ABU DHABI GLOBAL MARKET ACADEMY

ADGM Academy

RESEARCH CENTRE

LEVERAGING ARTIFICIAL INTELLIGENCE TO ENHANCE THE SME ECOSYSTEM IN THE UAE

FULL PAPER

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ABU DHABI GLOBAL MARKET ACADEMY (ADGMA) RESEARCH CENTRE

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IN COLLABORATION WITH

ASIAN INSTITUTE OF DIGITAL FINANCE (AIDF), NATIONAL UNIVERSITY OF SINGAPORE

NUS-AIDF DEEP CREDIT ANALYTICS TEAM

NUS National University of Singapore | Asian Institute of Digital Finance

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1 Forewords

The ADGM Academy Research Centre collaborated with the Asian Institute of Digital Finance (AIDF) from the National University of Singapore to produce a white paper on how big data and artificial intelligence can be leveraged to develop a more informative credit model to support the UAE SME ecosystem and drive improved decision making when lending to SMEs.

The research was supported by a Working Group consisting of senior representatives from across the UAE financial ecosystem. The ADGM Academy Research Centre acknowledge and thank the following organisations for their support, guidance and input throughout this project:

- ***Abu Dhabi Department of Economic Development (DED)***
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دائرة التنمية الاقتصادية
DEPARTMENT OF ECONOMIC DEVELOPMENT

Mrs. Mouza Obaid Al Nasri, Executive Director of the SMEs Sector, Abu Dhabi Department of Economic Development

"There is a great deal of literature that discusses the SME ecosystem in general or that focuses on the most important component of this model, which is access to finance. However, there are few works that go beyond a review of the well-known facts to provide practical solutions that are applicable and could have a significant impact on proper application.

This white paper, produced by ADGM Academy, is one of those distinguished studies that was able to diagnose the SMEs ecosystem accurately and comprehensively in the UAE and Abu Dhabi, as well as describe one of the successful experiences, which is to create a model that employs artificial intelligence to assist banks in making decisions regarding financing the SMEs that apply to them. This model will have a significant impact on the SMEs landscape in the UAE.

In its ongoing effort to enable SMEs and start-ups to play a pivotal role in broadening Abu Dhabi's economic landscape and creating a more diversified, knowledge-based and sustainable economy, the SMEs Sector of the Abu Dhabi Department of Economic Development, believes that this whitepaper and the proposed model would contribute to achieving the sector's objectives."

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Ahmed Mohamed Al Naqbi, Chief Executive Officer, Emirates Development Bank (EDB)

"SMEs comprise the backbone of most of the world's economies, with the UAE being no exception. The SME sector represents more than 94% of the total number of companies operating in the country, employing more than 86% of the private sector workforce. The contribution of the SME sector to the UAE's GDP was estimated at 53% in 2019 and set by the Federal Government to be increased to around 60% by 2021. Globally, however, access to finance is cited as the second most common obstacle facing SMEs in growing their businesses in emerging markets and developing countries. This is often on account of SMEs being considered more opaque than large firms, making it more challenging for them to obtain bank loans.

Although significant steps have been made to improve the ecosystem in the UAE in the past decade, there is still room for improvement, especially regarding access to finance, including debt financing. EDB supports the national agenda to build and provide flexible financing solutions for SMEs. The Bank's new strategic positioning raises its contribution to the national GDP by AED 10 Bn in 2026 and has four developmental objectives to (1) support and empower the implementation of the country's industrial development strategy, (2) facilitate the adoption of advanced technology, (3) empower the growth of SMEs, and (4) encourage start-ups and innovation. With its impact scorecard, comprehensive product offering across the company lifecycle, and patient debt approach with flexible pricing and tailored financing solutions, EDB aims to enhance the bankability of underfinanced SMEs.

EDB has set a target to deploy AED30 billion of financing support to 13,500 companies within the five priority sectors by 2026. The intrinsic link between SMEs and the UAE economy means that through our support of SMEs, the Bank continues to play a leading role in the economic development and industrial advancement of the UAE."

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Wai Lum Kwok, Senior Executive Director - Authorisation & Fintech, ADGM Financial Services Regulatory Authority

"A healthy and growing SME sector is key to the UAE's ambition to diversify its economy. Enabling SMEs' access to appropriate means of financing their growth and expansion is a core requirement to achieve this goal. In this regard, the white paper's proposed federated credit model could help reduce barriers to SMEs' access to financing by providing banks and other lenders with tools that let them better identify the actual credit risk of SMEs, thereby allowing lenders to more effectively deploy credit.

As Abu Dhabi's international financial centre, ADGM supports the growth of the SME sector in the UAE by offering a sound legal system and regulatory regime and a welcoming environment for them to establish themselves. Moving forward, ADGM is building a platform to support SMEs in obtaining financing by facilitating the secure transfer of information needed for credit assessments, thereby reducing informational asymmetries and operational costs. Once the federated credit model is put in place, ADGM will be happy to work with lenders to see how best appropriate data can be channelled into the model."

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Ahmad Ali Alwan, Deputy CEO, Hub71

"As a global tech ecosystem located in the heart of Abu Dhabi's international financial center, Abu Dhabi Global Market (ADGM),

Hub71 is uniquely positioned to further enhance the business environment for startups, SMEs and tech companies. This white paper from the ADGM Academy Research Center reinforces the importance of enabling startups and SMEs to access capital as they set up to grow from Abu Dhabi. Understandably, financial institutions have robust controls in place to reduce lending risk, especially when dealing with high growth companies. In parallel, we see the potential of startups and SMEs that have robust long-term strategies designed for sustainable growth.

These businesses constitute a sizeable portion of the economy that is expected to grow. It is essential for startups and SMEs to access funding, whether from banks, VCs, family offices or other capital providers. In our efforts to enhance the funding journey, we engage startups and SMEs with investors, corporations, regulators, and financial institutions. This supported our startup community's ability to raise funds, secure contracts and access banking services at a faster pace. Collaborating with ADGM, and our investor, corporate and banking partners is crucial to these efforts, which will long continue.

This white paper identifies ways to increase the ease of financing efficacy for startups and SMEs, which will improve the scalability of entrepreneurial ventures and fortify the UAE's ability to attract talent and high-growth businesses that will shape Abu Dhabi's future."

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Jin-Chuan Duan, Executive Director of AIDF and Jardine Cycle & Carriage Professor of Finance, National University of Singapore

"The challenges faced by SMEs around the globe in getting access to fair financing have been well documented. Though the responsibility of addressing such broad issues typically falls on the shoulders of governments, I am of the opinion that a more effective way lies in incentivizing the lending institutions to come together and leverage the latest digital technology to close the information asymmetry gap present between lenders and SMEs.

ADGM Academy and AIDF collaborated to produce this white paper, highlighting the pain points felt by parties in the ecosystem pertaining to SME financing in the UAE and Abu Dhabi region, and propose a simple, yet robust, solution that paves the way to create an Artificial Intelligence (AI) and Big Data analytics-based *Credit Bureau 3.0*, a coordinated but decentralized digital platform. I can envision its profound impact on the SME financing environment and on the wider growth of those deserving SMEs in the UAE and Abu Dhabi region."

2 Introduction

SMEs represent "the backbone of most of the world's economies"[1]. As a result, they are getting thoughtful attention from planners, economists, governments, and multilateral agencies for their impact on national economies and the continuous market dynamics they are likely to produce in creating jobs, contributing to productivity, fostering innovation, generating tax revenues and achieving the Sustainable Development Goals (SDGs) by delivering more inclusive economic growth, environmental sustainability, promoting sustainable industrialisation, reducing income inequalities, and alleviating poverty (Carrier, 1999; Agupusi, 2007; ILO, 2015; OECD, 2017). They represent more than 90% of all companies, generate between 60% and 70% of employment and are responsible for 50% of the Gross Domestic Product (GDP) worldwide[2]. According to the World Bank estimates, in 2020, there were over 322 million formal SMEs, employing more than 705 million people, and nearly 3.3 million jobs will be needed every month to absorb the growing workforce in emerging markets by 2030, where SMEs generate 7 out of 10 formal jobs[3]. In the U.S., small businesses accounted for 62% of the net new jobs created between 1995 and 2020[4].

Because they are considered more opaque than large firms, SMEs are less likely to obtain bank loans. As a result, between 200 and 245 million companies, of which 90% are SMEs, do not have access to bank loans globally[5]. Additionally, over 70% of SMEs operate in the economy's informal sector, which implies that they rely on informal financing, mainly from their resources or from the capital of family and friends, usually called "love money"[6]. Therefore, to improve SMEs' access to bank loans, a better appreciation of their overall creditworthiness and probability of default is crucial.

The UAE has long held ambitions to be among the most innovative countries in the world, supported by digitisation, owing to advanced and creative talent, legislation, government efficiency, availability of capital and infrastructure. The UAE started its digital transformation journey in 1982 by establishing the Public Information Authority. It invested in I.T. infrastructure and launched several strategic initiatives, such as the eDirham in 2001, the Telecommunications Regulatory Authority (and the Digital Government) in 2003, the eGovernment in 2011, the smart Government in 2013, the digital identity (UAEPass) in 2016, and the digital wallet (using blockchain) in 2018 (TDRA, 2020). Today, the UAE is leading the region in government service automation. It continues investing in its digital transformation to support improving the quality of government service and customer happiness and developing science and technology-based innovations[7].

Digital capabilities in the UAE are a significant asset to mobilise to address the SMEs' credit finance gap and improve their broader access to finance. Therefore, Abu Dhabi Global Market Academy (ADGMA) Research Centre collaborated with the Asian Institute of Digital Finance (AIDF) at the National University of Singapore to prepare this white paper on how the incorporation of novel and cutting-edge digital technology trends can improve financial institutions' credit lending decisions and risk management capabilities for SMEs. The research included a Working Group consisting of senior representatives from the UAE Central Bank, the Department of Economic Development (DED), Emirates Development Bank (EDB), ADGM Financial Services Regulatory Authority (ADGM FSRA) and HUB71.

1 https://www.un.org/en/observances/micro-small-medium-businesses-day
2 https://www.un.org/en/observances/micro-small-medium-businesses-day
3 https://www.worldbank.org/en/topic/smefinance
4 https://cdn.advocacy.sba.gov/wp-content/uploads/2021/12/06095731/Small-Business-FAQ-Revised-December-2021.pdf
5 https://www.worldbank.org/en/topic/smefinance
6 https://www.un.org/en/observances/micro-small-medium-businesses-day
7 https://u.ae/en/about-the-uae/digital-uae/digital-transformation-in-the-uae

The structure of the white paper is as follows. First, the SME credit gap challenge is explained. Then, the importance of SMEs in the UAE and Abu Dhabi is showcased before contextualising the SME credit gap issue in the UAE. Next, local initiatives and international best practices are presented before a case study from Singapore on the benefits of an Artificial Intelligence, Machine Learning (AI-ML) based platform for informed credit-related decisions is showcased. Finally, we conclude with a call to action.

3 Problem statement

3.1 What is an SME?

Small and Medium-sized Enterprises (SMEs) come in many shapes and sizes. The SME definition is a practical tool to help SMEs, governments, investors and other stakeholder identify them and treat them as a distinct category of business with unique characteristics and requirements. Yet, a standard international definition of the SME does not exist, which has always created inconsistencies and affected the effectiveness of policies targeting them. For example, the European Union (E.U.), the United Nations (U.N.), and the World Trade Organization (WTO) commonly refer to SMEs. In contrast, in the United States, these firms are frequently referred to as small-to-mid-size businesses (SMBs).

In the U.S., the Small Business Administration (SBA) classifies small businesses according to ownership structure, number of employees, earnings, and industry[8]. However, regarding taxes, the U.S. Internal Revenue Service (IRS) does not categorize businesses into SMBs. Instead, it separates small businesses and self-employed individuals into one group and large to mid-size businesses into another[9]. In Asia, the definition of SMEs depends on specific indicators related to investment, employment or output or a combination of these three variables (Bala Subrahmanya, 2009). On the other hand, the World Bank continues to have no definition of SMEs and relies on country standards, which vary widely. At the same time, the International Finance Corporation (IFC) and the Multilateral Investment Guarantee Agency (MIGA) use a common standard definition (Table 1), according to which an enterprise qualifies as a small or medium enterprise if it meets two out of three criteria (employees, assets, and sales), or if the loan to it falls within the relevant SME loan size proxy (The Word Bank, 2019).

Table 1: IFC Definitions and Proxies for SMEs

Indicator	IFC SME Definition			SME Loan Size Proxy
	Employees (no.)	Total Assets ($)	Annual Sales ($)	Loan size at origination ($)
Small Enterprise	10-49	100,000 - < 3,000,000	100,000 - < 3,000,000	<100,000
Medium Enterprise	50-300	3,000,000 – 15,000,000	3,000,000 – 15,000,000	<1,000,000 or 2,000,000

The Basel Committee on Banking Supervision (2017) considers the corporate to be an SME when the reported annual sales for the consolidated group of which the corporate counterparty is a part is less than or equal to €50 million for the most recent financial year. SMEs are defined by the OECD (2005)[10] as non-subsidiary, independent firms which employ fewer than a given number of employees. The European Union (E.U.) offers more precise definitions. The European Commission Recommendation of 6 May 2003 concerning the definition of SMEs uses three main factors: staff headcount and either

[8] https://www.sba.gov/federal-contracting/contracting-guide/size-standards
[9] https://www.irs.gov/about-irs/small-business-self-employed-division-at-a-glance
[10] https://stats.oecd.org/glossary/detail.asp?ID=3123

turnover or balance sheet total (Table 2). The numbers vary across national statistical systems. The upper limit in the European Union is 250 employees. Some countries set the limit at 200 employees[11]. For firms to be considered small, the number of employees should not exceed 50. Regarding the financial assets, the European Union definition, which came into force on 1 January 2005 and applied to all community acts and funding programmes as well as in the field of State aid, places the financial ceilings at EUR 50 million for the turnover of medium-sized enterprises and EUR 10 million for small enterprises. Alternatively, balance sheets for medium and small enterprises should not exceed EUR 43 million and EUR 10 million, respectively.

Table 2: Main factors used by the European Union to define SMEs (European Commission, 2015[12])

Company Category	Staff Headcount	Turnover	Balance Sheet Total
Small	<50	≤ € 10 m	≤ € 10 m
Medium-Sized	<250	≤ € 50 m	≤ € 43 m

But before applying these calculations, the first step for an SME identification in the E.U. zone is to check if it qualifies to be considered an enterprise. Then, an enterprise must demonstrate whether it is an autonomous enterprise, a partner enterprise, or a linked enterprise. These criteria, set by the European Union relating to the notion of control – both legal and de facto, are essential as, in some instances, those relationships, mainly if they create significant ownership links or give access to additional financial or other resources, imply that an enterprise will not be considered as an SME.

