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Micro-Businesses in Ireland: From Ambition to Innovation

Cork University Business School

Micro-Businesses in Ireland:

From Ambition to Innovation

April 2019

Dr. Jane Bourke and Prof. Stephen Roper

Dr. Jane Bourke is a Senior Lecturer in Economics at University College Cork. Her research interests include Innovation, Technology Adoption, Business Performance, and Health Economics. Jane is a co-investigator and senior researcher at the Enterprise Research Centre. She is a founding member and theme leader (Innovation Systems) at the Spatial and Regional Economics Research Centre at UCC. Jane has published her work in internationally recognised peer-reviewed journals such as Research Policy, Technovation, and International Journal of Innovation Management.

Professor Stephen Roper is Director of the Enterprise Research Centre and Professor of Enterprise at Warwick Business School (WBS). His research interests include innovation, enterprise growth and development, regional development, and industrial policy evaluation. Stephen has led over 50 externally funded research projects, ran his own consultancy company for some years, and works regularly with OECD on consultancy assignments relating to small business policy and evaluation. He has also consulted for a range of other private sector and policy organisations.

SRERC Spatial & Regional Economics Research Centre

ERC Enterprise Research Centre

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ABOUT THIS REPORT

This report represents a collaboration between University College Cork and the UK Enterprise Research Centre. Views in the report are those of the authors alone and do not necessarily reflect those of the sponsoring organisations.

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The Spatial and Regional Economics Research Centre (SRERC) was launched in 2018 and arises from the extensive experience and research expertise in regional science developed by a cluster of staff in the Department of Economics, University College Cork. The Centre operates on the philosophy of research excellence and policy relevance. The Centre focuses on three central themes: Spatial Economic Analysis; Innovation Systems; and Urban and Regional Economics. Members of the SRERC have been engaged in consultancy and research funded by the European Commission, Environmental Planning Agency, the UK Economic and Social Research Council, Science Foundation Ireland, the Irish Research Council, Forfás, Enterprise Ireland, Irish Regional Assemblies and and city and county councils, among others.

ENTERPRISE RESEARCH CENTRE

The Enterprise Research Centre is an independent research centre which focusses on SME growth and productivity. ERC is a partnership between Warwick Business School, Aston Business School, Queen's University School of Management, Leeds University Business School and University College Cork. The Centre is funded by the Economic and Social Research Council (ESRC); Department for Business, Energy & Industrial Strategy (BEIS); Innovate UK, the British Business Bank and the UK Intellectual Property Office.

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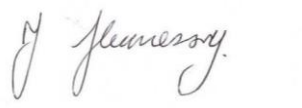
FOREWORD

I am delighted to introduce this important report, conducted by my colleagues in Cork University Business School in collaboration with the Enterprise Research Centre in the UK. This report presents new information on the ambitions, growth aspirations and innovation levels of Irish micro-businesses.

Micro businesses, typically businesses with 9 employees or less, play an important role in stimulating innovation, employment and growth. Despite this, relatively little is known about this important segment of the business population as such businesses are often excluded from official surveys. This report presents the findings of a survey conducted on micro-businesses in Ireland.

Ambition plays an important role in ensuring businesses achieve their full potential. The survey conducted during the course of this project reveals that one in four micro-businesses in Ireland want to build a national or international business. Within Ireland, micro-businesses in the West are amongst the most ambitious nationally. Interestingly, however, business and personal ambitions are broadly similar for male and female micro-businesses owners. For many people flexibility is a key personal motivator for running their own micro-business.

This report provides the first detailed information on the uptake of digital technologies by micro-businesses in Ireland. The results suggest that Irish micro-businesses perform well, adopting digital technology at a faster rate than their counterparts in the UK and particularly the USA. Micro-businesses in Ireland also compare well internationally with respect to introducing new or improved products and services. Finally, the report emphasises the importance that micro-businesses, due to their scale and access to technology, should not be left behind larger businesses in the global digital revolution.



Professor Thia Hennessy
Dean, Cork University Business School

Micro-business Ireland

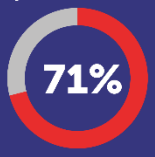
Ambition

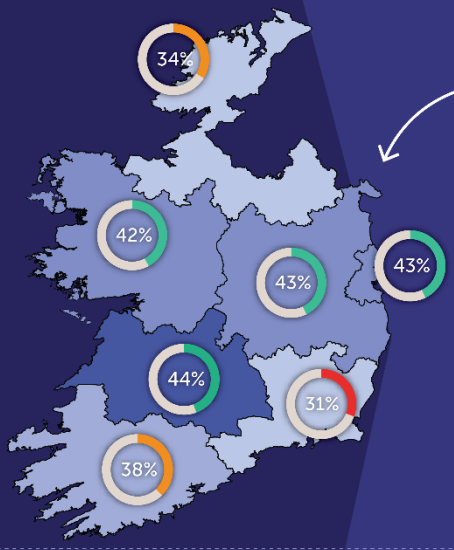
An ambitious minority of micro-businesses in Ireland want to build a national or international business. But over two-thirds emphasise the importance of keeping their business similar to how it operates now.

"Build a national or international business"



"Keep my business similar to how it operates now"





Innovation

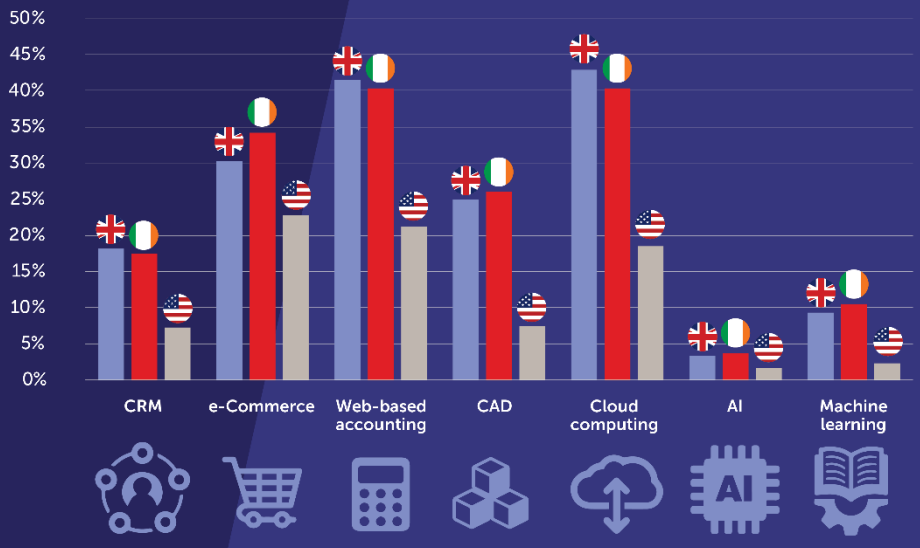
Levels of innovation in Irish micro-businesses are higher than those in the UK and USA.

40% of micro-businesses introduced a new product or service in the last three years.

Levels of innovation vary by region.

Uptake of Digital Technology

From a relatively low base in 2012, diffusion of digital technologies by micro-businesses in Ireland is strong and growing.



CORK UNIVERSITY BUSINESS SCHOOL

Source: Bourke, Roper, *Micro-businesses in Ireland: From Ambition to Innovation* (April 2019)

ERC Enterprise Research Centre

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EXECUTIVE SUMMARY

This report describes new and unique survey data on established micro-businesses with 1-9 employees in Ireland. The report focuses on the ambitions – business and personal- of the owners; as well as innovative activity and the uptake of digital technology within micro-businesses.

In Ireland, most micro-businesses are mature, and many are home-based. They are closely related to the families which own and run them.

A Story of Ambition – for the business, for the individual

- An ambitious 27 per cent of micro-business in Ireland want to build a national or international business, while 71 per cent of micro-businesses emphasise the importance of keeping their business similar to how it operates now.
- Over 80 per cent of micro-business owners report 'freedom to adapt my own approach to work' and 'greater flexibility for personal and family life' as key personal motivators.
- Micro-businesses in the West (Galway & Galway City, Mayo & Roscommon) are amongst the most ambitious in the country.
- Micro-businesses in the Border region (Cavan, Donegal, Leitrim, Monaghan, Sligo) reveal a low ambition profile.
- One-third of micro-businesses in Dublin consider growth to be an important ambition. However, micro-businesses based in Dublin are not markedly more ambitious than micro-businesses across the country.
- In the South-East (Carlow, Kilkenny, Wexford, Waterford & Waterford City), micro-business owners are more likely to emphasise personal rather than business ambitions.
- Profiles of ambition for male and female business owners are largely similar.

Innovation - new products, new services, new ways of doing things

- Levels of innovation in Irish micro-businesses in Ireland are higher than those in the UK and USA.
- 40 per cent of micro-businesses introduced a new or improved product or service in the three years prior to the survey.
- One in four micro-businesses introduced new business models or forms of organisation in the three years prior to the survey.
- The percentage of sales derived from innovative products and/or services is approximately 11 per cent.

Uptake of Digital Technology: Trends & Patterns

- From a relatively low base in 2012, diffusion of digital technologies by micro-businesses in Ireland is strong and growing.
- Uptake of digital technologies by micro-businesses in Ireland compares well with those in the UK and is considerably higher than those in the USA.
- The most popular digital technologies among micro-businesses in Ireland are Cloud Computing and Web-based Accounting Software, with 40 per cent of micro-firms using these technologies.
- 34 per cent of micro-businesses in Ireland are using E-Commerce, while 26 per cent and 17 per cent are using Computer-Aided Design (CAD) and Customer Relationship Management (CRM) respectively.
- There is little variation in the average number of technologies adopted by micro-businesses across the regions of Ireland.
- However, approximately one in four micro-businesses have not adopted any digital technology.

1. Introduction

In Ireland, micro-businesses with less than 10 employees comprise over 90 per cent of businesses.[i] These firms are critical to future productivity and job growth. However, we know little about micro-businesses as they are often excluded from national and international surveys.[ii] Using new survey data, this report describes this diverse segment of the SME population in Ireland, focusing on business and personal ambition, innovation and digital technology adoption.

There are a quarter of a million micro-businesses in Ireland, employing almost 400,000 people.[iii] These businesses play an important role in all of our lives. They are our plumbers, our builders, our hairdressers and our mechanics. They are also our architects, designers, artists, lawyers and accountants. Most micro-businesses start small and stay small. For other entrepreneurs their micro-business is the launchpad for scale-up. Or, at least, the test-bed for a new business idea or innovation.

The purpose of this survey-based project is to study the ambitions, growth aspirations and levels of innovation among established micro-businesses in Ireland, the UK, and the USA, and to help us understand what drives their growth and productivity.[iv] Data was collected from 1,500 micro-businesses over three years old in Ireland between January and March 2018, as well as 6,200 in the UK and 2000 in the US. Like all survey analyses, results have a small sampling error; therefore, responses are weighted to give representative results.

Section 2 briefly profiles micro-businesses in Ireland. Section 3 looks at the business and personal ambitions of micro-business owners in Ireland at national and regional levels, as well as looking at gender differences. Section 4 describes innovation metrics for micro-businesses in Ireland. Section 5 focuses on the uptake of digital technology by micro-businesses in Ireland.

2. Understanding Micro-businesses in Ireland

A brief description of established micro-businesses (i.e. more than three years old) in Ireland is provided below.

- On average micro-businesses in Ireland have 3.1 employees and have been operating for 24.7 years.

- The ratio of male to female owners is approximately 2:1.

- Around half (47.3 per cent) of all micro-businesses in Ireland are home-based, while 77 per cent of micro-businesses in Ireland are family-owned.

- Typically, the founder is not the only member of the firms' leadership team. On average, the size of the leadership team is 1.8.

- Approximately 85 per cent of micro-businesses in Ireland traded profitably over the period 2017-8.

- 45 per cent of micro-businesses reported an increase in turnover from the previous 12 months, while 10 per cent reported a decline in turnover. 45 per cent reported that their turnover had remained the same as the previous 12 months.

- 41 per cent of micro-businesses export their goods and/or services to international markets. The average percentage of sales derived from international markets is 12 per cent.

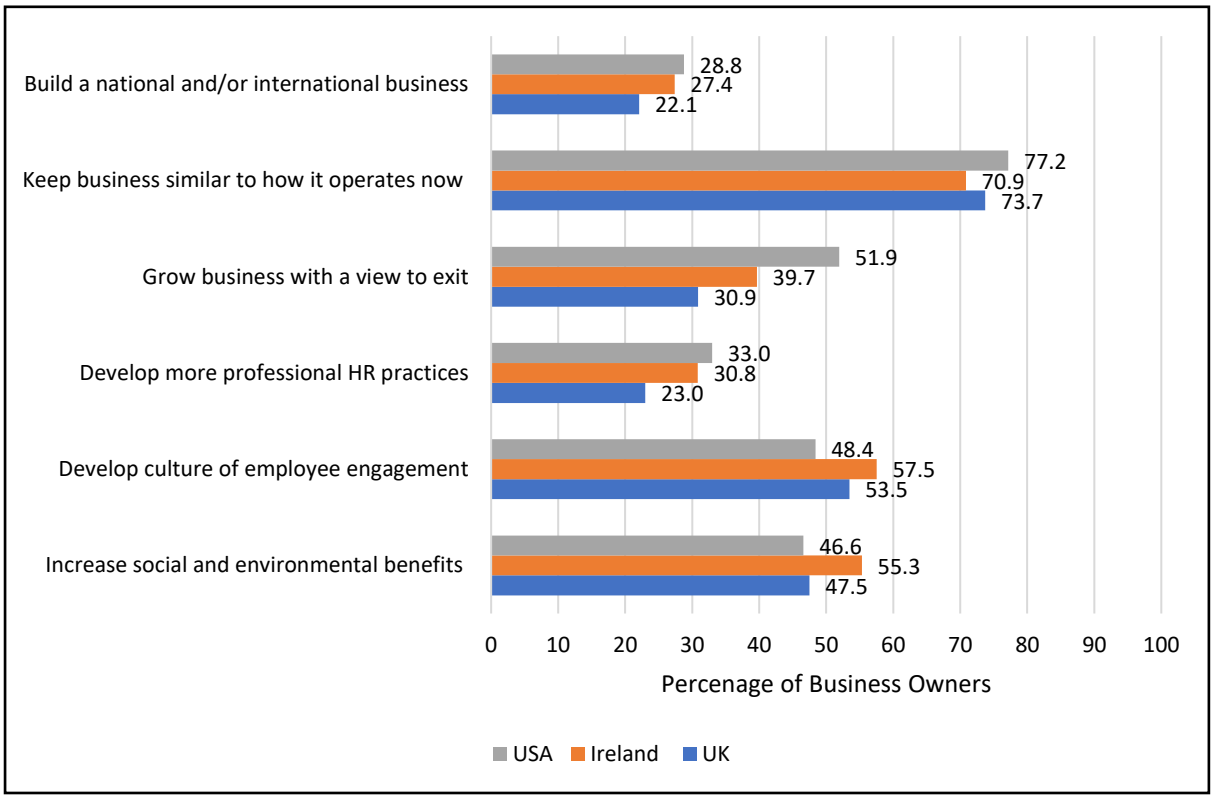
- In Ireland, 47 per cent of micro-businesses use external finance from banks or other lenders. This is considerably higher than the UK and USA. Less than 5 per cent of micro-businesses access funding from family & friends. Almost one in five micro-businesses have sought additional finance over the last year.

