University of Strathclyde Business School

Hunter Centre for Entrepreneurship

Archangels: Impact evaluation of activities, 1992-2015

Dr Niall G MacKenzie, Margaret Coughtrie
Hunter Centre for Entrepreneurship, Strathclyde Business School, University of Strathclyde

Executive Summary

Background
This report was commissioned by Archangels in the spring of 2015. Final draft report was submitted in early August 2015. Final version was completed late August 2015.

Archangels was established in 1992 as a partnership between Barry Sealey and Mike Rutterford. It has since grown into a syndicate comprising around 200 individual investors since inception, of whom around 70 are currently members and is the oldest continuously operating angel syndicate in the world investing in high-risk knowledge intensive companies with growth potential.

Archangels does not operate as a fund – its members invest directly into investee companies and can create their own portfolios whilst the Archangels office exists to facilitate the activities of its members. Its investment criteria comprise four main aspects. Investee companies:

- must be based in Scotland;
- must have high growth and international sales potential;
- should have defensible technology, with clear intellectual property; and
- should be in a sector which qualifies under the Enterprise Investment Scheme.

The funding proposal may cover a range from 'proof of concept' through expansion capital and can include start-up or early stage. The range of investment is typically from £50k to £2m but can be outwith this range for what Archangels considers to be the right opportunities.

At the time of publication, Archangels' portfolio has an estimated current book value of active investments of £37.9m. There are 22 active companies in Archangels' book, 3 are dormant and 36 have failed. There have been 3 Initial Public Offerings (IPO), 1 Management Buyout (MBO) and 14 trade sales.

EVALUATION OBJECTIVES

The evaluation had two main objectives:

1. To understand the economic impact of Archangels' investment activities 1992-2015.

2. To understand the wider, less tangible impact their activities have had within the Scottish economy.

METHODOLOGY

A number of different methodologies were deployed in the evaluation of the impacts that Archangels has had over the period. These include:

1. Literature reviews.

2. Interviews with key stakeholders inside and around Archangels including investment professionals, companies, policymakers, academics and investors.

3. Data collection and analysis using Companies House, FAME, news reports, press releases and interviews.

4. The development of a framework of analysis which captures the investment process and its outcomes leading into an economic impact analysis.

Where possible we have sought to provide comparability and benchmarking of performance in order to show Archangels' impact compared with other relevant organisations and activities.

KEY FINDINGS

Archangels has invested over £90m in 80 companies since it was formed in 1992 and has returned £100.4m by way of exit proceeds or dividends. It currently has an active portfolio of 22 companies, with a book value of £37.9m.

- **Employment**
  Archangels investee companies have created an estimated 2955 jobs over the period 1992-2015. The average salary per job created increases over the period of investment to well in excess of the Scottish average.

- **Economic Contribution**
  Archangels has made a significant contribution to Scottish GVA with an average GVA per company invested in of £1.5m per annum compared with £1.13m for other SCF partner investors.

  Using the 2012 portfolio, for every pound invested by Archangels produced a GVA Economic Impact of between £7.08-£8.94. Including dividends as part of the economic impact the number rises to £7.12-£8.99.

  Between £14.34 and £20.39 of turnover is generated per £ invested by Archangels' companies – in excess of previously documented US VC performance of $6.27 for every $ invested.

- **Support**
  Archangels has historically supported and continues to support pre-revenue companies – 25% of its active portfolio over the period has typically comprised high-risk, technology investments that do not generate revenue.

  Archangels are patient investors with an average investment period of 6 years for the portfolio as a whole, and 8 years for sold companies.

  Archangels offers more than just financial support – it has helped grow the Scottish business angel market through sharing of operational learning with other angel groups and it supports investee companies by sharing access to its networks of professional and other contacts, thereby helping to add value to the companies and the wider Scottish economy.

- **Failures**
  Failures comprise 44% of Archangels' total number of investments, but just 14.9% of the monies invested. Archangels spots failures quickly with an average investment period of 3.66 years, compared to 8 years for sold companies.

- **Exits**
  Archangels has exited from 18 investee companies, of which 12 remained in Scotland and/or the UK, 3 moved abroad and 3 were dissolved. Of the companies that remained in Scotland, they have generated revenues of at least £587m and created a minimum net sum of 240 jobs.

- **Returns**
  Since Archangels' formation, £36.6m has been invested in companies that were successfully exited, returning £100.4m of value to investors. A further £38.6m has been invested in the current active portfolio of 22 companies, some of which are nearing exit events.

  Archangels 10 year returns to 2014 were 20.9% compared with the BVCA's 14.9% for the same period. The Archangels returns are unleveraged, whereas the BVCA returns will have benefited from structural leverage.

Contents

1 Introduction: Purpose of evaluation

This evaluation differs from more traditional assessments of business angel investment activities in that it addresses both the economic impact of the activities of the Archangels syndicate and its commercial performance, rather than focusing solely on the commercial performance.

Business angel syndicates are well established in the UK, and in Scotland in particular[1], but few can claim the history and heritage of Archangels, which has been operating since 1992 and was the first of its kind in Scotland. After 23 years of continuous investment in Scottish-based early stage innovative companies, Archangels has built up a strong reputation and has played an important role in the establishment and growth of angel investing in Scotland. At the time of Archangels' creation, there were no other angel investment groups in Scotland; as of 2015, there are 22 angel groups with at least 1100 individual investors[2] and more family offices that invest, illustrating both the growth of the industry and the increasing importance of angel investment to the Scottish economy in supporting early stage, high growth potential companies.

When considering high-growth firms, it is important to recognise that growth rarely occurs in a continuous or linear fashion.[3] Instead, growth trajectories are often punctuated by critical events including, but not limited to, accessing finance, entering a new market, acquiring another firm, establishing a joint venture, or exporting to a new country. These events typically represent key challenges for SMEs, acting as either triggers or development blockages.[4] Archangels' activities chiefly concern two broad areas which are recognised as posing growth challenges for SMEs:

1. **Acquiring the necessary finance to support capital expenditure or cashflow needs during periods of expansion; and**

2. **Implementing strategies and managerial practices to support growth**

Growth focused SMEs recognise access to funding as the most prominent barrier that they face.[5] Periods of expansion also often require new and more sophisticated managerial practices but SME management teams do not always possess the requisite experience to negotiate the challenges associated with expansion. As such, growth-focused SMEs can benefit significantly from strategic and operational support in the lead up to, and throughout, growth episodes. Research suggests that firms value hands-on, relational support from peers or role models, particularly if this is tailored to their specific strategic and management challenges.[6] Archangels has become well-known for taking exactly this approach to its investments in high growth potential Scottish companies. One of Archangels' co-founders Barry Sealey describes it as 'getting your arms around a company' to help it grow.[7] Consequently this evaluation does not take the typical 'bottom line' approach of seeking to understand the figures only, but also the more intangible contribution that Archangels has made in terms of the wider Scottish angel market and approaches to facilitating early stage company growth approaches.

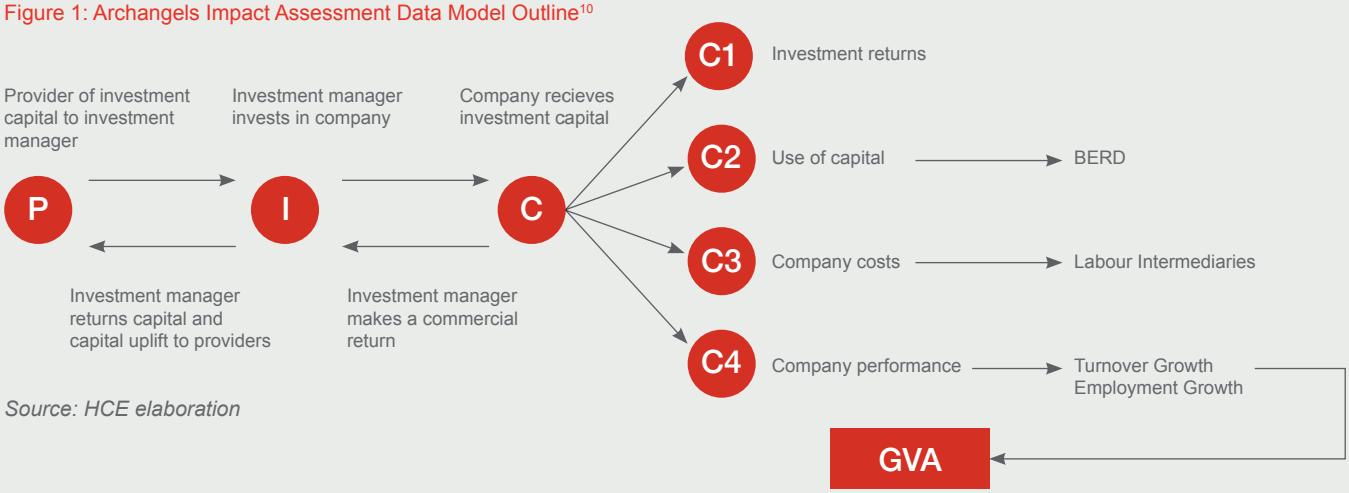
1.1 Assessing Archangels' Economic Impact: Data and Methodology

As part of the design of the methodological and analytical framework, a series of interviews and discussions with academics, reviews of policy and industry literature, and interviews with Archangels' investment professionals were undertaken to develop an appropriate way of assessing the impact that Archangels has had. While most evaluations of public sector interventions take a typically quantitative approach, it was felt that this would only provide a superficial understanding of the impact that Archangels has had. As a result, we have developed a framework which allows us to both assess the process and outcomes of the investments made and what they mean for Scottish economic development. Using a data model outline devised within the Hunter Centre for Entrepreneurship[8], which encompasses the angel investment process and outcomes, we have constructed a database comprising figures from the right hand side of the model below (figure 3), using historical company accounts, which seeks to encapsulate the methodological outline above. The principle behind this approach is about trying to capture Archangels' involvement with, and impacts on, the companies in which its members invested. This approach was taken in order to capture how the investee companies have changed in key areas which then allows for an enhanced understanding of what the economic impact of these activities has been at regional and national levels.[9]

1 OECD (2011). Financing High-Growth Firms: The Role of Angel Investors, OECD Publishing. Paris.
2 Business Insider, 2015.
3 Garnsey, E., Stam, E. and Heffernan, P. (2006) New firm growth: Exploring processes and paths, Industry and Innovation, 13, pp. 1-20.
4 Brown, R. and Mawson, S. (2013) Trigger points and high-growth firms: A conceptualisation and review of public policy implications, Journal of Small Business and Enterprise Development, 20(2), pp. 279-295.
5 BIS (2012) SME Access to External Finance, Department of Business Innovation & Skills, BIS Economics. Paper No.16, London.
6 OECD (2013) An international benchmarking analysis of public programmes for high-growth firms, OECD LEED programme, Paris.
7 Interview with Barry Sealey & Mike Rutterford, 26/06/2015.
8 The methodology has been created and developed in conjunction with Professor Martin Hughes.
9 Due to the lack of consistent data for all companies we have used a representative sample in our calculations, which is consistent with the Archangels' portfolio.

1 Introduction: Purpose of evaluation

Figure 1: Archangels Impact Assessment Data Model Outline[10]



Source: HCE elaboration

Within the confines of the model above, focus has typically been centred on the investment activities and performance of investors as articulated in the green circle I and orange C1 in the model. The company's use of monies and the resultant economic impact of the investment activities undertaken by business angels in Scotland, and indeed more generally[11], remain less well understood and this evaluation is intended to go some way towards addressing this. To that end, the constructs contained within circles C1, C2, C3, and C4 allow us to understand what companies have done with the monies and support received from Archangels in terms of employment growth/jobs created, and the return to Archangels' members on their investment. The constructs C3 & C4 form the basis for the economic impact calculations that we have made on Archangels' estimated contributions to employment and turnover, and the GVA contribution also contained in section 5.

1.2
Data Sources

Data for the evaluation is comprised of four main parts;

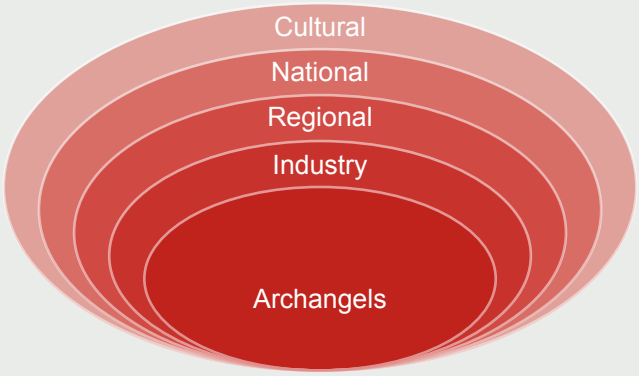
1. **Archangels' proprietary investment portfolio database**
2. **Company output database (compiled by HCE and Archangels)**
3. **Interview materials with Archangels' stakeholders (investors, investment team, companies and other identified stakeholders)**
4. **Data from LINC Scotland**

Archangels holds its own records of investments made by each of its members over the period 1992-present day. Archangels shared these records with us for the purpose of the evaluation, which has allowed us to evaluate the performance of the portfolio and benchmark it against other relevant figures.

The company output database has been constructed using company accounts from the investee companies, sourced from Companies House, Archangels' archives, FAME, public announcements, and interviews with the companies themselves to ascertain relevant information on the performance of the companies in various measures including turnover, employment, R&D spending, wages, operating profit, depreciation, and amortisation. A further dataset was made available to us by David Grahame of LINC Scotland which allowed for a comparison of Archangels' number of deals, value of deals and comparisons with LINC Scotland's remaining membership and the levels of engagement with the SCF.

During the course of the evaluation we interviewed and communicated extensively with Archangels, in particular with Chief Operating Officer David Ovens, the co-founders Barry Sealey and Mike Rutterford, the Chief Executive Officer John Waddell and other employees. Further, we engaged with LINC Scotland and a host of other actors in the Scottish angel investment market to understand Archangels' role in Scotland and how it has changed over the period. The schematic below illustrates how we sought to understand Archangels' impact over its period of investment to date.

Figure 2: Archangels Impact Analysis Schematic



10 BERD stands for Business Expenditure on Research and Development.

11 An exception to this is the publication of a recent report by Amy Bloom and Marie Tyvoll assessung the economic impact of angel investment in Oregon, USA. For more information on this see: Bloom, A & Tyvoll, M (2015), Oregon Angel Investment: The Economic Impact of High-Risk Investment in Oregon's Entrepreneurial Enterprises, Portland Seed Fund/Technology Association of Oregon. However, the report does not explicate its methodology and uses only revenue generation and employment creation as its measures.

