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ADR NORTHERN IRELAND

Data Insight

Impact of technology investment on Northern Ireland's economy

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Date: June 2023

This study explored the effects of technology investment on Northern Ireland's economy. It found that firms investing in technology experience increased employment growth and offer higher wages. However, the impact on overall productivity is minimal. The relationship between technology investment and economic outcomes varies based on firm size.

Understanding these dynamics is crucial for policymakers, business owners, and the public to address the productivity puzzle and mitigate job insecurity and inequality. Our research supports the Department for the Economy's vision and emphasises the importance of balancing technological advancements with inclusive growth strategies.

Background

The Northern Irish economy has long struggled with low productivity, predating the challenges faced since the late 1960s. Despite various policies aimed at addressing this historical underperformance, success has been limited. The Department for the Economy's 2021 10x vision focuses on driving productivity growth through targeted technologies and strategic clusters, reminiscent of the capital subsidies employed during the third industrial revolution. However, we find ourselves in a new era of industrial transformation known as Industry 4.0, characterised by real-time data, interconnectivity, machine learning, and automation.

The COVID-19 pandemic has further underscored the need for technology investment, with both companies and the government recognising its importance. However, understanding of the impact of this trend on the economy remains limited. Studies have shown that embracing advanced technology can lead to productivity gains, while the failure to adopt such technologies has been linked to the slowdown in productivity growth across Europe. Nonetheless, the specific implications of technology investment on the Northern Irish economy are still uncertain, with initial findings suggesting only a restricted short-term impact on productivity.

It is crucial to consider the potential consequences of increased technology investment, including potential unemployment, social inequality, mistrust, and even populism . As Northern Ireland embraces this new era, striking the right balance between technological advancement and societal wellbeing becomes paramount.

What we did

In our study, we analysed data from the Northern Ireland Statistics and Research Agency's (2022) Northern Ireland Annual Business Inquiry to gain insights into the impact of technology investment on the performance and growth of organisations in Northern Ireland. We focused on investment in technology to understand how it influences productivity growth, inclusive growth, and green growth.

To gain a deeper understanding of the data, we employed statistical measures such as averages, modes, medians, and ranges. Visual representations, such as charts and graphs, were also used to identify any missing or unusual values in the data. Through these analyses, we gained valuable insights into how organisations in Northern Ireland received subsidies, made investments, and experienced employment growth.

To conduct more rigorous analyses, we employed a statistical technique called fixed effect panel regressions. This method allowed us to account for individual differences between organisations and control for any hidden factors that could impact our results. Sensitivity checks were performed to ensure the reliability of the relationships between different variables in our analysis.

Throughout our study, we considered important factors such as firm size, legal status, subsidies, and industry sectors. By examining these factors collectively, we obtained a comprehensive understanding of the dynamics of the business environment in Northern Ireland.

What we found

The results, reported in Table 4, provide empirical evidence of the positive impact of technology investment on employment growth and wages. Specifically, we found a significant increase in employment growth associated with an increase in technology investment. This suggests that firms investing in technologies tend to create more jobs. Similarly, we observed a positive relationship between technology investment and wages, indicating that firms investing in technology tend to offer higher wages to their employees. Additionally, we identified a significant positive association between technology investment and a proxy for eco-unfriendly growth, suggesting that technology adopters are less likely to adopt environmentally-friendly practices.

When examining the relationship between technology investment and labour productivity, we found no effect. This suggests that while technology investment may lead to employment and wage growth, it may not substantially impact overall productivity levels. Furthermore, we noted a negative relationship between technology investment and alternative employment (part-time employees, unpaid employees, and temporary agency staff), indicating that overall employment conditions are likely to improve somewhat. Still, the relationship is insignificant, so we cannot establish a binding relationship for an average firm.

Interestingly, in the additional regressions reported in Table 5, the effect of firm size emerged as a significant moderator. Further analysis uncovered that for larger firms, investment in technology does not necessarily result in higher employment, with the coefficient now being negative. For smaller firms, we see that the growth in employment is significant. We also find that larger firms, which possess greater resources and flexibility, exhibited less impact on employment conditions and offered higher wages compared to smaller firms. Thus, technology enables smaller firms to mitigate their lower employment growth, but it does not necessarily translate into improved employment conditions for these firms.