3. A Story of Ambition – for the business, for the individual

3.1 Profile of Ambition in Micro-Businesses in Ireland

Previous research has linked owner-managers' growth ambitions to the subsequent growth and performance of the firm.[v] In this survey, we use a new set of ambition questions which reflect individuals' aspirations for their own future and their aspirations for the future of their business. In the Dutch Growth Accelerator programme, for example, attendees are asked to reflect on their own individual aspirations for the future and separately on their aspirations for the future of their business[vi]. Given the nature of micro-businesses these two sets of aspirations are often strongly interlinked but for many owner-managers their aspirations for the business will be a means towards a more personal ambition.

Figure 3.1: Indicators of business ambition



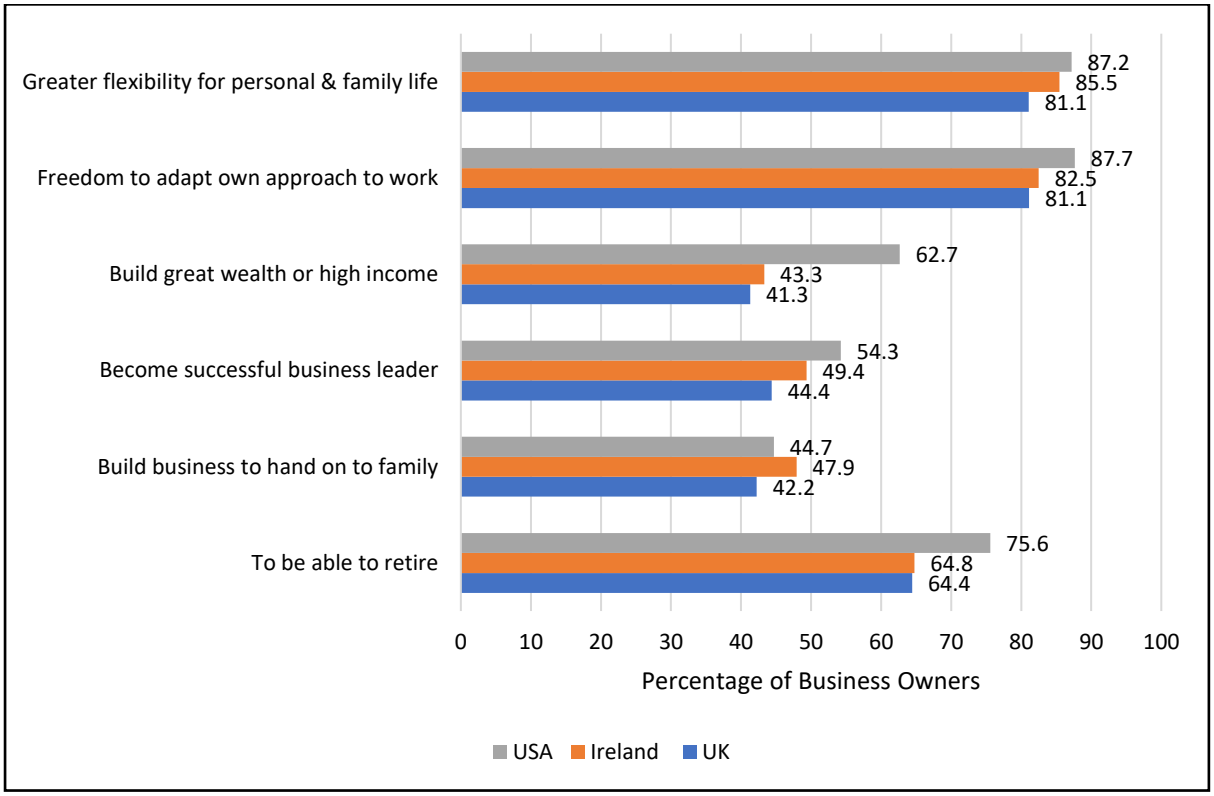
Looking first at respondents' aspirations for their micro-business we consider the proportion of respondents ranking each aspiration as 'important' or 'very important'. There is a sharp

distinction between 71 per cent of Irish respondents' who aim to 'keep their business similar to how it operates now', and a more ambitious 27 per cent who aim to build a 'national or international business' (Figure 3.1). Other more operational aspirations – employee engagement, HR practices, social benefits - fall between these two extremes with 57.5 per cent of all micro-business owners in Ireland aiming 'to create a culture of employee engagement' and 55 per cent aiming 'to increase the social and environmental benefits of the business (Figure 3.1).

Overall, the profiles of business ambition are broadly similar in Ireland and the UK, and a little lower than their micro-business owner counterparts in the USA. For instance, the proportion of firms which aim to 'grow rapidly with a view to exit' differs significantly across these regions; 58 per cent in the US compared to 40 per cent in Ireland and 31 per cent in the UK (Figure 3.1).

Individuals' personal ambitions suggest a rather different set of priorities, with a marked emphasis on 'freedom' and 'flexibility' (Figure 3.2). Over 80 per cent of micro-business owners in Ireland aim 'to have considerable freedom to adapt my own approach to work' and 'to have greater flexibility for my personal and family life'. This is consistent with much of the research literature on self-employment and entrepreneurship which stresses the financial as well as the non-financial benefits of being your own boss.

Figure 3.2: Indicators of personal ambition



In terms of personal ambition, 65 per cent of micro-business owners in Ireland want 'to be able to retire', while almost half of micro-business owners want 'to build a business I can hand on to my family' and 'to fulfil a personal vision of becoming a successful business leader in the community'. Interestingly, only 43 per cent want 'to have a chance to build great wealth or a very high income'. This is in marked contrast to the USA where this figure is 63 per cent. In general, Irish micro-businesses owners profess similar personal ambitions to their counterparts in the UK.

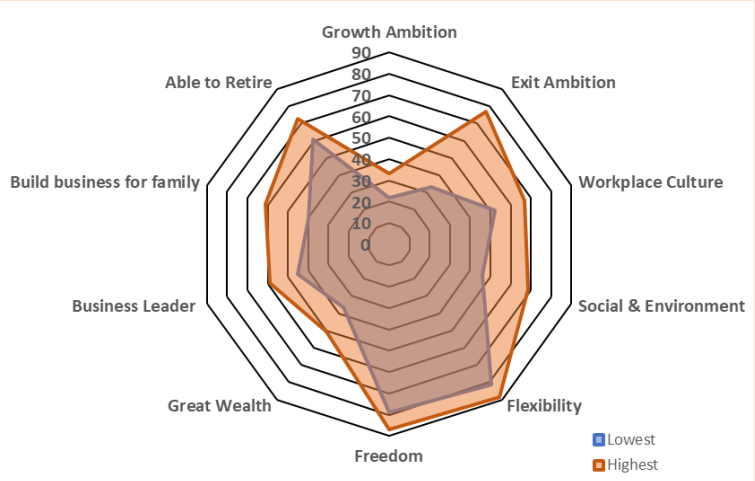
3.2 The Geography of Ambition in Ireland

Now we consider the regional differences in business and personal ambition among micro-businesses in Ireland. Our regional analysis uses the Nomenclature of Territorial Units for Statistics (NUTS3) for Ireland.[vii] Due to sample size restrictions, we have combined the Mid-East and Midlands regions. The shape of ambition – business and personal – for micro-businesses varies across Ireland. We use radar charts to illustrate these regional variations.

DESCRIPTION: Radar Ambition Charts

Our radar charts illustrate the range of ambition indicators at the regional level.

The orange line is an indicator of the highest level of ambition recorded for each of the business and personal ambition measures at the regional level, and the blue line is an indicator of the lowest level of ambition recorded.



For instance, the extent to which micro- businesses across the regions consider the ambition 'to build a business to hand on to family' to be important ranges from 40 per cent (blue line) to 60 per cent (orange line) approximately. While the social and environmental elements of the business are important to between 40+ and 70 per cent of micro-businesses. Highest and lowest indicators of ambition are constant all the radar charts

The black lines in the radar charts illustrate how each region compares across these business and personal ambitions. The closer the black line (region) is to the orange line (highest level of ambition), the more ambitious that region is relative to other regions with respect to that particular ambition measure. Similarly, when the black line is close to the blue line (lowest level of ambition), this reflects low levels of ambition for that particular ambition indicator in micro-businesses in that region.

Figure 3.3. allows us to compare the ambition profile of micro-businesses in Dublin with the rest of the country. We can see that micro-businesses in Dublin are at the upper end of the ambition scale with respect to growing their business and the personal ambitions of flexibility and freedom. However, their ambition profile is low with regard to building a business to hand on to family, being able to retire, accumulating great wealth and being considered a business leader in the community.

Figure 3.3: Ambition in Micro-businesses: Dublin

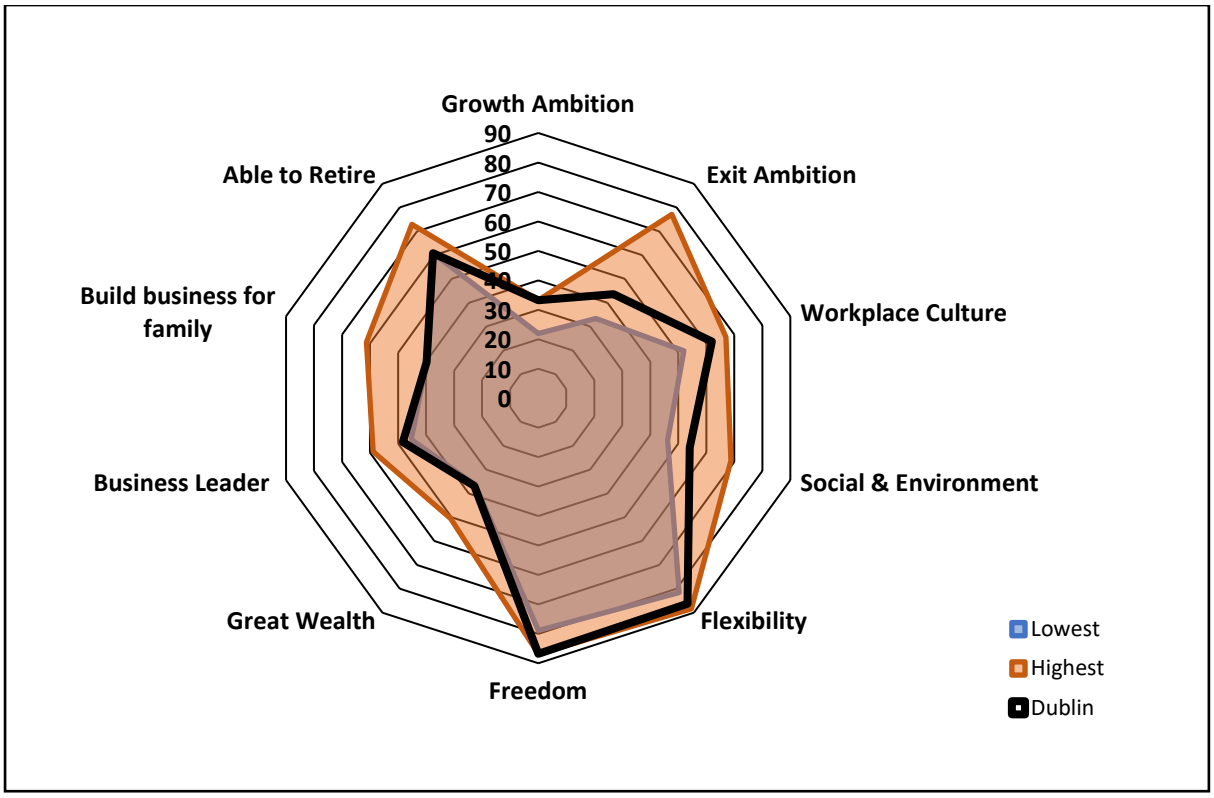
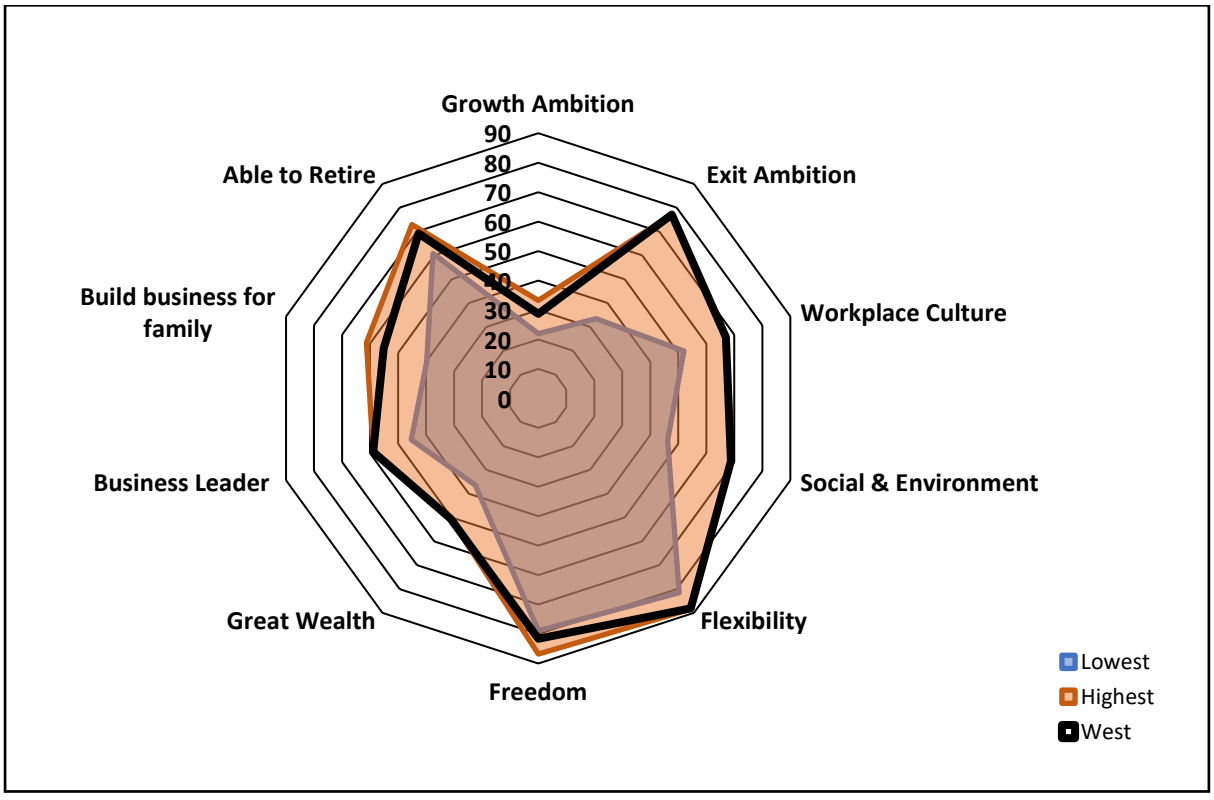