2 Scottish economic and industrial context

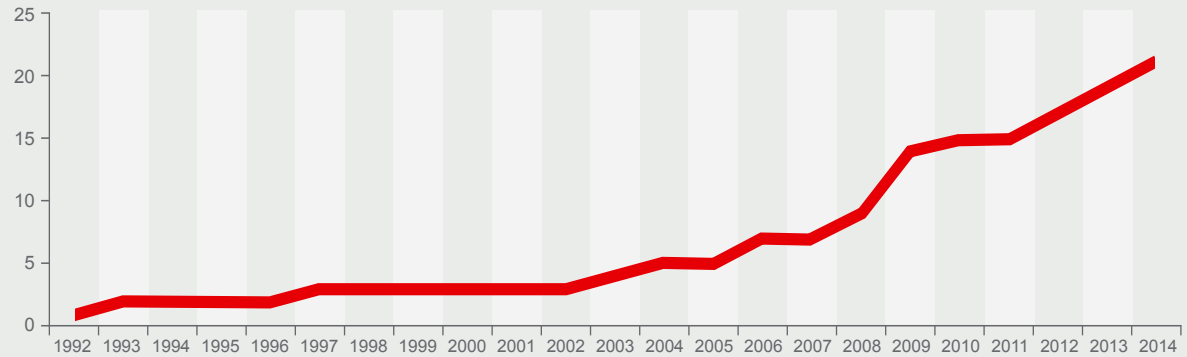
At the time of Archangels' creation, the Scottish economic and industrial context was one that had experienced significant change in the preceding decades – the 'Staple Industries' of coal, steel and shipbuilding that had sustained, then latterly constrained, Scottish economic growth for much of the post-war period had gone, replaced with a Foreign Direct Investment strategy that focused on bringing large foreign multinationals to Scotland with large grants and low exit costs, resulting in them eventually upping sticks and leaving for cheaper locales when grants dried up or competing nations offered more favourable terms. On the positive side, this did result in a number of managers who had been either imported or recruited in Scotland who wished to stay and had skills that led to the creation of new businesses.[12] In the early 1990s Scotland was not seen as a place that was particularly conducive to enterprise or entrepreneurship with the recent long history of labour disputes, paternalistic regional policies, a left-leaning political bent and low business start-up rates. To address this, the Scottish Development Agency and Scottish Training Agency were merged and replaced by Scottish Enterprise in 1991, with a separate agency for the Highlands also created, and the Business Birthrate Strategy launched in 1993.[13] The enterprise agencies and birthrate strategy were established with a view towards improving the environment for a more enterprising culture and to enhance Scottish competitiveness. It is against this backdrop that Barry Sealey and Mike Rutterford embarked upon their business angel investment activities – a term that neither recognised at the time, but which was gaining growing currency in the USA before making the jump across the Atlantic.[14]

2.1
Angel Investing and the Growth of the Scottish Angel Market

Business angels have a long history in supporting new ideas. The term was coined in relation to the financial backers of Broadway performances in New York, but the history of investment in speculative ventures stretches much further back in time. In Scottish terms, the most high profile example (and the most painful for the investors involved) was the Darien Scheme – a Scottish plan in the late 1690s to establish a colony in the Gulf of Darien to connect the Pacific and Atlantic oceans for trade. The Darien Scheme was supported by between a quarter and a half of all monies circulating in Scotland at the time and when it failed, caused enormous political and economic disruption, which has been cited as one of the reasons for the 1707 Act of Union. What Darien represents in contemporary terms is an early example of business angel activity in Scotland – the willingness of investors to invest in a venture at an early stage in its development, requiring both financial and non-financial support to succeed. Business angels have received growing attention and recognition for their activities in the UK, with policy recognition and support growing significantly in the last 25 years. Business angels will typically bear very high risks to support investee ventures – they are private individuals investing in unquoted companies with little guarantee of success, which can make policy support problematic. Their investments typically involve receiving equity that is reduced with further rounds of financing for investee companies. Time, effort and money are typically invested in order to help companies grow and make a return. Angel investment involves a material risk of failure, but the promise of 'winning big' on a minority of deals (around 9% of deals generate ten times the original investment) is one of the drivers which convince angels of the worthiness of the risks of investment.[15]

Scotland possesses a highly developed and very active business angel network that is now embedded into the Scottish entrepreneurial eco-system.[16] From the early 1990s when Archangels began, the industry has developed rapidly, with more than 1100 active single investors[17] and around 20 different groupings of angels currently engaged in supporting early stage businesses.[18]

Figure 3: Number of Angel Groups in Scotland, 1992-2014 *Source: Young Company Finance, 2015 and Group websites.*



12 An example of this is Lab901 Ltd in which Archangels invested and successfully exited. Two former Motorola employees started the company.
13 Scottish Enterprise (1993), Scotland's Business Birth Rate: A Strategy for Scotland, (Edinburgh).
14 Interview with Barry Sealey & Mike Rutterford, 26/06/2015.
15 Wiltbank, R. (2009), Siding With the Angels: Business angel investing – promising outcomes and effective strategies. Nesta, London, pg. 5.
16 Levie et al, MIT REAP Report Scotland, 2014; LINC Scotland, 2015; Mason, et al, 2013.
17 David Grahame of Linc Scotland estimates that there be as much as three times as many single investors as this number.
18 Business Insider, 2015.

2 Scottish economic and industrial context

2.1
Angel Investing and the Growth of the Scottish Angel Market (continued)

Table 1: Scottish Business Angel Groups[19] and Launch Year

	Name	Launch Year
1	Archangels	1992
2	Barwell PLC	1993
3	Braveheart	1997
4	Hamilton Portfolio	1999
5	Aurora Private Equity	2003
6	Tri Capital Ltd	2004
7	Discovery Investment Fund	2006
8	Highland Venture Capital	2006
9	Grampian Biopartners	2008
10	Par Equity	2008
11	Alida Capital International Ltd	2009
12	Bradenham Partners (Northern Ireland, not Scotland)	2009
13	Kelvin Capital	2009
14	Innova Partnerships	2009
15	Equity Gap	2010
16	Gabriel Investments	2012
17	London & Scottish Investment Partners	2012
18	Apollo Informal Investment	2013
19	Investing Women	2013

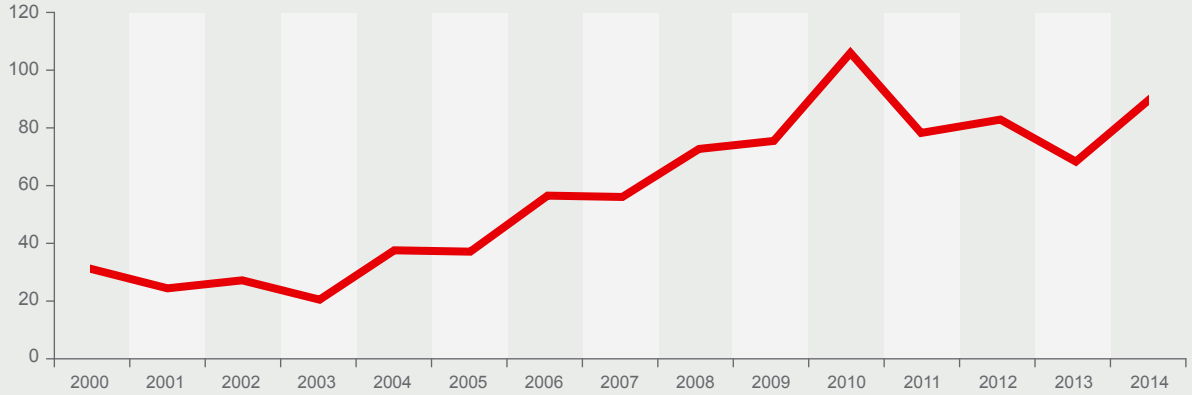
Source: Young Company Finance, 2015 and Group websites.

The proliferation and activities of business angel groups in Scotland has been the subject of a great deal of pioneering work by Professor Colin Mason of the University of Glasgow, and Professor Richard Harrison of the University of Edinburgh, both of whom have contributed significantly to our understanding of the business angel market in Scotland and beyond. Explanations for the growth vary, but it is worth noting that the UK has the most favourable tax benefits for angel investors in Europe[20], offering an incentive to invest. The Enterprise Investment Scheme[21] is principal amongst the different benefits and has played a critical role in helping the angel market develop in Scotland, as well as the development of Archangels' activitie.[22] Furthermore, the creation of LINC Scotland as the national association of business angels in 1993 and its close relationship with Scottish Enterprise[23] helped improve awareness of and educational support for angel activities. LINC Scotland's engagement with government at Scottish and UK levels has been another critical part of the growth of the Scottish angel community. The establishment of the Scottish Co-Investment Fund (SCF) in November 2002 helped the industry grow further.

With the demonstrable growth of angel groups in Scotland came a consequential growth in the number of deals done. Below is a figure showing the growth in the number of deals done in Scotland by LINC Scotland members during the period 2000-2014.

The significant growth of the number of deals is perhaps not surprising given the increase in the number of angel groups in Scotland, but the cumulative total is impressive. Between 2000-2014, LINC Scotland members did a cumulative total of 854 deals with a total value of £273.84m invested – an average of £18.26m invested in an average of 57 companies per year. It is against this backdrop that Archangels evolved from an informal two-man partnership into a significant player in the Scottish angel investment market.

Figure 4: No of Deals by LINC Scotland members, 2000-2014[24] *Source: LINC Scotland.*



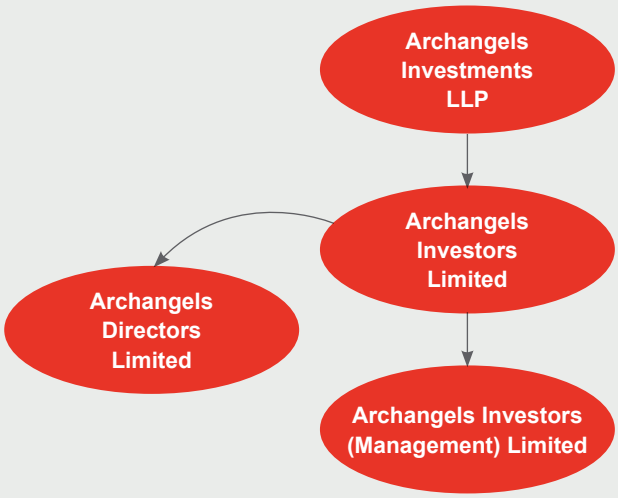
19 We have excluded family offices from this selection – Barwell qualifies by virtue of having other non-family investors involved.
20 Levie et al, *MIT REAP Report Scotland, 2014, pg. 32.*
21 www.gov.uk/government/publications/the-enterprise-investment-scheme-introduction
22 Interview with Barry Sealey & Mike Rutterford, 26/06/2015.
23 Gray, N. (2014). *Rationale and Options for the Development of Business Angels as a Source of Funding for High Growth Potential Businesses. Note for the Task and Finish Group Panel, Development Bank for Wales. Pg. 10.*
24 This includes Archangels deals.

3 Archangels Operations and History

Archangels was established in 1992 by Barry Sealey and Mike Rutterford and is the oldest business angel syndicate in Scotland and the longest, continuously operating angel syndicate in the world. Since it was established, it has managed investment of approximately £91.5m of equity and loan finance on behalf of over 200 investors into 80 companies across Scotland. During this period £100.1m of cash has been returned as exit proceeds or dividends, with a current book value of active investments of £38.9m. There are 22 active companies in Archangels' portfolio, 3 are dormant and 36 have failed. There have been 3 Initial Public Offerings (IPO), 1 Management Buyout (MBO) and 14 trade sales.

The current group structure of Archangels is set out below:

Figure 5: Archangels group structure



Archangels Investments LLP was established in November 2014 to engender a sense of ownership of the business amongst Archangels' investors. It is not a trading entity, but is the ultimate holding entity for the group. The majority of Archangels' investors are partners in Archangels Investments LLP and, as at the date of this report, there were approximately 70 partners. Archangel Investors Limited (formerly Archangel Informal Investments Limited) was incorporated in July 2000 and is currently the main trading entity within the group. The company's board comprises six non-executive directors and one executive director (the CEO). In addition to the board, the company has a team of three investment executives, one office manager and a Chief Operating Officer. Barry Sealey and Mike Rutterford have both been involved as founder members since the organisation's inception, with three different gatekeepers during this period.[25]

3.1 Operations

The group's business ethos is underpinned by four fundamental pillars, which are to:

1. Give something back;
2. Help young Scottish companies;
3. Generate attractive investment returns; and
4. Have fun.

Archangels is a professional business angel syndicate, owned by its members, all of whom have the right to invest in any investment proposition put forward by the investment team following due diligence and Archangels' Board support. A board of directors, who invest at least £100,000 in all new deals, oversees the business, and the core objective of Archangels is not to build its own balance sheet, but rather to create value for its members through careful and active management of the portfolio companies from initial investment through to exit. Archangels does not operate or manage a fund. Its members invest directly into investee companies and can create their own portfolios, whilst the Archangels office exists to facilitate the activities of its members. In terms of investment criteria, Archangels apply the following:

Investee companies:

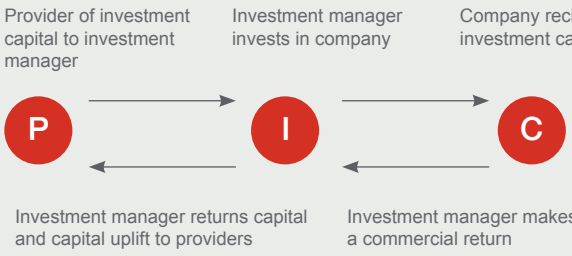
- must be based in Scotland;
- must have high growth and international sales potential;
- should have defensible technology, with clear intellectual property; and
- should be in a sector which qualifies under the Enterprise Investment Scheme.

The funding proposal may cover a range from 'proof of concept' through expansion capital and can include start-up or early stage. The range of investment is typically from £50k to £2m but can be outwith this range for what Archangels considers to be the right opportunities.

Archangels' core operating proposition is represented below:

Figure 6: Archangels Operations Model

Source: HCE elaboration



P = Provider of investment capital (the members/investors)
I = Investment Manager (Archangels)
C = Company receiving funding

Within the operating model outlined above, it is important to note that Archangels' members select and invest directly themselves, i.e. they can choose whether or not to invest in any company and the amount of investment.

25 The three gatekeepers are Juliette Chapman (1997-2000), Peter Shakeshaft (2000-2005) and John Waddell (2005-2015), the latter two of which have been Chief Executive. For more on gatekeepers and business angel groups see Paul, S. and Whittam, G. (2009). Business angel syndicates: an exploratory study of gatekeepers. Venture Capital, 2009, vol. 12, issue 3, pages 241-256.

3 Archangels Operations and History

3.2 Analysis

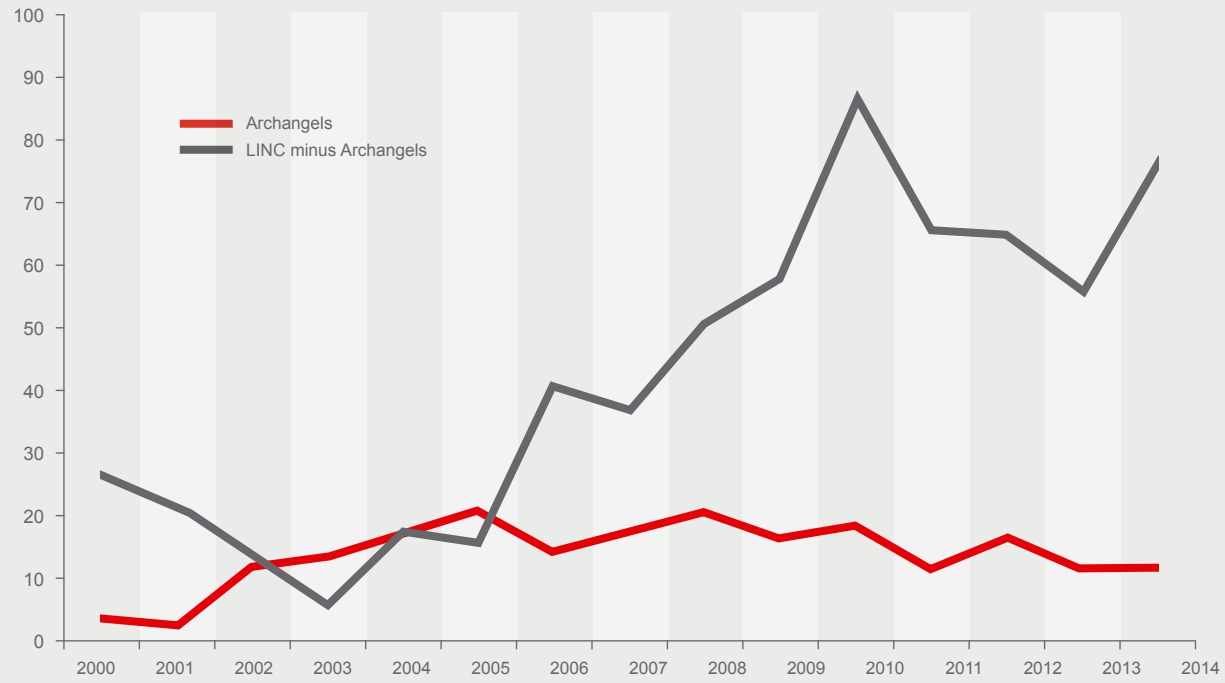
As the first angel group of its kind in Scotland, Archangels very much led the way in helping grow the size and scale of angel investing in Scotland in partnership with LINC Scotland, of which Archangels is a member. In terms of the number of deals done throughout the period 2000-2014[26], at the start of the period we see an increase in Archangels' deals whilst the remaining LINC Scotland members were showing a decline until 2003. In the early 2000s, after the dotcom crash, venture capitalists became much less active in the Scottish early-stage investment market, leaving a significant gap in risk financing.[27] At this point the SCF was introduced[28] as a pari passu investor providing up to £1 for every £1 invested by its private partners. The period after SCF's introduction then saw an increase in both LINC Scotland and Archangels' deals for the first few years, before Archangels began to level off and LINC Scotland showed significant increases in activity as its membership increased.

