

The impact of the knowledge economy on the financing constraints of firms: within and between country effects

Knowledge
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Abstract

Purpose – This study employs firm-level data to evaluate how the knowledge economy impacts the financing constraints of businesses across 106 low- and middle-income nations, focusing on the influence of technological transformation on corporate financing choices.

Design/methodology/approach – The research centers on privately held, unlisted firms and examines the distinct effects of knowledge at both the within-country and between-country levels using a panel dataset. Rigorous sensitivity and endogeneity analyses are conducted to ensure the reliability of the findings.

Findings – The findings indicate that greater levels of the knowledge economy correlate with reduced financing constraints for firms. However, this effect varies depending on the location within a country and across different geographical regions. Firms situated in larger urban centers and more innovative regions reap the most significant benefits from the knowledge economy when seeking external funding. Conversely, firms in smaller cities, rural areas and regions characterized by structural and institutional inefficiencies in knowledge generation experience fewer advantages.

Originality/value – The impact of knowledge exhibits variability not only within and among countries but also between poor and affluent developing nations, as well as between larger and smaller countries. The knowledge effect on firms' access to external finance is influenced by factors such as financial openness and development, educational quality, technological absorption capabilities and agglomeration conditions within each country.

Keywords Financing constraints, Knowledge economy, Location, Institutions, Developing countries

Paper type Research paper

1. Introduction

The financing constraints of firms reflect the extent to which firms have adequate access to external finance to carry out their business operations. Financing constraints affect firms' investment decisions, innovation, and hence entrepreneurial activity (Broome *et al.*, 2018). The identification of firms' financing constraints is therefore a much-debated issue in the finance and development literature (Levine, 2005; Karlan and Morduch, 2010).

Financing constraints are especially important for small, innovative firms. Understanding the causes and regional distribution of financing constraints is important for making

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effective policy decisions and understanding small firm entrepreneurial diversity (Pucher *et al.*, 2016). In this respect, an important consideration for researchers and policymakers is the link between knowledge, innovation and corporate financing. Knowledge assumes formal and informal, codified and tacit forms and it is measured rather indirectly at either the firm or the country level using economic and non-economic information (Shapira *et al.*, 2006). The knowledge economy uses knowledge inputs to produce the output (Stehr and Mast, 2012). It refers to the extent of skilled labor and high-tech capital across cities, countries and regions. It differs from an agrarian economy, which uses unskilled labor to produce primary sector products, and from an industrial economy, which uses low-skill labor with physical capital in mass producing output. Instead, the knowledge economy uses information and intangible capital to produce the output.

Long ago, Schumpeter (1942) stressed the importance of this link. He argued that entrepreneurs stimulate economic dynamism by transforming ideas into technological inventions, accessing financing and subsequently turning inventions into innovations with commercial use (Kurz, 2012). Research in the Schumpeterian tradition has generated several economic debates (Carlsson *et al.*, 2013). These debates focus mainly on whether business opportunities are discovered or created (Alvarez *et al.*, 2013) and whether certain business conditions stimulate innovation and entrepreneurial activity (Autio *et al.*, 2014; Acs *et al.*, 2014). Further, knowledge, gained through education, experience and learning by doing, affects the ability of individual entrepreneurs to identify business opportunities and engage in their pursuit (Aldrich and Yang, 2014). The generation and overtime accumulation of knowledge by corporate founders passing information to their heir, the interaction of firms within and across industries and during upstream and downstream operations as well as the recurrent capitalization of scientific, technological and organizational advances, all are key determinants of firms' entrepreneurial performance and competitive survival (Agarwal and Shah, 2014; Klepper, 2015; Adams *et al.*, 2016). Some of these ideas have recently been incorporated in macroeconomic models. For example, Hall (2010) notes that the models of endogenous economic growth have managed to formalize some aspects of the knowledge-innovation dynamic for explaining economic outcomes. The recent emergence of fintech and digitization trends worldwide has further elevated the importance of knowledge in financial analysis. Indeed, Aghion *et al.* (2017) stress the importance of artificial intelligence and the knowledge economy for financial development and economic growth, whilst Korinek and Stiglitz (2017) stress their implication for income inequality and financial inclusion. However, the role of the knowledge economy as a whole has yet received little attention, especially in financial analysis.

There is increasing evidence that the obstacles on firms' external finance exhibit spatial variation, especially in the developed countries (Wójcik, 2016; Martin, 2011; Lee and Brown, 2017). The variation is associated with economic, institutional and technological factors, of which the knowledge economy is a key one. For example, Garretsen *et al.* (2009) stress the role of information and communication technology (ICT) in reducing the impact of physical distance in financial transactions thereby affecting the location choice of financial institutions. Castells-Quintana (2017) documents that urban agglomeration has widened the range of investment financing opportunities for small firms.

However, the empirical link between knowledge, geography and firms' financing constraints and its spatial manifestation has yet to be adequately explored. The literature focuses either on the effect of knowledge on firms' innovation and growth (Antonelli and David, 2016; Antonelli and Colombelli, 2017) or on the geographies of firms' access to finance and innovation (Appleyard, 2013; Lee and Luca, 2019; Zhao and Jones-Evans, 2017; Mina *et al.*, 2013). This link between knowledge and corporate finance is very important for firms in developing countries due to their suffering from large information asymmetries, weak credit assurances and human capital deficiencies, as well as due to the tremendous possibilities that the knowledge environment present for overcoming their underdevelopment. It is also

important from a policy perspective. Many developing countries are looking to reducing their development gaps by riding the wagon of the “4th industrial revolution.” It is conceivable that in the modern world of globalization, ICT expansion and fast technological progress, firms’ financing constraints would be less binding and entrepreneurship less constrained, if firms capitalize on the opportunities offered by digitization and knowledge.

Using firm-level survey data from the World Bank, this study analyzes the empirical relation between the knowledge economy and the financing constraints experienced by firms in 106 developing countries. The relevant literature is rather silent with respect to this relation. An additional novel contribution of the study is the estimation of the distinct within- and between-country spatial effects of knowledge on corporate finance access. A further key strength of the data is a focus on privately held (non-listed) firms in developing countries, on which there is little and mostly non-audited information (Farooq *et al.*, 2021, 2023). Spatial dimensions affect the knowledge effect on firms’ access to external finance. To our knowledge, there is no other cross-country evidence of the association between the knowledge economy, location of operation and firms’ financing constraints for the whole range of developing countries.

Our conceptualization of the knowledge economy draws on the World Bank’s (2012) suggestions and refers to a country’s ability to generate, absorb and diffuse knowledge. Our measurement of the knowledge economy captures whether a country’s overall business environment generates and uses knowledge to enhance economic transformation and development and therefore to push the country towards the knowledge economy. Our composite measure of the knowledge economy comprises four dimensions of related information. The first dimension captures the extent to which the economic and institutional environment creates incentives for the efficient production and absorption of new knowledge and for its contribution to entrepreneurship. The second dimension captures the extent to which education and skills are properly articulated to enhance human capital. The third dimension captures the extent to which the overall ICT infrastructure provides a foundation for the knowledge economy. The fourth dimension captures the extent to which the national system of innovation, comprising the constellation of and interaction among firms and research organizations diffuse knowledge adequately as measured by a country’s ability to create, publish and patent scientific results. In our study, the mechanism through which the knowledge economy effect is exerted include information asymmetry mitigation between lenders and borrowers, cost/price calculations under generalized uncertainty, cognitive decision-making and know-your-client efficiency. The knowledge economy effect is mediated by formal and informal institutions and technological capabilities, coordination effectiveness and network resilience of the financial system as a whole. Knowledge is taken as an exogenous, economy-wide factor that predicts individual firm financing behavior.

The results of the analysis show that higher levels of the knowledge economy are broadly associated with lower firms’ financing constraints throughout the developing countries. The size of the effect is on average considerable, it is higher in richer and larger countries and lower in poorer and smaller countries. It is also higher in mid-size cities with populations between 0.5 and 1 million inhabitants and insignificant in small cities and rural areas. It appears that policies aiming at enhancing firms’ access to external finance in developing countries would be more efficient if they account for the state of the knowledge economy and the spatial conditions of firms’ operation.

The study contributes to the literature on the firms’ access to external finance and growth (Ayyagari *et al.*, 2008, Ayyagari *et al.*, 2016; Mertzanis, 2017, 2019a, b). It stresses the role of the knowledge economy in affecting the supply of and demand for firms’ external finance thereby influencing their performance (Alonso *et al.*, 2019; Durst *et al.*, 2023; Fischer *et al.*, 2021). It uses a large and diversified sample of mostly privately held firms operating in developing countries. The knowledge effect on private firms has not been extensively studied (Alsebai *et al.*, 2022). It is nonetheless an important area of research for the financing decisions

of private firms which are not directly subject to market pressures but reflect more internal considerations. It further adds to the literature on the geography of access to external finance and the spatial heterogeneity of financial markets (Martin, 2011; Wójcik, 2016; Lee and Brown, 2017) with a focus on developing countries. Finally, it contributes to the strand of literature that focuses on the relation between agglomeration and financial development (Duranton, 2014; Castells-Quintana, 2017).

The study is organized as follows. Section 2 reviews previous studies and the related literature; section 3 describes the identification strategy, data and the empirical methodology used for the estimation; section 4 analyzes the predictive power of the knowledge economy and firm-specific characteristics on corporate finance obstacles; section 5 applies sensitivity tests and endogeneity analysis; section 6 applies additional country-level checks of robustness of results; and finally, section 7 concludes the analysis.

2. Related literature

Firms' access to financial services and products differs from the actual use of them. This is because firms may not use finance either involuntarily or voluntarily. Some firms have access to financial services, but they do not use them because either they do not need them, or they do not wish to use them due to social, religious or cultural reasons. Few studies consider whether knowledge-related factors play a role in providing firms with needed access to financial services (Agénor and Canuto, 2017; Bertoni *et al.*, 2015; Colombelli and Quatraro, 2018). Further, few studies consider the role of geography on knowledge sharing and local information asymmetry between lenders and borrowers and therefore on financial inclusion in local financial markets (Clarkson *et al.*, 2007). We describe the role of these knowledge-related factors by considering their effect on the demand for and supply of financial services and products as well as on the structure of financial intermediation.

Knowledge considerations affect the firms' demand for external finance mainly through information asymmetry. Masiak *et al.* (2019) note that the assumption of widely available and free financial information may not be valid regarding small-size new firms, whose owners make entrepreneurial decisions under heightened uncertainty. Lowik *et al.* (2012) argue that most firms generally have a limited knowledge of financing alternatives, which hampers their ability to use new and affordable financing investments. Chaudhary (2019) shows that entrepreneurs, who are not knowledgeable of certain financing instruments, are more often than not self-discouraged from actively searching for more financing knowledge. This implies that adequate knowledge of financing alternatives and processes is important even for firms that do not need or cannot raise external finance, as this impedes the meeting of their future financing needs. The impact of knowledge on firms' demand for finance also varies in accordance with their stage of development, where informal sources may be more important at their earlier stages, whilst formal, knowledge-demanding ones may be more important at later development stages (Xiao, 2011).

Further, knowledge affects the demand for external finance through personal human capital. Hurst and Lusardi (2004) stress the role of entrepreneurs' wealth in strengthening their personal human capital due to more extensive acquisition of knowledge they need to meet their financing constraints. Another way of influence is through the value signals, which the quality of entrepreneurs' personal human capital conveys to external investors, ensuring trust and commitment. Hallen (2008) notes that higher quality of entrepreneurs' human capital increases the probability of external investors committing financial resources to uncertain new ventures. Hsu (2007) argues that these channels of influence explain why new business ventures that are established by entrepreneurs that care to improve their own human capital experience lower financing constraints. Moreover, knowledge affects the demand for finance through the individuals' cognitive reactions. Atkinson *et al.* (2007) argue

that the understanding of the nature and quality of judgments made for seeking finance can explain the borrowers' financial capabilities.

Knowledge affects the supply of finance mainly through the improved ability to assess borrower creditworthiness. Assessing and monitoring creditworthiness requires the containment of information asymmetry between lender and borrower. Assessment mechanisms are also diverse, combining different sources of formal and informal, quantitative and qualitative information about the borrowers, different procedures of screening this information, different contractual structures and terms of lending and different monitoring strategies and enforcement mechanisms. [Berger and Udell \(2002, 2006\)](#) and [DeYoung et al. \(2010\)](#) distinguish between transaction-lending decisions, based primarily on the use of "hard" and objective knowledge and relationship-lending decisions, based on "soft" informal and qualitative knowledge. The former requires adequate financial information of the borrowing firm, adequate ICT infrastructure and cognitive skills to carry out credit scoring of informationally deficient or opaque firms and their owners. The latter requires adequate and persistent "relationship banking" with the borrowing firm, its owners and the local community as well as ongoing monitoring of corporate performance across all types of financial relationships, including contracting, spending and financing. [Liberti and Mian \(2009\)](#) argue that the extent of geographical and hierarchical distance between the information-collecting officer and the loan-approving officer affects the extent of reliance on objective versus subjective knowledge. [Uchida \(2011\)](#) finds that, during the loan application screening process, smaller and provincial banks assign higher importance to relationship-based knowledge and use third-party provided information often, but they also place greater emphasis on the borrowers' collateral value as insurance.