In the UAE, the definition of SMEs is given by the UAE Cabinet of Ministers Executive Regulation number 35 for 2016. However, it varies based on the type of business: trade, industry, and services and according to annual returns (revenue) or the number of employees (Table 3).

Table 3: Main factors used to define SMEs in the UAE (Source; Ministry of Economy[13])

Company Category	Number of Employees			Annual Returns (AED)		
	Trade	Manufacturing	Services	Trade	Manufacturing	Services
Small	6-50	10-100	6-50	<Dh50m	<Dh50m	<Dh20m
Medium-Sized	51-200	101-250	51-200	<Dh250m	<Dh250m	<Dh200m

3.2 Importance of ecosystems to support SMEs growth

SMEs are generally confronted with unique issues related to inefficiencies in the business environment and policy sphere. These inadequacies generate market failures and structural barriers that could hinder their progress. For example, market failures could be related to the lack of access to finance which could affect SMEs' capacity to grow. Moreover, SMEs often must overcome structural barriers such as a lack of management and technical skills, rigid labour markets and limited knowledge of opportunities for international expansion (European Commission, 2015). Therefore, to create conducive framework conditions and healthy competition for SMEs to thrive, it is crucial to understand the ecosystem that characterizes the environment in which they operate and compete with other entities to appreciate better the challenges they face. Scholars in entrepreneurship and organization theory studying "entrepreneurial ecosystems" highlight the importance of venture capital, a skilled labour pool, a sophisticated services infrastructure, universities and research institutions, the existence of large established corporations (that can spin off new ventures), the informal and formal networks among

[11] The United States considers SMEs to include firms with fewer than 500 employees
[12] https://ec.europa.eu/regional_policy/sources/conferences/state-aid/sme/smedefinitionguide_en.pdf
[13] https://www.uaesme.ae/en/about/official-definition

entrepreneurs, the physical infrastructure, and the culture and the entrepreneurial spirit of the ecosystem (Roundy, 2017).

In conjunction with the Babson College Entrepreneurship Ecosystem Project, Isenberg (2011) conceptualized entrepreneurial ecosystems. Although every entrepreneurial ecosystem is unique and consists of a myriad of specific elements, an ecosystem is commonly comprised of general factors that span socio-cultural (e.g., institutional support) and economic forces (e.g., venture-friendly markets), besides the presence of serial entrepreneurs to drive the formation and development of such ecosystems. According to Isenberg (2011), entrepreneurial ecosystems consist of six key domains: "a conducive culture, enabling policies and leadership, availability of appropriate finance, quality human capital, venture-friendly markets for products, and a range of institutional and infrastructural support."

The Global Entrepreneurship Monitor (GEM)[14] framework describes and assesses an economy's entrepreneurial ecosystem against nine Economic Framework Conditions (EFCs) that shape the context in which entrepreneurial activities take place: (1) financing, (2) government policies (relevance and support; taxes and bureaucracy), (3) government programs, (4) entrepreneurial education (school-level entrepreneurship education and training, post-school entrepreneurship education and training), (5) R&D transfer, (6) access to commercial and professional infrastructure, (7) internal market dynamics and burdens, (8) access to physical and services infrastructure, and (9) social and cultural norms (figure 1). The state of these EFCs can encourage, constrain, or completely discourage either the setting up of new businesses or the development of new start-ups into established businesses which can generate sustained incomes and jobs (GEM global report, 2021/22).

Figure 1: GEM Economic Framework Conditions

3.3 The state of entrepreneurial finance and the SMEs credit gap

In the initial stage of enterprises, entrepreneurs might need considerable capital to advance their ventures. However, evaluating SMEs' risk and success in their early years is challenging. It triggers a low level of trust in early-stage entrepreneurs as economic agents and a widespread sceptical attitude toward the possibility of setting up and running a successful business. According to the U.S. Bureau of Labor Statistics, the average SME survival rate is 50% after five years and 35% after ten years[15]. For instance, this creates structural barriers to accessing necessary financing, which produces a significant hurdle threatening SMEs' survival and hampering their development.

[14] The Global Entrepreneurship Monitor is a networked consortium of national country teams associated with top academic institutions and centres of excellence for entrepreneurship research worldwide. GEM is the only global research source that collects data on entrepreneurship directly from individual entrepreneurs through the Adult Population Survey (APS). GEM also collects data from carefully selected panels of national experts (National Experts Survey) and produces the National Entrepreneurship Context Index (NECI) to chart how conducive individual national contexts are to promoting entrepreneurship: https://www.gemconsortium.org/

[15] https://www.bls.gov/bdm/us_age_naics_00_table7.txt

access to finance is the second most cited obstacle facing SMEs in growing their businesses in emerging markets and developing countries (Owens and Wilhelm, 2017). It is estimated that 65 million firms, or 40% of formal micro, small and medium enterprises in developing countries, have an unmet financing need of $5.2 trillion every year, representing 1.4x the current level of global SME lending, which is equivalent to 19% of the Gross Domestic Product (GDP) of countries covered in their analysis. Latin America, the Caribbean, the Middle East, and North Africa regions have the highest proportion of the finance gap compared to potential demand, measured at 87% and 88%, respectively. About half of formal SMEs don't have access to formal credit. The financing gap is even more prominent when micro and informal enterprises are considered. There is an estimated $2.9 trillion potential demand for finance from informal enterprises in developing countries, equivalent to 10% of the GDP in these countries (Owens and Wilhelm, 2017)[16].

It is essential to provide SMEs with adequate access to financial sources during their start-up, growth, and transfer phases. To support SMEs in addressing the different financing needs they encounter along their life cycle, a wide range of financing alternatives should be made available, such as seed funding, angel funding and quasi-equity financing, and crowdfunding, in addition to stimulating the supply of debt finance. Because of the reforms after the 2008 global financial crisis, banks deleveraging process aiming at contracting their balance sheets to meet the increasingly rigorous prudential rules has adversely exposed the SME sector to new credit constraints, even though prudential rules for SMEs have not changed. As a result, the new way financial institutions operate is inclined against offering what they consider “low-return” finance to any form of “risky and uncertain enterprise”, such as SMEs, and this "new normal" creates debt financing gaps for SMEs and entrepreneurs. Therefore, more diversified financing options are needed to support long-term investments and reduce SMEs' vulnerability to changes in the credit market. The OECD report on new approaches to SME and entrepreneurship financing categorizes financing instruments that are alternatives to straight debt ordinary lending, into four groups (Table 4), characterized by differing degrees of risk and return: asset-based finance, alternative debt, hybrid instruments and finally, equity instruments (OECD, 2015).

Table 4: Alternative external financing techniques for SMEs and entrepreneurs (OECD, 2015)

Low Risk / Return	Low Risk / Return	Medium Risk / Return	High Risk / Return
Asset-Based Finance	**Alternative Debt**	**Hybrid Instruments**	**Equity Instruments**
▪ Asset-based lending ▪ Factoring ▪ Purchase order finance ▪ Warehouse receipts ▪ Leasing	▪ Corporate bonds ▪ Securitised debt ▪ Covered bonds ▪ Private placements ▪ Crowdfunding (debt)	▪ Subordinated loans/bonds ▪ Silent participations ▪ Participating loans ▪ Profit participation rights ▪ Convertible bonds ▪ Bonds with warrants ▪ Mezzanine finance	▪ Private Equity ▪ Venture capital ▪ Business angels ▪ Specialized platforms for the public listing of SMEs ▪ Crowdfunding (equity)

SMEs could combine internal (profits and revenues) and external (bank credit, asset-based finance, equity funding, etc.) forms of funding to support their activities and growth. Internal profits and revenues remain SMEs' primary source of funding. As for the other external funding options, they are not equally available across firms. For instance, SMEs with a lower risk of default but a limited return on investment would use alternative debt. In comparison, innovative ventures with high growth potential and higher return on investment but at higher risk would favour equity instruments (OECD, 2021). Although debt financing appears to be ill-suited for newer, innovative, and fast-growing companies with a higher risk-return profile, bank credit remains SMEs' primary source of external funding, and for many SMEs

[16] https://www.worldbank.org/en/topic/smefinance

and entrepreneurs, the preferred financing alternative to manage their working capital requirements, capital acquisitions and capacity expansion, and launch new products and services in the market. According to the European Commission report on access to finance, in 2021, 65% of European SMEs preferred bank loans to finance their future growth ambitions, and another 16% reported loans from other sources. Equity investment is the preferred type for only 6% of SMEs (European Commission, 2021). A survey conducted by EY with 5,600+ SMEs across the globe shows that banks are still the most trusted type of financial services provider in SMEs' eyes, but not by a large margin since other providers such as Big Tech corporations, large companies expanding into financing and FinTech players are quickly catching up[17].

According to the Development Research Group at the World Bank (2017), 20% of SMEs in high-income countries, 28% of SMEs in middle-income countries, and 44% of SMEs in low-income countries need loans but refrain from applying for credit. Some SMEs do so because they lack profitable investment projects. Others perceive that their credit application will not succeed because they lack enough collateral or cannot provide all the required information.

The SME credit gap is an enduring structural feature across developing and developed markets, even those that have enacted various policy measures to support SMEs and enhance financial inclusion more broadly. There are many factors to explain this gap. The general economic and financial environment, fiscal policies, and financial regulations requiring banks to keep detailed information on clients and loan originations could trigger the credit gap for SMEs. Moreover, the very nature of SMEs that are operating in innovative sectors or which could be informal could compound the problem in addition to other factors on both supply and demand sides. A problem is on the supply side if the SMEs have profitable investment projects but cannot get sufficient external funds to finance them. Limitations, in this case, are associated with the overall opacity of the SME finance market, persistent regulatory impediments, and costs of regulatory compliance which translate into limitations in terms of the size of loans or availability of credit lines, the terms and conditions of bank financing, including the levels of interest rates due to charging a higher risk premium, collateral requirements, required guarantees, information requirements, procedures, and the time needed for loan approval and loan covenants. They could be due also to market imperfections, such as information asymmetries or weak creditor protection, which could make it more difficult for financial intermediaries to assess the creditworthiness of SMEs, monitor their actions, and enforce repayment. These imperfections can limit lending to firms, including those with profitable investment opportunities. On the other hand, a problem is on the demand side when SMEs are not creditworthy or do not have the appropriate financial knowledge, strategic vision, resources and sometimes even the willingness or awareness to attract sources successfully (OECD, 2017). Lending, in this case, is not extended because of the pessimistic outlook concerning their sales, profitability and business plan.

17 https://www.ey.com/en_gl/banking-capital-markets/the-five-step-journey-to-sme-banking-transformation

4 Importance of SMEs in the UAE and Abu Dhabi

Entrepreneurial activity and the prevalence of successful SMEs are the product of individuals' capacity to innovate, identify and seize opportunities, as well as the national and entrepreneurial frameworks in which basic business requirements, efficiency enhancers, innovation adoption and business sophistication are developed and supported to influence individuals' decisions to pursue entrepreneurial initiatives and grow SMEs.

4.1 National Framework Conditions in the UAE

The UAE's economy is the second largest in the region after Saudi Arabia, and the UAE is also one of the wealthiest countries on a per capita basis. In 2020, the UAE GDP per capita was estimated to be approximately USD$ 36,284, with an overall GDP of nearly USD$358 billion[18]. With a strategic location, high connectivity, state-of-the-art infrastructure, and quality of life, including safety and economic stability, the UAE has considerable advantages in becoming a regional and global business hub. As an essential prerequisite of a diversified, innovative, and resilient economy, SMEs get particular focus from the UAE Government. The UAE Vision 2021 was launched to make the UAE among the best countries in the world to live, work, and do business. It aims to make the UAE among the best countries in the world for entrepreneurship by encouraging UAE nationals to be the driving force of economic development through SMEs and by serving as a magnet for entrepreneurs from throughout the region and the world who would like to start or scale businesses in the UAE[19].

The "Fifty Economic Plan", which represents the new vision for the economic framework in the UAE for the years 2021-2071, consolidates the previous vision by aiming to stimulate entrepreneurship and SMEs, spread the culture of entrepreneurship among future generations, and establish the position of the UAE as a global hub and destination for entrepreneurship, especially in the areas of innovation and technology. In addition, the National Agenda for Entrepreneurship aims to establish the UAE as "the entrepreneurial nation" by 2031. It includes 29 initiatives aimed at enhancing the business environment and entrepreneurial mindset in the UAE, and an integrated package of incentives that will enable the country to increase the number of its start-ups to reach one million, incubate ten unicorn start-ups and achieve a strong partnership between the public and private sectors[20].

The UAE authorities – federal and local governments – have taken essential measures recently to improve the business ecosystem and provide SMEs with the necessary support. Over the past two decades, specialized free zones were created to establish a solid foundation for entrepreneurship in the UAE. The taxation system in the UAE is still favourable for entrepreneurs and SMEs. Even though the UAE started levying Value Added Tax in January 2018 at a rate of 5% with certain exemptions, federal corporate income tax (CIT) will be applied for fiscal years starting on or after 1 June 2023. The UAE still does not levy income tax on individuals. The UAE also allows full foreign ownership of specific businesses and provides golden visas for entrepreneurs. Among the projects of the 50s to boost the contribution of nationals to the private sector and SMEs creation, a subsidized career break of six-to-twelve months was decided for Emiratis in federal government positions to start a business. An early retirement plan was also approved to offer Emiratis in federal government positions the possibility to explore business opportunities and start a private sector business. The AED1 Bn Graduate Fund is another project aiming to support the university and fresh graduates to create business projects in collaboration with UAE universities.

