matching trades internally, broker-dealers can reduce their execution costs and offer better pricing to clients. This system also allows broker-dealers to manage large orders more effectively, minimising the market impact of such trades and protecting their clients' strategies from public view.

In the U.S., internalisation has allowed broker-dealers to become more competitive by offering clients better execution quality. This has been particularly beneficial for institutional investors, who can execute large trades without signalling their intentions to the broader market. A similar system could be adapted for the Brazilian market, providing broker-dealers with greater flexibility in managing their order flow while improving execution outcomes.

### **1.3.2. Advantages for retail and institutional investors**

Retail investors stand to gain from trade internalisation through improved execution quality and reduced transaction costs. The Brazilian system of Retail Liquidity Providers (RLPs) has demonstrated that internalisation can narrow spreads and enhance execution speed, benefiting smaller investors. Our analysis of Brazil's RLP system shows that these benefits have already been realised in specific asset classes, such as mini-contracts.

Institutional investors, on the other hand, benefit from the ability to execute large trades in dark pools or ATS without significantly impacting public prices. The anonymity provided by internalisation allows for more strategic execution, ensuring that large orders are completed without causing price disruptions in the market.

## **1.4. Addressing regulatory concerns**

### **1.4.1. Balancing oversight and cost efficiency**

A central concern for the CVM is the potential cost of overseeing internalised trades, particularly given the opacity of dark trading. However, international experience shows that regulatory costs can be managed effectively through post-trade transparency requirements. In the U.S., for example, Rule 605 mandates that broker-dealers submit detailed trade execution reports, ensuring that internalised trades are subject to oversight without the need for intrusive pre-trade monitoring ([SEC, 2021](#)).

Brazil could adopt similar measures to maintain regulatory oversight without imposing excessive costs on market participants. Enhanced post-trade

reporting would allow the CVM to track internalised trades, ensuring transparency and market integrity while minimising the burden on both regulators and broker-dealers.

### **1.4.2. Ensuring fair access and competitive markets**

Concerns about market fragmentation and unequal access to liquidity are valid but can be addressed through regulatory safeguards. Markets such as Australia and Canada have implemented minimum price improvement rules, ensuring that internalised trades offer better prices than those available on lit exchanges. These measures protect retail investors while allowing broker-dealers to compete effectively in the internalised market.

Brazil could implement similar rules, ensuring that internalisation enhances market efficiency without disadvantaging smaller investors. By requiring price improvements and maintaining a level playing field between lit (i.e., public exchanges with pre-trade transparency) and dark venues (i.e., private exchanges, no pre-trade transparency) the CVM can foster a competitive market structure that benefits all participants.

## **1.5. Regulatory considerations for internalisation in Brazil**

### **1.5.1. Structured introduction of internalisation**

While trade internalisation presents significant benefits, its introduction in Brazil should be carefully structured. Based on international experience, a measured approach that prioritises liquidity improvements in specific asset classes, such as equities and index futures is a proven initial strategy. By



focusing on these segments, regulators can monitor the impact of internalisation and adjust as necessary before expanding to other asset classes.

While this report does not advocate for an overly cautious or prolonged phased implementation, ensuring that initial steps are well monitored will allow Brazil to adopt internalisation in a controlled, beneficial manner.

### **1.5.2. Guardrails to ensure market integrity**

To address regulatory concerns, several guardrails that can be implemented alongside the introduction of trade internalisation:

- **Enhanced post-trade transparency:** Internalised orders can be reported post-trade, increasing transparency and allowing the regulator to maintain market oversight.
- **Price improvement requirements:** Internalised trades can offer price improvements or match trades in lit markets, benefiting retail investors and sustaining market competition.
- **Periodic market reviews:** Regular reviews of the impact of internalisation on liquidity, volatility, and price discovery should be conducted to allow for regulatory adjustments as necessary.

## 1.6. Conclusion

The findings from markets studied suggest that trade internalisation could offer substantial benefits to the Brazilian market, improving liquidity, reducing volatility, and enhancing price discovery. While regulatory concerns around transparency and oversight are legitimate, these risks can be mitigated through enhanced post-trade transparency and other safeguards. By allowing internalisation in a structured manner, Brazil stands to enhance its market competitiveness and provide welfare benefits to both retail and institutional investors.

## 2. Introduction

*“Adding a dark pool alongside an exchange concentrates price-relevant information into the exchange and improves price discovery” ([Federal Reserve Bank of New York and Massachusetts Institute of Technology Sloan, 2012, p.1](#)).*

*“The use of trading venues with lower pre-trade transparency [e.g., dark trading] is associated with lower execution costs ([Financial Conduct Authority, 2021a, p. 4](#)).*

*“Liquidity on lit markets [public exchanges] and market efficiency increase together with dark trading, particularly for small and mid-market capitalisation stocks” ([Monetary Authority of Singapore \(MAS\), 2019, p.2](#)).*

*“The introduction of dark pools and growth in internalisation has eroded exchange monopolies and improved market quality” ([CFA Institute, 2012, p.59](#)).*

The preceding quotes illustrate that key regulators and authorities recognise the benefits of trade internalisation, often referred to as dark trading. Although some stakeholders associate anonymity with negative implications, the advantages, particularly regarding liquidity, are notable. These insights highlight how trade internalisation can improve market conditions, especially for less liquid securities, small- to medium-capitalisation stocks, and emerging market exchanges, by enhancing liquidity and facilitating price discovery.

Against this backdrop, Brazil’s securities regulator, CVM – Comissão de Valores Mobiliários, is actively pursuing strategies to enhance competition within its

capital markets. A key area of focus in this initiative is the exploration trade internalisation. To guide this effort, the CVM has published a detailed report titled “Internalisation of Orders – Study based on the Regulatory Impact Analysis (RIA) methodology” ([CVM, 2024](#)) which examines the effects of such systems on capital markets in jurisdictions including the United States, the European Union, and Australia.

To contribute to this discourse, two prominent Brazilian financial institutions, BTG Pactual and XP Inc., have undertaken a comprehensive study to evaluate the implications of trade internalisation in the Brazilian market. Acknowledging the need for additional specialised expertise, these institutions have partnered with Accenture to assist in refining the research methodology, conducting data analysis, and testing hypotheses.

The following paper provides not only a comprehensive quantitative and qualitative analysis of some of the regions cited in the [CVM 2024](#) report but also expands on more directly comparable stock markets to that of Brazil, such as the Russell 2000, a small-cap index in the U.S., and emerging markets like the Johannesburg Stock Exchange (JSE) in South Africa. It delves into the details, particularly from the perspective of welfare benefits and costs. It also evaluates the impact of proxies of trade internalisation on market liquidity, market volatility—especially during times of crises—and the quality of price formation. Additionally, it offers an overview of well-established regulatory frameworks from the U.S. and other countries, highlighting the lessons learned and guardrails that can be adapted to Brazil. It also recognises that the origins of dark trading and other forms of internalisation have evolved over the past

45 years, led by the U.S., followed by Canada and Australia, and now widely adopted internationally.

Qualitatively, the study incorporates insights gained from the systematic literature review of 11,200 publications analysed using Artificial Intelligence (AI) tools and filtered down to 50 reports. Upon further examination, 22 key reports were identified, with 6 of these selected for quantitative analysis, using established statistical methods to evaluate trends and relationships within the data. A majority of the literature highlights the role of trade internalisation and dark trading in modern developed markets and acts as a counterbalance to critiques that are usually rooted in analysis dating over decades.

To underscore the significance of trade internalisation in capital markets, this paper conducts several statistical analyses. Liquidity impacts were verified through panel regression using fixed effects for both individual stocks and time, which controls for variables that remain constant throughout the period. The fixed effects model is widely regarded as a reliable method to estimate causal effects across disciplines ([Millimet and Bellemare, 2023](#)). For volatility, a Granger causality test ([Granger & Newbold, 1974](#)) was employed to determine causal relationships. To understand the impact on information efficiency, panel regression with fixed stock effects was used, following methodologies from highly cited literature. Furthermore, robustness was assessed by subjecting the data to widely accepted transformations and eliminating outliers using established methods.

## 2.1. Evolving financial markets: Trade internalisation

The landscape of financial markets has evolved significantly over the past few decades, driven by technological advancements, regulatory changes, and the increasing complexity of trading strategies. Among the most notable developments is the proliferation of trade internalisation (i.e., dark trading), which encompasses the rise of other specialised trading venues, e.g., alternative trading systems including systematic internalisers and dark pools. These systems have gained popularity by offering unique trading environments that cater to the specific needs and preferences of market participants.

### 2.1.1. Origins of trade internalisation led by the U.S.

Trade internalisation or dark trading coexist with traditional exchanges and their origins can be traced back over the past 45 years, with significant developments led by the United States. The implementation of U.S. Securities and Exchange Commission (SEC) Rule 19c-3 in the Securities Acts Amendments of 1975 and the Off-exchange Rules allowed off-exchange trading of certain stocks, paving the way for trade internalisation ([U.S. SEC, 2021](#)). This was part of a broader movement to increase competition and efficiency in capital markets and create a National Market System ([Macey and O'Hara, 1999](#)). The rise of high-frequency trading (HFT) in the early 2000s has led large institutional investors to gravitate toward dark pools as an avenue to execute large trades, aiming to minimise market impact and avoid unfavourable price movements ([Bayona, 2020](#)). The National Market System

(NMS) Regulation 611, introduced in 2005, included the 'Order Protection Rule,' which mandated that trading centres route orders to the venue displaying the best price or match them internally ([SEC, 2005](#)). While this regulation aimed to enhance price transparency and combat market fragmentation, it inadvertently contributed to the proliferation of Alternative Trading Systems (ATS) and dark pools. As institutional investors sought to execute large trades without revealing their strategies to the broader market, dark pools became an appealing option, leading to increased trading activity in these less transparent venues ([CFA Institute, 2012](#)). By 2010, high-frequency trading (HFT) accounted for 56% of all trades in the U.S., a significant rise from less than 10% in the early 2000s ([Capgemini, 2017](#); [Barra, Grist and Berg, 2024](#)). While Europe experienced slower growth in HFT, by 2010, it made up 38% of trading volumes. In the Asia-Pacific region, HFT comprised 45% of equity trades in Tokyo and 26% on the Singapore Exchange ([CapGemini, 2017](#)). Concerns about high-frequency trading (HFT) have grown, especially considering events such as the "flash crash" in May 2010, when the Dow Jones dropped 9%, highlighting some risks associated with algorithmic trading ([The Conversation, 2013](#)). Additionally, the emergence of dark pools—venues where trades are not publicly disclosed—has introduced additional dynamics by allowing significant transactions to take place discreetly. These dark pools may provide opportunities for algorithmic traders to capitalise on price discrepancies, further complicating the landscape of HFT ([The Conversation, 2013](#)). The U.S. SEC responded to this growth with proposals for more safeguards on off-exchange trades, including enhanced disclosure on best execution transparency through Rule 605 and drafting new rules such as

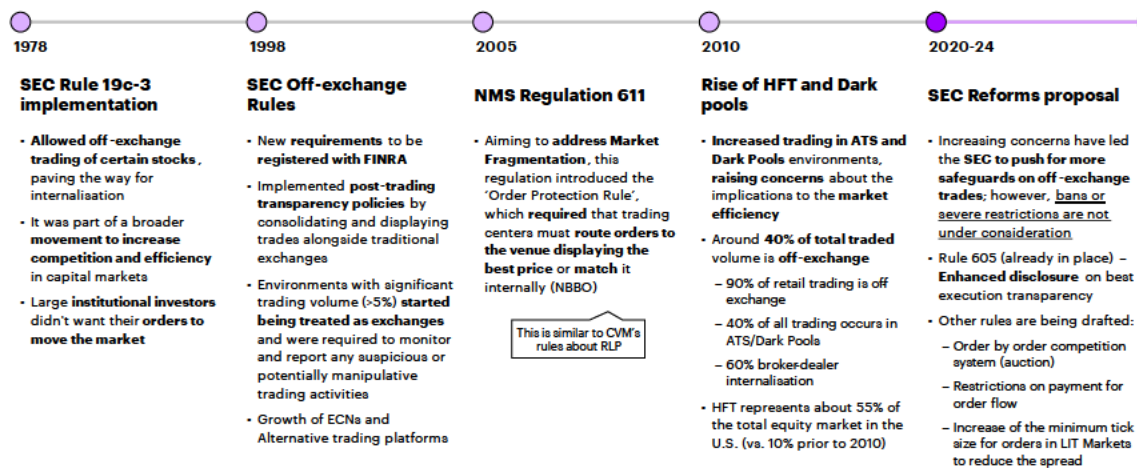


order-by-order competition systems and restrictions on payment for order flow ([SEC, 2021](#)).

**Figure 1: Summary of the origins of trade internalisation in the U.S. market**

Origins and current state of Trade Internalisation in the US

**Trade internalisation emerged from gradual developments in the America market, now a major focus for regulatory oversight due to its importance**



Source: Accenture desk research, expert interviews.  
Notes: ECN = Electronic Communication Network

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Source: Accenture Strategy and expert interviews.

## 2.1.2. Regulation of trade internalisation or dark trading in international markets

In Canada, dark trading emerged in the early 2000s, driven by institutional demand for anonymous trading venues. Regulatory intervention began in 2012 to balance dark trading with transparency ([CSA, 2012](#)). The Order Exposure Rule, introduced by IIROC in 2012, required smaller orders to be exposed to public markets before being executed in dark pools ([IIROC, 2012](#)). In Australia, dark pools gained traction in the early 2000s with the rise of ATS platforms. Regulatory action to control dark pool trading began in 2013, particularly through the introduction of price improvement rules ([ASIC, 2013](#)). Both countries developed dark pools primarily to help institutional investors

minimise market impact but have since regulated them to maintain market fairness and transparency ([ASIC, 2013](#)).

In August 2019, Brazil's financial market saw a significant change with the introduction of the Retail Liquidity Provider (RLP) system by B3, in collaboration with the Comissão de Valores Mobiliários (CVM), the country's financial market regulator ([De Genaro and Pedro, 2021](#)). The RLP was designed to enhance liquidity and efficiency in the trading of minicontracts for indices and currencies such as the dollar, allowing financial institutions to act as counterparties to retail investors ([B3, no date](#)). This system aimed to provide better pricing and greater liquidity, while adhering to global best practices from markets like the New York Stock Exchange.

The implementation of the RLP followed a collaborative discussion between B3, the CVM, the self-regulatory body (BSM), and various brokers. All trades conducted under the RLP system are subject to strict transparency regulations overseen by the CVM, ensuring that post-trade pricing remains visible to the broader market, unlike the opacity seen in dark pools where pre-trade data is hidden.

By 2021, the RLP system had been fully operational across different asset classes, with broader implementation by 2022, including equities. This framework ensures retail investors can access competitive pricing, with RLP counterparties providing prices equal to or better than those available in the public order book. The empirical evidence demonstrates that the adoption of the Retail Liquidity Provider (RLP) model has significantly improved market quality, notably in terms of enhanced liquidity, reduced volatility, and greater

pricing efficiency in dollar and index mini-contracts ([De Genaro and Pedro, 2021](#)). Furthermore, existing literature (see Chapter 2) suggests that these benefits may extend to broader trade internalisation practices across other markets. This proposition is further explored quantitatively through theoretical frameworks and hypotheses, as discussed in Chapters 3, 4 and 5, which indicate the potential for deeper, systemic benefits in market structure.

**Figure 2: Summary of the origins of trade internalisation in other markets**



Source: Accenture Strategy and expert interviews.

### 2.1.3. Recent regulatory changes in the U.S.

From 2020 to 2024, the regulatory landscape in the U.S. has continued to evolve, with ongoing efforts to address the implications of dark pools and internalisation on market efficiency and transparency. The SEC has proposed further reforms to enhance market integrity and protect investors ([SEC, 2021](#)). One of the changes proposed by the SEC is the creation of a new best execution framework, complementing existing regulations run by the Financial

Industry Regulatory Authority (FINRA). Under the reforms, broker-dealers would be required to establish and enforce written policies to comply with the new standard. This initiative aims to address the increasing use of less transparent off-exchange dark venues, making best execution crucial for investor protection. Another reform is to improve retail order execution. Currently, around 90% of retail trades are routed to wholesalers, which typically execute these orders internally ([SEC 2024](#)). The proposed rules would require wholesalers to include some retail orders in a 'qualified auction' run by an 'open competition trading center' before internal matching ([SEC 2024](#), p. 56). The SEC is proposing amendments to Regulation NMS, the last major overhaul of US trading rules implemented in 2005. The changes include adopting variable tick sizes for greater pricing flexibility, lowering fees for accessing protected quotes, and boosting transparency around best-priced orders. These updates aim to address the growing use of dark trading (**Figure 3**), which operate under different rules. Whilst regulation on dark trading has evolved, international rules have balanced the benefits of dark trading while providing certain guardrails. This has coincided with progressive growth in dark trading. Since 2007, volume traded in dark venues has grown rapidly from 30% to 61% in 2024 for Russell 2000 (**Figure 3**) in the US whereas it has reached 24% in 2024 from 10% in 2019 for Johannesburg Stock Exchange (JSE). In emerging markets such as South Africa, trade internalisation is still at an initial stage and accounting for less share volume than in developed markets with good growth opportunities. The Johannesburg Stock Exchange (JSE)

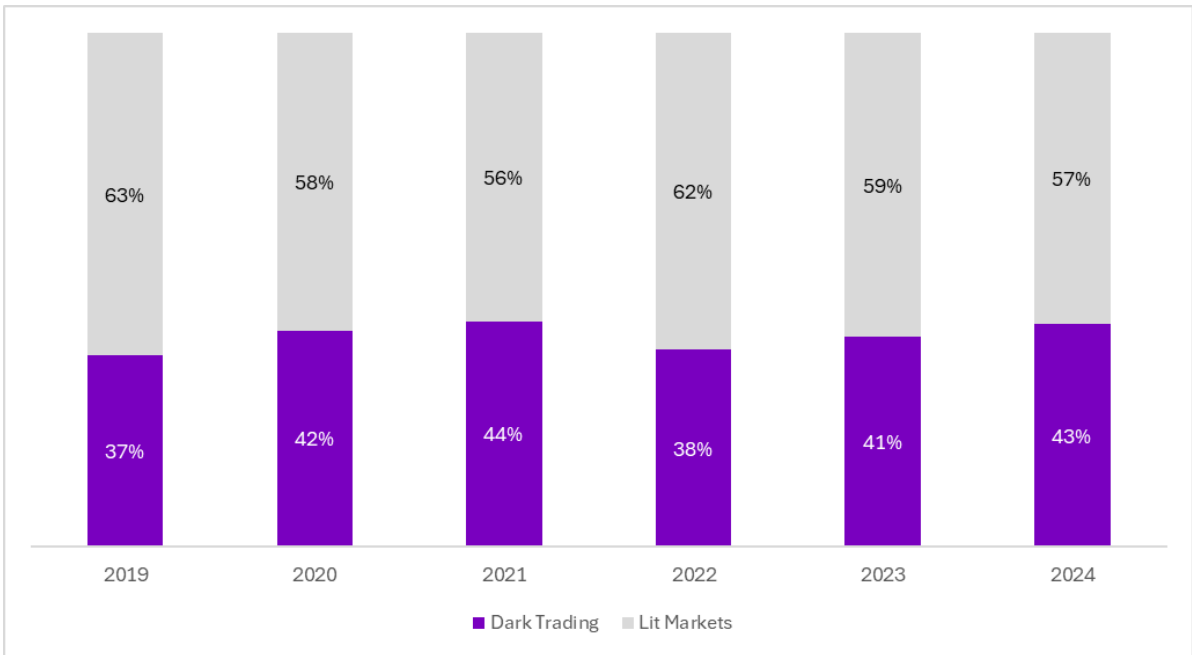
experienced solid growth in dark trading share volume of total trade, increasing from 10% in 2019 to 22% in 2024 (**Figure 5**).

In March 2024, the SEC also adopted rule amendments to update disclosure requirements under Rule 605 of Regulation NMS for order executions in national market system stocks (NMS stocks). The amendments aim to improve transparency and enhance competition in equity markets, particularly addressing the growing use of dark venues. Key changes include expanding the scope of entities subject to Rule 605, modifying the categorisation and content of order information, and requiring monthly summary reports on execution quality. The updates will capture more relevant execution quality information for various order types and modify time-to-execution categories ([SEC, 2024](#)). However, as observed in Europe, some dark pools aim to structure fees to encourage liquidity provision and compete by offering the lowest costs and best quality of service for clients ([Petrescu and Wedow, 2017](#)). This highlights the need to strike a balance between retaining the benefits of dark trading and ensuring market transparency. The lessons from these implemented rules and regulations, along with the vast history of their impact and evolution of trade internalisation globally, put us in a unique position to leverage the insights gained. Through this work we address and clarify misconceptions about the real impact of trade internalisation on a country's stock market.

### 2.1.4. Growth of trade internalisation across major countries

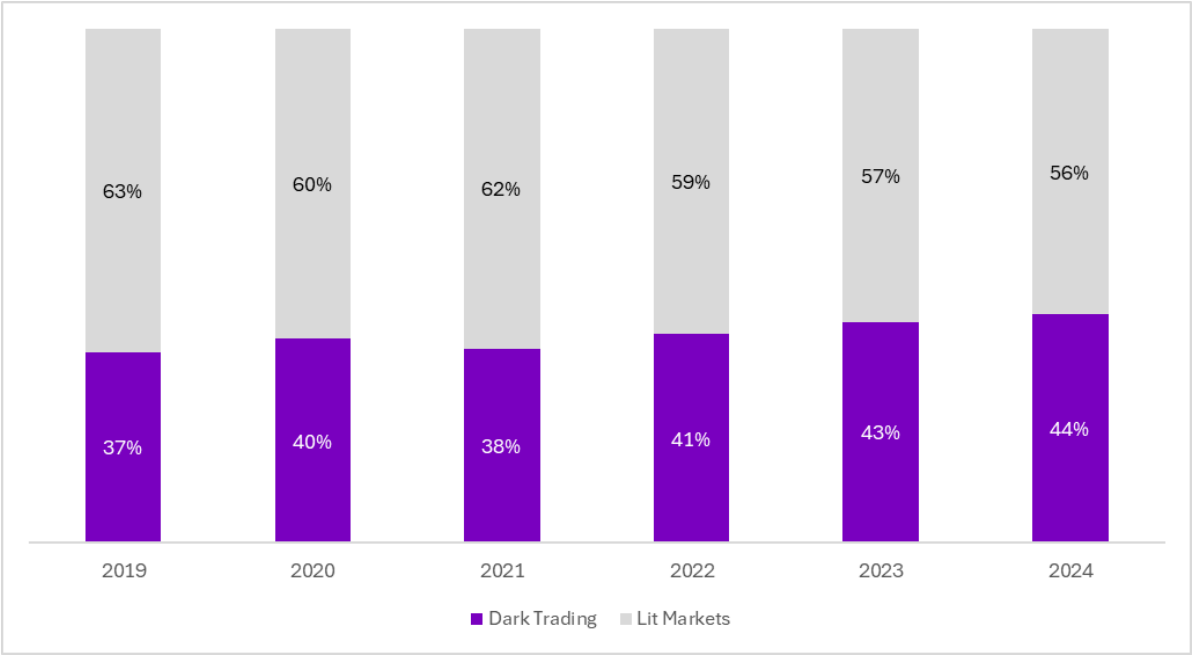
In the U.S. equity market, trade internalisation continues to gain strength, accounting for approximately 43% for Russell 2000 (**Figure 3**) and 44% for S&P 500 (**Figure 4**) constituents (2024) of total share volume. As a proxy for analysing small-cap stocks, we selected the Russell 2000 index, which saw an increase in dark trading proportion from 37% to 43% over the last five years (**Figure 3**). For large-cap stocks, we selected the S&P 500 index, which experienced similar growth during the same period, rising from 37% to 44% in dark trading. Both indexes serve as strong representations of the U.S. market as a whole. The [SEC \(2024\)](#) in one of its reports stated the total volume share of dark trading for the whole market to be ~44% in Q1 2023.

**Figure 3: Dark trade proportion (dark trade volume/total volume) – Russell 2000**



Source: Bloomberg and Accenture Strategy analysis  
Note: 2024 data is till August 08, 2024, and the percentages are calculated after removing ADRs

**Figure 4: Dark trade proportion (dark trade volume/total volume) – S&P 500**



Source: Bloomberg and Accenture Strategy analysis  
Note: 2024 data is till August 13, 2024, and the percentages are calculated after removing ADRs

A further examination of US equity market suggests, in Q1 2023, National securities exchanges handled around 56% of the total share volume (59% of total notional volume), while off-exchange market centres accounted for approximately 44% of the share volume and 41% of the notional volume.

Table 1) ([SEC 2024](#), p. 371). A significant portion of off-exchange activity was conducted by wholesalers, who were responsible for executing 26.9% of the total share volume and about 61% of off-exchange trades. Some market makers, including wholesalers, operate Single-Dealer Platforms (SDPs) which they use to execute institutional orders in NMS stocks from their own inventory. SDPs contributed to around 4% of total trading volume in Q1 2023.



**Table 1: Percentage of the volume of shares traded by market centre type in Q1 2023**

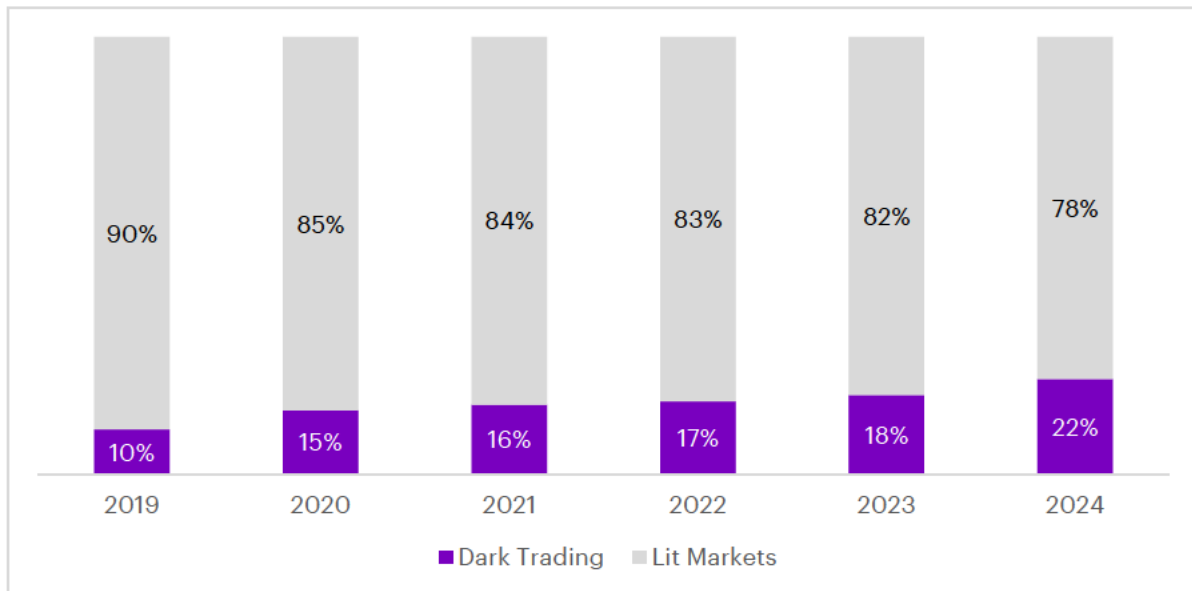
Market centre type			Venue count share	Volume (% of total volume)	Off-exchange share volume	Share in total trading
Public/Lit Trading	National Securities Exchanges		16	55.9%	-	55.9%
Dark Trading	NMS Stock ATs	33	10.7%	24.2%	44.1%	
	Wholesalers	6	26.9%	60.9%		
	Other FINRA Members	22	6.6%	15.0%		

Source: [SEC, 2024](#), p. 372 and Accenture Strategy analysis

Note: Off-Exchange share volume is % of total off-exchange

In emerging markets such as South Africa, trade internalisation is still at an initial stage and accounting for less share volume than in developed markets with good growth opportunities. The Johannesburg Stock Exchange (JSE) experienced solid growth in dark trading share volume of total trade, increasing from 10% in 2019 to 22% in 2024.

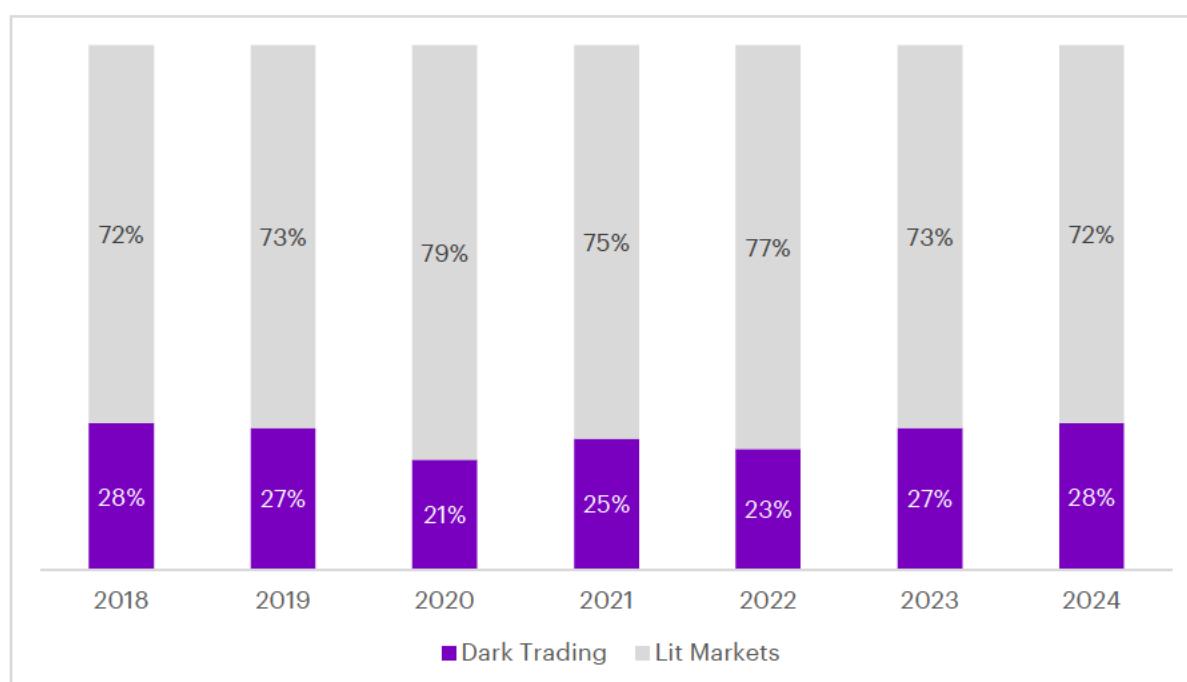
**Figure 5: Dark trade proportion (dark trade volume/total volume) - JSE (Johannesburg Stock Exchange)**



Source: Bloomberg and Accenture Strategy analysis  
Note: 2024 data is till August 13, 2024

Dark trading in the Australia equity market accounted 20% of total trading turnover in 2010 ([ASIC, 2013](#), p.28). The report further commented that in 2012, the volume of dark trading remained around 25–30% of the total equity market share in the years leading up to 2012 ([ASIC, 2013](#), pp.6, 26). The current (2024) proportion of 28% (**Figure 6**) indicates the evolution of rules and regulation to maintain balance and have maximum benefits of dark trading by the Australian regulators.

**Figure 6: Dark trade proportion (dark trade value/total value) – Australia**



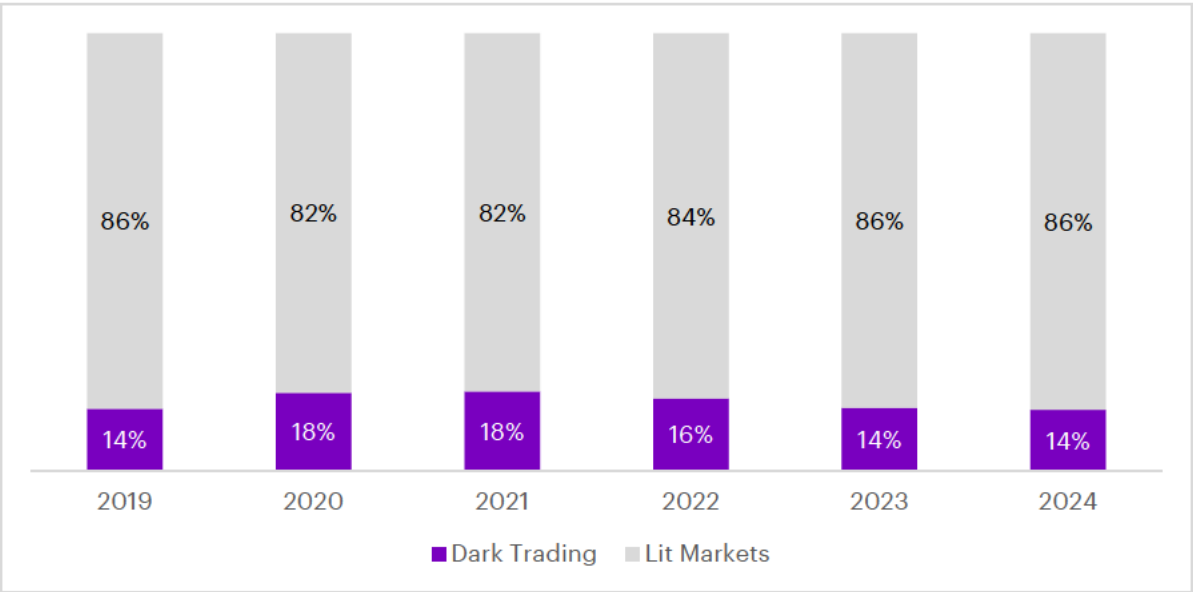
Source: [ASIC 2024](#) and [Accenture Strategy analysis](#)

Note: Numbers were estimated from a Figure chart and for 2024, number reported is till June 24

In the UK, for the FTSE 100 share of value traded in equities occurring on dark pools was 12% back in 2016 ([Petrescu and Wedow, 2017, p.27](#)), and broader dark trading a similar 14% in 2024 (**Figure 7**). The relatively stable levels of dark trading in recent years can be attributed to evolving regulations such as the European Union's MiFID II directive, which introduced the "Double Volume Cap" (DVC) mechanism ([Financial conduct authority, 2021a](#)). The DVC limited the volume of dark trading in certain venues when thresholds were exceeded. These rules encouraged transparency, leading to a cap on dark pool activities in favour of more transparent exchanges. However, the U.K. FCA ([Financial conduct authority, 2021b](#)) removed the volume caps to UK equities and then to all equities traded in the UK in 2021. The steady rates in recent years indicate

that dark trading has reached a balance between regulatory controls and market demand for liquidity.

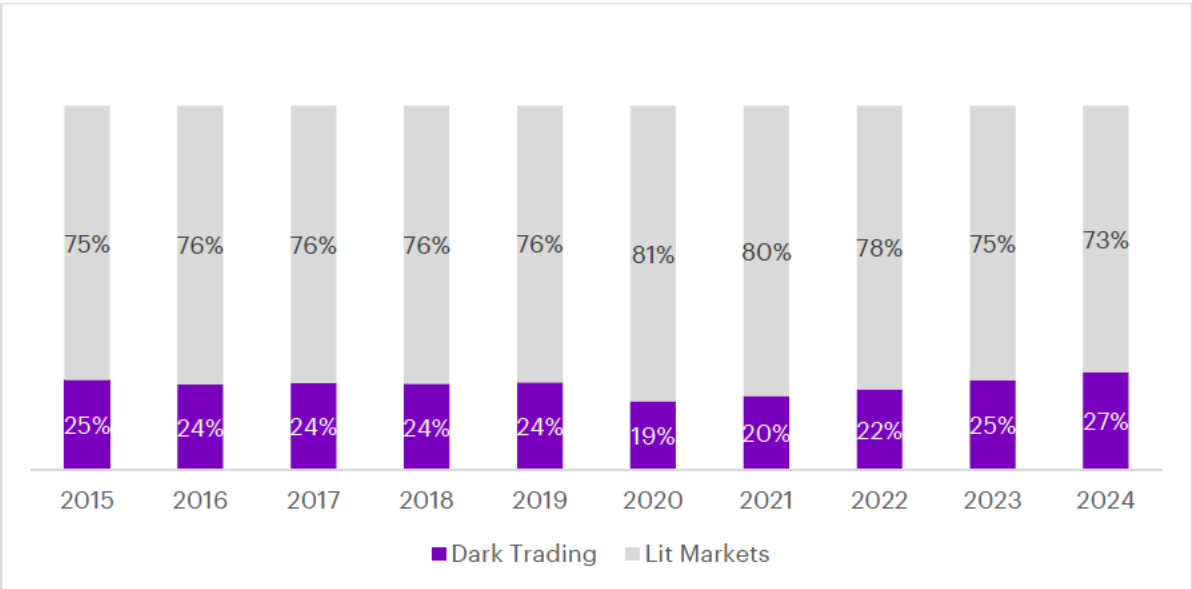
**Figure 7: Dark trade proportion (dark trade volume/total volume) - FTSE 100**



Source: Bloomberg and Accenture Strategy analysis  
Note: 2024 data is till August 13, 2024

In Canada, which has been a pioneer in trade internalisation, approximately 25% of total traded volume was attributed to trade internalisation as in 2015 ([Canadian Investment Regulatory Organization, 2024](#)) when considered the volume of intentional cross trades and the whole traded volume from alternative trading systems and dark pools. As of October 2024, trade internalisation has stabilised, holding a market share of around 27%. This stability reflects the ongoing adaptation of market participants to the regulatory framework while maintaining efficient trading practices in the equity market.