Further, knowledge affects the supply for finance through its ability to capitalize on high-level skill and expertise. Financial institutions provide a wide range of financial services by more or less specialized staff, ranging from tellers to credit officers, from traders to financial analysts, from policy distributors to reinsurance experts, with varying degrees of skill and expertise. [Merluzzi and Phillips \(2016\)](#) document that many jobs in banks usually are local hires, often devoid of necessary skills to provide financial sophisticated services. Skill here refers to both cognitive ability and the ability to understand the intricacies of valuing and marketing of intangible financial products, form financing alliances, perform relationship financing, capitalize on networks and social media, etc. Where knowledge levels are higher, the concentration and discharge of such skill and expertise are also higher and vice versa. [Lane et al. \(2006\)](#) note that the ability to internally train staff depends on the latter's already accumulated knowledge and educational background. Professional certification programs may often be expensive or confined to only a few eligible ones. [Luo et al. \(2009\)](#) document a positive relationship between the level of staff expertise and its ability to form financial alliances with partners that lead to successful ventures. [Gomes-Casseres et al. \(2006\)](#) show that knowledge flows among alliance-based firms are larger than knowledge flows among non-allied, pairwise interacting firms and lower than knowledge flows among units within remote firms. They further posit that similarities of business models between partners determine the flow of knowledge within alliances. [Jabbouri and Farooq \(2021\)](#) argue that firms employing inadequately skilled workforce are more likely to experience financing obstacles. The types of knowledge networks are key determinants of the way knowledge affects the concentration and discharge of human capital and hence its impact on financial decisions ([Lorentzen, 2008](#)).

Finally, the knowledge economy affects external finance through its impact on financial intermediation and the associated availability of funds. [Merton and Thakor \(2019\)](#) argue that the knowledge economy has made possible the emergence of fintech and non-intermediated peer-to-peer (P2P) lending vis-a-vis traditional bank lending. The rise of non-bank lenders is associated with new informational frictions and incentives as well as a new form of competition that affect the power of banks as deposit-collectors and the process of screening, monitoring

and relationship banking with borrowers. The spread of high frequency trading, e-trading and robo-advising and the use of big data for risk pricing affect the boundaries between direct and indirect financing mechanisms. Cong and He (2019) argue that the emergence of cryptocurrencies, mobile wallets and P2P transfers backed by the block chain technology creates a new competitive basis with traditional bank-originated fiat money thereby affecting the control and cost of financial transactions and the operation of the clearing and settlement process. Philippon (2018) argues that the emergence of fintech and dis-intermediated lending platforms can reduce the cost of financial intermediation considerably but also cause considerable regulatory challenges, all of which affect the provision of finance.

Overall, the literature suggests that the knowledge economy is associated with improvements in firms' access to external finance directly and indirectly, along individual and institutional channels. This leads to our key testing hypothesis:

- H1. Higher levels of the knowledge economy are associated with lower financing constraints of firms.*

The extent to which the knowledge economy affects financing decisions has also a spatial dimension that can assume either horizontal or vertically integrated forms. Knowledge spillovers within a country and across countries depend on the strength of knowledge-related externalities. Keilbach (2000) argues that the assumption of perfect interregional capital mobility seeking most profitable entrepreneurial ventures implies a restrictive geographical homogeneity in accessing finance. This view ignores the possibility that geographical cities and regions may trail others, allowing them to catch up in different paces by learning and replicating the more successful financial intermediation structure or technology. For example, the M-Pesa system of low-cost digital payment that has revolutionized financial access has thrived in Kenya but not in the neighboring Sudan and Uganda. The New Economic Geography School (e.g. Krugman, 1998; Baldwin and Martin, 2003) suggests that technological progress affects knowledge diffusion through learning-by-doing and a recurrent effect of gradual knowledge accumulation on investment, highlighting the role of urban agglomeration and institutions. Johansson (2021) argues that the geographic patterns of how entrepreneurial behavior affects technological innovation are linked with the knowledge communicated to entrepreneurs, which is in turn affected by the structure of the social networks of interpersonal communication. Faggian and McCann (2006) stress the importance of the interregional transfers of human capital (e.g. skilled labor possessing tacit knowledge) for knowledge diffusion. Eugster *et al.* (2018) show that knowledge spillovers between neighboring regions are determined by proximity and intergroup cohesion like an epidemic. Aghion and Jaravel (2015) show that regional knowledge spillovers depend in a hierarchical fashion on the network of innovators and potential adopters across geographical regions. The extent of industrial and financial agglomeration and the spread between center and peripheral regions depends on distance and knowledge complementarity. Nogueira *et al.* (2015) show that these agglomeration effects tend to facilitate firms' access finance through improved selection of lenders, learning of alternatives and monitoring efficiency of geographically concentrated investments. The preceding literature suggests that the effect of the knowledge economy on firms' access to external finance has a significant geographical dimension. This leads to our next testing hypothesis:

- H2. The effect of the knowledge economy on the financing constraints of firms depends on geographical factors.*

Thus, in this study, we test the impact of a composite country-level measure of the knowledge economy on the degree to which individual firms experience obstacles to accessing external finance. We also test for the within- and across-country manifestation of the knowledge effect, thus highlighting its regional dimension.

3. Data and methodology

We obtain the data on firms' access to finance from the Enterprise Surveys (ES hereafter) administered by the World Bank. The basic dataset includes 132,915 non-financial firms operating in 106 developing countries during 2006–2018. Our final dataset is constrained by the time span of the key independent variable and the associated controls, which comprise the final sample. The novelty of our data is that it focuses on privately held firms, where the knowledge effect has been inadequately studied. It is nonetheless important for the financing decisions of private firms which are not directly subject to market pressures but reflect more internal considerations. Moreover, not all firms and households need all financial services. The Global Findex database ([The World Bank, 2022](#)) reveals that some financial exclusion is voluntary, that is, some firms choose not to use financial services. Previous studies have shown that private firms in developing countries have relatively lower access to finance than publicly listed firms ([Mertzanis, 2019a, b, 2020](#)). The mode of ES data collection is face-to-face interviews. The sampling methodology for ES is stratified random sampling. In a simple random sample, all members of the population have the same probability of being selected and no weighting of the observations is necessary. The ES data are collected over several survey rounds. They are essentially independent collections of cross-section data, where only a few firms systematically appear throughout the successive surveys. The data structure is unbalanced but it has the advantage of containing consistent information across all survey years. The ES data have the important strength of including different firms depending on their size, sector of activity and other firm-specific characteristics. The survey responses of the firms reflect their experience and perception of the surrounding business environment and the obstacles therein. To contain self-selection bias, the ES data use random samples of representative firms across different sizes and sectors of activity, which are subsequently updated for each country and properly brought into consistent form. A potential drawback of the ES data is about whether they truly reflect firms' financing constraints. However, in the absence of audited, high-quality census data in most developing countries, survey data include information that directly reflects the corporate views, which may be more valuable with respect to the true financing constraints of firms.

The outcome variable of our analysis is the individual firms' access to finance, ACCESS. The latter is an ordinal variable that captures the individual firm's experience of financing constraints, based on the answer to the survey question: "How much of a problem is access to finance for operating and growing your business?" The answer ranges between no obstacle (0), minor obstacle (1), moderate obstacle (2), major obstacle (3) and severe obstacle (4). However, these responses may capture only part of the firms' reality since some firms may not be constrained or may experience liquidity distress only. Therefore, we are cautious about interpreting the results properly. Alternative metrics for gauging financing constraints are typically derived from balance-sheet information ([Almeida *et al.*, 2021](#)). Nonetheless, our metric possesses distinct advantages. Firstly, it adopts a more comprehensive scope, incorporating the influence of expectations and uncertainty conditions on financing decisions. This is particularly noteworthy considering [Shleifer's \(2019\)](#) emphasis on the increasing reliability of survey data as a source for evaluating market expectations. Secondly, our measure encompasses both the availability and cost of financing, considering factors such as interest rates, fees and collateral requirements. This holistic approach proves advantageous, especially when analyzing the cascading effects of significant external shocks across multiple levels. Thirdly, our metric embraces the entirety of alternative external financing forms, which are often prevalent and difficult to differentiate in developing countries. This includes various sources such as bank financing, equity financing, trade/supplier finance and informal finance. This inclusive framework ensures a more nuanced understanding of the diverse avenues through which firms secure external funding in varying economic contexts.

The main explanatory variable in our study is the knowledge-economy index (KEI), which is an economy-wide measure of the knowledge economy. The KEI index is based on the

knowledge assessment methodology (KAM) used by the World Bank ([The World Bank, 2012](#)). It is a composite index that measures a country's ability to generate, absorb and diffuse knowledge. The KEI measures whether the overall environment of a country creates and uses knowledge to enhance economic transformation and development and therefore push the country towards the knowledge economy. [Chen and Dahlman \(2005\)](#) note that the methodology comprises 148 structural and qualitative variables normalized into 12 knowledge indicators, which are subsequently grouped into four pillars to provide a country scorecard. The first pillar considers whether the economic and institutional environment creates incentives for the efficient production and absorption of new knowledge and its contribution to entrepreneurship. The second pillar considers whether education and skills are properly articulated to enhance human capital. The third pillar considers whether the overall ICT infrastructure provides a foundation for the knowledge economy. The fourth pillar considers whether the national system of innovation, comprising the constellation and interaction of firms, research centers, universities and other relevant organizations, diffuses knowledge adequately as measured by a country's ability to create, publish and patent scientific results. The KEI ranges within the [0, 10] interval, with higher values indicating higher ability to create, absorb and diffuse knowledge. It is best suited for the present analysis. While there may be concerns about the robustness of the KEI as an aggregate indicator, it fares well in comparative studies and most importantly it has the key advantage of being widely representative of the quantitative, qualitative and structural aspects of the knowledge economy and consistently measured across our entire sample of 106 countries ([Chen and Dahlman, 2005](#)). While endogeneity analysis is performed, the paper analyzes knowledge as an input to financial decision-making.

[Table 1](#) reports average per country values of ACCESS and KEI. These values show substantial discrepancies across countries. Firms located in Burkina Faso (3.01), Côte d'Ivoire (2.72) and Ghana (2.57) experience access to finance to be a severe obstacle to their business operations; firms located in Eritrea (0.43), Estonia (0.50) and Israel (0.53) experience it as no significant obstacle; whilst firms located in Egypt (1.55) and Nigeria (1.55) express median positions. The whole sample distribution of ACCESS shows that on average 9.3% of firms disclose that access to external finance is a severe obstacle; 16.2% disclose that it is a major obstacle; 21.7% disclose that it is a moderate obstacle; 20.3% disclose that it is a minor obstacle and 32.5% disclose that it is no obstacle. Moreover, Israel has the highest KEI (8.14), followed by Estonia (8.37) and Slovenia (8.36); whilst Liberia has the lowest KEI (0.89) followed by Sierra Leone (0.91) and Myanmar (0.93). The sample average is 3.98.

Further, while the knowledge economy is expected to affect firms' financing constraints, the effect is not directly observed. Therefore, we control for other characteristics of firms that mitigate the effect. The firm-specific characteristics provide external financiers with essential information to evaluate the risk and potential return associated with providing funds to a particular firm ([Ayyagari et al., 2008](#), [Ayyagari et al., 2016](#)). These characteristics serve as tangible indicators of a firm's creditworthiness, financial health and ability to effectively use external finance, making them critical predictors in the decision-making process of external financiers. We undertake a careful approach to ensure the robustness of our findings by controlling for various characteristics of firms that have the potential to influence or mitigate the observed effect. This comprehensive control strategy involves accounting for factors such as firm size, age, sector of business activity, corporate legal status, auditing of accounts, export performance and ownership structure. The ES data serve as a valuable resource, providing rich information on these firm-specific characteristics. Our methodology aligns with the work of [Adian et al. \(2020\)](#), who leverage ES data to emphasize the central role of a firm's age and size in shaping its access to finance, particularly in the context of the challenges posed by the pandemic. Additionally, insights from [Mertzanis \(2017, 2019a, b\)](#) underscore the significance of ownership structure in influencing firms' access to finance, highlighting the nuanced interplay between corporate ownership arrangements and financial