[18] https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=AE
[19] https://www.vision2021.ae/en
[20] https://www.moec.gov.ae/en/uae-business-ecosystem

In terms of regulations, policies and programmes, Federal Law No. 2 of 2014 on Small and Medium Enterprises was issued in 2014 to protect, promote and regulate SMEs. In 2016, the Federal Decree Law on Bankruptcy (No. 9 of 2016) was issued and came into force. It represents a step forward for the UAE's insolvency regime, notably with the removal of the criminal offence of bankruptcy by default, criminal involvement in matters relating to bounced cheques, and a new threshold and requirement for creditor-initiated insolvency proceedings. Established according to Federal Law No. 2 of 2014, the National SME Programme was launched under the umbrella of the Ministry of Economy to empower National SMEs by providing them with benefits and incentives such as technical and administrative support, financing, marketing, training, and exposure. The UAE SME Council was also created to develop strategic plans and policies for SMEs and set the necessary rules and regulations to enhance coordination between the SME National Programme and participating bodies. This Council is chaired by the Minister of State for entrepreneurship and SMEs, a new ministerial portfolio created to illustrate the Government's strong support for SMEs. In April 2019, the UAE Government launched the Ministry of Possibilities, representing the next generation of government operations. Virtual, with no Minister, and managed by the members of the UAE Cabinet, the Ministry's work includes several national programmes in the form of four departments, one of them is the Department of Government Procurement, which aims to make government procurement faster and more accessible, especially for SMEs. For instance, the Ministry of Finance has launched the Federal Supplier Register to facilitate the participation of small entrepreneurs in bids and tenders from federal government entities without paying registration fees. In 2019, the National Cybersecurity Strategy was approved to implement a comprehensive legal and regulatory framework covering all cybercrimes, securing existing and emerging technologies and protecting SMEs against the most common cyber threats. Finally, Operation 300bn, the UAE's ten-year industrial strategy, was launched in 2021 to increase the industrial sector's contribution to the GDP from the current AED133 billion to AED300 billion by 2031. In alignment with the UAE's commitment to global climate action and along with Circular Economy Policy 2021-2031, the Ministry of Industry and Advanced Technology and Emirates Development Bank, the critical enabler of Operation 300bn, will support 13,500 industrial SMEs in priority sectors to encourage the development and adoption of the Fourth Industrial Revolution (4IR) applications and advanced technologies. This will generate significant economic returns and create 25,000 jobs while reducing the environmental footprint of the industrial sector.

4.2 Abu Dhabi Initiatives

Abu Dhabi has ambitious goals to further develop the SME sector, which is expected to play an important role in diversification strategies and in increasing the local labour force (UAE nationals), which is currently less than 10%.

Abu Dhabi Vision 2030 has two economic policy priorities: (1) building a sustainable economy and (2) ensuring a balanced social and regional economic development approach that benefits all. Developing industrial and service SMEs is key to achieving this economic vision[21]. Many initiatives have been launched to support implementing this vision, including but not limited to Ghadan 2021, the AED50 billion three-year investment and reform programme launched in 2019. It includes 16 initiatives to improve the ease of doing business and reduce the cost of living in the Emirate, among them nine initiatives aiming at boosting the development of SMEs and the private sector: (1) Abu Dhabi's instant licence, (2) industrial tariffs launched by Abu Dhabi Department of Economic Development (ADDED), (3) licences for technology businesses by the ADDED, (4) SME credit guarantee scheme through a guarantee provided by the Abu Dhabi government to Abu Dhabi banks, (5) corporate R&D programme by Abu Dhabi Investment Office (ADIO), (6) open data initiative launched by the Abu Dhabi Digital Authority (ADDA), (7) TAMM (Abu Dhabi Government Services Ecosystem) a one-stop-shop portal to access multiple government services, launched by ADDA, (8) Sharaka platform developed by Abu

[21] https://www.actvet.gov.ae/en/Media/Lists/ELibraryLD/economic-vision-2030-full-versionEn.pdf

Dhabi Council for Economic Development (ADCED) and finally (9) ecotourism incentives undertaken by ADIO along with the Department of Culture and Tourism (DCT) of Abu Dhabi. An SME Sector was recently established within the ADDED to develop and monitor the SMEs strategy, facilitate conducive policies, and ensure the implementation of relevant initiatives in coordination with ecosystem stakeholders. ADDED has partnered with 23 other government and private entities to launch "Set-up in Abu Dhabi", a comprehensive SME enabling platform to support ease of business in the Emirate[22]. ADDED has also launched the "Investor Journey" as part of TAMM to address the needs of current and prospective businesses, entrepreneurs, and investors by reducing costs, offering seamless integration and an advanced service ecosystem to facilitate new business ideation and set-up. Finally, ADDED and the Khalifa Fund for Enterprise Development (KFED) also launched The Abu Dhabi SME Hub, an interactive digital platform to support SMEs by consolidating the local business ecosystem to enable entrepreneurs to grow, thrive and innovate in the UAE[23].

Another major initiative in Abu Dhabi aiming at boosting diversification through the creation of technology businesses is the establishment in May 2020 of the Advanced Technology Research Council as the overarching advanced technology research body in Abu Dhabi and the UAE. The Council was established to shape research and development for transformative technology outcomes that will support science and technology SMEs in the country. Two pillar entities have joined in 2021 the growing hub of world-class sustainable technology innovators at Masdar City: Technology Innovation Institute (TII), the dedicated 'applied research' pillar of ATRC with seven initial research centres of excellence in quantum, autonomous robotics, cryptography, advanced materials, digital security, directed energy and secure systems; and ASPIRE, the technology programme management pillar of ATRC that will fund research projects and develop and launch international competitions and grand challenges.

4.3 Ecosystem Framework Conditions in the UAE

The national framework conditions, legal frameworks, policies, and initiatives launched by the UAE federal government to ensure the growth and success of SMEs support the development of a favourable entrepreneurial ecosystem. According to the GEM UAE 2020/2021 report, the UAE entrepreneurial ecosystem has continued to improve in the past six years. All framework conditions have improved by almost more than 100%, with R&D Transfer (142.75%), financing for entrepreneurs (133.08%) and taxes and bureaucracy (127.57%) showing the best improvement (Table 5).

[22] https://added.gov.ae/Media-Center/Business-News/Setup-in-Abu-Dhabi-Platform-as-a-Gateway-for-mSMEs-launched
[23] https://www.adsmehub.ae/en

Table 5: UAE Entrepreneurial Framework Conditions (EFC) in 2021 (Source: GEM UAE 2021/22 national report)

Entrepreneurial framework conditions	2016	2017	2018	2019	2020	2021	Change (%)
Financing for entrepreneurs	2.66	2.96	2.60	4.91	5.26	6.2	133.08%
Governmental support and policies	3.51	3.74	3.56	6.49	6.81	6.99	99.15%
Taxes and bureaucracy	3.30	3.56	3.14	5.82	5.72	7.51	127.57%
Governmental programs	3.34	3.23	3.32	5.94	6.01	6.53	95.51%
Basic-school Entrepreneurial Education and training	2.68	3.03	2.67	5.36	5.83	5.73	113.81%
Post-school entrepreneurial education and training	2.84	3.32	3.08	5.57	5.58	6.42	126.06%
R&D Transfer	2.55	2.92	2.64	4.72	5.11	6.19	142.75%
Commercial and professional infrastructure	3.29	3.45	3.06	5.71	5.95	6.75	105.17%
Internal market dynamics	3.44	3.31	3.54	6.13	6.19	7.25	110.76%
Internal market openness(burdens)	3.00	3.20	2.75	5.13	5.22	6.16	105.33%
Physical and services infrastructure	4.25	4.40	4.01	7.53	7.33	8.14	91.53%
Cultural and social norms	3.69	4.06	3.61	6.79	7.33	7.71	108.94%

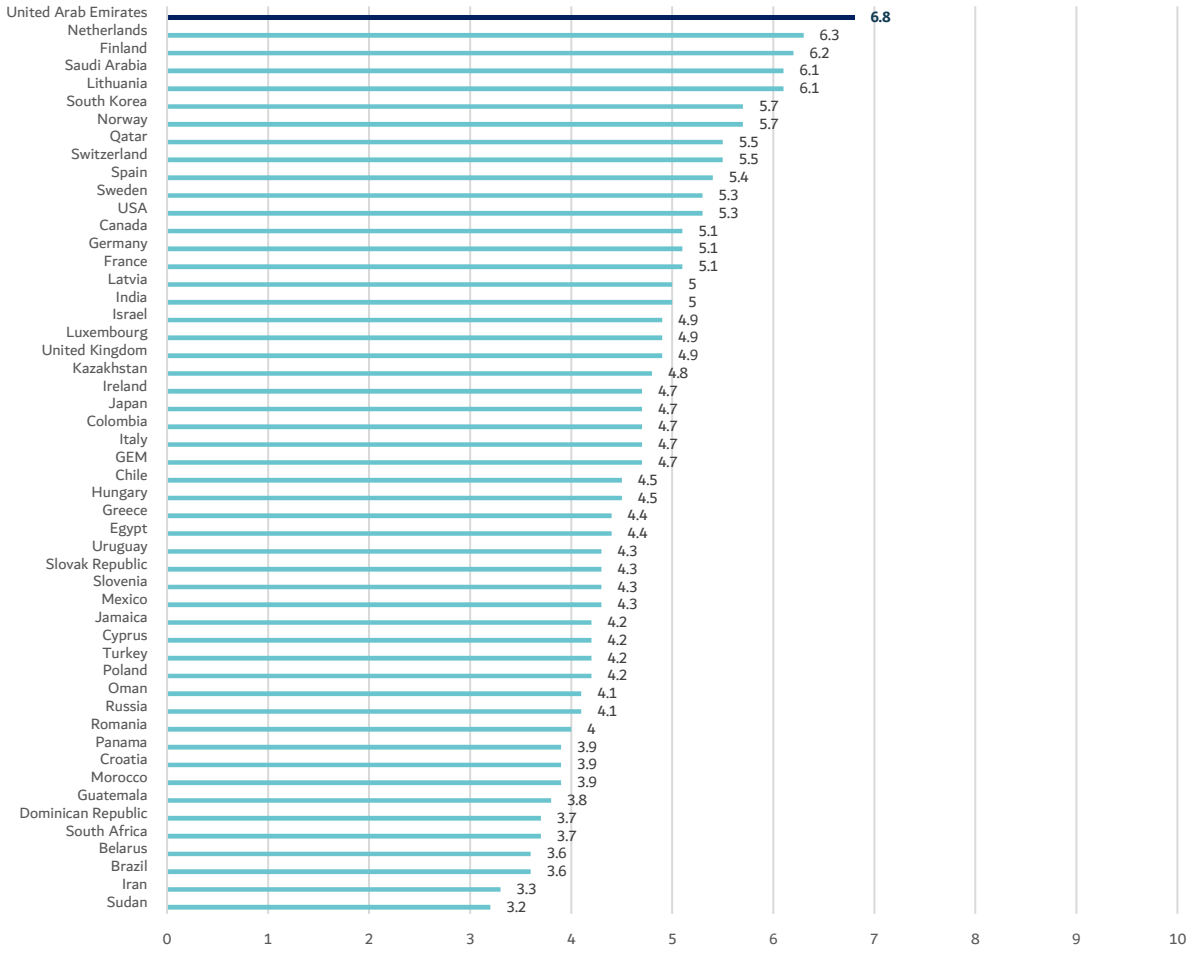
The UAE is at the top of the world for government policy support, relevance, taxes, and bureaucracy, and it has also improved so that it is top for entrepreneurship education at both the school and post-school stage, cultural and social norms. All other conditions are ranked 2nd or 3rd, with only entrepreneurial finance and commercial and professional infrastructure being the lowest at 4th in the world (Table 6).

Table 6: UAE ranking of main entrepreneurial framework conditions (Source: GEM UAE 2021/22 national report)

Entrepreneurial framework conditions	UAE rank over (X) economies			
	2018 (55)	2019 (54)	2020 (44)	2021 (51)
Entrepreneurial finance	31	21	13	4
Government policies: support and relevance	6	1	2	1
Government policies: taxes and bureaucracy	7	4	5	1
Government entrepreneurship programs	10	7	8	2
Entrepreneurship education at the school stage	5	2	3	3
Entrepreneurship education at the post-school stage	19	9	9	1
R&D transfer	19	12	8	1
Commercial and professional infrastructure	23	12	10	4
Internal market dynamics	12	8	8	2
Internal market burdens or entry regulation	15	10	9	3
Physical infrastructure	18	9	10	3
Cultural and social norms	6	3	2	2

The UAE has the first position in the 2021/22 GEM Global National Entrepreneurship Context Index (NECI) ranking (Figure 2). Well above the average score, overall, the UAE entrepreneurship context is favourable for developing entrepreneurial and established business activities.

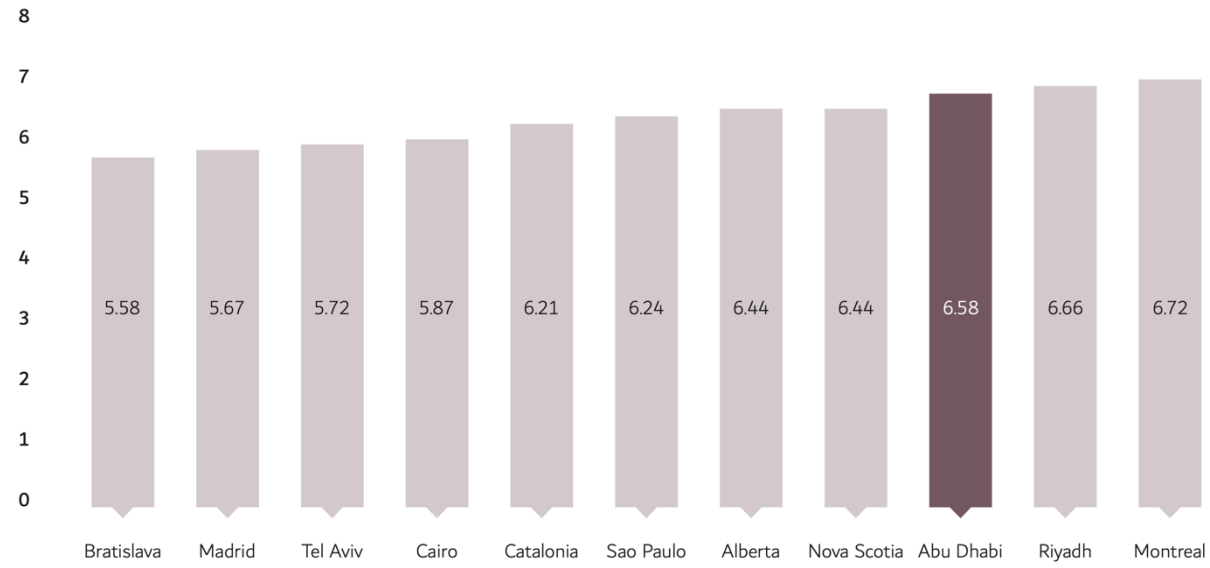
Figure 2: GEM National Entrepreneurship Context Index (NECI) 2021/2022 (source: GEM UAE 2021/22 national report)



4.4 Ecosystem Framework Conditions in Abu Dhabi

According to GEM UAE 2019/20 special report on Abu Dhabi Entrepreneurial Ecosystem Index (ESI), Abu Dhabi has a moderately high-quality entrepreneurial ecosystem. As a result, the Emirate is a favourable environment to develop innovative and high-growth entrepreneurship. Its physical infrastructure, culture, talent, networking, and demand stand out as its strengths. However, to improve the entrepreneurial ecosystem, attention must be paid to financing, formal institutions, leadership, support services, and knowledge framework conditions. With a score of 6.58, Abu Dhabi ranked third, only slightly behind Riyadh (6.66) and the leader Montreal (6.72), and slightly ahead of Nova Scotia (6.44), Alberta (6.44) and Sao Paolo (6.24) (Figure 3).