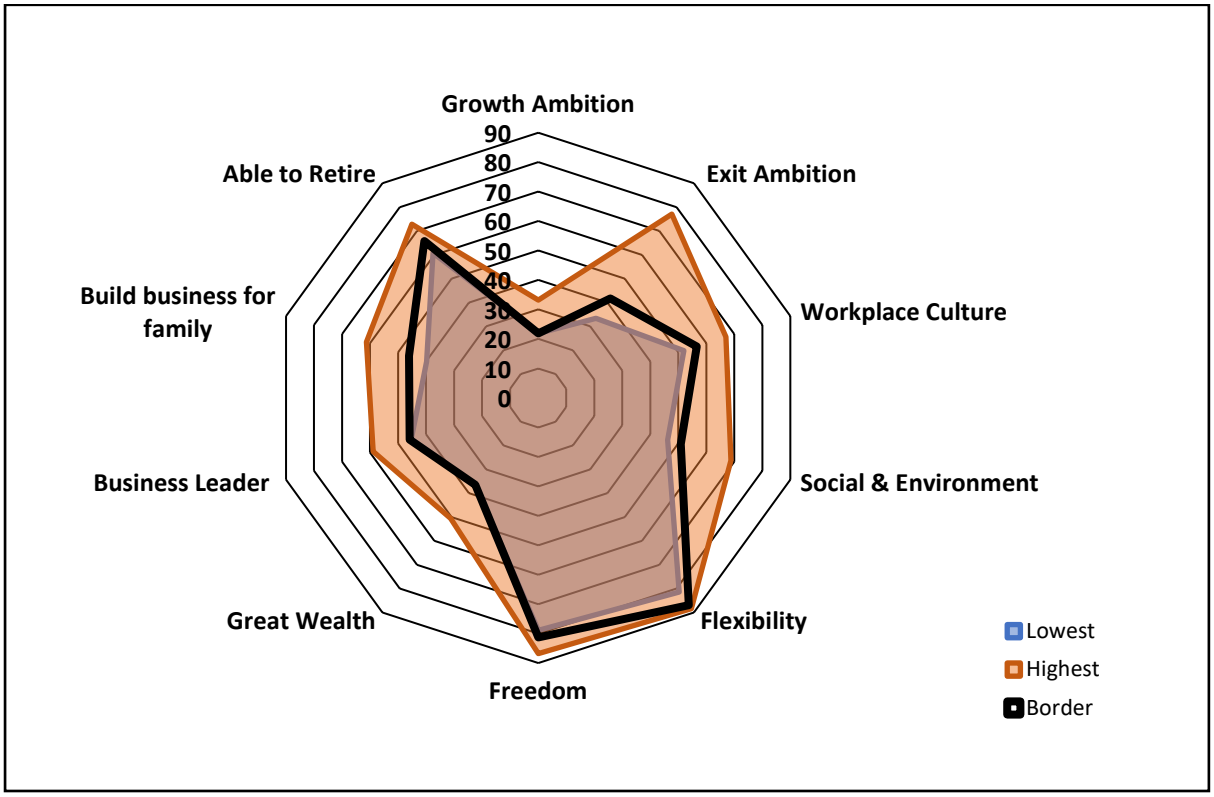
Figure 3.4 shows that micro-businesses in the West are amongst the most ambitious in the country. The West is consistently the most ambitious region across business and personal ambition indicators. For instance, micro-businesses in the West are more likely to consider workplace culture and social and environmental elements of the business to be important motivations than micro-businesses in other regions. Interestingly, Figure 3.4 reveals that almost 80 per cent of micro-businesses in the West consider building their business with a view to exit as being important. This is significantly higher than all other regions in Ireland, including Dublin where the corresponding figure is approximately 45 per cent.

Figure 3.4: Ambition in Micro-businesses: West



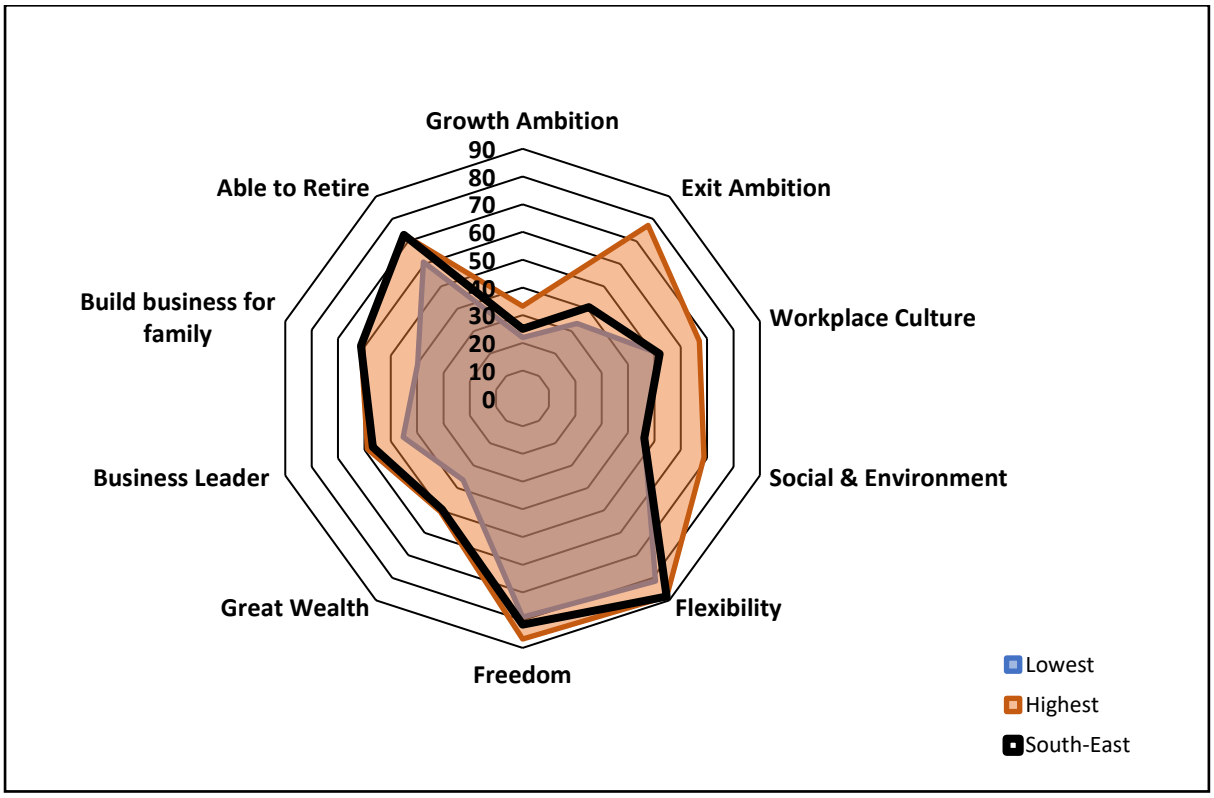
This contrasts with micro-businesses in the Border region (see Figure 3.5) which reveal a profile of lower ambition, for both business and personal indicators. Micro-businesses in the Border region are less likely to be motivated by growth, great wealth and being a business leader in their community than micro-businesses in other parts of the country.

Figure 3.5: Ambition in Micro-businesses: Border



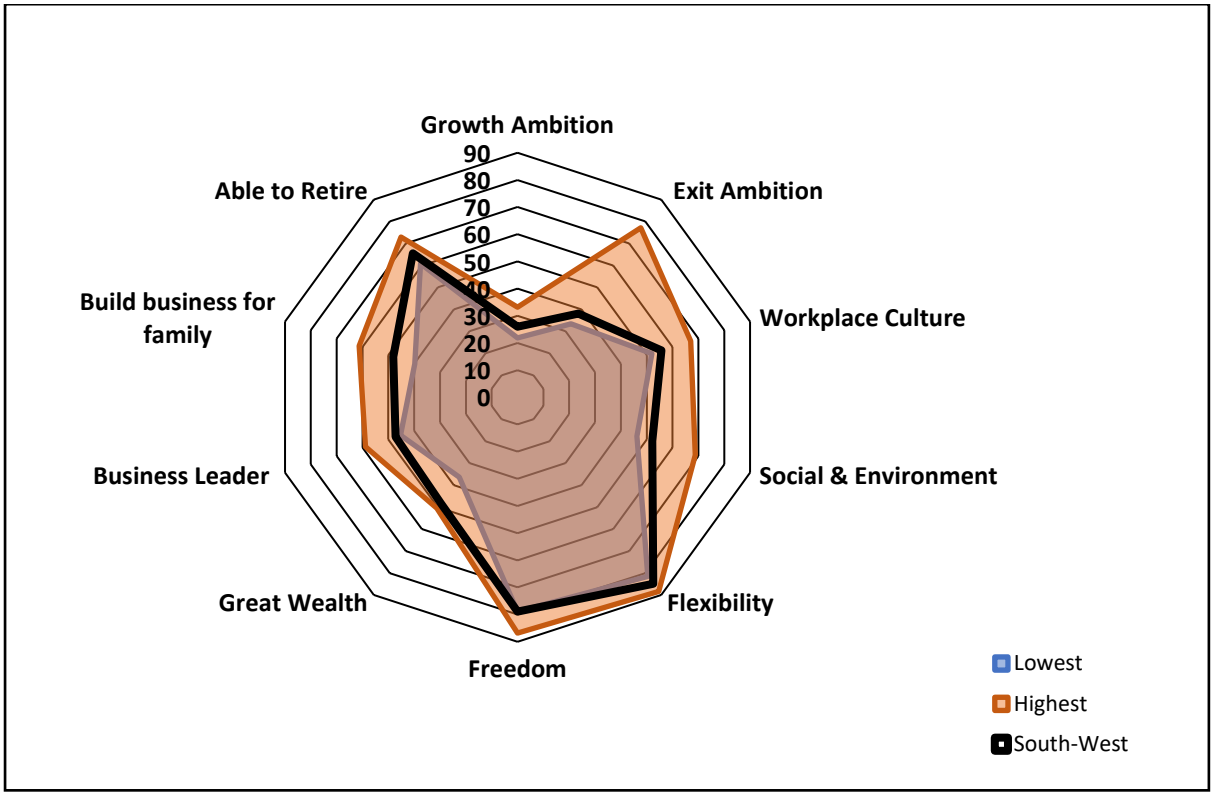
There are interesting contrasts between business and personal ambitions amongst micro-businesses in the South-East (see Figure 3.6). Micro-businesses owners in the South-East are at the lower end of the scale for business ambitions such as growth, view to exit, workplace culture and social and environmental elements. However, micro-businesses in the South-East reveal high personal ambitions compared to other regions. They are at the upper end of the scale regarding flexibility, accumulating great wealth, building a business to hand on to family, being able to retire and being considered a successful business leader in the community as being important motivators.