Country	ACCESS	KEI	Country	ACCESS	KEI	Country	ACCESS	KEI
Albania	1.04	4.07	Guyana	1.31	4.31	Panama	0.88	5.45
Angola	2.36	1.38	Guinea	2.23	1.58	Paraguay	1.37	3.66
Argentina	1.98	6.02	Guyana	1.31	4.31	Peru	1.30	4.77
Armenia	1.72	5.30	Honduras	1.47	3.31	Philippines	0.84	4.09
Bangladesh	1.75	1.63	Hungary	0.74	7.94	Poland	1.29	7.39
Barbados	1.85	7.25	India	1.16	3.06	Romania	1.64	6.59
Belarus	1.35	5.31	Indonesia	1.16	3.17	Russia	1.45	5.71
Benin	2.13	1.99	Israel	0.53	8.14	Rwanda	1.60	1.26
Bolivia	1.52	4.09	Jamaica	1.72	5.05	Samoa	1.30	2.63
Bosnia and Herzeg	1.42	4.70	Jordan	1.97	4.95	Senegal	2.24	2.91
Botswana	1.69	4.54	Kazakhstan	1.30	5.03	Serbia	1.45	5.30
Brazil	2.34	5.57	Kenya	1.65	2.90	Sierra Leone	2.20	0.91
Bulgaria	1.23	6.22	Kyrgyz Rep	1.43	3.78	Slovak Rep	1.26	7.49
Burkina Faso	3.01	1.65	Lao PDR	1.16	1.67	Slovenia	1.23	8.13
Cambodia	1.22	1.71	Latvia	1.27	7.52	South Africa	0.73	5.77
Cameroon	2.30	1.69	Lebanon	1.76	4.56	Sri Lanka	1.60	4.16
Cape Verde	1.93	3.25	Lesotho	1.72	2.43	Sudan	1.24	1.48
Chile	1.34	7.05	Liberia	1.85	0.89	Swaziland	1.49	3.37
China	0.81	4.38	Lithuania	1.23	7.74	Sweden	0.61	9.43
Colombia	1.73	4.48	Madagascar	1.60	2.05	Tajikistan	1.30	2.96
Costa Rica	2.06	6.06	Malawi	1.96	1.84	Tanzania	2.15	1.86
Cote d'Ivoire	2.72	1.80	Malaysia	1.37	6.10	Thailand	0.58	5.21
Croatia	1.28	6.84	Mali	2.32	1.98	Trinidad and Tob	1.78	5.65
Czech Rep	1.37	7.98	Mauritania	2.19	1.92	Tunisia	1.14	4.56
Dem. Rep. Congo	2.27	3.83	Mauritius	1.89	5.18	Turkey	0.84	5.37
Ecuador	1.52	3.77	Mexico	1.44	5.44	Uganda	2.02	2.28
Egypt	1.55	3.78	Moldova	1.24	4.98	Ukraine	1.61	2.41
El Salvador	1.52	4.18	Mongolia	1.80	4.46	Uruguay	1.44	6.51
Eritrea	0.43	1.07	Morocco	1.29	3.61	Uzbekistan	0.96	3.21
Estonia	0.50	8.37	Mozambique	2.11	1.76	Venezuela	1.23	4.59
Ethiopia	1.67	1.23	Myanmar	0.99	0.96	Vietnam	0.98	3.20
FYR Macedonia	1.45	5.49	Namibia	1.68	4.25	Yemen	1.64	1.85
Georgia	1.34	4.93	Nepal	1.53	1.59	Zambia	1.64	2.52
Ghana	2.57	2.84	Nicaragua	1.24	2.91	Zimbabwe	2.52	2.51
Guatemala	1.46	3.21	Nigeria	1.55	2.15			
Guinea	2.23	1.58	Pakistan	1.30	2.31	Total average	1.50	3.98

Source(s): Authors' calculation

Table 1.
Access to finance and
the knowledge
economy index
(country mean values)

outcomes. Moreover, our study extends into the realm of firm competitiveness, drawing inspiration from [Falciola et al. \(2020\)](#), who utilize ES data to construct firm competitiveness levels. This approach involves considering not only business obstacles but also firm-level characteristics, including legal status. By incorporating these elements, we aim to provide a nuanced understanding of the factors influencing the competitive landscape of firms, shedding light on how the legal organization of firms shapes their overall competitiveness. Furthermore, [Lee et al. \(2020\)](#) use the ES data to analyze the intricate relationship between corruption, firm-specific characteristics and external finance. [Farooq et al. \(2021, 2023\)](#) use firm-specific information from the ES data to control for the effect of economic and political uncertainty on financing constraints.

A key firm-specific variable for the analysis is the location of the firm, LOCATION. The variable documents whether a firm is in the capital city or in cities with smaller population as well as in rural areas. The distribution of firms in our sample shows that 14.5% of firms are in the capital city; 24.7% are in cities with more than 1 million inhabitants; 19.4% are in cities

with 0.25–1 million inhabitants; 13.9% are in cities with 0.05–0.25 million inhabitants; 9.9% are in cities with less than 0.05 million inhabitants and 17.8% of firms are in rural areas. Wójcik (2016) suggests that the divide between large financial centers, mid-level cities and rural areas plays a key role in the differences in corporate finance access. Igwe *et al.* (2019) use the ES data to show that firm location predicts investment, productivity and growth of SMEs in Africa. We use LOCATION in all models to capture within-country spatial effects. Finally, we use country-level variables to control the impact of national economic and institutional effects. The Appendix includes a description of all the variables in the study. Where necessary, we took logarithmic values of level variables to contain potential outlier bias.

Table 2 displays summary information of the variables in the study. The mean country value for ACCESS is 1.5 and the standard deviation is 1.33, indicating considerable dispersion. Further, the within-country distribution of ACCESS shows that firms located in the capital city have an average value of 1.61; firms located in cities with at least one million people have an average value of 1.43; firms located in cities between 0.25 and one million people have an average value of 1.48; firms located in cities between 0.05 and 0.25 million people have an average value of 1.50; firms located in cities between less than 0.05 million people have an average value of 1.41; and firms located in rural areas have an average value of 1.55. It appears that firms in the capital cities experience the most severe financing obstacle and those in smaller cities less than 0.05 million people experience the least severe obstacle. Moreover, the mean country value of KEI is 3.98 and its standard deviation is 1.79, also indicating considerable dispersion. About 47.2% of the firms in the sample are small firms, 33.7% are medium-size and 19.1 are large firms. Further, 45.5% of firms are joint stock companies, 47.5% are established and operate in the capital city and major cities. The sample is quite diverse and balanced.

Since ACCESS is an ordinal variable, we deploy an ordered probit model for estimating the causal effect, using the maximum likelihood estimator (Greene, 2012). We consider only observations with non-missing values for the estimation. In our cross-country setting with a potential omitted variable bias, we use country fixed effects to capture unobservable

Variable	Obs	Mean	S.D.	Min	0.25%	Mdn	0.75%	Max
ACCESS	128,284	1.5	1.33	0	0	1	3	4
KEI	122,527	3.98	1.79	0	2.51	3.78	5.4	9.43
LOCATION	109,328	2.76	1.27	1	2	3	4	6
AGE	130,423	7.57	0.02	5.56	6.56	7.56	7.58	7.61
SIZE	132,904	1.72	0.76	1	1	2	2	3
LEGAL	132,900	2.83	1.13	1	2	3	3	7
EXPORT	131,060	7.21	21.67	0	0	0	0	100
AUDIT	132,699	1.51	0.54	1	1	1	2	3
OWNF	132,371	7.88	25.31	0	0	0	0	100
OWNG	132,380	0.55	6.52	0	0	0	0	100
TECHCAP	121,542	1.24	0.23	0.43	1.21	1.43	1.67	1.91
CREDIT	128,482	1.51	0.31	0.31	1.33	1.52	1.71	2.2
FINOPEN	129,763	1.25	0.7	0.04	0.91	1.19	1.87	2.41
GINI	132,904	40.04	8.15	25	33.6	39.2	45.5	65
QUALEDUC	117,166	3.39	0.71	0	2.88	3.39	3.94	5.44
FDITECHTRAN	117,166	4.49	0.6	0	4.19	4.55	4.88	5.92
TECHABS	117,166	4.41	0.59	0	4.1	4.34	4.75	6.07
POPdens	129,993	136.51	195.72	2	32	73	147	1,178
DISTANCE	127,973	672.61	844.22	0	220	425	823	4,322
AGGLOMER	128,198	43.48	19.1	4.8	28.8	42.9	53.6	90.5
POP75	130,404	37.47	32.57	0	12.7	25.1	57	100

Table 2.

Descriptive statistics

Source(s): Authors' calculation

influences of time-invariant factors (i.e. geography, institutions, etc.) among countries. We also use year effects to capture unobservable time-relevant influences (i.e. shocks, crises, etc.) that affect all countries. Subsequently, we add country-level control variables in separate groups to study different economic and institutional influences while containing collinearity. In this setting, we measure the key predictor variable at the country level whereas we measure the outcome variable at the firm level. Moulton (1990) identified the statistical bias that results from the attempt to measure the effect of aggregate policy variables on micro units. Consequently, we cluster the standard errors at the country level in all regressions. Our setting also implies that in a given country and year, there are several different firm-level observations per one key predictor observation. The error term of the estimation might be large since it is difficult to fit all the outcome points at the same time thereby inducing a more conservative estimate of the effect of the key predictor variable. The model of empirical estimation assumes the following form:

$$\text{ACCESS}_{ijt} = \alpha + \text{KEI}_{jt} \beta_1 + X_{2ijt} \beta_2 + X_{3jt} \beta_3 + \mu_{ijt} \quad (1)$$

The outcome variable ACCESS_{ijt} shows the probability that the firm i , operating in city l , in country j , during year t , perceives access to finance to be either no or minor or moderate or major or severe obstacle to its business; KEI_{jt} is the knowledge economy index per country j and year t ; whilst X_{2ijt} is the vector of firm-specific characteristics used as control variables, and X_{3jt} is the vector of country-level factors used as control variables. The term μ_{ijt} is the overall regression's error term that comprises the sum of η_j , θ_b , λ_t and $e_{i,b}$, where η_j accounts for the unobservable country-specific effects, θ_b accounts for location-specific effects, λ_t accounts for the time-specific effects and the $e_{i,b}$ is a disturbance parameter that is assumed to vary across firms, cities, countries and years and follow the normal distribution. Note that the use of an ordered probit model to analyze ordinal variables does not produce a goodness-of-fit statistic like the R^2 of OLS regression. The probit estimates are maximum likelihood values produced through a process of iteration and not calculated to minimize variation. The probit model produces a pseudo R^2 measure of the goodness-of-fit, which ranges too from 0 to 1 and higher values imply better fit of the model. However, these pseudo R^2 values are typically very low. Wooldridge (2010) suggests that in the case of a binary outcome variable, the McFadden's pseudo R^2 values could have an interpretation that is parallel to the R^2 in the OLS regression. We address potential endogeneity arising from omitted variables by using fixed effects and applying an instrumental variables method with a suitable instrument. Finally, we are careful to interpret our parameter estimates as indications not of outright causation but of strength of association. In the text, we may use the terms "cause" or "predict" only to facilitate discussion. Table 3 presents the matrix of correlations between KEI and the firm-specific regressors, which are less than the 0.5 value, and therefore do not exhibit severe collinearity.

4. Analysis of the results

4.1 Baseline effects

The estimation results report the change in the probability that a firm describes financing as an obstacle to business operation following a change in the state of the knowledge economy in each country. To estimate the basic relation under different conditions, we estimate successive maximum likelihood models, applying a sample split between rich and poor countries as well as large and small counties, based on the median values of the GDP per capita and population, respectively. We include interaction effects based on the mean values of interacted variables to better capture the spatial dynamic of the knowledge effect. Table 4 presents the baseline estimates. In all models, KEI is a negative and strongly significant

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
KEI (1)	1								
LOCATION (2)	0.225*	1							
AGE (3)	0.125*	-0.027*	1						
SIZE (4)	0.074*	-0.061*	0.241*	1					
LEGAL (5)	-0.259*	-0.049*	0.055*	-0.083*	1				
EXPORT (6)	0.055*	0.042*	0.083*	0.266*	-0.048*	1			
AUDIT (7)	-0.027*	0.010*	-0.139*	-0.286*	0.004	-0.110*	1		
OWNF (8)	0.014*	-0.032*	0.038*	0.163*	-0.068*	0.186*	-0.129*	1	
OWNG (9)	-0.014*	0.016*	0.004	0.082*	-0.039*	0.013*	-0.044*	0.007*	1
VIF	1.39								

Note(s): Pairwise correlations among the KEI and the specific characteristics of firms. The symbol * indicates a significant coefficient at the 5% level. VIF mean values above 4 for a small sample, or 10 for a large sample, indicate collinearity

Source(s): Authors' calculation

Table 3.
Correlations matrix

predictor of firms' financing constraints throughout the developing countries in all models. The magnitude of the effect is considerable; it is higher in high-income and high-population countries and lower for low-income and low-population developing countries. These results tend to confirm our first testing hypothesis, by documenting a positive association between the level of the knowledge economy and firms' access to external finance. It appears that firms in high-income and high population countries can better take advantage of the knowledge economy in reducing information asymmetry, enhancing human capital input, and effectively using informal practices to address their financing constraints than is the case in low-income and population countries. Thus, country size and income do affect the impact of the knowledge economy on corporate finance behavior. The results further show that the knowledge effect differs between the whole sample and the subsamples by development level, indicating considerable differences in the knowledge diffusion process as well as reflecting the within-country distribution effects of financing constraints experienced by individual firms in countries with different financial systems and institutional conditions. The interaction effects are significant and mostly negative, which shows that higher spatial decentralization is associated with a stronger knowledge effect. This dynamic effect is stronger in high-income and low-population countries. These findings appear to generalize, by considering broader external financing options and all developing countries, the earlier findings of [Berger and Udell \(2002, 2006\)](#), [DeYoung et al. \(2010\)](#), [Uchida \(2011\)](#) and [Uchida \(2011\)](#).