**Figure 8: Dark trade proportion (dark trade volume/total volume) – Canada equities**

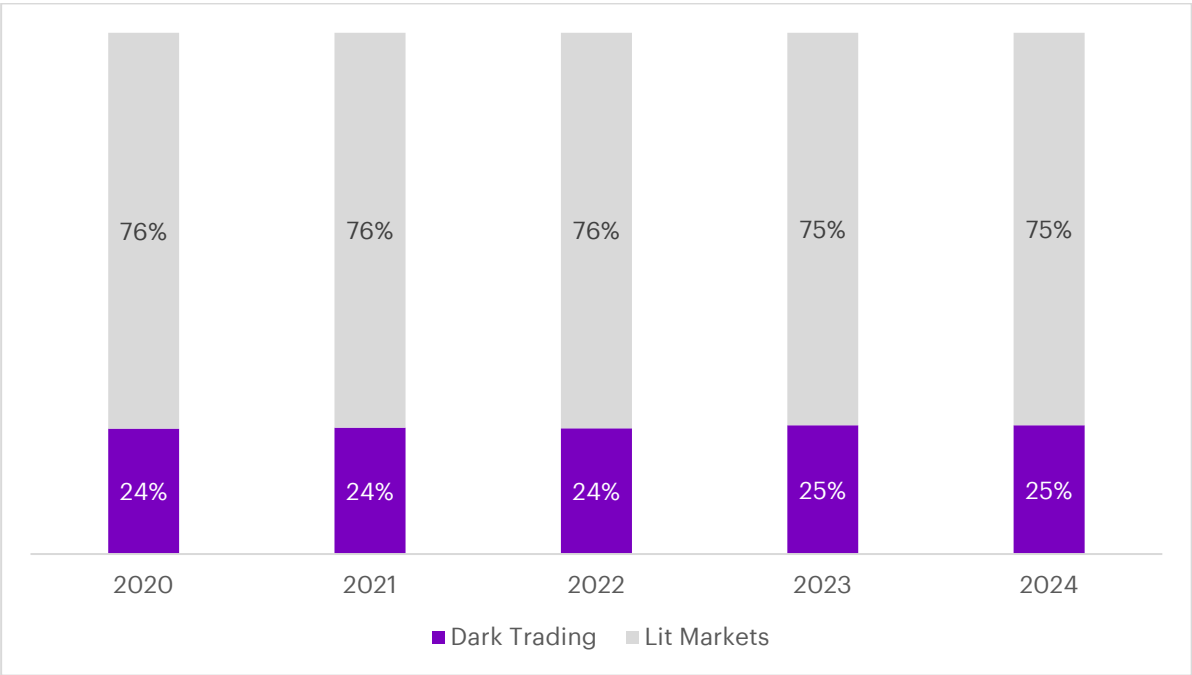


Source: [Ciro Reports of Market Share by Marketplace](#) and Accenture Strategy analysis  
Note: 2024 data is till September 31, 2024

In Brazil, the Retail Liquidity Provider (RLP) program, started in 2020 and is used as a proxy for trade internalisation in the report. Since there are multiple contracts, we focused the analysis on the most liquid Index (WIN) and Dollar (WDO) mini contracts available for each trading date. To find the proportion of trades via RLP for each contract, we aggregated the volume traded daily and measured the total volume of the trades that were part of the RLP mechanism versus the total market, resulting in a proportion between 24% and 25%. For the purposes of the proportion analysis, the volume considered as “RLP” was the full trade executed (orders from both sides), instead of considering just the order from the buyer or the seller (one side). It is important to note that, since RLP was in a trial phase during the period analysed, some restrictions were imposed on the maximum percentage of retail volume allowed, ranging from

23% to 36% for the WIN contract and 35% to 67% for the WDO contract, depending on the month analysed.

**Figure 9: Dark trade proportion (dark trade volume/total volume) - Brazil (RLP for future contracts)**



Source: BTG Pactual – Market Data Services and Accenture Strategy analysis  
Note: Dark trading is proxied by mini contracts (futures) in RLP, and 2024 data is till August 2, 2024

## 2.2. Definitions

Trade internalisation refers to the activity of an intermediary matching buy and sell orders in an off-exchange environment, with the intermediary potentially acting as a counterparty to provide liquidity and ensure best execution. This concept is interchangeable with dark trading, and the execution of such trades away from public exchanges plays a significant role in financial markets. Trade

internalisation (or dark trading) encompasses various trading systems, including alternative trading systems (ATS) such as dark pools and systematic internalisers. It is important to clarify these concepts. A summary of the relevant terminologies is presented in **Figure 10**.

**Figure 10: Understanding trade internalisation and its categories across jurisdictions**

The most accepted definitions regarding internalised trading		
Off-exchange mechanisms per country		internalisation / Off-exchange / Dark trading definitions:
USA	Alternative Trading Systems	All current ATSs are "dark pools"; dark pools are trading systems that allow users to place orders without displaying the size and price of their orders to other participants in the dark pool, publicly (Data reported to FINRA and Exchange and available as consolidated SIP)
	Internalisers – Single Dealer Platforms	"Electronic trading platform operated by a broker-dealer where the firm itself acts as the principal counterparty for every transaction" – FINRA
	Wholesalers	"A broker-dealer that acts as a market maker, a firm that actively quotes two-sided markets in a particular security (...) A wholesaler's business is to execute those orders, which may involve <u>executing the orders itself</u> or further routing to other venues." – FINRA
	Cross Trades	Cross trade occurs when a broker-dealer matches trade orders between two or more of its clients' accounts
Brazil	Retail Liquidity Provider	"RLP allows broker-dealers (...) to be counterparty to their retail clients' buy and sell orders for securities, creating greater liquidity for clients to trade in the markets operated by B3" – B3
	Direct / Cross Orders*	"A cross order is a bid and an ask for a given asset or derivative registered simultaneously at the same price by the same full trading participant or trading participant in the trading environment, representing both the buyer and seller" – B3
Singapore	Dark Trades	"Trades executed off-exchange without pre-trade transparency of the price and quantity of the orders placed" – MAS
EU	Dark Trades	"Dark trading is defined as trading under pre-trade waivers, meaning when the pre-trade transparency requirements are waived by national competent authorities" - ESMA
	Systematic Internalisers	Investment firms dealing on own account when executing OTC orders on an organized, frequent, systematic & substantial basis
South Africa	Hidden Orders	Trade without displaying either price or volume to other participants. Trades need to be reported to JSE post-execution

Source: Accenture Strategy analysis

### 2.2.1. Trade internalisation and Lit markets

Traditional stock exchanges, often referred to as *lit markets* or *lit venues*, are public trading platforms where the order book is fully visible to all market participants. In these markets, buy and sell orders are displayed openly, offering transparency regarding the current supply and demand for securities ([FINRA, 2023](#)). Prominent examples include the New York Stock Exchange (NYSE), the London Stock Exchange (LSE), and B3 S.A. – Brasil, Bolsa, Balcão. These centralised exchanges provide a high degree of transparency, liquidity,



and regulatory oversight, operating under well-defined rules and regulations that ensure fairness and market integrity. In contrast, trade internalisation through various alternative channels provides distinct mechanisms for executing trades, catering to specific trading needs and aiming to enhance overall market efficiency, while complementing lit markets by offering additional options not available in these venues.

**Figure 11: Most common trading venues in American Market**

In addition to the lit market, the American stock market includes a variety of off-exchange trading venues

Off-exchange trading venues	Definition	Transparency	Liquidity	Access	Impact on Price	Examples
Stock Exchanges	Centralized venues where stocks are listed and traded.	<b>High</b> (with public reporting of prices and volumes)	<b>High</b> (many participants)	<b>Open</b> (many participants)	<b>High</b> (central role in price discovery due to high volume and participant diversity)	  
Alternate Trading Systems (ATS)	Private venues that match buyers and sellers, often off-exchange.	<b>Varies</b> (some provide pre- and post-trade transparency, but less than exchanges)	<b>Varies</b> (generally less than exchanges)	<b>Limited</b> (usually accessed by institutional investors and broker-dealers)	<b>Medium</b> (contributes to price discovery, but less central than exchanges)	   
Single-Dealer Platforms (SDPs)	Platforms operated by a single dealer for trading selected securities.	<b>Limited</b> (trade details are often not disclosed publicly)	<b>n/a</b> (liquidity provided by the single dealer operating the platform.)	<b>Limited</b> (usually limited to clients of the dealer platform)	<b>Limited</b> (single dealer control impacts price discovery)	 
Wholesalers	Firms that execute retail orders from broker-dealers.	<b>Limited</b> (trade details are often not disclosed publicly)	<b>High</b> (wholesalers aggregate and execute a large volume of orders)	<b>Limited</b> (retail broker-dealers send to wholesalers)	<b>Limited</b> (Minimal impact on price discovery; more focused on order execution)	 

Source: SEC.gov, FINRA, Accenture Strategy analysis

Each of these trading systems (**Figure 11**) serves different purposes and caters to various market participants. They coexist with traditional exchanges, providing market participants with multiple options to execute trades based on their specific needs and strategies. The interaction between these systems contributes to the overall market structure, price discovery, and liquidity. However, they also pose unique challenges and have been subject to regulatory scrutiny to ensure fair and transparent markets.

While we have previously defined trade internalisation (see above), it can also be broadly characterised as the process whereby a broker executes a buy or sell order using the firm's own inventory instead of routing it to a market or market-makers for execution ([U.S. SEC, 2000](#)). This process is closely related to dark trading, which can be understood as the execution of trades in private, off-exchange venues without pre-trade transparency regarding the price and quantity of orders placed ([Monetary Authority of Singapore \(MAS\), 2019](#)). Additionally, dark trading is characterised by transactions conducted at a reference price through negotiated deals, often leveraging large-in-scale pre-trade transparency exemptions ([Guagliano et al., ESMA 2020](#)). Alternatively, the U.S. [FINRA \(2024\)](#) classifies trading internalisation or dark trading, as over-the-counter (OTC) that takes place on off-exchange execution venues, including alternative trading systems (ATSs) and broker-dealers acting as wholesalers. There are also several distinct subdivisions of *trade internalisation*.

### **2.2.2. Alternative Trading Systems**

Alternative Trading Systems (ATS) are trading venues that operates similarly to a stock exchange but does not function as a self-regulatory organization. ([FINRA, 2023](#)). Further [FINRA \(2023\)](#) describes it as an electronic platform that, like a stock exchange, connects buyers and sellers, but unlike exchanges, have subscribers instead of members and don't perform regulatory duties. They can facilitate trading of both listed stocks and over-the-counter (OTC) securities, including bonds. In the U.S. ATS are regulated and these platforms must be run by a FINRA member broker-dealer, comply with securities laws, and adhere

to additional rules like protecting confidential trading information and ensuring fair access for high-volume trading ([FINRA, 2023](#)).

### **2.2.3. Dark pools**

Dark pools are a type of ATS that are non-displayed trading systems that facilitate trade execution without publicly displaying orders, matching them within the bid-ask spread without guaranteeing execution ([Zhu, 2013](#)).

Designed for anonymous, large trades by institutional investors, dark pools offer anonymity and intended to minimise information leakage allowing substantial trades to be executed without impacting market prices ([Johnson, 2017](#)). Although dark pools do not display quotes, they are required to report trade information. All listed stock trades executed on Alternative Trading Systems (ATS), including dark pools, in the U.S. are reported to FINRA's Trade Reporting Facility (TRF) and appear on the consolidated tape. Trades of unlisted securities must also be reported to FINRA, with stocks directed to the OTC Reporting Facility (ORF) and fixed-income securities to the Trade Reporting and Compliance Engine (TRACE) ([FINRA, 2023](#)).

### **2.2.4. Systematic Internalisers**

Systematic Internalisers (SIs) are classified as a type of Alternative Trading System (ATS) that execute client orders internally rather than routing them to public exchanges. Under the EU Markets in Financial Instruments Directive (MiFID) framework, an investment firm that processes client orders on its own account outside designated trading venues is identified as a Systematic Internaliser ([European Securities and Markets Authority \(ESMA\), 2017](#)).

Typically, Systematic Internalisers match orders based on their own inventory and provide various execution options. They operate under specific regulations designed to ensure transparency and fair execution, particularly for retail and institutional clients ([European Commission, 2021](#)).

### **2.2.5. Electronic Communication Networks (ECNs)**

ECNs are another type of ATS that electronically match buy and sell orders.

Unlike dark pools, ECNs display their order books to participants, providing a higher degree of transparency. ECNs are often used by retail and institutional investors alike and can offer competitive pricing and execution speeds.

In the U.S., ECNs must register with the SEC as broker-dealers and adhere to Regulation ATS, as an ECN is a type of alternative trading system (ATS). They are known as multilateral trading facilities (MTF) in Europe. According to [SIFMA Insights \(2019\)](#), over the years, some ECNs merged with registered securities exchanges or became an exchange themselves, such as BATS and Direct Edge (BATS bought Direct Edge in 2013; now owned by Cboe Global Markets).

### **2.2.6. Crossing Networks**

Crossing networks, a type of ATS, match large buy and sell orders at a reference price, often based on external benchmarks like the National Best Bid and Offer (NBBO). They differ from dark pools, which continuously match orders within the bid-ask spread, crossing networks execute trades at scheduled intervals, offering no pre-trade transparency but ensuring anonymity for participants. While dark pools provide some degree of price discovery, crossing networks rely on external prices, often the NBBO midpoint,

to match trades. Both systems aim to minimise market impact for large institutional orders, yet crossing networks operate more predictably with their scheduled matching sessions.

### **2.2.7. Single order dealer platforms**

Single order dealer platforms (SDPs) are classified as off-ATS execution venues. An SDP is an electronic trading platform managed by a broker-dealer, which acts as the principal counterparty for all transactions ([FINRA, 2023](#)). These platforms allow clients to trade directly with the dealer, often providing customised liquidity and pricing, unlike Alternative Trading Systems (ATSs) where orders are matched between participants ([FINRA, 2023](#)). Single order dealer platforms support various order types, offering flexibility and potentially faster execution by minimising intermediary involvement ([Caplin, 2010](#)). While they facilitate discreet execution of large trades and reduce market impact, these platforms often lack transparency, as their order books remain inaccessible to other participants ([Menkveld, 2013](#)). Primarily serving institutional investors and high-net-worth individuals, SDPs enhance the trading experience through tailored services, despite uncertainties in pricing and execution costs ([Harris, 2003](#)).

### **2.2.8. Wholesalers**

Wholesalers in financial markets are intermediaries that facilitate large-volume trades between institutional investors, such as pension funds, mutual funds, and hedge funds. These trades, often executed outside of traditional exchanges to minimise market impact and ensure better pricing, are

frequently facilitated by broker-dealers ([Petrescu and Wedow, 2017](#)).

Wholesalers perform several key functions in the financial markets. They act as market makers, providing liquidity by standing ready to buy and sell securities at publicly quoted prices, which ensures that institutional investors can execute large trades without significantly affecting market prices ([Grossman and Miller, 1988](#)). Additionally, by aggregating large orders and executing them off-exchange, wholesalers contribute to price discovery, helping to set more accurate prices for securities that reflect the true supply and demand dynamics ([Madhavan, 2000](#)). Furthermore, wholesalers manage the risk associated with large trades by spreading them over time and across different venues, mitigating the market impact and reducing the risk of price slippage ([Harris, 2003](#)). Wholesale market trades can be conducted through various means, including:

- **Block trades:** Large transactions that are privately negotiated and executed, often at a discount or premium to the current market price.
- **Upstairs market:** A market where large blocks of securities are traded privately among institutions, usually facilitated by broker-dealers who act as intermediaries.
- **Dark pools:** As mentioned earlier, dark pools can also facilitate wholesale market trades by providing a non-displayed trading environment where large orders can be matched with minimal market impact.

Wholesale market trades are an essential part of the overall market structure, providing liquidity and allowing institutional investors to efficiently manage

their portfolios. These trades coexist with traditional exchanges, alternative trading systems, and other trading mechanisms to create a diverse and interconnected market ecosystem.

### **2.2.9. Retail investors**

According to [FINRA \(2024b\)](#), retail investors are “referred to as individual investors, [who] use their own money to buy and sell securities and other investment products for themselves.” Typically, they access the markets through brokers, are less informed than institutional investors and have smaller trades, thus making less impact on the markets. Since they rely on less advanced information and research, retail investors usually have more regulatory protections against unfair practices by other market participants like lack of transparency and best execution rules. While institutional investors have access to more complex financial products such as over-the-counter instruments, retail investors concentrate their trading in more standardised products like stocks, mutual funds, ETFs and bonds. Despite all that, retail investors contribute to the financial market by also providing liquidity and depth across different assets, increasing the overall price efficiency.

### **2.2.10. Implications**

The coexistence of various types of trade internalisations such as alternative trading systems, including dark pools, Systematic Internalisers (SIs), as well as Single Dealer Platforms (SDPs) and wholesalers reflect the diversity and complexity of modern financial markets. While these systems differ in terms of transparency, anonymity, regulatory oversight, and execution mechanisms,

they share common goals of enhancing liquidity, reducing transaction costs, and catering to the varied needs of market participants. This diversity has significantly shaped the evolution of today's most advanced markets, fostering innovation and promoting competition. For policymakers, regulators, and market participants, understanding the unique features of each system is essential to navigating the constantly shifting financial landscape.

## **2.3. Structure and organisation of the paper**

This introduction sets the stage for a deeper exploration of the theoretical underpinnings, empirical evidence, and regulatory implications of trade internalisation. More specifically this paper investigates the welfare benefits and costs of trade internalisation. Chapter 2 systematically reviews the literature on trade internalisation and in the context of alternative trading systems and other venues ([O'Hara, 1995](#)). The study raises research questions from the literature, focusing on both international and Brazilian contexts, while identifying research gaps. Chapter 3 presents the research model and mixed-methods approach, combining quantitative data analysis with qualitative semi-structured interviews to address the hypotheses. Chapter 4 explores the findings on welfare benefits and costs of trade internalisation, along with proxies for alternative trading systems. Chapter 5 contrasts the findings with the existing literature and analysis, discussing impacts and lessons. Chapter 6 contextualises research implications, limitations, and it suggests future exploration.

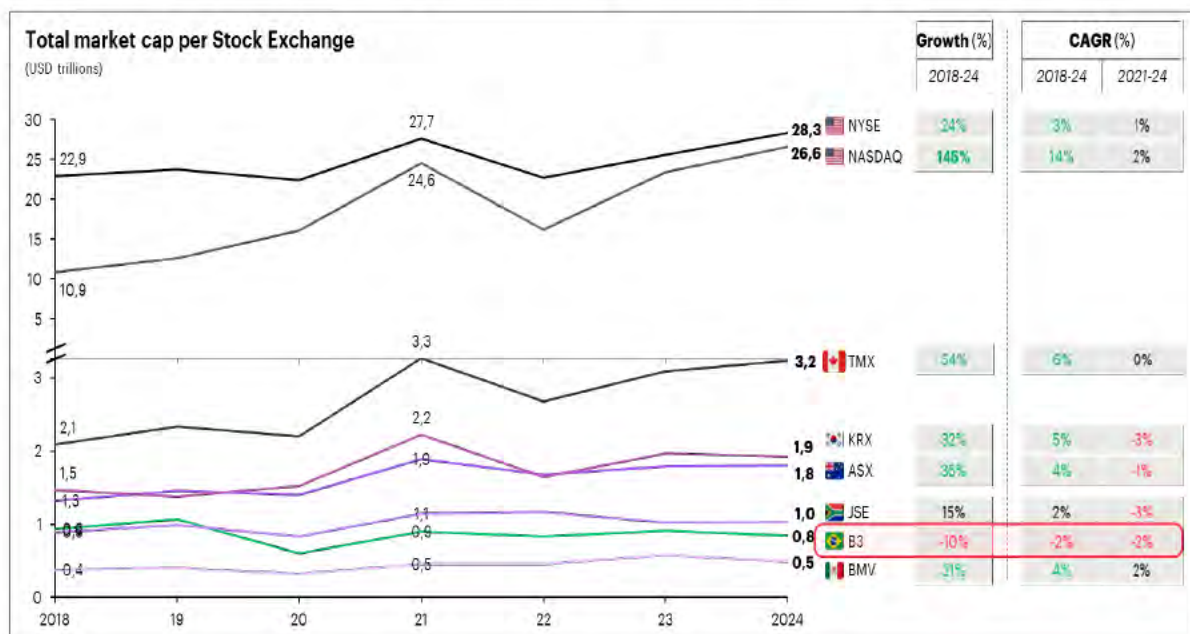


## 2.4. BOX 1: Brazil's stock market assessment

A well-performing financial market is essential for attracting investors and providing companies with alternative ways to finance themselves, particularly through public offerings. When the market underperforms over the long term, investors tend to seek more attractive opportunities in other assets or even foreign markets, reducing liquidity and trading volumes domestically. This scenario also discourages new players from entering the sector, limiting competition—whether from potential exchanges or alternative trading systems (ATS). The reduced competition results in poorer and more expensive services for end consumers, which ultimately hampers the country's financial development and limits the growth potential of its economy.

While developed markets like the U.S., Canada, and South Korea experienced solid growth in total market capitalisation between 2018 and 2024, Brazil saw a decline of 10% over the same period. This represents poor performance, even when compared to other emerging markets such as Mexico and South Africa, which reported growth of 31% and 15%, respectively.

**Figure 12: Total market capitalisation per stock exchange**



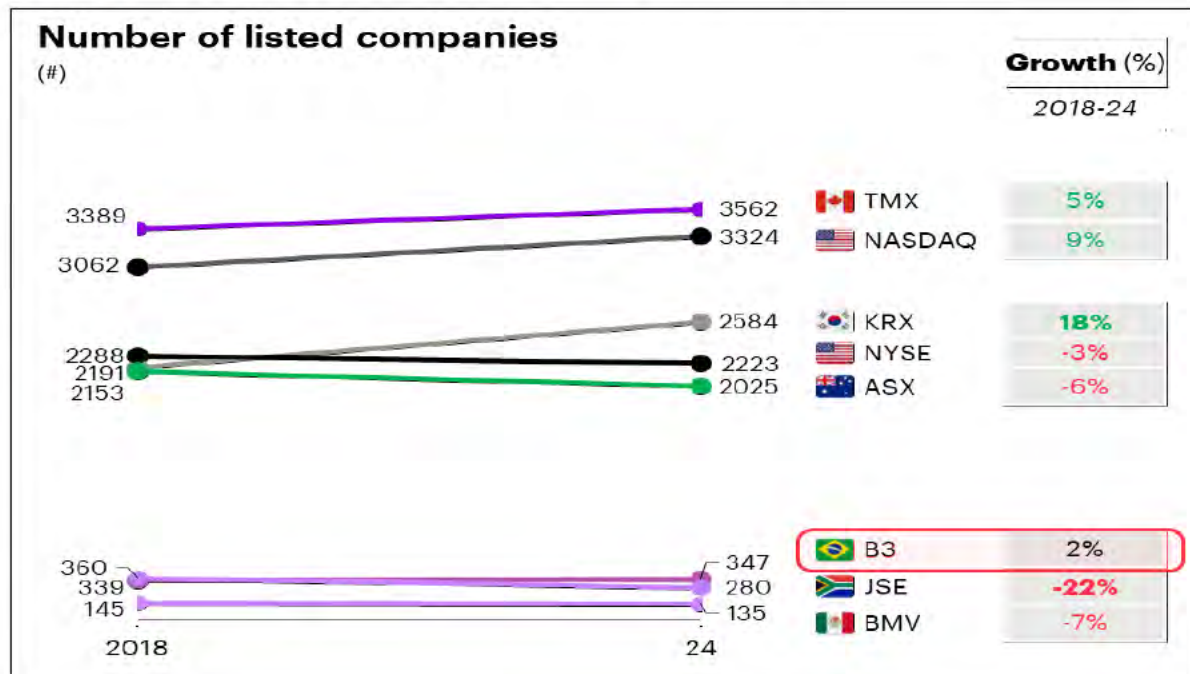
Source: World Federation of Exchanges, Accenture Strategy analysis

This underperformance can be attributed to several factors, both macroeconomic and microeconomic. During our research, we identified a few key contributors:

## 2.4.1. Listed companies in stock exchanges

Although the number of listed companies in Brazil increased slightly by 2%, from 339 in 2018 to 347 in 2024, in the U.S., Canada, and South Korea there were a more substantial growth. Comparing to other emerging markets, Brazil outperformed: Mexico experienced a 7% decrease, and South Africa saw a 22% decline, primarily due to the consolidation of listed companies on the Johannesburg Stock Exchange.

**Figure 13: Number of listed companies per exchange**

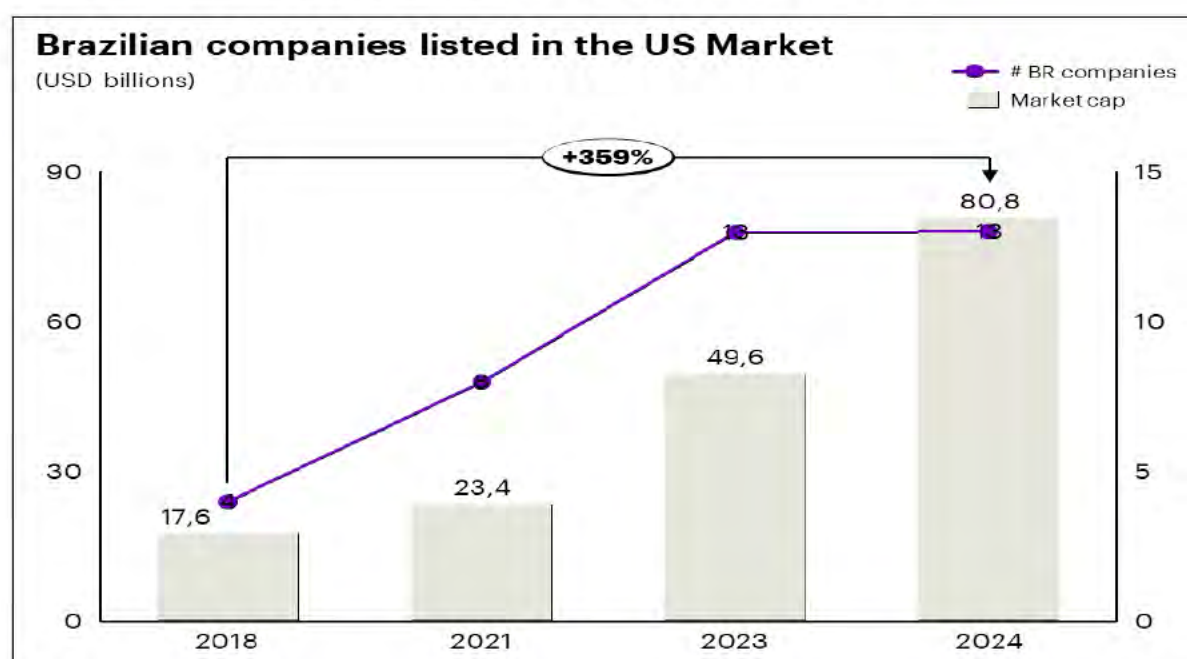


Source: S&P Global, Capital IQ, World Federation of Exchanges, Accenture strategy analysis

Despite that, we could see a recent trend of Brazilian companies looking to more developed markets for public listings, seeking higher valuations. In the past six years alone, 38 Brazilian companies have conducted Initial Public Offerings (IPOs) or follow-ons in the American market, raising approximately \$172 billion. This factor alone could have shifted Brazil's total market capitalisation from a 10% decline to a slight increase.



**Figure 14: Brazilian companies listed in the U.S. Market**



Source: S&P Global, Capital IQ, World Federation of Exchanges, Accenture Strategy analysis

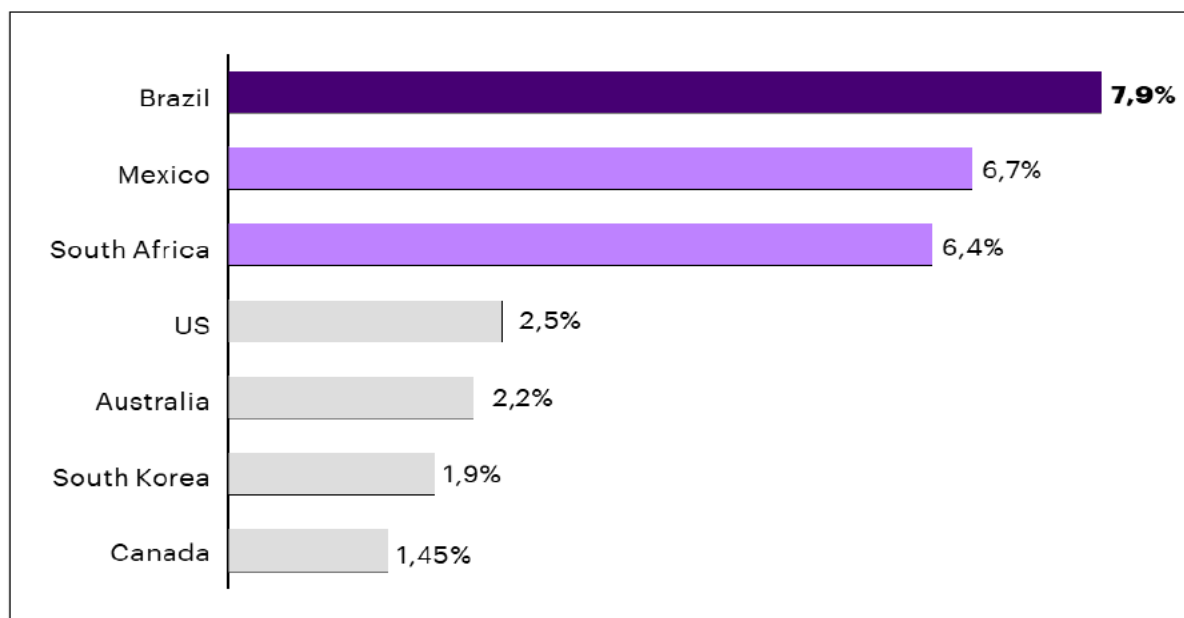
### **2.4.2. Compressed valuations**

Brazil has a long history of high interest rates, which have increased the costs for companies to finance themselves, whether through debt or raising capital in the stock market. While Canada had an average nominal risk-free rate from 2018-2024 of 1.45% (measured by the 10-year interest rate minus the 10-year credit default swap cost), Brazil's average was 7.9%.

These elevated risk-free rates significantly compress the valuations of listed companies, reducing market capitalisation and discouraging other companies from going public.

From an investor's perspective, fixed income becomes a more attractive asset class, offering high returns with much less risk than stocks.

**Figure 15: Comparison of the nominal risk-free interest rate per country**

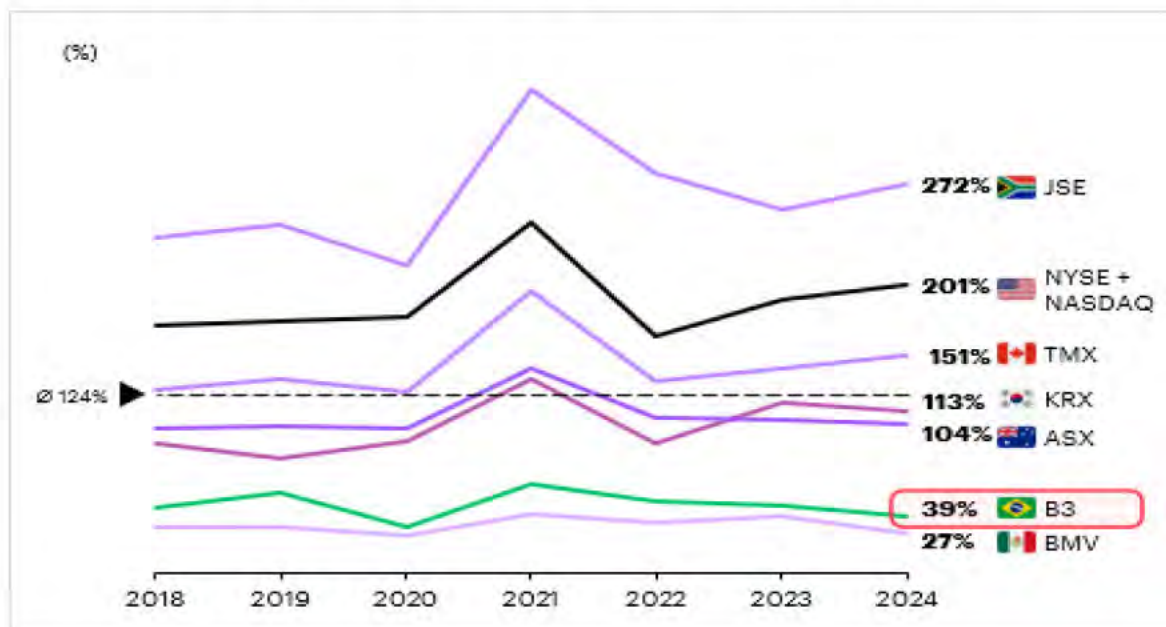


Source: Investing.com, Accenture Strategy analysis

The relationship between a country's stock market performance and its economy can be summarised by the "Buffett Indicator." Named after Warren Buffett, this metric compares the total market capitalisation of a country's publicly traded stocks to its gross domestic product (GDP). It is commonly used to assess whether a stock market is overvalued, undervalued, or fairly valued, and can also serve as a reflection of the economy's performance.

An indicator of 100% represents a fairly valued stock market, or at least a healthy one aligned with the country's economic growth. In Brazil's case, however, the indicator reflects an unhealthy stock market, reinforcing that key Brazilian companies driving the economy are not adequately represented in the stock market.

**Figure 16: The buffet indicator – stocks market CAP / country GDP**

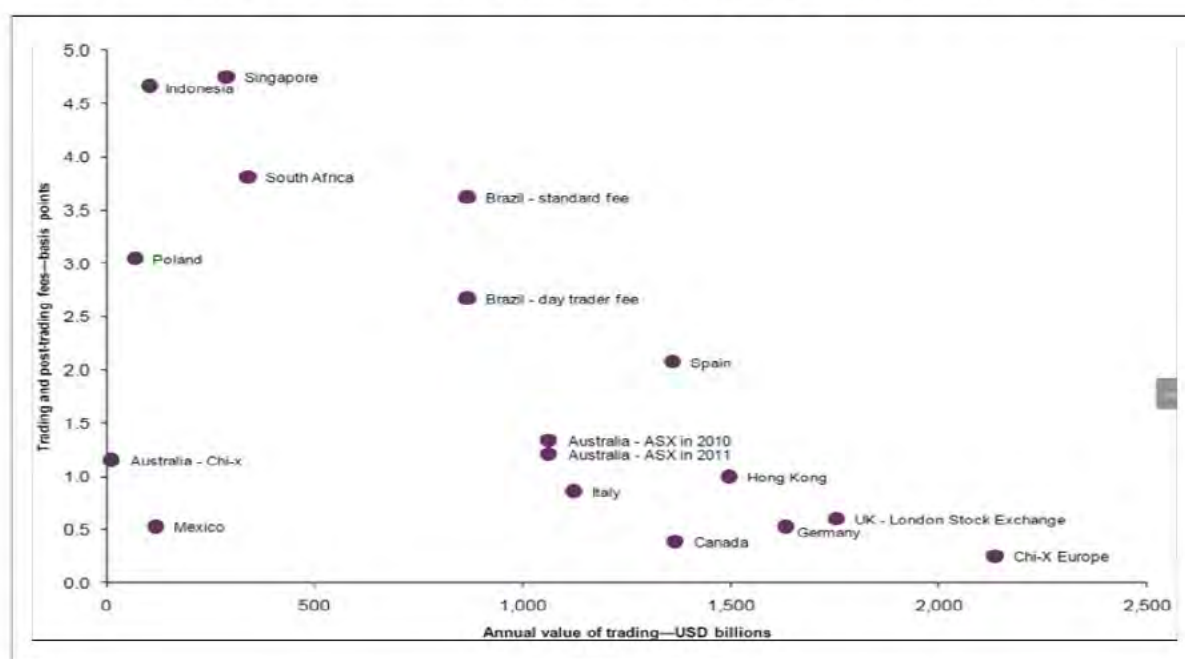


Source: S&P Global, Capital IQ, World Federation of Exchanges, Accenture Strategy analysis

### 2.4.3. Transaction costs

A study conducted by [Oxera \(2012\)](#), titled "What would be the costs and benefits of changing the competitive structure of the market for trading and post-trading services in Brazil?," evaluated the transaction costs of the Brazilian stock market, comparing them with other markets, both emerging and developed.