Table 1: Descriptive statistics with investment in technology and various outcome variables across regions in NI

	Investment		Growth in Employment		Growth in Alter. Emp.		Growth in Wages		Growth in LP		Growth in Eco-adverse		N
Region	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Mid and East Antrim	682.04	3386.50	-0.06	0.18	1.16	0.26	0.06	0.49	0.04	1.18	-0.08	0.18	328
Mid Ulster	643.49	2288.10	-0.02	0.24	1.31	0.29	0.03	0.37	0.10	1.67	-0.08	0.17	590
Newry, Mourne and Down	860.82	5411.62	-0.03	0.34	1.21	0.59	0.03	0.43	0.07	2.49	-0.09	0.19	568
Belfast	1173.00	8836.10	-0.02	0.41	1.36	1.30	0.14	2.62	0.69	9.29	-0.07	0.18	1249
Fermanagh and Omagh	620.51	2799.37	-0.05	0.21	1.32	0.42	0.00	0.47	-0.07	0.41	-0.09	0.22	357
Antrim and Newtownabbey	1337.63	5418.02	0.13	2.22	1.21	0.06	0.03	0.59	0.28	5.05	-0.08	0.17	401
Causeway Coast and Glens	1869.83	17375.83	-0.05	0.19	1.27	1.19	-0.01	0.22	0.14	1.97	-0.10	0.17	374
Lisburn and Castlereagh	610.12	2980.14	-0.03	0.26	1.21	0.51	0.03	0.39	0.07	2.44	-0.10	0.17	478
Armagh City, Banbridge and Craigavon	1207.81	5422.71	-0.01	0.28	1.38	2.10	0.01	0.30	0.12	2.02	-0.07	0.18	604
Derry City and Strabane	882.87	9122.59	-0.05	0.23	1.13	-0.20	0.01	0.50	-0.01	0.78	-0.10	0.20	355
Ards and North Down	313.59	2313.51	-0.06	0.24	1.08	-0.03	0.01	0.35	-0.04	0.46	-0.09	0.20	380

Notes: This table illustrates variations in key indicators across different NI regions. Each region is characterised by an average value ('Mean', expressed in thousand £), a spread of values ('standard deviation'), and the total sample size (N). The main outlier is Belfast, where companies invest an average of £1,173,000 in technology with a deviation up to £8,836,100, indicating high variability. Moreover, though productivity in Belfast has increased rapidly, this growth is inconsistent. Growth figures represent annual changes, computed using logarithmic measures.

Table 2: Descriptive statistics with investment in technology and various outcome variables across sectors in NI