Figure 3: Abu Dhabi ESI Index Composite International Comparison (Source: GEM UAE 2019/20 special report on Abu Dhabi ESI)



4.5 Entrepreneurial activity through the business phases in the UAE and Abu Dhabi

The SME sector in the UAE is continuously developing. According to the Ministry of Economy, the SME sector represents more than 94% of the total number of companies operating in the country. In addition, it provides jobs for over 86% of the private sector's workforce [24] . According to the Federal Competitiveness and Statistics Authority, the contribution of the SME sector to the UAE's GDP was estimated at 53% in 2019 and is expected to contribute to 60% of the UAE's GDP by 2021 [25]. In Dubai, SMEs make up nearly 95% of all companies, employing 42% of the workforce and contributing about 40% to Dubai's GDP [26]. Figure 4 shows the sectoral distribution of the 350,000 SMEs in the UAE as of mid-2020[27]. In Abu Dhabi, SMEs make up 98% of businesses and 44% of Abu Dhabi's non-oil GDP (GEM UAE special report on Abu Dhabi ESI, 2019/20).

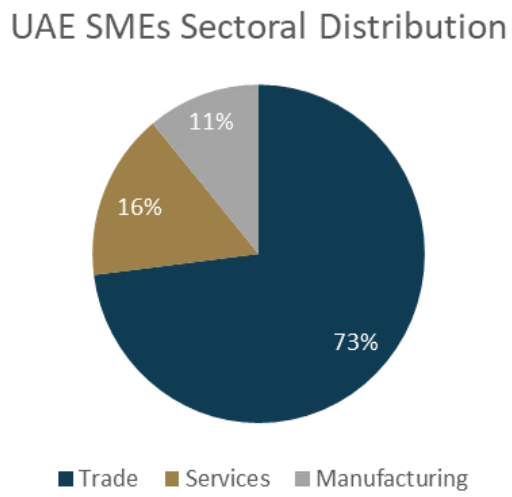


Figure 4: Sectoral Distribution of SMEs in the UAE (Source: Ministry of Economy website)

To capture the importance of SMEs in the UAE, we look at the Total Entrepreneurial Activity rate (TEA), which indicates the prevalence of individuals engaged in nascent entrepreneurship (business start-up) and new firm ownership (business consolidation) in the adult (18 - 64 years of age) population. We also

[24] https://u.ae/en/information-and-services/business/crowdfunding/the-impact-of-smes-on-the-uae-economy
[25] https://www.mediaoffice.abudhabi/en/economy/khalifa-fund-and-eci-partner-to-boost-export-capabilities-of-smes-in-uae/
[26] https://u.ae/en/information-and-services/business/crowdfunding/the-impact-of-smes-on-the-uae-economy
[27]https://u.ae/en/information-and-services/business/small-and-medium-enterprises/small-and-medium-enterprises

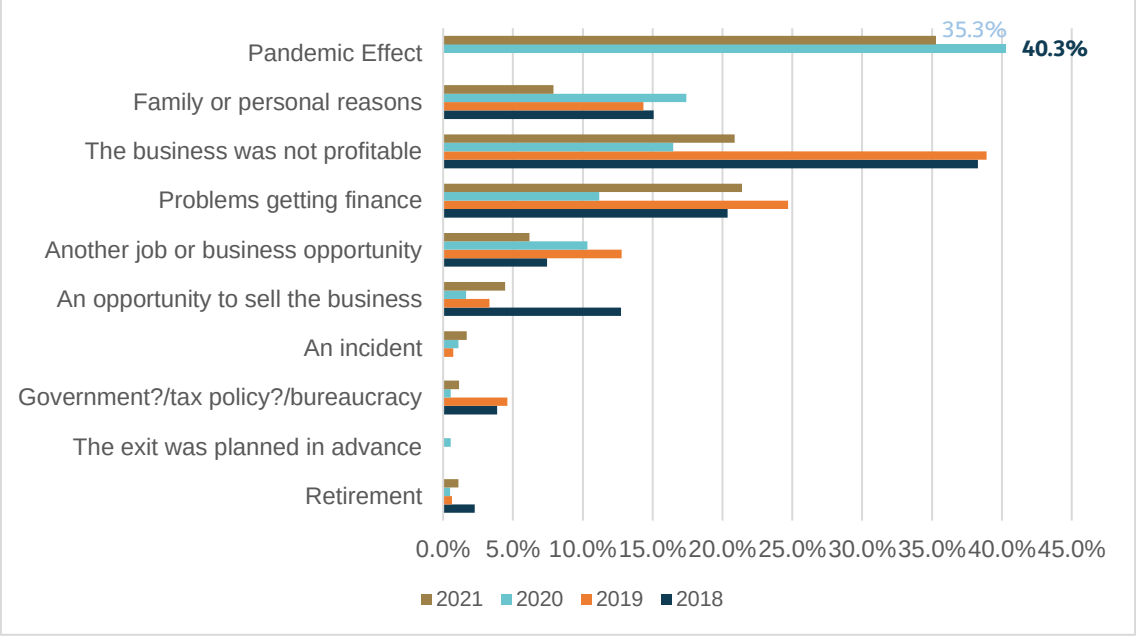
look at the rate of the adult population reporting as owner-managers of established businesses who have been active in the market for more than 42 months, which measures business development and persistence. According to GEM UAE 2021/22 report, the TEA rate in the UAE in 2021 was 16.51% (with nascent activity estimated at 9.38% and new activity representing 7.58%.) The rate of established businesses was 6.4%. This entrepreneurial activity was concentrated in the consumer-oriented sector, with more than 60% of the TEA and almost half (49.09%) of the established entrepreneurial activities being in the consumer-oriented sector. Total discontinuation of businesses, which measures activity exited from the market, was 10.2% of the 18-64 aged population. A dynamic economy requires a higher entry-than-exit rate. The UAE's exit rate was higher than its entry rate (10.2% versus 9.38%), which needs to be addressed. Moreover, among the discontinued businesses, 54.9% have completely exited the market (Table 7).

Table 7: UAE's 2021 results on entrepreneurial activity through the phases of business (Source: GEM UAE 2021/22 national report)

Activity at each phase of business creation, development, consolidation, and discontinuation (Percentages of UAE's population aged 18–64 involved in each stage)					
Potential	**Nascent**	**New**	**TEA**	**Established**	**Discontinuation**
42.64%	9.38%	7.58%	16.51%	6.40%	10.2%
Business discontinuation composition: 10.2% (100%) (Percentages of UAE's population aged 18–64 involved in each phase)					
Business continued in other hands	**Business continued but changed its main activity**	**Business exited the market completely**	**Don't know/Refuse**		
3.5% (34.3%)	0.7% (6.9%)	5.6% (54.9%)	0.4% (3.9%)		

In 2021, the main reason to abandon a business in the UAE was the effect of the pandemic (35.3%), which is a slight decrease compared to 2020. Problems in getting finance (21.4%) were the second main reason to abandon a business in the UAE right before lack of profits (20.9%) (Figure 5).

Figure 5: Main reasons for business discontinuation in the UAE (Source: GEM UAE 2021/22 national report)



5 SMEs finance challenges in the UAE

Although giant steps have been made to improve the ecosystem in the UAE and Abu Dhabi, there is still room for improvement. Addressing issues such as the cost of living, the lack of affordable office spaces, the consistency of regulations over time and across the emirates, the lack of exit opportunities, the possibility for SMEs to scale up beyond the UAE and the region, the lack of reliable and transparent data about SMEs that could be used by authorities and financial institutions dealing with them are significant actions to improve the ecosystem. Another major step would be expanding SMEs' access to finance, mainly debt finance.

5.1 Availability and ease of access to finance

Considering the quality of the entrepreneurial finance ecosystem framework condition in the UAE, the GEM UAE 2021/22 report shows that financing for entrepreneurs is improving, with an average score of 6.2 out of 10, with informal funding (7.21), professional business angels (6.45), government subsidies (6.43), venture capital (6.28) and equity funding (6.06) considered sufficient. However, only crowdfunding (4.92) is not perceived as sufficient (Table 8). In terms of access, most entrepreneurs find it easiest to attract investors once the start-up phase has been completed (6.39), followed by debt funding (6.06) (table 9).

Table 5: UAE experts' assessment of the sufficiency of entrepreneurial finance from 2016 to 2021 (Source: GEM UAE national reports 2016/17/18/19/20/21/22)

Financing for entrepreneurs' block: in the UAE, there is sufficient ...	2021	2020	2019	2018	2017	2016
Equity funding	6.06	5.94	5.54	4.68	5.61	4.79
Debt funding	6.00	4.94	5.06	4.51	4.69	4.67
Government subsidies	6.43	5.94	5.54	5.28	5.34	5.75
Informal investors' funding (family, friends, and colleagues)	7.21	5.76	5.41	5.86	6.33	5.53
Professional business angels	6.45	5.33	4.97	4.31	4.69	4.42
Venture capitalists	6.28	5.68	5.22	4.51	4.97	4.61
Funding through Initial Public Offerings (IPO)	5.14	4.96	3.91	3.59	4.35	4.21
Private lenders' funding (crowdfunding)	4.92	4.26	4.20	3.77	4.03	3.88
Financing for Entrepreneurs' Average Score	**6.2**	**5.26**	**4.91**	**2.6**	**2.96**	**2.66**

Table 6: UAE experts' assessment of the ease of access to entrepreneurial finance in 2021 (Source: GEM UAE national reports 2016/17/18/19/20/21/22)

Financing for entrepreneurs' block: in my country it is easy...	2021
To get debt funding (bank loans and similar for new and growing firms)	6.06
To hire financial support services at reasonable cost for new and growing firms	5.48
For nascent entrepreneurs to get enough seed capital to cover start-up and early-stage expenses of a new business	5.47
To attract investors / funds to make a new business grow once the start-up phase has completed	6.39

According to GEM UAE 2019/20 special report on Abu Dhabi Entrepreneurial Ecosystem Index, the finance pillar scores moderately low, with an average score of 5.45 out of 10. New and established (8.04) and nascent (7.46) entrepreneurs think there are adequate external start-up funding sources in Abu Dhabi. Yet, informal investment (3.33), debt funding (4.33) and business angels (4.56) seem to be not easily accessible. This suggests that financing for entrepreneurs is mainly in the hands of the Government (6.07) rather than traditional financing sources. Finally, it seems that the pre-start-up phase suffers the most compared to the start-up and growth phases (Table 10). Findings also suggest the importance of introducing a business angel network and a crowdfunding platform to improve the state of entrepreneurial finance in Abu Dhabi.

Table 7: The average state of the finance pillar and its components in Abu Dhabi in the year 2019 (Source: GEM UAE 2019 special report on Abu Dhabi ESI)

Finance Pillar	Average score (0-10) 5.45
Informal Investment	3.33
Adequate sources of external start-up funding for nascent entrepreneurs	7.46
Adequate sources of external start-up funding for new and established owner-managers	8.04
New and growing firms have sufficient access to equity funding	4.98
New and growing firms have sufficient access to debt funding	4.33
New and growing firms have sufficient access to government subsidies	6.07
New and growing firms have sufficient access to funding from business angels	4.56
New and growing firms have sufficient access to funding from venture capitalists	5.15
Entrepreneurs have sufficient access to pre-start-up funding	4.91
Entrepreneurs have sufficient access to funding for their start-up phase	5.95
Entrepreneurs have sufficient access to funding for business growth	5.99

The SMEs finance gap could be explained firstly by the relatively narrow financing options and credit lines limited to letters of credit, equipment loans (secured), working capital loans (unsecured), overdrafts (used mainly for working capital purposes), leasing and factoring, performance bonds and guarantees (commonly used in the construction sector). It is also explained by the size and availability of loans. According to an IFC study in 2017[28], only 10 to 12% of UAE banks' corporate lending book is extended to SMEs. With an AED 106 Bn supply of finance to SMEs, the estimated unmet credit demand for SMEs in UAE is AED 296 Bn. In another study by BCG, the average financing gap in 2020 was estimated to be between AED310 Bn and 330 Bn[29]. The problem of supply of finance is compounded by the SMEs supply chain's lengthy payment terms, which could sometimes reach 180 days for 26% of exporters, according to a survey by COFACE in 2017, and the average payment delay, which is between 30 and 60 days according to the same survey[30].

5.2 The SMEs debt finance challenge in the UAE

The review of the SME banking landscape and the interviews with the working group members helped identify the following pain points that impede SMEs' access to debt finance in the UAE.