**Figure 17: Relationship between the cost of trading and post-trading and the value of trading— institutional investors using large intermediaries**



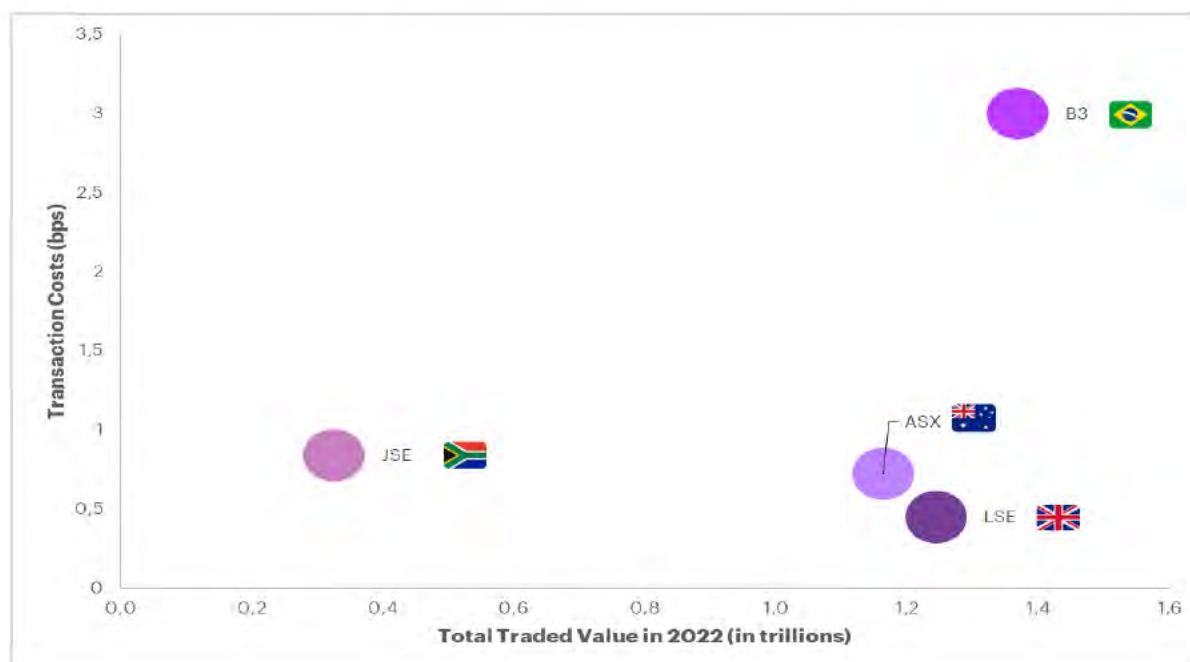
Source: Oxera Report: What would be the costs and benefits of changing the competitive structure of the market for trading and post-trading services in Brazil?

The conclusion was that transaction costs for the end consumer are higher in Brazil than in other countries, even with the different ranges of services offered. Some of the reasons cited for this were the lack of competition for the Brazilian exchange (both from a second exchange and Alternative Trading Systems), low trading volumes, and a higher level of regulatory requirements.

Updating this analysis to 2022, we see that Brazil remains an expensive country for trading in terms of transaction costs, especially when analysing settlement and trading costs (around 3 bps), even when compared to countries with similar volumes, such as South Africa (0.8 bps), Australia (0.7 bps), and the United Kingdom (0.5 bps).



**Figure 18: Traded value in 2022 vs transactions costs for retail investors vs Market cap**



Source: Electronic Order Book – World Federation of Exchanges (<https://focus.world-exchanges.org/issue/february-2023/market-statistics>), Exchanges Websites and Accenture Strategy analysis

The study also states that “International experience shows that introducing competition through new entry can bring down prices and benefit investors, but effective competition requires changes to the regulatory framework”, emphasizing that a cautious and phased approach is necessary to ensure that competition does not compromise the stability and efficiency of the Brazilian stock market. Other forms of competition are not only new stock exchanges, but also the rise of alternative trading systems and the permission for orders to be internalised by the brokers – as it occurs on the other countries analysed.

The regulatory cost of increased competition has been a constant concern among Brazilian market regulators. However, recent initiatives in the country, such as ‘Open Finance’, demonstrate that alternatives like self-regulation can be adopted to mitigate supervision costs while retaining the benefits of increased competition, helping to develop the capital markets. Lessons learned from the ‘Open Finance’ programme and its structure will be more detailed ahead in the ‘Box 2: Lessons Learned for self-regulation’ segment.

### 3. Literature Review

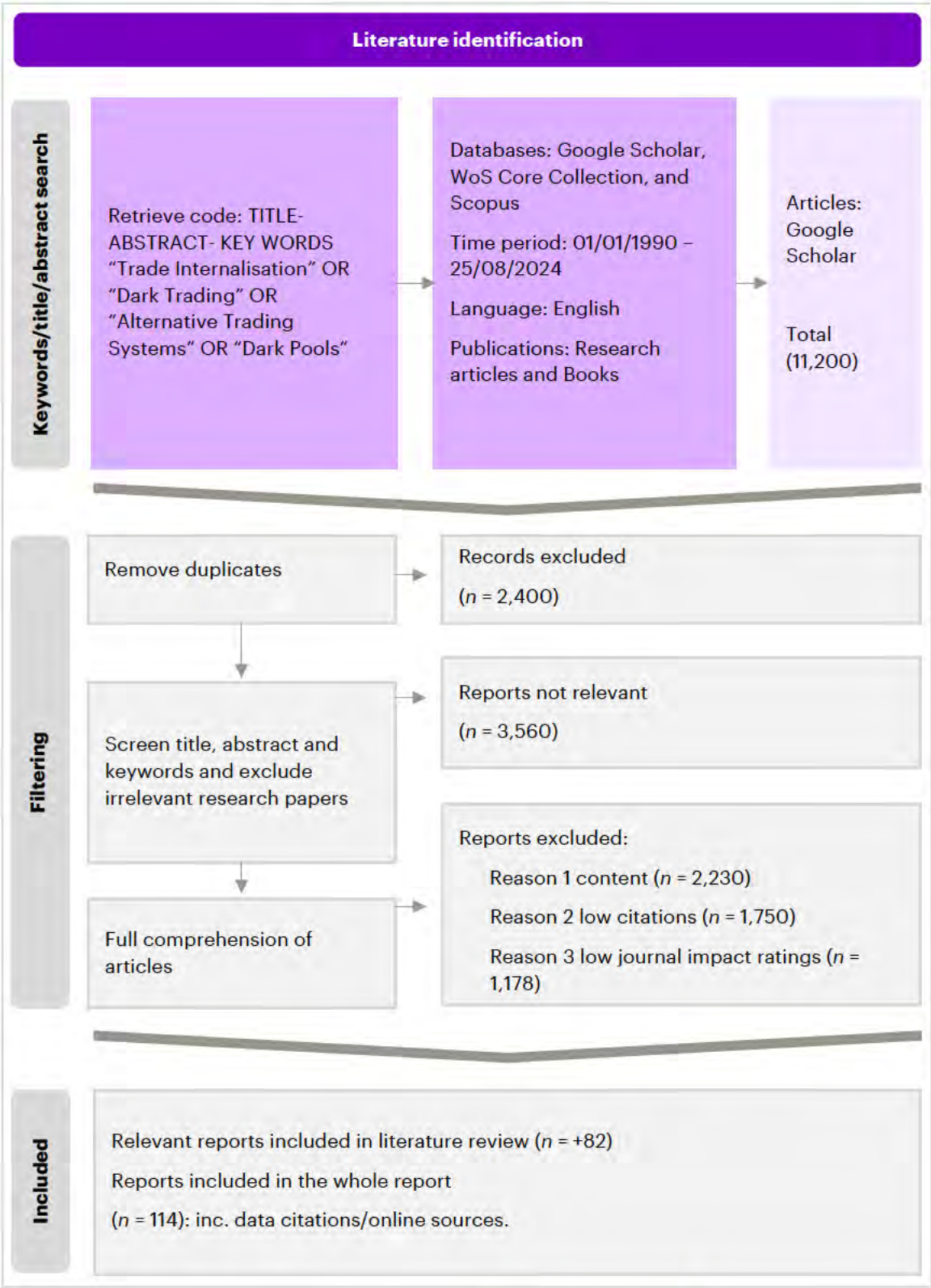
This paper examines the context of trade internalisation and proxies across geographies. Existing research and practices predominantly focus on major exchanges, particularly in the U.S. This study directly compares indices with similar market capitalisation and composition to Brazil, including other emerging markets. Building upon the theoretical frameworks of liquidity and price formation, this study aims to expand the literature by incorporating the analysis of market volatility, particularly in relation to trade internalisation.

#### 3.1. Systematic literature review

A literature review, grounded in [Hart's \(2001\)](#) framework for summative, analytical, and evaluative analysis ([Maylor et al., 2017](#)), is incorporated in this paper. This provides theoretical foundations for market liquidity, volatility, and price formation related to trade internalisation. A systematic literature review (SLR) approach ([Page et al., 2021](#)) is also adopted using Cochrane methodology ([Higgins et al., 2017](#)), mitigates bias. Searches across Google Scholar and Scopus, utilising Boolean logic ([Boole, 1847](#); [Dunn and Hardegree, 2001](#)), identified 11,200 publications (**Figure 19**) related to trade internalisation, dark trading, alternative trading systems, liquidity, volatility, and regulation. This SLR and additional screening reinforced limited trade internalisation research for developing countries, with only a few high-impact articles available.



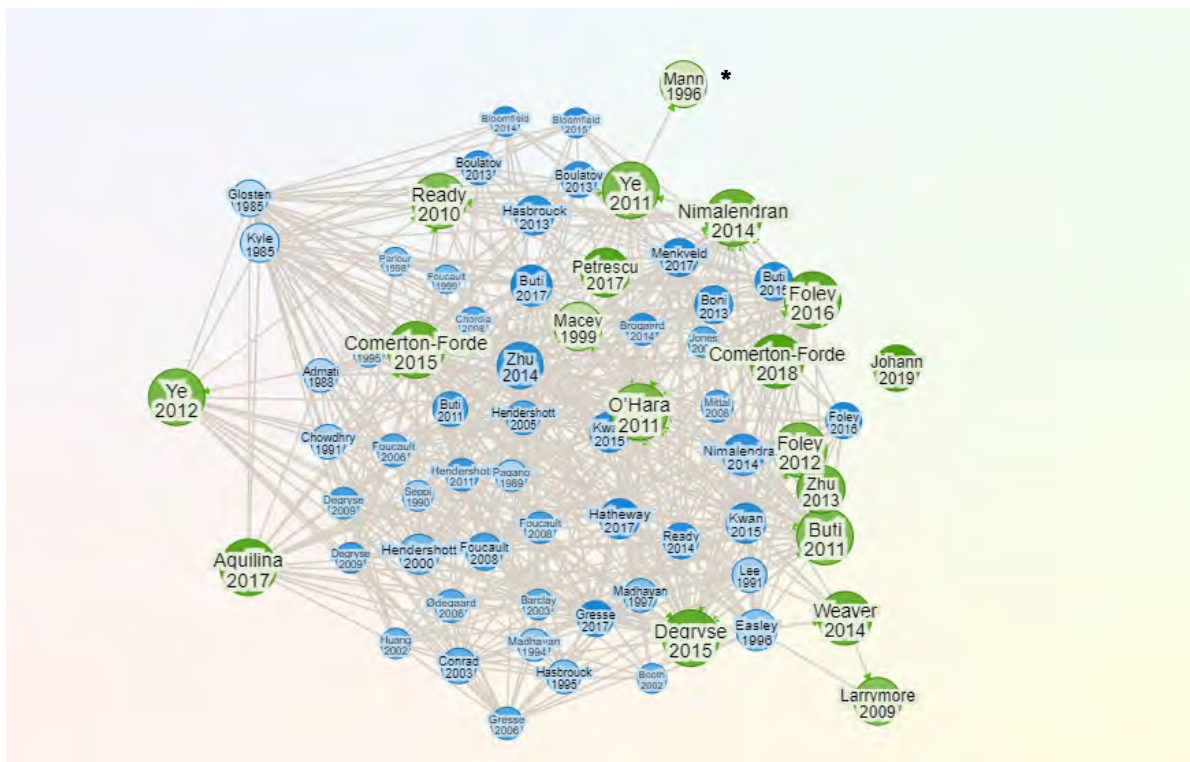
**Figure 19: Systematic Literature Review Process**



Source: adapted from PRISMA Flow Diagram, [Page et al., \(2021, p.19\)](#) and Accenture Strategy analysis

To construct a theoretical framework, multiple high-impact articles (and seminal books) provide the basis of additional literature mapping, using [Research Rabbit \(no date\)](#) an artificial intelligence platform for multiple research connections (**Figure 20**) and linked to similar articles for further verification. The process was replicated for theoretical concepts of liquidity, volatility, and price formation within a trade internalisation and dark trading context. Further screening based on content and relevance, followed by high citation counts, which are influential in each field of research ([Garfield, 1970](#)), Journal Impact Factor™ by Clarivate Analytics, and H-index ([Hirsch, 2005](#)), resulted in the selection of 50 highly cited peer-reviewed articles and a few seminal books, as the primary foundation for this study.

**Figure 20: Literature mapping of theoretical foundations of trade internalisation**



Source: ([Research Rabbit, no date](#)) and Accenture Strategy analysis

Note: Buti (2011) is a working paper that corresponds to [Buti et al. \(2022\)](#), while Mann (1996)

corresponds to [O'Hara \(1995\)](#). [MAS \(2019\)](#) and [Weaver \(2011\)](#) appear in the map but aren't highlighted. Additionally, one of the [Aquilina \(2017\)](#) entries is the same as [Ibikunle et al. \(2021\)](#), as both are working papers by the same authors.

Further examination using Zotero 6.0 and NVivo 14 software for word patterns/clouds (**Figure 21**) context coding and identifying research questions and narrowed the selection to 22 papers ([Buti et al. \(2022\)](#); [Ibikunle et al. \(2021\)](#); [MAS \(2019\)](#); [Johann et al. \(2019\)](#); [Comerton-Forde et al. \(2018\)](#); [Aquilina \(2017\)](#); [Petrescu et al. \(2017\)](#); [Foley and Putniņš \(2016\)](#); [Comerton-Forde and Putniņš \(2015\)](#); [Degryse \(2015\)](#); [Weaver \(2014\)](#); [Nimalendran and Ray \(2014\)](#); [Zhu \(2013\)](#); [Foley et al. \(2012\)](#); [Ye \(2012\)](#); [O'Hara and Ye \(2011\)](#); [Weaver \(2011\)](#); [Ye \(2011\)](#); [Ready \(2010\)](#); [Larrymore and Murphy \(2009\)](#); [Macey and O'Hara \(1999\)](#); [O' Hara \(1995\)](#)). Identifying word clouds also helps form a theoretical framework as part of content analysis identifying key themes, concepts and trends. **Figure 21** contextualises the key words within the 22 studies selected, providing a visual representation of the themes and concepts discussed. This highlights from a quantitative perspective (e.g., data and regressions), a stronger emphasis on efficiency, compression, reduced volatility, and improvement of price formation, and spread (bid-ask) compression, suggesting a positive impact of dark trading predominately in the literature

[illegible]

The word and construct distribution analysis of the Comissão de Valores Mobiliários ([CVM, 2024](#)) report **Figure 22** reveals also a strong focus on data analytics, but it diverges from much of the existing literature, which predominantly emphasises the benefits of trade internalisation. In contrast, the [CVM \(2024\)](#) report frequently references retail investors and highlights concerns about costs rather than benefits. This suggests that the CVM takes a more cautious approach in assessing the impact of trade internalisation, particularly regarding its effects on retail participants. However, the comprehensive literature review in Chapter 2, along with the quantitative analyses in Chapters 3 and 4, directly addresses these concerns, offering a



balanced evaluation of both the costs and benefits associated with trade internalisation.

**Figure 22: CVM report keyword extraction**



Source: [CVM 2024](#), NVivo 14 software and Accenture Strategy analysis

Finally, six seminal papers were identified out of the remaining 22 key publications for the methodology to statistically assess the attributes of trade internalisation (**Table 2**). This encompasses correlation, regression, and causality tests of liquidity ratios, bid-ask spreads, volatility during periods of stress, and market quality within the context of price formation.

**Table 2: Identifying relevant quantitative literature on internalisation**

Topic	Literature	Research question (s)	Empirical Method	Learnings
<b>Liquidity</b>	Effects of dark trading on liquidity of Singapore equity market  <a href="#"><u>Monetary Authority of Singapore (2019)</u></a> . <i>Effects of dark</i>	To find the impact of dark trading on market quality and efficiency (trying to measure the impact on liquidity)	Analysed data of 700+ small cap, medium cap and large cap using through temporal aggregation.	An increase in dark trading is associated with an increase in liquidity.  Smaller market cap stocks experience more

Topic	Literature	Research question (s)	Empirical Method	Learnings
	trading on liquidity of Singapore equity market. MAS Staff Paper No. 56. Monetary Authority of Singapore.		Compared data of Lit vs Dark pool.  Conducted panel regression with fixed effects for time.	increases in lit liquidity than those for larger market cap stocks as dark trading increases.
	City goes dark: Dark trading and adverse selection in aggregate markets  <a href="#">Ibikunle, G., Aquilina, M., Diaz-Rainey, I. and Sun, Y. (2021). City goes dark: Dark trading and adverse selection in aggregate markets. Journal of Empirical Finance, 64, pp.1-22.</a>	Is dark trading related to an improvement in liquidity and informational efficiency in the aggregate market and	Assessed 288 stocks, accounting 96.6% market capitalisation of FTSE 100 Conducted Series of stock-day panel regressions  Dark trade measured by pound share of dark trade in aggregate markets	As dark trading increases liquidity is enhanced in the aggregate markets as dark pools is more attractive to uninformed traders than to informed traders and encourages the provision of liquidity that otherwise would not have occurred
Volatility	Do dark pools amplify volatility in times of stress?  <a href="#">Petrescu, M., Wedow, M., and Lari, N. (2017). Do dark pools amplify volatility in times of stress? Applied Economics Letters, 24(1), 25–29.</a>	Does dark pool trading have explanatory power in predicting (current) volatility?	Granger causality test for the relationship between the growth in the share of trading on dark pools and volatility  VAR models, as well as models with ARCH or AMRA errors to assess the direction of the impact	Dark pool trading impacts volatility, suggesting that dark pools, by altering the balance of liquidity on lit venues, may affect the dynamics of price formation, and thus market conditions  If the share of dark pool trading grows, volatility is lower; the larger the growth in dark pool market share, the larger the fall in volatility
	Diving into dark pools  <a href="#">Buti, S., Rindi, B. and Werner, I.M. (2022). Diving into dark pools. Financial Management, 51 (4), pp.961-994.</a>	What factors influence order routing to dark pools and internalising OTC market makers?  Does dark trading affect market quality?	Natural logarithm of both market conditions and market quality measures  Express each measure as a fraction of consolidated share volume  Conduct two-stage least	Dark trading is generally beneficial for market quality in general times, but evidence suggest that a detrimental effect of dark pool trading, particularly for large caps, in stress time



Topic	Literature	Research question (s)	Empirical Method	Learnings
			squares instrumental variables (IV/2SLS) panel regressions	There is a need for balanced regulation that allows for the advantages of dark pools while addressing the potential risks to market integrity and stability
<b>Price Discovery</b>	Should we be afraid of the dark? Dark trading and market quality.  <u><a href="#">Foley, S. and Putnins, T.J. (2016), "Should we be afraid of the dark? Dark trading and market quality." Journal of Financial Economics, 122(3), pp. 456-481.</a></u>	Impact of dark trading on liquidity measures pre and post minimum price improvement rule implementation in Canada and Australia Aggregate impact of dark pools on informational/ price efficiency measures	One-stage least squares (OLS) panel regressions of market quality metrics on dark trading and control variables.	Two-sided dark trading is beneficial to both liquidity and informational efficiency. It tends to lower quoted, effective, and realized spreads, reduces price impact measures of illiquidity, and makes prices closer to the random walk that would be expected under informational efficiency
	Is market fragmentation harming market quality?  <u><a href="#">O'Hara, M. and Ye, M. (2011). Is market fragmentation harming market quality? Journal of Financial Economics, 100(3), pp.459-474.</a></u>	Does market fragmentation harm market quality, measured by – transaction cost and price discovery	Measure price efficiency using two standard proxies: short-term volatility and variance ratios. Short-term volatility is return volatility measured over a 15- minute interval  Used t-test (mean) and regression to show statistical association	Fragmentation appears to reduce effective spreads and increase execution speeds. While the magnitude of these effects differs across listing and size regimes.

## 3.2. Liquidity

It is important to differentiate between measurements of welfare benefits and costs of trade internalisations/dark trading and their proxies. One such measure is market liquidity and generally refers to the ease with which assets can be bought or sold without significantly affecting their prices. However,

"market liquidity" is a complex and multifaceted concept, encompassing various transactional properties such as "tightness" (the cost of quickly reversing a position), "depth" (the order flow required to change prices significantly), and "resiliency" (the speed at which prices recover from random, uninformative shocks) ([Kyle, 1985, pp. 1316-1317](#)). [Black \(1971\)](#) intuitively describes a liquid market as one where investors can consistently buy or sell small amounts of stock at narrow bid-ask spreads, while large trades can be executed immediately, but with a premium or discount that increases with the size of the trade.

In essence, a liquid market is continuous, allowing almost any amount of stock to be traded immediately, and efficient, enabling small amounts to be traded near the current market price and large amounts over extended periods.

Trade internalisation can impact market liquidity in several ways. It can provide immediate execution and potentially better prices for certain orders, thereby enhancing liquidity ([Comerton-Forde and Putniņš, 2015](#)). This immediate execution can be particularly beneficial for large orders, as it allows them to be filled quickly and discreetly ([Degryse et al., 2015](#)).

However, trade internalisation is claimed by some to have a detrimental effect on market liquidity. [Larremore and Murphy \(2009\)](#) argues, it can reduce overall market transparency by isolating orders from the broader market, which can lead to wider bid-ask spreads. Additionally, the fragmentation of liquidity caused by trade internalisation can result in less efficient price discovery, as prices may not reflect the true supply and demand dynamics of the market ([Ye, 2011](#)). Furthermore, [Foley et al. \(2012\)](#) states the practice of trade



internalisation can create conflicts of interest, as a firm's role as an agent for its clients may conflict with its role as a principal in the market

Contrary to this, recent research underscores the potential benefits of dark trading in enhancing market dynamics. As [Ibikunle \(2021\)](#) asserts, dark trading is intricately linked to reduced adverse selection risk and improved liquidity in the broader market. This mechanism protects uninformed traders from adverse selection, suggesting that the introduction of dark trading venues can catalyse an increase in trading activity. Specifically, dark pools, which serve as proxies for dark trading, provide uninformed traders the opportunity to execute trades more securely and cost-effectively—minimising spreads and price impacts, particularly for large orders ([Nimalendran and Ray, 2014](#)).

More recent research underscores the potential benefits of dark trading in enhancing market dynamics. As [Ibikunle \(2021\)](#) asserts, dark trading is intricately linked to reduced adverse selection risk and improved liquidity in the broader market. This mechanism protects uninformed traders from adverse selection, suggesting that the introduction of dark trading venues can catalyse an increase in trading activity. Specifically, dark pools (proxy of dark trading) provide uninformed traders the opportunity to trade more securely and cost-effectively— minimising spreads and price impacts, particularly for large orders ([Nimalendran and Ray, 2014](#)). Consequently, orders that might have otherwise been withheld are now executed, thereby bolstering liquidity in the aggregate market. This assertion is further corroborated by [Monetary Authority of Singapore \(2019\)](#), who underscore the positive correlation between dark trading and lit liquidity. This relationship may be attributed to

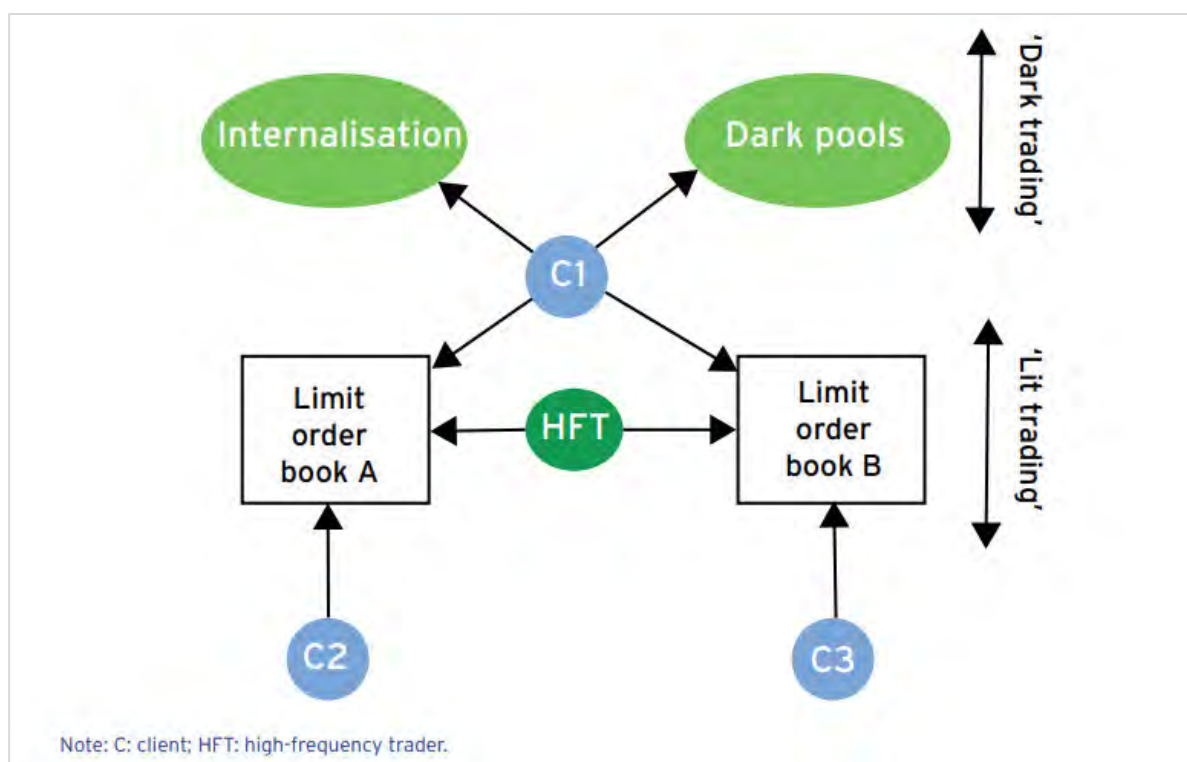
the phenomenon of liquidity externalities—commonly encapsulated by the phrase “liquidity begets liquidity.” ([Monetary Authority of Singapore, 2019, p. 2](#)). These externalities are especially potent in market structures where dark and lit trades are consolidated and disseminated through a unified data feed. As trading information becomes widely available, market participants become cognisant of growing interest in specific securities, which in turn generates additional trading interest, further amplifying liquidity.

### **3.3. Market volatility**

*“We find evidence that dark pool trading has explanatory power in predicting volatility, implying that dark pools may affect the dynamics of price formation through liquidity” - ([Petrescu, Wedow and Lari, European Central Bank, 2017](#))*

Understanding the relationship between investor preferences for trading on dark trading and market volatility is critical for assessing the potential role of dark trading during periods of market stress and their broader implications for financial stability. This area of research has gained increasing relevance in light of recent episodes of elevated volatility in financial markets, where price fluctuations and liquidity dynamics become heightened. During such periods, liquidity and volatility often interact, creating feedback effects that can exacerbate market instability ([Cespa and Foucault, 2014](#)). This feedback loop can lead to situations where illiquidity further increases volatility, which in turn makes liquidity scarcer, thereby fuelling a vicious cycle of market stress. Understanding how dark trading fits into this dynamic is essential for regulators, policymakers, and market participants.

**Figure 23: Lit vs dark trading**



Source: ([Duffie et al., 2022](#), pp. 100) and Accenture Strategy analysis

In this research paper, dark trading has been used as proxy for internalisation as both are not as transparent pre-trade as lit venues, even though they must report trades in real time.

The role of dark trading during times of volatility has been the subject of mixed findings. [Ready \(2010\)](#) suggests that when stocks experience heightened price volatility, investors tend to route their orders to dark trading. However, contrasting evidence comes from [Buti et al. \(2022\)](#) and [Petrescu et al. \(2017\)](#), who find that, for individual stocks, dark trade market share tends to be higher on days with lower volatility. This implies that in calm market conditions, investors might use dark trading more frequently, perhaps because the need for rapid execution on lit venues is diminished, or due to lower risks of adverse

selection. [Buti et al. \(2022\)](#) explore dark trading behaviour during periods of low returns, high selling pressure, or elevated volatility—key indicators of market stress. Interestingly, they find that during these periods, both dark pools and over the counter (OTC) market maker shares tend to decline, indicating that investors may shift their trading preferences towards more transparent, lit venues during times of heightened uncertainty.

*“Historically, levels of off-exchange trading decline during periods of high volatility or market stress, as trades move back onto exchanges to improve price discovery (and vice versa during lower volatility periods). Off-exchange trading as a percent of total equities volumes was 39.9% on average in January 2020, dropping to 36.6% on average in March 2020 (-3.3 pps), the height of the COVID-related market turmoil.”*

- ([SIFMA](#), 2021, p. 8)

The question then arises as to how dark trade function during periods of market stress, particularly whether they exacerbate or dampen volatility. [Petrescu \(2017\)](#) and [Buti et.al \(2022\)](#) both found an inverse relationship between dark trading activity and volatility. [Petrescu \(2017\)](#) states that the relationship may be attributed to asymmetric information dynamics. This is particularly notable in 2009, when higher dark trading via dark pools or internalising OTC market makers activity on stressed days led to narrower spreads and lower short-term volatility, suggesting a stabilising effect. In Europe, the impact of dark trading on market volatility appears to follow a different pattern. [Gomber et al. \(2015\)](#), in their study of French and German stocks, find no significant relationship between volatility and the share of dark

trades. However, more granular evidence from the UK's FTSE 100 index, provided by [Petrescu et al. \(2017\)](#), shows that dark pool trading share has predictive power over market volatility. Their findings align with the theory that dark trading can help smooth price discovery by removing noise created by uninformed traders on lit venues. In this context, increased dark trading usage is associated with lower price volatility, supporting the idea that dark trading may contribute to more stable market conditions by filtering out speculative or noise trading, which often distorts prices in transparent venues.

Overall, the evidence suggests that dark trading contributes positively to market stability by absorbing volatility and enhancing liquidity. While its role may vary depending on market conditions, dark trading serves as an essential mechanism for mitigating adverse market impacts, especially during times of stress. As market participants navigate complex trading environments, the continued utilisation of dark trading can help stabilise markets, ensuring that liquidity is preserved, and price discovery remains effective.

### **3.4. Research gap**

A significant research gap in the literature is the lack of a direct connection between price volatility and market volatility, especially concerning dark trading. Although [Buti et al. \(2022\)](#) and [Ibikunle and Rzayev \(2023\)](#) address short-term volatility in the context of market quality, they do not explicitly explore how price volatility within dark trading relates to overall market volatility. This oversight presents an important area for future research, as understanding the interplay between these two forms of volatility is crucial for evaluating market stability and the broader implications of dark trading on

market behaviour. By addressing this gap, future studies could provide deeper insights for regulators and market participants, enhancing strategies for managing volatility and promoting a more resilient financial environment.

## 3.5. Information efficiency

### 3.5.1. Information and price efficiency

Fama (1969) describes an "efficient" market as one where prices accurately reflect all available information. In such a market, prices help firms make production and investment decisions, and investors can choose securities with the confidence that prices represent all relevant information. [Ayadi \(1994\)](#) expands on this idea by defining price discovery as how well a market processes information. This leads to the understanding that any inefficiencies in the market, such as short-term price changes caused by order imbalances or imperfect liquidity, can hinder effective price discovery.

[Foley and Putniņš \(2016\)](#) elaborate on this by highlighting two main types of inefficiencies: delays in incorporating new information into prices and overreactions or underreactions to news. Dark trading, which includes non-transparent trading practices such as dark trading, non-transparent order types on lit exchanges, and internalising order flow by brokers, plays a role in this dynamic. [Comerton and Putniņš \(2015\)](#) and [Zhu \(2013\)](#) states that dark pools attract less informed traders, while informed traders tend to gather in lit markets. This separation of traders impacts both the liquidity of lit markets and their informational efficiency by altering the motivation to seek information. [Zhu's \(2013\)](#) model suggests that if all informed traders receive the same

information, dark trading can enhance price discovery. Fewer uninformed traders in the lit market decrease competition for the same set of private information, allowing informed traders to more effectively incorporate information into prices.

[Biais \(2002\)](#) describes price discovery as “the process by which market pricing is progressively adjusted, to reflect buying and selling interest and information relevant for the valuation of the shares” and argues disapprovingly, if internalisation reduces pre-trade transparency, it can disrupt price discovery by limiting investors' access to information about buying and selling interests.

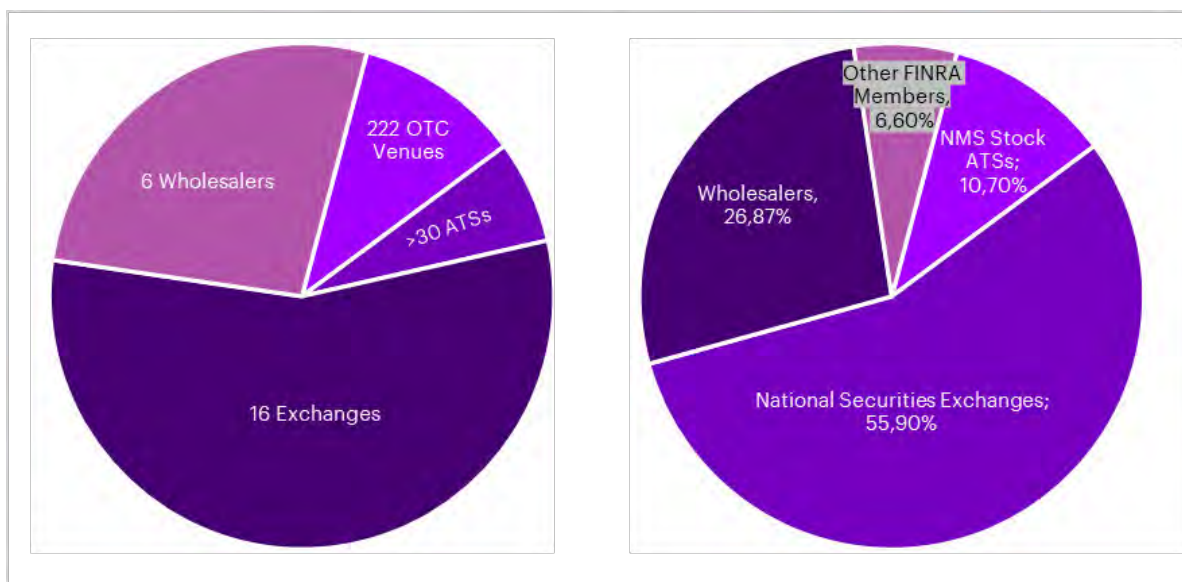
In contrast, [Aquilina \(2017\)](#) suggests that the coexistence of lit venues and dark pools could enhance overall market quality if traders can self-select their preferred trading venue based on their available information. [Foley and Putninš \(2016\)](#) further suggest that dark trading can enhance liquidity and informational efficiency, but its effects vary based on the types of dark trading involved. The paper concludes that dark trading should not be viewed as a uniform group, and their different types should be distinguished for effective policy-making. Allowing tick sizes to remain flexible can improve price conditions. Their finding aligns with research by [Ibikunle \(2021\)](#), which showed that market pricing noise decreases significantly with increased dark trading in the London equity market.

In summary, dark trading can play a crucial role in enhancing price discovery and market efficiency. By facilitating the movement of informed traders to lit markets and reducing noise, dark trading mechanisms can lead to more accurate price formation.