It is not surprising that the LINC Scotland members increased dealflow relative to Archangels in this period, given the significant increase in its membership. However, despite Archangels' relatively lower number of annual deals, it is the its financial strength which sets it apart from other angel groups in Scotland. This is more clearly illustrated in Figure 8 below, which shows the annual average value of each deal done.

Archangels typically leads all funding rounds in which it participates and leverages the financial strength and track record of its syndicate to bring in other investors where appropriate, in what has been termed 'bundled investment'.[29] In recent years this has resulted in several of its companies benefitting from other angel groups such as TriCap and Barwell getting involved, as well as single investors, and large organisations including Amadeus, 3i, ConocoPhillips, Statoil Technology Invest, Scottish Enterprise and the Scottish Investment Bank, bringing both financial benefit and global expertise to Scottish companies.

On the one hand this spreads risk for all parties, but on the other, it encourages greater dealflow, plays in other angel groups (building capacity and opportunities for learning) and allows for access to greater networks of the social and reputational capital the investors hold for investee companies.[30] Archangels' ability to undertake deals of a higher average value is a critical part of both encouraging dealflow by virtue of Archangels being an active and willing investor, which encourages growth potential companies that finance is available, even where companies need a higher level of funding in order to achieve loftier growth ambitions.

Figure 7: No of deals, 2000-2014 *Source: LINC Scotland.*



26 Data kindly provided by David Grahame of LINC Scotland. The period 2000-2014 is used due to availability of reliable data for this period allowing for comparability.
27 Mason, C. M. and Botelho, T. and Harrison, R, (2013). The Transformation of the Business Angel Market: Evidence from Scotland (August), pg. 18.
28 A brief history of the SCF is discussed in the next section.
29 Mason, C.M. and Botelho, T, (2014), The 2014 Survey Of Business Angel Investing In The UK: A Changing Market Place, pg. 17.
30 There is an increasing body of literature which supports the importance of social capital in high growth ventures. For more on this see Stuart, Toby E. and Olav Sorenson (2010). "Strategic Networks and Entrepreneurial Ventures." Strategic Entrepreneurship Journal.

Figure 8: Average Value of Deals, 2000-2014 (£m) *Source: LINC Scotland.*

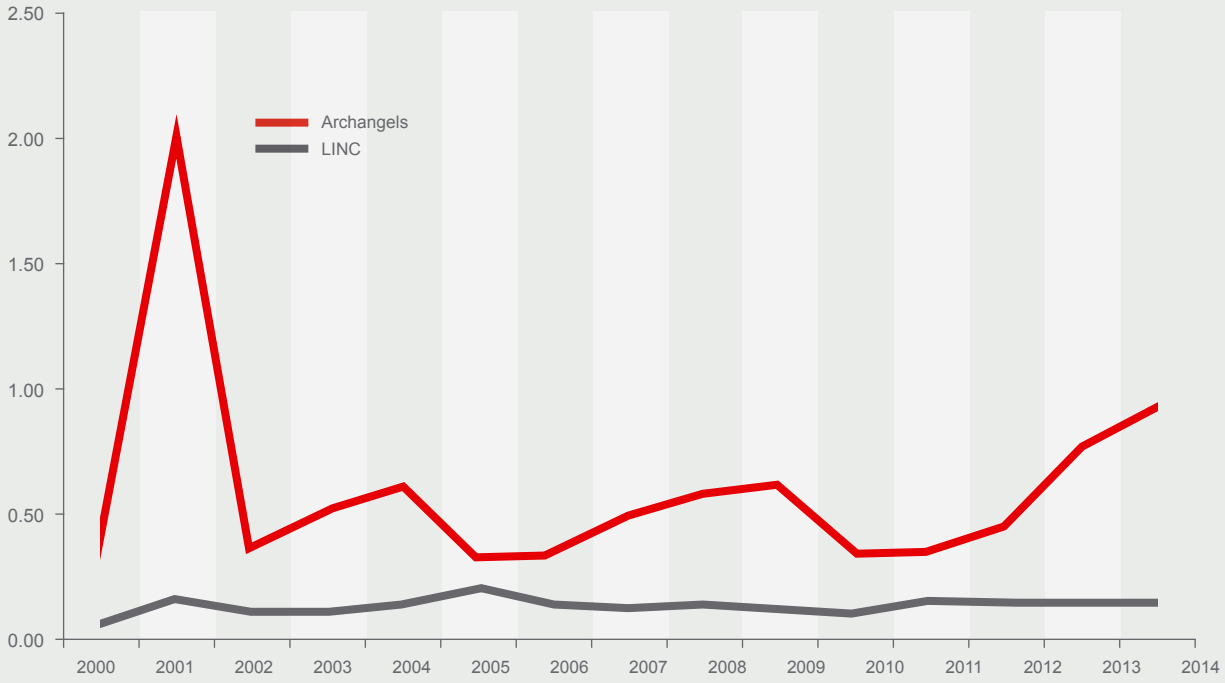
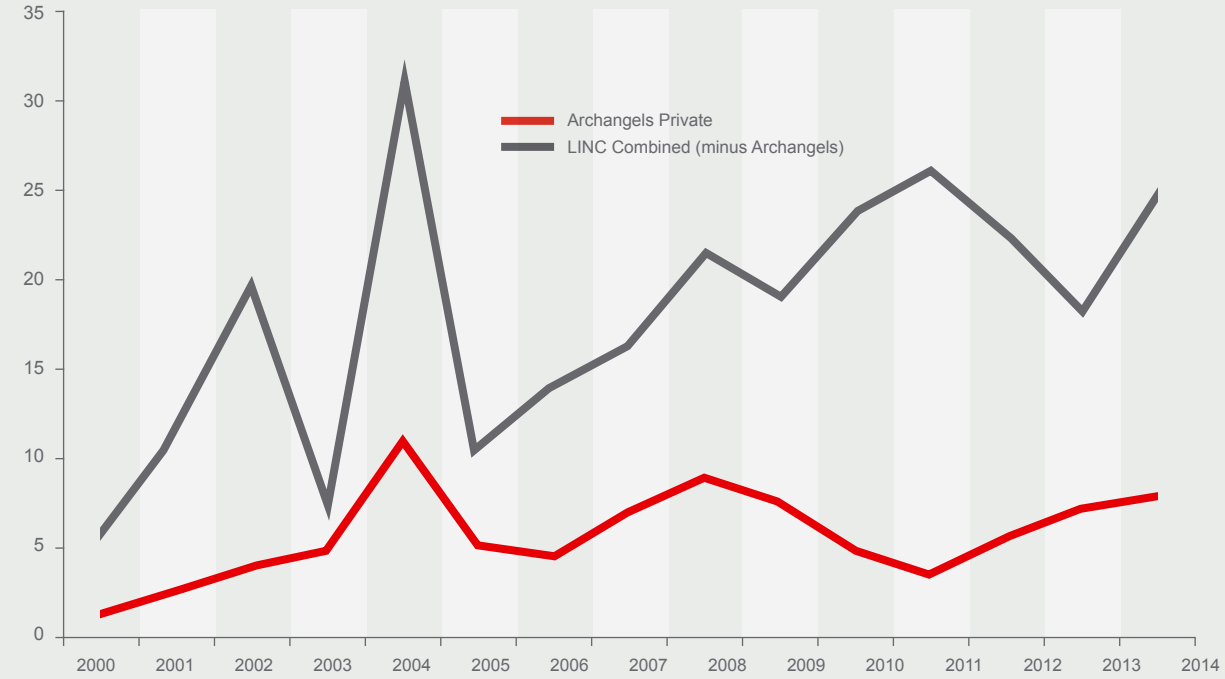


Figure 9: Annual Value of Deals by LINC Scotland Members and Archangels Members' Investment, 2000-2014 (£m)
Source: LINC Scotland.



3 Archangels Operations and History

3.3
Archangels and Scottish Co-Investment Fund

Another critical factor in the increasing dealflow in Scotland was the creation of the Scottish Co-Investment Fund (SCF) in November 2002 (and its subsequent iterations), which has gone some way to helping sustain the higher levels of investment shown by Archangels. Interviews with key stakeholders in the angel community revealed that a joint approach by Archangels (Peter Shakeshaft) and LINC Scotland (David Grahame) to Scottish Enterprise helped create what has now become known as the 'Scottish Model' of angel investment which sees the public sector and private sector partnering to support risk financing of early stage high-growth potential companies with the public sector playing a passive role, allowing the private sector partners to use their expertise to select the investments. Respondents indicated that such a move would not have been possible without the joint efforts of Archangels and LINC Scotland in demonstrating the critical role of angel investors in Scotland in supporting early stage companies. The original plan for the SCF was to support venture capital monies only, but with Archangels and LINC Scotland's joint input a new and innovative model was developed which has now become widely replicated across Europe and beyond. The willingness of policymakers in Scotland to find a way of supporting unregulated investments by private sector partners with public monies was an innovative and critical component in the development of the Scottish angel community and would arguably not have happened without the foresight of Archangels and LINC Scotland in getting together and pushing for recognition of angels in Scotland.

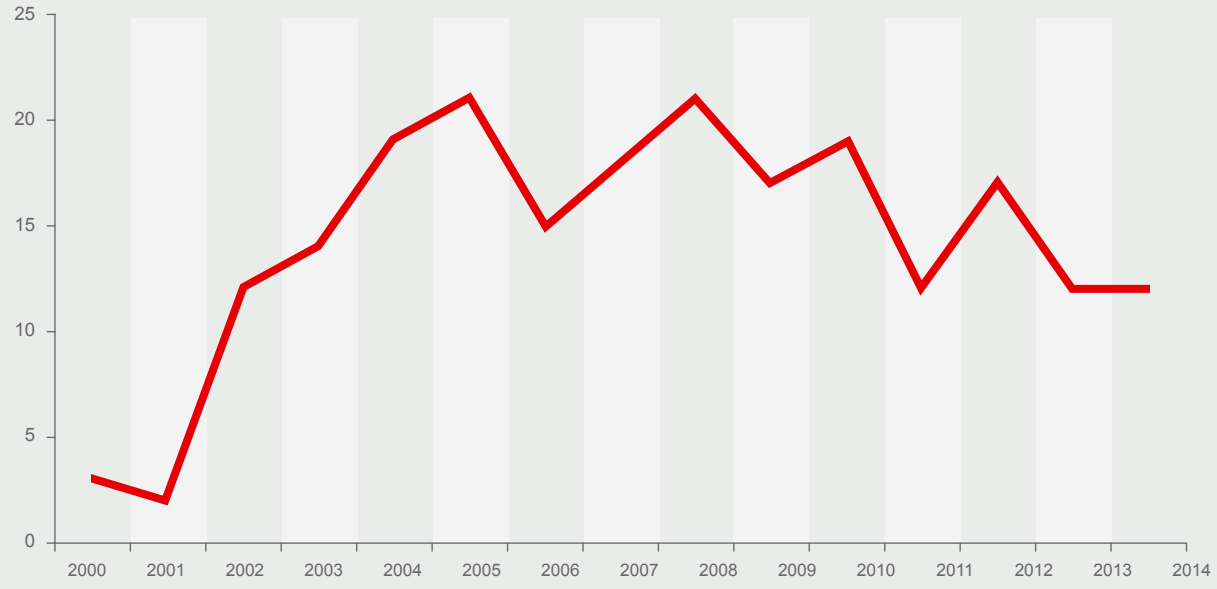
Interviews with Archangels suggested that the SCF has helped 'increase firepower' in terms of the number and size of deals it undertakes, allowing it to invest in more companies than it otherwise would/could have.[31] This is illustrated below:

SCF's creation saw an increase in the number of funding deals for new and existing portfolio companies done by Archangels, which has since settled into between 10-20 deals per annum. SCF operates on the principle that government funds match private funds up to a maximum of £1m, relying on the judgement of the private sector partner. In addition to this, further support includes mentoring and other practical support for investee companies from the public sector, illustrating what has been a well-functioning public-private partnership for supporting early stage growth companies in Scotland. This has resulted in Scottish Enterprise, through the SCF and related sources, having invested around £26.9m in Archangels' active portfolio to date.[32]

Although the SCF has increasingly participated in Archangels' deals, the amount of public monies invested as a proportion of total investment has remained relatively steady at around 25-30% of the average value since 2005, indicating that Archangels has a stable relationship with SCF, using it to increase leverage, particularly in later rounds rather than as a crutch:

It is clear from the graphs above that there is an ongoing, stable relationship between SCF and Archangels which has both helped increase the number of deals Archangels has been able to do in the market, as well as sustaining high levels of investment. The increasing involvement of SCF in Archangels' deals is contextualised by the steady percentage of the value of the deals that SCF has staked suggesting quite clearly that the SCF has avoided moral hazard in its arrangements with Archangels and the partnership is operating effectively.

Figure 10: Annual No of Archangels Deals, 2000-2014 *Source: LINC Scotland.*



31 Interview with Barry Sealey & Mike Rutterford, 26/06/2015.
32 Archangels Database.

Figure 11: Involvement of Public Co-Investment Deals as Proportion of Number of Archangels Deals, 2000-2014 (%)
Source: LINC Scotland.