5.2.1 Opening a bank account and the KYC issue

A bank account is crucial for operational transactions and depositing shareholders' capital. One of the significant challenges impeding start-ups development in the UAE is opening a bank account, which may take up to three months in some instances. Onboarding small businesses by banks in the UAE is generally stringent due to anti-money laundering and combatting the financing of terrorism regulations which make the KYC process extremely long and tedious. The KYC process requires all banks to always maintain valid identity information for their customers, which helps them know and better understand their customers and their financial dealings to serve them better and manage risks prudently. The process is initiated by assigning a bank relationship manager, who will collect documents to be reviewed by the compliance department. The risk assessment, conducted according to internal procedures, covers the start-up and the licencing entity and determines whether additional background checks are required. However, because of the banks' legacy I.T. infrastructure, the inconsistency of the documents collected, the lack of integration with authorities downstream of the licensing process, the delays in

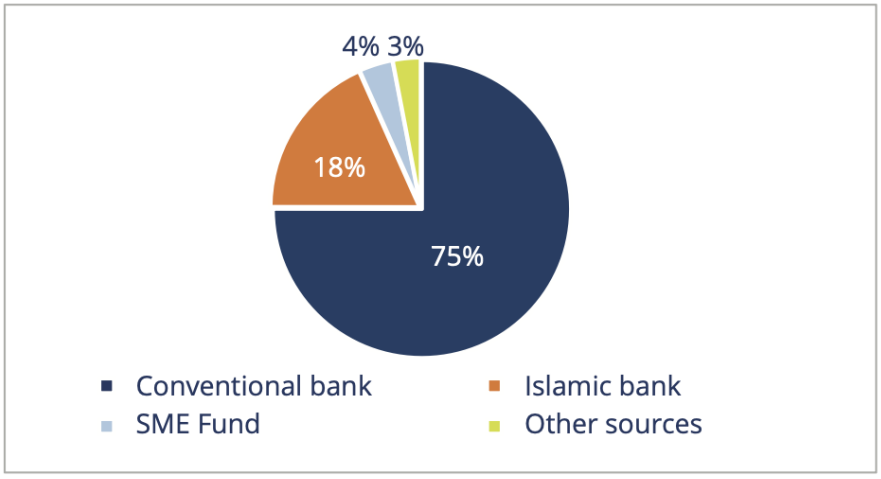
[28] EDB internal documents
[29] EDB internal documents
[30] Internal documents provided by EDB

submitting duly authenticated and notarised documents by the start-ups, and the risk-averse nature of banks when dealing with start-ups having many ultimate beneficial owners (UBOs), the KYC process is cumbersome. To bridge the underbanked and SMEs gap, EDB has initiated the digital account initiative, opening accounts for local transactions within 48 hours. Digital banking is also growing in the UAE with Wio Bank, Al Maryah, the first digital and Community Bank in the UAE and Zand digital bank[31]. Improvements could be made by establishing a pre-approved directory of investors, creating light bank accounts with limited features, leveraging the risk level identified by licencing entities and integrating them to obtain start-up documents seamlessly. Finally, creating an e-KYC platform to inform banks of red flags and share parts of the process could be a significant step in improving SME finance in the UAE (Hub 71, 2021).

5.2.2 Challenges perceived on the demand side

According to the Central Bank of the UAE (2020), only 17% of SMEs surveyed applied for bank credit in 2020, and 9% of SMEs were able to secure the finance needed, i.e., about half of those who applied. Moreover, a higher proportion of SMEs secured finance from conventional banks (75%) than from Islamic banks (18%), while SME Development Funds and other sources (e.g., family and friends) played a limited role (7%) (Figure 6).

Figure 6: Sources of SMEs financing in 2020 (Source: Central Bank UAE SMEs business survey report, 2020)



The survey shows that SMEs are constrained when applying for bank financing due to: (1) the low lending sums involved that make them less important to lenders, (2) the resulting high cost of processing their credit applications, and (3) the high risk of default and lack of credible credit history. In addition, newly- established businesses in the UAE may face obstacles such as lacking a credit score from Al Etihad Credit Bureau, not having audited financial statements, not being on the Emirates Movable Collateral Registry at the Emirates Development Bank, having weak business performance, and being risk averse or believing the credit application would be rejected. Another significant factor limiting SMEs' demand for bank financing is the cumbersome and confusing lending regulations and application process, which push SMEs to rely heavily on their funding and leaves bank financing as a last resort solution.

5.2.3 Challenges perceived on the supply side

[31] https://wio.io, https://www.mbank.ae and https://zand.ae/en

In 2020, banks continued tightening their lending standards for the following reasons: (1) weak book-keeping and financial management, which recalls the importance of raising SMEs' financial literacy, including how to prepare audited financial statements (2) the absence of a federal credit guarantee scheme, (3) absence of a dedicated regulatory framework for SME lending, (4) limited alternatives (e.g., venture capital), (5) and absence of federal small business administration. In addition, the significant decline in sales and profits due to the pandemic also constrains banks significantly from lending to SMEs (Central Bank of the UAE, 2020).

6 Addressing the SMEs' access to debt finance challenge in the UAE

6.1 Innovations and international best practices

Many innovative initiatives have been developed to increase SME finance worldwide, and best practices can be found in different countries.

Governments use public Credit Guarantees (PCG) to channel credit toward SMEs. It offers risk mitigation to lenders by taking a share of the lenders' losses on SME loans in case of default. In 2015, the World Bank Group and the FIRST Initiative developed a set of principles for the design, implementation, and evaluation of public CGSs for SMEs (The World Bank & First Initiative, 2015). In the UAE, EDB Credit Guarantee Scheme (CGS) was launched in partnership with ten commercial banks to provide a guarantee of up to 50% or AED 7.5M (whichever is lower). This has led to mobilise up to AED 499M in the first nine months of 2022 for SMEs. Trade Credit Insurance (TCI) also protects lenders from the effects of the bad debt or late payments. Yet, these solutions can lead to lower creditworthiness and higher defaults due to an increased moral hazard.

Online platforms are developed to conduct reverse factoring transactions to facilitate supply-chain finance for SMEs. In 2020, Emirates Development Bank (EDB) launched the UAE's National Supply Chain Finance (SCF) platform, giving UAE businesses improved access to working capital by enabling suppliers to gain quicker access to money owed while buyers get more time to pay off their invoices[32].

Reforms of secured transaction systems are also a crucial innovation in expanding finance to SMEs. They define the legal and institutional structures that govern agents' creation of security interests over movable assets, which might lessen banks' preference for immovable assets as collateral since movable assets account for most SMEs' assets. Many countries engaged in modernizing their laws related to secured transactions while protecting existing lending practices and facilitating the development of new practices simultaneously. The Model Inter-American Law on Secured Transactions, approved in 2002, includes current, future, tangible and intangible movable assets widely used to secure domestic and international financing transactions. The Model Law has been supplemented by the Model Registry Regulations, approved in 2009, which guide establishing and operating security rights registries[33]. More recently, the World Bank named countries like Jordan that introduced a centralized collateral electronic registry to enable all registrations, modifications, and cancellations of security interests in movable assets to be performed through an e-platform freely accessible to a broad audience[34].

[32] https://www.edb.ae/en/news/emirates-development-bank-launches-national-supply-chain-finance-platform
[33] http://www.oas.org/en/sla/dil/docs/secured_transactions_newsletter_aug_2013.pdf
[34] https://subnational.doingbusiness.org/en/data/exploretopics/getting-credit/reforms

Credit rating for SMEs is another solution that was adopted in several countries, including India, where CRISIL SME Grading is an indicator of the overall creditworthiness of an SME based on its operating and financial strength[35].

Aware of the upside potential they offer, many players in the banking industry of developed markets started focusing on start-up banking, a segment often overlooked by large traditional banks. Silicon Valley Bank (SVB) is a perfect example, with over 30,000 start-ups served to date. As a result, the bank is positioning itself as the go-to bank for start-ups and venture capitalists. In 2019, 69% of U.S. Venture capital-backed companies that issued an IPO that year had SVB accounts (Hub 71, 2020).

To better understand how they operate, which may facilitate start-up banking, other banks partner with venture capital firms to launch new financing solutions and provide strategic advice and technical support. For example, Egypt's most prominent national banks - Banque Misr, National Bank of Egypt, and Banque du Caire – and Global Ventures, a leading MEA-focused venture capital firm, recently announced this year the launch of Nclude by Global Ventures to accelerate Fintech Innovation and drive Financial Inclusion, following approval by the Central Bank of Egypt (CBE). In addition to investing in existing start-ups, the fund will provide them with the required strategic and technical support by partnering with Shipyard Technology Ventures - a global venture builder. In the UAE, EDB has launched a micro-lending platform to grant loans up to AED 2M (unsecured) and AED 5M (secured), for which decisions are communicated within five business days.

With SMEs now expecting to be able to engage with their banks through various digital channels, their onboarding process is expected to involve less human interaction, more transparency, speed, and automation[36]. Many countries like India, Singapore, and Bahrain are working towards implementing a centralized e-KYC platform. Many technologies are available to support the KYC process's digitization, such as using an E-ID reader (electronic identification) or optical character recognition (OCR).

6.2 Significant initiatives launched in the UAE

In the UAE, many initiatives have been launched to provide SMEs with the required funding. The Khalifa Fund for Enterprise Development (KFED) was launched in 2007 with a capital of AED 300 million, which increased to AED 2 billion and now covers SMEs across the UAE. Established in 2002, Dubai SME supports GCC nationals in developing SMEs in the Emirate of Dubai. It offers a loan on the seed capital to a maximum of 1 million AED to reduce the initial costs of starting a business project and various continuing funding solutions to help SMEs grow[37]. Launched in 2015, Emirates Development Bank (EDB) supports the national agenda to build and provide flexible financing solutions for SMEs and non-financial services to increase the financial literacy of SMEs[38]. The bank's new strategic positioning raises its contribution to the national GDP by AED 10 Bn in 2026 and has four developmental objectives to (1) support and empower the implementation of the country's industrial development strategy, (2) facilitate the adoption of advanced technology, (3) empower the growth of SMEs, and (4) encourage start-ups and innovation. With its impact scorecard, comprehensive product offering across the company lifecycle, and patient debt approach with flexible pricing and tailored financing solutions, the bank aims to enhance the bankability of underbanked SMEs. Strategic Development Fund (SDF), the investment arm of the Tawazun Economic Council, was established in February 2019. The fund offers venture debt to UAE-based SMEs for expanding operations, developing capabilities, and innovating products and solutions[39]. During the pandemic, the Central Bank of the UAE has extended benefits to SMEs through the TESS programme (targeted Economic Support Scheme) to help lenders mitigate the

[35] https://www.crisil.com/en/home/our-businesses/sme-solutions/smefirst/sme-performance-grading.html
[36] https://www.ey.com/en_gl/banking-capital-markets/the-five-step-journey-to-sme-banking-transformation
[37] https://u.ae/en/information-and-services/business/small-and-medium-enterprises/small-and-medium-enterprises
[38] https://www.edb.gov.ae/en/sme-finance and https://www.edb.gov.ae/en/non-financial-services-platform
[39] https://www.sdf.ae

effects of the Covid-19 pandemic and support the country's economic recovery. The Central bank has made it less capital-intensive for banks to finance small businesses. They were also eligible for loan deferrals during the pandemic, financed by CBUAE's zero-cost funding facility, which has been extended until mid-2022 (Central Bank of the UAE, 2020).

At the end of 2020, a new regulatory framework for loan-based crowdfunding was implemented. Furthermore, in April 2021, the Central Bank issued the Small to Medium Sized Enterprises Market Conduct Regulation to promote best practices among licensed financial institutions when engaging with SMEs. The regulation also requires financial institutions to have appropriate systems in place to ensure the opening of a Customer Bank Account can be completed within three business days, provided that the licensed financial institutions undertake proper due diligence related to financial crime compliance and that the borrowing company presents a low risk of money laundering or terrorism financing. Furthermore, to support SMEs in sourcing financing for their needs, ADGM launched in 2018 its framework to regulate operators of Private Financing Platforms (PFPs) serving equity investment, debt financing and trade receivables funding needs of start-ups, private enterprises, and SMEs. ADGM is also developing a platform to support the provision of financing to SMEs by facilitating the transfer of information on SMEs needed for credit assessments and by providing a way for SMEs to discover products offered by more lenders.

6.3 A case for an AI-ML-enabled platform using a coopetition model

6.3.1 The information asymmetry challenge

In traditional debt finance, the extension of the credit is primarily based on the overall creditworthiness of the firm, and the lender generally views the expected future cash flows of the firm as the primary source of repayment. Different lending technologies are used to assess and monitor the firm's creditworthiness, considering the information asymmetry between lenders and borrowers. They combine diverse sources of information about the borrower, screening and underwriting procedures, structure of the loan contracts, monitoring strategies and mechanisms. The literature distinguishes two types of lending: (1) transaction lending, which applies to informationally transparent borrowers and is based primarily on 'hard' quantitative data such as audited financial statements and (2) relationship lending, which, on the other hand, may be applied to informationally opaque entities and uses 'soft' qualitative information such as small business credit scoring (OECD, 2015).

Because they have less publicly available information, SMEs are more opaque than large firms. Opacity refers to lenders' difficulty ascertaining if firms can and are willing to pay (De La Torre et al., 2008). As a result, banks have more problems assessing their creditworthiness and rely more on relationship lending when dealing with SMEs. Loan officers gather, in this case, soft information through personalized contacts. When banks maintain more impersonal relations with their clients, such as in the case of large and foreign banks, relationship lending decisions are substituted with higher requirements for collateral. Collateralized loans could be provided whenever policies to establish which assets can be collateralized, institutions to enforce contracts, and swift judicial procedures exist.

The literature shows that an increased engagement with SMEs benefits banks in a context where margins narrow in other banking segments because of intensified competition. Moreover, this SME debt finance gap represents a lucrative business opportunity for financial institutions to tap into the SME market. As a result, SMEs have emerged as a strategic sector for most banks, including large ones. In addition, new transactional technologies applied to SME financings increased interest in dealing with SMEs, such as asset-based lending, factoring, fixed-asset lending, and leasing. Moreover, banks find financing SMEs profitable through a combination of services, which places cross-selling at the heart of their SME business strategy. Finally, by serving many SMEs through large multi-service platforms, branch networks, sophisticated business models and risk management systems, banks exploit more easily economies of scale and scope to gain a competitive edge and to compensate more efficiently for the fixed costs they might incur (De La Torre et al., 2008).

In this white paper, we present a case study emulating the lack of data on SMEs' default events and view data sharing as an effective way of reversing banks' low-risk appetite to increase their engagement with SMEs and reduce the credit gap. Privacy-preserved data sharing among creditors about the creditworthiness of borrowers is a significant innovation that promotes SME finance. It is based on the principles of coopetition, which support reducing information asymmetries between debtors and creditors for all lending institutions but still allow them to build an individual competitive edge.

6.3.2 Coopetition through Federated Learning

The principles and practices of coopetition can be found in an earlier book by Adam M. Brandenburger and Barry J. Nalebuff, first published in 1996. Coopetition combines the words cooperation and competition. This practice is common in many industries and has been adopted by rivals such as Apple and Samsung, DHL and UPS, Ford and G.M., and Google and Yahoo (Brandenburger and Nalebuff, 2021). The reasons why competitors must cooperate are multiple. The main goal of coopetition is to move the competitors away from a zero-sum game, in which the winner takes all and losers are left empty-handed, to a positive-sum game, where the result is profitable for all the competitors when they work together. This win-win situation is possible when companies combine their unique advantages and complementary strengths, distribute the workload, team up against larger competitors, improve market performance, foster technological innovation, and establish industry standards.