### 3.5.2. Market fragmentation

Fragmentation can take two main forms: first, when several transparent and open order books compete for the order flow; and second, when part of the order flow is internalised off-exchange by dealers or crossing engines, either under regulatory frameworks or within the over-the-counter (OTC) market ([Gresse, 2017](#)). Market fragmentation in the context of trade internalisation refers to the division of trading activity across multiple venues, including internal order books of broker-dealers, rather than being concentrated in a single, centralised exchange. Traditionally, US-listed securities traded only on stock exchanges, or since 1971 on Nasdaq, but this has changed dramatically. ([O'Hara, 2011](#)). This is further visible in Q1 2024 market share of US Equity exchange.

**Figure 24: US equity exchanges: Q1 2023 quarterly market share by volume**



Source: [SEC \(2023, pp. 372\)](#) and Accenture Strategy analysis



Fragmentation due to internalisation occurs because orders are matched within the firm, isolating them from interaction with the wider market. The impact of market fragmentation due to trade internalisation is mixed in the literature. The practice has previously raised concerns about reduced transparency, potential violations of price and time priority rules, and the impact on market quality and liquidity ([Comerton-Forde and Putniņš, 2015](#); [Degryse et al., 2015](#); [Larrymore and Murphy, 2009](#)). [Comerton-Forde and Putniņš, 2015](#) states that the dark market's share of price discovery increases at a slower rate than its increase in market share. [Gajewski and Gresse \(2007\)](#) demonstrate that off-book trading within hybrid markets generally leads to higher trading costs compared to transactions in a centralized order book. Their findings imply that the component of dark trading involving dealers' off-exchange executions could be more harmful to liquidity.

However, more recent studies highlight that market fragmentation caused by dark trading has positive effects. [William et.al. \(2014\)](#) suggests the proliferation of dark trading venues has created a new way for market participants to execute orders without pre-trade transparency. [Buti et al. \(2016\)](#) show that bid-ask spreads of stock prices increase with [crossing networks](#), a type of off-book trading, only when the primary order book is thin; otherwise, spreads tend to narrow. Moreover, research by [Brugler \(2015\)](#) and [Foley and Putniņš \(2016\)](#) further supports the notion that dark trading venues and hence market fragmentation improves overall liquidity e.g. including lit markets.

In this context, [Johann et al. \(2019\)](#) provide an analysis of how dark liquidity fragments across various venues, such as dark pools, internalisation systems,

and other quasi-dark mechanisms. Their study examined the effects of the ban on dark pools in Europe, revealing that while there was only a modest increase in continuous lit market activity, there was a significant surge in trading on internalisation platforms, periodic auctions, and block trading venues. Notably, trading in these alternative venues grew nearly three times more than in continuous markets. [Johann et al. \(2019\)](#) also highlight that the increased transparency and shift in liquidity can lead to greater adverse selection costs, as traders in lit markets may exploit knowledge of the presence, direction, and magnitude of natural liquidity.

### **3.5.3. Adverse selection**

Adverse selection refers to a situation where information asymmetry among market participants might lead to potential imbalances in information and unfairness among all market participants ([Nestenborg and Erch, 2023](#)). In [Zhu's \(2013\)](#) model, the introduction of a dark pool into the market incentivises uninformed traders to shift their activity from the lit exchange to the dark pool, as the risk of being adversely selected by informed traders is lower in the dark pool (subset of dark trading). This leads to a concentration of informed traders on the lit exchange, which, in turn, enhances price discovery in the market. Uninformed traders self-select to trade in dark trading venues, reducing their exposure to adverse selection risk. Consequently, traders choose their trading venues based on their information levels, influencing adverse selection risk and broader market quality. This research builds on prior theoretical frameworks, contrasting with earlier works like those by [Ye \(2011\)](#), which suggested dark pools could harm price discovery by allowing informed traders

to dominate. [Ye \(2011\)](#) additionally asserts that there are significant concerns that informed traders might exploit crossing networks to generate toxic order flow or manipulate prices for profit. This can undermine price discovery, as these traders can conceal their transactions within the dark venues.

When all informed traders possess similar sets of information—such as fundamental data about an asset’s value, as [Zhu \(2013\)](#) models—the self-selection dynamic fostered by dark pool trading can reduce adverse selection risk and improve price discovery efficiency. This is because the number of uninformed traders in the lit market decreases, resulting in fewer opportunities for informed traders to execute trades against uninformed counterparts.

According to [Kyle \(1985\)](#) and [Glosten and Milgrom \(1985\)](#), informed orders typically execute against uninformed orders on lit exchanges, so the reduction in uninformed traders lowers competition among informed traders.

Consequently, the risk of adverse selection in the overall market decreases, even though the aggregate amount of private information held by informed traders remains constant. However ([Zhu, 2013](#)) argues as uninformed traders exit the lit exchange, informed traders constitute a growing proportion of the participants in these venues, increasing adverse selection risk within the lit market itself as dark pool trading volume rises. Similar to this, [CVM \(2024\)](#) states in a market of heterogeneous agents, where there are different profiles of knowledge about the traded asset, it is rational to consider a probability greater than zero of finding a better counterparty.

Contrary to this, dark trading provides a protective environment for uninformed traders by shielding them from adverse selection risks. This leads

to an increase in uninformed trading activity in dark pools (a subset of dark trading) once they are introduced. Dark pools not only reduce the likelihood of uninformed traders being selected against but also offer cost advantages, such as lower spreads and diminished price impact for large order sizes, as observed by [Nimalendran and Ray \(2014\)](#). Consequently, orders that would otherwise not have been submitted in the lit market are more likely to be placed in dark pools. This phenomenon mirrors the role of traditional upstairs markets, where transactions that would not have occurred in the more transparent lit exchange are facilitated. [Madhavan and Cheng \(1997\)](#) show that upstairs markets enable large, less risky trades, akin to the way dark pools operate.

While dark trading may reduce liquidity on lit exchanges by drawing uninformed traders away, it improves overall liquidity in the aggregate market. This is because dark pools allow uninformed traders to trade more safely, reducing their adverse selection risk and encouraging higher trading volumes. As uninformed trading volume increases in dark pools, the proportion of informed traders relative to the total market decreases, leading to a reduction in adverse selection risk and improving market liquidity. In essence, while adverse selection risk may become concentrated in lit markets as uninformed traders move to dark pools, the aggregate market benefits from reduced adverse selection risk, enhanced liquidity, and improved price discovery ([Zhu, 2013](#); [Nimalendran and Ray, 2014](#); [Madhavan and Cheng, 1997](#)).

By effectively lowering adverse selection risk through the self-selection of traders into appropriate venues, dark pools contribute to the overall health of

the market. They provide a venue where uninformed traders can execute trades without fear of being taken advantage of by informed traders, while informed traders continue to concentrate in lit exchanges where they can contribute to efficient price discovery ([Zhu, 2013](#)). The net effect is a reduction in adverse selection risk across the aggregate market, alongside improvements in market efficiency and liquidity.

### **3.5.4. Free rider**

The concept of free riding, where individuals or entities benefit from a collective public good without contributing to its provision ([Olson, 1971](#)), is less prevalent within trade internalisation and dark trading environments. These systems are structured to mitigate information asymmetry and improve liquidity, and similarly to reduce the risks associated with adverse selection ([Chapter 3.5.3](#)). Dark pools allow institutional investors to execute large trades with discretion, minimising the risk of adverse price movements and deterring predatory trading strategies ([Bayona, 2020](#)). By keeping order details initially concealed, these venues create a more equitable environment, limiting opportunities for free riders to exploit the research and trading efforts of others without incurring the associated costs ([Buti et al., 2022](#)).

Moreover, the use of advanced execution strategies in dark pools, including algorithmic trading, further reduces the ability of free riders to anticipate and capitalise on market movements ([Bayona, 2020](#)). In terms of market structure, publicly available bid and ask data on lit exchanges can be viewed as a public good ([Federal Reserve Bank of New York and Massachusetts Institute of Technology Sloan, 2012](#)). Dark pools and their participants utilise these public

quotes for reference without preventing others from doing so. Once such data becomes publicly available, excluding users becomes practically impossible.

However, [CVM \(2024\)](#) raises concerns about a potential imbalance in the market, where the fees for real-time market data may not reflect the value that internalising entities derive from it. These entities, benefiting from real-time data for trade execution, may exploit the system without adequately contributing to the costs of data production and maintenance, effectively acting as "free riders" ([CVM, 2024, p. 9](#)). This issue arises due to regulations that mandate non-discriminatory access to real-time data, which, while intended to ensure fairness, inadvertently may allow some entities to extract greater value than they contribute. [O'Hara \(2014\)](#) advocates for a more balanced approach to pricing and access, which could ensure equitable participation and fair cost-sharing among all market participants.

Although the concept of free riding in trade internalisation is scarcely addressed in the literature, as evidenced by a systematic review of 11,200 studies ([Chapter 3.1](#)), it remains a consideration when examining the sustainability of market infrastructure and the need for regulatory policy adjustments.

## **3.6. Regulations**

The growth of trade internalisation has sparked concerns about their impact on financial asset liquidity, market fragmentation, and conflict-of-interest. Trade internalisation, where broker-dealers execute orders in-house or route them to their market-making divisions, has drawn regulatory scrutiny

([Larrymore and Murphy, 2009](#)). This practice fragments the market, as orders are matched within the firm, isolating them from the broader market. The key debate centres on whether trade internalisation harms market quality and liquidity, potentially violating price and time priority rules. Additionally, a firm's role as an agent for clients may conflict with its role as a principal. Major exchanges like the New York Stock Exchange (NYSE) and the Toronto Stock Exchange (TSE) have introduced rules to mitigate these effects. Crucially, however, such regulation acknowledges the economic role of these trading systems within capital markets. For instance, the SEC recognises that regulation should accommodate market innovation and “not stifle innovation” ([Macey and O’Hara, 1999, p. 23](#)). Alternative trading systems also function effectively and contribute productively to markets when they (1) safeguard customers’ rights to information, (2) address conflict-of-interest issues within firms acting as both brokers and dealers, and (3) innovate to enhance market conditions by lowering secondary market transaction costs ([Macey and O’Hara, 1999](#)).

### **3.6.1. Adjustments of regulations in the US**

An example of regulation in the US that accommodates trade internalisation but incorporates best price practices is trade-at rule. The rule similar to MPIR (minimum price improvement rules) of Canada is referred to as a trade-at rule or, more precisely, a trade-at prohibition, meaning that dark orders must execute at prices better than the displayed national best bid and offer. As part of the 2016 SEC and Financial Industry Regulatory Authority (FINRA) Tick Pilot, one group of pilot securities is subject to trade-at prohibition. The design of

the trade-at rule is consistent with the Canadian MPIR in that dark trades can occur only at midpoint, but, in the US, retail order flow and negotiated trades are exempt from the prohibition. ([Comerton-Forde et al., 2018](#))

### **3.6.2. Impact of pricing regulations in dark trading for Canada and Australia**

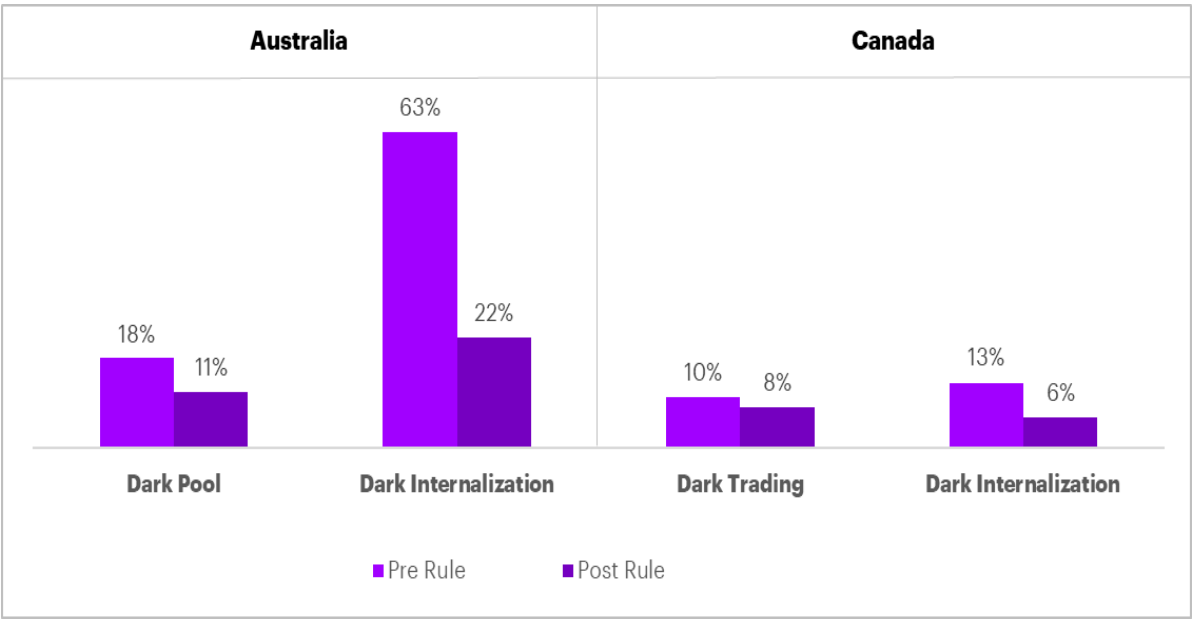
On October 15, 2012, the Investment Industry Regulatory Organization of Canada (IIROC, now CIRO) implemented two changes to its rules and regulations. IIROC amended its rules on dark liquidity (dark trading) and, in particular, introduced an additional rule regarding the entry and exposure of orders. This new rule, UMIR 6.6, titled “Provision of Price Improvement by a dark Order,” requires that marketable orders that are at or below 50 standard trading units or \$100,000 in value and that trade against a non-displayed order be provided with a price improvement upon the national best bid and offer prices by at least one trading increment or by half an increment if the bid-ask spread is one trading increment. For securities that are priced above \$1, the trading increment is one cent, and a trading unit is one hundred shares. The rule mandates that dark orders offer a price that is one cent better (one-half cent for one cent bid-ask spreads) than the best price posted across the visible marketplaces. IIROC further clarified that this rule does not apply to the hidden portion of so-called iceberg orders. The rule change is referred to as the minimum price improvement rule.

The set of minimum price improvement rules (MPIR) for dark trading were introduced in Canada in October 2012 (the first such regulation in the world) and Australia in May 2013. The rules required that dark trades provide one full



tick of price improvement (or half a tick if the spread is constrained at one tick). When the rules came into effect, dark trading fell by over one-third in both countries, literally overnight ([Foley and Putniņš, 2016](#)). According to [Comerton-Forde et al. \(2018\)](#), the MPIR changed the economics of liquidity provision, because traders were allowed to post liquidity only at the midpoint, therefore making it impossible to earn a spread by providing liquidity on both sides of the dark order book.

**Figure 25: Change in dark trading due to trade at rule**



Source: [CFA Institute \(2014\)](#) and Accenture Strategy analysis

As [Foley and Putniņš \(2016\)](#) states, one of the reasons why the decline in dark trading in Australia was larger than in Canada is that the accompanying reductions in block size thresholds allowed large dark orders to be executed as blocks and bypass the minimum price improvement requirements (block trading increased from around 9.7% to 12.5% of total dollar volume). The fraction of dark dollar volume executed at the midquote increased from 46%

before the regulation to 81% after. Therefore, the minimum price improvement requirements in Australia also provide a useful instrument to analyse the causal effects of dark trading.

### **3.7. Theoretical framework and research questions**

The literature review forms the theoretical foundation for this paper, exploring the welfare benefits and costs of trade internalisation in the context of Brazil vs other countries. Consequently, three research questions arise:

- RQ1: What are the key metrics to measure the impact of trade internalisation?
- RQ2: How does the role of trade internalisation vs. lit market differ across countries allowing the practice?
- RQ3: Which benchmarks define the benefits or costs of trade internalisation?

The literature review underscores the complex and multifaceted role of trade internalisation and dark trading in financial markets. Recent studies have demonstrated that these practices can enhance market liquidity by tightening bid-ask spreads and improving price discovery under specific conditions ([Foley and Putninš \(2016\)](#) and [MAS \(2019\)](#)). However, concerns regarding market transparency persist as a significant issue. Notably, though many critiques of dark trading practices are rooted in historical analyses, often dating back over a decade, which may not fully reflect the current landscape of trading venues and their evolving impacts on market dynamics.

The discussion highlights the importance of considering the specific contexts and regulatory frameworks in which these practices take place, as their effects can vary significantly across different market environments. While contemporary research points to benefits such as liquidity enhancement and efficient execution, persistent concerns about transparency—though sometimes regarded as outdated—still hold relevance, particularly in light of regulatory scrutiny and evolving market structures. This body of work points to the necessity for balanced regulatory measures that permit the advantages of dark trading while mitigating risks to market integrity and stability. Striking this balance is essential, as overly restrictive policies may stifle liquidity, whereas insufficient oversight could exacerbate risks such as a reduction in price transparency. Additional research should aim to bridge the identified gaps, particularly in understanding the interplay between dark trading and market volatility. Developing deeper insights into this relationship will be crucial for regulators and market participants alike, as it will support the creation of effective policies that promote market efficiency, liquidity, and stability.

Moreover, these findings will inform Chapter 3 (Methodology), particularly in formulating hypotheses derived from the key research questions, focusing on the interactions between trade internalisation and other proxies with liquidity, market volatility, and price discovery.

## 4. Methodology

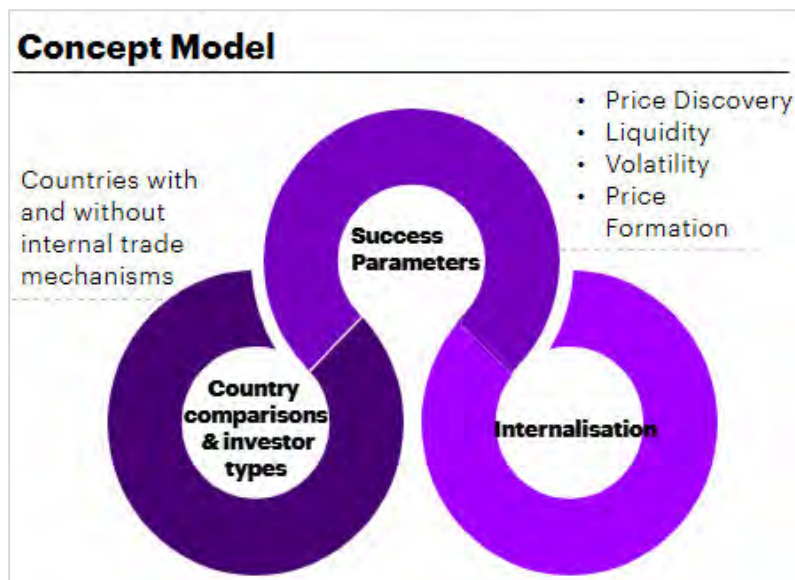
This study adopts a mixed-method approach, utilising quantitative analysis and semi-structured interviews ([Appendix D](#)) to reinforce relationships and hypotheses. This includes the systematic literature review from section 2 for RQ1, regression, volatility and correlation analysis to investigate RQ2 and a quantitative survey to examine RQ3 to compare international alternative trading systems and trade internalisation with that of Brazil.

### 4.1. Research model and hypotheses

Addressing research questions RQ1, RQ2 and RQ3 (Chapter 2), a hypothesis technique was used. The research questions identified via the literature analysis aided to carve out precise hypotheses (**Figure 26**). Each hypothesis was formulated through a detailed synthesis of existing literature and quantitative analysis, and adapting methodologies, in particular from [Buti et al. \(2022\)](#), [Ibikunle et al. \(2021\)](#), [MAS \(2019\)](#), [Petrescu et al. \(2017\)](#), [Foley and Putniņš \(2016\)](#), [O'Hara and Ye \(2011\)](#). This blend of external research and the paper's own empirical findings guided the hypothesis creation process.

By closely aligning the research questions with theoretical frameworks and quantitative techniques, as laid out in the research model (**Figure 26**), the study ensures a coherent framework for testing these hypotheses. This structured method facilitates the validation process through the collection and analysis of relevant data.

#### **Figure 26: Research model**



Source: Adapted (Bacharach, 1989; [Maylor et al., 2017](#)) and Accenture Strategy analysis

## Hypothesis H1: Trade internalisation improves liquidity

- H1a: Increased volume in trade internalisation narrows bids-ask spread and improves liquidity ratio ([Monetary Authority of Singapore, 2019](#))

Internalising trades enables firms to match buy and sell orders within their own order flow, avoiding external routing and reducing transaction costs, including the bid-ask spread. This should lead to improved liquidity by decreasing market frictions and increasing order availability. Also, this additional liquidity could result in liquidity externalities, where “liquidity begets liquidity”.

([Monetary Authority of Singapore, 2019, p. 8](#)) Trades on exchange-listed securities, whether they are executed off-exchange or on the lit market, are aggregated and disseminated as market data. Market participants will thus become aware that there is trading interest in those securities, and such increased trading volume may generate further trading interest. We expect higher volumes of internalised orders to result in narrower bid-ask spreads and

a better liquidity ratio, reflecting a more efficient trading environment

([Monetary Authority of Singapore, 2019](#))

H1b: Increased internalisation trading leads to improved liquidity in lit market for small and medium capitalisation stocks more than large capitalisation stocks ([Monetary Authority of Singapore, 2019](#)). Small and medium capitalisation stocks typically face lower liquidity and wider spreads in traditional markets. Internalisation can offer a more efficient trading environment for these stocks, potentially improving their liquidity more significantly than for large-cap stocks, which already benefit from higher liquidity. Thus, internalisation is expected to have a more pronounced positive effect on small and medium-cap stocks by providing better conditions for these securities to trade ([Monetary Authority of Singapore, 2019](#)).

## **Hypothesis H2: Trade internalisation reduces volatility at times of market stress**

- H2a: Volatility is associated with previous period changes in internalisation trading ([Petrescu et al., 2017](#))

During periods of high volatility investors' trading needs become more urgent and necessitate their migration from the low-cost and low-immediacy venues (e.g., dark pools) to high-cost and high-immediacy venues (e.g., lit markets) ([Ibikunle, 2023](#)). The shift helps in better price formation in lit market leading to stabilising of prices and liquidity supply on lit venues, implying a reduction in price volatility.



- H2b: Direction of effect of internalisation trading on volatility ([Petrescu et al., 2017](#))

The impact of internalisation on volatility can vary depending on market conditions. In times of market stress, internalisation is expected to reduce volatility by limiting the market impact of large orders. However, during normal market conditions, the effect could be lower or even. We expect a predominantly negative relationship between internalisation and volatility, particularly during stressful periods ([Petrescu et al., 2017](#)).

**Hypothesis H3: Trade internalisation tends to contribute to more accurate price formation ([Comerton-Forde and Putniņš, 2015](#) and [Foley and Putniņš, 2016](#)).**

- H3a: Whether dark trading (proxy for trade internalisation) reduces the level of all informational inefficiency, i.e. absolute autocorrelations (absolute value of first-order mid-quote return autocorrelations for each stock-day)
- H3b: Whether dark trading reduces the level of all informational inefficiency i.e. variance ratios, price series' deviation from the characteristics that would be expected under a random walk (e.g., [Lo and MacKinlay, 1988](#))

Positive or negative mid-quote return autocorrelations indicate that prices deviate from a stochastic random walk and exhibit short-term return predictability. This predictability can be influenced by informed traders—those with special knowledge—who are key for helping markets set the right prices. Dark trading, where trades are made without revealing pre-trade details to the public, can affect how well prices reflect information. On the one hand, it can

reduce transparency, but on the other, it provides a way for large, informed trades to happen without causing big price swings. According to the model by [Boulatov and George \(2013\)](#), hiding some of the orders helps price discovery because it makes informed traders compete harder to offer better prices in public markets. [Foley and Putniņš \(2016\)](#) confirm this idea, finding that two-sided dark trading where dark liquidity is available at different prices for both buyers and sellers simultaneously can improve market quality by increasing competition among those providing liquidity.

[Zhu \(2013\)](#) suggests that informed investors usually gather on the more active side of the market because their trades are closely linked to the true value of the asset and tend to be similar to one another. As a result, informed investors are less likely to trade in dark pools compared to uninformed investors. Dark pools usually have less trading activity than traditional, more transparent exchanges, making them a better fit for uninformed traders who don't have access to the same level of information.

Lit exchanges, on the other hand, provide faster execution speeds, which makes them more appealing to informed investors ([Zhu, 2013](#)). As dark pools increasingly draw uninformed traders, the activity of informed investors becomes more concentrated on lit exchanges. This higher concentration of informed versus uninformed activity enhances price discovery on lit exchanges. We expect dark trading to enhance discovery in lit markets by improving information efficiency

## **Hypothesis H4: Trade Internalisation improves liquidity and price discovery, therefore indicates integration rather than market fragmentation**

- H4a: Dark trading (proxy of trade internalisation) is associated with a decrease in adverse selection across the overall market ([Ibikunle et al., 2021](#))
- H4b: Market fragmentation as a result of dark trading might improve liquidity and provide additional trading opportunities ([Ibikunle et al., 2021](#))

As discussed in the previous hypothesis, uninformed traders shift towards dark pools because they face a reduced risk of being adversely selected by informed traders, who tend to concentrate on the lit exchanges. This self-selection based on information hold lowers the adverse selection risk for uninformed traders in dark pools. ([Ibikunle et al., 2021](#))

In addition, when informed traders share similar information sets, as modelled by [Zhu \(2013\)](#), dark pools can further reduce adverse selection risk and enhance price discovery efficiency. Fewer uninformed traders in the lit market led to fewer instances where informed trades execute against uninformed orders (informed orders execute against uninformed orders as shown by [Kyle, 1985](#), and [Glosten & Milgrom, 1985](#)), rendering low competition on the same private information held by informed traders. This suggests a reduced risk of adverse selection for uninformed traders in the overall market, even though the total amount of private information remains unchanged, as all informed traders possess the same information ([Ibikunle et al., 2021](#))

## 4.2. Data methods

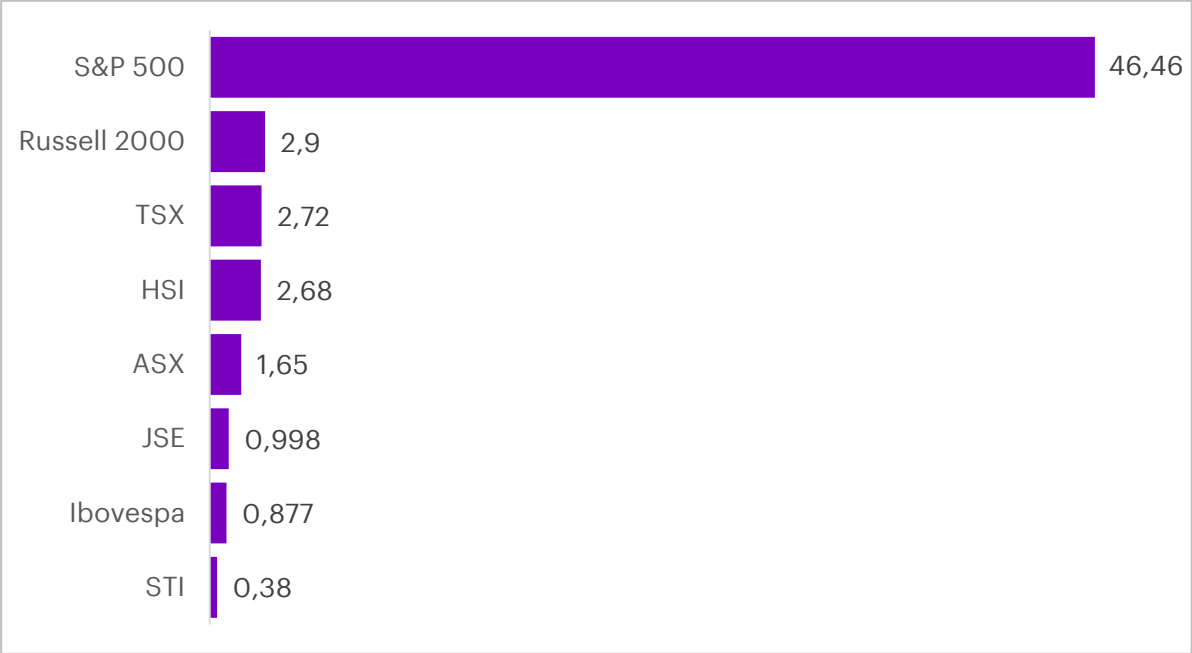
For the liquidity and volatility analysis, we examined different markets over various time periods. The data set for the U.S. indices (Russell 2000, S&P 500) spans from January 2005 to July 2024, while the UK-FTSE 100 analysis covers January 2019 to July 2024. This range was chosen to include significant stress periods such as the Global Financial Crisis and the COVID-19 pandemic. Data sources for these markets include Bloomberg, FINRA, SEC, and TMX. For the Brazilian market, the data was sourced from BTG Pactual's Market Data Services and covers trades from all Brazilian players from January 2020 to July 2024 .

Our sample included the constituents of major stock indices such as the Russell 2000, S&P 500, FTSE 100 and the top 51 most liquid stocks for the JSE JALSH index. Russell 2000 includes approximately 2,000 of the smallest securities based on a combination of their market cap in the US equity market. S&P 500 is a gauge of large-cap U.S. equities. The index includes 500 leading companies and covers approximately 80% of available market capitalisation. ([S&P Global](#), no date). FTSE 100 Index (UKX) comprises the 100 most highly capitalised blue chip companies listed on London Stock Exchange.

For the Brazil analysis, we examined Retail Liquidity Provider and Lit market data of Mini Dollar and Index. The U.S. indices were chosen based on market capitalisation, with the median market cap of the Russell 2000 being similar to the median market caps of IBOVESPA (significant performance indicator of the equities traded in B3 and includes major companies in the Brazilian capital market ([B3](#), n.d.)) and JALSH (JSE). A comparison of the market capitalisations

is listed below in **Figure 27** and **Table 3**. The Figure highlights other capital market indices like S&P/TSX composite index (TSX), the headline index for the Canadian equity market, Hang Sen Index (HSI), gauge of the Hong Kong stock market, includes the largest and most liquid stocks listed in Hong Kong, Straits Times Index (STI), that tracks the performance of the top 30 companies listed on Singapore Exchange and FTSE/JSE (JALSH), measures the performance of the major capital and industry segments of the South African market. The index represents 99% of the full market capital value i.e., before the application of any investable weightings, of all ordinary securities listed on the main board of the Johannesburg Stock Exchange (JSE) ([FTSE Russell](#), 2024).

**Figure 27: Market capitalisation by index (USD Tn)**



Sources: [Visual capitalist](#), Bloomberg, Refinitiv and Accenture Strategy analysis  
Note: STI is as of 2022

**Table 3: Index market capitalisation comparison**

In USD Mn	Average Market Cap	Largest Market Cap	Median Market Cap	Total Market Cap	Smallest Market Cap
<b>Russell 2000</b>	\$996	\$7,100	\$3,403	\$2,900,000	\$150
<b>S&amp;P 500</b>	\$99,187	\$3,511,505	\$35,995	\$49,891,141	\$5,612
<b>FTSE 100</b>	\$27,076	\$242,659	\$9,471	\$2,707,610	\$1,205
<b>Brazil (Ibovespa)</b>	\$8,982	\$94,248	\$4,208	\$754,448	\$184
<b>JSE (FTSE)</b>	\$2,907	\$36,524	\$958	\$357,558	\$35

Sources: LSEG, Russell, S&P Global, Investing.com and Accenture Strategy analysis  
Note – Largest and Smallest market capitalisation are the market capitalisation of the largest and smallest market constituents of the Index Currency conversion rates considered are – 1 GBP = 1.31USD, 1 BRL = 0.18USD and 1 ZAR = 0.056USD

The indices were selected based on their mean, median and smallest constituent market capitalisation. The aim was to ensure that the study covers the impact of dark trading on both high market capitalisation stocks and small market capitalisation stocks. The Russell 2000 and JSE are more similar to Brazil (Ibovespa) in terms of market capitalisation metrics. Brazil's mean market cap of \$8,982 million and median of \$4,208 million are closer to the Russell 2000's mean of \$996 million and median of \$3,403 million, and the JSE's mean of \$2,907 million and median of \$958 million (**Table 3**). In contrast, the S&P 500 and FTSE 100 exhibit significantly larger market capitalisation figures, making the Russell 2000 and JSE more comparable to Brazil's market structure.

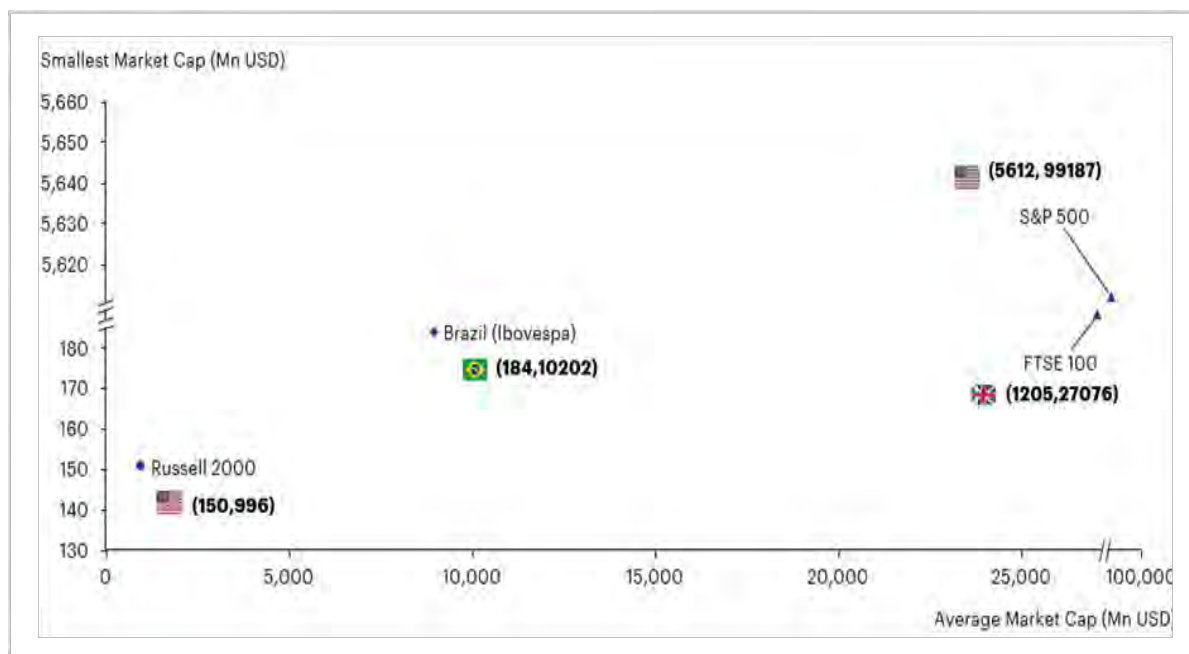
The selection of countries for this research was based on a ranking of the largest stock exchanges by market capitalisation, ensuring a representative sample from both developed and emerging economies. South Africa, represented by the Johannesburg Stock Exchange (JSE), was chosen as it



ranks 19th globally (Brazil, with its B3 stock exchange closely following JSE at 20th in the global ranking) and is particularly noteworthy for its adoption of hidden orders, a functionality that is similar to dark trading but conducted on-exchange. As an emerging economy, South Africa provides an interesting case for analysing the role of such mechanisms in market dynamics ([Visual Capitalist, 2023](#))

As outlined, we have included indices from different market capitalisation to assess the impact of dark trading on liquidity across various stock groups. As Russell 2000 is more closely mirroring the market of Brazil, it is used as a proxy for assessing the impact of dark trading on liquidity in the Brazilian market.

**Figure 28: Smallest constituents and average market cap of different stock group**



Source: Bloomberg, Refinitiv, Investing.com and Accenture Strategy analysis

Dark trading data was obtained from Bloomberg for the Russell 2000, S&P 500, and JSE. For the FTSE 100, off-exchange volume data was used from 2019

to July 2024. This data helped calculate the proportion of dark trades relative to total traded volume. Outliers were identified as values two standard deviations above or below the mean and were capped accordingly to ensure accurate analysis ([Lee et al., 2022](#)).

For the panel models, daily data for each stock was aggregated or averaged on a monthly basis. This monthly approach is consistent with long-term behavioural analysis in financial markets ([Petropoulos and Kourantzis, 2014](#)).

To provide a sense of the difference in dark trading between large market capitalisation stocks vs. small market capitalisation stocks, below **Table 4** represents the descriptive analysis of dark trading in different indices. The Russell 2000 and S&P 500 exhibit similar average dark trading levels, with means around 50%, while the FTSE 100 and RLP display significantly lower proportions, averaging 14% and 23%, respectively. The FTSE 100 also shows a much lower median, highlighting less frequent use of dark trading in U.K. comparison to the U.S. indices.