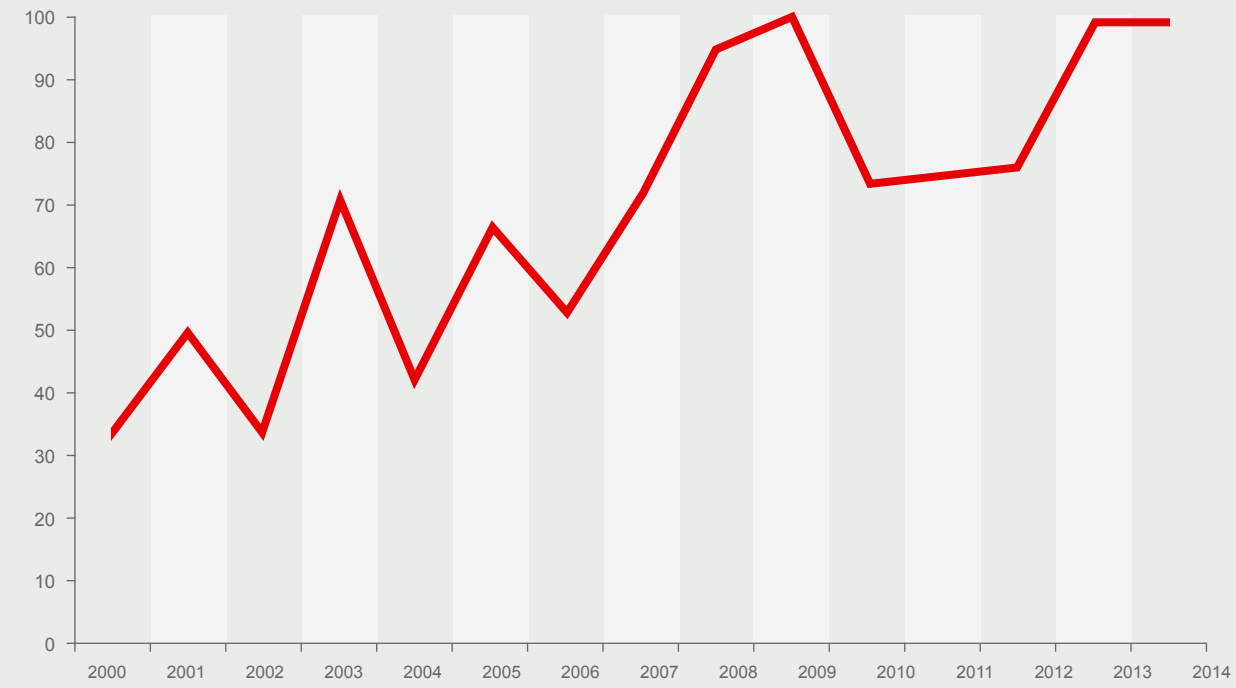
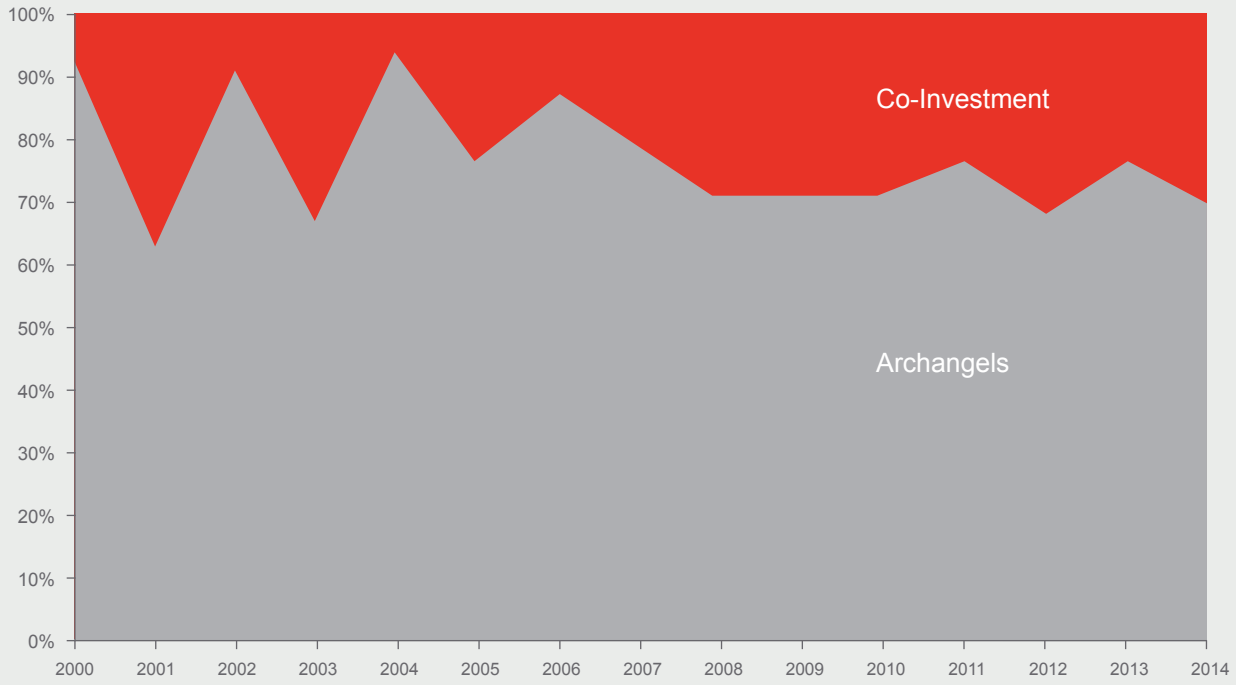


Figure 12: Involvement of Public Co-Investment Deals as Proportion of Value of Archangels Deals (%)
Source: LINC Scotland.



3 Archangels Operations and History

3.4
Archangels' investments by sector

The role of Archangels in the Scottish market can be analysed in a variety of ways, but it is worth considering first what sectors it has invested in in order to understand the impact that Archangels has had more generally in the Scottish market. Below is a chart representing the sectoral breakdown of Archangels' investee companies across the period 1992-2015.

In any given year the investments made by Archangels is an amalgamation of the individual decisions made by its members. It is not surprising, as the membership has grown and with the advent of the SCF in 2002, that the number of companies in which Archangels had an investment - its portfolio - is larger in the 2000s than the 1990s. This was a result of both the increase in the number of investors in the group as well as the aforementioned benefit of the SCF, adding 'firepower' to the number of deals. In fact the average number of companies in the portfolio in the 1990s was 10, in the 2000s it was 30. It is worth mentioning that the discussion of averages raises a very interesting point as in fact there is very little that is 'average' about the Archangels' portfolio. The figure below attempts to depict Archangels' 'portfolio' at any point in time and the ultimate fate of the investments at that time

For any economic impact analysis the key number in Figure 14 is the total number of companies in the portfolio in any given year whether they ultimately failed, are still active or were sold as in that year of analysis they were active and impacting. The colour coding of Sold or Failed outlines the companies' ultimate fate and some of the current active portfolio, in a few years time will be coloured Failed or Sold as their fate will be known. The figure shows that the oldest investment in the current portfolio was invested in 1998. The figure does not represent the time when the company failed or was sold but rather a snap shot of the portfolio at point in time reflecting the investments' ultimate outcome. This shows that all the active positions in the portfolio in 1995 were either sold or they failed and those reflect the ultimate binary outcomes for active companies. For example, the diagram shows that in 2007 there were 32 active companies, 11 of which have since failed, 8 of which have been sold and 13 of which are still active.

Figure 13: Archangels Portfolio by Sector, 1992-2014 *Source: Archangels Database*

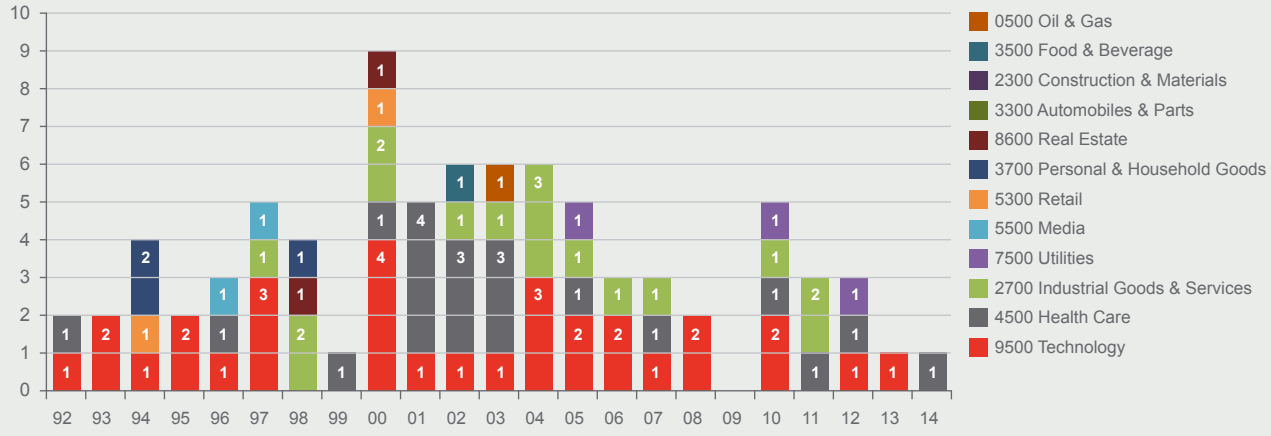
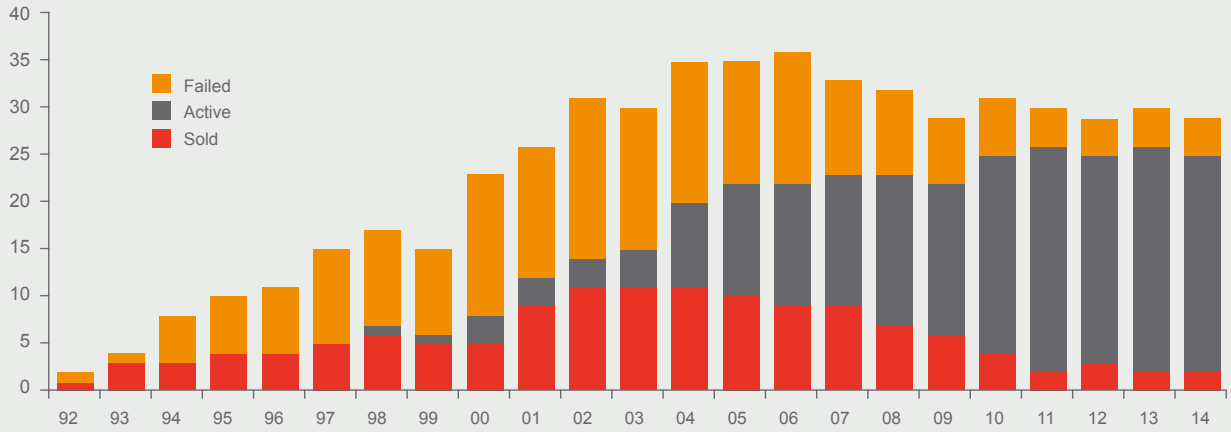


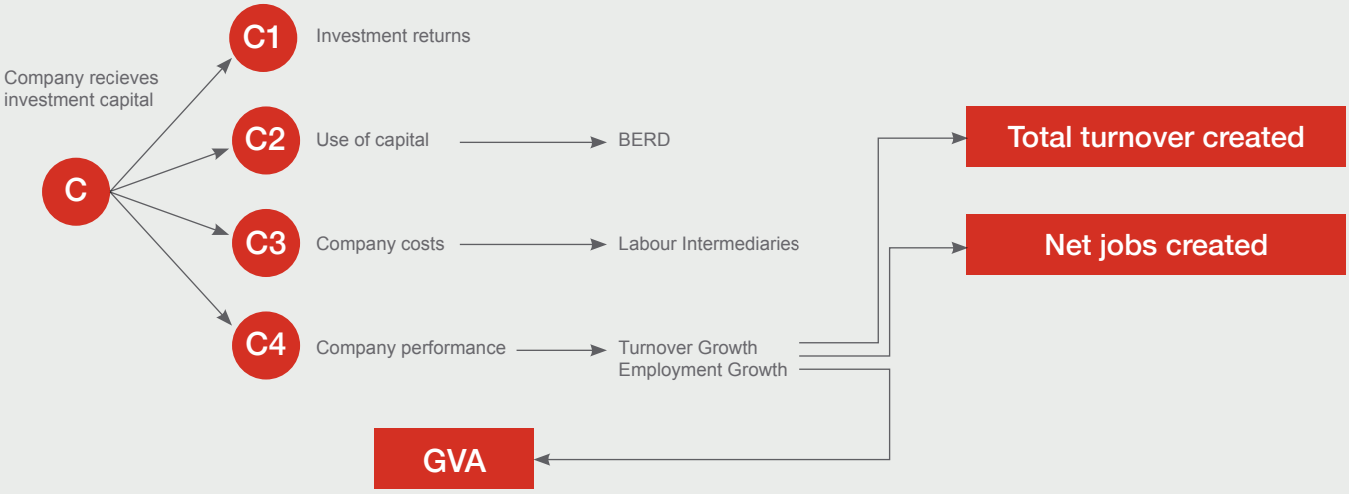
Figure 14: Archangel Portfolio Outcomes *Source: Archangels Database*



4 Archangels performance and impact

Using the right hand side of our evaluation framework noted below, we used the constructs C1 – Investment returns, C2 Use of capital, C3 – Company costs, and C4 Company performance to construct the remainder of the evaluation, which is focused on Archangels' direct influence. Constructs C3 and C4 form the basis for our economic impact evaluation for estimated turnover created, net jobs created and GVA created.

Figure 15: Archangels Impact Assessment Outcomes *Source: HCE elaboration*



4.1
C1 – Investment Returns

4.1.1 Archangels portfolio performance

Of a total cash investment of £91.5m since Archangels' creation, £36.6m has been invested in companies that were successfully exited, returning £100.4m of value to investors. £38.6m has been invested in the current active portfolio of 22 companies.

Figure 16: Archangels Portfolio Spread *Source: Archangels Database*

4 Archangels performance and impact

Figure 17: Archangel Portfolio Outcomes by Sector, 2000-2014 *Source: Archangels Database*

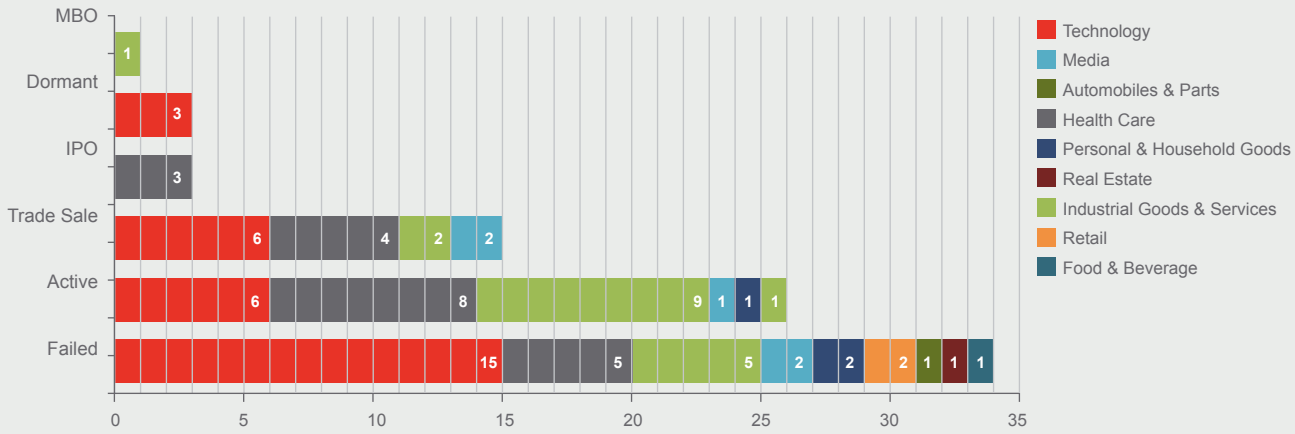


Table 2: Archangels Realised Investments and Returns *Source: Archangels Database*

Year	Sector	Invested (£m)	Returned (£m)	Net (£m)	Multiple	IRR (%)
2014	Utilities	-3.2	8.7	5.6	2.8	24
2012	Health Care	-1.2	3.6	2.4	3.0	26
2011	Health Care	-3.4	3.1	-0.3	0.9	-2
2011	Technology	-0.3	1.1	0.8	3.5	25
2011	Industrial Goods and Services	-0.4	1.0	0.7	2.8	8
2010	Health Care	-5.8	9.7	4.0	1.7	16
2007	Industrial Goods and Services	-0.6	0.1	-0.5	0.2	-25
2006	Health Care	-16.3	56.0	39.7	3.4	23
2006	Technology	-1.2	0.1	-1.1	0.1	-64
1005	Health Care	-0.7	1.4	0.6	1.9	41
1004	Technology	-0.5	0.4	-0.1	0.8	-4
2001	Health Care	-1.7	5.9	4.2	3.5	149
1999	Technology	-0.5	4.4	3.4	4.7	73
1998	Technology	-0.1	1.4	1.3	10.9	88
	Failed	*-12.70*		*-12.7*		
Total		**-48.6**	**96.9**	**48**		

4.1.2 Returns

Calculating financial returns for the overall 'portfolio' or investee companies in any given year serves as a standard comparison tool for investors and observers of the market. Angel syndicates by their nature do not act as a bloc as each member chooses whether to participate in any investment being offered. As not all members have the same tastes in terms of interest and risk appetites, the returns of each member's portfolio can be quite different. In this section however we will look at the investments overall or the Archangels portfolio so we can draw comparisons with other investment bodies, principally the British and European Venture Capital associations. This will allow for a degree of benchmarking against recognised industy metrics.