Figure 3.6: Ambition in Micro-businesses: South-East



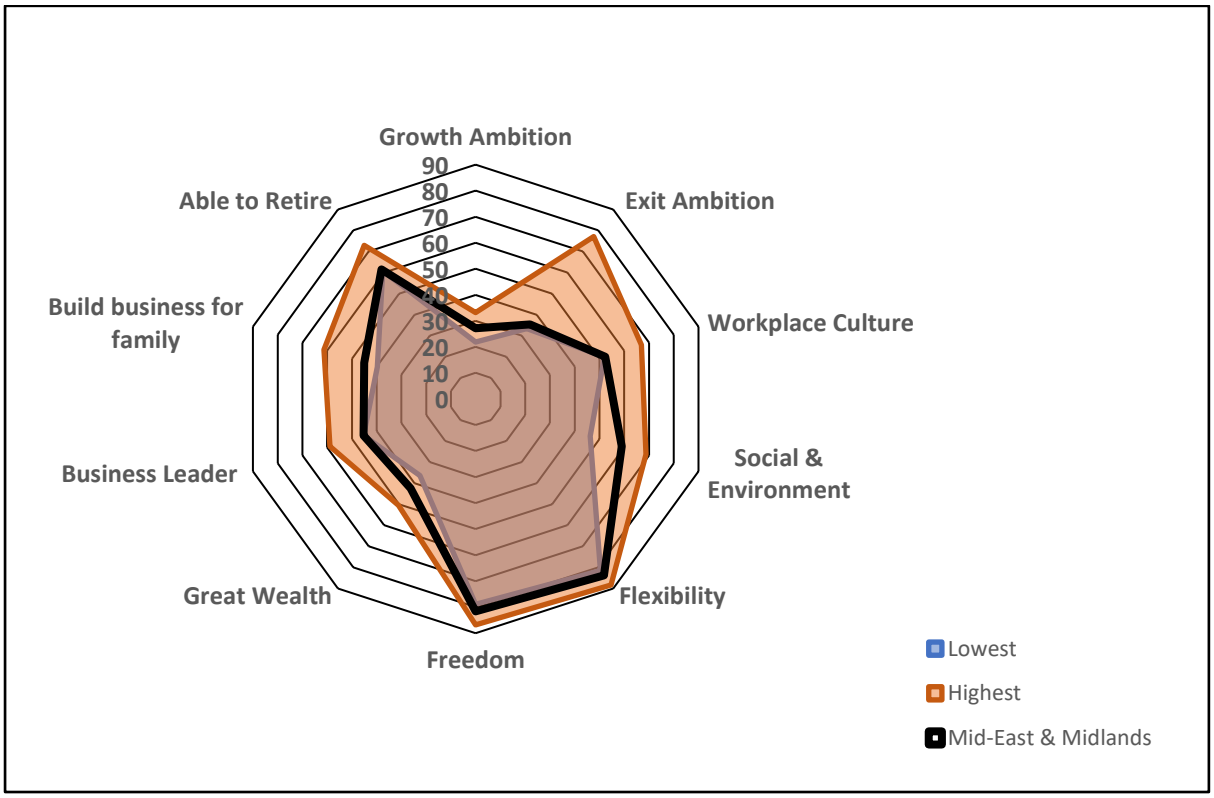
Owners of micro-businesses in the South-West (see Figure 3.7) do not appear to be particularly motivated by business ambitions, but do consider accumulating great wealth as a higher priority than micro-businesses in other regions.

Figure 3.7: Ambition in Micro-businesses: South-West



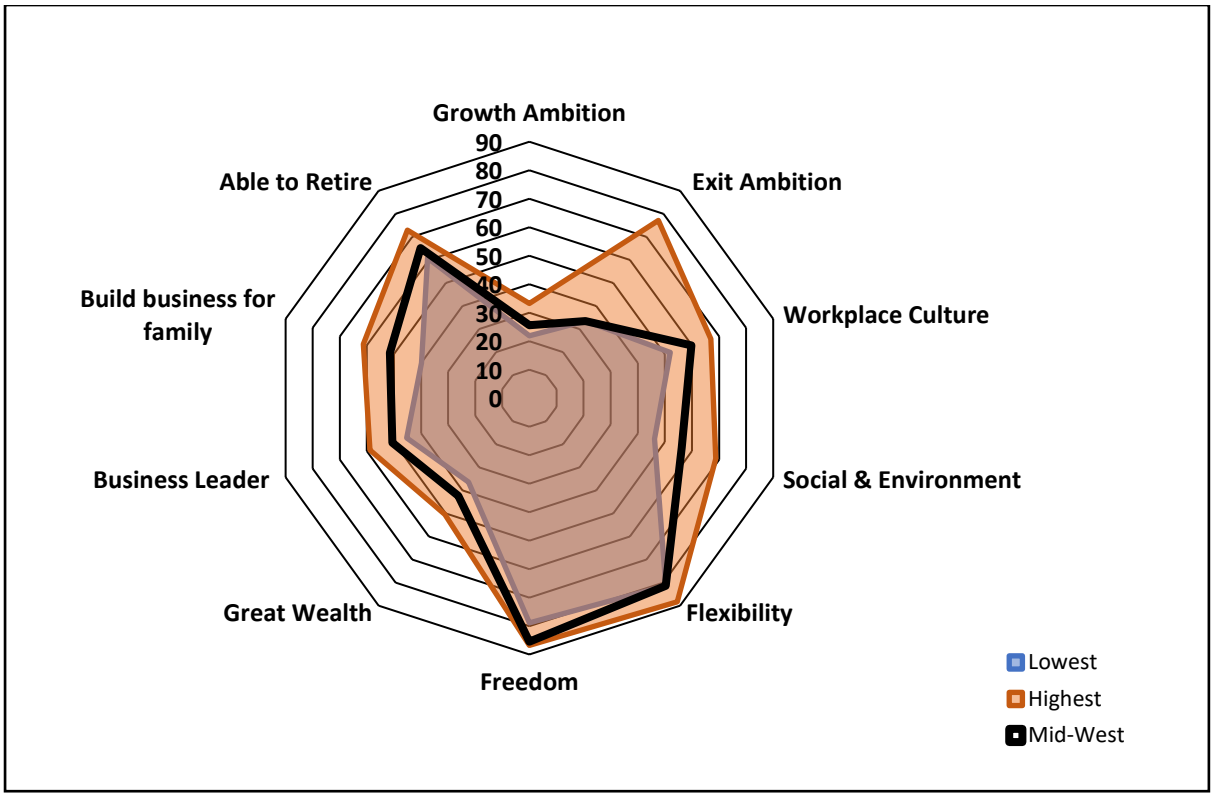
Similarly, business ambitions tend to be relatively low in the Mid-East and Midlands (Figure 3.8) relative to other regions. As across all regions, 'flexibility' and 'freedom' are important personal aspirations for micro-business owners in the Mid-East & Midlands.

Figure 3.8: Ambition in Micro-businesses: Mid-East & Midlands



Micro-businesses in the Mid-West reveal a moderate ambition profile relative to other regions (Figure 3.9). Business ambitions around growth and exit strategies are low, with freedom to adapt their own approach to work and being able to retire being more important.

Figure 3.9: Ambition in Micro-businesses: Mid-West



3.3 Gender Differentials in Ambition Profiles

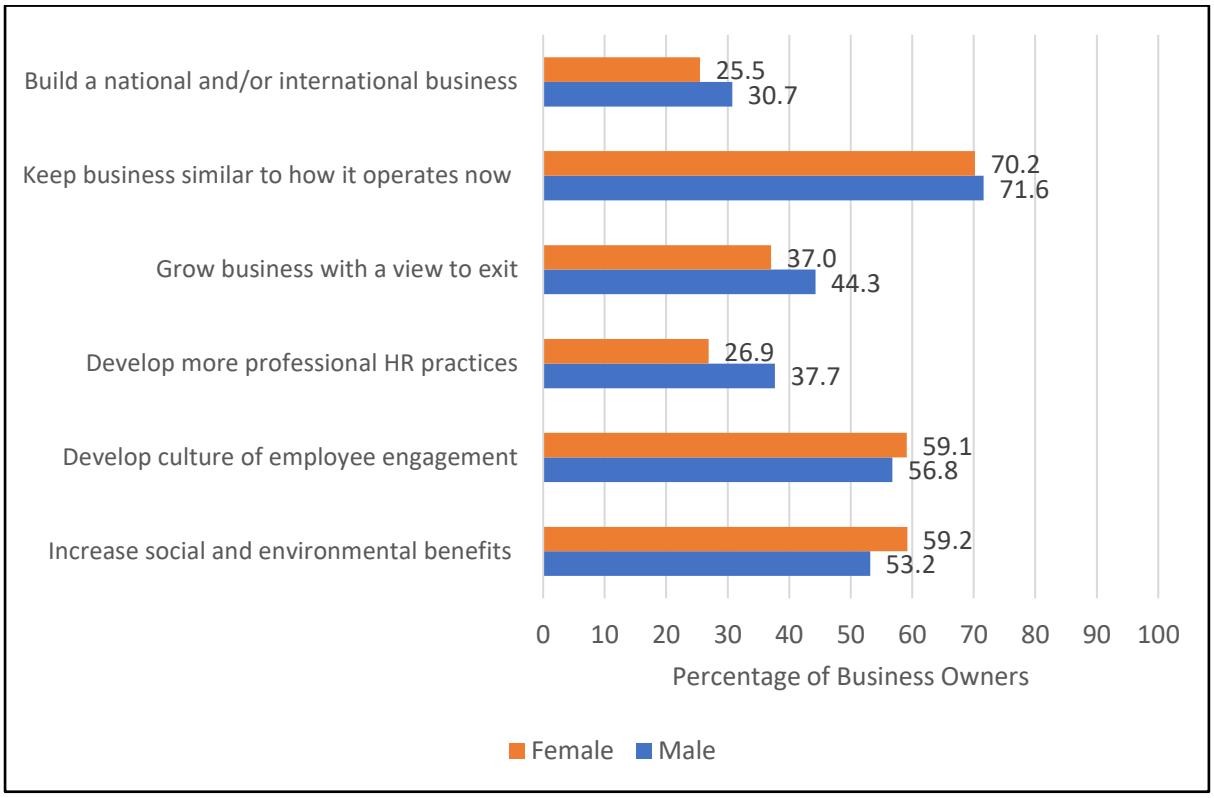
We see very similar profiles of business and personal objectives for male and female micro-business owners (Figures 3.10 and 3.11), albeit with some male-female distinctions in terms of the importance placed on business versus personal ambitions.

Firstly, looking at business ambitions, over two-thirds of male and female business owners emphasise their desire to keep the business similar to how it operates now (Figure 3.10). However, slightly more male business owners report higher growth ambitions with respect to building a national and/or international business than their female counterparts.

In addition, male business owners are more likely to aspire to build a business quickly and profitably with a view to exit, and they are more likely to want to develop more professional HR practices. However, female business owners place a greater value on developing a

culture of employee engagement and increasing the social and environmental benefits of the business than male business owners.

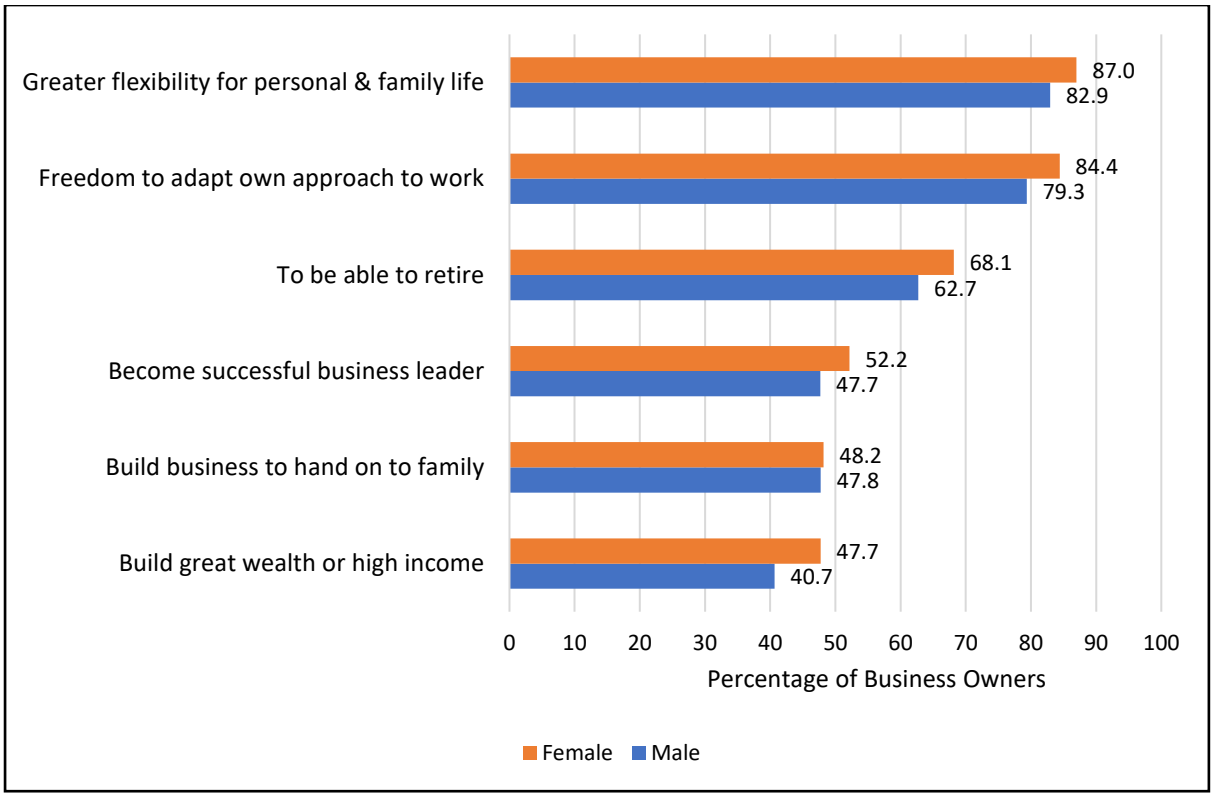
Figure 3.10: Business Ambition by Gender



In relation to personal motivations, we also see similar profiles of ambition among male and female micro-business owners; although female micro-business owners place a slightly greater importance on personal ambitions than male micro-business owners.

Both male and female business owners place considerable emphasis on 'flexibility' and 'freedom'. Approximately four in five business owners place importance on the greater flexibility for personal and family life and the freedom to adapt their own approach to the business. However, slightly more females consider the objectives of 'flexibility' and 'freedom' to be important.

Figure 3.11: Personal Ambition by Gender



The next most important personal ambition for both genders is to able to retire. 63 and 60 per cent of male and female business owners respectively consider this an important motivation.

48 per cent of male and female micro-business owners are motivated to build the business to hand on to their family. More female business owners are motivated in terms of building great wealth or a high income (48 versus 41 per cent); and becoming a successful business leader in the community (52 versus 48 per cent).

