University of Strathclyde Business School

Fraser of Allander Institute

The value of college graduates to the Scottish economy

September 2017

Fraser of Allander Institute

Contents

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Preface

The analysis in this report has been conducted by the Fraser of Allander Institute (FAI) at the University of Strathclyde. The FAI is a leading academic research centre focussed on the Scottish economy.

The report was commissioned by Colleges Scotland. Colleges Scotland asked the FAI to estimate the long-term value to the Scottish economy from graduates of Scotland's colleges.

The technical analysis, methodology and writing of the results was undertaken independently by the FAI, using their detailed macroeconomic model of the Scottish economy to undertake the analysis.

The FAI is committed to informing and encouraging public debate through the provision of the highest quality analytical advice and analysis. We are therefore happy to respond to requests for factual advice and analysis. Any technical errors or omissions are those of the FAI.

Acknowledgements

The Fraser of Allander gratefully acknowledges the support of Colleges Scotland in helping to make this study possible.

We also thank the Scottish Funding Council who provided necessary data on students and costs.

Executive Summary

The value of college graduates to the Scottish economy

- Scotland's colleges are significant economic institutions in their own right. Their activities help support and sustain employment across the communities that they serve.
- However, the key contribution that colleges make extends well beyond simply how much they spend or invest in the local economy.
- Colleges play a crucial role in developing Scotland's growth potential through enhancing human capital – whether that be providing routes from school to work, further training or university; continuous skills-development (often in conjunction with employers); or re-training people for new opportunities.
- By developing a more productive workforce and boosting participation, colleges help deliver long-term sustainable and inclusive economic growth. Sustainable growth is more important than ever given the new revenue raising responsibilities of the Scottish Parliament.
- This study undertakes a detailed assessment of the contribution to Scotland's economy from a cohort of college learners over the eight years 2008/09-2015/16.
- To do this we assess the costs and benefits to the economy from graduates leaving college with a nationally recognised qualification. We use the Fraser of Allander's macroeconomic model of the Scottish economy to provide a robust estimate of the impact on Gross Domestic Product (GDP), employment and tax revenues.
- For the period 2008/09-2015/16 graduate cohorts we estimate that:
    - The Scottish economy (as measured by GDP) will be better off by over £20 billion in present value terms (i.e. with future benefits discounted) over the long-term.
    - This corresponds to around an additional £55,000 boost to productivity for the Scottish economy per graduate.
    - The present value of the increase in public sector revenues is estimated to be £6.8 billion. Over the years studied, the total costs to the public sector of investing in these learners through nationally-recognised qualifications was approximately £2.4 billion – just 35% of the cumulative tax revenues generated over the long-term.
    - The investment is estimated to support 13,896 full time equivalent (FTE) jobs in present value terms.

Introduction and Overview

Chapter 1

Scotland's colleges make a crucial contribution to the Scottish economy.

Each college is a major economic player in its own right – both at a national level and in the local communities that they serve. In many parts of Scotland, the sector provides vital employment opportunities that would not otherwise be available.

Scotland's colleges spent over £660[1] million in 2015/16, spending that supports economic activity across Scotland helping to create jobs and boost growth.

However, the contribution of the college sector extends beyond simply the impact of its spending power.

In addition to widening access to educational opportunities – potentially improving income equality and inclusive growth – colleges contribute to national economic growth through increasing human capital.

There is a body of evidence that measures the labour market benefits to an individual of education and training. These studies find evidence that education and training results in the individual benefitting from a wage and employment "premium" relative to those with less education: individuals earn a higher wage and have a higher probability of employment as a consequence of their increased skills.

Less emphasis has been placed on understanding how these effects impact on the wider economy. Where studies do seek to measure the system-wide or macroeconomic impacts of education, these typically take the form of traditional 'economic impact' studies where the knock on or "multiplier" effects of an institution's or sector's spend on the economy is assessed. The focus is solely on the institution's/sector's (and sometimes their students') expenditures – that is, on the demand side of the economy. Very few studies recognise, and attempt to measure, the potential boost to the productivity of the economy from the more skilled workforce created by the institution/sector.

This study aims to help fill this gap. We evaluate the economic contribution of college graduates from 2008/09 – 2015/16 to Scotland's economy over the long-term. To do this, we make use of our detailed model of the Scottish economy.

For the period 2008/09 – 2015/16 graduate cohorts we estimate that:

- The Scottish economy (as measured by GDP) will be better off by over £20 billion in present value terms (i.e. with future benefits discounted) over the long-term.
- This corresponds to around an additional £55,000 boost to productivity for the Scottish economy per graduate.
- The present value of the increase in public sector revenues is estimated to be £6.8 billion. Over the years studied, the total costs to the public sector of investing in these learners through nationally-recognised qualifications was approximately £2.4 billion – just 35% of the cumulative tax revenues generated over the long-term.
- The investment is estimated to support 13,896 FTE jobs in present value terms.