Credit information-sharing mechanisms commonly take the form of credit registries and credit bureaus (The World Bank, 2017). The case study from Singapore we present in the following two sections extends information sharing among lenders to reduce SMEs' credit constraints without the intervention of either public authorities (such as central banks) or private entities. It also allows lenders to share without giving direct access to the underlying borrower's information. This is made possible by Federated Learning of interpretable credit risk models, combining Artificial Intelligence (A.I.), Machine Learning (M.L.) and Big Data (B.D.). The solution increases accuracy and reliability while significantly reducing time to process and operating costs. Furthermore, this privacy-protected sharing system works on some standard data fields agreed to by all lending institutions and accommodates alternative data unique to individual lenders. Finally, it allows relationship lending while anchoring through "hard (more quantitative) information" to increase SMEs' access to debt finance.

7 AI-ML based platforms for informed credit-related decisions

The central idea underpinning the solution we present to solve challenges related to SME financing in the UAE is a digital SME credit analytics platform built on data from multiple lenders that form a consortium. In essence, the infrastructure can be considered a technology-enabled digital Credit Bureau 3.0 that can leverage conventional financial variables and alternative data from digital footprints to aid lenders in making smarter decisions at a lower cost on which SMEs they want to finance based on their risk appetite. By providing more accurate credit risk information about SMEs to lenders, this proposed infrastructure improves lending institutions' capabilities in managing costs and risks related to SME financing. It also provides an opportunity to enhance SMEs' financing environment and make it fairer by tackling critical problems related to the information asymmetry between lenders and borrowers prevalent in this lending segment.

Intuitively, sharing informative data between lending institutions can improve each institution's internal credit model (for example, a probability of default (P.D.) model and a model for recovery rates). However, with default information fragmented across multiple lenders, individual lending institutions tend not to witness enough defaults in their lending portfolios to calibrate their credit models accurately.

Therefore, the proposed solution calibrates a credit model using pooled data from multiple lending institutions while the underlying data remains private to each lender.

Naturally, one of the primary points of concern for lending institutions under such an infrastructure, from both a legal and competitive standpoint, is data privacy. If borrowers have consented to use customer-specific information in a lender's internal processes without anonymisation, sharing data pools between different lenders is impermissible. New trends in digital technology and the use of decentralised databases across multiple lenders that join the consortium can help tackle this challenge.

'Federated Learning' underlines the technical approach to training a model iteratively over multiple distributed data sites without explicitly exchanging the underlying data samples between institutions and databases. In its essence, each member's local data site generates and transmits onto a central node, referred to as Calibration Central, highly aggregate functional values (a single value corresponding to a parameter value to represent a credit portfolio), which are used to calibrate a credit risk model's coefficient. An overall likelihood value will indicate how good the model is for the data pooled from the members at the proposed parameter value. After the model is trained, i.e., optimized iteratively based on individual lending institutions' submitted functional values to the Calibration Central, each member can use the trained credit model for their internal risk management and cost-benefit analysis. This 'Federated Learning' approach allows lending institutions to share the information stored in their individual lending experience while eliminating the need to transmit granular and privacy-sensitive data about individual customers to other parties.

However, the practical implementation of such technology comes with its own set of challenges – namely, network latency and intermittent transmission disruptions. The solution, highlighted in the following parts of this white paper, utilizes a cutting-edge and yet practical global optimization approach to this issue devised by Duan (2021), which uses both edge and soft computing to gain robustness over network latency and intermittent transmission disruptions in a distributed network spanning multiple institutions. In addition, the design for model calibration makes the system resilient from an implementation point of view. What distinguishes this 'Federated Learning' system from others is its ability to handle interpretable credit risk models that are highly desirable from a managerial and/or compliance perspective.

7.1 Construction of a credit risk model for SMEs

For illustration purposes and to show the feasibility and benefits of the shared lending experience, we deploy a three-class logistic regression credit model (a probability of default and other-exit model) for one-year corporate default prediction, overlooking its limitations in terms of generating consistent term structures of P.D.s as articulated in Duan, et al. (2012). Given the limitations in interpretability of typical machine learning tools[40], we opt for the credit model based on the logistic regression in our demonstration because it provides conventional interpretability while retaining reasonable flexibility to capture the nature of the data. The purpose is to study the benefits of privacy-preserved data sharing through a robust 'Federated Learning' platform and examine its real-world applicability to the SME space in the MENA region.[41]

The dataset that each lender has on their respective obligors can be viewed as an incomplete dataset where the dependent variable can take the value of 0, 1, or 2 to capture survival, default, or other

[40] For example, neural networks are fundamentally inadequate for situations that require extrapolation (for example stress-testing) due to their lack of a theoretical and/or intuitive basis in economics/finance. Interpretation of results will especially be unreliable for scenarios that training data has previously not covered.

[41] To get a more comprehensive understanding of the workings of this 'Federated Learning' platform applied on an interpretable credit risk model, please see Duan (2021) where the power of this approach has been demonstrated using the ASEAN data.

corporate exits (such as discontinuation of banking services between the borrower and the lender) respectively at any given time point. The explanatory variables are predictive attributes comprising common macroeconomic risk factors (such as short-term interest rates) faced by borrowers and borrower-specific characteristics (such as leverage, liquidity, and profitability, among others).

At the conceptual level, the model is a mathematical function linking the probability of a realized outcome (i.e., 0, 1, or 2) over a particular future period to a borrower's many attributes available at the time of prediction. It is important to note that the probability of a firm defaulting within a specific period of interest depends on the firm surviving all periods before the period of interest. For example, suppose we are interested in a firm's one-month probability of default six months later. In that case, it can be thought of as the probability that a firm will default between the sixth and seventh month from today, conditional on the firm surviving the first six months. As corporates can exit for reasons other than the default (for example, an entity acquired in an M&A), we must factor in the chance for that to happen. The resulting model naturally has two intertwined components: the probability of default (P.D.: realized outcome = 1) and the probability of other exits (POE: realized outcome = 2). As an obligor can only be in either one of the three states at a given time point, as such, the probability of survival (POS: realized outcome = 0) can be calculated by subtracting the probability of default and probability of other exits from 100%.

7.2 Calibration over multiple lending institutions

This section briefly describes calibrating a credit risk model using the data pooled from multiple lending institutions. Calibration is the process which produces optimized coefficients for the model to link the probability of a realized outcome (i.e., 0, 1, or 2) in the future to a borrower's many predictive attributes.

The Calibration Central initially sends a set of proposed vectors of coefficients to all lender data servers. Then, at each lending institution's site, a locally installed API calculates the log-likelihood value for each proposed vector of coefficients and transmits the results back to the Calibration Central. Finally, each lender’s log-likelihood value is computed with the proposed model coefficients, individual borrower attributes and default information to produce a single highly aggregated sample log-likelihood value for the entire credit portfolio which does not carry any obligor-specific information. Since the inversion of these highly aggregated log-likelihood values back to obligor-specific attributes is impossible, data privacy is preserved.

The Calibration Central will then sum up individual lenders’ sample log-likelihood values and use the total aggregated functional value to determine the next set of best-proposed vectors of coefficients. This process is repeated sequentially and multiple times until the model calibration is complete, and the final optimized model coefficients are determined. Lending institutions can then use the optimal model coefficients in the credit model to generate default probabilities for obligors in their credit portfolios. This process allows each lender to optimize its credit risk model’s coefficients as if access to the information possessed by all lenders were possible, even though transmitting the actual data has been completely avoided. Through such a ‘Federated Learning’ framework, it is possible to treat the improved credit model as a common good shared by all lenders in the spirit of coopetition. Nevertheless, lending institutions still compete by differentiating themselves in risk appetite, services, and operational efficiency.

A key factor in consideration is that the Calibration Central must repeatedly compute the aggregated log-likelihood value at different proposed coefficient values over a distributed data network. Under such a scenario, it is likely to encounter network latency and intermittent transmission disruptions. This problem is solved by utilizing an SMC (Sequential Monte Carlo) technique, which provides a globally optimal solution robust to network issues. The idea is simple. An approximation function is activated whenever transmissions are disrupted that prevent the Calibration Central from receiving information from some lenders regarding their individual aggregated log-likelihood values. As a result, the approximation quality may be inadequate when a missing aggregated log-likelihood value is initially

approximated; however, as the SMC optimization progresses over multiple iterations, the quality naturally improves because the set of enhanced coefficients begins to concentrate in a smaller area.

7.3 Incorporation of alternative data to construct lender-specific enhanced models

As corporates' digital footprints become increasingly incorporated into credit risk management and lending decisions, integrating these alternative data into credit risk models becomes appealing. Examples of such alternative data abound, including utility usage, conventional media coverage, social media chatter, mobile GPS locations, and government filing records. On this data-sharing platform, alternative data can, in principle, offer additional insights above and beyond the information in conventional data.

Certain limitations must be considered to ensure that the platform does not naively incorporate alternative data into the data-sharing system. First, some lending institutions may have the facilities/resources to gather alternative data about credit risk, but others may not. Second, individual lenders may view such data as a way of gaining a competitive edge over others, making them hesitant to share information on the nature of these variables with other lenders. Moreover, compiling alternative data reflects an institution's preference and priority. Therefore, incorporating alternative data into a database is expected to create inhomogeneity across lending institutions regarding the number of data fields and the definition of such variables.

The iCASS platform can robustly incorporate alternative data into credit risk models by creating lender-specific, enhanced credit risk models that utilize alternative data available to a particular lender without compromising the quality of the standard benchmark model shared by all. The steps to generate lender-specific models are almost identical to those for the benchmark model, except that not all lenders will have the same data fields in this case. As such, during the calibration process, the coefficients on the alternative data fields will be determined by the optimization algorithm only for the institution that possesses these alternative data, whereas the input values for these alternative data fields will be treated as zero for all other lending institutions. In a nutshell, there is a hidden grand model comprising all alternative data fields from multiple lenders. The grand model handles individual lenders' alternative data only when they are relevant, with all other lenders, in effect, applying zero values.

The remainder of the aggregation, transmission, optimization, and re-distribution follows the same process described before. Therefore, when a lending institution has sufficient credit events to support the incorporation of its lender-specific alternative data, the calibrated enhanced credit model can benefit from sharing the conventional credit data while retaining its competitive advantage. Hence, this privacy-preserved data-sharing platform can be considered a technology-enabled digital Credit Bureau 3.0, which operates as a coordinated decentralized system that leverages both conventional and evolving alternative data to enhance credit models for lending institutions that join the consortium.

In summary, this Credit Bureau 3.0 operating on the iCASS platform allows the calibration of credit risk models on data pooled from multiple lending institutions without any single party gaining direct access to the data owned by other lenders. This is made possible by using only a single aggregated functional value to summarize the needed information for the model calibration purpose effectively. For credit granting decisions, a member institution can plug in a borrower's attributes on a case-by-case basis to assess the borrower's credit risk.

8 Performance improvement of credit model: iCASS example

With a holistic understanding of the credit risk model and the calibration system that can share data while protecting privacy described in the previous section, this section will showcase how the incorporation of a shared lending experience through iCASS can help improve the credit model's performance for lending institutions in the MENA+ region, like the infrastructure that is being implemented in the ASEAN region. An important point to note is that the sample of companies in this case study solely includes publicly listed corporations from the wider MENA+ region in the NUS-AIDF database. Furthermore, this section of the white paper will also aim to showcase, through examples, the benefit of incorporating alternative data in constructing a credit risk model to improve out-of-sample performance. Therefore, for the remainder of this section, lenders using just standard financial data fields to build the model will be referred to as those utilising the benchmark model, whereas lenders incorporating alternative data will be directed to those using the enhanced model.

We conceive four hypothetical financial institutions, which we refer to as Bank A to D, to emulate the data-sharing arrangement. The corporates with alternative data, 713 out of 4,854 corporates in the sample, will be assigned exclusively to Bank A to facilitate the study that looks at the effect of alternative data. The rest will be randomly assigned without replacement to one of the four banks to ensure that each bank's portfolio ends up with a similar number of corporates.[42] Table 11 presents the summary statistics for these hypothetical banks.

Table 11: Summary statistics on the four Hypothetical banks in the MENA+ region from Dec-1993 to Jun-2022

Summary Statistics on four hypothetical banks in the MENA+ region	Bank A	Bank B	Bank C	Bank D	Total (Grand Bank)
# of borrowers	1,214	1,214	1,213	1,213	4,854
# of defaults	63	31	47	38	179
# of other exits	350	400	418	398	1,566
# of firm-month observations	167,181	119,490	122,256	120,799	529,726

It becomes pretty apparent from Table 11 that individually, Bank A to D do not witness many defaults, making them good candidates to benefit from shared information in constructing a default prediction model[43]. Furthermore, by pooling credit information across lending institutions through the proposed iCASS platform, each lending institution can better calibrate its credit model by leveraging data in others' databases.