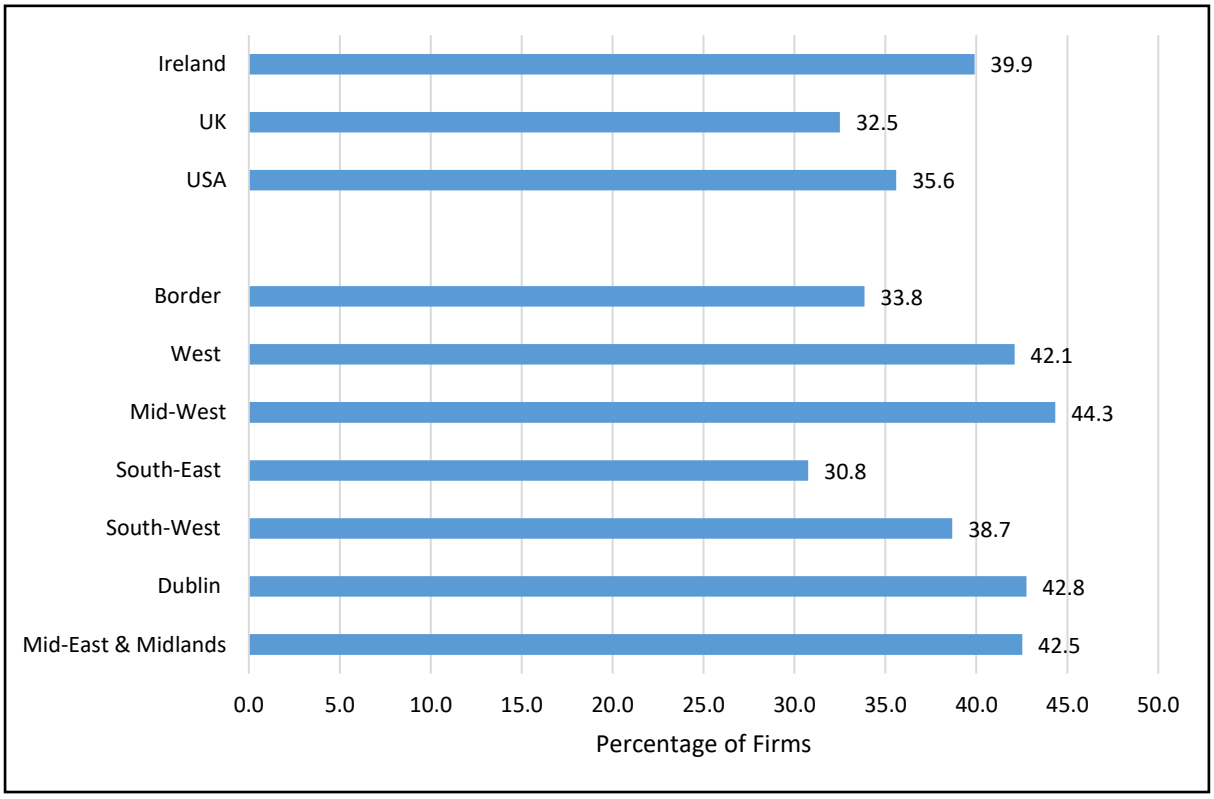
4. Innovation

Innovation has the capacity to enable micro-businesses to increase productivity and growth.[viii] However, we know little about the nature of innovation activity in micro-businesses in Ireland as they are excluded from the Innovation in Irish Enterprises Survey.

4.1 New products or services and new forms of organisation

First, we consider two indicators relating to whether micro-businesses introduced new or improved products or services over the three years prior to the survey (Figures 4.1 and 4.2) or introduced new business models or forms of organisation (Figures 4.3 and 4.4).

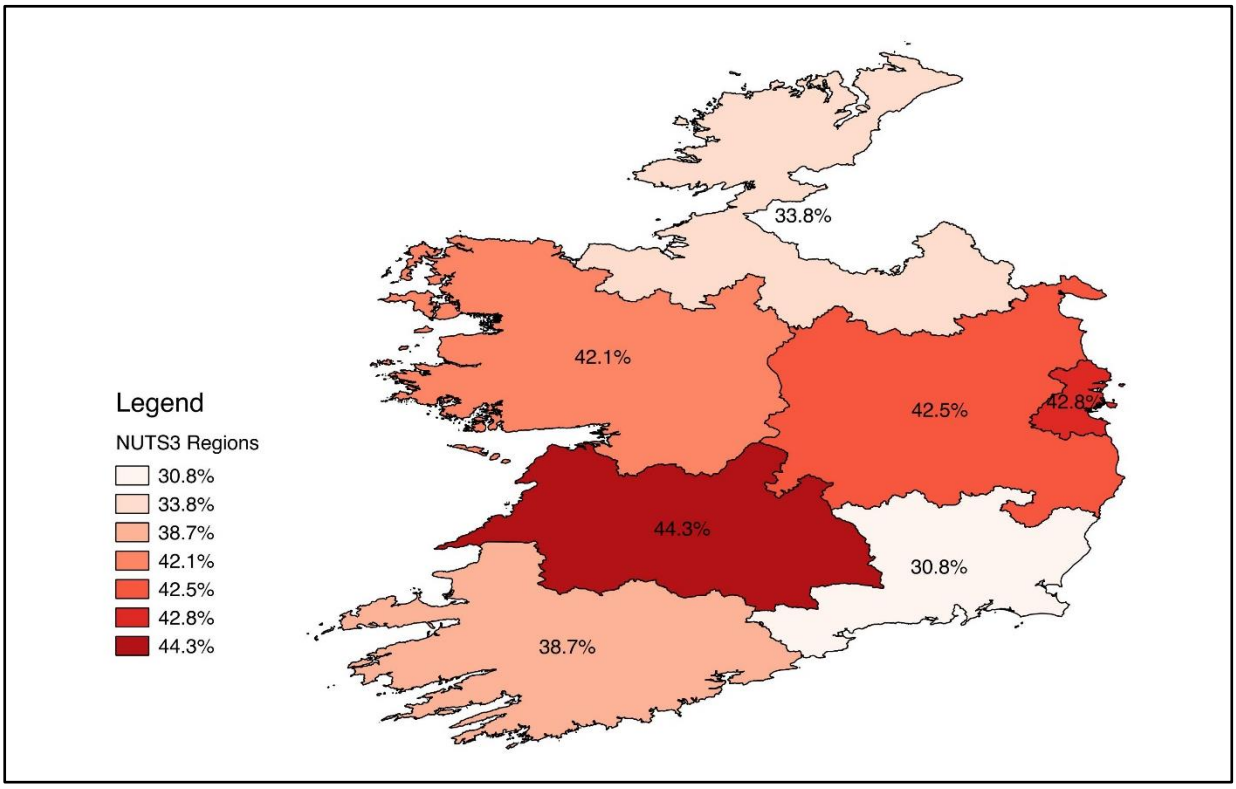
Figure 4.1: Product or Service Innovation



As illustrated in Figure 4.1, 40 per cent of micro-businesses in Ireland have introduced new or improved products or services over the three years prior to the survey. This compares to figures of 33 and 36 per cent in the UK and USA respectively.

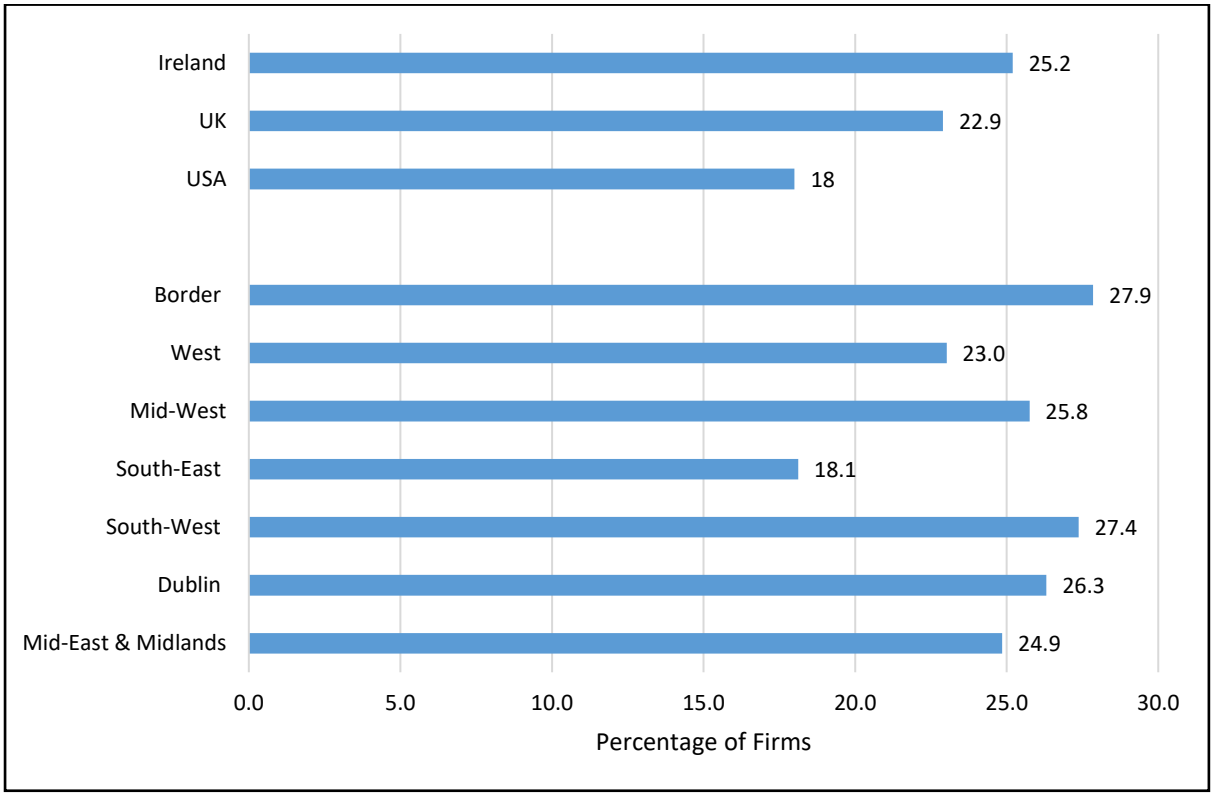
At the regional level, we can see that the Mid-West, Dublin , Mid-East & Midlands, and the West perform relatively well in relation to new product or service innovation (Figures 4.1 and 4.2). On average, more than 40 per cent of micro-businesses in these regions introduced new products and services in the last three years. These compares to 33.8 per cent of businesses in the Border region and 30.8 per cent in the South-East.

Figure 4.2: Regional Map of Product or Service Innovation



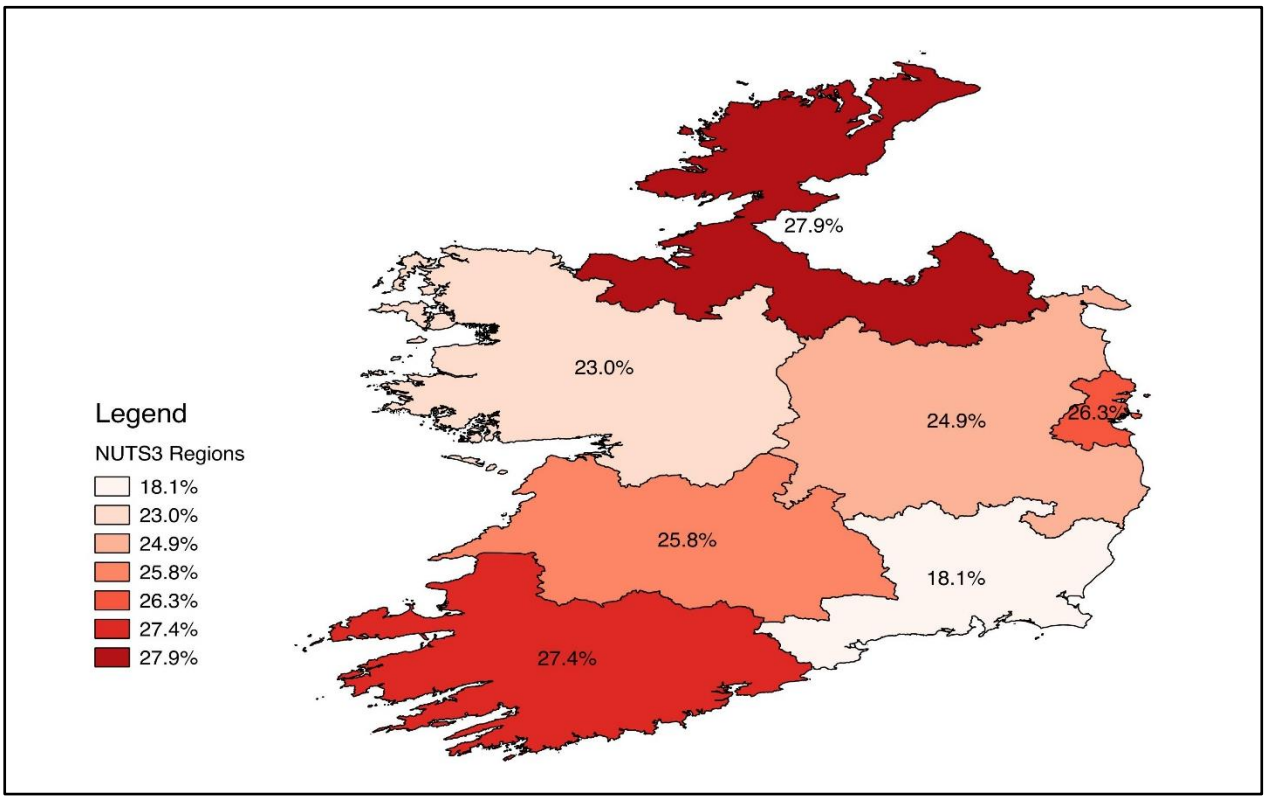
In relation to organisational innovation, 25 per cent of micro-businesses in Ireland have introduced new business models or forms of organisation in the three years prior to the survey (Figure 4.3). This is slightly ahead of micro-businesses in the UK (23 per cent), and considerably ahead of micro-businesses in the USA (18 per cent).

Figure 4.3: Organisational Innovation



In addition, there is little variation across the regions with approximately one in four micro-businesses engaging in organisational innovation in the previous three years, although the figure for the South-East is lower at 18 per cent (Figures 4.3 and 4.4).