Our analysis shows that the annual Internal Rate of Return (IRR) for Archangels since inception is 12.6%. However, upon isolating time periods to draw more appropriate comparisons with the BVCA or ECVA, we find the following:

Table 3 IRR comparisons between Archangels, BVCA & EVCA

Group	Since inception	10yr rtns to 2014	Vintage pre-2002
Archangels	12.60%	20.90%	12.60%
BVCA	13.80%	14.90%	14.60%
EVCA	9.20%		

Source: BVCA 2015 Performance Measurement Survey, EVCA reports & Archangels Database

In the above, we have calculated the IRR based on monthly cash flows from the first month of investment in September 1992 until December 2014 when we have taken the estimated value of the active portfolio at that time and assumed it is liquidated at these values. In this measure Archangels substantially outperforms the EVCA, but is slightly outperformed by the BVCA. However, it is important to note that Archangels' valuation practice has generally been to value their stake at the price of the last round of funding, whereas Venture Capital funds (VCs) generally estimate their

values annually. This different valuation practice may deflate Archangels' relative return to the VCs. In addition, the Archangels' returns are unleveraged, whereas the BVCA returns will have benefitted from a large degree of structural leverage. There is the further consideration to be made that the VC returns are based on finite funds whereas Archangels operates a largely evergreen approach.

In order to calculate the 10 year comparison we valued Archangels' portfolio along the lines of valuing the whole stake at the price of the last round of funding. The portfolio at the end of 2004 contained 29 companies and following this methodology resulted in an opening portfolio value of £35.9m. On this measure Archangels significantly outperforms the BVCA rate.

4.1.3 Failures

According to the Nesta business angel report Siding With Angels, the most likely outcome in any single angel investment is failure, but 'winning' investments are very attractive; they found that 56% of exits fail to return capital, while 9% generate more than ten times the capital invested.[33] Meanwhile, Mason (2009) points out only about 20% of investments will succeed.[34] Therefore, failure is an inevitable part of angel investment. 44% of companies Archangels invested in failed, which represents 14.9% of the total monies invested (£13.6m), and marginally less than the Scottish business angel average losses of 17%.[35]

From a commercial perspective, failure is obviously a significant downside, a guaranteed aspect of angel investing and an accepted risk for investors. However, from an economic development perspective there are wider economic and cultural impacts that are drawn from business failures. Many of Archangels' failures occurred from earlier investments made when the group was formalising its activities and learning about angel investing – what works, what industries to target and where. Consequently we see 29 of the 34 failures occurring before 2005, with only 5 since then suggesting an improvement in performance.

Table 4: Failed Archangels Investments by Average Age and Investment Period, 1992-2015.

	No.	Avg Age at Failure	Avg investment time
Post-2005	5	3.16 years	3.90 years
Pre-2005	29	2.12 years	3.62 years
Total	34	2.27 years	3.66 years

Source: Archangels Database

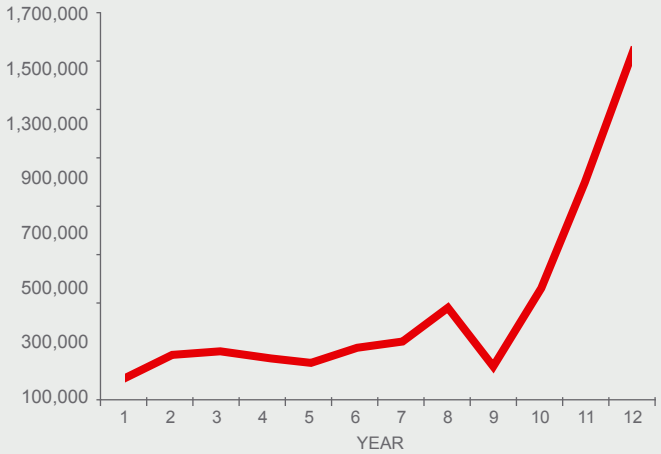
As Archangels is often investing at the cutting edge of technology, there are accelerated developments in knowledge through innovation in the investee companies. Thus, when a company fails, the knowledge created is often re-utlised elsewhere due to its value. From the Archangels' portfolio there are a number of examples where new ventures spawned from the experiences had in the failed company. One is where a professional learned the commercialisation skills to leave to set up his own venture. Another is where a talented employee bought back the shares from Archangels and rebuilt the business into a successful creative company today. It was clear that in the process he acquired the fruits of that investment of knowledge and capital that had gone before.

Archangels is known for supporting the businesses its members invest in and letting the management run them unless more experienced management is required, in which case it will help source suitable people through its network. This empowerment of the management can be seen in the failed investments where there have been at least three instances where the company went into liquidation within six months of raising the last round of capital. This was a painful experience for the investors but does demonstrate a key role Archangels are playing in economic terms where they are absorbing that risk for which few others have the appetite.

4.2
C2 – Use of Capital

Archangels has largely invested in knowledge intensive companies that undertake research and development (R&D). As part of the ongoing development of Scotland into a knowledge-based economy, investment in early stage technologically oriented companies is a critical component. Archangels' support of early stage, high-risk companies with potentially disruptive technologies requiring patience, capital and support underpins the wider development of knowledge as a competitive asset. Consequently we sought to understand what Archangels' investee companies spend on R&D during the period of investment.

Fig. 18: Annual Average R&D Spend of Archangels' Companies (£)
Source: HCE Calculations. n = 13



33 Wiltbank, R. (2009), *Siding With the Angels: Business angel investing – promising outcomes and effective strategies.* Nesta, London, pg. 5.
34 Mason, C.(2009) 'Venture capital in crisis?' Venture Capital: an international journal of Entrepreneurial finance, 11 (4), 279-285
35 Mason, C. M. and Botelho, T. and Harrison, R, (2013). *The Transformation of the Business Angel Market: Evidence from Scotland* (August), pp 26-27. It is worth noting that Archangels play a significant role within the Scottish average business angels losses given that The three oldest groups account for 82% of all losses.

4 Archangels performance and impact

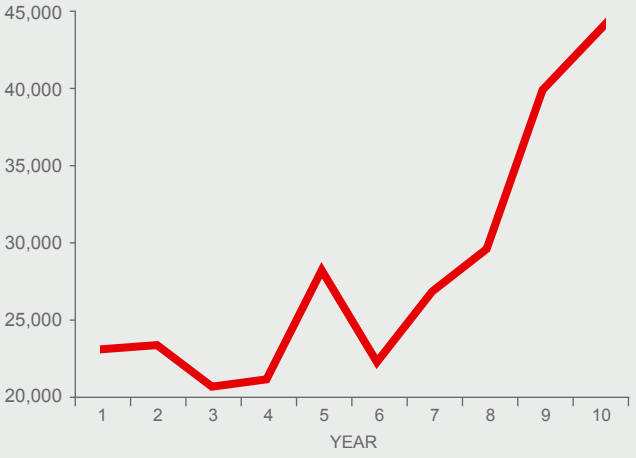
4.2
C2 – Use of Capital

What we see from the figures is that Archangels' investee companies average a stable investment rate for the first eight years, before increasing substantially from year nine onwards. This is consistent with Archangels' average investment period in the portfolio of around 8 years for sold companies before exiting suggesting that the investment in R&D runs alongside the support Archangels offer before exiting.

4.3
C3 – Company Costs

Another important component of understanding the impact of Archangels' investment is what companies do with the investment – what do they spend the money on (other than R&D)? The principal costs incurred by early stage knowledge intensive companies, other than R&D costs, are wages. Consequently we calculated the average salary per job created in invested in companies over a ten-year period.[36]

Figure 19: Average Salary per Job Created in Archangels' Companies, Years 1-10 (£)
Source: HCE Calculations. n = 26



These figures reveal that the patient investment approach that Archangels undertakes creates value in the long run in terms of the types of jobs created in their investee companies. Early stage, high risk companies are not typically well-paying employers – they have to manage cash flow carefully and are focused on developing their unique selling point (USP) in the products or services that they are trying to sell. However, what we see with the above figure is that Archangels' companies start to increase their employees' salaries significantly as they grow. This suggests that Archangels are helping to grow the number of high-value added jobs within Scotland over a longer period of time.

4.4
C4 – Company Performance

4.4.1 Turnover

As part of seeking to understand the impact that Archangels' investments have had over the lifetime of the group, we sought to estimate the sum of companies' turnover generated by the investee companies during the lifetime of investment.[37] We calculated this using annual average turnovers and the average period of investment from the sample and multiplied those by the total number of businesses Archangels invested in, which gives us an estimated sum turnovers over the period of investment for firms Archangels have invested in.

This is represented in the calculation below:

Average annual turnover[38] per invested in company
X
Average period of investment
X
Total number of invested in companies
=
Estimated total turnover created during period of investment

This gives us the following outcomes:

Table 5: Estimated Total Turnover Creation Over Period of Investment 1992-2015[39]
Source: HCE Calculations

	Sample	Portfolio
Average Annual Company Turnover (£)	£2.73m	£2.73m
Average Investment time (yrs)	8.53	6
Estimated Total Turnover (£)	£1.87bn	£1.31bn
Revenue raised per £ invested (£)	20.39	14.34

n = 26 or 30% of total portfolio

This number equates to an estimated total portfolio turnover of between £1.31bn and £1.87bn generated over the 23-year lifetime of Archangels activities depending on whether we use the sample's average investment time (8.53 years) or the portfolio's (6 years). Throughout the period Archangels invested £91.5m in its supported companies. Again, using the sample and the portfolio's investment time, if we divide the estimated total sum of turnovers by this figure, we get between £14.34 and £20.39 of turnover generated per £ invested by Archangels over the period 1992-2015. Both of these figures are in excess of the American National Venture Capital Association's figures of $6.27 generated for every $ invested by VCs in the US between 1970-2010.[40]

36 We matched wages and employee numbers to create a sample of 15 companies to calculate this. The wages do not include Directors' salaries.
37 The lifetime of the investment was used in order to provide a degree of attribution.
38 These have been adjusted for inflation using the Scottish Investment Bank's GDP deflators. 2012 = 100.
39 Our sample comprised of the same number of pre-revenue companies (25%) as the average active portfolio throughout the period.
40 NVCA/IHS Global Insight (2011). Venture Impact: The Economic Importance of Venture Capital-Backed Companies to the U.S. Economy. pg. 2.

4.4.2 Employment

Taking a similar approach to the turnover calculation and attribution, we sought to understand what impact the Archangels' investee companies have had in terms of estimated net jobs created during the period of investment.

Using our representative sample, we made the following calculation:

Average of (Final Year No. of Jobs – Start Year No. of Jobs)
companies in sample
X
No. of total companies in portfolio
=
Estimated net jobs created during investment period

This gave us the following outcomes:

Table 6: Estimated Net Total Jobs Created During Period of Investment, 1992-2015
Source: HCE Calculations

Average jobs created per company	36.93
Portfolio of companies	80.00
Estimated net total of portfolio	**2954.67**

n=15 or 19% of portfolio

During the period 1992-2015, we estimate that Archangels has created 2955 net jobs. This gives an average of 37 jobs created per company invested in. We have not applied any multipliers to the total figure, so it can be considered a conservative estimate.

5 Gross Value Add

5.1
Archangels' Investments and their contribution to GDP

This section undertakes a Gross Value Add (GVA) Economic Impact analysis. For such an exercise it is the number of companies and the level of the variable we are considering which is important. In this analysis we focus on turnover so it is the level of turnover that matters and as outlined in the next paragraph even pre-revenue companies and failed companies need to be considered as they are having an economic impact in the calendar years in which they are in the portfolio. To calculate the total GVA Economic Impact of Archangels on the economy, the GVA Economic Impact of each company in the portfolio for each of the years needs to be calculated and summed as per the equation below:

Total GVA economic impact
=
∑GVA impact for each calendar year

In any year, on average, around 25% of Archangels' portfolio is pre-revenue. Being pre-revenue does not mean there is no economic impact as often this is accompanied by high operating losses as the company invests in product and market development and hence the application of the same methodology as is applied to the companies with turnover is appropriate as the suppliers and wage-earners will be receiving the cash that is creating these losses and will be spending some of it and hence still be increasing GDP. Another consideration is failed companies – the sample we used in our GVA analysis included one failed company but in that year (2007) it was producing turnover in excess of £1.0m and was hence contributing to the turnover of its suppliers and the wage bills of employees involved in the production.

5.1.2 The Gross Value Add Economic Impact Analysis

Gross Value Add (GVA) Economic Impact analysis is a methodology which assesses the gross value add to the economy of an economic event by considering the interdependencies between industries, producers and consumers. It aims to capture all the economic impacts that result from that event, these being the direct, indirect and induced effects[41] and focus on merely the value add. An example of how it works might be as follows – when final demand or GDP is increased due to the sale/purchase of a raincoat, the output of raincoats will increase as producers will make more, this is the direct effect. More inputs will be required from the suppliers, which is the indirect effect and both of these effects will cause incomes to rise in households in the economy as more people are employed and some of these incomes will be spent on final goods and services which is the induced effect.[42]

The methodology uses Scottish Input/Output Tables as defined by the European System of Accounts.[43] For each industry these tables provide annual data which show the transactions each industry has undertaken with other industries and then what is the amount non-disbursed in their cost of goods sold or gross value add which is used to pay staff, taxes (net of subsidies) and are profits. In these tables each industry has a GVA amount for each year as well as Total Output amount. In another section of the tables there are multipliers for each year. There are various types of multipliers but our interest is the Type II GVA multiplier which aims to capture the direct, indirect and induced effects as outlined above. These multipliers thus pick up the employment and final demand effects that occur from the supply chain.

5.1.3 Our GVA Economic Impact analysis and the Hayton study

To give a frame of reference for our analysis and draw some comparisons our analysis focuses on the GVA economic impact of the Archangels portfolio in 2007. In 2008 an evaluation was undertaken, which sought to analyse the economic impact of the Scottish Co-Investment (SCF) five years after its launch by using company data from 2007.[44] The purpose of Hayton's study is different to ours as their focus was to determine the economic impact the Scottish Government had had through the SCF as a financial instruments policy tool. Hayton's study was concerned with net additionality which aims to assess the isolated impact of the government's intervention and to that aim economic development that would have happened anyway are excluded. Despite this difference of objective, the Hayton study focuses on a similar universe of companies as those included in Archangels' portfolio including the focus on early stage risk capital companies. Archangels is a significant partner of the SCF and in fact until 2007 although it was one of 28 partners, Archangels had been responsible for 18% of the SCF's investments. Another reason for the choice of the Hayton study as a comparator is the lack of alternatives; it is the only report to date which assesses the economic impact of similar invested capital in Scotland. In that respect some of their findings have been useful to this study and helped with some of our data limitations such as his considerations on displacement and leakages.

5.1.4 The intricacies of our study

As per the Hayton study our methodology derived GVA 'from turnover using Government standard ratios'.[45] We have included a worked example hereafter. In our analysis we consider the portfolio that Archangels had in 2007 which included 32 companies and we consider a 'truncated portfolio' which includes only companies in which Archangels invested post 2002. We undertake the later analysis so the result can be directly comparable with a grossed up version of the work in the Hayton study.