As a conceptual device to gain a better understanding, one can envision a hypothetical bank, referred to as the Grand Bank of MENA+, that holds the total data individually stored by Bank A to D. Model parameters calibrated to Grand Bank's data, which witnesses all 179 default cases, will be most accurate as compared to any one of Bank A to D individually. Simply put, the iCASS platform allows each Bank A to D to have a model on par in quality with the Grand Bank's model. Therefore, we first

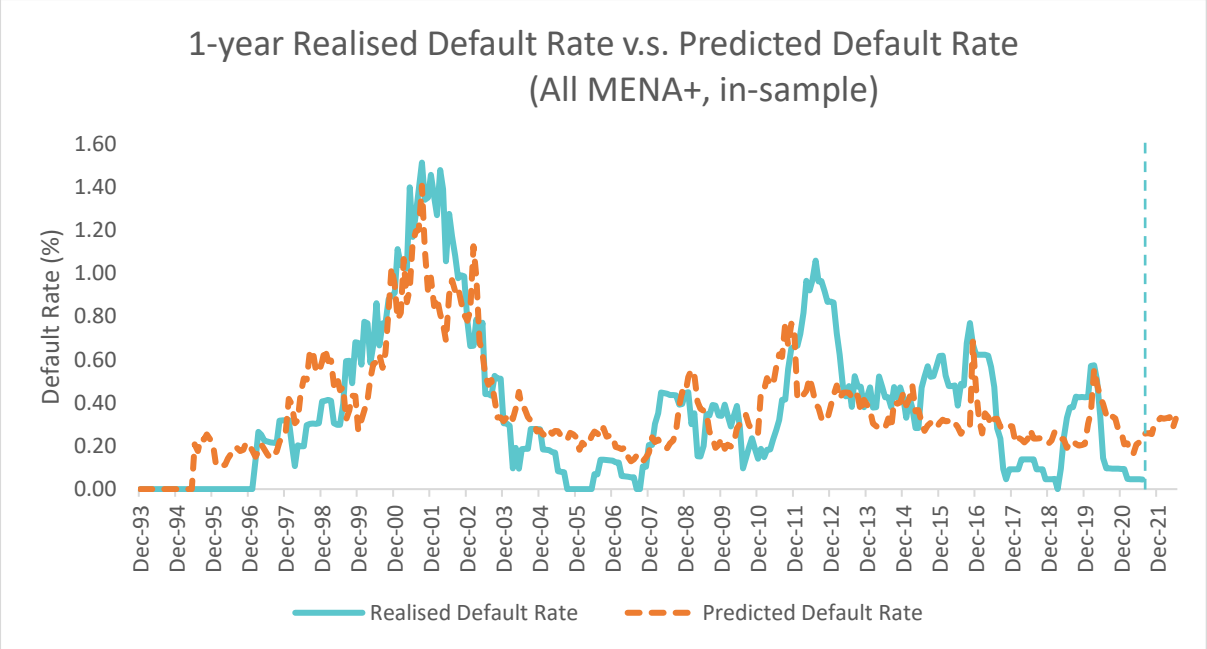
[42] The corporate profile is made up of all publicly listed firms in the MENA+ region from the NUS-CRI database. However, not all of these are SMEs, because the total number of publicly listed SME defaults witnessed in this region is small and not sufficient to reasonably demonstrate the benefit of calibrating a credit model with shared data. This also shows why it is beneficial to set up a consortium, as individual financial institutions may not witness enough default events in their individual lending portfolios even after adding in private SMEs.

[43] The credit risk model utilised for this example has 22 explanatory variables, of which 16 are in line with NUS-CRI's corporate default prediction model. These include firm-specific DTD level and DTD trend, Net income/total asset level and trend, Relative Size level and trend, Market to book ratio, Idiosyncratic volatility, current asset/current liability level and trend for non-financial firms, cash/total assets level and trend for financial firms, economy-specific stock index return, short term interest-rate and Aggregate (median) DTD for financial and non-financial firms. In addition, six more variables are selected using the zero-norm variable selection technique of Duan (2019) specific to the MENA+ region. These include Effective exchange rate of Saudi Arabia and Egypt, the Aggregate DTD levels of financial and non-financial firms in China, as well as the unemployment rate and CPI of Egypt.

look at the model performance for Grand Bank, which under our assumption, has been lending to all publicly listed firms in the MENA+ region.

Figure 7 displays the performance of the credit model, which has a one-year prediction horizon, by comparing the model's predicted one-year default rate with the realised default rate one year ahead, which is subsequently witnessed in the region. The predictions are in-sample, meaning that the model has been calibrated with data from all 4,854 entities over the entire sample period. For ease of comparison in this figure, we have brought back the realised default rates by one year to align them with their intended period, where the predicted default rates are tallied. Naturally, the realised-default plot ends earlier because, beyond this time, the corresponding realised defaults are not yet available for tallying. Visually comparing the two time-series plots reveals that, at the portfolio level, the model's prediction seems to capture the overall movement of the realised default rate. A time series performance measure can quickly summarize performance in an R^2 style on the portfolio in the time dimension[44], referred to as dynamic R^2, which equals 53.03% for the in-sample prediction.

Figure 7: Realised default rate over one year vs the corresponding predicted default rate for the credit portfolio of Grand Bank of MENA+ (in-sample)



[44] This dynamic R^2-typle measure is defined to be 1 minus the ratio of two items where the first item is the sum of squares of prediction errors of the PD model (realised default rate minus its corresponding predicted probability), and the second item is the sum of squares of prediction errors of the naive prediction (where predicted probability is the mean of the trailing 12-month realized default rates). Using default rates instead of default numbers in this measurement is for standardization because the number of borrowers varies over the sample period. Particularly for emerging markets, the number of listed firms tends to rise over time.

A different and common way of checking a credit risk model's performance is how it ranks individual borrowers cross-sectionally and over time in terms of the credit risk, measured through the accuracy ratio[45]. For example, the resultant in-sample accuracy ratio of the model for Grand Bank's loan portfolio's one-year default prediction is 74.67%. Taking the in-sample accuracy ratio and the dynamic R^2 measure together, this credit risk model offers a good prediction power for corporates domiciled in the MENA+ region.

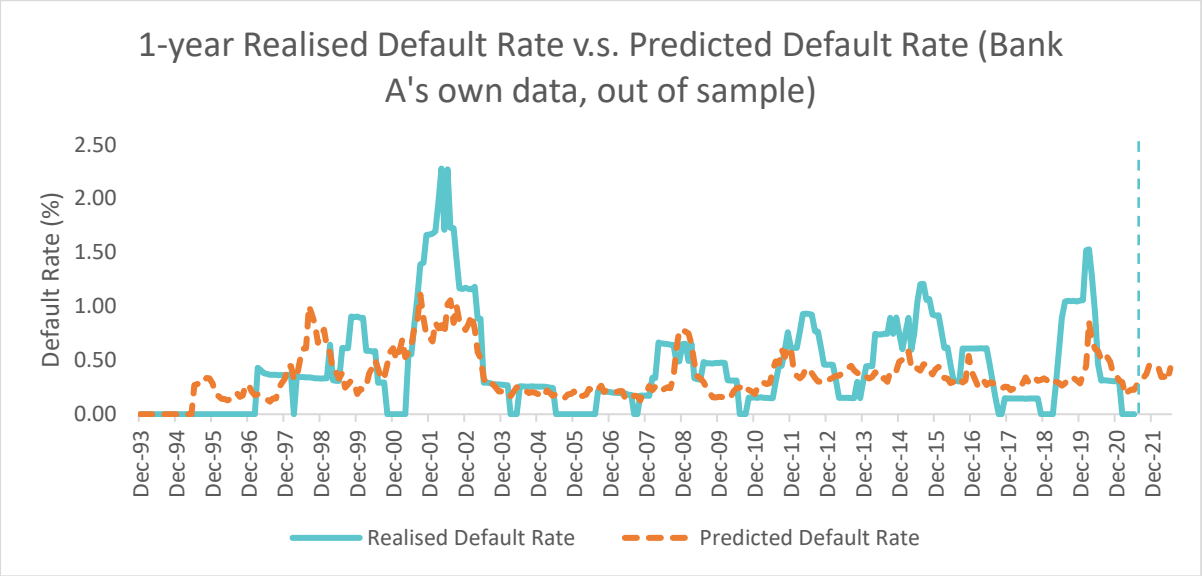
The results reported thus far are in-sample findings. However, what about the model's out-of-the-sample performance? Instead of dividing the sample into the typical training and testing subsamples, the sample is randomly five-fold partitioned into subsamples, much like a typical cross-validation exercise. The model is always calibrated by combining four of the five subsamples while leaving one remaining subsample for testing. Rotating the subsamples chosen for calibration and testing and repeating the exercise five times, in effect, generates a testing sample equal to the total sample size. Performance conducted in this way maintains the spirit of out-of-the-sample analysis. This way, in effect, gives rise to a more extensive testing sample which can be pretty helpful in the later analysis of a single bank's credit portfolio vs using the iCASS platform to mimic Grand Bank's portfolio. Using the Grand Bank data to check the out-of-the-sample performance by the described approach generates a dynamic R^2 of 52.88% and an accuracy ratio of 74.58%. Compared to those in-sample figures, the out-of-the-sample performance measures are, as expected, worse but almost inconsequentially, suggesting a reasonably stable credit risk model.

8.1 Evaluating the benchmark model's performance

To evaluate the added value of the iCASS platform for individual lenders, we start by looking at the benchmark model's performance from the lens of a single bank. For this white paper, the benefits of using iCASS will only be looked at from the lens of Bank A, but similar results can be expected for the other banks (B to D) as well. The real utility of the iCASS performance is better judged in terms of whether data pooling can enhance the performance of a credit risk model for individual banks like Bank A. Figure 8 displays the model's out-of-the-sample time-series performance of one-year default rate prediction for Bank A using exclusively its data, which has a dynamic R^2 of 64.00% and an accuracy ratio of 71.62%.

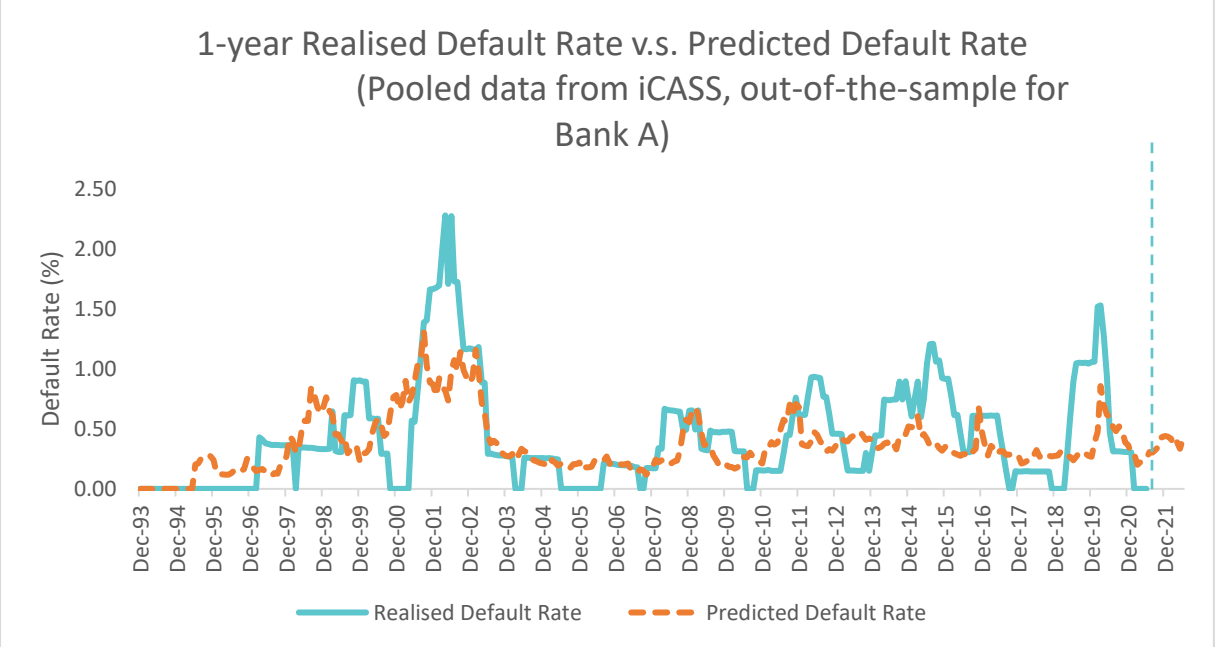
[45] AR is the ratio of `ar' over `ap' where the former is the area between the Cumulative Accuracy Profile (CAP) of the rating model and the CAP of the random (totally uninformed) model, and the latter is the area between the CAP of the perfect model and the CAP of the random model. The CAP is obtained by first ordering the PDs in a descending order. Then, for a given fraction x of the total number of firms, the CAP curve indicates the fraction of the defaulted firms whose PDs are greater than or equal to the minimum PD up to fraction x, where fraction x will be varied from 0% to 100%.

Figure 8: Realised default rates over one year vs the corresponding predicted default rates for Bank A (out-of-the-sample, bank's data)



For Bank A to utilise the iCASS platform to pool data from other lenders, i.e., Bank B to D, mimics the data held by Grand Bank of MENA+. Figure 9 provides the time series of out-of-the-sample predicted default rates on Bank A's portfolio, along with the realised default rates, where the model has been calibrated on the pooled data via iCASS. The summary performance figures suggest that the federally calibrated model applied to Bank A's portfolio gives rise to an out-of-the-sample dynamic R^2 of 64.44% and the accuracy ratio of 73.43%, clearly better, albeit marginally, than their corresponding values of 64.00% and 71.62% stated earlier for the model using Bank A's data to calibrate the model.

Figure 9: Realised default rate over one year vs the corresponding predicted default rate for Bank A (out-of-the-sample, calibrated on the pooled data via iCASS)

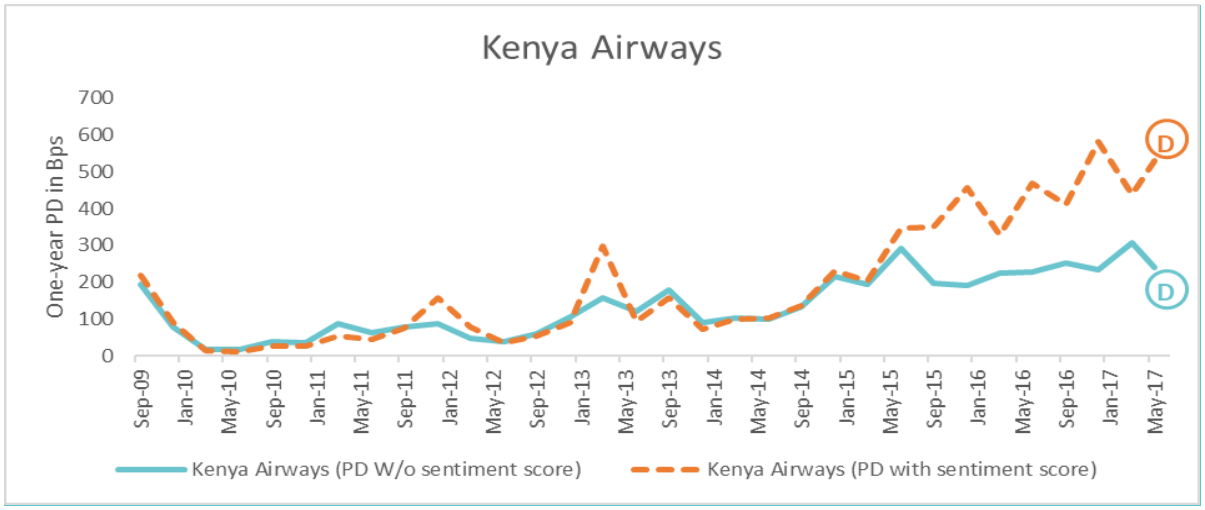


8.2. Constructing an enhanced model by incorporating alternative data

The iCASS platform can also accommodate institution-specific alternative data to create an enhanced credit risk model in addition to the benchmark model that relies on the standard data fields agreed to by all members. As stated in earlier sections, incorporating alternative data can aid institutions' lending decisions through many channels, including reducing information asymmetry. Furthermore, by sharing the same parameter values on those standard data fields, a lending institution's default events are directed to calibrating those parameters on the alternative data fields. This white paper demonstrates the benefits of incorporating alternative data using media sentiments. These media sentiments have been extracted for companies in the MENA+ region from three leading international business media publications (The Wall Street Journal, Financial Times, Thompson Reuters) by AIDF using Natural Language Processing (NLP)[46]. As mentioned earlier, listed corporates covered by these media sources over the sample period have all been assigned to Bank A's lending portfolio.