Moreover, firms' access to external finance is strongly associated with the location within the country that the firms reside. On average, the direct location effect on firms' access to external finance is stronger and beneficial for firms operating in large cities with over one million inhabitants, except for poor countries. The location effect is considerably higher in rich (7.8%) and large countries (8.1%). These differences are also manifested, albeit less strongly and with an inverse sign, in the other locations. As expected, the knowledge effect is weak or nonexistent for firms residing in small cities and rural areas. Thus, a significant direct within-country location effect is documented regarding firms' experience of financing constraints that influences the knowledge effect, which is beneficial for firms' access to external finance mainly in large cities. It appears that, in line with the predictions of the New Geography School, larger cities experience agglomeration economies that facilitate learning and information sharing that tend to improve firms' access to external finance. In this respect, richer countries have an advantage ([Duranton, 2014](#)). On the other hand, in large countries,

ACCESS	Knowledge economy and finance				
	All countries	High-income countries	Low-income countries	High population countries	Low population countries
KEI	-0.056** (0.023)	-0.259*** (0.033)	-0.169*** (0.051)	-0.252*** (0.090)	-0.105*** (0.034)
City over 1 ml people	-0.049*** (0.014)	-0.078*** (0.024)	-0.024 (0.019)	-0.081*** (0.021)	0.062*** (0.022)
City over 1 ml people * KEI	-0.091*** (0.007)	-0.206*** (0.015)	0.098*** (0.012)	-0.081*** (0.009)	-0.273*** (0.018)
City between 0.25 and 1 ml	0.044*** (0.014)	0.045* (0.024)	0.038** (0.018)	0.031 (0.021)	0.082*** (0.020)
City between 0.25 and 1 ml * KEI	-0.056*** (0.007)	-0.186*** (0.016)	0.050*** (0.011)	-0.036*** (0.009)	-0.234*** (0.019)
City between 0.05 and 0.25 ml	0.049*** (0.015)	0.064** (0.025)	0.036* (0.019)	0.088*** (0.023)	0.008 (0.019)
City between 0.05 and 0.25 ml * KEI	-0.037*** (0.007)	-0.124*** (0.019)	-0.013 (0.012)	-0.053*** (0.008)	-0.123*** (0.020)
City less than 0.05 ml	0.047*** (0.017)	-0.040 (0.031)	0.106*** (0.021)	0.125*** (0.030)	0.007 (0.021)
City less than 0.05 ml * KEI	-0.050*** (0.008)	-0.071*** (0.025)	-0.073*** (0.012)	-0.030*** (0.009)	-0.256*** (0.021)
AGE	-1.031*** (0.240)	-1.331*** (0.357)	-0.736** (0.326)	-1.236*** (0.322)	-0.657* (0.367)
SIZE	-0.059*** (0.005)	-0.083*** (0.008)	-0.044*** (0.007)	-0.052*** (0.007)	-0.071*** (0.008)
LEGAL	0.016*** (0.004)	0.021*** (0.005)	0.008* (0.005)	0.014*** (0.005)	0.014** (0.006)
EXPORT	-0.001** (0.001)	-0.001* (0.001)	-0.001 (0.001)	-0.001*** (0.001)	0.001* (0.001)
AUDIT	0.041*** (0.009)	0.083*** (0.012)	0.005 (0.012)	-0.008 (0.012)	0.090*** (0.012)
OWNF	-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.002*** (0.001)	-0.003*** (0.001)
OWNG	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.002* (0.001)	0.001 (0.001)
Year effects	Yes	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.050	0.057	0.041	0.043	0.055
N	91,928	43,973	47,955	50,760	41,168

Note(s): The outcome variable is access to external finance, ACCESS. The independent variable is the knowledge economy index. We cluster the standard errors at the country level. The first-level control variables include the specific characteristics of firms. The standard errors are in parentheses. We use an order probit model. We report the location effects, but not the country-year effects. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Source(s): Authors' calculation

Table 4.
Knowledge and access
to finance – baseline
results

the knowledge effect is stronger in both very large and very small cities, but with beneficial and detrimental, respectively, effects on access to external finance. The difference between the population size effects and the city size effects highlight the importance of the distribution of population within countries for firms' access to external finance. Our results also confirm our second testing hypothesis, by documenting the significant role of the firms' location and geography in influencing the knowledge effect on their external finance decisions.

Finally, the specific characteristics of firms predict firms' access to external finance. On average, older, larger and export-oriented firms, incorporated as joint stock companies face lower financing constraints. These results largely conform to prior findings in the literature regarding the role of firm-specific characteristics for firms' access to external finance

(Ayyagari *et al.*, 2008, Ayyagari *et al.*, 2016; Mertzanis, 2017, 2019a, b). Overall, this evidence shows a significant impact of the knowledge economy on firms’ access to external finance in developing countries, which is also influenced by the firms’ location. The knowledge and location effects vary considerably with the size and economic development of counties. It appears that knowledge diffusion affects differently the demand for and supply of finance in developing countries, which has a significant regional dimension.

4.2 Within and between-country effects

To examine in more detail aspects of the regional impact of knowledge on firms’ access to external finance, we split the total sample to capture within country and across geographical region dimensions. The sample split is also a robustness check against potential measurement error based on a different set of observations. The within-country dimension includes five different locations, according to whether the firm operates in the capital city or in cities with successively lower population. Table 5 presents the marginal effects of the within-country location impact of KEI on firms’ financing constraints. The results show that the impact of the knowledge economy on the firms’ financing constraints carries a consistent negative sign, but its magnitude varies considerably among the different locations a firm is residing with a country. It is higher in mid-size cities with population between 0.5 and 1 million inhabitants (30.3%) and insignificant in small cities and rural areas. Interestingly, the knowledge effect is insignificant for firms located in the capital city. This may be due to the

ACCESS	Capital city	City with more than 1 ml people	City with between 1 ml and 0.5 ml people	City with between 0.5 ml and 0.25 ml people	City with between 0.25 ml and 0.05 ml people
KEI	−0.205 (0.559)	−0.199** (0.086)	−0.303*** (0.061)	−0.301*** (0.079)	−0.051 (0.079)
AGE	−1.092* (0.575)	−1.039** (0.459)	−1.368*** (0.472)	−1.419** (0.585)	−0.077 (0.761)
SIZE	−0.088*** (0.012)	−0.051*** (0.010)	−0.065*** (0.011)	−0.068*** (0.013)	−0.070*** (0.017)
LEGAL	−0.001 (0.008)	0.029*** (0.006)	0.016** (0.008)	0.009 (0.009)	−0.013 (0.012)
EXPORT	0.001 (0.001)	−0.002*** (0.001)	−0.001 (0.001)	−0.001 (0.001)	0.001 (0.001)
AUDIT	0.082*** (0.021)	0.044*** (0.015)	0.094*** (0.019)	0.013 (0.022)	−0.069*** (0.026)
OWNF	−0.003*** (0.001)	−0.003*** (0.001)	−0.002*** (0.001)	−0.003*** (0.001)	−0.003*** (0.001)
OWNG	0.002 (0.002)	−0.003*** (0.001)	0.002 (0.001)	−0.001 (0.001)	−0.001 (0.002)
Year effects	Yes	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes	Yes
Pseudo R ²	0.015	0.028	0.014	0.016	0.021
N	16,235	29,614	23,111	15,725	10,363

Note(s): The sample is split by within-country location. We cluster the standard errors at the country level. The outcome variable is access to external finance, ACCESS. The independent variable is the knowledge economy index. The first-level control variables include the specific characteristics of firms. The standard errors are in parentheses. We use an order probit model. We report the location effects, but not the country-year effects. **p* < 0.1, ***p* < 0.05, ****p* < 0.01

Source(s): Authors’ calculation

Table 5.
Spatial analysis –
within country effects

practice of financial institutions in most developing countries adhering to relationship-financing more often than in developed ones. Relationship financing and community banking are more feasible and less costly when the firm operates outside the capital city facing a lower cost of client monitoring (Gilbert and Wheelock, 2013). Further, since often capital cities are not necessarily the largest cities in a country, any differences in the knowledge effect may also reflect the role of bureaucracies and other capital city-specific factors and restrictions. Capital cities tend to finance large development projects than small firms. The results of the recent Small Business Credit Survey in the USA shows that small firms have better access to external finance in smaller cities (Prakash, 2020). Finally, the knowledge effect would be stronger when firms choose to seek finance directly through the more sophisticated security exchanges, mostly located in capital cities. However, few firms in developing countries qualify for exchange listing even if this option were ever available. While the results of the baseline model remain generally stable, the size distribution of the knowledge effect is wider, implying a strong within-country location influence. It appears that the knowledge diffusion process is faster outside the capital cities, concentrating mainly on large and mid-size cities and less on small cities and rural areas, thereby influencing the location intensions of firms seeking external finance. Casual observation shows that many “smart cities” in developing countries are located far away from huge metropolitan areas (e.g. Cairo, Rio) (Buntz, 2017). While financial centers are mostly located in capital cities and overall population size matters, firms seeking external finance appear better able to benefit from the dynamic of the knowledge economy if they reside outside the vast metropolitan areas. This finding for the developing countries differs to some extent from Wójcik’s (2016) suggestion that differences in firms’ access to external finance are associated with the divide between large financial centers and rural areas.

Second, to see the geographical region impact of the knowledge economy on firms’ access to external finance, we split the sample into the UN-classified regions of the world. The UN classification is based on such factors as proximity standards, development levels, geographical morphologies, international body memberships and shared norms and cultures among the countries grouped in each world region. Table 6 presents the marginal effects of the geographical region impact of the KEI on firms’ financing constraints. The results show considerable differences in the knowledge effect among the different geographical regions. The distribution of the knowledge effect is wider than that of the baseline models. KEI is negative and significant in all geographical regions, except for the firms residing in East Asia and Pacific, Central Asia and the Middle East countries. Its magnitude is stronger in firms residing in Latin America (97.9%), South-East Asia (53.3%) and Africa (39.5%) and weakest in firms residing in Europe (14.7%). While firms residing near or within some parts of the European Union may benefit from EU technological advance and proximity, firms residing in the Latin America and South-East Asia regions appear to benefit the most, perhaps because the catching up process has had more distance to cover. Dahlan (2007) stresses the difficulties involved in embracing the knowledge economy by Latin American countries early on. However, a recent report by the Institute of International education (IIE) (2019) highlights the large progress made in the Latin America countries during the last decade in adopting the knowledge economy. Degelsegger-Márquez *et al.* (2018) have documented the progress of the Southeast Asia countries, characterized by huge coastlines and strong innovative activity, towards the knowledge economy. Further, Bizri (2018) notes that, despite considerable progress, economic and infrastructural inequalities in the Middle East and North Africa may explain the region’s slow pace towards the knowledge economy.

Further, the direct impact of within-country location on financing constraints also varies considerably among geographical regions. Firms seeking external finance are more likely to benefit by moving into the large cities in South-East Asia (41.3%) and East Asia (18.8%), less

ACCESS	Africa	East-Asia and Pacific	Central Asia	Europe	Latin America	Middle East and North Africa	South-East Asia
KEI	−0.395*** (0.044)	−0.130 (0.105)	−0.063 (0.048)	−0.147*** (0.138)	−0.979** (0.446)	−0.054 (0.034)	−0.533*** (0.047)
City over 1 ml people	0.098** (0.038)	−0.188*** (0.051)	−0.115*** (0.041)	−0.007 (0.070)	−0.029 (0.029)	0.098** (0.042)	−0.413*** (0.104)
City between 0.25 and 1 ml	0.194*** (0.039)	−0.186*** (0.053)	−0.029 (0.038)	0.159*** (0.055)	−0.116*** (0.027)	0.127*** (0.037)	−0.138** (0.084)
City between 0.05 and 0.25 ml	0.257*** (0.043)	−0.152*** (0.057)	0.007 (0.036)	−0.153*** (0.051)	−0.063** (0.032)	0.240*** (0.041)	−0.151 (0.101)
City less than 0.05 ml	0.054 (0.081)	−0.299*** (0.067)	−0.014 (0.037)	−0.077 (0.049)	0.031 (0.044)	0.314*** (0.040)	−0.022 (0.107)
AGE	−1.133** (0.565)	−0.949 (0.655)	−0.022 (0.553)	−0.365 (0.833)	−0.587 (0.563)	−1.404* (0.806)	−4.350*** (0.707)
SIZE	−0.118*** (0.012)	0.002 (0.014)	0.001 (0.013)	−0.052*** (0.019)	−0.114*** (0.013)	−0.068*** (0.018)	−0.099*** (0.014)
LEGAL	0.032*** (0.008)	0.038*** (0.010)	−0.023** (0.010)	0.007 (0.015)	0.001 (0.008)	0.031*** (0.012)	0.042*** (0.011)
EXPORT	−0.002*** (0.001)	−0.002*** (0.001)	0.001 (0.001)	0.001 (0.001)	0.001* (0.001)	−0.001 (0.001)	−0.001 (0.001)
AUDIT	0.149*** (0.017)	0.062*** (0.023)	−0.035* (0.020)	−0.038 (0.030)	0.048** (0.021)	0.012 (0.032)	−0.021 (0.025)
OWNF	−0.003*** (0.001)	−0.002*** (0.001)	−0.002*** (0.001)	−0.003*** (0.001)	−0.003*** (0.001)	−0.002** (0.001)	−0.004*** (0.001)
OWNG	0.001 (0.001)	−0.006*** (0.001)	−0.001 (0.001)	0.001 (0.002)	−0.002 (0.004)	0.001 (0.002)	0.005 (0.004)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.059	0.032	0.027	0.032	0.037	0.024	0.025
N	20,029	13,750	15,132	7,703	14,784	7,704	12,826

Note(s): The sample is split by the key UN geographical regions. We cluster the standard errors at the country level. The outcome variable is access to external finance, ACCESS. The independent variable is the knowledge economy index. The first-level control variables include the specific characteristics of firms. The standard errors are in parentheses. We use an order probit model. We report the location effects, but not the country-year effects. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Source(s): Authors' calculation

Table 6.
Spatial analysis –
between country/
region effects

so in Central Asia (11.5%), but not in Europe. Similar variations in the direct location effect are observed on locational divergence of the knowledge effect can be made for firms residing in other within-country locations. These results provide some prima facie evidence of the likely locational concentration of finance-hungry firms throughout the developing world. The location effect is generally weaker in firms residing in Central Asia countries, as the area is characterized by relatively less advanced financial systems. Overall, the regional effects are strong but also quite diversified within countries and across geographical regions. The impact of knowledge diffusion in affecting the supply of and demand for external finance takes on a diverse regional manifestation that may not be explained solely along economic and technological grounds. For example, [Mertzanis \(2017\)](#) notes the significance of institutions and social structures in affecting firms' access to external finance. This is new evidence on the association between the knowledge economy and firms' financing constraints that exhibits a strong geographical dimension.