41 Scottish Government (2015) a. Input Output Introduction http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output (Accessed 1 August 2015).
42 Scottish Government (2015) b. Multipliers http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Mulitipliers (Accessed 1 August 2015) & European System of Accounts (2010). http://ec.europa.eu/eurostat/web/esa-2010 (Accessed 1 August 2015).
43 Scottish Government (2015) a. Input Output Introduction http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output (Accessed 1 August 2015).
44 Hayton, K., Thom, G., Percy, V., Boyd, C. and Latimer, K (GEN) (2008) Evaluation of the Scottish Co-Investment Fund, A Report to Scottish Enterprise, Glasgow UK.
45 Hayton et al, pg. 75.

Things to bear in mind are the different time spans at play: Archangels began in 1992 and the SCF in 2002. From its inception to 2007, Archangels had invested in 53 companies and at the end of 2007 had 32 active companies in its portfolio compared to 100 and 91 for the SCF respectively. The truncated portfolio included 26 companies. Our sample was 10 companies for the truncated portfolio for which we had turnover data for the year of 2007 and we had data for 12 companies of the active portfolio of that year.

There are four main adjustment factors which often occur in a GVA analysis after the company's level of GVA has been established which have an impact on the results:

- Leakage – this reflects to what degree the economic impact needs to be reduced due to some of the benefits being actually experienced outwith the geographic area under consideration
- Displacement – this reflects the degree to which the company concerned displaced its competitors and so to what degree there was no net economic benefit as it just transferred from one company to the other.
- The multiplier – this is the Type II GVA multiplier which is taken from the Scottish Government's Input/Output Tables.
- Deadweight – reflects what would have happened without the Government intervention. This is applied to evaluate the effectiveness of policies.

A worked example of the methodology is shown in Table 7 below where the turnover of firms in the sample for that year were taken, their GVA is ascertained by applying the GVA ratio from the Input/Output tables.[46] for the year 2007

Table 7: Worked example of economic impact calculation for one company
Source: HCE elaboration, Presentation based on Hayton et al (2008), page 118

Action	Value	Components
Take Company Turnover 2007	£100,000	2007 turnover achieved by the company as per published accounts
Calculate GVA ratio	e.g. 0.7	Take the industries GVA for the year of 2007 and divide it by the Total Output for that industry (at base prices)
Calculation 1	£70,000	Multiply the company's turnover by its industry GVA
Leakage	0%	Deduct the percentage related to the activities undertaken outwith the geographic area. If all in Scotland 0%
Calculation 2	£70,000	Turnover-(Turnover x Leakage Value)
Displacement	25%	Based on company view that a minority of competitors are based in Scotland, which is translated into 25% Displacement
Calculation 3	£52,500	(Calculation 2 value x (1-Displacement value))
Substitution	0%	No evidence of substitution
Calculation 4	£52,000	Calculation 3 (value x (1-Substitution value))
Multiplier	1.5	Output multiplier value for SIC number (based on Input output industry for that SIC code) derived from Scottish Government Input Output Values
Calculation 5	£78,750	Calculation 4 value x Multiplier value
Ownership adjustment	0.8	Archangel does not own 100% of these companies, however in most cases the company would have have existed without their capital so 100% allocated. For 25% of the universe apply the 37% ownership of the current portfolio
Calculation 6	£63,000	Value from Calculation 5 x ownership adjustment
Economic Impact of that company in the year of 2007	£63,000	

46 Scottish Government (2015) b. Multipliers http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Mulitipliers (Accessed 1 August 2015).

5 Gross Value Add

5.1
Archangels' Investments and their contribution to GDP

5.1.4 The intricacies of our study *(continued)*
Unlike the Hayton study we did not consider deadweight factors as these are metrics used in policy evaluations to attempt to ascertain the pure value of the government's intervention by attempting to subtract the economic impact which would have happened had the Government not been involved. In the SCF study the deadweight adjustment factor resulted from interviews with the capital providers and reflected the degree to which they their supply of capital increased due to existence of the fund, hence causing additional impact – on average this resulted in a net additional GVA impact of 28% due to the public policy. As Archangels' is a private group operating in the private sector no application of deadweight is appropriate.

For the displacement methodology we applied that of the Hayton study which was as follows

- 0% displacement if no competitors are based in Scotland;
- 25% displacement if a minority of competitors are based in Scotland;
- 50% displacement if around half of competitors are based in Scotland;
- 75% displacement if the majority of competitors are based in Scotland; and
- 100% displacement if all competitors are based in Scotland.

We received our information of the competitive landscape during our interviews and where we had not interviewed the company we allocated the number 25% which we believe is a generous assumption in accordance with the findings of the Hayton study as stated below

> *Displacement was judged to be very low amongst those surveyed. Over half (55%) of the firms stated that they had no competitors in Scotland and that they were largely competing against American or European based multi-national corporations. Furthermore, the remainder of the firms surveyed suggested that only a minority of their competitors were based in Scotland. It is, however, acknowledged that if companies are operating in growing markets then, regardless of where competitors are based, displacement may still be low. This will be even more so if companies are exporting. However, given that most of the companies were working on emerging technologies and were therefore at the forefront of developing the market, it was felt that the negative impacts on other Scottish firms were low. (Hayton et al, 2008, pg. 79)*

We chose to allocate 25% to the ten companies in the truncated portfolio as we thought 25% generously represented the displacement the Archangels' companies created. The Hayton study's results and findings were based on the 48 interviews conducted in 2007 so we believe these findings can easily be used here, although a lower number may well be appropriate which would then result in a greater economic impact. One might even argue no displacement should be considered as we are not interested in a net economic impact but rather the economic impact these companies have and to displace competition is generally what private sector companies try to do. Nonetheless, when we evaluated the active portfolio for 2007 we did allocate 50% to one firm as we knew from the interview they worked in a more competitive industry. Leakage in the Hayton study was determined by whether the company had its head office or not in Scotland, we chose to allocate a 50% leakage to two of the companies we interviewed, which we know have substantial overseas sales. We did make an adjustment for ownership as Archangels do not own 100% of these companies. In our interviews we found that 75% of the companies would not have existed at all without Archangel as their capital was vital, in that respect we are comfortable attributing all of the economic impact to Archangels but believe an adjustment is required for non-vital capital. Archangels, on average own 37% of the companies in their current portfolio, we thus applied that percentage to 25% of the portfolios hence deflated the overall impact by 20%.

5.1.5 Outcomes
Our analysis showed an economic impact of £15.0m from the ten companies in our sample for the truncated portfolio and £18.5m for the active portfolio sample where we had a sample of 12 companies. So for the live portfolio in 2007 we estimate a GVA economic impact of £47.7m. One should remember this is one year of the 23 years Archangel has been in existence and should we attempt to estimate the overall economic impact we would need to look at each year individually and then total them. At the company level this translates into a GVA economic impact per company in calendar year 2007 of £1.50m and £1.54m respectively and although Archangels has had 80 investments since 1992, due to the length of time they have been in its portfolio in calculating a GVA impact analysis we would have 547 annual company impacts to collate. The larger economic impact number for the Archangels 2007 active portfolio likley reflects the impact of two businesses which have greater maturity and hence larger turnover.

5.2
Comparison with the Hayton study

Table 8: Archangels GVA Impact Assessment 2007 – comparison with the Hayton study

Source: HCE calculations

Portfolio	Hayton study Scottish Co-investment Fund	HCE Archangels
Total invested portfolio to 2007 from inception	100	53
Active Portfolio as of 2007	91	32
No of companies invested in between 2002 and 2007	100	28
No of active companies in 2007 portfolio invested since 2002	91	25
No of companies in sample invested in after 2002 and in portfolio at 2007	48	10
Economic Impact per company – net additional & truncated 2007 portfolio	£0.3m	£1.5m

Table 8 draws out the key metrics from our study and compares them with Hayton study of the SCF. The lower economic impact number for the SCF in 2007 is not at all derisory as it is measuring a different thing. The Hayton study focused on the net additional benefit which the SCF brought to the economy. As the SCF is a passive investor with investment decisions being made by its private sector partners, the SCF reflects the decision-making of all 28 of its partners. In that respect by grossing up the Hayton study's SCF results for the deadweight adjustment, the estimation of the GVA economic impact of the financial partners overall can be ascertained. This exercise results in an economic impact per company for the SCF'S financial partners outlined in table 9 below:

Table 9: Gross Value Add Comparison 2007 – Archangels cf. average Scottish Co-Investment Fund financial partner

Source: HCE calculations

Entity	Average Estimated GVA impact per company
Archangels	£1.5m per annum
Average Scottish Co-Investment Fund Partner	£1.13m per annum

The estimated 30% greater economic impact from Archangels may result from Archangels' longer experience of investing than some of the SCF partners or perhaps it reflects the embedded superior skill-set within Archangels, resulting from the successful careers of many of its members. Whether it is innate or learned, superior skill is always welcome in investing as it generally means higher returns.

5.3
GVA Economic Impact to Invested Capital

5.3.1 Data

In the GVA Economic Impact to Capital Invested analysis we focused on the latest portfolio for which Tables were available, which is 2012. There were 33 companies in the portfolio that year and since that time 4 have been sold and 4 have failed. Our sample of companies for which we had turnover for that year was 12 companies and their industrial distribution is outlined in Table 10 below in comparison for the industrial breakdown of the whole portfolio since inception

Table 10: Industrial Exposure of Sample in comparison to Portfolio

Industrial Group	Sample	Whole portfolio
Industrial Goods	6	16
Healthcare	3	20
Technology	1	30
Oil & Gas	1	1
Construction	1	1
Energy		3
Other		9

We can see that the sample is under represented with respect to technology representation and over represented with respect to industrial goods. Archangels investments in Industrial Goods have often been in companies which are producing high value add components or services. If the computer services sector as classified in the Tables were considered a representation of the Technology sector and the 'Computers, Electronics and Opticals' sector as a representation of the Industrial Goods sector the Tables for 2012 has allocated the same GVA ratio and GVA multiplier to both that of 0.7 and 1.5 respectively. These ratios for the Pharmaceuticals sector are 0.8 and 1.2 which suggests that the former two sectors have a 10% or so greater impact than Pharmaceuticals. In terms of holding period our sample average 7.7 years to the end of 2012 and this compares with the portfolio average of 6.1 years.

5.3.2 Methodology

We employed the same methodology outlined in Table 7 for each of the companies in the sample and for each of the years for which we had data for them. For our sample we had data points for 47 years in total and were missing data points for 38 years. To put this in context the whole portfolio would have data points of 488 years for this analysis if all the data were available. We took an average per year GVA for the 47 data points and then grossed it up to represent the 85 data points, which is the number of years invested for the capital concerned with each company and each year being a discrete data point.

5.3.3 Results

In our sample the total invested capital to 2012 amounted to £18.4m which is 20% of the overall capital invested. During that period in one of the instances dividends had been paid and so capital had been returned as well.

Our analysis shows that every pound invested by Archangels produced a GVA Economic Impact of £8.94, and if we were to include the dividends as part of the economic impact the number rises to £8.99.

6 Archangels' Role in Scottish Business Angel Investing

6.1 Learning

Archangels operates an approach to learning that comprises three main components:

1. **Learning about the companies invested in;**
2. **Learning from failure; and**
3. **Sharing operational learning with other angels.**

In the above three components the first two are internally focused in that they are centred on how Archangels improves its own operations and efforts. To this end, we have produced four case studies to provide insight into how Archangels supports companies in non-financial ways. In an interview with the co-founders of Archangels, Barry Sealey stated his oft-repeated mantra that Archangels offer financing, as well as what he calls "Capital Help"[47] which is focused around getting companies market ready, whether it is encouraging processual change within the company or bringing in external support and help in the form of non-executive directors (NEDs) or experienced executives, or leveraging wider social and industry contacts and reputations to help companies access new markets, products, services and financing. In each of these cases, learning about the companies invested in, and arguably more importantly from previous investment failures. Feedback from investee companies is effusive, with the following comments made:

> *The real test comes when the business is under pressure and seeking to up its game. I have the greatest respect for Archangels for sticking with entrepreneurs in those circumstances and seeing things through with them. In my view Archangels is a truly outstanding organisation. (Respondent D).*

> *Archangels has been a first-rate partner and investor… Their unflappable but demanding nature helps set standards within investee companies. Not overly impressed by good news, but similarly not unnecessarily flustered by bad news, they provide a strong sounding board, source of advice and provider of confidence for young businesses treading a path previously experienced by other Archangels companies. (Respondent E)*

> *[Archangels are] good at promoting links across their portfolio of companies and willing to provide introductions or insights into other companies which helps build a successful network. (Respondent F)*

> *VCs don't want to finance this sort of thing anymore. They may have done 12-15 years ago but not now and no one else really is now in this part of the market. VCs have become more risk averse and find it easier if folks like Archangels or proprietors take the early risk and they come in a bit later when the returns are more sure, which is a problem in the market. (Respondent G)*

The third component comprises a feature of the impact that Archangels has had more generally in Scotland that is both equally important and intangible. Archangels took a decision early on to share learning with other angels and angel groups where appropriate in order to help grow the business angel market in Scotland.[48] This decision was important for various reasons, including not least the fact that in the early 2000s a majority of business angels lacked experience of small business.[49] Mason et al's 2013 report on the Scottish angel market confirms Archangels' support for other angels, stating "The older, established groups were willing to share their knowledge with the new groups".[50] One respondent neatly captures Archangels' impact on the growth and development of Scottish angel investment, stating:

> *Archangels' visibility as an angel group and their willingness to share insights has been very important in helping grow the angel market in Scotland and to show policymakers the importance of what we do. (Respondent A)*

Others posited that:

> *Archangels and LINC really helped create the business angel community in Scotland. (Respondent B)*

> *Archangels have been the main stimulus in the market, particularly in the early years… their impact has been huge in Scotland. (Respondent C)*

> *Archangels' opinions are highly valued by business, by government and by academia. I have been impressed with the discretionary effort they are prepared to put into the development of knowledge and ideas for the public good. (Respondent D)*

Further interviews and discussions with various actors in the angel investment market (angels, academics, policymakers and businesses) reaffirmed this, revealing that Archangels' position as a visible, committed investor that is collegiate in sharing its knowledge into the angel process was and continues to be an important component in encouraging angel investment, entrepreneurial behaviour, and significant levels of financial capital to support high-growth potential Scottish firms. With the growth in the number of angel groups and deals being done in Scotland, Archangels has found itself in the position of being a grandee in the market – it is able to act as well as share its experiences with other angels which in turn has had a halo effect of encouraging a greater entrepreneurial culture in Scotland.

By virtue of being first in the market in terms of organising itself, Archangels occupies an important place within the Scottish business angel landscape. From being a two party partnership, the syndicate now has a large number of members and has

47 Interview with Barry Sealey & Mike Rutterford, 26/06/2015.
48 Interview with Barry Sealey & Mike Rutterford, 26/06/2015.
49 Paul, S., Whittam, G., Johnston, J.B. (2003) The operation of the informal venture capital market in Scotland. Venture Capital, 5: 313–323.
50 Mason, C. M. and Botelho, T. and Harrison, R, (2013). The Transformation of the Business Angel Market: Evidence from Scotland (August), pg. 18.

formalised itself increasingly in terms of how it operates and the types of investments that it makes. Consistent within this is the issue of learning – Archangels has learned about itslef, about the market and the companies it invests (and sometimes doesn't invest) in, and has sought to push that learning out into the wider angel community and beyond into the policy domain in order to facilitate improved performance and impacts economically. This has resulted in the creation of 'competitive collegiality' amongst angel investors in Scotland – there is a large degree of trust and complementarity in how angels operate in Scotland that sees them compete, but not undermine each other. The open innovation approach taken by Archangels from an early stage has helped facilitate the wider growth of angel investing in Scotland and helped supply capital in an area of the market which is difficult for policymakers to engage in due to the high risk of failure and the need to protect public monies.