Before proceeding to measure model performance improvement using iCASS and alternative data, it is worthwhile to look at how a company's probability of default changes when alternative data, in the form of media sentiments, is incorporated. To illustrate this, we use the example of Kenya Airways. Kenya Airways is the flagship national airline of Kenya. The company has been battling high debt burdens amidst a poor operating environment for a decade. In June 2017, Kenya Airways entered a debt restructuring plan, defaulting on the initial amount of USD 225mn owed to its creditors. Naturally, this was a high-profile case with extensive media coverage given its importance in the region, making it an apt case study to examine how the incorporation of media sentiments into the credit risk model can potentially provide improved default prediction capabilities, as well as can serve as early warning indicators for risk-management purposes. Figure 10 below displays the time series of the estimated one-year probability of defaults with and without sentiment data incorporated. As one can see from the figure, before its default, P.D.s with sentiment data is higher than P.D. without, as media sentiments highlighted the higher credit risk associated with Kenya Airways than those captured solely by conventional financial metrics. Through this study, we can see how the incorporation of alternative data can potentially improve default prediction capabilities.

Figure 10: One-year P.D.s of Kenya Airways with and without incorporating media sentiments before defaulting in June 2017 quarterly (3-month averaged P.D.)



It is important to note that alternative data tend not to be consistent across lending institutions for many reasons. For example, the measurement methodology of similar metrics may be different, leading to

[46] These media sentiments are extracted by an AIDF-NLP team deploying a combination of NLP techniques (Source-LDA, NER, Coreference Resolution and TABSA-BERT) to obtain the credit-focused, entity-specific at the article-level media sentiments expressed on those firms.

non-standardized data sets that cannot be compared directly. Additionally, some lending institutions may focus only on a specific type of alternative data that turns out to be of low importance to others and, therefore, not captured. Consequently, for each lending institution's alternative data, the iCASS platform assigns other lenders without the same alternative data field(s) missing values and calibrates the model accordingly.

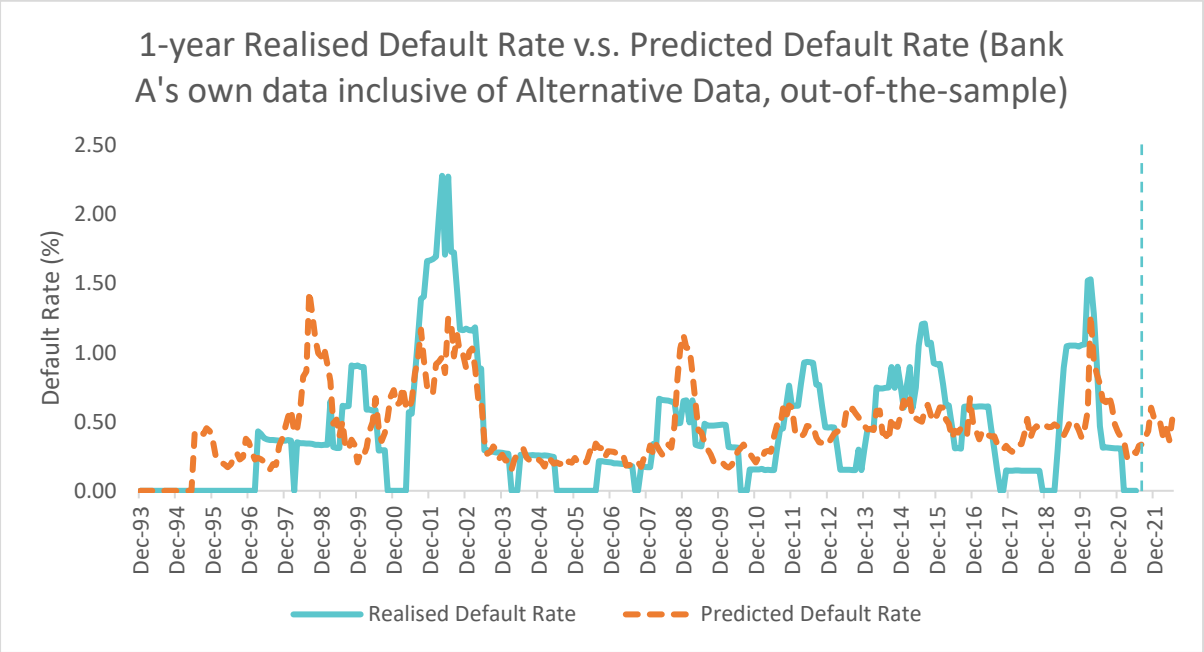
Table 12 provides summary statistics on the alternative data attributed to some corporates in Bank A's credit portfolio.

Table 12: Summary statistics on alternative data (sentiment scores) in Bank A's portfolio

Bank A	
# of companies with a sentiment score	713
# of total firm-month observations	167,181
# of firm-month observations with a sentiment score	5,505

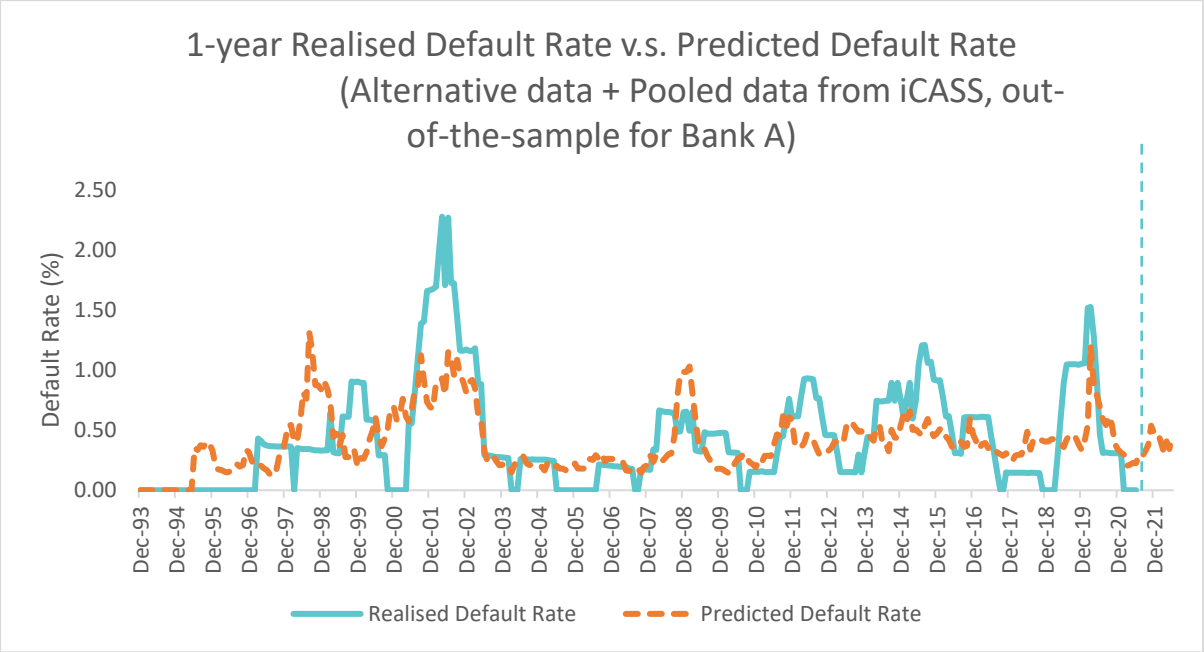
Before analysing the impact of alternative data on the model in the Federated Learning set-up, let us look solely at the performance of the enhanced model on Bank A's portfolio with its data inclusive of the above-mentioned alternative data points. As shown in Figure 11, the enhanced model that utilises alternative data improves the performance by close to 2.25 percentage points in the out-of-the-sample AR from 71.62% to about 73.87%, whereas the out-of-the-sample dynamic R^2 increases from 64.00% to 65.02%.

Figure 11: Realised default rate over one year vs the corresponding predicted default rate for Bank A (out-of-the-sample, calibrated on its data inclusive of alternative data)



Model performance can improve further by data pooling over four banks on the iCASS platform. Figure 12 below shows this enhanced model's out-of-the-sample time series pattern. Bank A experiences an out-of-the-sample A.R. improvement of a further 1.10 percentage points to 74.97% with data pooling via iCASS, with the dynamic R^2 improving by close to 0.19 percentage points to 65.21%. Notwithstanding the magnitude of change which in this case is marginal, the positive improvement in both the A.R. and the dynamic R^2 highlights the benefits of incorporating alternative data into such a federated learning framework.

Figure 12: Realised defaults over one year vs the corresponding predicted defaults for Bank A (out-of-the-sample, calibrated on the pooled data and its alternative data via iCASS)



This illustrative case study reveals how sharing the lending experience can improve credit risk model performance for all lenders in the industry. Data sharing technology enables lenders to form, for example, a consortium to manage their credit risk better and lower costs through better risk assessments of loans to SMEs. The iCASS platform engages lending institutions cooperatively, gaining traction among some lenders in the ASEAN region and can be expected to benefit SMEs by gaining fairer access to finances for their business needs.

Through such a consortium, the improved benchmark credit model becomes a common good among consortium members. However, the enhanced credit model(s) are still private goods, enabling lending institutions to compete. The consortium, therefore, becomes a realization of *coopetition.*

9 Call to Action

The case study illustrates how sharing lending experiences improves credit risk model performance for all lenders in the industry. Data sharing technology enables lenders to form a consortium to manage their credit risk and lower costs through better risk assessments of loans to SMEs. The improved benchmark credit model becomes a common good among its members through such a consortium. However, the enhanced credit model(s) remain a competitive edge to those institutions with access to alternative data, enabling lending institutions, while benefiting from the shared infrastructure, to continue competing in loan pricing, niche strategy and service package. The consortium, therefore, becomes a realisation of *coopetition* and, in effect, acts like a *Credit Bureau 3.0*, a coordinated decentralized operation.

We call on conventional and digital banks, finance companies, lending platforms, and FinTech companies that possess credit-relevant data in the UAE to form a consortium, Credit Bureau 3.0, to explore the benefits of developing an intelligent credit analytics-sharing system supported by a technology-enabled digital platform for a privacy-preserved data-sharing solution using coopetition.

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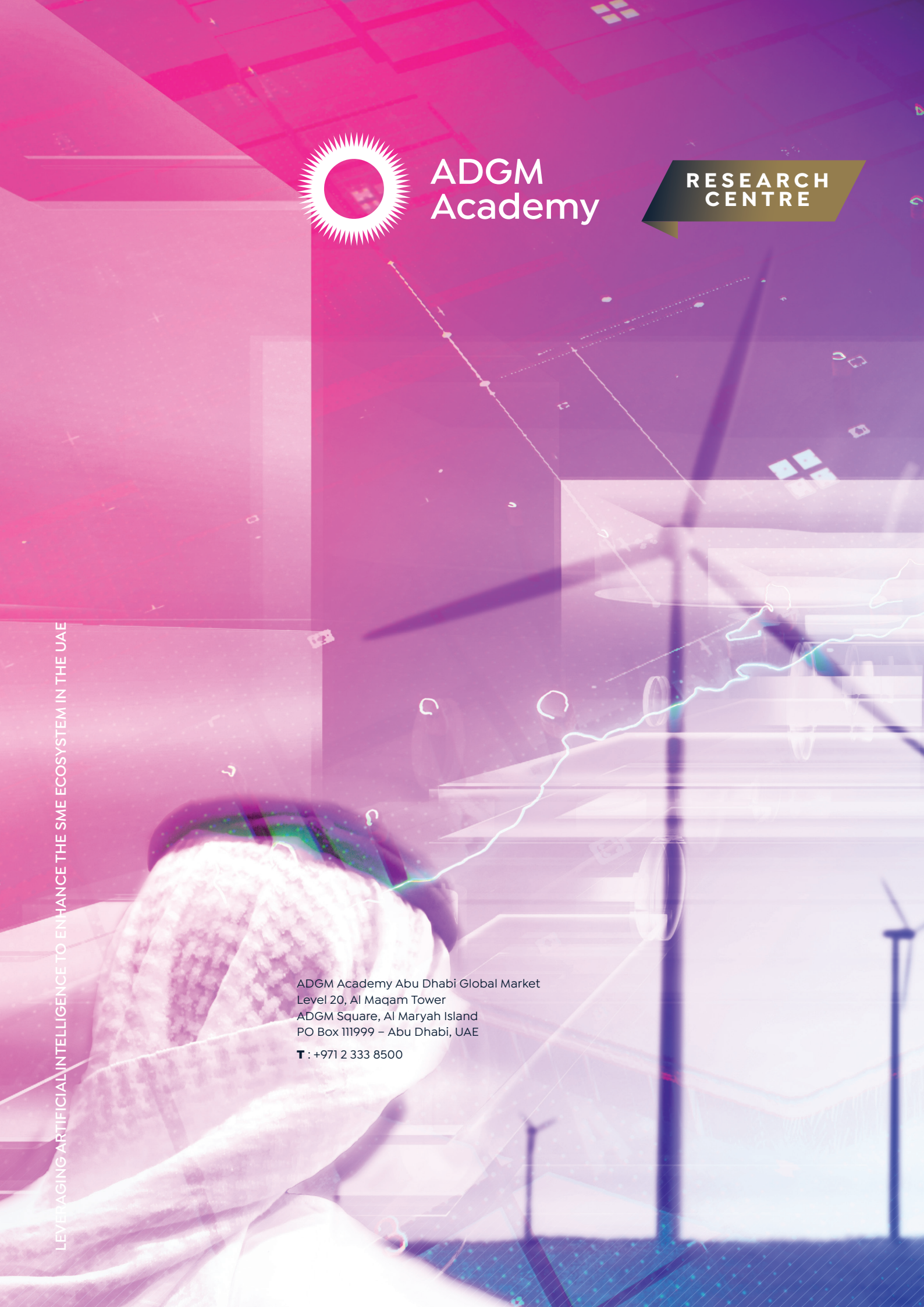

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