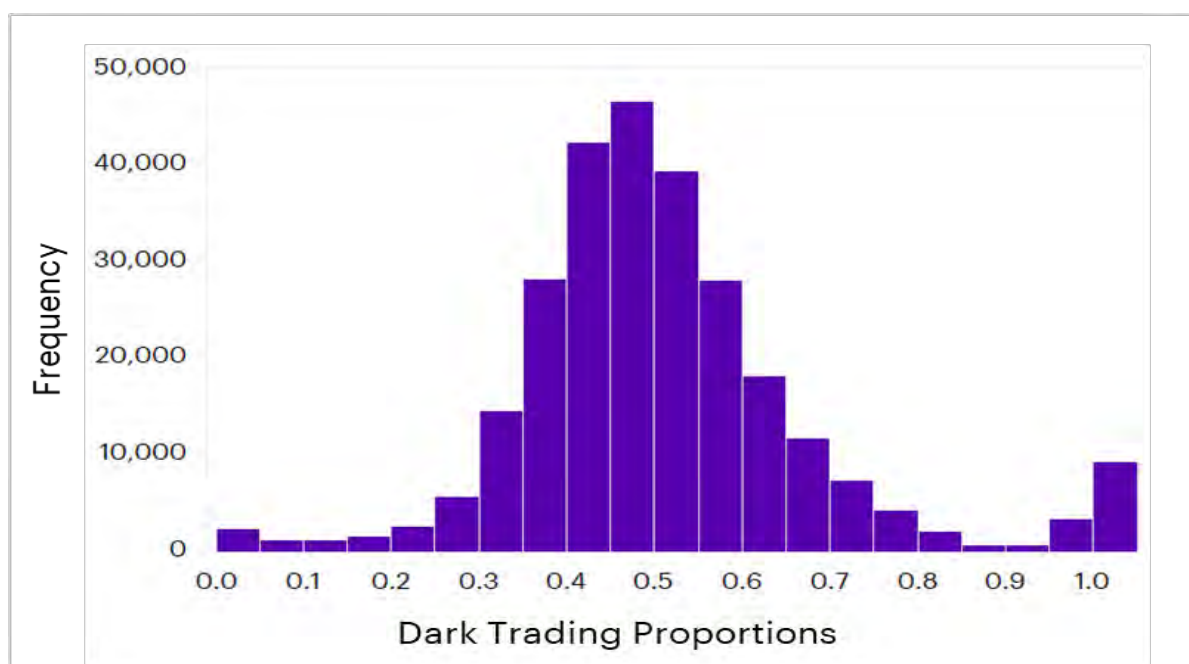
**Table 4: Descriptive statistics on dark trading proportions**

	Russell 2000	S&P 500	FTSE 100	RLP
Sample Period	01/2005 to 07/2024	01/2005 to 07/2024	03/2019 to 07/2024	12/2020 - 11/2023
Mean	0.51	0.504	0.14	0.23
Median	0.49	0.49	0.089	0.24
Maximum	1.00	1.00	0.98	0.34
Minimum	0.005	-	0.00030	0.00001

Source: Bloomberg, BTG Pactual and Accenture Strategy analysis

To understand the distribution of dark trading in Russell 2000, the histogram in **Figure 29** illustrates the proportion of stock-months with different levels of dark trading. A significant concentration of stock-months falls within the 40%-60% dark trading range, peaking around 50%. Relatively few stock-months have dark trading proportions below 10% or exceeding 80%.

**Figure 29: Distribution of dark trading (as % of total volume) across stock-months – Russell 2000**



Source: Bloomberg and Accenture Strategy analysis

Brazil RLP data comprised of aggregated daily trading data for the Mini Dolar and Mini Index contracts for both lit and RLP markets between 2020 and 2024. Since there are multiple contracts with different expiration dates (six per year for Mini Index and twelve per year for Mini Dolar), we selected the most traded ones for each day during the period.

To investigate the impact of dark trading on information efficiency and price discovery, we draw data from the SEC's Tick Size Pilot Program, which was

designed to assess the effects of wider minimum quoting and trading increments (tick sizes) on the liquidity and trading of small-capitalisation stocks (U.S. – NYSE). The pilot, initiated in October 2016, included companies with a market capitalisation of \$3.0 billion or less, a closing price of at least \$2.00, and an average daily volume of one million shares or fewer.

The data provided from the pilot was made available through FINRA and the exchanges’ websites, providing a valuable dataset for assessing the market dynamics influenced by tick size variations.

For our sample, we focus on stocks listed on the New York Stock Exchange (NYSE) between April 2018 and March 2019, examining how these structural changes in tick size impact the informational efficiency of prices and the dynamics of price discovery. The sample consisted of 2139 securities out of ~2300 listings in NYSE.<sup>1</sup> The \$3.0 billion or less market capitalisation threshold makes the data a more suitable proxy for the Russell 2000 and Brazilian capital markets (**Table 3**).

**Table 5** provides a clear snapshot of the period, sources, and characteristics of each market to aid in understanding the scope of the analysis.

**Table 5: Data snapshot**

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<sup>1</sup> See on NYSE website - [For the first time in our history, NYSE will trade all 8,000 securities listed on all U.S stock exchanges, including exchange traded funds.](#)

Index/Exchange	Time Period	Data Sources	Type	Characteristics
<b>US - Russell 2000</b>	Jan 2005 - July 2024	Bloomberg	Lit and dark daily aggregated trades	Small-cap stocks
<b>US - S&amp;P 500</b>	Jan 2005 - July 2024	Bloomberg	Lit and dark daily aggregated trades	Large-cap stocks
<b>UK - FTSE 100</b>	Jan 2019 - July 2024	Bloomberg	Lit and off-exchange daily aggregated trades	Large-cap stocks
<b>Brazil – RLP</b>	Jan 2020 - July 2024	Market Data Services (BTG Pactual)	Lit and RLP daily aggregated trades	Future contracts
<b>South Africa - JSE (FTSE subset)</b>	Jan 2019 - July 2024	Bloomberg	Lit and hidden daily aggregated trades	Mixed-cap stocks
<b>NYSE – Tick Size Pilot Program</b>	April 2018 and March 2019	FINRA	Lit and dark tick data	Stocks with \$3.0 billion or less market cap and a closing price of at least \$2.00

## 4.3. Liquidity

Liquidity is measured by the bid-ask spread [CVM \(2024\)](#) and the liquidity ratio used by [Monetary Authority of Singapore \(2019\)](#). The bid-ask spread reflects the difference between the highest price a buyer is willing to pay and the lowest price a seller will accept; narrower spreads generally indicate higher liquidity, allowing for more efficient trading. For analysis, bid-ask spread was calculated as difference between best bid price and the best ask price, scaled by the midpoint price which is the price between the best bid price and best ask price. The calculation considered was a slight modified version of bid-ask spread mentioned used by [Monetary Authority of Singapore \(2019\)](#).

$$\text{Bid-ask spread (bps)} = \frac{\text{ask price} - \text{bid price}}{\text{midpoint price}} * 1000$$

Other Bid-ask spread metrics considered was average of bid-ask spread (%) a metric derived directly from Bloomberg, defined as average of all bid/ask spreads taken as a percentage of the mid-price All the spread metrics were measured in percentage points. For liquidity analysis using bid-ask spread, the method considered was correlation to determine a preliminary association. Due to the presence of trend ([non-stationary](#)) in the dark trade volume, a difference rather than level or a lag was considered to make the variable stationary.

For further robustness, regression was used with liquidity ratio as independent variable. The liquidity ratio assesses the market's ability to absorb large trades without significant price impacts, with higher ratios signifying greater liquidity. The liquidity ratio derived from [Monetary Authority of Singapore \(2019\)](#) is a modified version illiquidity measure described by [Amihud \(2002\)](#). [Amihud's \(2002\)](#) illiquidity metric is a measure of price impact scaled by traded dollar volume, and therefore captures depth and resiliency. [Monetary Authority of Singapore \(2019\)](#) defined liquidity ratio as,

$$\text{Liquidity Ratio (\$/1\%)} = \frac{\text{Lit Trade Value}}{\text{true range \%}}$$

Unlike traditional measures that rely solely on absolute stock returns, this ratio incorporates a broader definition of price movement through the true range (tr), defined as the maximum of three components: the daily range (the difference between the daily high and low), the absolute difference between



the previous closing price and the daily high, and the absolute difference between the previous closing price and the daily low. By doing so, the liquidity ratio captures the relationship between price changes and trading volume. This metric is crucial for understanding market behaviour, as it highlights the ease or difficulty of buying or selling a security without significantly impacting its price, thereby helping investors assess the risks associated with trading illiquid assets, especially in volatile conditions. A higher liquidity ratio suggests that a larger amount of trading value occurs for a given range of price movement, indicating higher market liquidity.

Further for a more robust analysis, a monthly panel regression<sup>2</sup> with fixed effects for time and individual stocks was performed having the liquidity measures as the dependent variable and dark trading proportion and volatility as the independent variable similar to the empirical methods of [Monetary Authority of Singapore, 2019](#)), and [Comerton-Forde and Putniņš \(2015\)](#)

$$y_{it} = \beta_1 + \beta_2 (\text{Dark trade proportion}) + \beta_3 (\text{volatility})_{it} + \text{lag}(y_{it})_{-1} + \alpha_i + \alpha_t + u_i$$

where  $y_{it}$  refers to the lit market liquidity metric - liquidity ratio (see [Monetary Authority of Singapore, 2019](#)). Other regression variables control for factors known to affect market quality to enable the effects of dark trading activity and internalisation to be cleanly captured ([CFA Institute, 2012](#)). Specifically, volatility measured by daily price range divided by average of open and close price was used as control variable. Volatility is controlled for because higher

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<sup>2</sup> All the tests and regressions performed in the report were conducted on E-views

volatility is thought to increase spreads and reduce depth ([Chordia et al., 2000](#)). [CFA Institute \(2012\)](#) states, intuitively, the risk of holding inventory is greater the more volatile the stock. Market makers compensate for this risk by widening the spread or by quoting in smaller sizes. In other words, higher volatility is associated with lower liquidity.

**Table 6** below represents the liquidity analysis performed for different indices.

**Table 6: Snapshot of liquidity tests performed**

Index	Test Performed
Russell 2000	Lagged bid-ask spread – Correlation Liquidity Ratio - Regression
JSE	Average bid-ask spread (%) – Correlation
FTSE 100	Liquidity Ratio – Regression
S&P 500	Liquidity Ratio – Regression
RLP	Liquidity Ratio – Regression

**4.3.1. Data transformation & model enhancements**

As most of the variables and the liquidity metrics exhibit heavy skew, a Box-Cox transformation with relevant lambda was used for liquidity ratio, volatility and dark trade proportion. The Box-Cox transformation ([Box & Cox, 1964](#)) represents a family of power transformations that incorporates and extends the traditional options to help researchers easily find the optimal normalising transformation for each variable. As such, Box-Cox represents a potential best practice where normalising data or equalising variance is desired

$$y(\lambda) = \frac{y^\lambda - 1}{\lambda}, \text{ if } \lambda \neq 0;$$

$$y(\lambda) = \log y, \text{ if } \lambda = 0$$

where the parameter  $\lambda$  yields independent variable  $y$  with minimum skewness ([Gonçalves & Meddahi, 2011](#)). The Box-Cox transformation helped to equalise variances and improved the overall fit of our regression model by reducing skewness in the distribution of the dependent and independent variables.

Further for robustness, we consider several diagnostic tests and adjustments within the model. Coefficients were checked for significance using p-value which provides insight into the statistical significance of each predictor variable in the regression model.

- P-value check: This helped determine the statistical significance of predictor variables. Following, [Wooldridge \(2016\)](#) significance thresholds used were:
  - $P < 0.01$  (1% confidence) – Strong significance
  - $P < 0.05$  (5% confidence) – Moderate significance
  - $P < 0.10$  (10% confidence) – Weak significance
- R-squared & Adjusted R-squared: We used R-squared to measure how well the independent variables explain the variance in the dependent variable. Higher values suggest a better fit, but we also relied on Adjusted R-squared, which accounts for model complexity and provides a more accurate measure.

- T-statistic and F-statistic: The significance of individual variables was assessed using the t-statistic, testing whether the estimated coefficients differed from zero. For large samples ( $n > 30$ ), a t-statistic greater than 1.96 at the 5% significance level (95% confidence interval) indicates statistical significance, as per [Cohen et al. \(1998\)](#). The following thresholds apply:
  - Greater than 1.96 for 5% level of significance and greater than 2.576 for 1% level of significance
  - Greater than 1.645 for 10% level of significance

The F-statistic was employed to assess the overall significance of the regression model. A significant F-statistic, exceeding specific critical values, indicates that the independent variables collectively have a significant impact on explaining the variation in the dependent variable. This suggests that the model provides a better fit than a model without any predictors, thus validating the inclusion of the explanatory variables ([Greene, 2018](#)). The F-test, therefore, serves as a key measure of the model's overall explanatory power.

Finally, after all the statistical checks, the model issues were identified and addressed for endogeneity, autocorrelation and heteroscedasticity.

- **Endogeneity:**

One of the key challenges in studying the impact of dark trading on market quality is endogeneity, where dark trading is endogenous to the prevailing market conditions. For instance, periods of high volatility or illiquidity might encourage increased dark trading, complicating efforts to isolate the direct effect of dark trade on market quality. Without addressing endogeneity, the

results could be biased, as the relationships observed might be driven by unobserved market factors.

To address this issue, we included lagged endogenous variables as instruments in the regression model, a common practice in microstructure studies to mitigate the influence of endogeneity on the model estimates ([Foley & Putniņš, 2016](#)). These lagged variables help capture the dynamic relationship between market conditions and dark trading, thereby improving the model's accuracy in isolating the true effect of dark trading.

- **Autocorrelation:**

We used the Durbin-Watson test to check for autocorrelation, which occurs when residuals (errors) are correlated, potentially skewing results. The Durbin-Watson statistic ranges from 0 to 4, where a value around 2 indicates no autocorrelation, and values below 2 suggest positive autocorrelation ([Durbin and Watson, 1950](#)). Introduction of lagged variable helped further to reduce autocorrelation.

- **Heteroscedasticity:**

Heteroscedasticity refers to the circumstance where the variance of the residuals is not constant across all levels of the independent variables. This condition can lead to inefficient estimates and biased standard errors, affecting the reliability of hypothesis tests.

To address heteroscedasticity, standard errors were clustered in this analysis. This approach accounts for potential non-constant variance and

intra-group correlation, yielding robust standard error estimates and enhancing the reliability of the coefficient estimates ([White, 1980](#)).

- **Residual analysis:**

For validating the regression model, a residual analysis was conducted, whereby examining the distribution and skewness of the residuals, it is assessed whether the residuals are normally distributed. Ideally, residuals should exhibit a symmetric distribution centered around zero, with a skewness value near zero.

If residuals show patterns, this might imply model misspecification, which could be resolved by incorporating further lags or transformations (such as Box-Cox) to stabilise variance across variables.

## 4.4. Market volatility

For volatility and price changes, we utilise data sourced from Bloomberg.

Volatility is measured as the difference between the highest and lowest index prices during each trading day. To align with our focus on dark trades during periods of market stress, we classify days with significant price swings as high volatility days, while days with frequent minor fluctuations around a stable price level are categorised as low volatility days.

Following the methodology outlined by [Petrescu \(2017\)](#). In this paper, volatility is defined as:

$$Volatility = \frac{P_{max} - P_{min}}{(P_{close} + P_{open})/2}$$



where  $P_{max}$  and  $P_{min}$  represent the maximum and minimum index prices during a given period, while  $P_{close}$  and  $P_{open}$  denote the closing and opening prices, respectively

To further identify the stress periods, we used the CBOE Volatility Index (VIX) which serves as a widely recognised measure of expected volatility in the U.S. equity markets. Specifically, the VIX quantifies the implied volatility of the S&P 500 (SPX) over the next 30 days, providing an estimate of the range within which market prices are likely to fluctuate. A higher VIX indicates a broader range of potential market movements, reflecting elevated uncertainty, while a lower VIX suggests more stable conditions with narrower price fluctuations.

Often referred to as the "fear gauge," the VIX tends to spike during periods of market distress, as implied volatility rises when investors anticipate larger swings in asset prices. This makes the VIX a useful proxy for market sentiment, particularly in capturing periods of heightened worry or uncertainty.

Conversely, when stock prices are rising or market conditions are calm, the VIX typically declines or remains at lower levels. In this way, the VIX is often negatively correlated with stock market performance. ([S&P Global, 2024](#))

For instance, during the onset of the COVID-19 pandemic in March 2020, the VIX reached an unprecedented high of 82.69, reflecting extreme market uncertainty as investors grappled with the global economic fallout.

Historically, a VIX value above 50 is often associated with extreme market uncertainty and volatility, as observed during major crises such as the 2008 global financial crisis, the 2020 COVID-19 pandemic, and other significant

economic downturns. However, typically a VIX reading of 30 or higher typically reflects heightened fear and panic in the markets, signalling severe investor risk aversion and potential liquidity disruptions ([S&P Global, 2024](#)). Our samples each include a dramatic decline in the stock market and elevated uncertainty, associated with the Great Financial Crisis in 2009 and the COVID pandemic in 2020, followed by a steady recovery. Volatility spiked during the rapid stock market decline in the first half, particularly during 2020. ([Buti et.al., 2022](#)) Periods covered in the sample allowed us not only to study if and how dark trading has changed over time, but also to examine the role of dark trading during periods of market stress.

#### **4.4.1. Correlation analysis**

To investigate the relationship between dark trades and market volatility, we began by calculating a rolling correlation between dark trade volume and volatility. Following [Petrescu et al. \(2017\)](#), the dark trade volume analysed is considered at the level rather than at a difference, as previously mentioned.

Correlation coefficient ( $r$ ) quantifies the statistical relationship between two variables representing the strength and direction of their association. The value of the coefficient ranges from +1.0 to -1.0, where the magnitude indicates the strength of the relationship, and the sign indicates its direction. A negative correlation coefficient ( $r < 0$ ) signals an inverse relationship between the variables, meaning that as one variable increases, the other decreases, and vice versa. Conversely, a positive correlation coefficient ( $r > 0$ ) reflects a direct relationship, where both variables move in the same direction—when one increases, the other also increases, or when one decreases, so does the other.

When the correlation coefficient is 0, it suggests no linear relationship between the variables, implying that changes in one variable do not systematically correspond with changes in the other. As a thumb rule, correlation ranging from 0.4 to 0.7 is considered moderate correlation, with substantial relationship whereas a correlation coefficient of 0.7 to 0.8 is termed as strong and high correlation, marked relationship as defined in **Table 7**.

**Table 7: Correlation coefficient descriptions**

Correlation Co-efficient	Implication
<b>0 to 0.2</b>	Slight correlation, negligible relationship
<b>0.2 to 0.4</b>	Low correlation, definite but small relationship
<b>0.4 to 0.7</b>	Moderate correlation, substantial relationship
<b>0.7 to 0.9</b>	High correlation, marked relationship
<b>0.9 to 1</b>	Very high correlation, very dependable relationship

Source: (Overholser and Sowinski, 2008)

For our investigation, the analysis was conducted on a rolling window basis with a period of eight quarters, spanning from July 2008 to September 2009 to capture the impact of the financial crisis and from June 2019 to June 2022 to capture impact of COVID-19, for Russell 2000. The objective was to test whether dark trades absorb or amplify volatility, particularly during periods of market stress. By introducing a one-quarter lag in dark trade volume, we demonstrated that past values of volatility exert an additional explanatory effect on dark trading ([Petrescu et.al., 2017](#)). The lag in dark trade volume helped us to better capture the delayed effects of volatility on trading activity.

Given the complex relationship between market volatility and trading behaviour, it is reasonable to assume that traders and institutional participants in dark trades might not respond instantaneously to changes in market conditions. A lagged variable allows us to account for the possibility that the impact of volatility on dark trading is distributed over time. The correlation was further conducted on Johannesburg Stock Exchange (JSE) with same set of variables, to observe the impact of dark trading on volatility in emerging markets. Although widely used, the correlation coefficient has its limitations, primarily because it only measures linear relationships ([Australian Bureau of Statistics, 2023](#)).

#### **4.4.2. Granger causality test**

Causality is a concept in statistics that is often misunderstood and misapplied, with many people erroneously assuming that a correlation in data implies a causal relationship. Causation signifies that one event directly results from the occurrence of another, establishing a cause-and-effect relationship between the two events. The theoretical distinction between correlation and causation is straightforward—where one event can either cause another or simply correlate with it—misinterpretations frequently arise in practical applications ([Australian Bureau of Statistics, 2023](#)).

To further assess the direction of relation between dark trade and volatility, we employed the Granger causality test ([Petrescu et.al., 2017](#)). The test helps to determine whether past values of dark trading proportion have predictive power over volatility. Dark trade proportion is defined as the share of dark trades relative to the total volume of trades, while volatility was calculated

using the formula mentioned previously. The formula allowed us to capture the intraday price range relative to the average of the opening and closing prices.

The Granger causality test was performed using time series data on both variables. The core idea behind the Granger test is to assess whether lags of one variable (in this case, dark trade proportion) can explain the future behavior of another variable (volatility). By incorporating lagged values of dark trades, we tested whether historical dark trade activity helps in predicting future volatility.

The Granger causality test could be one sided or two sided depending on whether the relationship between the growth in the dark trade volume proportion and volatility results in acceptance or rejection of both the hypothesis tested i.e. i) Dark trading does not Granger cause volatility and ii) Volatility does not Granger cause dark trading. If both hypotheses are rejected, this would indicate a bidirectional (two-sided) relationship, where each variable, dark trade proportion and volatility influences the other. If only one of the hypotheses is rejected, it suggests a unidirectional (one-sided) causality. Therefore, a two-sided Granger causality test investigates whether there is mutual influence, whereas a one-sided test focuses on a single directional effect.

Before conducting the Granger causality test, it was essential to ensure that both variables, dark trade proportion and volatility, were stationary.

Stationarity is a fundamental prerequisite in time series analysis, as non-stationary data may lead to misleading and spurious results, including inflated regression coefficients and false significance levels. A stationary time series

has a constant mean, variance, and autocovariance over time, whereas a non-stationary series may exhibit trends or variance that changes over time.

To verify the stationarity of the time series, we applied the Augmented Dickey-Fuller (ADF) test, which is widely used for unit root testing. The ADF test extends the basic Dickey-Fuller test by including lagged differences to account for autocorrelation, as outlined by [Ibrahim \(2000\)](#), who states that “to check for stationarity, the Augmented Dickey-Fuller test is commonly applied” ([Ibrahim, 2000, p. 40](#)). The null hypothesis of the ADF test is that the series contains a unit root, indicating that it is non-stationary. Conversely, the alternative hypothesis suggests that the series is stationary. Financial data often exhibit trends over time; therefore, the trend and intercept specification were primarily used for the ADF test. According to literature, financial time series data frequently display deterministic trends and are better modelled with trend and intercept components ([Hamilton, 1994](#); [Granger & Newbold, 1974](#)).

The ADF test was conducted on both the dark trade proportion and volatility series in. We selected the appropriate lag length using the Akaike Information Criterion (AIC) to avoid overfitting while capturing the necessary dynamics of the series. The lag selection process was critical because an incorrect lag length could bias the results of the ADF test. The critical values for the ADF test were compared against the test statistic to determine whether the null hypothesis could be rejected. The ADF test revealed that volatility was stationary at level. However, for the dark trade proportion, the null hypothesis of a unit root could not be rejected, indicating non-stationarity. Non-

stationarity can arise from the presence of trends or evolving volatility in the series, which would distort the results of subsequent tests like Granger causality.

Since non-stationarity was detected in our case on dark trade proportion variable, by applying first differences, we eliminated any trends or stochastic drifts in the time series, thereby converting it into a stationary form. After differencing, we re-ran the ADF test to confirm the stationarity of the transformed series. With stationary variables and optimal lags, the Granger causality test was conducted assessing whether dark trading proportions Granger-cause volatility and vice versa. The Granger causality tests results were analysed based on p-values.

## **4.5. Information efficiency and price discovery**

To measure the informational efficiency, we employed two high-frequency metrics: autocorrelations of mid-quote returns and variance ratios. These metrics help quantify the degree to which stock prices deviate from random walk behaviour, indicating the presence of inefficiencies such as underreaction or overreaction to new information.

In 1965, Paul Samuelson suggested that, in an informationally efficient market, price changes must be unforecastable if they are properly anticipated in line with Fama (1969) encapsulation that “efficient market is a market which adjust rapidly to new information.” We calculate the informational efficiency measures for each stock-day using intraday data. While return predictability



effectively captures permanent price movements toward fundamental value, autocorrelation and variance ratio measures capture both temporary and permanent price movements. At high frequencies, autocorrelations and variance ratios are likely to be significantly influenced by temporary price movements, reflecting not only informational efficiency but also illiquidity. Therefore, we also consider low-frequency informational efficiency measures, which are less prone to this issue. However, using high-frequency metrics is crucial to maximising the statistical power of our tests.

[Rösch et al.\(2013\)](#) provide evidence that intraday informational efficiency metrics are highly correlated with low-frequency measures and distinct from liquidity measures. Similarly, [Anderson et al. \(2013\)](#) finds that partial price adjustments, such as slow price adjustment and overshooting—implying a degree of informational inefficiency—are a major source of positive and negative autocorrelations. In robustness tests, we confirm that our results hold at lower frequencies (estimating the measures for each stock-month using daily data), although these tests have lower statistical power and precision. ([Comerton-Forde et al., 2015](#)).

### **4.5.1. Autocorrelation**

Autocorrelations of mid-quote returns serve as an indicator of price inefficiency, measuring the extent to which returns are predictable based on past information. Positive or negative autocorrelations imply that price adjustments are not fully instantaneous and may reflect either underreaction or overreaction to information, consistent with the partial price adjustment hypothesis ([Anderson et. al. 2013](#)). Autocorrelations that deviate significantly

from zero suggest that prices do not follow a random walk, indicating informational inefficiency.

We compute the first-order autocorrelation for each stock-day at intraday intervals of 30 seconds and 60 seconds, following the approach of [Foley and Putniņš \(2016\)](#). The formula for the autocorrelation of mid-quote returns at frequency,  $k$  is as follows:

$$\text{Autocorrelation}_k = |\text{Corr}(r_{k,\tau}, r_{k,\tau-1})|$$

Where  $r_{k,\tau}$  represents the  $\tau$ -th midquote return at time interval  $k$  within a stock-day. We use the absolute value of the first-order autocorrelation as a measure of informational efficiency, where larger values suggest greater inefficiency. This approach captures both underreaction and overreaction, with values closer to zero indicating greater market efficiency. Relevant studies that underpin this methodology include [Foley and Putniņš \(2016\)](#), Forde and Putniņš (2015), and [Anderson et al. \(2013\)](#).

#### **4.5.2. Variance ratio**

Aligned with the methodologies of [Ibikunle et al. \(2021\)](#), [Foley and Putniņš \(2016\)](#), [Comerton-Forde and Putniņš \(2015\)](#), [O'Hara and Ye \(2011\)](#) and [Lo and MacKinlay \(1988\)](#), we employ the variance ratio as a proxy for informational or price efficiency. In an efficient market, stock prices follow a random walk, meaning that the variance of returns over longer time horizons should equal the sum of variances over shorter horizons. As a result, variance ratios closer to one suggest higher informational efficiency, while values above one

indicate lower efficiency. We anticipate that informational efficiency will improve as pricing noise diminishes ([Ibikunle et al., 2021](#)).

The variance ratio for each stock-day is calculated using different intraday return frequencies (30 seconds and 60 seconds), as outlined in [Lo and MacKinlay \(1988\)](#). The formula is given by:

$$\text{Variance Ratio}_{kl} = \left| \frac{\sigma_{kl}^2}{k\sigma_1^2} - 1 \right|$$

Where  $\sigma_1^2$  and  $\sigma_{kl}^2$  represent the variances of 1-second and kl-second mid-quote returns, respectively. Higher variance ratio values correspond to greater inefficiency. For this study, we computed two variance ratios for each stock-day, using combinations of the 30-second and 60-second frequencies.

A panel regression was used further to identify the relationship between the informational proxies and dark trading with fixed stock effects.

$$y_{it} = \beta_1 + \beta_2 (\text{Dark trade proportion}) + \beta_3 (\text{volatility})_{it} + \beta_4 (\text{time}) + \beta_5 \ln(\text{dollar volume}) + \varepsilon_{it}$$

Where  $y_{it}$  is the dependent variable autocorrelation and variance ratio. Dark trade proportion is the volume of dark trading divided the aggregate market traded volume. Following [Foley and Putniņš \(2016\)](#) we used time as a control variable, time takes the value zero on the first day in the sample and increments by one every subsequent day. It removes general time-series trends in dark trading and in market quality. The other control variables are \$Volume (the natural log of traded dollar volume), Volatility (the stock day's high-low price range divided by average of open and close price of the day).

## 5. Findings & Implications

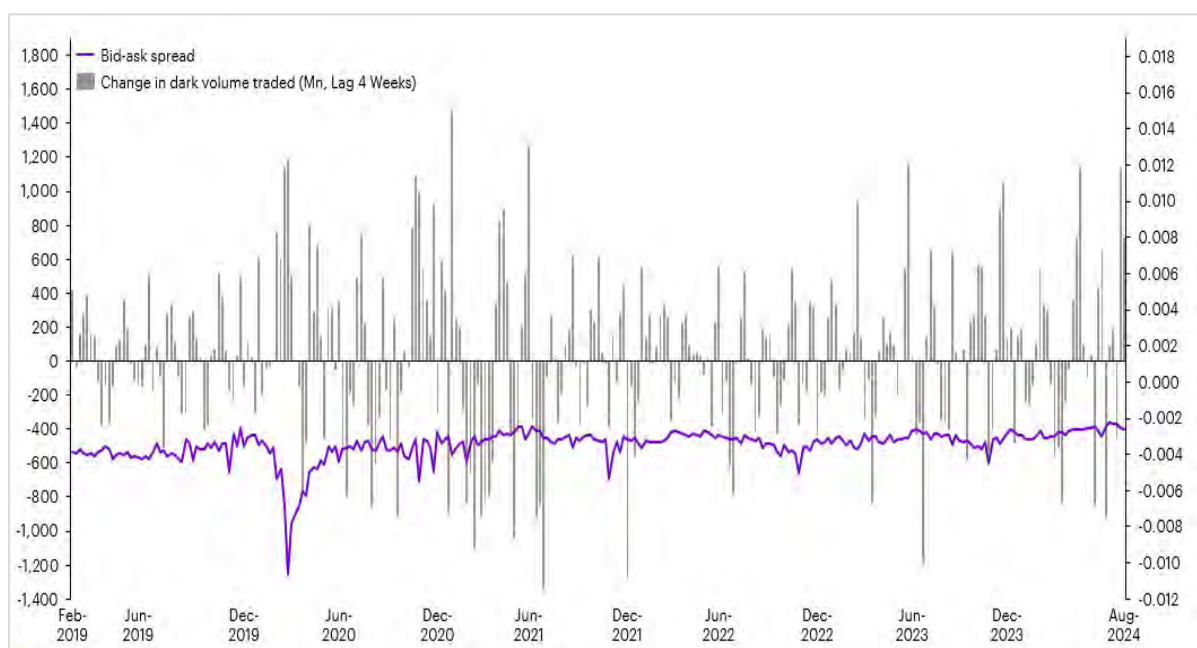
The study indicates that an increase in trade internalisation (or dark trading) across international exchanges is generally associated with improvements in key market metrics. Regulation has therefore accommodated the growth of dark trading alongside the lit exchanges to attract different segments of investors. For instance, the SEC recognises that regulation should accommodate market innovation and “not stifle innovation” ([Macey and O’Hara, 1999, p. 23](#)). This is consistent with the findings from our interview with Capstone ([Appendix D](#)), which indicate that the SEC recognises the benefits of trade internalisation. These benefits include price improvement, liquidity enhancement, and overall market quality. As a result, the SEC does not aim to systematically eliminate trade internalisation.

The findings from the correlation analysis, causality tests, and panel regressions outlined in [Chapter 3](#) (Methodology), suggest a strong association between dark trading volumes, and proxies, with enhanced liquidity, reduction in volatility, and improvements in price formation. These results provide empirical support for our hypotheses ([Chapter 3](#)), highlighting the significant role that dark trading plays in shaping market conditions particularly regarding liquidity, volatility, and price formation. The nuanced relationship between dark trading volumes and these liquidity measures becomes evident as we delve into the findings more closely, offering new insights into the practical implications for both emerging and developed markets.

## 5.1. Liquidity – spread and ratio

By examining key liquidity metrics, such as bid-ask spreads and liquidity ratios, we can better understand the mechanisms through which dark trading influences overall market liquidity conditions.

**Figure 30: Weekly change in dark trading volume and bid-ask spread of Russell 2000**

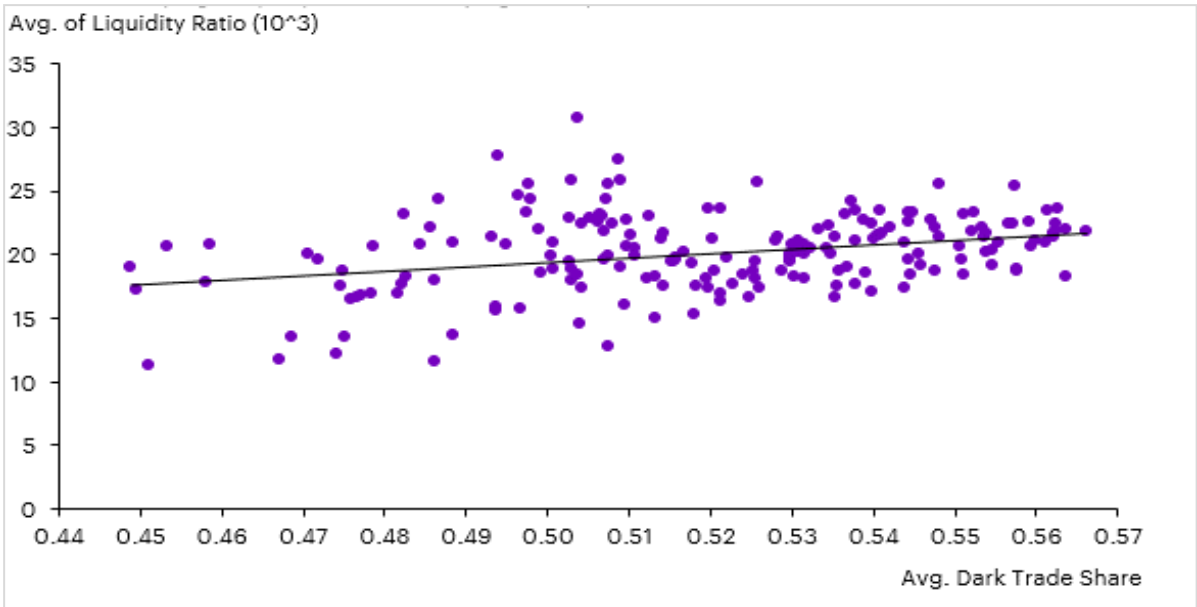


Source: Bloomberg and Accenture Strategy analysis

The analysis of the Russell 2000 market highlights a notable correlation between dark trading volume and market liquidity (**Figure 30**). This contradicts the earlier findings of [Degryse \(2015\)](#) and [CVM \(2024\)](#) who suggests that an increase in the level of opaque trading would reduce the aggregate liquidity of the fragmented market based on depth and spread. A preliminary examination revealed a negative correlation coefficient of -0.2 between the bid-ask spread and a four-week lag in dark trading volume, suggesting that increased dark

trading may coincide with a narrowing of the bid-ask spread. This trend indicates lower trading costs and greater market liquidity, particularly in the context of small-cap stocks.

**Figure 31: Positive association of dark trade share and liquidity ratio in Russell 2000**



Source: Bloomberg and Accenture Strategy analysis

Note: The Figure captures the movement of monthly avg. of liquidity ratio with monthly avg. of dark trade share and outliers were removed

To validate these observations, regression analysis was performed using the liquidity ratio as a proxy for market liquidity, in line with the approach taken by [Monetary Authority of Singapore \(2019\)](#). The regression outcomes, displayed in **Table 8**, indicate some association between dark trading volume and the liquidity ratio within the Russell 2000.