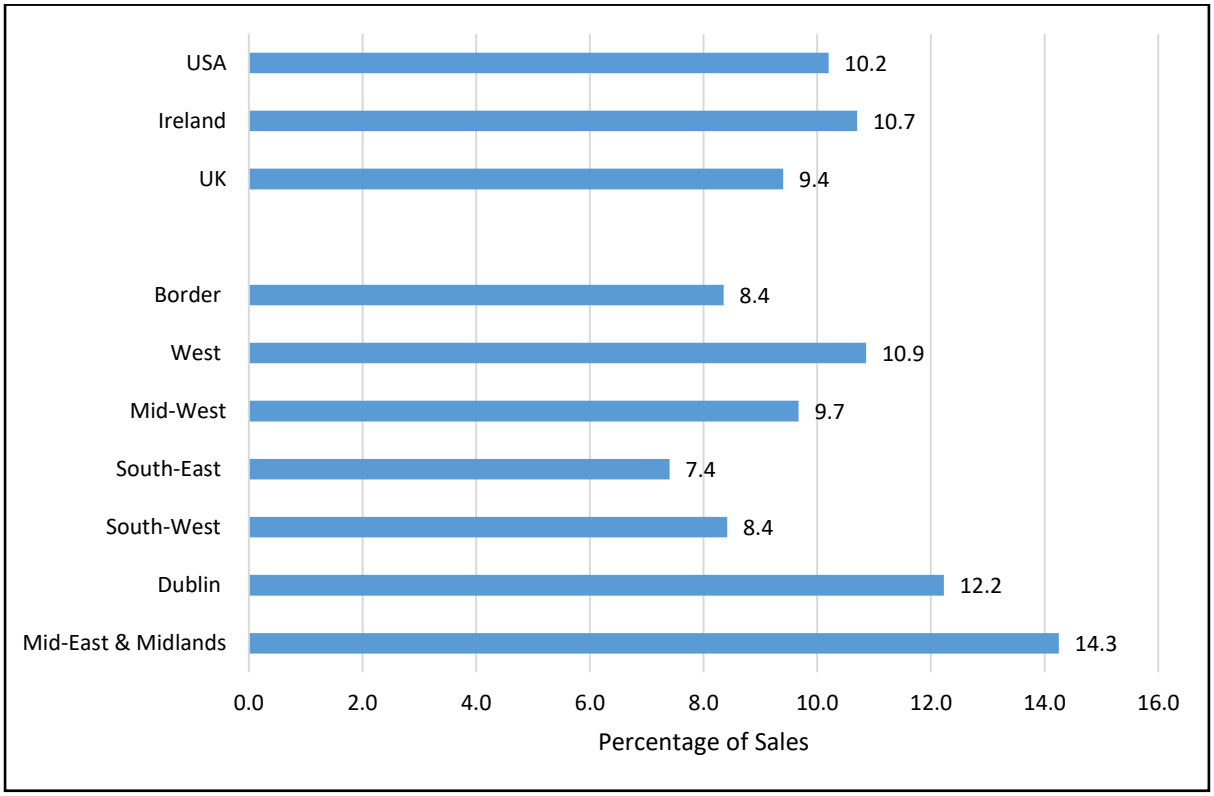
Figure 4.4: Regional Map of Organisational Innovation



4.2 Innovation Success

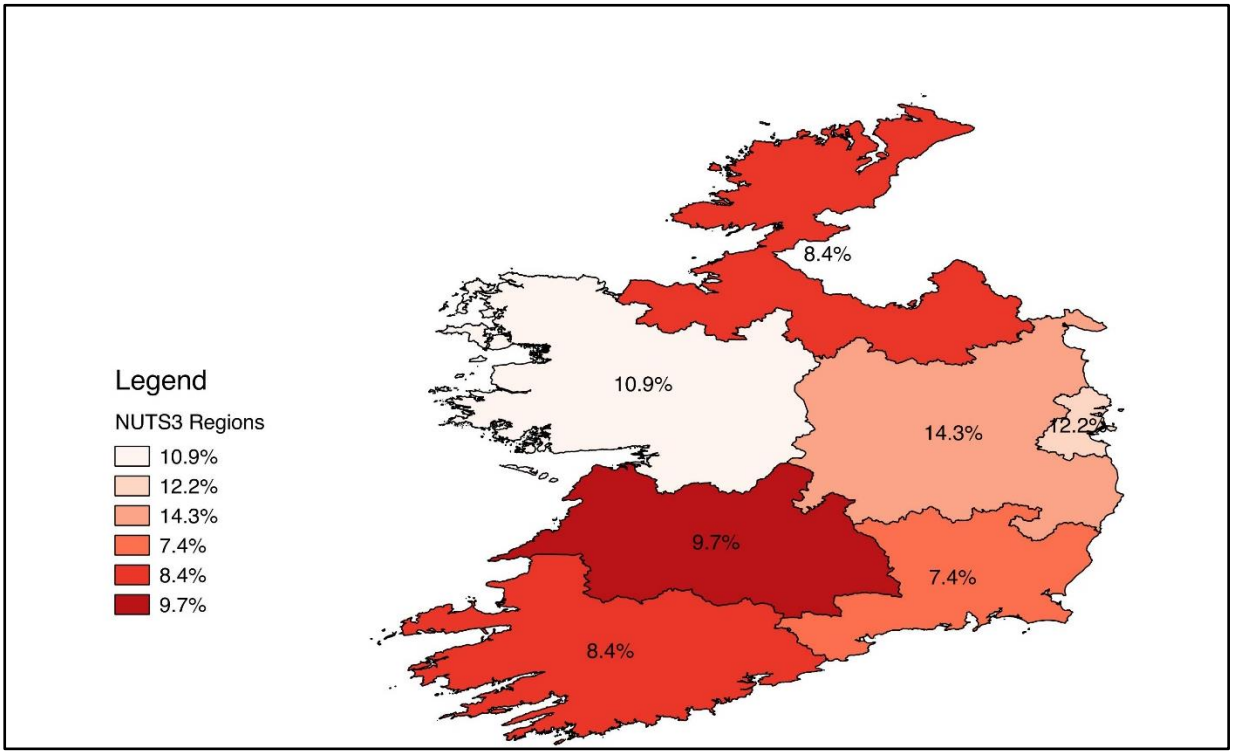
Another innovation indicator - the proportion of sales derived from innovative products or services - provides an indication of the extent to which firms are able to derive sales from their new products or services – a measure of innovation success. In the year prior to the survey, Irish firms derived around 11 per cent of their sales from innovative products/services compared to 9 per cent for the UK as a whole and 10 per cent in the USA (Figure 4.5).

Figure 4.5: Sales from Innovative Products or Services



Micro-businesses in Dublin (12.2 per cent) and the Mid-East and Midlands regions (14.3 per cent) derive a slightly higher percentage of sales from innovative products or services than the national average (Figures 4.5 and 4.6). The remaining regions derive a relatively lower percentage of sales from innovative products and services, particularly the South-East (7.4 per cent), the Border (8.4 per cent) and the South-West (8. 4 per cent).

Figure 4.6: Regional Map of Percentage of Sales from Innovative Products or Services



5. Digital Technology: Adoption and Diffusion

The adoption or diffusion of information technology has been one of the key drivers of productivity across the advanced economies over the last three decades. The advent of Industry 4.0 presents businesses with new challenges relating to digitisation in both selling and operations.[ix] International evidence on adoption is available for firms with 10 or more employees from OECD survey statistics. However, micro-businesses are excluded from the OECD analysis, and this survey data provides the first robust benchmarks for digital adoption in firms with less than 10 employees.

The survey asked firms about the adoption of seven general-purpose digital technologies. Five of these were 'established' technologies:

- **Customer relationship management (CRM) systems** use data analysis about customers' history to improve business relationships with customers, specifically focusing on customer retention.
- **E-commerce** involves selling goods and/or services through the company website.
- **Web-based accounting software** is an accounting information system which can be accessed with any device which is internet enabled.
- **Computer-aided design software** aids in the creation, modification, analysis, or optimization of a design.
- **Cloud computing** involves the practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer.

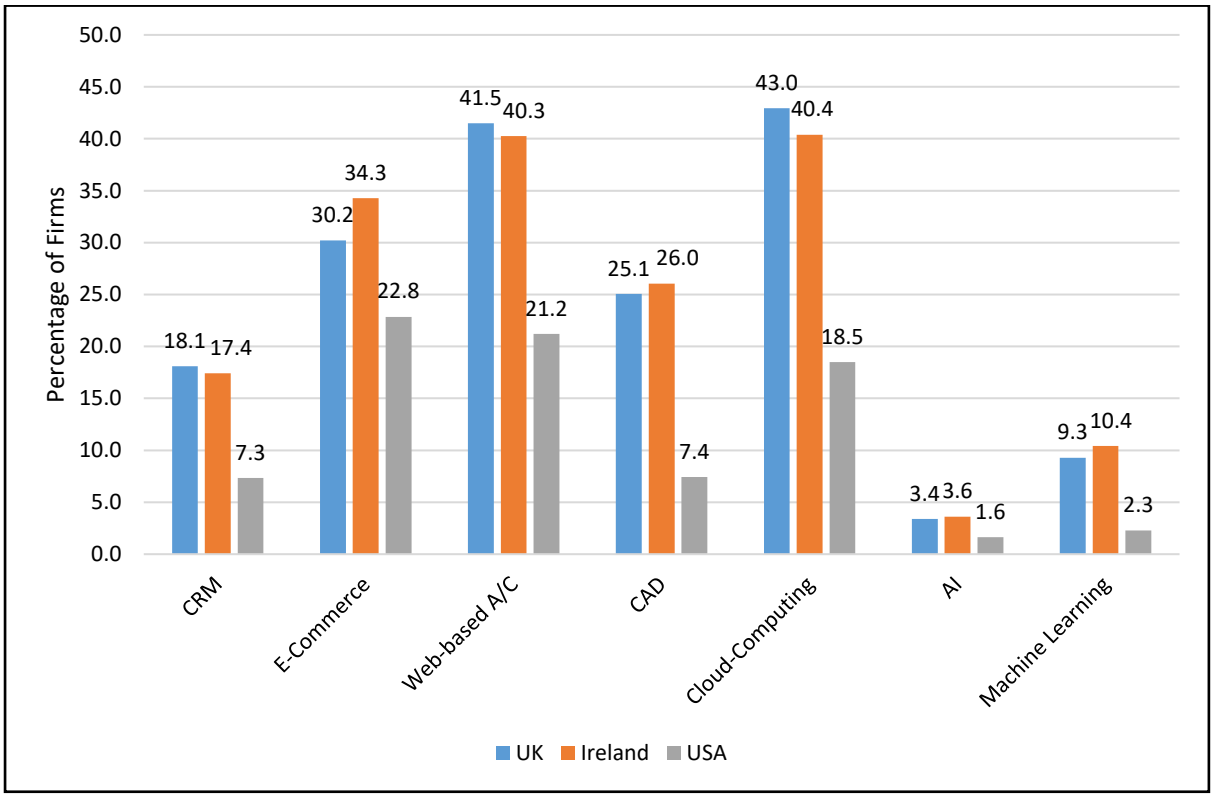
Two other technologies fall into the more 'emergent' category of technology:

- **Artificial intelligence (AI)** is the simulation of human intelligence processes – learning, reasoning and self-correction - by machines, especially computer systems.
- **Machine learning technologies** use statistical techniques to give computers the ability to "learn" (i.e., progressively improve performance on a specific task) with data, without being explicitly programmed.

5.1 Digital Technology Adoption in Ireland

Figure 5.1 profiles the proportion of micro-businesses using each digital technology in Ireland and comparator areas. Generally, adoption rates for established technologies in Ireland compare well with those in the UK and are markedly higher than those in the USA.

Figure 5.1: Digital adoption in micro-businesses

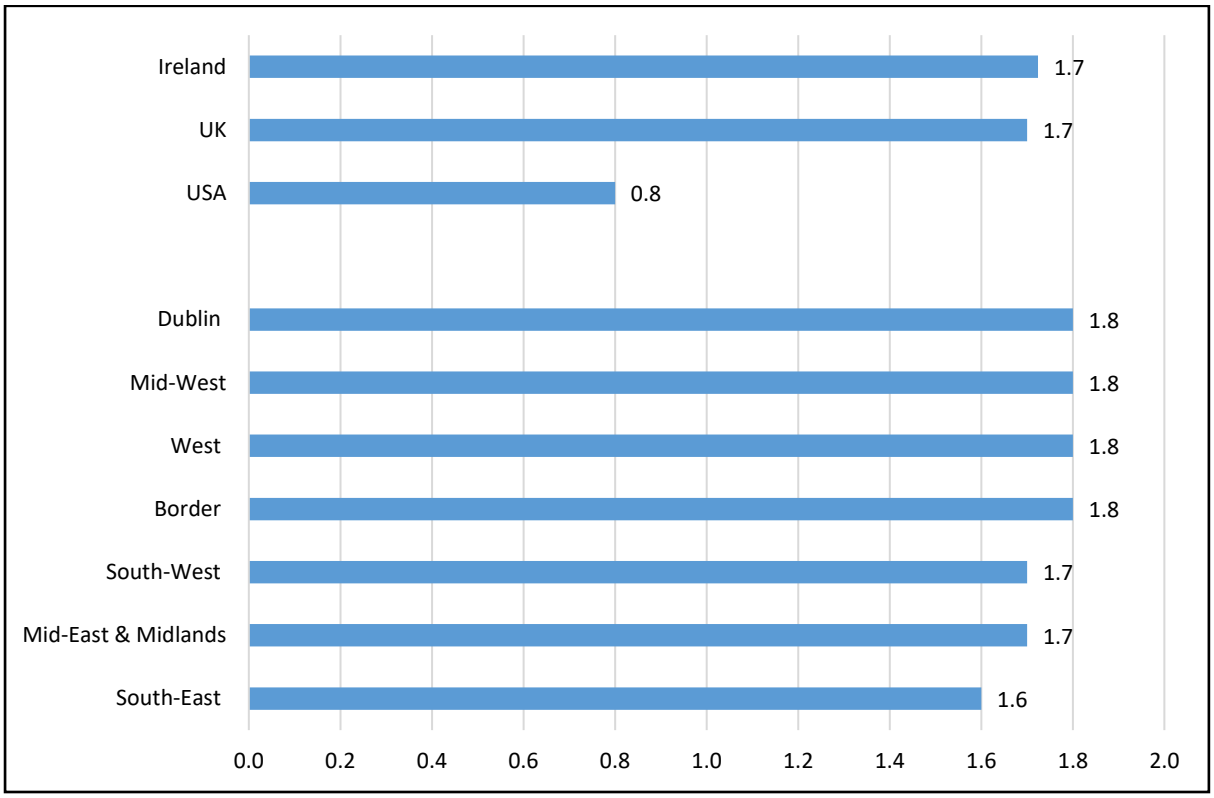


40 per cent of Irish micro-businesses use web-based accounting and cloud computing. Uptake of e-commerce (34 per cent) is higher in Ireland than in the UK and USA.