6.2
Patient Capital and Exits

6.2.1 Patience

Regarding the required length of investment for business angels, in a recent interview with Business Insider, Archangels' Chief Executive John Waddell stated:

> *Everybody says it's three to five years and I don't know where they get that idea from, because it never is. It's probably about eight or nine years before you start to make money. (Business Insider, 2015)*

In order to quantify Waddell's comments, we undertook an analysis of the length of time Archangels typically invests in its portfolio, and separated it out into the different outcomes of the investment in terms of whether or not it is still active, if it failed, became dormant, IPOed or was subject to a Trade Sale.

Table 11: Length of Investment in Years of Archangels' Portfolio, 1992-2015.*Source: Archangels Database*

	Length of Investment (yrs)	Average age of company when first invested
Active	8.11	2.22
Failed	3.66	2.26
Dormant	5.32	1.62
IPO	7.84	0.58
Trade Sale	8.17	2.31
Portfolio Average	6.07	2.15

Interestingly, Archangels' experience suggests that patience is key in its activities and investments. On average, it has taken it 7.84 years to exit an investment through an IPO and 8.17 years for a Trade Sale, which is consistent with the comments of Archangels' Chief Executive. On the other hand, it appears to 'fail fast' where an investment is not working with a significantly lesser time of investment of 3.66 years. In terms of the average age of investee companies, for companies that have exited through an IPO, Archangels invested very early on at an average of around 6 months old. For Trade Sale exited companies it is 2.31 years. In terms of the overall portfolio of investments, an average time of 6.07 years of investment (including Active, Failed, Dormant, IPO and Trade Sales) and an average company age of 2.15 years emerged.

A further aspect to Archangels' patient approach is its willlingness to support businesses that are not yet producing revenue. No profit means no return to financial capital. Six of the fourteen companies in which Archangels have invested in the last ten years are still pre-revenue, with one of those companies having been in the portfolio for more than 10 years. Pre-revenue companies have typically comprised around 25% of Archangels' active portfolio throughout its period of investment.[51] Archangels' involvement in these early stage innovative ventures plays an important role in the Scottish economy. The lack of supply of capital for small businesses has been a long-standing issue. With its support of the knowledge economy, Archangels is not only bearing the risk of supplying capital to small businesses, but as providers of capital for innovation its risk is multiplied by difficulties entailed in early stage technology development. Baum and Silverman (2004) found that in the decade of their Canadian Biotechnology study 34% of the 204 companies they studied that had started within that decade failed, as did another 431 that had started prior to that decade.[52] Mason (2009) points out only about 20% of angel investments made will succeed.[53] When we consider Archangels' portfolio we can see that it has suffered a 44% failure rate in terms of number of companies but just 15% in terms of capital invested lost. This suggests it spots failures early, however the fact it has so many suggests its members are risk-takers and willing to accept failure.

6.2.2 Exits

A way of measuring the economic contribution of Archangels is to consider the value derived from the ventures it has sold on, as the value of the knowledge is captured at that point. Since inception Archangels has had 18 exits, so 22.5% of its portfolio, on which it has created a value of almost three times greater than the capital investment. For its £37m of original investment it has generated an additional wealth of over £60m. This suggests a multiplier of almost three times, and even after netting the losses of the failures, its net economic contribution has been £48m. Below is a breakdown of Archangels' total, pre-2005 and post-2005 exits by length of investment and average age of company when first invested in:

51 Interview with John Waddell, 07/08/2015.
52 Baum, J. and Silverman, B. (2004) 'Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology start-ups' Journal of Business Venturing, Vol.19 (3). pp 411-436.
53 Mason, C.(2009) 'Venture capital in crisis?' Venture Capital: an international journal of Entrepreneurial finance, 11 (4), 279-285.

6 Archangels' Role in Scottish Business Angel Investing

6.2.2 Exits

Table 12: Archangels' Exited Companies, pre- & post- 2005
Source: Archangels' Database

	Length of Investment	Average age of company when first invested
Pre-2005	8.28yrs	1.95
Post-2005	5.06yrs	2.27
Total	7.57yrs	2.02

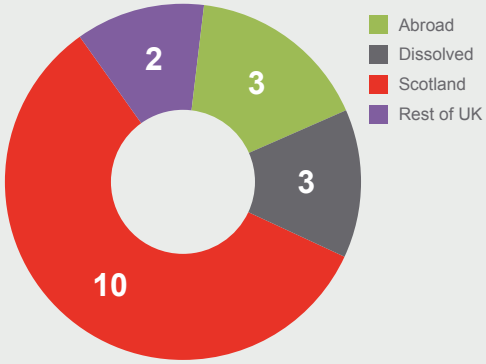
From a commercial perspective, the point of angel investing is to successfully exit having grown the investment – it rewards the entrepreneur, it rewards the investor by releasing capital invested for other investments (and more if successfully grown) and helps create churn in the economy and attracts new angels to the market. However, it does beget an economic development question of what happens to a company after the exit? A recent report jointly produced by the Royal Society of Edinburgh, Scottish Financial Enterprise and The Institute of Chartered Accountants Scotland entitled The Supply of Growth Capital for Emerging High-Potential Companies in Scotland considered some of the potential outcomes of an acquisition of an exited company by a 'non-indigenous entity', suggesting that a loss of strategic control, centralisation of key management functions and impacts on supply chain were three considerations with the potential for impact on the Scottish business eco-system.[54] A report by Scottish Enterprise that addressed the question of inward acquisitions of Scottish companies produced evidence which argued that

> *… acquisition was viewed as a means to take internationalisation further by expanding products and services in order to offer more to new and existing clients and customers… [it] not only brought financial benefits and investment, but through partnering with a company based abroad, they were now able to use their new owners contacts to extend their activity internationally. The ability to deepen their international connections was a major driver for Scottish companies to consider a trade sale to a foreign company.*[55]

Interestingly, of the Scottish companies that were acquired between 2003-2012, 75% were done so by companies based in the UK, 8% from the USA, and the remainder from the rest of the world[56], suggesting that the concerns expressed in The Supply of Growth Capital report may be overstated.

Given the debate over what happens to Scottish companies after acquisition, we sought to investigate the registered headquarters of Archangels' exited companies to understand where the companies' headquarters were situated after acquisition. The following figure shows the breakdown of the locations of the headquarters of the 18 exits that Archangels has undertaken (including trade sales, Initial Public Offerings (flotations) and Management Buy Outs).

Figure 20: Registered location of Archangels Invested Companies After Exit, 1992-2014.
Source: Company websites, Companies House



As the figure above shows, the vast majority of Archangels' exited companies have remained in Scotland and the UK, with the remaining split evenly between being wound up or moving abroad. Of those companies that did move abroad, one came from an IPO, and two came from trade sales. Of the IPO exited companies, one remained in Scotland, one moved abroad, and one moved elsewhere in the UK. This suggests that the concerns expressed in the Supply of Growth Capital for Emerging High-Potential Companies in Scotland do not apply to Archangels' exited companies.

A further point regarding economic development in relation to exited companies who continue to operate in Scotland is that they continue to contribute in both turnover and employment measures. To this end we analysed the published company accounts of Archangels' exited companies and found that they have generated revenues of £587.45m and created a net sum of 240 jobs. By far the largest contributor to these figures is Optos who went to an IPO in 2006 and were recently purchased by Nikon for £259m in February 2015 in a move which Optos' CEO Roy Davis expects to increase the amount of R&D conducted by the company in Scotland. From an economic development perspective, the continued operation of the exited companies in Scotland has clear benefits and although the revenues generated and net jobs created are not directly attributable to Archangels as they currently stand, there is a strong case to be made that Archangels helped establish these companies in Scotland and contributed towards their continued presence and the economic benefits that this has brought.

54 RSE (2014). The Supply of Growth Capital for Emerging High-Potential Companies in Scotland, (Edinburgh), pg. 10.
55 Hopkins, P. (2014). The Role of Acquisition in Company Growth, (Scottish Enterprise, Glasgow), pg. 52.
56 Hopkins, P. (2014). The Role of Acquisition in Company Growth, (Scottish Enterprise, Glasgow), pg. 24.

6.2.3 Other Impacts – Spill-overs

A further impact is based on the notion of spill-overs. This is the idea that one type of the economic resource of 'knowledge' is the knowledge embodied in an employee or an entrepreneur. Such knowledge is indispensable in the creation of the value-add to help economies grow. Often early stage companies are built on products by inventors who are considered technically very knowledgeable, but lacking in commercial nous. These companies are usually resource constrained and the technician needs also to learn commercialisation skills to help establish and grow the company as there is typically no budget to employ others for that purpose. Due to the constrained nature of early stage businesses people who own knowledge can often find more lucrative opportunities by moving to a new place of employment or to begin entrepreneurial ventures themselves.

For some time there has been a belief that there is a spill-over economic benefit from early stage businesses due to personnel leaving and taking the knowledge that they have learned in that business to build on it elsewhere. There remains a lack of documented evidence to support this however, and even some to negate it (Moen 2007). For this study we undertook four case studies and interviewed the management of these companies for this purpose. Some of that questioning covered the idea that the economic impact of the investment Archangels made was limited to the companies in its portfolio but actually it was greater than that due to spill-over effects. Of the four company interviews we conducted, evidence emerged that there had been a wider impact that moved beyond purely economic terms. In two of the cases the respondents said past employees were building on their experience from that company to develop other economically active ventures.

> *Oh I am sure that is the case as one of our staff who left and is now working at the University is now one of our customers. (Respondent 1)*

> *Being in a company like this also teaches you the skills how to run a business and one ex-employee has definitely gone off to start his own business and now he is one of our customers. (Respondent G)*

From this perspective there is an interesting question of what kind of knowledge spill-overs have been generated by Archangels' support of early stage, knowledge intensive companies? The evidence we have is anecdotal, but there certainly seems to be the case that spill-overs have, do and will continue to occur through Archangels' support of these types of companies given the porousness of knowledge.

7 Case Studies

In order to provide a more nuanced understanding of the impact of Archangels' investment and engagement with Scottish companies, we undertook a series of interviews with investee companies to better ascertain the tangible and intangible impacts that the relationship with Archangels has had. To this end we selected four companies – Oregon Timber Frame, Optos, Touch Bionics and Airborne Energy. Semi-structured interviews were conducted by telephone and then information gleaned triangulated with company records, public news stories and other relevant information to provide a short, but rich case study for each company and the type of engagement and support received by Archangels.

7.1
Case Study 1: Oregon Timber Frame

Age of Company at first Archangels investment: 2 months
Length of Investment: 17 years, 6 months
No. of employees 96
Turnover: £14m

Oregon Timber Frame ("Oregon") is one of the UK's largest independent timber frame manufacturers, specialising in the design, manufacture and erection of timber frame structures for the construction industry. The company specialises in complete structural platform timber frames comprising wall panels, both open and pre-insulated, and roof and floor cassettes. Its subsidiary, Oregon Contract Management, erects timber frames on site for the customer. Oregon is based in Selkirk in the Borders and Burton upon Trent in Staffordshire and can currently manufacture up to 6000 timber frame units per year with further capacity in the planning stages. The company is registered to quality standard ISO 9001:2000 and carries PEFC™ Chain of Custody certification.

Oregon is not a typical Archangels' investment. Archangels first invested in Oregon in 1998 when investors were sought to support a management buy-out of the wood-frame timber business within a failed property development company based in the Borders. The development company had mainly served the local community in the Borders but ultimately there was insufficient demand to enable the business to survive resulting in the company going into receivership. Members of Archangels were introduced to the investment opportunity in the timber framing business by their legal advisor Sandy Finlayson of MBM Commercial. Others were interested in providing capital to the business, but Archangels provided the terms that secured the deal. The managers themselves provided the majority of the capital required to make the company active again (with Archangels making up part of the remainder), and were granted subsequent options. However, Archangels' involvement in the business went well beyond the capital they have provided, helping provide enhanced credibility to the business and smoothing relationships with creditors who 'know Archangels have deep pockets' and so offer the expectation of additional funds if required. Archangels also helped in developing the demand side of the business by leveraging its extensive social and reputational capital gained from its involvement in property and property development markets to aid the company in accessing larger clients with bigger product demands. This expertise was of considerable help to Oregon. Archangels' Non-Executive Director representative on the Board, Eric Young, has substantial property and development experience and provided market insight and guidance as to how to respond to trends in demand. Oregon has also been introduced to the networks of some of Archangels' property developer members which has helped enable a more geographically diversified client list and stronger and larger business.

From sales of zero in 1998 when Archangels first invested, Oregon now registers sales in excess of £14m and has plans to acquire a new facility which will expand the business further. The growth in job creation has been equally impressive with the company going from 14 employees in 1998 to 96 in 2014, which is growth of nearly a factor of 10, (the company also has plans to increase the workforce by another 50% with its new facility). Oregon's growth brings additional benefits to the Scottish economy both up and down the economic structure. For supplies it buys its timber from a merchant in Fife. Although the wood is mainly imported from abroad this merchant in Fife has likewise experienced growth due to the success of Oregon. The company has also contributed to output in the services sector; from time to time it involves Napier University in research projects, the output of some of which it retains in-house for its own efficiency improvements, the results of others are published by Napier so the community at large can benefit from their findings.

Key points:

Regional Impact: Oregon Timber Frame employs 96 people in Selkirk in the Scottish Borders, and is one of the largest private sector employers in the area. It has recently agreed to takeover a warehouse in the town with plans to increase the workforce by another 50.

Turnover Growth: After the difficult downturn in the construction market, Oregon has seen turnover growing from £8.7m in 2009 to £14m in 2013 with plans to increase this further.

Supply Chain Enhancement: Oregon imports timber from abroad, via a supplier in Fife, and engages Napier University in R&D projects as an on-going partner bringing benefit beyond its immediate locale.

7.2

Case Study 2: Touch Bionics

Age of Company at first Archangels' investment: 1 year, 8 months
Length of Investment: 11 years, 6 months
No. of employees 95
Turnover: £12.3m

Archangels first invested in Touch Bionics in early 2004 at which point the company was seeking to develop and manufacture a myoelectric prosthetic hand and arm. David Gow conceived of the product whilst working for the NHS as a prosthetist. Originally wanting to create a hand and an arm, Gow began operationing within an start-up incubator in the NHS called Scottish Health Innovation Ltd. After securing SMART grants he was keen to develop the idea further and so approached Archangels.
Touch Bionics has since developed a number of highly advanced products including myoelectric prosthetic hand and prosthetic finger solutions. Company acquisitions by Touch Bionics have resulted in the production of a highly realistic passive silicone prostheses that match the natural appearance of the wearer under its auspices.

Archangels' involvement was vital to the development of the company – Gow's product was only a concept at the stage where Archangels invested and few others were interested. Due to Archangels' initial investment further capital was obtained from the Scottish Co-investment Fund and in due course certain banks also decided to provide capital. Aside from providing capital, Archangels' representative on the Board was instrumental in helping with the finances of the company. The first couple of years focused on R&D and perfecting the product, during which time it was decided to focus on hand production with advanced finger solutions. The first hand was produced and sold in 2007 ushering in the beginnings of a high growth company which has kept its manufacturing and R&D base in Scotland. Its growth has involved two acquisitions in the USA which today serve as mainly sales and marketing offices. R&D continues and 2013 saw the commercialisation of the fourth generation hand. Sales have grown strongly and are now in excess of £13m p.a. There is evidence of economic benefits being spawned elsewhere as a previous R&D employee is now a customer of the company suggesting that there are clear spill-overs from the company into another, helping create further economic value.