**Table 8: Estimates from instrumental variables regressions in Russell 2000**

$$\text{Liquidity Ratio} = -1.75 + 4.68 \cdot \text{Dark Pool Share} - 9.9 \cdot \text{Volatility} + 0.82 \cdot \text{Liquidity Ratio} (-1) + [CX=F, PER=F] + \alpha_i + \alpha_t + u_i$$

Variable	Coefficient	Std. Error	t-Statistic	P-value
Constant	-1.75	0.48	-3.6	
Dark Trade Volume Proportion	4.68**	0.14	34.3	<0.05
Volatility	-9.9**	0.36	-27.0	<0.05
R-Square	0.936			
Adjusted R-Square	0.935			
Durbin-Watson Stat	2.32			
Fixed Effects	Stock and Period			

Source: Bloomberg and Accenture Strategy analysis

Note: The coefficients calculated for box-cox transformed variables. For more details on transformation refer to Appendix (C)

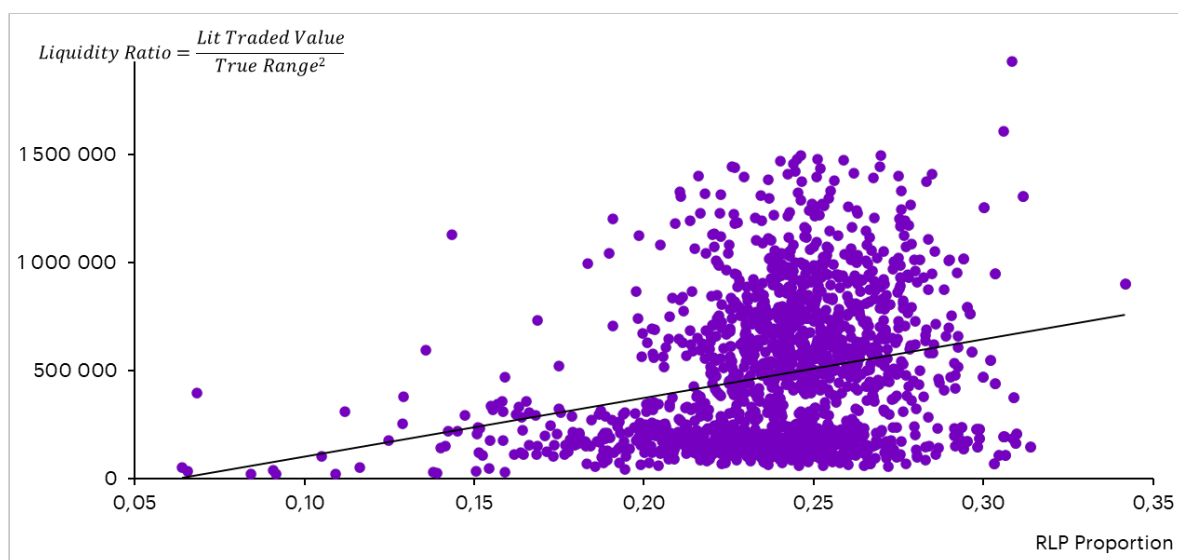
Specifically, the regression analysis using Russell 2000 monthly data from 2005 to 2024 indicates highlight that an increase in the dark trade share leads to an improvement in the liquidity ratio. The model explains 93% of the variability in liquidity, as demonstrated by the R-squared value. Initially, a regression on the raw data yielded an R-squared of 0.67 and a Durbin-Watson statistic of 0.47, suggesting potential autocorrelation issues (Refer [Chapter 3.3.1](#)). However, after introducing a 1-month lagged liquidity ratio as an independent variable, the R-squared improved to 0.93, and the Durbin-Watson statistic rose to 2.32, indicating that past liquidity ratios significantly influence current values.

In the Brazilian market, similar patterns were observed concerning the relationship between Retail Liquidity Provider (RLP) trade volumes and the liquidity ratio (**Figure 32**). A correlation analysis revealed a positive association of 0.531 between these two variables, suggesting that as the volume of trades



executed through RLP increases, the liquidity ratio also rises, and vice versa. This implies that higher RLP trading activity contributes positively to market liquidity, a higher liquidity ratio suggests that a larger amount of trading value occurs for a given range of price movement, indicating higher market liquidity, much like the effects observed in other indices such as the Russell 2000. The regression results further confirm the statistical significance of the relationship between RLP trade volume share and the liquidity ratio, reinforcing the positive influence of RLP trading on market liquidity. The regression results further confirm the statistical significance of the relationship between RLP trade volume share and the liquidity ratio, reinforcing the positive influence of RLP trading on market liquidity.

**Figure 32: Positive association of dark trade share and liquidity ratio in RLP (futures contracts)**



Source: Bloomberg and Accenture Strategy analysis

Note: The Figure captures the movement of daily movement of avg. of liquidity ratio with daily avg. of dark trade share. Outliers were removed.

**Table 9: Estimates from instrumental variables regressions in RLP trade data – Brazil**

$$\text{Liquidity Ratio} = 425406.89 + 1161774.53 \cdot \text{RLP Volume Share} - 12105450.35 \cdot \text{Volatility} + [\text{CX}=\text{F}, \text{PER}=\text{F}]$$

Variable	Coefficient	Std. Error	t-Statistic	P-value
Constant	425406.89	42734.76	9.95	
RLP Trade Volume Share	1161774.53**	152917.2	7.60	<0.05
Volatility	-12105450.35**	1227030	-9.87	<0.05
R-Square	0.968			
Adjusted R-Square	0.869			
Durbin-Watson Stat	2.34			
Fixed Effects	Stock and Period			

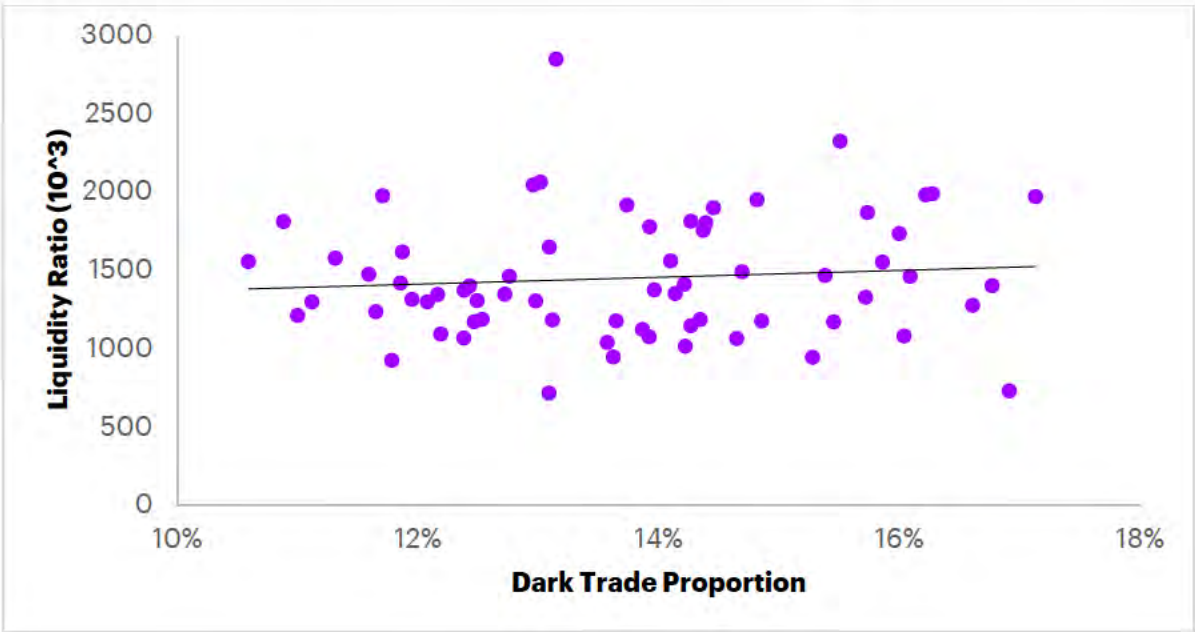
Source: Bloomberg and Accenture Strategy analysis

Note: The coefficients are much higher than Russell 2000 as the variables were transformed because of skewness and regression residuals.

In other markets, a trend similar to Brazil and Russell 2000 were observed, such as the FTSE 100 and S&P 500, illustrated in **Figure 33** and **Figure 34**.

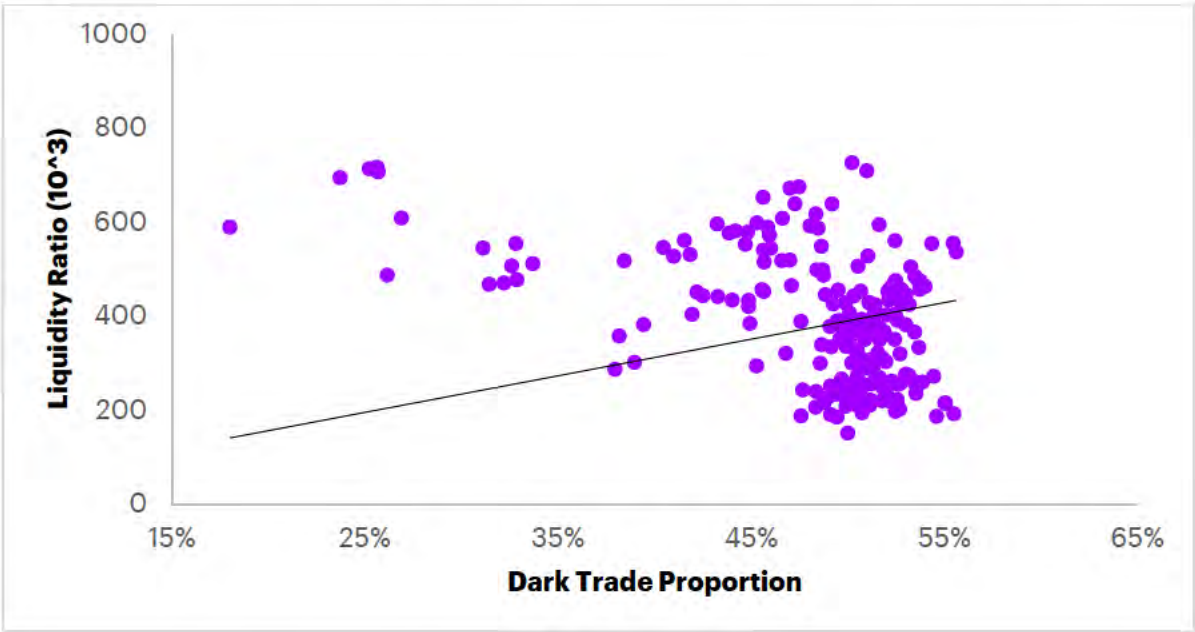
These results suggest a consistent pattern across different international exchanges, where increased dark trading correlates with enhanced liquidity, potentially leading to reduced trading costs and improved market efficiency.

**Figure 33: Positive association of dark trade share and liquidity ratio in FTSE 100**



Source: Bloomberg and Accenture Strategy analysis  
Note: Outliers were removed

**Figure 34: Positive association of dark trade share and liquidity ratio in S&P 500**



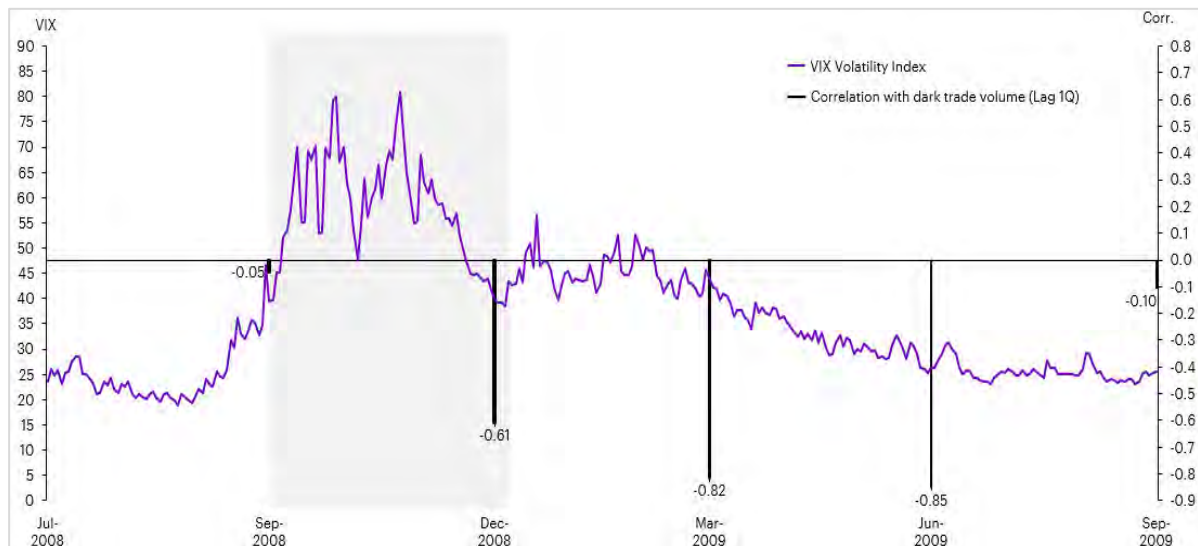
Source: Bloomberg and Accenture Strategy analysis  
Note: Outliers were removed

## 5.2. Market volatility – correlation and causality

Beyond enhancing liquidity, dark trading also appears to contribute to market stability in times of heightened uncertainty. The findings presented in this section indicate that dark trading plays a significant role in absorbing volatility, particularly during periods of market stress. The negative correlation observed in our sample aligns with the results of [Petrescu et al. \(2017\)](#), who also demonstrated inverse relationship through a Granger causality test. The negative correlation between dark trading and volatility suggests that dark trading effectively mitigates market volatility in times of turmoil, while its influence is less impactful during stable conditions (**Figure 35**). For this analysis, dark volume share is considered at its level rather than its difference and lagged by a quarter to get the impact of the past values of dark trading, as outlined in the methodology.

**Figure 35** captures the correlation between dark trade volume and volatility during the 2008 financial crisis in the Russell 2000 index. The rolling correlation with the VIX volatility index over five quarters indicates that dark trading volume had a dampening effect on volatility during this period of heightened uncertainty.

**Figure 35: Correlation between dark trade volume and volatility during 2008 financial crisis in Russell 2000**

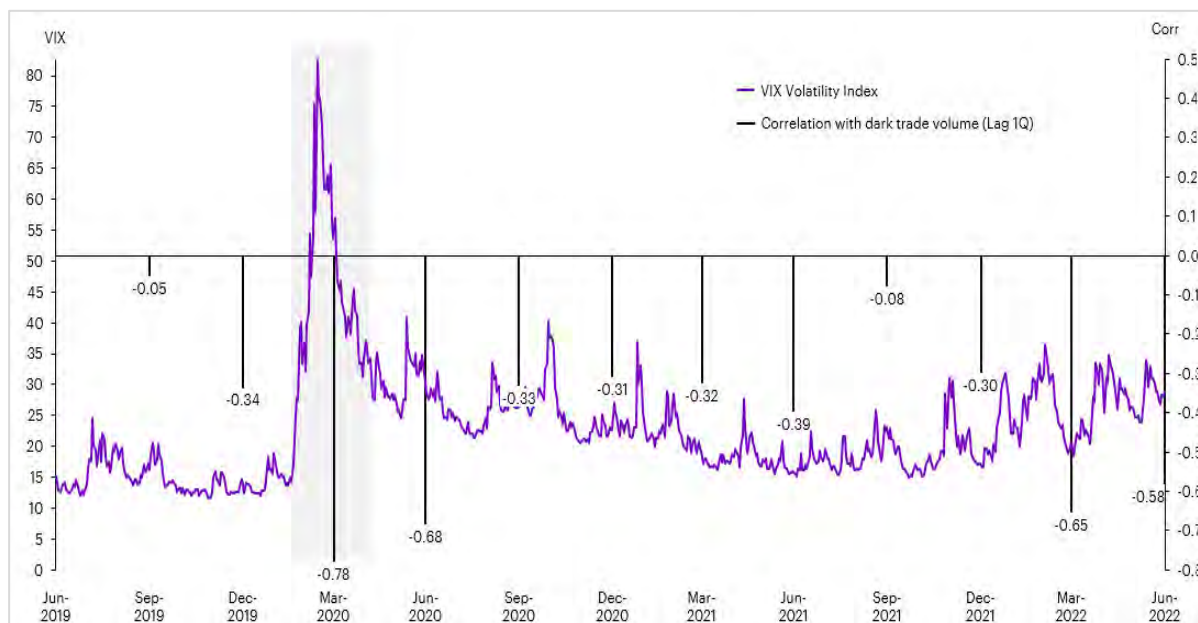


Source: Bloomberg and Accenture Strategy analysis

Note: VIX Volatility index and 5 quarters rolling correlation with Dark trade volume, Russell 2000

Similarly, explores the relationship during the COVID-19 pandemic, with an 8-quarter rolling correlation again showing a strong negative correlation between dark trading and volatility. This highlights that dark trading had a stabilising effect during the pandemic as well.

**Figure 36: Correlation between dark trade volume and volatility during COVID-19 in Russell 2000**

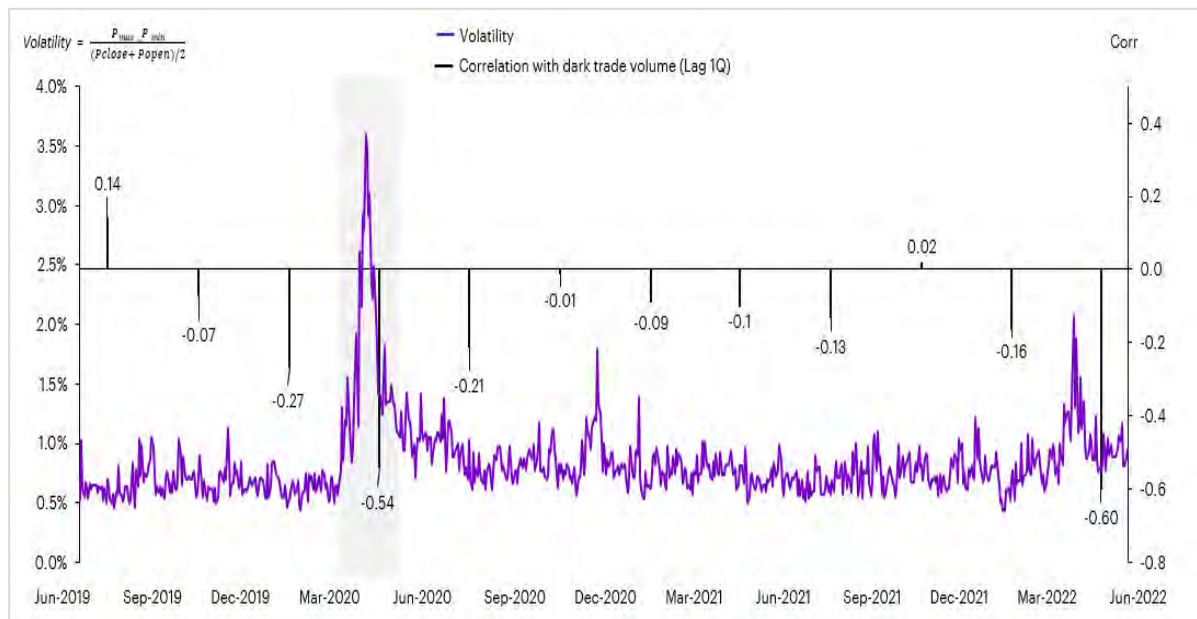


Source: Bloomberg and Accenture Strategy analysis

Notes: VIX Volatility index and 8 quarters rolling correlation with Dark trade volume, Russell 2000

A comparable trend was observed in emerging markets, exemplified by the Johannesburg Stock Exchange (JSE) (**Figure 37**). During the COVID-19 crisis, the correlation was significantly negative, further supporting the hypothesis (H2) that dark trading helps reduce volatility in times of stress, though this effect diminishes during more stable periods.

**Figure 37: Correlation between dark trade volume and volatility during COVID-19 in JSE**



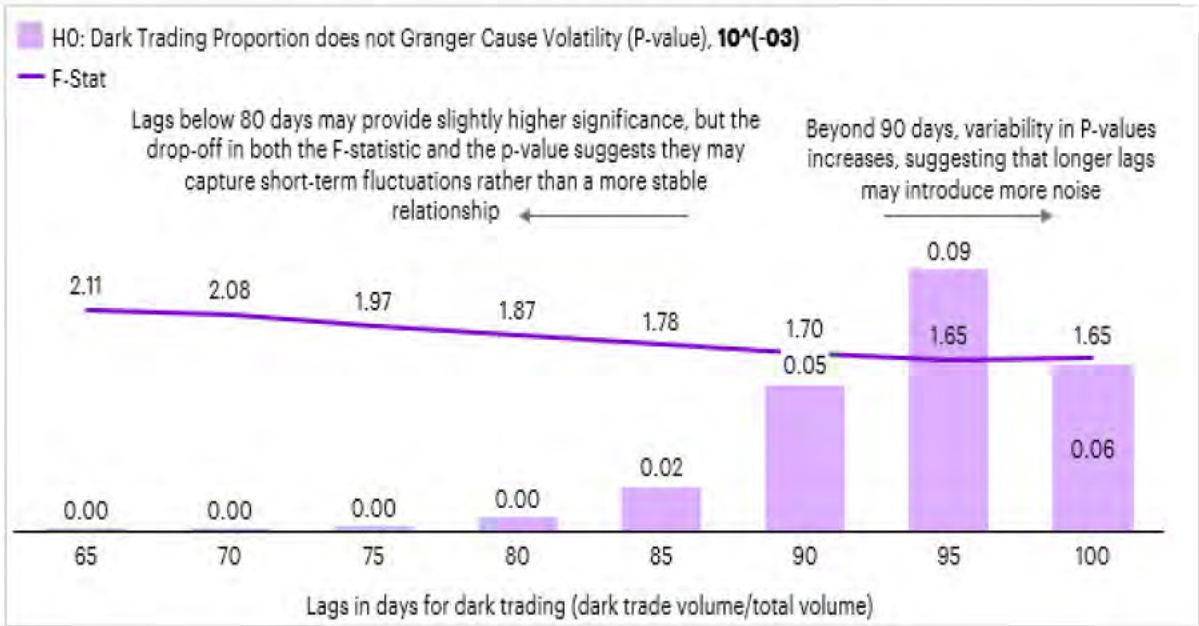
Source: Bloomberg and Accenture Strategy analysis

Notes: Volatility and 8 quarters rolling correlation with Dark trade volume, JSE

Further exploration of the association between dark trading and volatility demonstrates that dark trading Granger-causes volatility (**Figure 38**), as lagged dark trading activity over a 90-day period exhibits considerable explanatory power in forecasting future volatility. The result of the Granger causality, presented in **Table 10** indicates that dark trading proportions significantly Granger-cause volatility (p-value = 0.0002). This suggests a causal linkage between dark trading and volatility. Conversely, the analysis reveals that volatility does not Granger-cause dark trading proportions (p-value = 0.7193). This finding aligns with [Petrescu et al. \(2017\)](#), who identified a similar causal relationship from dark trading to volatility, reinforcing the idea that elevated dark trading activity contributes to a decrease in market volatility.



**Figure 38: P-value and F-stats of Granger causality test for right lag (days) selection of dark trading – Russell 2000**



**Table 10: Granger causality test - Russell 2000**

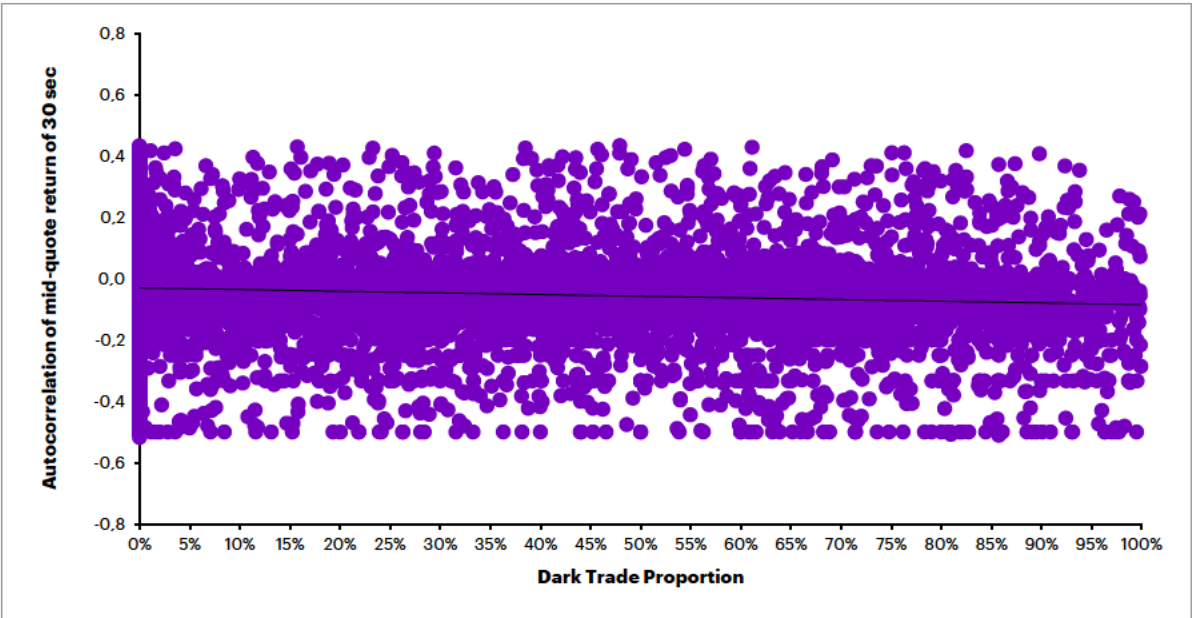
Pairwise Granger Causality Tests			
Sample: 1/03/2005 8/13/2024			
Lags: 90 days			
Null Hypothesis:	Obs	F-Statistic	Prob.
Dark Trading does not Granger Cause Volatility	5025	1.7	0
Volatility does not Granger Cause Dark Trading		0.91	0.71

### 5.3. Information efficiency – autocorrelation and variance ratio

While dark trading helps to absorb volatility and improve liquidity, its influence extends further into improving price formation (defined by information efficiency). Turning to the informational efficiency proxies—specifically, absolute autocorrelations of mid-quote returns at 30 sec and 60 sec,—the

graph in **Figure 39** and **Figure 40** suggests that dark trading reduces the level of informational inefficiency. A subsequent panel regression in **Table 11**, reveals a p-value  $<0.05$  and negative coefficient suggesting that aggregate dark trading in our sample is statistically instrumental in enhancing informational efficiency. The negative correlation of dark trading and autocorrelation of both 30 sec and 60 sec mid-quote returns in NYSE data contrast with findings of [Degryse \(2015\)](#) and [Weaver \(2011\)](#) that off-exchange reported trades, which mostly represent dark trades, negatively impact the market quality for US stocks. Moreover, the analysis of variance ratio suggested dark trading to be insignificant in determining the variance ratio (Appendix G). Our findings suggesting the beneficial impact aligns with the findings of [Foley and Putniņš \(2016\)](#), further supporting the role of dark trading in promoting market efficiency.

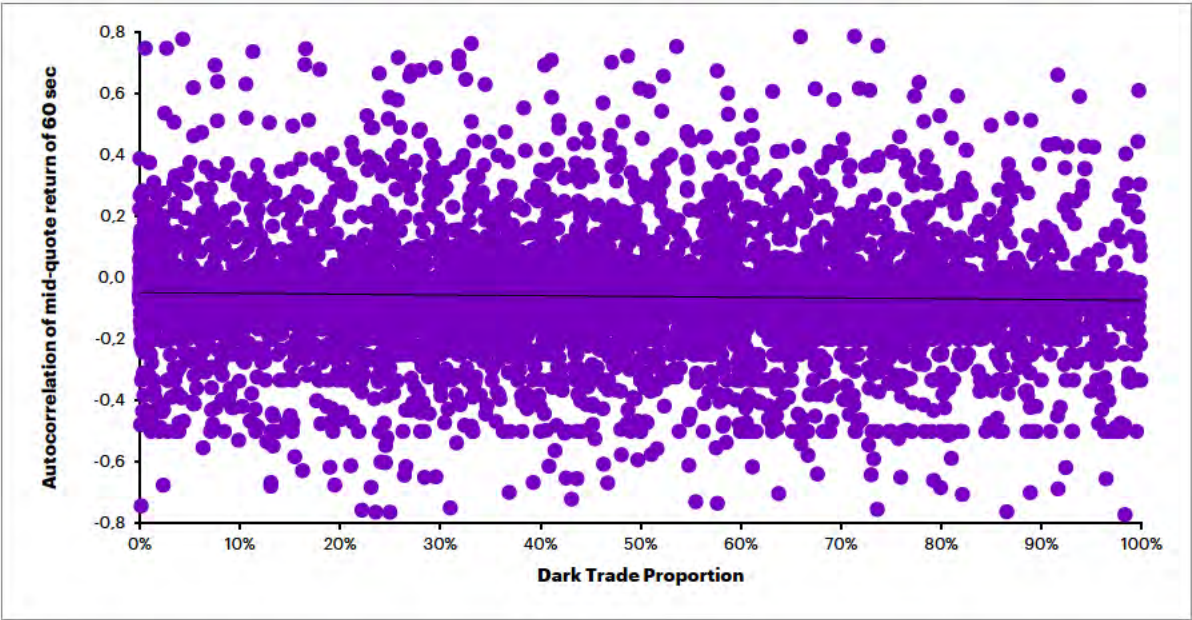
**Figure 39: NYSE Raw data indicates a negative association of dark trade share and autocorrelation (30 Seconds)**



Source: SEC and Accenture Strategy analysis

Note: The graph is showing the movement of daily autocorrelation of mid-quote returns at 30 seconds with dark pool trading in Mar-2019 (whole period not included for the graph as the data is too large to accommodate all 30 sec returns in 1 year in a single plot)

**Figure 40: NYSE Raw data indicates a negative association of dark trade share and autocorrelation (60 Seconds)**



Source: SEC and Accenture Strategy analysis

Note: The graph is showing the movement of daily autocorrelation of mid-quote returns at 30 seconds with dark pool trading in Mar-2019 (whole period not included for the graph as the data is too large to accommodate all 60 sec returns in 1 year in a single plot)

**Table 11: Regression results of dark trading proportion and autocorrelation (30 sec)**

Variable	Coefficient	P-Value	Significant
Constant	-0.50	0.00	
<b>Dark Trade Proportion</b>	<b>-0.01</b>	<b>0.02</b>	<b>Yes</b>
Traded Value	0.04	0.00	Yes
Time	0.00	0.60	No
Volatility	0.22	0.00	Yes



## 6. Discussion

The findings of the empirical analysis ([Chapter 4](#)) contribute to the growing body of literature suggesting that, despite the opacity often associated with trade Internalisation / dark trading, they can play a constructive role in improving market efficiency under certain conditions. This paper delved into the intricate landscape of trade internalisation and its proxies across various geographies, with a specific focus on Brazil. The research was guided by three pivotal research questions that aimed to unravel the complexities and multifaceted roles of trade internalisation and dark trading in financial markets.

### **RQ1: What are the key metrics to measure the impact of trade internalisation?**

The literature review revealed several key metrics that are instrumental in measuring the impact of trade internalisation. These include liquidity ratios, bid-ask spreads, volatility measures, and market quality indicators as frequently cited in [Buti et al. \(2022\)](#), [Ibikunle et al. \(2021\)](#), [Monetary Authority of Singapore \(2019\)](#), [Petrescu et al. \(2017\)](#), [Foley and Putniņš \(2016\)](#), [O'Hara and Ye \(2011\)](#). These metrics in the literature provide a comprehensive framework for understanding the nuanced effects of trade internalisation across different markets, including small and medium companies in major markets. In addition, this method is used in this paper for comparable emerging economies like South Africa and Brazil, in the absence of existing studies. The systematic literature review (SLR) approach, coupled with the

Cochrane methodology, ensured that the identified metrics were robust and free from bias.

## **RQ2: How does the role of trade internalisation vs. lit market differ across countries allowing the practice?**

The examination of trade internalisation across different countries highlighted significant variations in its role and impact. For instance, the U.S. markets, represented by the Russell 2000 and S&P 500 indices, exhibited high levels of dark trading, with means around 60% (

**Figure 3** and **Figure 4**). In contrast, the FTSE 100 in the U.K. showed much lower proportions, averaging 14% (**Figure 7**). This disparity underscores the context-specific nature of trade internalisation and its differential effects across markets. The inclusion of emerging markets like Brazil and South Africa further enriched the analysis, providing insights into how trade internalisation operates in developing economies. In South Africa (JSE), hidden orders (a form of dark trading) account for 22% of total volume in 2024.

In emerging markets such as South Africa, trade internalisation is still at an initial stage and accounting for less share volume than in developed markets with good growth opportunities. The Johannesburg Stock Exchange (JSE) experienced solid growth in dark trading share volume of total trade, increasing from 10% in 2019 to 22% in 2024 (**Figure 5**), whereas in Brazil (RLP for futures contracts) they are 25% of total volume (**Figure 9**).

Some previous studies have compared the benefits of dark trading across different geographies, though most analyses have been limited to one or two

countries. In contrast, our quantitative analysis covers multiple countries and indices, providing a broader perspective on the impact of dark trading across diverse markets. Putninš (2016) notes that the qualitative impact of dark trading—such as reduced quoted, effective, and realised spreads, decreased price impact measures of illiquidity, and enhanced information efficiency (bringing prices closer to a random walk)—is similar in Australia and Canada. [Ibikunle \(2021\)](#) indicates that trades executed in dark pools accounted for 9.1% (April 2019) of all on-exchange activity in European markets. This marked one of the highest monthly volumes recorded since the implementation of a MiFID II provision, which imposes an 8% cap on dark trading stock-level volumes over any 12-month period in European financial markets. By focusing on the UK stock market, they have tried to elucidate the European context. Their findings suggest dark trading is linked with a statistically significant reduction in adverse selection risk and improvements in liquidity and informational efficiency in the aggregate market. These findings align with our results on the impact of dark trading on liquidity. The results suggests that dark trading plays statistically significant role in explaining liquidity for the constituents of UK-FTSE 100. The relationship was also evident in emerging countries like Brazil ( **Table 9**) where and JSE ( [Appendix C](#)). Furthermore, [Brugler \(2015\)](#), mentions for mid-sized and smaller stocks, dark trades result in greater increases in market depth, both in the short run and the long run, compared to trades that occur on the limit order book (LOB), thus more improvement in liquidity. Our findings reveal a similar result, with dark trading in Russell 2000 leading to a narrower bid-ask spread (**Figure 30**) and improvement in liquidity ratio (Error!

Reference source not found.). A significant p-value and high R square and Durbin Watson test suggest the robustness of the results (**Table 8**). Further, a raw regression analysis on Russell 2000 and S&P 500 of the US market revealed dark trading has statistical significance and positive effect on liquidity for small cap – Russell 2000 but not much statistical significance for S&P 500 (Appendix C). Similar proportions of dark trading in both these indices, additionally helped us to conclude for small to mid-cap stocks, dark trading proves advantageous even at elevated levels (e.g., Russell 2000), indicating that, when considering the Russell 2000 as a proxy for the Brazilian market, an increase in transaction volume within RLP causally enhances the liquidity index (liquidity ratio).

The findings of our analysis also coincide with the conclusion of [Monetary Authority of Singapore \(2019\)](#) that dark trading (5-9% of total volume in 2016 in Singapore) is beneficial for small capitalisation stocks—which are typically more illiquid than large-cap stocks—even at relatively high levels of dark trading. Therefore, it can be asserted that dark trading market structure (with a concurrent lit market) is especially beneficial to small market capitalisation stocks which tend to be less liquid than the larger market capitalisation stocks.

### **RQ3: Which benchmarks define the benefits or costs of trade internalisation?**

The literature review underscored the importance of benchmarks in defining the benefits and costs of trade internalisation, i.e., RQ1. Key benchmarks identified include liquidity enhancement, improved price discovery, and reduced volatility. However, concerns about market transparency persist,



highlighting the need for balanced regulatory measures. The analysis of the [CVM \(2024\)](#) report indicated a predominant focus on data analysis and retail investors, with less emphasis on measuring the costs and benefits of trade internalisation. This gap was addressed through the comprehensive literature review ([Chapter 2](#)) and quantitative analysis ([Chapter 4](#)) presented in the subsequent chapters. Analysis of the effect of dark trading on liquidity (Refer section [4.1](#)) uncovered the positive impact on key metrics, bid-ask spread and liquidity ratio. The influence was further substantiated by the negative correlation between dark trading and volatility (Refer section [4.2](#)). The coefficient was more negative on a market stress day compared to less volatile day. The causality was confirmed with significant p-value of dark trading in Granger causality test, the result of which stressed that past values of dark trading explain volatility. The inverse relations identified in the statistical tests confirmed the importance of dark trading on reducing volatility. Similarly, the negative association of dark trading and autocorrelation, a measure of information inefficiency revealed the significance of dark trading in improving price discovery via reducing noise due to shift of uninformed traders to dark venues (Refer section [2.4](#)). The interplay further suggests a reduction in adverse selection in aggregate market and an integration rather than fragmentation of liquidity.

To investigate the research questions further we formulated several hypotheses to conduct a quantitative study aimed to assess the effects of dark trading across international exchanges, particularly in relation to Brazil's market dynamics.