5. Endogeneity analysis

The robustness of the estimates depends on addressing several potential econometric biases. First, the problem of reverse causality implies a possibility that firms' financing constraints influence endogenously the constituent elements of the knowledge economy, causing the regressors to be correlated with the regression's error term. We argue that endogeneity concerns due to reverse causality are not credible in this study. It is rather unreasonable to expect a feedback effect from the financing obstacles of an individual firm to the state of the knowledge economy in the country as a whole. The formation of the knowledge capability and knowledge diffusion networks predates and outweighs the measurement of the dependent variables, especially given the long-term nature of the educational improvements and the technological progress. Further, the large cross-section of sample data also lowers the possibility of reverse causation.

Second, time-invariant or very slowly changing country-level factors, such as geography, social norms and institutions, may exert considerable unobservable effects across countries on individual corporate behavior and therefore be correlated with the regression's error term. It is possible that firms may choose to locate in different cities for other reasons, thereby affecting their access to external finance. We have dealt with this potential endogeneity problem by including country-year fixed effects, adding firm-level control variables, and will be adding country-level collinearity-corrected control variables, capturing non-linearities (log values).

Third, to further check the robustness of our estimates against potential omitted variable bias, we perform an endogeneity analysis using alternative estimation methods. We apply an OLS as a benchmark, along with instrumental variable (IV) methods for estimating our [equation \(1\)](#). The OLS method applies an ordinary least squares approach to estimate the results. The IV-2SLS method fits an IV approach that uses the 2SLS estimator, whilst the IV-GMM method uses an instrumental variable approach that uses the two-step GMM estimator. A key consideration is the identification of a proper external IV instrument. We use the average country-level measure of IQ as our external instrument for the IV methods. The IQ variable reflects an approximation of a country's cognitive ability, based on the use of various cognitive tests performed on individuals in a country ([Lynn and Becker, 2019](#)). It is strongly correlated with the knowledge economy (0.608 pairwise) and weakly with the individual firms' financing constraints (0.109). The IQ variable makes considerable economic sense too. Making economic decisions requires the effective use of cognitive abilities. Cognition affects individuals' ability to gather information about economic variables, to solve technological and resource-allocation problems over time, and to grasp economic reasoning and intuition, thereby facilitating projections and efficient choice ([Falk et al., 2018](#)). Using cross-country analysis, [Lin and Bates \(2022\)](#) find that higher cognitive ability is associated with higher economic knowledge and financial literacy, both directly and indirectly. [D'Acunto et al. \(2019\)](#) further argue that individuals with higher cognitive ability make lower financial forecast errors because they comprehend abstract economic concepts better and are more capable of forecasting mean-reverting processes.

[Table 7](#) presents the results from using separately the OLS method (column 1) and the two IV estimation methods (columns 2 and 3). The results show that the KEI remains negative and significant in all alternative estimation methods. However, the magnitude of its effect is relatively lower and differs little among the IV methods. The spatial variables also broadly retain their baseline configuration. The first stage IV results show that a country's average IQ level is a significant predictor of the state of its knowledge economy. The large value of the F statistic suggests that our chosen IQ variable is a relevant external instrument in our IV analysis associated with small standard errors. In the second stage results, since clustering standard errors at the country level implies a drop of the i.i.d. assumption, the appropriate Kleibergen–Paap LM statistic rejects the null hypothesis that our model is underidentified,

ACCESS	OLS (1)	IV-2SLS (2)	IV-GMM (3)	CMP (4)
KEI	−0.064* (0.038)	−0.071*** (0.217)	−0.072*** (0.217)	−0.131*** (0.027)
City over 1 ml people	−0.082* (0.058)	−0.0645*** (0.0190)	−0.0644*** (0.0190)	−0.196** (0.083)
City between 0.25 and 1 ml	0.023* (0.048)	0.0440** (0.0190)	0.0441** (0.0190)	0.155** (0.064)
City between 0.05 and 0.25 ml	0.054 (0.050)	0.0873*** (0.0199)	0.0874*** (0.0199)	−0.097 (0.064)
City less than 0.05 ml	0.062 (0.054)	0.118*** (0.0229)	0.118*** (0.0229)	0.131*** (0.027)
Firm-specific characteristics	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes
<i>First-stage</i>				
IQ		0.086*** (0.001)		0.093*** (0.011)
F statistic		94.51		18.589
<i>Second stage</i>				
Kleibergen-Paap_Wald_F_stat		93.999	93.259	
Kleibergen-Paap_LM_stat (p-v)		41.970 (0.000)	41.122 (0.000)	
Stock-Wright_LM_stat (p-v)		29.975 (0.762)	29.153 (0.758)	
AR (2)			1.02 (0.072)	
Wald χ^2				345.504
Atanhrho				0.145 (0.032)
N	114,772	113,768	113,768	122,450

Note(s): The outcome variable is access to external finance, ACCESS. We cluster the standard errors at the country level. The independent variable is the knowledge economy index. The first-level control variables include the specific characteristics of firms. The standard errors are in parentheses. We report the location effects, but not the country-year effects. The column OLS presents the results of fitting an ordinary least squares model. Column IV-2SLS presents the results of fitting a 2SLS instrumental variables model. The column GMM presents the results of fitting an instrumental variable approach that uses the GMM estimator. The column CMP presents the results of applying a conditional mixed process. The external instrument is the average IQ level per country. Country-year effects and firm-specific characteristics are not reported. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7.
Endogeneity analysis

Source(s): Authors' calculation

and further the Kleibergen–Paap Wald statistic shows that the excluded instrument is not strongly correlated with the endogenous regressors. These statistics suggest that the excluded instrument is exogenous to our outcome variable and therefore suitable for our IV analysis. Moreover, the Stock-Wright LM statistic exceeds the Stock-Yogo threshold (16.38), which suggests that the orthogonality conditions regarding the joint significance of potentially endogenous regressors are valid and thus our IV estimates are broadly consistent. Finally, the AR (2) test in the GMM estimation indicates rejection of the null hypothesis and thus no second order Arellano–Bond serial autocorrelation at the 5% level.

To further insulate our results from the possibility of inconsistency and omitted variable bias, we use another IV method that might fit better our estimation framework. We use a conditional mixed process (CMP) with the maximum likelihood estimator and standard errors clustered at the country-level for the estimation of possible endogeneity of the KEI (Roodman, 2011). The conditional process means that the model can vary by observation. An estimation method can be dropped for observations for which it is not relevant. The mixed process means that different equations can have different types of dependent variables (different

response types). The maximum likelihood approach to estimating the separate equations as a system (mixed process) rather than as a two-step (individual) process, has benefits. It overcomes several potential problems of unobservable influences, but at the cost of estimation efficiency. Similarly, we use the average country-level measure of IQ as our external instrument. [Table 7](#) (column 4) reports the results of the mixed conditional process. The LR χ^2 statistic is high enough, indicating that our model is a good approximation. The point of interest is the significance of the Atanhrho coefficient, which measures the correlation between the errors of the two estimation processes. The results show that the Atanhrho coefficient is insignificant and hence the null hypothesis of KEI exogeneity is not rejected at the 10% level. This implies that, since the external instrument is broadly suitable and the endogeneity test confirms the exogeneity of KEI, our estimates are broadly consistent.

6. Country-level factors and further robustness checks

The link between knowledge, geography and finance is multifaceted. [Mason \(2010\)](#) identifies three channels through which geography affects financial activity: distance, capital and centralization flow. First, a large geographical distance between lenders and business borrowers reduces the number of personal interactions due to communication and transport cost, thereby exacerbating any existing information asymmetries. [Zhao and Jones-Evans. \(2017\)](#) confirm that physical distance between financial institutions and SMEs affects their financing. Second, financial institutions operate within competitive, more or less centralized financial systems and geographies. The Global Financial Development Report (2022) argues that densely populated urban areas offer greater proximity to financial services and institutions where they perceive lower costs and risks than rural areas. [Liang *et al.* \(2014\)](#) find evidence for clustering of the financial services industry in large cities, which drives competition and in turn reduces financing constraints. [Degryse and Ongena \(2005\)](#) note that the localized form of “relationship banking” in each geographical region explains the extent to which repeated social interactions generate preferential treatment towards local borrowers because of their lower information asymmetries and lenders’ stake in the well-being of the local/regional economy thereby affecting access to external finance. Third, given financial openness, financial institutions collect and manage savings from all localities and regions within and between countries, which they subsequently reinvest in different geographical regions through diverse financial networks and strategies. Coastlines translate exposure for sea transport and trade and access to external finance. The [OECD \(2014\)](#) assesses the impact of ports on cities and documents the role financing activities play in conjunction with coastline exchange.

The knowledge economy further mediates these regional effects. The geographic compactness of population affects knowledge spillovers through communication efficiency. [Shabani *et al.* \(2011\)](#) argue that high population density facilitates physical interaction due to proximity, strong social networks and institutions of communication and information exchange. [Ponds *et al.* \(2010\)](#) highlight the role of the regional configuration of university–industry links. [Zheng \(2022\)](#) documents the propensity of firms to concentrate in certain locations is higher in areas and sectors where new knowledge gets more easily codified and transmitted with less human mediation, such as in large cities. [Caniels and Verspagen \(2001\)](#) suggest that coastal geographical regions influence the degree of connectedness and knowledge diffusion among geographical regions and model the impact of distance on knowledge spillovers.

To evaluate the relevance of these conjectures, we apply additional robustness tests to assess the role of financial conditions, education and technology and geographical and demographic factors. We expand the arguments of [equation \(1\)](#) to include new regressors

capturing some aspects of these country-level factors. In all models we add the variable CRISIS that captures the effects of the global financial crisis. Table 8 presents the new baseline estimates after having controlled for financial openness (FINOPEN), financial development (CREDIT), income inequality (GINI), the quality of the education system (QUALEDUC), the extent of technology absorption by the firms (TECABSR), the extent of FDI and technology transfer (FDITECTRN), population density (POPDENS), geographical

ACCESS	Financial development	Education and technology	Geography and demography	All countries	High- income countries	Low- income countries
KEI	-0.048*** (0.002)	-0.099*** (0.003)	-0.090*** (0.003)	-0.084*** (0.004)	-0.154*** (0.011)	-0.041*** (0.005)
City over 1 ml people	-0.059*** (0.012)	-0.129*** (0.013)	-0.088*** (0.012)	-0.093*** (0.013)	-0.038 (0.024)	-0.127*** (0.017)
City between 0.25 and 1 ml	0.026** (0.013)	0.053*** (0.013)	0.047*** (0.013)	0.064*** (0.013)	-0.011 (0.024)	0.035** (0.017)
City between 0.05 and 0.25 ml	0.010 (0.014)	0.034** (0.014)	0.015 (0.013)	0.025* (0.014)	0.031 (0.025)	0.050*** (0.019)
City less than 0.05 ml	0.007* (0.016)	0.022 (0.016)	0.007* (0.015)	0.045*** (0.017)	0.028 (0.032)	0.108*** (0.020)
CRISIS	0.053** (0.023)	0.098*** (0.022)	0.113*** (0.022)	0.120*** (0.025)	0.181*** (0.043)	0.304*** (0.041)
CREDIT	-0.382*** (0.013)			-0.417*** (0.016)	-0.261*** (0.029)	-0.208*** (0.027)
FINOPEN	-0.002** (0.005)			0.035*** (0.006)	0.053*** (0.010)	-0.016** (0.008)
GINI	0.005*** (0.001)			0.008*** (0.001)	-0.001 (0.001)	0.012*** (0.001)
QUALEDUC		0.017** (0.007)		0.056*** (0.008)	0.050*** (0.016)	0.137*** (0.012)
TECABSR		0.069*** (0.008)		0.048*** (0.009)	0.082*** (0.018)	-0.104*** (0.012)
FDITECTRN		-0.114*** (0.008)		-0.120*** (0.009)	-0.097*** (0.016)	-0.114*** (0.013)
POPDENS			-0.001*** (0.002)	-0.002 (0.002)	-0.001*** (0.002)	-0.001*** (0.002)
DISTANCE			0.001*** (0.003)	0.002*** (0.002)	-0.001*** (0.002)	-0.002 (0.002)
AGGLOMER			0.002* (0.002)	0.002*** (0.002)	-0.001 (0.002)	0.008*** (0.002)
Firm-specific character	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R ²	0.018	0.017	0.016	0.021	0.032	0.020
N	109,872	106,621	112,676	101,196	46,601	54,595

Note(s): The outcome variable is access to external finance, ACCESS. We cluster the standard errors at the country level. The independent variable is the knowledge economy index. The first-level control variables include the specific characteristics of firms. The standard errors are in parentheses. We use an order probit model. We report the location effects, but not the country-year effects. We do not report the effect of the firm-specific characteristics for space reasons. The second-level control variables include the country-level values of financial conditions (column 1), the education and technology conditions (column 2) as well as of geography and demography conditions (column 3). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Source(s): Authors' calculation

Table 8.
Additional robustness:
Impact of financial,
technological and
geographical
conditions

distance (DISTANCE), level of agglomeration (AGGLOMER) and the extent of population living within 75 Kms from the sea (POP75). The [Appendix](#) details all control variables. Pairwise correlations between these control variables for each group do not indicate significant multicollinearity problems.