Key points:

Export Growth: Over 95% of Touch Bionics' sales are exported outside the UK and the company has subsidiaries in the USA and Germany and sells to companies all over the world. In 2008, export sales were around £4.7m. By 2014, they had risen to £13m, representing growth of around 180%.

Job Creation: In 2008, Touch Bionics employed 30 people. By 2014, it employed 121 people. Job creation has in the main been in engineering, sales, customer support, business development and marketing.

Turnover Growth: In 2008, total sales were £4.9m. By 2014, total sales had risen to £13.5m, representing growth of 176%.
Supply Chain Enhancement: Touch Bionics sources parts from around the world, including Scotland, England, the USA, Switzerland and Korea. It continuously seeks to source the highest quality components.

7 Case Studies

7.3

Case Study 3: Airborne Energy

Age of Company at first Archangels' investment: 4 months
Length of Investment: 5 years
No. of employees: 6
Turnover: n/a

Archangels describes itself as investing in innovation; indeed it is the strap line to its logo. The case of Airborne Energy is an example of this – Archangels has helped facilitate risky, early stage investment into the company through the provision of capital and know how. Archangels was a very early supplier of vital private capital and commercial acumen in Airborne Energy, an early stage energy company that is developing a vertical-axis turbine which will allow small scale wind turbines to be located in populated urban environments or areas where wind conditions may not be ideal, generating electricity safely and quietly while rotating at very low speeds whilst also allowing for 'kinetic promotion' advertising of products or purchasers branding offering a further potential income stream for the company.[57]

Having spent over five years developing its product and spending almost £0.75m on R&D, Airborne is testing a commercial scale turbine for sale next year. Archangels has been instrumental helping Airborne move towards commercialising its technology. Using its extensive network of connections, Archangels brought in a new CEO, experienced entrepreneur Simon Hardy, two years ago[58] who has strong knowledge and experience in the alternative energy sector, as well as enlisting support from the SCF and a private investor.[59]

Airborne's turbine is self-starting in all winds – no power is needed to start rotation. It is designed to cope with variable and turbulent wind; the pitch of the blades changes to maximise wind capture. The turbine generates electricity over a broad range of wind speeds, and the unique generator design optimises voltage output, whatever the speed of the wind. Wind energy is not the cheapest form of energy but growing the share of renewable energy production, such that it is 100% of Scottish gross consumption by 2020, is part of the Scottish Government's Renewables Energy agenda[60] to reduce the carbon footprint of Scotland and move towards cleaner energy sources. In this respect Archangels' investments in this area are contributing to a wider public policy move towards transforming an important part of the economy.

Archangels' investment in Airborne Energy has also been a facilitated giving employees transportable business skills which adds to the knowledge in the overall economy. Simon Hardy the CEO said

> *[for electrical engineers] working in a place like this teaches you skills in setting up your own business which you can take with you.*[61]

Another benefit of its investment has been spill-over effects elsewhere as employees have left to start their own ventures. In this instance we have at least one case where an ex-employee is now running their own business having previously worked for Airborne.

57 Young Company Finance Scotland (2013), Issue 178, October 2013.
58 Interview with Simon Hardy, CEO Airborne Energy .24 July 2015.
59 Young Company Finance Scotland (2013), Issue 178, October 2013.
60 Scottish Government Renewable Energy http://www.gov.scot/Topics/Business-Industry/Energy/Energy-sources/19185 (Accessed 26 July 2015).
61 Interview with Simon Hardy, CEO Airborne Energy .24 July 2015.

7.4
Case Study 4: Optos

Age of Company at first Archangels' investment: 3 months
Length of Investment: 14 years (exited 2006 by IPO)
No. of employees: 391
Turnover: £40.6m p.a. (at exit); £110m p.a. (2014)

Optos represents Archangels' biggest exit to date, and one of its longest investment periods. Originally invested in in 1992, Archangels exited Optos in 2006 in an IPO managed by Goldman Sachs. What originally started as an idea pitched by Douglas Anderson using a ping pong ball has resulted in the establishment of a world-leading research centre in Dunfermline specialising in ophthalmology, optics and photonics employing around 150 people[62], which is around 40% of its total global workforce.[63]

Optos' platform technology is the Panoramic200 Scanning Laser Ophthalmoscope device, known as the P200. In a quarter of a second the P200 produces a high resolution image of up to 200 degrees or approximately 82% of the retina in a single capture. The image, branded the Optomap Retinal Exam, provides eye care practitioners with clinically useful information that facilitates the early detection of disorders and diseases evidenced in the retina, such as glaucoma, diabetic retinopathy and age-related macular degeneration. Retinal imaging can also indicate evidence of non-eye or systemic diseases such as diabetes, hypertension and certain cancers. Optos' technology provides a combination of ultra-wide field retinal imaging, speed and convenience for both practitioner and patient and can help save sight and save lives. R&D and manufacturing are conducted in Scotland and the USA and the products are sold all over the world.

Optos' founder Douglas Anderson first conceived of the idea for an ophthalmological imaging device that, unlike what was in the market at the time, was non-invasive and did not require anaesthetic. After pitching his idea to Barry Sealey who then took the idea to others, Anderson received an initial investment of £80,000 that eventually stretched to 31 rounds of investment over a period of 14 years. Archangels showed significant patience and willingness to absorb risk in their relationship with Optos – they invested around £16m in total and leveraged significant other investment from a number of other investors including other Scottish angel groups, venture capitalists and institutional investors. Archangels' sustained support of what was a cash hungry business with high capital expenditure costs was critical to its eventual success. Our interview with Optos revealed that it considered Archangels' help as being 'vital' to the company's development and its chances of financing its business elsewhere as 'poor'. More importantly, Optos stated that it does not believe it would have been successful without Archangels' support.[64]

Archangels' investment in Optos also provided non-financial capital in the provision of both a chairman and non-executive directors in the pre-IPO period that was invaluable in helping the business grow and develop. In the very early stages it was Barry Sealey who wrote the business plan, then became chairman until it floated. The introduction of experienced directors, several of whom were recruited from outside of Scotland, helped steer the company through growth. When further financing was required from venture capital, Archangels used its networks and worked with funds from outside of Scotland to facilitate this. The engagement of Archangels in Optos' growth trajectory is one that was punctuated by moments of turbulence, but is ultimately characterised by patience and willingness to provide money where necessary.

Effective angel investment is about 'cash +' – Archangels provided both the cash and the + in the form of patient capital and 'capital Help' with Optos throughout the period of investment. The result is a Scottish success story – a successful angel investment exit, a world-leading R&D facility in Dunfermline, penetration of global markets, and a visible example of the effectiveness of angel investment in Scotland.

Key Highlights

Optos had 31 rounds of investment, with the first of £80,000 in October 1992, suported by nine angel investors.

At the time of its IPO, Optos was turning over £40.6m, employing 214 people. It now turns over £110m and employs 391 people.

Optos has offices in the UK, USA, Germany and Australia. 85% of its devices are installed in the USA, with the remaining 15% in the rest of the world.

The company was floated on London Stock Exchange in April 2006 for £164m. It was sold to Nikon in 2015 for £259m.
Regional Impact

Optos' registered head office is in Dunfermline where it is a significant local employer, as well as being a world-class research and development facility in opthalmology, optics, and photonics.

Optos engages with a number of Scottish universities as well as various Scottish companies in its R&D and supply chain activities. Dunfermline is one of its two main maunfacturing bases, with the other being in the USA.

62 Optos plc Annual Report and Accounts 2012.
63 Interview with Roy Davis, CEO Optos plc.
64 Interview with Roy Davis, CEO Optos plc.

7 Case Studies

7.5
Case Study Insights

From the case studies conducted, a deeper understanding of Archangels' impact emerged. It is apparent from the discussions that we conducted that Archangels supplies more than just financial capital to the companies its members invest in. In each case study, we asked questions around what ancillary support was received by the companies when Archangels invested – each gave a picture of an organisation that is willing to put in money certainly, but also lends network development support through leveraging and exploiting relationships, reputations, industry and personal contacts, and commercial links. In the case of Airborne, the CEO was appointed as a result of personal contacts from within Archangels; in relation to Touch Bionics, Archangels' financial standing allowed for further investment to be accessed. Oregon isn't a typical angel investment in that Archangels has been involved for a great deal of time (since 1998), but the impact of its investment goes beyond just helping the company and has helped establish Oregon as a major employer within the community whilst developing a scalable business model and product resulting in the company firmly establishing itself.

8 Conclusions

This evaluation has sought to understand the impact of Archangels in Scotland in both tangible and non-tangible ways. In doing so we considered a range of different metrics designed to capture the angel investment process, the outcomes of the financial and non-financial support provided to companies and the wider impact such investments have had on the economy. It is clear from the analysis undertaken that Archangels has played, and continues to play, a critical role in supporting high growth potential companies and helping grow and deepen the angel investment marketplace in Scotland. Archangels operates at a higher financial level than the rest of the visible angel market in Scotland and provides support to companies, policymakers and other angel groups as well as a willingness to engage across a variety of different issues. As Scotland's oldest angel syndicate, Archangels has been a vital facor in the substantial growth in angel investing in the country and enjoys a strong reputation amongst different stakeholders within the community. Its willingness to include other angels in deals, sharing information and learning, and open lines of communication has helped create the competitive collegiality that characterises the angel investment community in Scotland.

The outcomes of our analysis of key measures of turnover generation, net employment created, average salary per job created over period of investment, and GVA contribution reveals that Archangels' impact in economic development terms is both substantial and far exceeds its pure financial investment, although it has successfully returned capital and provided capital uplift to its investors. Archangels has played, and continues to play, a crucial role in supporting early stage companies in Scotland in line with national economic strategic priorities and has helped facilitate the growth and establishment of a number of new ventures through its blended approach of patience, finance and 'capital Help'. Its early engagement in supporting early stage, high-risk companies was key to helping persuade Scottish policymakers of the need to support angel investors in Scotland in order to ensure innovative companies were given every opportunity to survive, thrive and grow. This has resulted in the creation of a number of high-impact Scottish technology companies that are active in the global marketplace and contributing significantly to Scottish economic growth and the replication in other countries of what has become known as the 'Scottish Model' of public-private partnering in supporting early stage, high-growth potential companies in the move towards leveraging knowledge as a competitive asset. Archangels' pioneering angel activities has contributed in no small measure to creating the vibrant and enterprising Scotland we see today.

9 Bibliography

BIS UK (2012) *SME Access to External Finance*, Department of Business Innovation & Skills, BIS Economics. Paper No.16, London.

Bloom, A & Tyvoll, M (2015), *Oregon Angel Investment: The Economic Impact of High-Risk Investment in Oregon's Entrepreneurial Enterprises*, Portland Seed Fund/Technology Association of Oregon.

Brown, R. and Mawson, S. (2013) Trigger points and high-growth firms: A conceptualisation and review of public policy implications, *Journal of Small Business and Enterprise Development*, 20(2), pp. 279-295.

British Venture Capital Association, (2013). *Private Equity and Venture Capital Report on Investment Activity* 2012.

European System of Accounts (2010). http://ec.europa.eu/eurostat/web/esa-2010

European Venture Capital Association, (2013), *Pan-European Private Equity Performance Benchmarks Study.*

Garnsey, E., Stam, E. and Heffernan, P. (2006) New firm growth: Exploring processes and paths, *Industry and Innovation*, 13, pp. 1-20.

Gray, N. (2014). *Rationale and Options for the Development of Business Angels as a Source of Funding for High Growth Potential Businesses. Note for the Task and Finish Group Panel, Development Bank for Wales.*

Hayton, K., Thom, G., Percy, V., Boyd, C. and Latimer, K (GEN) (2008) *Evaluation of the Scottish Co-Investment Fund, A Report to Scottish Enterprise*, Glasgow UK.

Mason, C.M. and Botelho, T, (2014), *The 2014 Survey Of Business Angel Investing In The UK: A Changing Market Place, Glasgow*. http://www.gla.ac.uk/media/media_362647_en.pdf

Mason, C. M. and Botelho, T. and Harrison, R, (2013). *The Transformation of the Business Angel Market: Evidence from Scotland* (August). http://dx.doi.org/10.2139/ssrn.2306653

MIT REAP Scotland (2014), *Increasing Innovation-driven Entrepreneurship in Scotland*, June, Massachusetts Institute of Technology.

Møen, J. (2007) R&D spillovers from subsidized firms that fail: Tracing knowledge by following employees across firms. Research Policy 36 (2007) 1443–1464

OECD (2011), *Financing High-Growth Firms: The Role of Angel Investors*, OECD Publishing. http://dx.doi.org/10.1787/9789264118782-en

NVCA/IHS Global Insight (2011). *Venture Impact: The Economic Importance of Venture Capital-Backed Companies to the U.S. Economy.*

OECD (2013) *An international benchmarking analysis of public programmes for high-growth firms*, OECD LEED programme, Paris.

Paul, S. and Whittam, G. (2009). Business angel syndicates: an exploratory study of gatekeepers. *Venture Capital*, 2009, vol. 12, issue 3, pages 241-256

Scottish Business Insider (2015), *Insider Special Report: Angels and Mentors*, (June). http://www.dailyrecord.co.uk/business/business-features/insider-special-report-angels-mentors-5948931

Scottish Enterprise (1993), *Scotland's Business Birth Rate: A Strategy for Scotland*, (Edinburgh).

Scottish Government (2007) Information on the introduction of Standard Industrial Classification 2007 PDF http://www.gov.scot/Topics/Statistics/Browse/Business/SourcesandSuitability/SIC2007PDF (Accessed 8 August 2015)

Scottish Government (2015a) Input Output Introduction http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output

Scottish Government (2015b) Multipliers http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Mulitipliers

Stuart, T. E. and O. Sorenson (2010). "Strategic Networks and Entrepreneurial Ventures." *Strategic Entrepreneurship Journal*.

Wiltbank, R. (2009), "Siding with the Angels: Business Angel Investing – Promising Outcomes and Effective Strategies", BBAA and NESTA, London, May.

Acknowledgements

We are grateful to Mike Rutterford, Barry Sealey, John Waddell, David Ovens, Martin Hughes, David Grahame, Jock Millican, Nelson Gray, Colin Mason, John Anderson, Peter Shakeshaft, Kirstin Macdougall, Andy Laing, Samuel Mwaura, Matthew Ngai, Stewart Dunlop, Optos, Oregon Timber Systems, Airborne Energy, and Touch Bionics who all took the time to speak to us and share their knowledge in the research for this evaluation.

All errors remain the authors'.

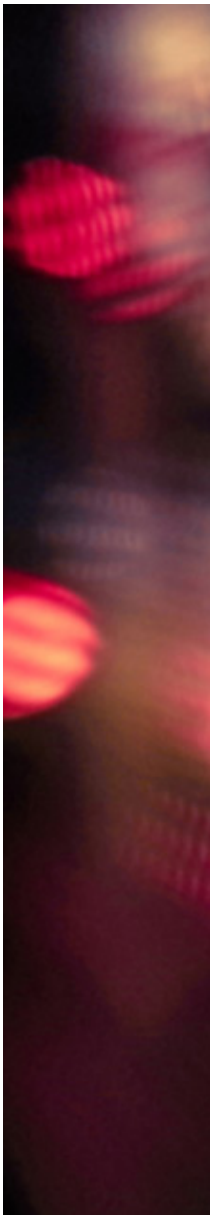
University of Strathclyde Business School

For more information on any of our programmes, please contact us at:

Hunter Centre for Entrepreneurship
Strathclyde Business School
Level 7, Sir William Duncan Building
130 Rottenrow,
Glasgow G4 0GE

www.strath.ac.uk/huntercentre

+44 (0)141 548 3482



THE UK Entrepreneurial University of the Year 2013/14
UK University of the Year 2012/13