The core hypothesis suggested that increased dark trading would lead to improved market liquidity (H1), reduced volatility (H2), and enhanced information efficiency in the Brazilian stock market context (H3). Adding all this, H4 suggests that trade Internalisation improves liquidity and price discovery, indicating integration rather than market fragmentation.

The findings support the hypotheses and indicate a robust relationship between increased dark trading volumes and improvements in liquidity metrics, decrease in market volatility and enhanced information efficiency. These results provide critical insights into the multifaceted role that dark trading plays in modern financial markets. Importantly, they contest the assumptions in previous literature that often frame dark trading practices as detrimental to market quality.

### **H1: Trade internalisation improves liquidity**

The liquidity analysis uncovers an essential relationship between dark trading and improving liquidity, evidenced by a negative correlation coefficient between dark trading volume and bid-ask spreads of Russell 2000 (**Figure 30**) and JSE (Refer [Appendix](#)). The findings support H1a, which states that increased dark trading enhances market liquidity by tightening bid-ask spreads. The result is consistent with the findings of [Monetary Authority of Singapore \(2019\)](#) and [Foley and Putniņš \(2016\)](#), that dark trading has a negative effect on all the spread measures, suggesting that aggregate dark trading in Canada benefits liquidity. The findings also contradicts the previous literatures like [Biais \(2002\)](#), internalisation reduces liquidity and widen spreads on market

by reducing competitive pressure among liquidity providers in the main market and [Weaver \(2014\)](#), that off-exchange trading is associated with wider spreads, and increased volatility.

The results of the liquidity ratio analysis using data from the Russell 2000 (**Table 8**), Brazilian markets (

**Table 9**), and other international exchanges FTSE 100 and S&P 500 (Refer [Appendix](#)) further upholds the hypothesis H1. With a p-value <0.05 and negative coefficients, regression analysis shows that an increase in the share of dark trading leads to a marked improvement in the liquidity ratio (H1a). This was validated by the results showing rise in dark trading volumes to be associated statistically significantly with increase in the liquidity ratio for Russell 2000 (**Figure 31**) Brazil RLP (**Figure 32**), FTSE 100 (**Figure 33**) and S&P 500 (**Figure 34**).

The results further align with the theoretical underpinnings established by [Monetary Authority of Singapore \(2019\)](#), which suggests dark trading provides additional liquidity sources. The literature states two probable reasons, first, the presence of dark venues encourages the entry of participants who would otherwise not be willing to trade on traditional exchanges (e.g. due to the price impact of their large trades). Second, this additional liquidity could result in liquidity externalities, where “liquidity begets liquidity” ([Monetary Authority of Singapore, 2019](#)). By encouraging a balanced environment where dark trading can reflect its positive effects, regulators can potentially alleviate some of the liquidity constraints investors face in the markets.

Confirming the hypothesis (H1b) and aligned with the conclusion of the [Monetary Authority of Singapore \(2019\)](#) for small to mid-cap stocks, dark trading proves advantageous even at elevated levels (e.g., Russell 2000 - and JSE - Error! Reference source not found.), indicating that, when considering the Russell 2000 as a proxy for the Brazilian market, an increase in transaction volume within RLP causally enhances the liquidity index (liquidity ratio - Error! Reference source not found.). It is interesting to note that our raw variable regression analysis also showed statistical significance of RLP in determining liquidity index but with low values for percentage of variance explained ( $R^2$ ). However, when conducted panel regression on transformed variables the  $R^2$  rose significantly to more than 90% in majority of the cases (**Table 8** and **Table 14**) The coefficients of regression performed on raw variables (without transformation- **Table 14**) further suggest that internalisation can offer a more efficient trading environment for small cap stocks (proxied by Russell 2000 and RLP data), potentially improving their liquidity more significantly than for large-cap stocks (proxied by S&P 500 and FTSE 100 - **Table 14** ), which already benefit from higher liquidity. (Refer to [Appendix C](#)).

Other markets, such as the Johannesburg Stock Exchange (JSE), exhibit similar patterns. On the JSE, dark trading volumes are also negatively correlated with the bid-ask spread (Refer to [Appendix](#) ). Given that South Africa's JSE ranks 19th in global market capitalisation—closely aligned with Brazil's 20th position—this negative correlation strengthens the case for the benefits of dark trading in markets of similar size and trading characteristics.

## **Hypothesis H2: Trade internalisation reduces volatility at times of market stress**

Adding to the benefits of dark trading to liquidity improvement, investigating dark trading's impact on market volatility reveals compelling evidence supporting H2 (**Figure 35**). The findings highlight the potential stabilising role of dark trading during periods of market volatility, reinforcing the argument that dark pools can serve as valuable instruments in mitigating price fluctuations.

The literature notes that dark trading activity tends to decline when market conditions become more volatile (Refer section [2.3](#)). This shift can be attributed to traders' preference for transparent venues following positive volatility shocks, as they seek to adjust their positions more urgently in high-cost, high-immediacy environments like lit markets ([Ibikunle, 2021](#); [Menkveld et al., 2017](#)).

**Figure 3** and **Figure 4** demonstrates the comparison of volume of dark trading in Russell 2000 during COVID-19 as vs. other years.

[Menkveld et al. 2017](#) states in contrast to periods of relative calm, when cost considerations and the anonymity of dark trading may be more attractive, stress periods shift the focus of investors toward achieving immediacy, resulting in increased activity on lit exchanges. This interplay between dark and lit exchange during the stress period supports the hypothesis that dark trading's influence on volatility is context-dependent (H2a), with its role as a volatility dampener being most evident under market stress conditions. The

stabilising function is therefore supported by the high negative correlation of -0.085 between dark trading and volatility during the 2008 crisis (**Figure 35**). During Covid period in both Russell 2000 (**Figure 36** and JSE (**Figure 37**)), i.e., the majority of Johannesburg stock exchange, both of which are comparable to Brazil market characteristics, the correlation coefficient decline to as low as -0.78 and -0.54 respectively.

The statistical significance of dark trading with p-value  $<0.05$  during Granger causality test (**Figure 38**), explaining causality relationship with volatility was further builds on H2b, identifying the nature of the direction of relationship between dark trading and volatility. The result highlighted that past values of dark pool trading have additional explanatory power on volatility, i.e., there is only one-sided causality flowing from dark trading to volatility. The observation was similar to that of [Petrescu \(2017\)](#) suggesting dark trading has explanatory power in predicting (current) volatility whereas no evidence highlights that volatility has explanatory power for trading on dark pools. Thus, asserting that increased dark trading does not increase volatility and dark trading may not be significantly detrimental to market stability in times of stress [Petrescu \(2017\)](#).

On calmer days (less volatility), although the relation is negative (**Figure 36**), the effect is less as explained by less negative coefficients like -0.3 in Q4 2021. During days of low volatility, when the trader migration is less, and the concentration of uninformed traders is more on dark venues, dark trading can

help smooth price discovery and reduce volatility caused by the noise created by uninformed traders on lit venues.

### **Hypothesis H3: Trade internalisation tends to contribute to more accurate price formation**

The role of dark trading in improving market information efficiency is evidenced by the reductions in autocorrelation and variance ratios observed in our study, supporting H3 (**Figure 39** and **Figure 40**). The nature of the data collected from NYSE (SEC Pilot program) with NMS (national market system) common stocks that have a market capitalisation of \$3.0 billion or less, a closing price of at least \$2.00, and a consolidated average daily volume of one million shares or less makes the study closer to Brazil market, where the median market capitalisation is comparable (**Table 3**).

Positive or negative mid-quote return autocorrelations reflect deviations from a stochastic random walk, highlighting short-term return predictability often caused by partial price adjustments to information, including under- and over-reactions ([Foley and Putniņš, 2016](#)). [Comerton-Forde and Putniņš \(2015\)](#) also emphasise that partial price adjustments—whether slow adjustments or overshooting—are significant contributors to informational inefficiency, resulting in positive and negative autocorrelations.

Specifically, our findings (Table 11) suggest that as dark trading activity rises, the degree of 30-sec price autocorrelation (**Figure 39**) and 60-sec price autocorrelation (**Figure 40**) diminishes, indicating that price movements are more reflective of new information rather than noise or other market



inefficiencies. The movement is aligned with the output of [Foley and Putniņš \(2016\)](#), who demonstrated that aggregate dark trading in Canada is beneficial for information efficiency. [Ibikunle et al. \(2021\)](#) expand on this by explaining the migration of uninformed trading volume to dark pools is linked to a reduction in noise in the price discovery process and, thus, an improvement in informational efficiency in the aggregate market. Our findings and literature review thus contradict [Aramian and Nordén \(2021\)](#) that trade internalisation is detrimental to liquidity due to the shift in trading by dealers from exchanges to dealer platforms. The contrast is further corroborated by [Zhu's \(2013\)](#) model suggesting that if all informed traders hold identical information, a reduction in the number of informed trades in the lit market brought about by fewer uninformed traders in the lit market leads to a decrease in the level of competition on the same private information set and improves the market's ability to incorporate information from order flow and thus improves price discovery ([Cometron-Forde and Putniņš 2015](#)). As prices become more efficient and accurately reflect available information, investors are better positioned to make informed decisions, enhancing overall market functionality.

#### **H4: Trade Internalisation improves liquidity and price discovery, therefore indicates integration rather than market fragmentation**

As information efficiency increases, measured by the inverse relationship with autocorrelation, the market experiences less adverse selection and signals greater integration rather than fragmentation (**Figure 39** and **Figure 40**). Our regression analysis (**Table 11**) shows a negative correlation between dark

trading (used as a proxy for trade internalisation) and the information inefficiency metric, autocorrelation. This aligns with the findings of [Ibikunle et al. \(2021\)](#), who indicate that dark trading is associated with reduced adverse selection across the broader market.

As outlined previously, uninformed traders are drawn to dark pools due to the reduced risk of adverse selection by informed traders, who typically operate on lit exchanges. This self-selection based on information asymmetry helps lower the adverse selection risk for uninformed traders within dark pools ([Ibikunle et al., 2021](#)).

When informed traders share similar information sets, as modelled by [Zhu \(2013\)](#), dark pools can further mitigate adverse selection risk while improving price discovery. As emphasised in [Chapter 2](#), uninformed or liquidity traders gravitate toward dark venues where their risk of facing adverse selection is lower. The reduced presence of uninformed traders in lit markets decreases the likelihood of informed trades being executed against uninformed orders, as shown by [Kyle \(1985\)](#) and [Glosten & Milgrom \(1985\)](#). This dynamic reduces the competition for private information held by informed traders, lowering adverse selection risk for uninformed traders across the market, even though the total volume of private information remains unchanged ([Ibikunle et al., 2021](#)).

An efficient market structure promotes integration rather than fragmentation. While market fragmentation between lit and dark trading venues is often criticised, it can enhance liquidity by increasing the number of liquidity providers ([Biais, Martimort, and Rochet, 2000](#)). This structure facilitates

mechanisms such as 'queue jumping' and encourages competition on pricing grids ([Foley and Putniņš, 2016](#)).

[Ibikunle et al. \(2021\)](#) further argue that by protecting uninformed traders from adverse selection, dark venues lead to increased uninformed trading activity. Dark trading creates a safer and more cost-effective environment for these traders by reducing the risks of adverse selection and minimising price impacts from large orders ([Nimalendran and Ray, 2014](#)). This allows orders that might not have been submitted in lit markets to be executed in dark venues, resembling the role of upstairs markets, which similarly shield uninformed traders from adverse selection. Consequently, dark venues increase participation rates among uninformed or liquidity traders, even though their presence in lit markets declines, leading to improved market efficiency.

From a transaction cost perspective, as [O'Hara \(2011\)](#) explains, fragmentation can lower effective spreads and increase execution speeds. While the impact of these benefits varies across stock listings and size categories, fragmentation is particularly advantageous for smaller stocks, as it heightens competition for traditionally less liquid securities.

## **6.1. Addressing concerns about trade internalisation**

Order internalisation raises some regulatory and market concerns, especially in jurisdictions where the mechanism is not yet implemented, such as Brazil. In this chapter, we explore the main concerns associated with order

Internalisation and how these issues have been addressed throughout this study.

## **1) Adverse selection**

According to the Brazilian capital market regulator, the [CVM \(2024, p 43\)](#), *“The risk of doing business with a better-informed counterparty consists of a higher probability of adverse price impact in the future, namely, a price drop after a purchase or a price increase after a sale.”* In other words, trading with more informed counterparties could lead to unfavourable price movements, diminishing expected returns. The analyses conducted during this report indicates that, when combined with the appropriate regulation, internalised trades lead to better price discovery as seen in the NYSE (New York Stock Exchange: SEC Tick size pilot program of small caps – US), aiding uninformed investors. This conclusion aligns with the literature reviewed on adverse selection: as discussed in [Zhu’s \(2013\)](#) model, allowing trade internalisation leads uninformed investors to concentrate their trades in dark pools, thereby reducing the risk of having informed traders as counterparties and thus lowering the risk of adverse selection. Consequently, informed traders concentrate in the lit exchange, enhancing price discovery in the market.

## **2) Regulatory Concerns**

One of the main concerns of regulators regarding the expansion of order internalisation is its impact on the regulatory framework of the capital markets and the cost of supervision. According to the [CVM \(2024, p.99\)](#), *“The persistent high concentration of traded volume among wholesalers and other*

*off-exchange venues [...] led the SEC to propose a significant restrictive change to the rules governing order Internalisation in the U.S. in a 2022 AIR: the order competition rule proposal.”*

During the benchmark of the history of trade internalisation in multiple countries, we concluded that the greater transparency and reporting requirements are part of a natural evolution of the market and ultimately benefits the more uninformed investor. In this instance, Brazil can leverage more than 20 years of experience in internalised orders from other countries to guarantee that the full benefits of trade internalisation can be achieved, such as Canada and Australia example that have developed the MPIR (minimum price improvement rule) to ensure that internalisation provides benefits without compromising market integrity.

Regarding the supervision costs, throughout the section “BOX 2: Lessons Learned for Self-Regulation,” we cite some recent examples that occurred in Brazil that helped mitigate these costs.

### **3) Benefits to investors**

Another common concern is whether trade internalisation provides any real benefits to investors, especially retail or uninformed investors. In the report, we illustrated how internalised orders help improve liquidity metrics, such as bid-ask spreads and liquidity ratios, enhance the price formation process for small cap stocks, and reduce volatility during periods of market stress, as indicated by the causality test during the 2008 financial crisis in the U.S. market. Finally, as discussed in Box 1, allowing Alternative Trading Systems

increases competition with the main exchange, which can ultimately lead to a reduction in transaction costs.

#### **4) Liquidity**

Some studies argue that liquidity metrics may deteriorate with the introduction of opaque or internalised trading after a certain threshold is reached. In this report, we examined how key liquidity metrics, such as bid-ask spreads and liquidity ratios, were influenced by dark trading volume. For the Russell 2000, we conducted a correlation analysis and found a negative correlation between dark trading volume and the bid-ask spread, suggesting that increased dark trading coincides with a narrower bid-ask spread.

A regression analysis between dark trading volume and the liquidity ratio reinforced this conclusion, indicating through a positive value that as dark trading volume increases, the liquidity ratio also rises.

Similar patterns were observed in the Brazilian market regarding the relationship between Retail Liquidity Provider (RLP) trade volumes and the liquidity ratio.

#### **5) Cost-benefit analysis & overseas comparison**

Lastly, one of the many difficulties in assessing the potential benefits and costs of implementing trade internalisation is the variation between markets in terms of size, number of participants, degree of maturity, and other characteristics.

To address this issue, the research provides insights into the benefits and costs of trade internalisation by analysing different market structures, including the Russell 2000, the US SEC's 'Tick Size Pilot Program' for small-cap

stocks on the NYSE, the S&P 500, the UK FTSE 100, and emerging markets such as South Africa’s Johannesburg Stock Exchange (JSE). Additionally, the study contrasts these with Brazil’s Retail Liquidity Provider (RLP) system. One key conclusion was that to maximise the potential benefits of trade internalisation, the regulatory framework needs to be tailored to account for the specific needs and conditions of each market.

Table 12 summarises the typical concerns regarding the implementation of internalisation and how this paper addresses them.

**Table 12: Summary of the concerns regarding implementation of order internalisation in Brazil**

Typical concerns		This paper analyses
Cost benefit analysis	“No studies” focus on liquidity variations, overlooking the cost-benefit analysis	<b>Welfare benefits: Data analysis indicates improvement in liquidity, better price discovery and lower volatility for all investors</b>
Internalisation	Not allowed in Brazil except for RLP (Retail Liquidity Provider)	<b>Internalisation helps reduce bid-ask spread and increase in traded volume</b>
Regulatory concerns	Internalisation impact on capital market regulation	<b>CVM permitting broader Internalisation facilitating larger trades, requires greater transparency and reporting, in turn benefiting the uninformed investors (retail)</b>
Impact assessment on investors	Assessing benefits of internalisation on retail investors	<b>Internalisation improves market stability and lower costs</b>



		<b>benefitting all investors including retail</b>
<b>Overseas comparisons</b>	Liquidity, market impact and legal framework	<b>Benchmarking Brazil with countries including US that already have internalised order mechanisms</b>
<b>Adverse selection</b>	Trading with more informed counterparties could lead to unfavourable price movements	<b>Evidence based on data analysis indicates internalised trades leads to better price discovery, aiding uniformed investors</b>

Source: Accenture Strategy analysis

## 6.2. BOX 2: Lessons learned for self-regulation

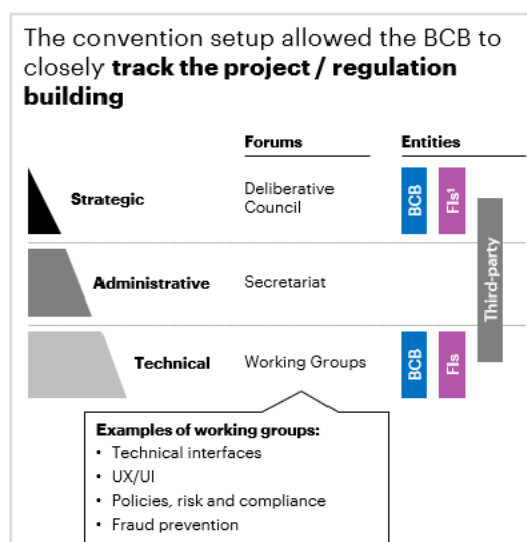
The CVM (Comissão de Valores Mobiliários) has raised concerns about its capacity to regulate and monitor trade internalisation effectively, given its limited resources. However, lessons from other local regulatory frameworks, such as those implemented by the Brazilian Central Bank (BCB), provide relevant examples of how oversight can be maintained through self-regulation.

### 6.2.1. Leveraging local regulatory experience

#### Open Finance case

The Open Finance initiative, led by BCB, demonstrates how a regulatory body can oversee a market-driven system while focusing on broad supervision rather than detailed day-to-day regulatory enforcement. To address its limited capacity, BCB created the Open Finance Convention, a governance structure comprised of various working groups responsible for setting technical standards, ensuring compliance, and monitoring the system's performance. These working groups handled the operational aspects, while BCB maintained oversight, stepping in only to approve key decisions and ensure alignment with the overall objectives of financial stability and transparency.

**Figure 41: Open Finance Brazil governance structure**



This framework allowed the market to innovate and create self-regulatory mechanisms, providing flexibility within a structured oversight regime. The Open Finance Convention acted as a bridge between the Central Bank and market participants, ensuring that the operational burden remained with the private sector while BCB retained control over the broader regulatory goals.

## **Desenrola Program case**

The Desenrola Program, initiated by the Ministry of Finance, adopted a similar approach by creating a system where the regulatory body set high-level guidelines but left the detailed implementation to a designated operator. This approach empowered market participants to establish business and technical rules, which were then submitted for approval by the Ministry of Finance. By taking on an oversight role rather than being involved in the operational aspects, the Ministry ensured that its regulatory objectives were met without overburdening its resources.

The program relied on a network of working groups, similar to Open Finance, to handle the practicalities of governance and compliance. This model allowed the Ministry to efficiently manage the program's implementation while retaining the ability to intervene, when necessary, thereby maintaining control over key regulatory outcomes.

### **6.2.2. Applying these lessons to trade internalisation**

CVM could apply the lessons from Open Finance and Desenrola to trade Internalisation by adopting a similar supervisory model that balances oversight with self-regulation. The following principles can guide the CVM in crafting a scalable and efficient framework for trade Internalisation:

#### **a) Set clear guidelines and accountability:**

One of the key lessons from both Open Finance and Desenrola is the importance of establishing broad regulatory guidelines while allowing market participants to manage the details. CVM can outline the core principles of trade Internalisation, such as promoting financial stability, transparency, and fair market access. Self-regulatory organizations (SROs) could then be tasked with designing and implementing the specific rules and governance structures. To ensure accountability, mechanisms such as independent audits, regular reporting, and board-level oversight should be established, allowing CVM to maintain high-level control without micromanaging the process.

#### **b) Create a regulatory backstop for intervention:**

While self-regulation would place much of the operational responsibility on the market, CVM must retain the authority to intervene when necessary. A well-defined regulatory backstop would allow CVM to step in if self-regulation fails to address critical issues, such as market abuses or systemic risks. This backstop would provide a safety net, ensuring that the broader objectives of the regulation are not compromised. In Open Finance, for example, BCB retained the ability to approve key decisions and monitor performance metrics, allowing for regulatory intervention when needed. Similarly, CVM could design a system where intervention is the exception rather than the rule, but always remains an option.

**c) Leverage technology for effective monitoring:**

One of the most significant benefits of adopting a self-regulation model is the potential for leveraging technology to streamline oversight. CVM could implement real-time monitoring systems that automatically track key metrics such as liquidity, transaction costs, and adverse selection. These automated systems, combined with regular reporting from SROs, would reduce the need for extensive manual oversight, allowing CVM to focus on strategic supervision. Open Finance has shown how technology can enhance regulatory efficiency, with real-time data collection enabling the Central Bank to maintain visibility over market operations without direct involvement in every transaction.

**d) Foster accountability and transparency through regular reporting:**

Regular reporting mechanisms would ensure that SROs remain accountable to CVM while providing the necessary transparency to maintain trust in the system. CVM could require self-regulatory bodies to submit periodic reports detailing their compliance with key regulations, market performance, and potential risks. By having a standardised reporting process, CVM can monitor the market's health and intervene if issues arise. This approach, as seen in Open Finance and Desenrola, allows the regulator to retain a strategic overview while empowering the market to handle the operational aspects of compliance.

### **6.2.3. Self-regulation as a scalable solution**

By applying the lessons learned from Open Finance and Desenrola, CVM can introduce trade Internalisation without overburdening its resources. A well-structured self-regulation system would allow market participants to manage compliance and governance, while CVM focuses on oversight and intervention when necessary. This model not only addresses CVM's capacity concerns but also provides flexibility for the market to adapt and innovate within a defined regulatory framework.

## 7. Conclusions

We provide evidence to understand the importance of dark trading. Our findings present compelling evidence on the importance of dark trading (trade internalisation) in enhancing liquidity, mitigating volatility, and supporting price discovery. Across various measurements, the relationship between dark trading and stock market quality is generally positive or, at worst, statistically insignificant. Comparable results emerge from panel regressions across different stock segments, reinforcing this pattern.

### 7.1. Aims

This study highlights that trade internalisation, or frequently referred to in the literature as dark trading, offers clear benefits in terms of liquidity enhancement, reduced volatility during periods of market stress, and improved price discovery. The study employed a mixed-methods approach, combining quantitative analysis (including panel regressions and causality tests) with qualitative semi-structured interviews. This methodology allowed for a robust examination of the hypotheses, providing both statistical evidence and contextual insights. By drawing on theoretical insights from a comprehensive literature review using artificial intelligence, systematic mapping, and empirical findings, the research effectively answered the research questions and hypotheses, demonstrating that trade internalisation can serve as a valuable tool for improving market quality, particularly when balanced with regulatory oversight.

## 7.2. Insights

The research offers clear insights into the benefits and costs of trade internalisation by analysing different market structures, including the Russell 2000, the US SEC's (2016) 'Tick Size Pilot Program' for small-cap stocks on the NYSE, the S&P 500, the UK FTSE 100, and emerging markets such as South Africa's Johannesburg Stock Exchange (JSE). Additionally, the study contrasts these with Brazil's Retail Liquidity Provider (RLP) system.

The empirical findings revealed that trade internalisation can indeed enhance liquidity. By examining key liquidity metrics, such as bid-ask spreads and liquidity ratios, we can better understand how dark trading influences overall market liquidity. In the Russell 2000 market, a notable negative correlation between dark trading volume and the bid-ask spread was observed, suggesting that increased dark trading coincides with a narrowing of the bid-ask spread. This trend indicates lower trading costs and greater market depth, both key indicators of enhanced liquidity, particularly for small-cap stocks. Regression analysis confirmed this, albeit via a positive association, between dark trading volume and the liquidity ratio within the Russell 2000, indicating that as dark trading volume increases, the liquidity ratio also rises. This suggests that dark trading contributes to greater market liquidity, as evidenced by the statistical significance of the relationship. Both key indicators of enhanced liquidity, particularly for small-cap stocks in the Russell 2000, which are comparable to the composition of the Brazilian stock exchange (**Table 3**). Similar patterns were also observed in the Brazilian market



concerning the relationship between Retail Liquidity Provider (RLP) trade volumes and the liquidity ratio.

Regarding volatility, the study finds that dark trading can reduce price fluctuations during periods of market stress. This effect is particularly evident in the U.S. market, where dark trading in Russell 2000 constituents helped stabilise prices during both the 2008 financial crisis and the COVID-19 pandemic in 2020. A rolling correlation between past dark trade volumes and volatility revealed a consistent negative association, suggesting that dark trading contributes to volatility reduction. Similar patterns were observed in the Johannesburg Stock Exchange (JSE) during COVID-19, where a rolling correlation analysis again showed a negative relationship between dark trading and volatility. Given the comparable market capitalisations and emerging market status of Brazil and South Africa, this result may extend to the Brazilian market as well. Additionally, causality tests support that dark trading exerts a proactive dampening effect on volatility during stress periods. The tests validate that this relationship is not merely associative, establishing that dark trading indeed Granger-causes reductions in volatility under stressful market conditions.

Price discovery was also enhanced through trade internalisation, as seen in the NYSE (New York Stock Exchange: SEC Tick size pilot program of small caps – US) market. Dark trading facilitated more efficient price formation for small-cap stocks, with empirical evidence showing faster convergence to fundamental values. Price efficiency was assessed using the autocorrelation of mid-quote returns, which reflects the predictability of returns based on past



information. Regression analysis on panel data, aligned with literature reviewed, revealed a negative correlation between dark trading and autocorrelation. This suggests that as dark trading increases, autocorrelation decreases, indicating that prices adjust more effectively to new information, thus reflecting fair value more accurately. For robustness, mid-quote returns at both 30- and 60-second intervals were analysed, with both timeframes showing similar results. Overall, the study proposes that dark trading can contribute to more accurate and timely price information. Given that the \$3 billion market cap threshold for stocks in this analysis (SEC tick size pilot program, 2016) aligns with the median market cap of Ibovespa (Brazil) and Russell 2000 (**Table 3**), the findings likely extend to the Brazilian market as well.

The benefits of improved liquidity, reduced volatility and increased price formation, however, must be weighed against the potential costs, e.g., particularly concerning market fragmentation and adverse selection risks. Despite market fragmentation, dark trading has shown to boost liquidity and, on an aggregate level, lower adverse selection. With informed traders gravitating toward lit markets, adverse selection risk intensifies there; however, uninformed traders benefit as they migrate to dark trading venues, where the risk of encountering informed traders is lower. This self-selection process helps shield uninformed trades in dark venues, effectively reducing the risk of adverse selection.

Overall, the findings indicate benefits of trade internalisation but underscore the importance of tailored regulatory frameworks. These frameworks should

account for the unique characteristics of each market, aiming to leverage the benefits of internalisation while mitigating its potential risks.

### **7.3. Regulatory challenges and policy implications**

The findings suggest that trade internalisation can enhance liquidity and facilitate price discovery, especially during times of market stress. However, concerns about transparency and potential market fragmentation were also addressed. The results highlight the need for balanced regulatory measures to maximise the benefits of dark trading while mitigating potential risks. This aligns with our interview findings, including the SEC's recognition of the benefits of trade internalisation rather than its systematic elimination ([Appendix D](#)).

Policymakers should consider implementing regulations that ensure transparency and fairness in dark trading practices, while also allowing for liquidity benefits to be realised. This could include enhanced reporting requirements and oversight mechanisms to monitor the impact of dark trading on market quality. For example, policymakers could apply the lessons from the Open Finance initiative in Brazil to trade internalisation by adopting a similar supervisory model that balances oversight with self-regulation. This includes setting clear guidelines and accountability, creating a regulatory backstop for intervention, leveraging technology for effective monitoring, and fostering accountability and transparency through regular reporting. Our interviews with a U.S. regulatory policy advisor also highlighted the importance of a balanced,

transparent approach to maximise the benefits of dark trading (trade internalisation).

## **7.4. Limitations**

The study employed a mixed-methods approach, combining quantitative analysis (including panel regressions and causality tests) with qualitative semi-structured interviews. This methodology allowed for a robust examination of the hypotheses, providing both statistical evidence and contextual insights.

However, the research is not without limitations. The focus on specific markets and the reliance on available data may limit the generalisation of the findings to other markets. The availability of data also limits the research on analysing the threshold of proportions of dark trading in the indices. The idea emerged as various research highlights that it is possible that the effects of dark trading on market quality are nonlinear. Till a certain threshold of dark trading, liquidity on lit markets and market efficiency increase together with dark trading, particularly for small and mid-market capitalisation stocks.

Additionally, the qualitative interviews conducted, while providing valuable insights, could be even more expansive to fully capture the diversity of market participants' experiences. Another such limitation is the potential for selection bias in the qualitative interviews. The participants may not be fully representative of the broader market, which could affect the quality of findings. Lastly, the regulatory frameworks and market conditions vary significantly across different regions, which could affect the applicability of the findings. The study primarily focused on developed markets and a few

emerging markets, and the results may not be directly transferable to other regulatory environments.

## **7.5. Final remark**

This study provides valuable insights into the benefits and costs of trade internalisation, with specific examples and analysis from various markets.

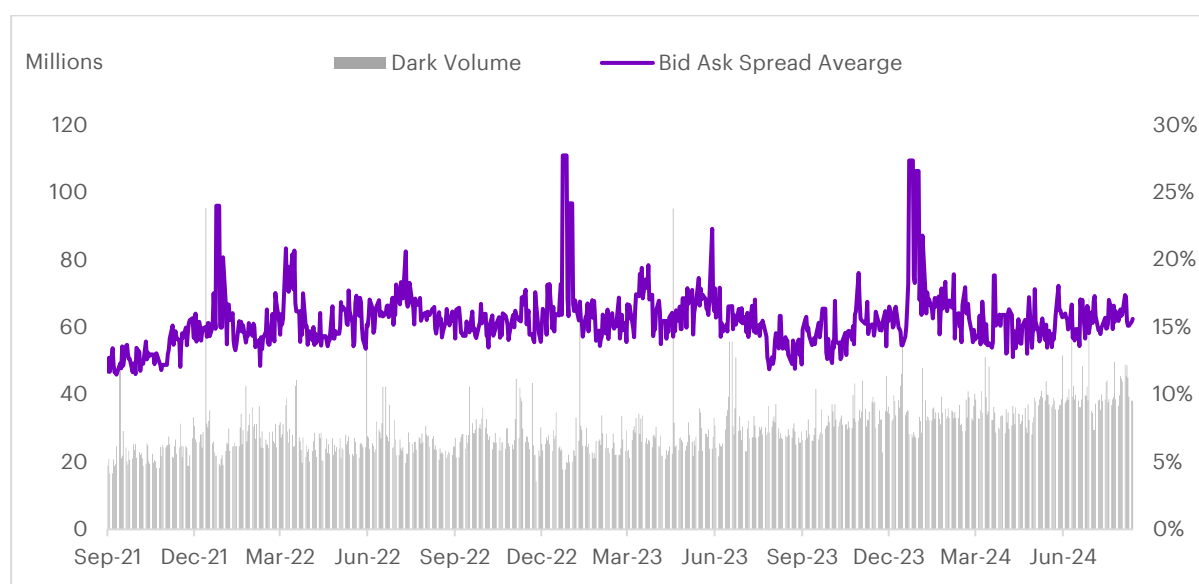
While trade internalisation can improve liquidity, reduce volatility, and enhance price discovery, it also presents regulatory challenges that need to be carefully managed. The empirical findings underscore the importance of balanced regulatory measures to maximise the benefits of dark trading while mitigating potential risks, offering valuable guidance for policymakers and market participants.

## 8. Appendices

### Appendix A

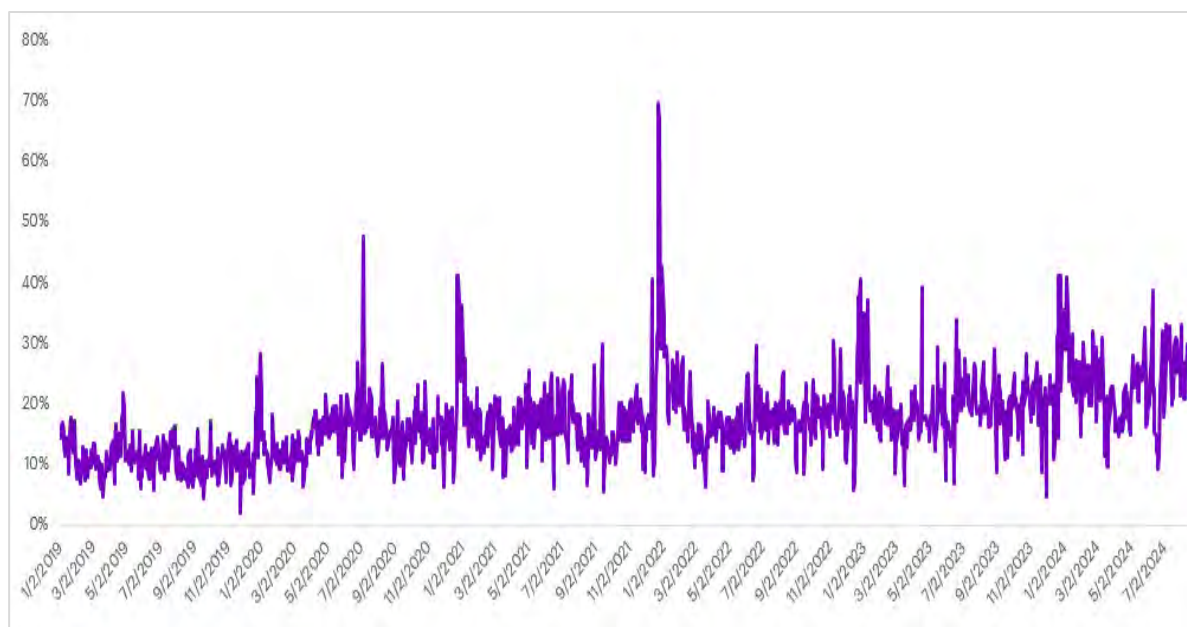
In South Africa, bid-ask spread percent correlates negatively with the change in dark trading volume, signalling an improvement in liquidity. The correlation coefficient in our sample was not high (-0.0136) but was negative, suggesting the association of increase in dark trade volume and narrowing of bid-ask spread.

**Figure 42: Daily change in dark trading volume and bid-ask spread percent - JSE**



Source: Bloomberg and Accenture Strategy analysis

**Figure 43: Daily trading percentage share by volume in South Africa - JSE**



Source: Bloomberg and Accenture Strategy analysis

## Appendix B.

Results of panel regressions conducted on transformed variables.