In terms of the newer technologies – AI and machine learning – adoption levels are much lower compared to the more established technologies across all regions. Fewer than 4 per cent of Irish micro-businesses are using AI and one in ten are using machine learning technology. However, uptake of these emergent technologies is similar to uptake by micro-businesses in the UK, and compares favourably with uptake by US micro-businesses.

Another way of comparing digital adoption across areas is to count the number of the seven digital technologies which each firm uses. This provides an overall indicator of the extent of uptake of digital technologies by micro-businesses (Figure 5.3).

Figure 5.3: Number of digital technologies adopted by micro-businesses



Micro-businesses in Ireland have adopted, on average, 1.7 digital technologies (Figure 5.3). Digital technology adoption in micro-businesses in Ireland is comparable to that in the UK (1.7), and considerably ahead of the USA (0.8). We see little variation in the average number of technologies adopted by micro-businesses across the regions in Ireland. See Appendix 2 for regional breakdown of digital technology adoption.

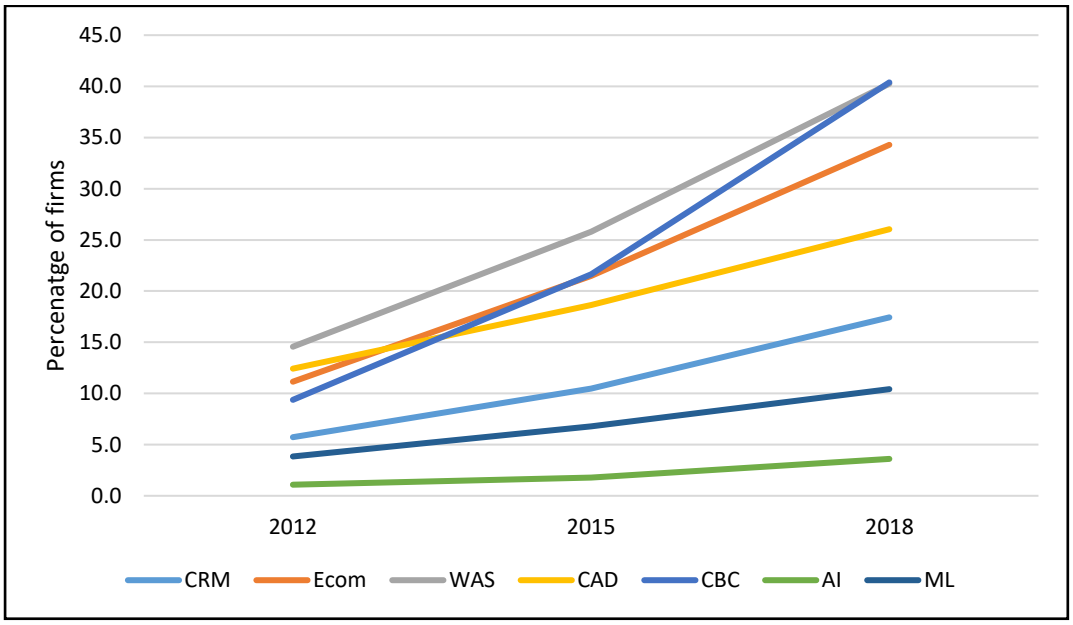
However, 27 per cent of micro-businesses have not adopted any of these seven digital technologies.

5.2 Diffusion of Digital Technology since 2012

Next, we consider the diffusion of digital technologies among micro-businesses over time (Figure 5.2). In 2012, diffusion of all seven technologies was less than 15 per cent among micro-businesses. Then, adoption of digital technologies by micro-businesses in Ireland begins to take off over the subsequent years; and by 2018, more and more micro-businesses in Ireland have adopted digital technologies.

Cloud-based computing and Web-based Accounting prove the most popular technologies among micro-businesses in Ireland. E-commerce is the next most popular technology. However, diffusion of AI and ML remains low.

Figure 5.2: Digital adoption in micro-businesses (2012-2018)



Appendix 1: Sectoral Overview of Survey Data

Table A1: Sectoral overview of survey data

	Ireland	UK	US
ABDE - Primary	58	369	111
	3.90%	5.90%	5.50%
C - Manufacturing	150	592	196
	10.00%	9.50%	9.80%
F - Construction	125	650	146
	8.30%	10.40%	7.30%
G - Retail, wholesale	273	1099	393
	18.20%	17.60%	19.60%
HI - Transport, accommodation, food	222	669	153
	14.80%	10.70%	7.60%
JKL - Information, finance, real estate	188	793	301
	12.50%	12.70%	15.00%
M - Professional, scientific	255	1038	298
	17.00%	16.60%	14.90%
N - Administrative services	104	507	189
	6.90%	8.10%	9.40%
PQRS - Other services	125	537	214
	8.30%	8.60%	10.70%

Appendix 2: Regional Breakdown of Technology Adoption

Table A2: Digital Technology Adoption by Region

	CRM	E-Commerce	Web-based A/C	CAD	Cloud-Computing	AI	Machine Learning
Border	14.7%	33.7%	42.2%	27.7%	40.2%	2.2%	14.8%
West	20.7%	36.4%	35.2%	34.3%	39.8%	1.4%	10.1%
Mid-West	16.1%	34.4%	44.8%	21.5%	47.6%	5.0%	12.5%
South-East	17.0%	39.2%	35.9%	16.5%	34.9%	1.9%	13.4%
South-West	14.3%	35.5%	41.1%	27.1%	39.0%	4.0%	5.9%
Dublin	20.4%	32.9%	43.3%	25.4%	44.0%	5.2%	9.1%
Mid-East & Midlands	18.3%	31.5%	37.5%	27.5%	37.3%	3.6%	11.6%

Figure A2.1: Adoption of Customer Relationship Management

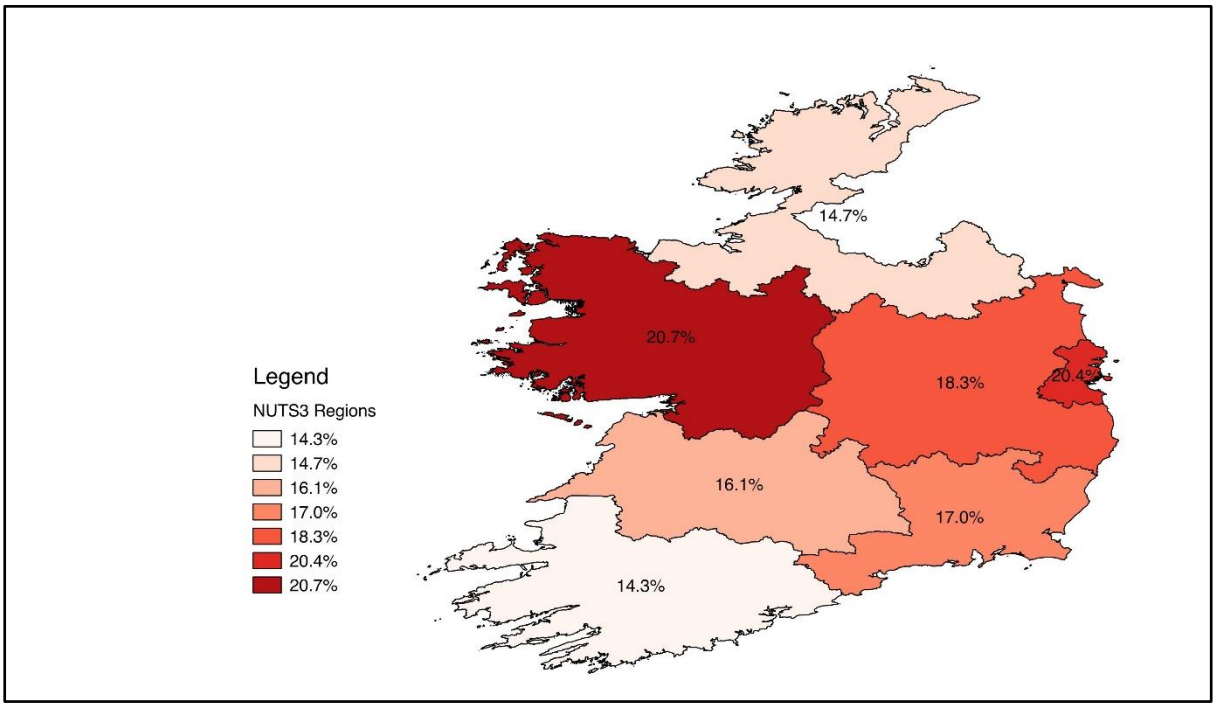


Figure A2.2: Adoption of E-Commerce

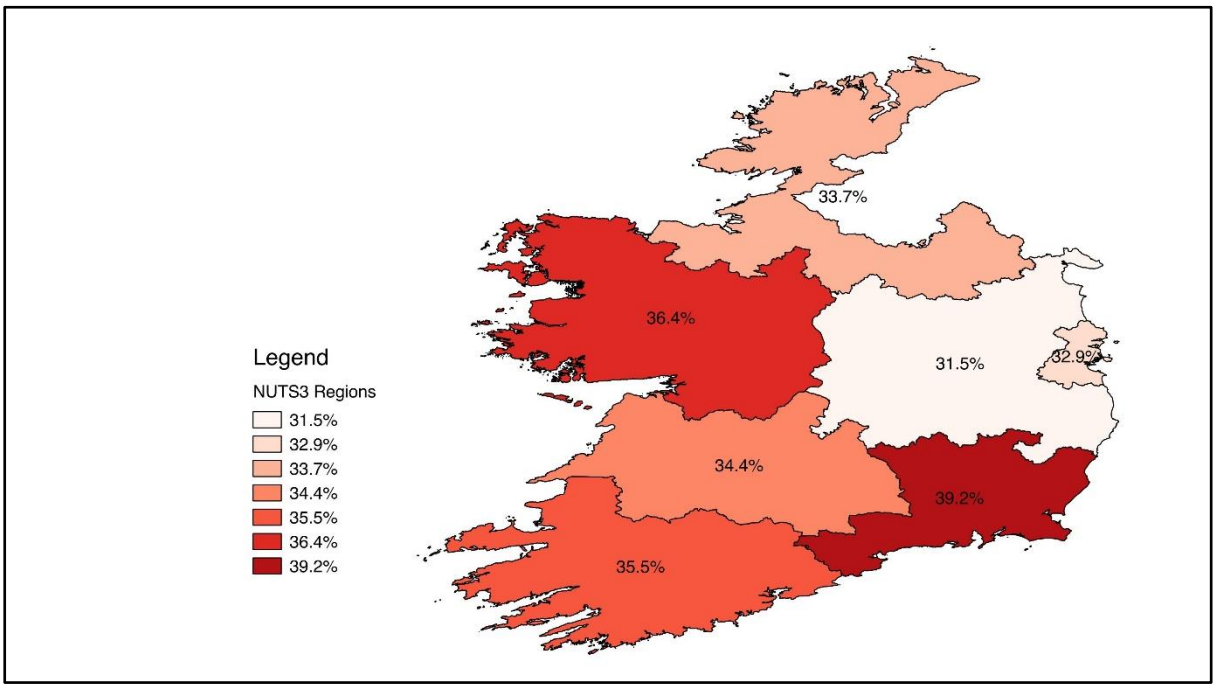


Figure A2.3: Adoption of Web-based Accounting Software

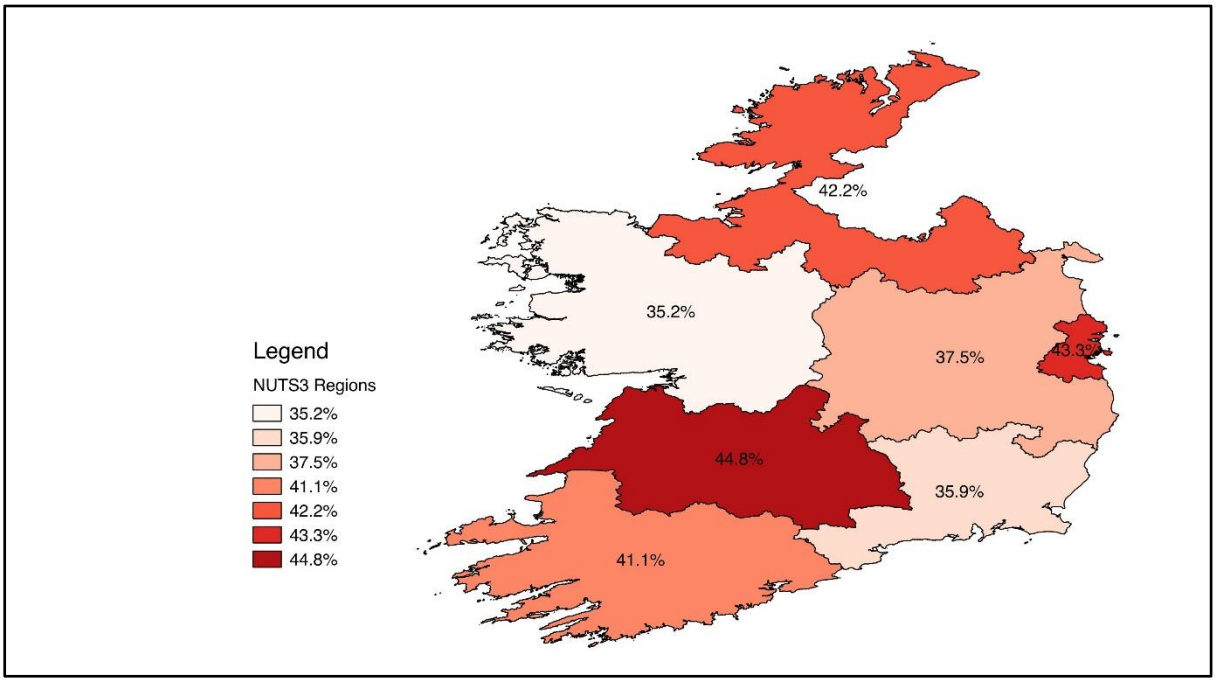


Figure A2.4: Adoption of Computer-aided Design (CAD)