	Investment		Growth in Employment		Growth in Alter. Emp.		Growth in Wages		Growth in LP		Growth in Eco-adverse		N
Sector	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
N	840.94	4414.27	0.22	1.24	1.01	3.48	0.09	0.49	2.78	20.23	-0.07	0.15	263
G	638.95	2211.25	-0.01	0.96	0.27	2.96	0.00	0.29	0.13	2.32	-0.07	0.22	1205
B	3224.78	4629.76	-0.03	0.19	0.53	1.79	0.05	0.61	-0.10	0.17	-0.08	0.17	29
S	33.12	153.63	-0.17	0.30	0.00	0.79	-0.02	0.63	0.10	1.99	-0.17	0.25	336
C	1465.62	6862.10	0.00	0.17	0.27	1.07	0.04	0.26	0.13	2.73	-0.05	0.12	1401
M	248.81	1509.56	0.00	0.35	0.41	3.80	0.02	0.33	0.14	1.95	-0.07	0.20	581
H	2647.78	13774.56	-0.04	0.34	0.22	0.93	0.03	0.53	0.06	1.06	-0.11	0.20	301
Q	316.62	2276.52	0.01	0.49	0.42	3.82	0.04	0.76	0.10	1.41	-0.06	0.14	347
F	1223.28	20016.73	0.02	2.01	0.41	2.07	0.05	0.97	-0.05	0.77	-0.13	0.22	649
I	420.84	2224.21	-0.07	0.23	0.37	2.46	0.01	0.29	0.49	3.52	-0.05	0.30	282
J	742.77	3855.96	0.03	0.43	0.30	0.94	0.47	5.41	0.60	5.73	-0.10	0.19	288
E	3036.53	18772.49	0.01	0.48	0.05	0.43	-0.02	0.24	-0.12	0.25	-0.11	0.25	73
L	368.52	2521.79	-0.16	0.27	-0.14	0.39	-0.06	0.27	-0.17	0.32	-0.20	0.24	184
P	2222.28	12549.07	-0.15	0.23	0.65	4.72	-0.06	0.34	0.50	2.50	-0.09	0.23	64
A	1494.63	15112.83	-0.11	0.24	-0.04	0.36	-0.06	0.32	-0.07	0.50	-0.12	0.21	131
R	2944.97	26680.39	-0.06	0.32	0.21	1.48	0.18	0.73	3.00	14.18	-0.08	0.22	111
D	6902.38	14278.96	0.03	0.16	0.41	1.00	0.09	0.12	1.23	6.34	-0.09	0.18	29

Notes: This table provides an overview of technology investment and related impacts across NI sectors, as classified by the SIC 2007 system. Each sector displays its average investment (mean in thousand £), variability (SD) in aspects such as employment, alternative employment, wage growth, labour productivity, and environmental metrics, and the total sample size (N). The SD values highlight considerable differences in technology investments and associated outcomes across sectors.

Table 3: Correlation analysis with investment in technology and the outcome variables across sectors in NI

Dependent variables (Growth in)	(1b) employment (log)	(2b) alternative employment (log)	(3b) wages (log)
Investment in technology (log)	-0.004 (0.005)	-0.033*** (0.013)	0.041*** (0.006)
Size – Medium	-0.219*** (0.034)	-0.184** (0.084)	0.225*** (0.044)
Sime - Small	-0.333*** (0.037)	-0.279*** (0.091)	0.450*** (0.048)
Investment: Medium	0.022*** (0.006)	0.034** (0.014)	-0.032*** (0.007)
Investment: Small	0.019*** (0.006)	0.034** (0.014)	-0.037*** (0.007)
Observations	20,420	22,892	20,370
R2	0.215	0.037	0.156
F Statistic	85.292*** (df = 43; 13390)	12.695*** (df = 43; 14367)	57.611*** (df = 43; 13366)

Notes: This table offers a correlation analysis between technology investment and different outcome metrics across NI sectors. It displays the relationship between technology investment, its growth, and growth in outcomes such as employment growth, alternative employment growth, wage growth, labour productivity, and environmental metrics. For instance, a positive correlation of 0.073 exists between investment and growth in wages. The data shed light on the linear relationships between technology investment levels and corresponding outcomes in NI.

Table 4: Extract from the panel regressions

	Investment	Growth in Investment
Growth in Employment	0.003	0.009
Growth in Alter. Emp.	0.002	0.008
Growth in Wages	0.073	0.075
Growth in LP	0.002	-0.003
Growth in Eco- adverse	0.010	0.010

Notes: This table presents panel regression results, focusing on the impact of technology investment on logged annual growth metrics: employment, alternative employment, wages, productivity, and green measures. Notable findings include a positive relationship between technology investment and both employment growth and wages. There's also a link between technology investment and eco-adverse growth, suggesting less eco-friendly practices among adopters. However, technology investment doesn't significantly affect overall productivity or alternative employment conditions. R-squared values range from 3.7% to 21.5%, demonstrating the models' explanatory capability, with the F-statistic emphasising the statistical significance.