### 1. Transformations applied using box cox transformation methods

$$y(\lambda) = \frac{y^\lambda - 1}{\lambda}, \text{ if } \lambda \neq 0;$$

$$y(\lambda) = \log y, \text{ if } \lambda = 0$$

where the parameter  $\lambda$  yields independent variable  $y$  with minimum skewness

**Table 13: Lambda used for box-cox transformations**

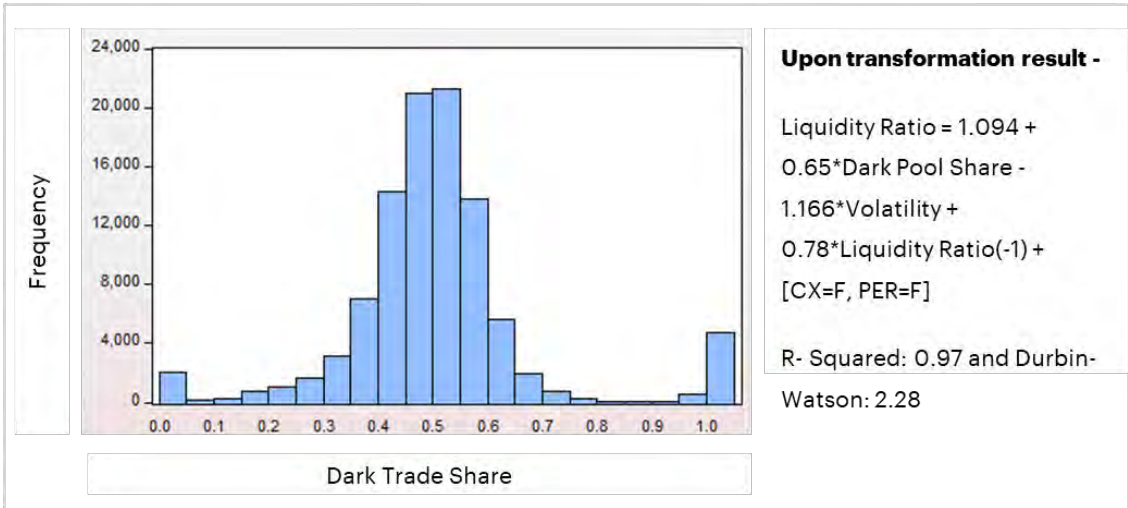
Index	Liquidity Ratio	Dark Proportions	Volatility
<b>FTSE100</b>	Ln (natural log)	0.2	0.268
<b>Russell 2000</b>	0.3	0.88	0.678
<b>S&amp;P 500</b>	-0.0202	0.95	0.695
<b>RLP</b>	-	3.1	-

### 2. Results of regression on transformed variables

### 3. S&P 500

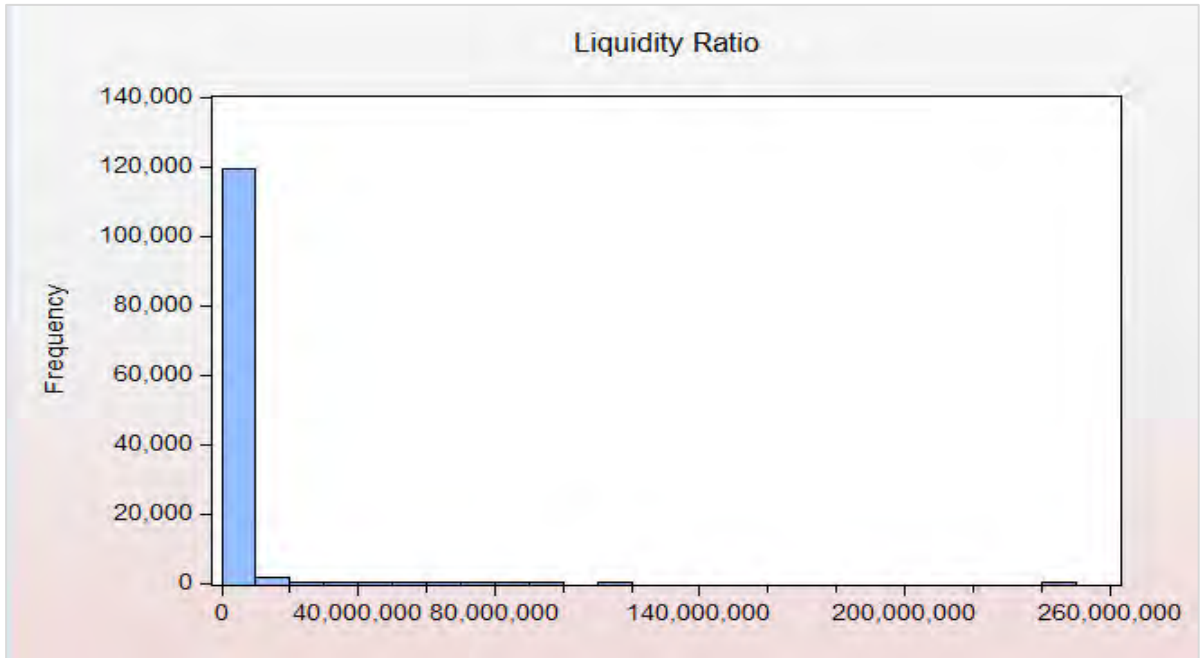


**Figure 44: Dark trade share in S&P 500: Frequency of non-transformed dark trade volume share, 2005-24**

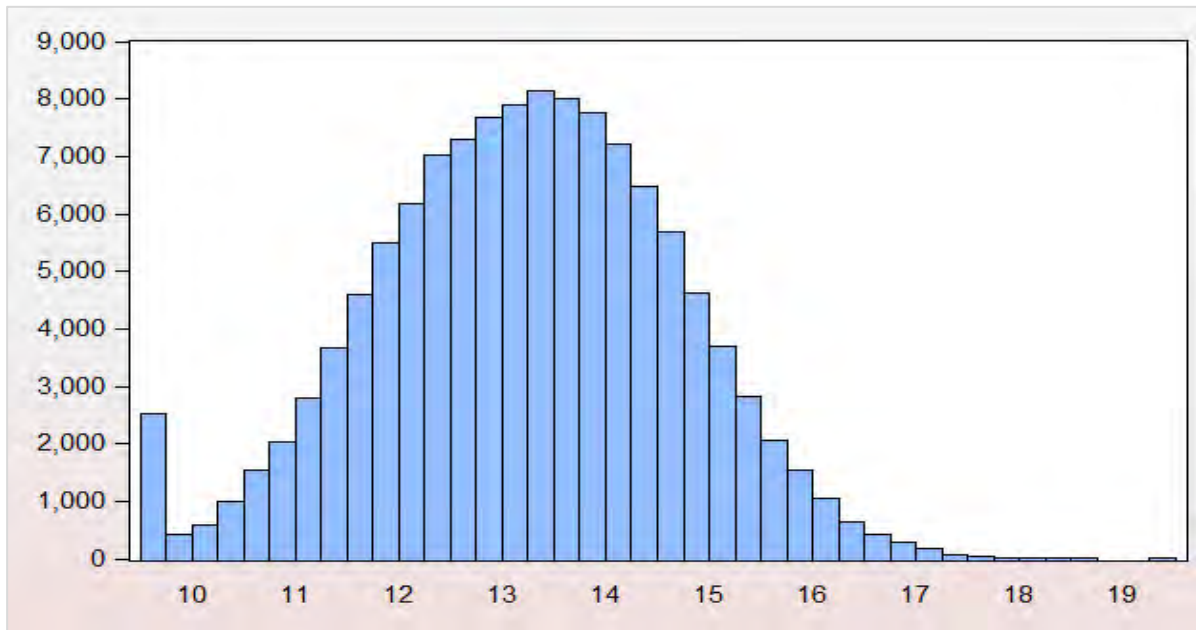


**4. FTSE -100**

**Figure 45: Distribution of raw liquidity ratio - FTSE 100**



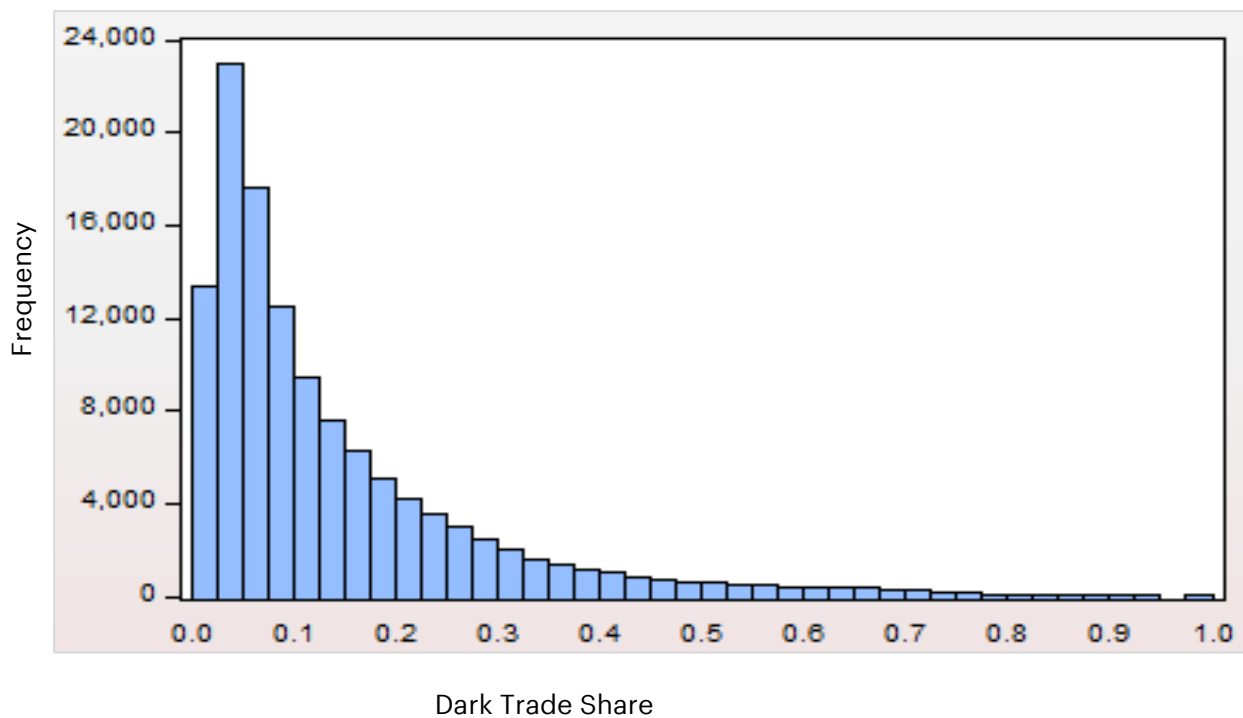
**Figure 46: Distribution of transformed liquidity ratio (To show the benefit of transformation)**



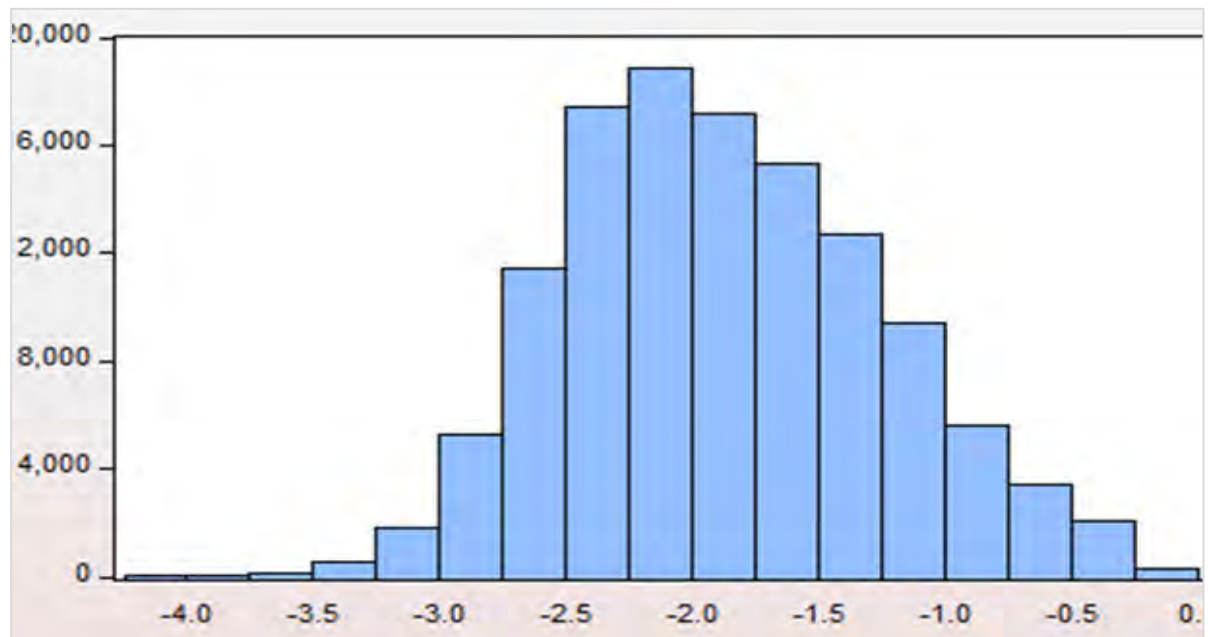
Kurtosis – 456.07

**Transformed Kurtosis 2.84**

**Figure 47: Distribution of raw dark trading proportion in FTSE 100**



**Figure 48: Distribution of transformed dark trading proportion (To show the benefit of transformation)**



Kurtosis – 7.32

Transformed Kurtosis 2.62

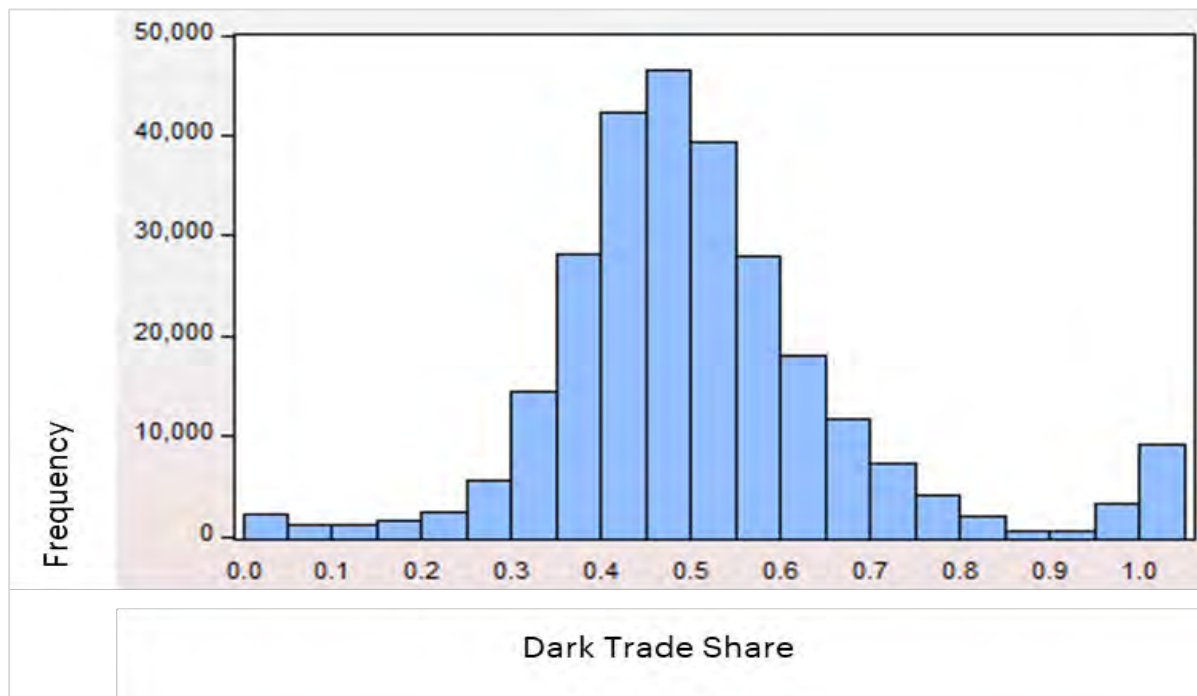
### **Upon transformation result -**

Equation - Liquidity Ratio =  $0.0106 \cdot \text{Dark Pool Proportion} + 0.0052 \cdot \text{Volatility} + \alpha_i + \alpha_t + 13.2634$

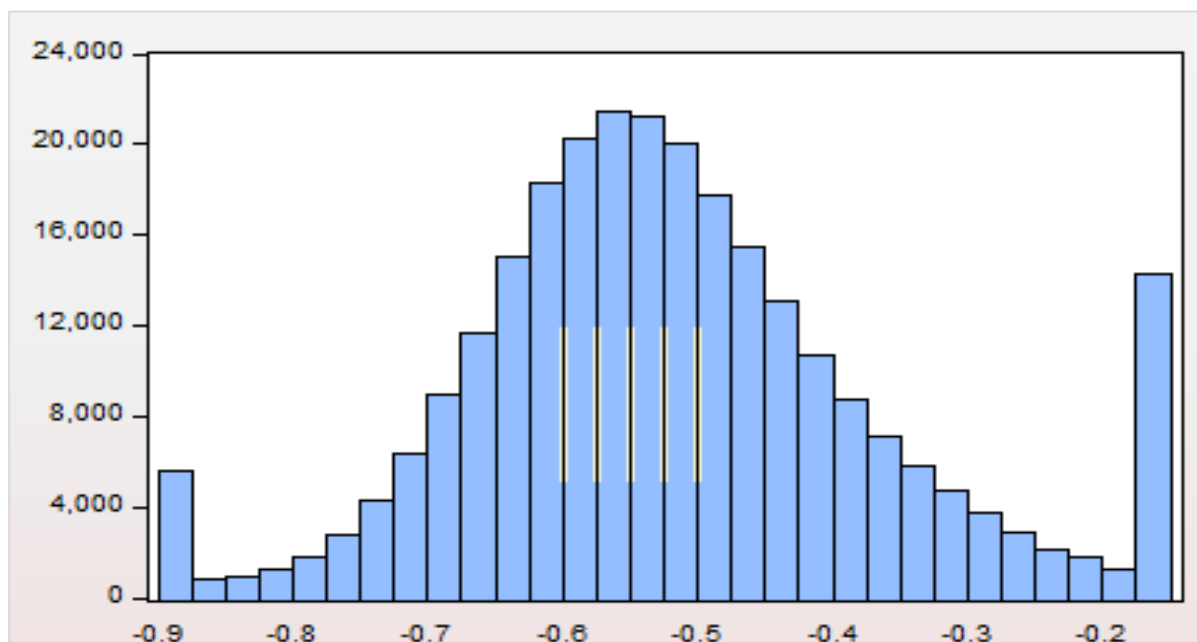
R-Square - 0.78 and Adjusted R Square - 0.778

## 5. Russell 2000

**Figure 49: Distribution of non-transformed dark trade share in Russell 2000**



**Figure 50: Distribution of transformed dark trade share in Russell 2000 (To show the benefits of transformation)**



**Old Kurtosis: 5.02**

### **Transformed Kurtosis: 3.3**

#### **Upon transformation result -**

Liquidity Ratio =  $-1.75 + 4.68 \cdot \text{Dark Pool Share} - 9.9 \cdot \text{Volatility} + 0.82 \cdot \text{Liquidity Ratio}(-1) + [\text{CX}=\text{F}, \text{PER}=\text{F}]$

R-square to 0.93 and Durbin Watson test statistic of 2.32

# Appendix C.

Table 14: Raw regression Results

Index Variable	Russell 2000	S&P 500	FTSE 100	RLP
Effect of 1% inc. in Dark Proportion	0.34%	0.00002181%	0.17%	1.77%
Dark Proportion	7233*	2451898305^	248151*	1161775*
Volatility	-90742	27324000758	576125	-12105450
Sample	2005M01 2024M08	2005M01 2024M08	1/03/2019 8/13/2024	1/02/2020 8/02/2024
R-Square	0.68	0.0069	0.49	0.98
Durbin – Watson	0.47	2.02	1.2	2.3
Fixed Effects	Both Stocks and Period	Both Stocks and Period	Both Stocks and Period	Both Stocks and Period

Note: \* means P-Value <0.05 and ^ means P-value > 0.05

Table 15: Log transformed regression results

Index Variable	Russell 2000	S&P 500	FTSE 100	RLP
Effect of 1% inc. in Dark Proportion	0.54%	0.20%	0.014%	2.78%
Dark Proportion	0.11*	0.20*	0.003^	0.56*
Volatility	-0.28	-0.28	0.013	-0.60
Sample	2005M01 2024M08	2005M01 2024M08	1/03/2019 8/13/2024	1/02/2020 8/02/2024
R-Square	0.76	0.91	0.76	0.96
Durbin – Watson	0.33	0.38	1.4	1.24

Note: \* means P-Value <0.05 and ^ means P-value > 0.05

## Appendix D

**Table 16: Interview questions regarding trade internalisation in the US for Capstone**

Topics (word count in CVM- 2024 report)	Questions
<b>Experience and Overview</b>	<ul style="list-style-type: none"> <li>Based on your experience, what were the main challenges faced in regulating order internalisation in the United States?</li> <li>What are the initial concerns of any regulator (e.g., SEC) when allowing order internalisation in the U.S. market? How were these concerns addressed?</li> </ul>
<b>Transparency (174) and Price Formation (26)</b>	<ul style="list-style-type: none"> <li>What strategies did the SEC use to maintain transparency and ensure that market prices remain fair and reflective of market reality?</li> <li>In the United States, how does the SEC handle pre-trade and post-trade transparency in internalised environments? Are there specific lessons that could be applied in Brazil?</li> <li>What are your thoughts on CVM concern that internalisation could negatively impact transparency and price formation?</li> </ul>
<b>Supervision and Regulation (198)</b>	<ul style="list-style-type: none"> <li>Considering the increasing complexity of markets, what could be the challenges in supervising internalised operations? What tools or technologies were essential in ensuring effective supervision?</li> <li>In your opinion, what can the CVM learn from other capital markets to ensure that order internalisation in Brazil is done safely and efficiently?</li> </ul>
<b>Liquidity (126) and Fragmentation (29)</b>	<ul style="list-style-type: none"> <li>Liquidity fragmentation is a key concern of the CVM. How did the US balance the need for innovation and competitiveness with the preservation of liquidity in lit markets?</li> <li>Is there any metric or study used to monitor liquidity fragmentation and its impact on market efficiency? What were the observed results?</li> </ul>
<b>Impact on Retail (105)/Institutional (24) Investors</b>	<ul style="list-style-type: none"> <li>How did the US ensure that retail investors are protected and benefited from order internalisation?</li> <li>In your opinion, is there any model that allow for better execution for retail investors?</li> </ul>
<b>International (21) Comparison, USA (55)</b>	<ul style="list-style-type: none"> <li>How do you compare the US approach with that of other international regulators, such as in the European Union or Australia? Are there practices or regulations that stand out in different countries?</li> <li>Is there any U.S. practice that you believe could be more challenging to implement in Brazil, considering the current stage of market development and regulatory structure?</li> </ul>
<b>Adverse Selection (30)</b>	<ul style="list-style-type: none"> <li>The CVM is concerned about the risk of adverse selection, where intermediaries might prefer to internalise retail investors' orders, leaving the traditional market with reduced liquidity. How did the US evaluate and mitigate this risk in their market?</li> </ul>

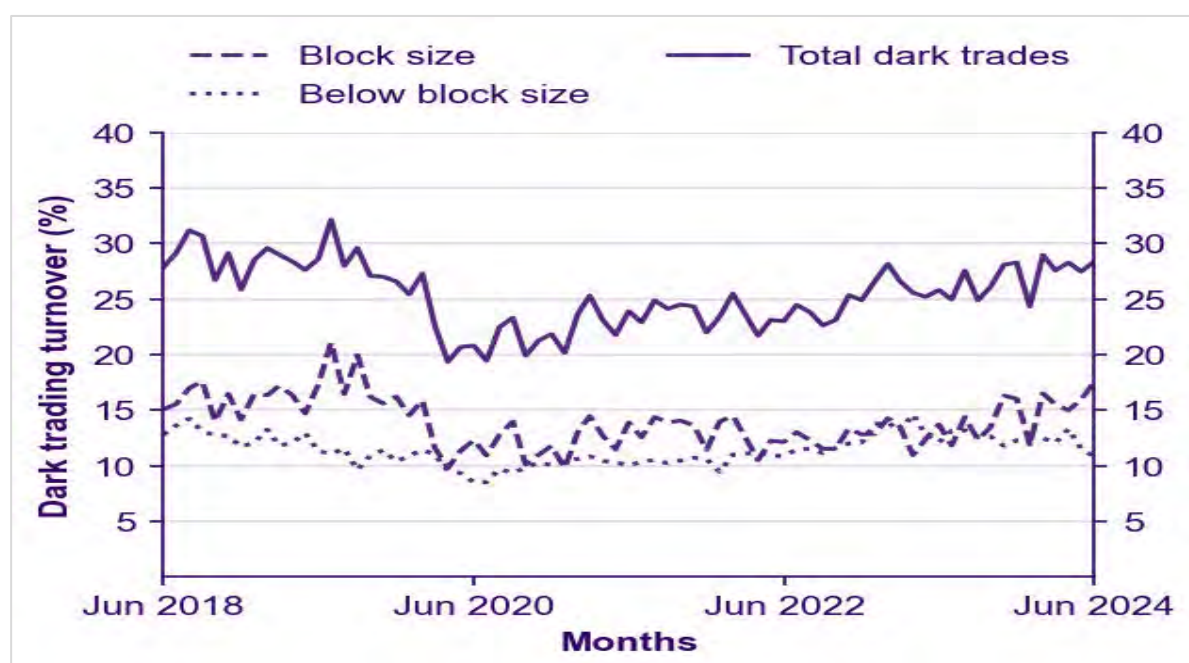


Topics (word count in CVM- 2024 report)	Questions
	<ul style="list-style-type: none"> <li>Are there specific mechanisms adopted to ensure that internalisation does not harm the quality of price formation and liquidity in the traditional market?</li> </ul>
<b>Free-Rider (4) Problem</b>	<ul style="list-style-type: none"> <li>One of the issues raised by the CVM is the “free-rider” problem, where internalisers might benefit from prices formed in organised markets without contributing to their maintenance. How did the US address this issue, and what solutions were implemented to avoid this problem?</li> <li>Are there specific mechanisms or fees imposed by the US to ensure that internalisers contribute to the overall market ecosystem?</li> </ul>
<b>Advice and Recommendations</b>	<ul style="list-style-type: none"> <li>What have been the long-term impacts of order internalisation in the U.S. market? What has been learned over time, and how has it shaped current regulation?</li> <li>What advice would you give to Brazilian regulators who are considering allowing order internalisation?</li> <li>Based on your experience, what are the common mistakes to avoid and the best practices to adopt when introducing internalisation in a developing market like Brazil?</li> </ul>

## Appendix E

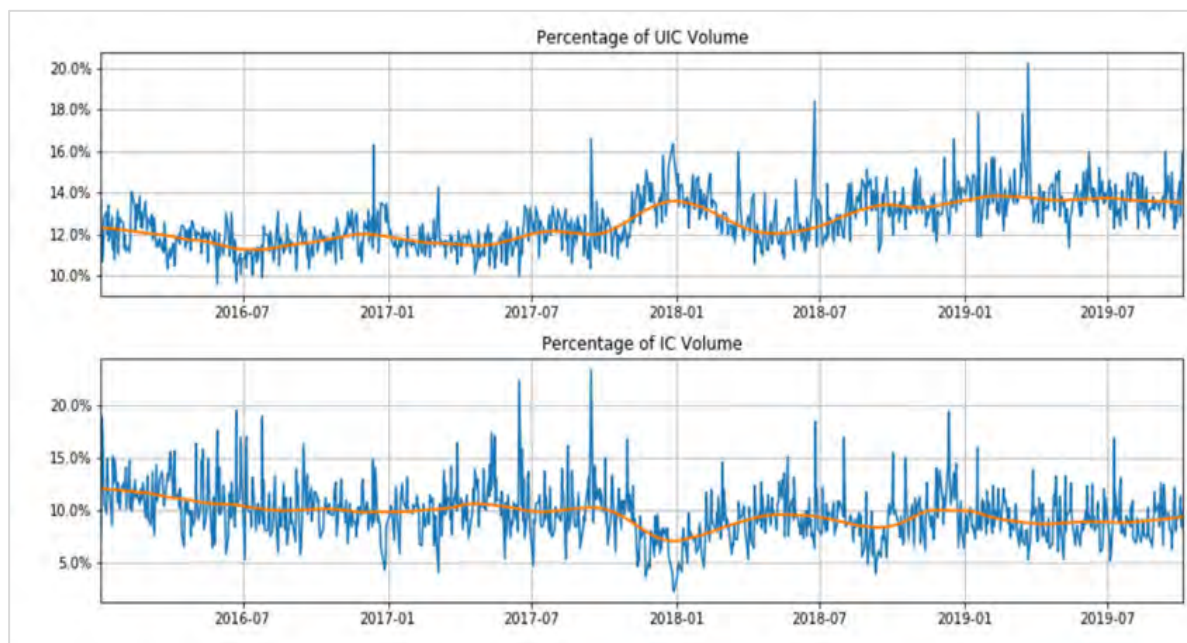
Charts in this Appendix shows the proportion of dark trading and trade internalisation reported the regulatory authority of Australia and Canada respectively.

**Figure 51: Dark liquidity proportion of total value traded – Australia**



Source: [ASIC](#)

**Figure 52: Percentage of total volume executed as intentional or unintentional crosses - internalisation types in Canada**

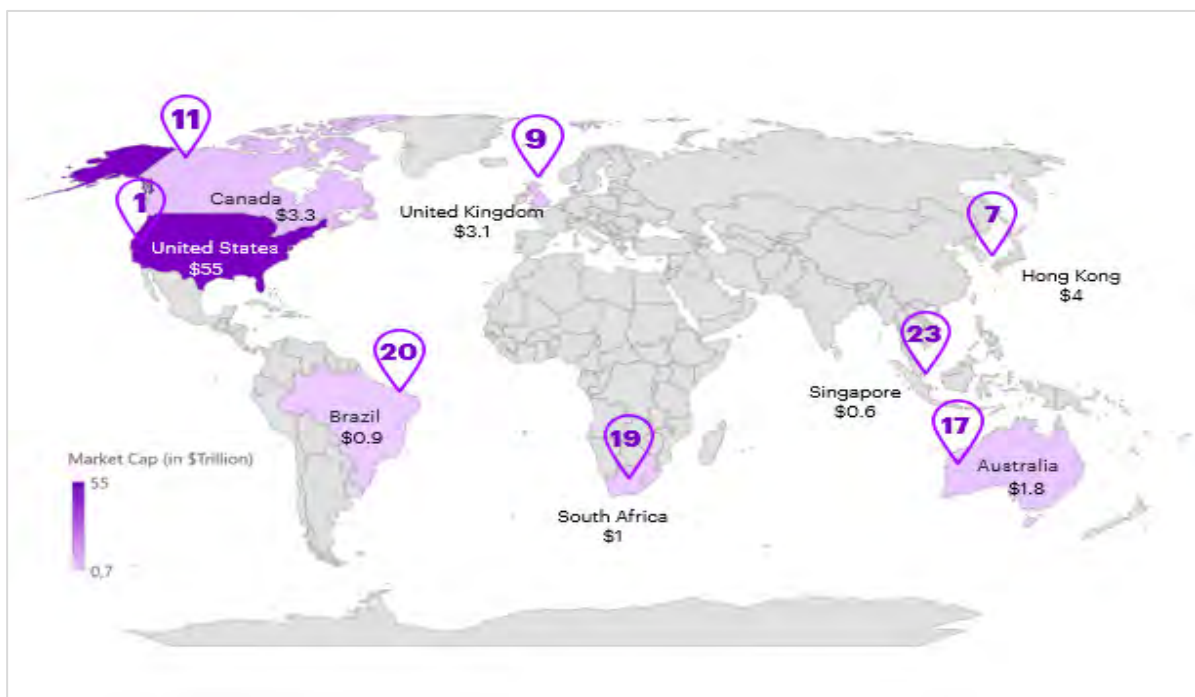


Source: [IIROC and OSC](#)

## Appendix F

Comparison of geographies by market cap and their market cap rankings in the world. The chart emphasises the closeness of ranking of Brazil and South Africa and thus establishes the importance of the South Africa study we have conducted.

**Figure 53: Top countries by market cap (in USD Trillion) – August 2024**



Source: [Visual Capitalist](#)

## Appendix G

Result on analysis of variance ratio implied dark trading being not statistically significant.

Dependent Variable: VARIANCE_RATIO				
Method: Panel Least Squares				
Date: 10/28/24 Time: 13:43				
Sample: 4/02/2018 3/29/2019				
Periods included: 251				
Cross-sections included: 1928				
Total panel (unbalanced) observations: 256346				
White two-way cluster standard errors & covariance (d.f. corrected)				
WARNING: estimated coefficient covariance matrix is of reduced rank				
Standard error and t-statistic probabilities adjusted for clustering				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.00E+23	1.01E+23	1.973082	0.0496
DP_PROPORTION	-7.92E+21	4.21E+22	-0.188253	0.8508
VOLATILITY	3.13E+23	2.32E+23	1.352718	0.1774
LOG(VALUE)	-1.58E+22	8.96E+21	-1.768345	0.0782
Effects Specification				
Cross-section fixed (dummy variables)				
Period fixed (dummy variables)				
R-squared	0.008178	Mean dependent var	1.32E+22	
Adjusted R-squared	-0.000329	S.D. dependent var	3.08E+24	
S.E. of regression	3.08E+24	Akaike info criterion	115.6220	
Sum squared resid	2.42E+54	Schwarz criterion	115.7109	
Log likelihood	-14817434	Hannan-Quinn criter.	115.6479	
F-statistic	0.961333	Durbin-Watson stat	1.787298	
Prob(F-statistic)	0.899389			

Dependent Variable: VARIANCE_RATIO				
Method: Panel Least Squares				
Date: 10/28/24 Time: 13:50				
Sample: 4/02/2018 3/29/2019				
Periods included: 251				
Cross-sections included: 1928				
Total panel (unbalanced) observations: 256346				
White two-way cluster standard errors & covariance (d.f. corrected)				
Standard error and t-statistic probabilities adjusted for clustering				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.67E+23	1.69E+23	1.578422	0.1157
DP_PROPORTION	9.83E+21	3.16E+22	0.311197	0.7559
VOLATILITY	3.69E+23	2.72E+23	1.357328	0.1759
LOG(VALUE)	-2.15E+22	1.41E+22	-1.532570	0.1266
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.007053	Mean dependent var	1.32E+22	
Adjusted R-squared	-0.000480	S.D. dependent var	3.08E+24	
S.E. of regression	3.08E+24	Akaike info criterion	115.6212	
Sum squared resid	2.42E+54	Schwarz criterion	115.6999	
Log likelihood	-14817580	Hannan-Quinn criter.	115.6441	
F-statistic	0.936330	Durbin-Watson stat	1.787105	
Prob(F-statistic)	0.977438			



## Appendix H

### Tabular descriptions of variables used

Term	Definition
<b>Bid-ask Spread</b>	The metric is calculated over a day as (ask-bid)/mid point b. midpoint price is the price between the best bid price and best ask price
<b>Average Bid-ask Spread Percentage</b>	Average of all bid-ask spreads taken as a percentage of the mid price. (Bloomberg)
<b>Best Bid Price</b>	The highest price that a buyer is willing to pay
<b>Best Ask Price</b>	The lowest price at which a seller is willing to sell
<b>Mid Price</b>	The average of the best bid and best ask prices
<b>Open Price</b>	The price at which a security first trades when the market opens
<b>Close Price</b>	The last price at which a security trades during the regular trading hours of a given day
<b>High Price</b>	The highest price at which a security trades during a given trading session
<b>Low Price</b>	The lowest price at which a security trades during a given trading session
<b>Daily Traded Value (Amount)</b>	The total monetary value of all trades executed in a security within a trading day
<b>Daily Traded Volume</b>	The total number of shares (volume) or contracts traded in a security during a trading day
<b>Daily Volume Traded Off Exchange (Dark Pools/ATS)</b>	The total number of shares (volume) traded off-exchange through Alternative Trading Systems or dark pools in a trading day
<b>Daily Volume Traded Off Exchange (Internailisation Mechanism)</b>	The total volume of trades executed via Internailisation
<b>Daily Traded Value Off Exchange (Internalisation Mechanism)</b>	The total monetary value of trades executed through the internalisation mechanism.
<b>Best Market Depth of the Day</b>	Combined dollar value of all the orders on the best bid and ask prices in the exchange order book
<b>Liquidity ratio (\$K/percent)</b>	Lit trade Value/Range tr, better substitue of absolute stock return
<b>Lit trade value (\$K)</b>	Lit liquidity metrics,the total dollar value of trading turnover for each security on the exchange order book excluding dark trades

Term	Definition
<b>Range, tr</b>	maximum of (i) the daily range (daily high minus daily low), (ii) absolute difference between previous closing price and daily high and (iii) absolute difference between previous closing price and daily low.
<b>Volatility</b>	Large swings in price as high volatility days, and those with frequent small fluctuations around a constant price level as low volatility days  Volatility = $(P_{\max} - P_{\min}) / ((P_{\text{close}} + P_{\text{open}}) / 2)$
<b>Autocorrelation</b>	absolute correlation -Informational Efficiency  Autocorrelation is the correlation between the midquote return at time $\tau$ and the midquote return at the previous time $\tau-1$ , both measured at the frequency $k$ (e.g., every 10 seconds).
<b>Mid quote</b>	Average of best bid and best offer
<b>Mid quote price return at 30 seconds</b>	$(\text{Mid quote price at 2}^{\text{nd}} \text{ 30 sec period} - \text{Mid quote price at 1}^{\text{st}} \text{ 30 sec period}) / (\text{Mid quote price at 1}^{\text{st}} \text{ 30 sec period})$
<b>Variance Ratio</b>	variance ratio of ten-second and one-minute midquote returns



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