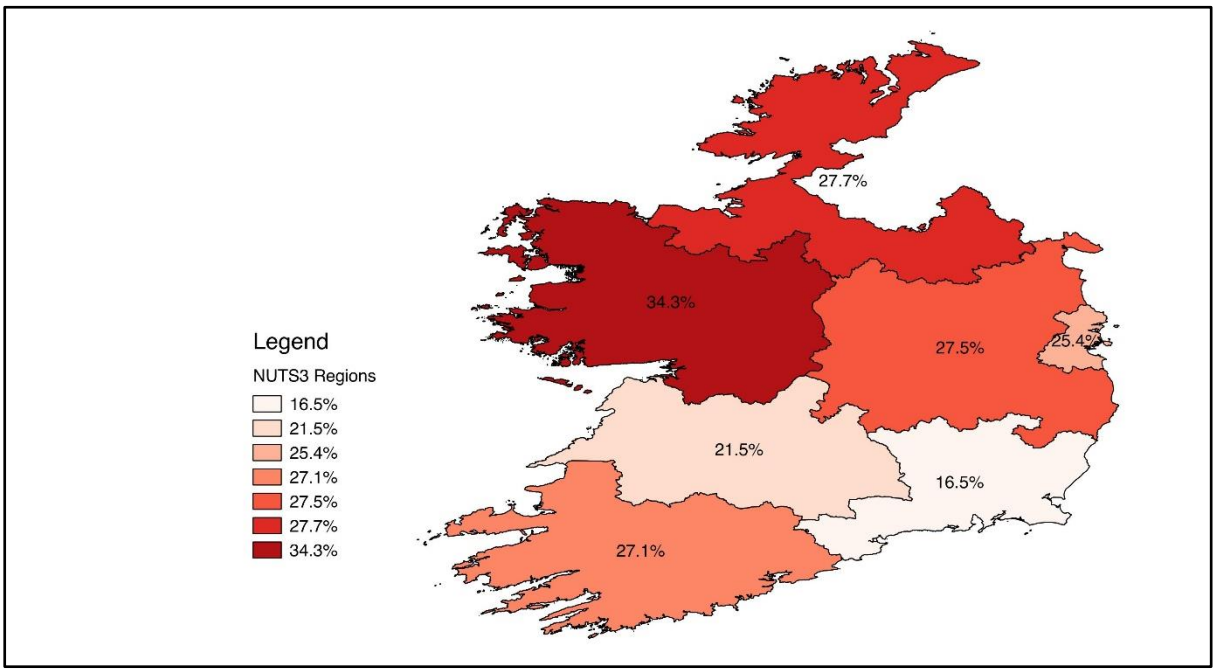


Figure A2.5: Adoption of Cloud Computing

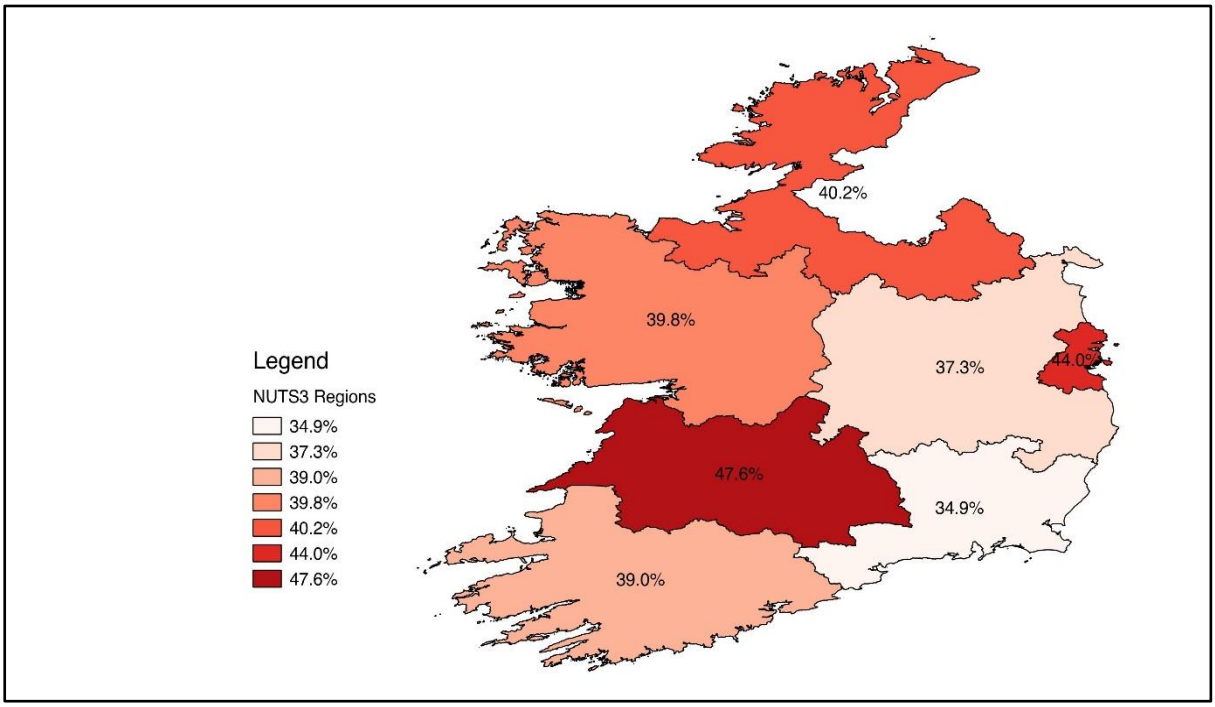


Figure A2.6: Adoption of Artificial Intelligence (AI)

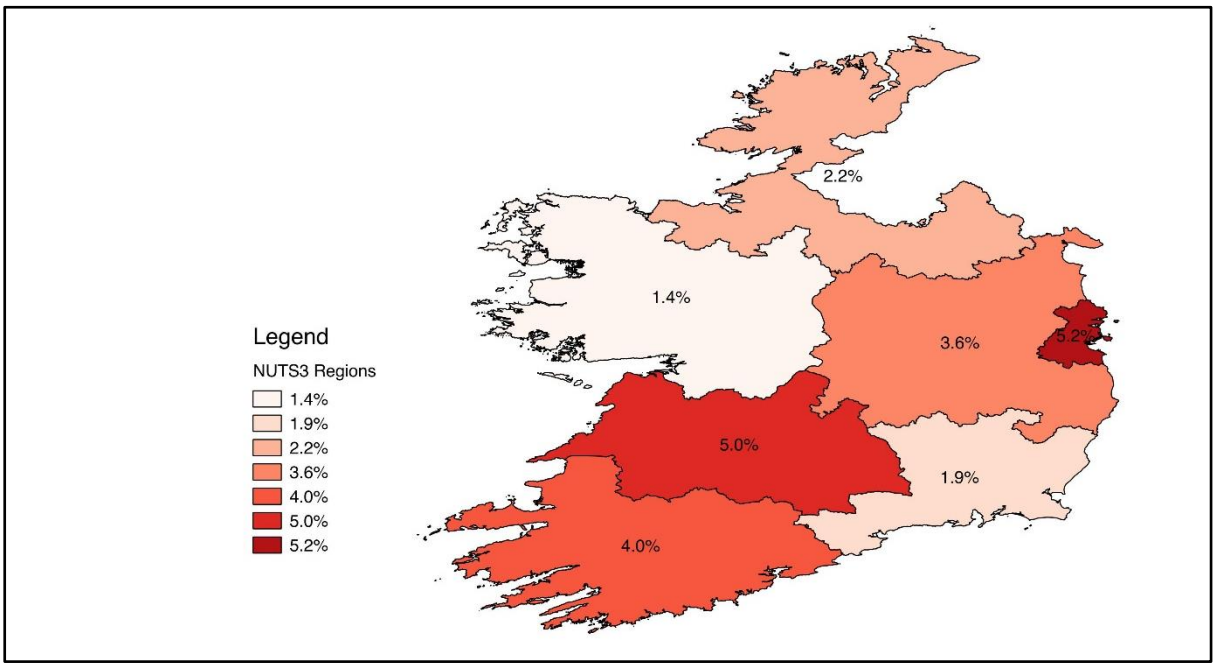
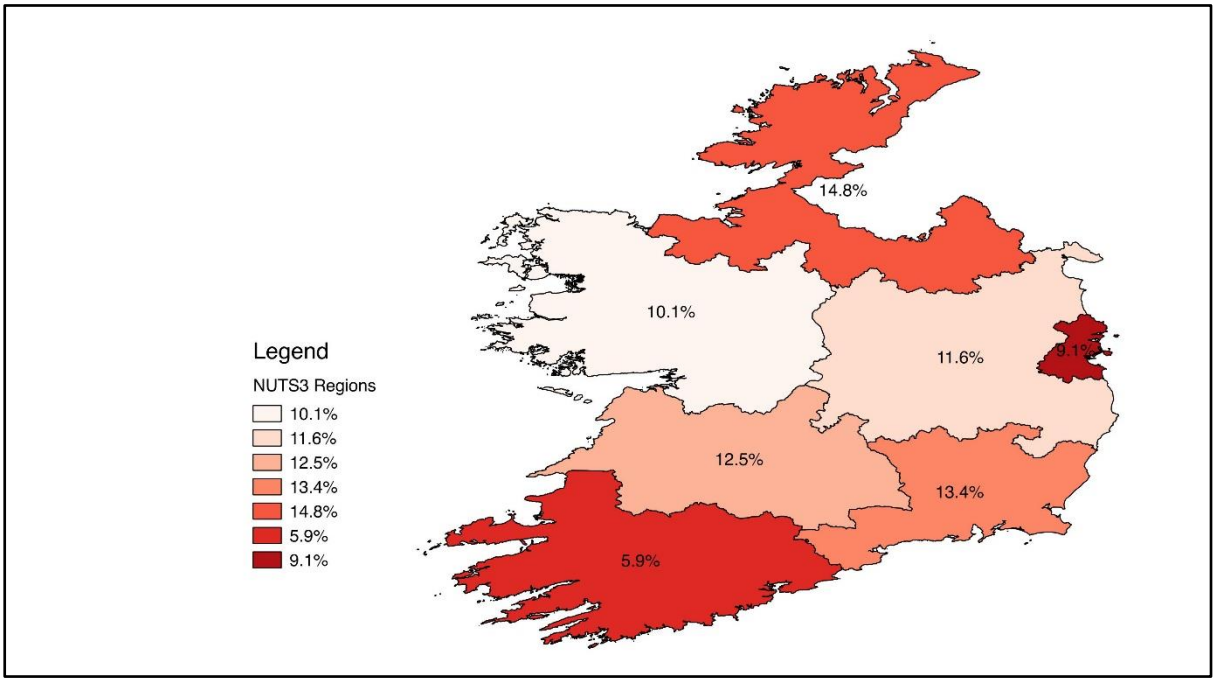


Figure A2.7: Adoption of Machine Learning



Endnotes

[i] Central Statistics Office (2018). Business Demography 2016. CSO statistical release 04 July 2018. https://pdf.cso.ie/www/pdf/20181024015127_Business_Demography_2016_full.pdf

[ii] For example, we know very little about the nature of innovation activity in micro-firms as firms with less than 10 employees are excluded from the flagship Innovation in Irish Enterprises Survey. Similarly, micro-businesses are also excluded from the OECD Digital Adoption survey so – until now – we have known very little about the adoption of new technologies by micro-firms.

[iii] Central Statistics Office (2018). Business Demography 2016. CSO statistical release 04 July 2018. https://pdf.cso.ie/www/pdf/20181024015127_Business_Demography_2016_full.pdf

[iv] This international project, undertaken by the Enterprise Research Centre, was funded by the UK Government.

[v] Hermans, J., Vanderstraaeten, J., Van Witteloostuijn, A., Dejardin, M., Ramdani, D., & Stam, E. (2015). Ambitious entrepreneurship: a review of growth aspirations, intentions and expectations. In *Entrepreneurial growth: individual, firm and region* (Vol. 17, pp. 127-160).

[vi] OECD. (2012). *An International Benchmark analysis of public programmes for high growth firms'.* Paris: Organisation for Economic Co-operation & Development.

[vii] The NUTS3 regions in Ireland include: Border (Cavan, Donegal, Leitrim, Monaghan, Sligo); West (Mayo, Roscommon, Galway & Galway City); Mid-West (Clare, Tipperary, Limerick City and County); South-East (Carlow, Kilkenny, Wexford, Waterford City & County); South-West (Kerry, Cork and Cork City); Dublin (Dún Laoghaire–Rathdown, Fingal, South Dublin and Dublin City); and Mid-East (Kildare, Meath, Wicklow, Louth).

[viii] Department of Enterprise, (2014). *Innovation survey of micro-businesses in Northern Ireland*. Belfast. Roper, S., & Hewitt-Dundas, N. (2017). Investigating a neglected part of Schumpeter's creative army: what drives new-to-the-market innovation in micro-enterprises? *Small Business Economics, 49*(3), 559-577. doi:10.1007/s11187-017-9844-z

[ix] OECD. (2017). *The next production revolution: implications for government and business*, Paris: Organisation for Economic Co-operation & Development.