Table 5: Extract from the panel regressions, inc. moderating effect of size

Dependent variables (Growth in)	employment (log)	alternative employment (log)	wages (log)	productivity (log)	eco-adverse (log)
Investment in technologies (log)	0.014*** (0.002)	-0.003 (0.005)	0.009*** (0.002)	-0.001 (0.003)	0.006*** (0.001)
Observations	20,420	22,892	20,370	22,965	22,966
R2	0.215	0.037	0.156	0.042	0.158
F Statistic	85.292*** (df = 43; 13390)	12.695*** (df = 43; 14367)	57.611*** (df = 43; 13366)	14.663*** (df = 43; 14437)	62.919*** (df = 43; 14438)

Notes: This table delves into panel regression results analysing the impact of technology investment on employment metrics, considering company size as a moderating factor. Key findings indicate a pronounced positive relationship between technology investment and employment growth in smaller firms. While many small firms investing in technology observe employment growth, these SMEs tend to rely more on alternative employment modes and present modest wage growth. The R-squared values range from 3.7% to 21.5%, with F-statistics underlining the significance of these relationships.

Numerous controls were included in the estimation but they were excluded from reporting. *p<0.1; **p<0.05; ***p<0.01

Why it matters

A deeper understanding of how investment in technologies affects the Northern Irish economy, including productivity and employment, is vital for policymakers, business owners, academics, and the general public. This knowledge is key to addressing the long-standing productivity puzzle in Northern Ireland and alleviating technological anxiety among the population.

Investing in technology has an increasingly significant impact on employment conditions and availability. Secure and well-paid jobs have been reduced and replaced by the gig economy. There is potential for further job reductions, as demonstrated by the partial displacement of taxi drivers by Uber and the future prospect of driverless cars. These emerging technologies are likely to exacerbate inequality and contribute to job insecurity and overall employment loss, particularly for lower-skilled workers.

While some evidence suggests that investment in technology creates new, higher-skilled jobs, its specific implications within Northern Ireland remain unclear. Robust and empirical evidence measuring the large-scale effects of technology investment on job creation across the entire UK is still lacking, further fueling technological anxiety.

This project played a vital role in reducing technological anxiety by providing a deeper understanding of how investment in computers, machinery, and equipment influences employment dynamics within organisations. By identifying the extent to which such investments contribute to changes in employment conditions, this research enhances our understanding of human capital needs and helps policymakers, business owners, and the general public navigate the challenges of Industry 4.0.

Additionally, the study contributes to the Department for the Economy's 10x vision, which aims to drive innovation, productivity gains, and inclusive growth through targeted technologies and strategic clusters. The project's descriptive statistics comparing regions and sectors in their technology investment and resulting benefits, such as economic growth, inclusive growth, and green growth, will support the assessment of the 10x vision's success.

Moreover, this research offers insights into the relationship between technology investment and employment growth and conditions in an advanced economy like Northern Ireland, where skill shortages pose challenges. The findings emphasise the importance of balancing technological advancements with strategies that promote inclusive growth and support small firms in adapting to changing economic landscapes.

By considering the impact of technology adoption on the workforce and implementing strategies to mitigate employment reductions, policymakers and businesses can effectively navigate the dynamic landscape of technological advancements. Addressing skill gaps and challenges related to digital exclusion is crucial to closing productivity gaps in regions like Northern Ireland and promoting sustainable economic development.

What next?

Our project extends beyond its current scope. We are actively disseminating our findings and engaging with the academic community. We presented our research at a prestigious conference: the Royal Statistical Society International Conference 2023. This platform allowed us to showcase our work and explore the intricate dynamics shaping technology investments and their implications for economic growth.

Furthermore, we have submitted our findings to the journal Economic Letters, known for its rigorous peer-review process and focus on impactful research. We also plan to expand our research for publication in Small Business Economics, emphasising the specific economic dynamics and challenges faced by small and medium-sized enterprises.

Looking ahead, we will continue building upon our research findings. Collaboration with industry leaders, policymakers, and stakeholders will be sought to explore innovative applications of technology and drive positive change across sectors. Our unwavering commitment to technology investment is motivated by its potential to shape a brighter and more prosperous future for Northern Ireland and beyond.

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