The new estimates show that KEI remains negative and significant in predicting firms' probability to experience financing constraints in all models, confirming the directions of the baseline results. The size of the effect is stronger when we control for the role of education and technological conditions, then for financial conditions and least so for geographical and demographic conditions. The effect is stronger in richer developing countries. As expected, the global financial crisis is found to have a detrimental effect on financing constraints in all models. It appears that, after the inclusion of country-level controls, the impact of the knowledge economy in richer developing countries reflects more complex country-level conditions tending to discourage external financing. One reason for the adverse may be the extent of "over-propertization" of knowledge, which in more developed countries has resulted from knowledge privatization away from 'open science', which signaled a progressive rise in the cost of finance ([Pagano and Rossi, 2009](#)). Another reason is that in more advanced developing countries, the disruptive effects of new technologies (i.e. fintech) are more strongly felt, thereby adversely upsetting traditional financial intermediation structures ([Merton and Thakor, 2019](#)).

The location effect shows that firms operating in large cities experience lower financing constraints, confirming the baseline results. However, the size of the direct within-country location effect is lower relative to the baseline results, whilst it is stronger for the financial and technological controls relative to the geography and demographics controls. Where the direct location effect is significant, the results show larger discrepancy between richer and poorer developing countries, reaffirming the key role of economic development. More specifically, credit expansion improves firms' access to external finance, except for poor countries, but current account openness and forex liberalization do not appear to benefit firms. Income inequality appears to affect adversely firms' access to external finance only in richer developing countries. Further, technology transfer associated with foreign direct investment facilitates access to external finance. However, better firm absorption of technology and higher quality of the educational system do not appear to improve firms' access to finance, especially in poor countries. This implies that absorptive capacity and education may be beneficial to firms only after they reach a certain level of absorption capacity. Finally, geography and demographics appear to be insignificant factors, except for distance and agglomeration. Lower distance is broadly associated with better firms' access to external finance, but only in richer developing countries. The rather chaotic transportation and communication conditions in many large cities in the developing world do not facilitate firms' access to external finance. In addition, the level of agglomeration appears important mainly in richer developing countries. Transport, environmental and other synergies in those countries are stronger and the concentration of financial activity is stronger, thereby facilitating the knowledge effect on firms' access to external finance. These findings appear to be only partly in line with those of [Wójcik \(2016\)](#) and [Martin \(2011\)](#). Overall, country-level factors reflecting the degree of financial openness and development, the quality and absorption of education and technology as well as geographical and demographic conditions appear to influence the knowledge effect on firms' access to external finance. However, the size and sometimes the direction of the knowledge effect vary in accordance with the different institutions and income levels, highlighting a divergent experience between developed and developing countries.

7. Conclusions

The knowledge economy stands as a crucial global phenomenon and a significant predictor of external finance accessibility for firms. It plays an essential role in meeting the varied

requirements – such as reputation, information and collateral – of firms seeking external financial support. Additionally, it fosters the development of cognitive skills among entrepreneurs, essential for navigating financing alternatives and influences the structure of financial intermediation. It is noteworthy that the impact of the knowledge economy extends spatially, affecting the horizontal and vertical diffusion of knowledge to decision-makers in diverse ways.

By leveraging firm-level survey data, this study examines the predictive power of a country's knowledge economy index concerning financing constraints across 106 developing nations. A distinctive aspect of the analysis is its consideration of both within-country and cross-regional knowledge effects. Several firm-specific characteristics are used to control for the knowledge effect across and within countries, capturing unique aspects of corporate organization.

The findings reveal that the knowledge economy index robustly predicts firms' external finance access in developing countries, with higher levels of the knowledge economy linked to lower financing constraints. The impact varies within-country locations and across geographical regions, underscoring the spatial nature of the knowledge economy effect. Notably, firms in major cities and specific regions experience the most significant benefits when seeking external finance, while those in smaller cities, rural areas and regions marked by structural and institutional inefficiencies gain the least.

Furthermore, the study demonstrates that specific firm characteristics play a significant role in determining financing constraints and influencing the knowledge economy effect. In addition, country-level factors, such as the level of financial development and openness, the absorptive capacity for education and technology by firms and the agglomeration conditions within each country all contribute to shaping the knowledge effect on external finance access. The results also highlight considerable differences in both the knowledge and regional effects between wealthier and poorer developing countries, emphasizing the relevance of economic development, particularly in larger countries with greater opportunities.

In conclusion, policy decisions aimed at enhancing firms' access to external finance would benefit from considering a country's knowledge economy conditions and the implications of knowledge diffusion within and across borders. Future analyses should examine in more depth the understanding of the channels through which knowledge effects diffuse, accounting for variations in technological progress pace and the supportive role of institutional conditions across countries.

References

- Acs, Z., Erkkö, A. and Szerb, L. (2014), "National systems of entrepreneurship: measurement issues and policy implications", *Research Policy*, Vol. 43 No. 8, pp. 476-494, doi: [10.1016/j.respol.2013.08.016](https://doi.org/10.1016/j.respol.2013.08.016).
- Adams, P., Fontana, R. and Malerba, F. (2016), "User-industry spin-outs: downstream knowledge as a source of entry and survival", *Organization Science*, Vol. 27 No. 1, pp. 18-35, doi: [10.1287/orsc.2015.1029](https://doi.org/10.1287/orsc.2015.1029).
- Adian, I., Doumbia, D., Gregory, N., Ragoussis, A., Reddy, A. and Timmis, J. (2020), *Small and Medium Enterprises in the Pandemic: Impact, Responses, and the Role of Development Finance*, The World Bank, Washington, DC.
- Agarwal, R. and Shah, S. (2014), "Knowledge sources of entrepreneurship: firm formation by academic, user and employee innovators", *Research Policy*, Vol. 43 No. 7, pp. 1109-1133, doi: [10.1016/j.respol.2014.04.012](https://doi.org/10.1016/j.respol.2014.04.012).
- Agénor, P.R. and Canuto, O. (2017), "Access to finance, product innovation and middle-income traps", *Research in Economics*, Vol. 71 No. 2, pp. 337-355, doi: [10.1016/j.rie.2017.03.004](https://doi.org/10.1016/j.rie.2017.03.004).
- Aghion, P., Jones, B.F. and Jones, C.I. (2017), "Artificial intelligence and economic growth", NBER Working Paper No. 23928.

-
- Aghion, P. and Jaravel, X. (2015), "Knowledge spillovers, innovation and growth", *The Economic Journal*, Vol. 125 No. 583, pp. 533-573, doi: [10.1111/econ.12199](https://doi.org/10.1111/econ.12199).
- Aldrich, H. and Yang, T.T. (2014), "How do entrepreneurs know what to do? Learning and organizing new ventures", *Journal of Evolutionary Economics*, Vol. 24 No. 1, pp. 59-82, doi: [10.1007/s00191-013-0320-x](https://doi.org/10.1007/s00191-013-0320-x).
- Almeida, H., Campello, M., Weisbach, M.S. (2021), "The cash flow sensitivity of cash: replication, extension, and robustness", SSRN: <https://ssrn.com/abstract=3773591>, doi: [10.2139/ssrn.3773591](https://doi.org/10.2139/ssrn.3773591).
- Alonso, A.D., Kok, S., Sakellarios, N. and O'Brien, S. (2019), "Micro enterprises, self-efficacy and knowledge acquisition: evidence from Greece and Spain", *Journal of Knowledge Management*, Vol. 23 No. 3, pp. 419-438, doi: [10.1108/jkm-02-2018-0118](https://doi.org/10.1108/jkm-02-2018-0118).
- Alsebai, M.M., Liu, P. and Nie, G. (2022), "Do knowledge economy indicators affect economic growth? Evidence from developing countries", *Sustainability*, Vol. 14 No. 8, p. 4774, doi: [10.3390/su14084774](https://doi.org/10.3390/su14084774).
- Alvarez, S.A., Barney, J.B. and Anderson, P. (2013), "Forming and exploiting opportunities: the implications of discovery and creation processes for entrepreneurial and organizational research", *Organization Science*, Vol. 24 No. 1, pp. 301-317.
- Antonelli, C. and Colombelli, A. (2017), "The locus of knowledge externalities and the cost of knowledge", *Regional Studies*, Vol. 51 No. 8, pp. 1151-1164, doi: [10.1080/00343404.2017.1331294](https://doi.org/10.1080/00343404.2017.1331294).
- Antonelli, C. and David, P.A. (2016), *The Economics of Knowledge and Knowledge-Driven Economy*, Routledge, London.
- Appleyard, L. (2013), "The geographies of access to Enterprise finance: the case of the west midlands, UK", *Regional Studies*, Vol. 47 No. 6, pp. 868-879, doi: [10.1080/00343404.2012.748979](https://doi.org/10.1080/00343404.2012.748979).
- Atkinson, A., McKay, S., Collard, S. and Kempson, E. (2007), "Levels of financial capability in the UK", *Public Money and Management*, Vol. 27 No. 1, pp. 29-36, doi: [10.1111/j.1467-9302.2007.00552.x](https://doi.org/10.1111/j.1467-9302.2007.00552.x).
- Autio, E., Acs, Z. and Szerb, L. (2014), "Entrepreneurial innovation: the importance of context", *Research Policy*, Vol. 43 No. 7, pp. 1097-1108, doi: [10.1016/j.respol.2014.01.015](https://doi.org/10.1016/j.respol.2014.01.015).
- Ayyagari, M., Beck, T. and Hoseini, M. (2016), "Access to finance and job growth, firm-level evidence across developing countries", Policy Research Working Paper No. WPS 7604, World Bank Group, Washington, DC.
- Ayyagari, M., Demirguc-Kunt, A. and Maksimovic, V. (2008), "How important are financing constraints? The role of finance in the business environment", *World Bank Economic Review*, Vol. 22 No. 3, pp. 483-516, doi: [10.1093/wber/lnh018](https://doi.org/10.1093/wber/lnh018).
- Baldwin, R.E. and Martin, P. (2003), "Agglomeration and regional growth", Discussion Paper No 3960 CEPR, London.
- Berger, A.N. and Udell, G.F. (2002), "Small business credit availability and relationship lending. The importance of bank organizational structure", *Economic Journal*, Vol. 112, pp. F32-F35.
- Berger, A.N. and Udell, G.F. (2006), "A more complete conceptual framework for SME finance", *Journal of Banking and Finance*, Vol. 30 No. 11, pp. 2945-2966, doi: [10.1016/j.jbankfin.2006.05.008](https://doi.org/10.1016/j.jbankfin.2006.05.008).
- Bertoni, F., Croce, A. and Guerini, M. (2015), "Venture capital and the investment curve of young high-tech companies", *Journal of Corporate Finance*, Vol. 35, pp. 159-176.
- Bizri, O. (2018), *Science, Technology, Innovation and Development in the Arab Countries*, Elsevier, doi: [10.1016/C2016-0-01541-3](https://doi.org/10.1016/C2016-0-01541-3).
- Broome, T., Moore, W. and Alleyne, P. (2018), "Financing constraints and the R&D decision in the Caribbean", *Entrepreneurship and Regional Development*, Vol. 30 No. 9, pp. 964-986, doi: [10.1080/08985626.2018.1515820](https://doi.org/10.1080/08985626.2018.1515820).
- Buntz, B. (2017), "Seven smart city strategies from cities across the world", available at: <http://www.ioti.com/smart-cities/7-smart-city-strategies-cities-across-world>, October 5th.

-
- Caniels, M.C.J. and Verspagen, B. (2001), "Barriers to knowledge spillovers and regional convergence in an evolutionary model", *Journal of Evolutionary Economics*, Vol. 11 No. 3, pp. 307-329, doi: [10.1007/s001910100085](https://doi.org/10.1007/s001910100085).
- Carlsson, Bo, Braunerhjelm, P., McKelvey, M., Olofsson, C., Persson, L. and Ylinenpää, H. (2013), "The evolving domain of entrepreneurship research", *Small Business Economics*, Vol. 41, pp. 913-930.
- Castells-Quintana, D. (2017), "Malthus living in a slum: urban concentration, infrastructure, and economic growth", *Journal of Urban Economics*, Vol. 98, pp. 158-173.
- Chaudhary, S. (2019), "Knowledge stock and absorptive capacity of small firms: the moderating role of formalization", *Journal of Strategy and Management*, Vol. 12 No. 2, pp. 189-207, doi: [10.1108/jsma-09-2018-0100](https://doi.org/10.1108/jsma-09-2018-0100).
- Chen, D.H.C. and Dahlman, C.J. (2005), "The knowledge economy, the KAM methodology and World Bank operations", World Bank Institute, November, Working Paper 37256.
- Chinn, M.D. and Ito, H. (2006), "What matters for financial development? Capital controls, institutions, and interactions", *Journal of Development Economics*, Vol. 81 No. 1, pp. 163-192.
- Clarkson, G., Jacobsen, T.E. and Batcheller, A.L. (2007), "Information asymmetry and information sharing", *Government Information Quarterly*, Vol. 24 No. 4, pp. 827-839.
- Colombelli, A. and Quatraro, F. (2018), "New firm formation and regional knowledge production modes: italian evidence", *Research Policy*, Vol. 47 No. 1, pp. 139-157, doi: [10.1016/j.respol.2017.10.006](https://doi.org/10.1016/j.respol.2017.10.006).
- Cong, W.L. and He, Z. (2019), "Blockchain disruption and smart contracts", *Review of Financial Studies*, Vol. 32 No. 5, pp. 1754-1797, doi: [10.1093/rfs/hhz007](https://doi.org/10.1093/rfs/hhz007).
- D'Acunto, F., Malmendier, U. and Weber, M. (2019), "IQ, expectations, and choice", NBER Working Paper Series No. 25496, National Bureau of Economic Research.
- Dahlan, C. (2007), "The challenge of the knowledge economy for Latin America", *Globalization, Competitiveness and Governability Journal*, Vol. 1 No. 1, pp. 18-46.
- Degelsegger-Márquez, A., Remøe, S.O. and Trienes, R. (2018), "Regional knowledge economies and global innovation networks - the case of Southeast Asia", *Journal of Science and Technology Policy Management*, Vol. 9 No. 1, pp. 66-86.
- Degryse, H. and Ongena, S. (2005), "Distance, lending relationships, and competition", *The Journal of Finance*, Vol. 60 No. 1, pp. 231-266, doi: [10.1111/j.1540-6261.2005.00729.x](https://doi.org/10.1111/j.1540-6261.2005.00729.x).
- DeYoung, R., Frame, W.S. and Glennon, D. (2010), "The information revolution and small business lending, the missing evidence", Working Paper 2010-7, Federal Reserve Bank of Atlanta.
- Duranton, G. (2014), "Growing through cities in developing countries", *World Bank Research Observer*, Vol. 30 No. 1, pp. 39-73, doi: [10.1093/wbro/lku006](https://doi.org/10.1093/wbro/lku006).
- Durst, S., Ingi Runar, E. and Foli, S. (2023), "Knowledge management in SMEs: a follow-up literature review", *Journal of Knowledge Management*, Vol. 27 No. 11, pp. 25-58, doi: [10.1108/jkm-04-2022-0325](https://doi.org/10.1108/jkm-04-2022-0325).
- Eugster, J.L., Matsumoto, A. and Pescatori, A. (2018), "International knowledge spillovers", IMF Working Paper WP/18/269, International Monetary Fund.
- Faggian, A. and McCann, P. (2006), "Human capital flows and regional knowledge assets: a simultaneous equation approach", *Oxford Economic Papers*, Vol. 58 No. 3, pp. 475-500, doi: [10.1093/oxep/gpl010](https://doi.org/10.1093/oxep/gpl010).
- Falciola, J., Jansen, M. and Rollo, V. (2020), "Defining firm competitiveness: a multidimensional framework", *World Development*, Vol. 129, 104857, doi: [10.1016/j.worlddev.2019.104857](https://doi.org/10.1016/j.worlddev.2019.104857).
- Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D. and Sunde, U. (2018), "Global evidence on economic preferences", *Quarterly Journal of Economics*, Vol. 133 No. 4, pp. 1645-1692.
- Farooq, O., Satt, H. and El Fadel, B. (2021), "Political uncertainty and the choice of external audit: international evidence from private firms", *International Journal of Managerial Finance*, Vol. 17 No. 4, pp. 568-588, doi: [10.1108/IJMF-07-2020-0384](https://doi.org/10.1108/IJMF-07-2020-0384).

-
- Farooq, O., Jabbouri, I. and Naili, M. (2023), "The nexus between economic policy uncertainty and access to finance: a study of developing countries", *International Journal of Managerial Finance*, Vol. 20 No. 1, pp. 222-246, Vol. ahead-of-print No. ahead-of-print, doi: [10.1108/IJMF-11-2022-0507](https://doi.org/10.1108/IJMF-11-2022-0507).
- Fischer, B., Salles-Filho, S., Zeitoum, C. and Colugnati, F. (2021), "Performance drivers in knowledge-intensive entrepreneurial firms: a multidimensional perspective", *Journal of Knowledge Management*, Vol. 26 No. 5, pp. 1342-1367, doi: [10.1108/jkm-03-2021-0264](https://doi.org/10.1108/jkm-03-2021-0264).
- Garretsen, H., Kitson, M. and Martin, R. (2009), "Editorial: spatial circuits of global finance", *Cambridge Journal of Regions, Economy and Society*, Vol. 2, pp. 143-148, doi: [10.1093/cjres/rsp019](https://doi.org/10.1093/cjres/rsp019).
- Gilbert, R.A. and Wheelock, A.C. (2013), *Big Banks in Small Places. Are Community Banks Being Driven Out of Rural Markets?*, Federal Reserve Bank of St. Louis Review, May/June, pp. 199-218.
- Gomes-Casseres, B., Hagedoorn, J. and Jaff, A.B. (2006), "Do alliances promote knowledge flows?", *Journal of Financial Economics*, Vol. 80 No. 1, pp. 5-33, doi: [10.1016/j.jfineco.2004.08.011](https://doi.org/10.1016/j.jfineco.2004.08.011).
- Greene, W.H. (2012), *Econometric Analysis*, 7th ed., Pearson, New York.
- Hall, B.H. (2010), "The financing of innovative firms", *Review of Economics and Institutions*, Vol. 1 No. 1, pp. 1-30, doi: [10.5202/rei.v1i1.4](https://doi.org/10.5202/rei.v1i1.4).
- Hallen, B.L. (2008), "The causes and consequences of the initial network positions of new organizations, from whom do entrepreneurs receive investments?", *Administrative Science Quarterly*, Vol. 53 No. 4, pp. 685-718, doi: [10.2189/asqu.53.4.685](https://doi.org/10.2189/asqu.53.4.685).
- Hsu, D.H. (2007), "Experienced entrepreneurial founders, organizational capital, and venture capital funding", *Research Policy*, Vol. 36 No. 5, pp. 722-741, doi: [10.1016/j.respol.2007.02.022](https://doi.org/10.1016/j.respol.2007.02.022).
- Hurst, E. and Lusardi, A. (2004), "Liquidity constraints, household wealth, and entrepreneurship", *Journal of Political Economy*, Vol. 112 No. 2, pp. 319-347, doi: [10.1086/381478](https://doi.org/10.1086/381478).
- Igwe, P.A., Amaugo, A.N., Ogundana, O.M., Egere, O.M. and Anigbo, J.A. (2019), "Factors affecting the investment climate, SMEs productivity and entrepreneurship in Nigeria", *European Journal of Sustainable Development*, Vol. 7 No. 1, pp. 182-200, doi: [10.14207/ejsd.2018.v7n1p182](https://doi.org/10.14207/ejsd.2018.v7n1p182).
- Jabbouri, I. and Farooq, O. (2021), "Inadequately educated workforce and financing obstacles: international evidence from SMEs in developing countries", *International Journal of Managerial Finance*, Vol. 17 No. 1, pp. 118-137, doi: [10.1108/IJMF-01-2020-0002](https://doi.org/10.1108/IJMF-01-2020-0002).
- Johansson, B. (2021), "Generation and diffusion of innovation", in Fischer, M.M. and Peter, N. (Eds), *Handbook of Regional Science*, Springer..
- Karlan, D. and Morduch, J. (2010), "Access to finance: a survey", in Rodrik, D. and Rosenzweig, M. (Eds), *Handbook of Development Economics*, North Holland, Vol. 5 No. 2.
- Keilbach, M. (2000), *Spatial Knowledge Spillovers and the Dynamics of Agglomeration and Regional Growth*, Springer, New York.
- Klepper, S. (2015), *Experimental Capitalism: the Nanoeconomics of American High-Tech Industries*, Princeton University Press, Princeton.
- Korinek, A. and Stiglitz, J.E. (2017), "Artificial intelligence and its implications for income distribution and unemployment", NBER Working Paper No 24174.
- Krugman, P. (1998), "Space: the final frontier", *Journal of Economic Perspectives*, Vol. 12 No. 2, pp. 161-174, doi: [10.1257/jep.12.2.161](https://doi.org/10.1257/jep.12.2.161).
- Kurz, H.D. (2012), "Schumpeter's new combinations: revisiting his Theorie der wirtschaftlichen Entwicklung on the occasion of its centenary", *Journal of Evolutionary Economics*, Vol. 22 No. 5, pp. 871-899, doi: [10.1007/s00191-012-0295-z](https://doi.org/10.1007/s00191-012-0295-z).
- Lane, P.J., Koka, B.R. and Suresh, P. (2006), "The reification of absorptive capacity. A critical review and rejuvenation of the construct", *Academy of Management Review*, Vol. 31 No. 4, pp. 833-863, doi: [10.5465/amr.2006.22527456](https://doi.org/10.5465/amr.2006.22527456).

- Lee, N. and Brown, R. (2017), "Innovation, SMEs and the liability of distance, the demand and supply of bank funding in UK peripheral regions", *Journal of Economic Geography*, Vol. 17 No. 1, pp. 233-260, doi: [10.1093/jeg/lbw011](https://doi.org/10.1093/jeg/lbw011).
- Lee, N. and Luca, D. (2019), "The big-city bias in access to finance: evidence from firm perceptions in almost 100 countries", *Journal of Economic Geography*, Vol. 19 No. 1, pp. 199-224, doi: [10.1093/jeg/lbx047](https://doi.org/10.1093/jeg/lbx047).
- Lee, C.-C., Wang, W. and Ho, S.J. (2020), "Country governance, corruption, and the likelihood of firms' innovation", *Economic Modelling*, Vol. 92, pp. 326-338, doi: [10.1016/j.econmod.2020.01.013](https://doi.org/10.1016/j.econmod.2020.01.013).
- Levine, R. (2005), "Finance and growth, theory and evidence", in Aghion, P. and Durlauf, S. (Eds), *Handbook of Economic Growth, 1A*, North Holland, Amsterdam.
- Liang, L., Lin, S. and Yu, Li (2014), "How agglomeration in the financial services industry influences economic growth: evidence from Chinese Cities", Economics Discussion Paper No 6.
- Liberti, J.M. and Mian, A.R. (2009), "Estimating the effect of hierarchies on information use", *Review of Financial Studies*, Vol. 22 No. 10, pp. 4057-4090, doi: [10.1093/rfs/hhn118](https://doi.org/10.1093/rfs/hhn118).
- Lin, C.-An and Bates, T.C. (2022), "Smart people know how the economy works: cognitive ability, economic knowledge and financial literacy", *Intelligence*, Vol. 93, 101667, doi: [10.1016/j.intell.2022.101667](https://doi.org/10.1016/j.intell.2022.101667).
- Lorentzen, A. (2008), *Knowledge Networks in Local and Global Space*, Entrepreneurship & Regional Development, Vol. 20, pp. 533-545.
- Lowik, S., van Rossum, D., Kraaijenbrink, J. and Groen, A. (2012), "Strong ties as sources of new knowledge: how small firms innovate through bridging capabilities", *Journal of Small Business Management*, Vol. 50 No. 2, pp. 239-256, doi: [10.1111/j.1540-627x.2012.00352.x](https://doi.org/10.1111/j.1540-627x.2012.00352.x).
- Luo, X.R., Koput, K.W. and Powell, W.W. (2009), "Intellectual capital or signal? The effects of scientists on alliance formation in knowledge-intensive industries", *Research Policy*, Vol. 38 No. 8, pp. 1313-1325, doi: [10.1016/j.respol.2009.06.001](https://doi.org/10.1016/j.respol.2009.06.001).
- Lynn, R. and Becker, D. (2019), *The Intelligence of Nations*, Ulster Institute for Social Research, Ulster.
- Martin, R. (2011), "The local geographies of the financial crisis, from the housing bubble to economic recession and beyond", *Journal of Economic Geography*, Vol. 11 No. 4, pp. 587-618, doi: [10.1093/jeg/lbq024](https://doi.org/10.1093/jeg/lbq024).
- Masiak, C., Block, J.H., Moritz, A., Lang, F. and Kraemer-Eis, H. (2019), "How do micro firms differ in their financing patterns from larger SMEs?", *Venture Capital*, Vol. 21 No. 4, pp. 301-325.
- Mason, C. (2010), "External finance in a regional economy", *Venture Capital. An International Journal of External Finance*, Vol. 12 No. 3, pp. 167-172, doi: [10.1080/13691066.2010.507033](https://doi.org/10.1080/13691066.2010.507033).
- Merluzzi, J. and David Phillips, J. (2016), "The specialist discount, Negative returns for MBAs with focused profiles in investment banking", *Administrative Science Quarterly*, Vol. 61 No. 1, pp. 87-124, doi: [10.1177/0001839215610365](https://doi.org/10.1177/0001839215610365).
- Merton, R. and Thakor, R. (2019), "Customers and investors, a framework for understanding the evolution of financial institutions", *Journal of Financial Intermediation*, Vol. 39, pp. 4-18, doi: [10.1016/j.jfi.2018.06.002](https://doi.org/10.1016/j.jfi.2018.06.002).
- Mertzanis, C. (2017), "The absorption of financial services in an Islamic environment", *Journal of Economic Behavior and Organization*, Vol. 132, pp. 216-236, doi: [10.1016/j.jebo.2016.10.025](https://doi.org/10.1016/j.jebo.2016.10.025).
- Mertzanis, C. (2019a), "Family ties, institutions and firms' financing constraints", *Journal of Banking and Finance*, Vol. 108, 105650, doi: [10.1016/j.jbankfin.2019.105650](https://doi.org/10.1016/j.jbankfin.2019.105650).
- Mertzanis, C. (2019b), "Financialization, institutions and firms' financing constraints in developing countries", *Cambridge Journal of Economics*, Vol. 43 No. 4, pp. 825-866, doi: [10.1093/cje/bez015](https://doi.org/10.1093/cje/bez015).
- Mertzanis, C. (2020), "Financial supervision, decentralized decision-making and financing constraints of firms", *Journal of Economic Behavior and Organization*, Vol. 174, pp. 13-37, doi: [10.1016/j.jebo.2020.03.004](https://doi.org/10.1016/j.jebo.2020.03.004).

-
- Mina, A., Lahr, H. and Hughes, A. (2013), "The demand and supply of external finance for innovative firms", *Industrial and Corporate Change*, Vol. 22 No. 4, pp. 869-901, doi: [10.1093/icc/dtt020](https://doi.org/10.1093/icc/dtt020).
- Moulton, B.R. (1990), "An illustration of a pitfall in estimating the effects of aggregate variables on micro units", *The Review of Economics and Statistics*, Vol. 72 No. 2, pp. 334-338.
- Nogueira, M., Crocco, M., Figueiredo, A.T. and Diniz, G. (2015), "Financial hierarchy and banking strategies, a regional analysis for the Brazilian case", *Cambridge Journal of Economics*, Vol. 39, pp. 139-156.
- Pagano, U. and Rossi, M.A. (2009), "The crash of the knowledge economy", *Cambridge Journal of Economics*, Vol. 33 No. 4, pp. 665-683, doi: [10.1093/cje/bep033](https://doi.org/10.1093/cje/bep033).
- Philippon, T. (2018), *The FinTech Opportunity*, Mimeo, New York University, March.
- Ponds, R., Oort, Fv and Frenken, K. (2010), "Innovation, spillovers and university-industry collaboration: an extended knowledge production function approach", *Journal of Economic Geography*, Vol. 10 No. 2, pp. 231-255.
- Prakash, P. (2020), "Rural small businesses earn better profits and more financing vs. City ones", June 25th, available at: <https://www.fundera.com/blog/rural-vs-urban-business-financing>.
- Pucher, J., Martinos, H. and Schausberger, W. (2016), "Obstacles to investments at local and regional level", Report QG-02-16-984-EN-N, European Union Committee of the Regions.
- Roodman, D. (2011), "Fitting fully observed recursive mixed-process models with cmp", *The Stata Journal*, Vol. 11 No. 2, pp. 159-206.
- Schumpeter, J.A. (1942), *Capitalism, Socialism and Democracy*, Harper & Row.
- Shabani, Z.D., Akbari, N. and Dalali Esfahani, R. (2011), "Effect of population density, division and distance on regional economic growth", *Iranian Economic Review*, Vol. 16 No. 31, pp. 101-121.
- Shapira, P., Youtie, J., Yogevaran, K. and Jaafar, Z. (2006), "Knowledge economy measurement methods, results and insights from Malaysian Knowledge Content Study", *Research Policy*, Vol. 35, pp. 1522-1537.
- Shleifer, A. (2019), "The return of survey expectations. NBER reporter 1", available at: <https://www.nber.org/reporter/2019number1/return-survey-expectations>.
- Stehr, N. and Mast, J.L. (2012), "Knowledge economy", in Rooney, D., Hearn, G. and Ninan, A. (Eds), *Handbook on the Knowledge Economy*, Edward Elgar, Vol. 2.
- The Institute of International Education (IIE) (2019), *Latin America's New Knowledge Economy*, IIE.
- The Organization of Economic Cooperation and Development (OECD) (2014), *The Competitiveness of Global Port-Cities*, OECD Publishing, Paris.
- The World Bank (2012), *Knowledge for Development K4D Knowledge Assessment Methodology*, World Bank Publications, Washington, DC, November.
- The World Bank (2022), *The Global Findex Database*, Washington, DC, available at: <https://www.worldbank.org/en/publication/globalfindex/Data>.
- Uchida, H. (2011), "What do banks evaluate when they screen borrowers? Soft information, hard information and collateral", *Journal of Financial Services Research*, Vol. 40 Nos 1-2, pp. 29-48, doi: [10.1007/s10693-010-0100-9](https://doi.org/10.1007/s10693-010-0100-9).
- Uchida, H. and Nelson, A. (2010), "Agglomeration index. Towards a new measure of urban concentration", Working Paper No 29/2010, World Institute for Development, 978-92-9230-264-1.
- Wójcik, D. (2016), "Financial center bias in primary equity markets", *Cambridge Journal of Regions, Economy and Society*, Vol. 2, pp. 193-209, doi: [10.1093/cjres/rsp008](https://doi.org/10.1093/cjres/rsp008).
- Wooldridge, J. (2010), *Econometric Analysis of Cross-Section and Panel Data*, MIT Press, Boston.
- Xiao, Li (2011), "Financing high-tech SMEs in China: a three-stage model of business development", *Entrepreneurship and Regional Development*, Vol. 23 Nos 3/4, pp. 217-234, doi: [10.1080/08985620903233937](https://doi.org/10.1080/08985620903233937).

Zhao, T. and Jones-Evans, D. (2017), "SMEs, banks and the spatial differentiation of access to finance", *Journal of Economic Geography*, Vol. 17, pp. 791-824.

Zheng, J. (2022), "Innovation concentration in knowledge network", *PLoS ONE*, Vol. 17 No. 4, e0266530, doi: [10.1371/journal.pone.0266530](https://doi.org/10.1371/journal.pone.0266530).

Further reading

Alvarez, S. and Barney, J. (2007), "Discovery and creation: alternative theories of entrepreneurial action", *Strategic Entrepreneurship Journal*, Vol. 1 No. 1, pp. 11-26, doi: [10.1002/sej.4](https://doi.org/10.1002/sej.4).

Cassiman, B. and Veugelers, R. (2002), "R&D cooperation and spillovers, some empirical evidence from Belgium", *American Economic Review*, Vol. 92 No. 4, pp. 1169-1184, doi: [10.1257/00028280260344704](https://doi.org/10.1257/00028280260344704).

Delavande, A., Rohwedder, S. and Willis, R. (2008), "Preparation for retirement, financial knowledge and cognitive resources", *MRRC Working Paper Series 190*.

Englmann, F.C. and Uwe, W. (1995), "Industrial centers and regional growth in the presence of local inputs", *Journal of Regional Science*, Vol. 35 No. 1, pp. 3-27, doi: [10.1111/j.1467-9787.1995.tb01397.x](https://doi.org/10.1111/j.1467-9787.1995.tb01397.x).

Fosfuri, A. and Ronde, T. (2004), "High-tech clusters, technology spillovers and trade secret laws", *International Journal of Industrial Organization*, Vol. 22 No. 1, pp. 45-65, doi: [10.1016/s0167-7187\(03\)00123-1](https://doi.org/10.1016/s0167-7187(03)00123-1).

Khayyat, N.T. and Lee, J.-D. (2012), "A new index measure of technological capabilities for developing countries", TEMEP Discussion Paper No 91, Seoul National University.

Martin, R. (1999), *Money and the Space Economy*, Wiley & Sons.

Nardo, M., Saisana, M., Saltelli, A. and Tarantola, S. (2005), "Handbook on constructing composite indicators. Methodology and user guide", OECD Statistics Working Papers, OECD Publishing.

Stock, J.H. and Motohiro, Y. (2005), "Testing for weak instruments in linear IV regression", in Stock, J.H. and Andrews, D.W.K. (Eds), *Identification and Inference for Econometric Models, Essays in Honor of Thomas J Rothenberg*, Cambridge University Press.

The World Economic Forum (2010), *Global Competitiveness Report*, The World Economic Forum, Geneva.

Variable	Description and source
ACCESS	An ordinal variable, from the World Bank's Enterprise Surveys, which assumes the value of 0 if a firm experiences no financing obstacle, 1 for minor obstacle, 2 for moderate obstacle, 3 for major obstacle and 4 for severe obstacle
KEI	The index of an economy-wide measure of the knowledge economy, ranging from 0 to 10, with higher values implying stronger knowledge economy, from the World Bank's Development Indicators
LOCATION	An ordinal variable, from the World Bank's Enterprise Surveys, which assumes the value of 1 if a firm is in the capital city, 2 in a city of more than one million people, 3 in a city between ¼ and one million, 4 in a city between 0.05 and ¼ of a million and 5 in a city less than 1/20 million
AGE	The logarithm of the number of years since the firm was first established, from the World Bank's Enterprise Surveys
SIZE	An ordinal variable, from the World Bank's Enterprise Surveys, which assumes the value of 1 if the firm is small (5–19 employees), 2 if it is medium (20–99 employees) and 3 if it is large (over 99 employees)
LEGAL	A binary variable, from the World Bank's Enterprise Surveys, which assumes the value of 1 if the firm is a joint-stock company and 0 otherwise
AUDIT	A binary variable, from the World Bank's Enterprise Surveys, which assumes the value of 1 if the firm's annual financial reports were reviewed by external auditor last year, and the value of 0 otherwise
EXPORT	The percent (%) of total corporate sales value that is exported directly, from the World Bank's Enterprise Surveys
OWNF	The percent (%) of total corporate equity capital that is owned by the overseas shareholders, from the World Bank's Enterprise Surveys
OWNG	The percent (%) of total corporate equity capital that is owned by the domestic state, from the World Bank's Enterprise Surveys
CRISIS	Dummy variable that takes the value of 1 during the 2007–2009 years and 0 otherwise. The variable captures the effect of the global financial crisis
CREDIT	The logarithm of the total amount of credit to the domestic private sector (% GDP), from the World Development Indicators. It generally measures financial development
FINOPEN	The Chinn-Ito index measures a country's degree of capital account openness, from Chinn and Ito (2006) (annually updated). This index takes on negative and positive values. Higher values imply fewer restrictions on cross-border financial transactions
GINI	The Gini coefficient, from the World Development Indicators, supplemented by UNDP information. It generally measures income inequality
QUALEDUC	The index of the education system quality, from the Global Competitiveness Report's Executive Opinion Survey. It ranges from 0 to 7 (best) and reflects the achievement of the education system, based on education results (e.g. PISA tests, etc.)
FDITECTR	The index of foreign direct investment and technology transfer, from the Global Competitiveness Report. It ranges from 1 to 7 (best) and measures the extent to which foreign direct investment brings new technology into the country
TECABSR	The index of the firm's absorptive capacity, from the Global Competitiveness Report, Executive Opinions Survey. It ranges from 0 to 7 (best) and reflects the extent to which business adopt new technology in their operation
POPDENS	The logarithm of the number of people per km ² , from the World Bank's World Development Indicators
DISTANCE	The average national distance to capital city (Kms), from the World Development Indicators. It measures the ease or difficulty for capital, labor, goods, services, information and ideas, to traverse through space
AGGLOMER	The index of agglomeration, from Uchida and Nelson (2010) , based on UN primary data and using a threshold of 100,000 or more for largest city size

Table A1.
(continued) Definition of variables

Variable	Description and source
POP75	The percent (%) of total population, living at less than 75 Kms from the coastline, from the World Development Indicators
INTERNET	The percent (%) of population using the Internet, from the World Development Indicators
IQ	The index of average IQ scores per country, from Lynn and Becker (2019) . It measures the degree of a country's average cognitive ability, as an aggregated value of individuals' cognitive tests. The variable is used an external instrument in the IV analysis
Table A1.	Source(s): Authors' calculation

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