The structure of the report is as follows. In Chapter 2, we provide some key facts on the college sector.

In Chapter 3, we discuss the avenues through which colleges – and, in particular, their graduates – can have an impact on the aims of the Scottish Government's Economic Strategy.

Chapter 4 outlines our methodology whilst Chapter 5 contains the results.

1 Figure from Scotland's Colleges 2017, Auditor General.

The College Sector in Scotland

Chapter 2

2.1 Introduction

In this section, we provide a summary of the college sector in Scotland.

Colleges in Scotland provide a wide range of training and qualifications across a variety of professions from basic skills to postgraduate degrees. They are the providers of both further and higher education (HE) in Scotland.

In 2015/16, over 227,000 students attended college of which, approximately two thirds studied part-time. In addition, colleges provide 28% of all HE level study in Scotland.

Following a series of mergers and a reform of the college sector from 2012 onwards, Scotland now has 26 colleges across 13 regions.

2.2 The Sector in Scotland

Table 1: FTE staff by occupation and mode of employment 2014/15 to 2015/16

			2014-15	% of staff	2015-16	% of staff	% change between years
Teaching	Permanent	Full-time	3,604	33.4%	3,626	33.6%	0.6%
		Part-time	1,225	11.4%	1,247	11.5%	1.8%
		Total	4,829	44.7%	4,873	45.1%	0.9%
	Temporary	Full-time	72	0.7%	53	0.5%	-25.7%
		Part-time	471	4.4%	398	3.7%	-15.6%
		Total	543	5.0%	451	4.2%	-16.9%
Teaching total*			5,372	49.8%	5,324	49.3%	-0.9%
Non-teaching	Permanent	Full-time	3,736	34.6%	3,775	34.9%	1.0%
		Part-time	1,201	11.1%	1,260	11.7%	4.9%
		Total	4,937	45.7%	5,035	46.6%	2.0%
	Temporary	Full-time	300	2.8%	262	2.4%	-12.4%
		Part-time	187	1.7%	183	1.7%	-2.2%
		Total	487	4.5%	446	4.1%	-8.5%
Non-teaching total*			5,424	50.2%	5,480	50.7%	1.0%
Staff total*			10,796	100.0%	10,804	100.0%	0.1%

* May not sum due to rounding

Source: Scottish Funding Council

There were 10,804 FTE staff in Scotland's colleges in 2015/16 compared to 10,796 in 2014/15, an increase of 0.1%.

Staff numbers have changed over the years. Following a series of mergers and reform of the college sector there was a nine percent fall in FTE staff numbers. However, this has increased in recent years.

Table 2 provides the most recent expenditure data for the sector. Expenditure totalled £663 million in 2015/16. By far the biggest expenditure was staff costs (65.3%) with other operating expenditures making up 25%.

Table 2: College expenditure for 2015/16

Type of Spending	Amount (£ million)	%
Staff costs	433	65.3
Exceptional staff costs	7	1.1
Other exceptional costs	1	0.1
Other operating expenses	166	25.0
Depreciation	47	7.1
Interest payable	9	1.4
Total spending	663	100

Source: Audit Scotland

Table 3 shows the revenue sources for 2015/16. Funding from public sources – grants, tuition fees and education contracts (91.3% in 2015/16).

Table 3: College income for 2015/16

Type of Income	Amount (£ million)	%
SFC grants	481	73.4
Tuition fees and education contracts	117	17.9
Donations, endowment and investment income	1	0.2
Other income	56	8.5
Total	655	100

Source: Audit Scotland

A report by education economic consultants EMSI (2015), looked at the impact of staff and college expenditure on the Scottish economy. They found that that during the academic year 2013/14 staff at Scottish colleges spent more than £392 million and colleges themselves spent more than £272 million to support their operations. The direct and indirect benefits of this are estimated to have added more than £700 million in Gross Value Added (GVA) to the Scottish economy in a given year.

2.3 Latest Student Figures

According to SFC, in 2015-16 there were 227,258 students (headcount) studying at Scotland's colleges. In full-time equivalent (FTE) terms, this figure was 121,184. Over the past few years, the number of students studying has reduced. This shift is largely due to a change in policies which have focused on the younger learner and on achieving recognised qualifications.

Table 4: Number of enrolements in Scotland's colleges: 2015/16

Mode of Study	Number of Enrolments	Average Hours of Learning
Full-time	78,754	510
Part-time	202,297	148
Total	281,051	

Source: Scottish Funding Council

In addition to headcount and the number of FTE students, it is also possible to measure enrolments at college. Enrolments tend to be higher than headcount and FTE as it is possible for people to sign-up for more than one course.

The majority of enrolments are on part-time courses reflecting, in part, the flexible nature of learning in the sector. In 2015/16, 65.9% of the sector's 281,051 enrolments were part-time. In total, the 227,258 students attending college in 2015/16 are estimated to have achieved more than 70 million hours, or 8,000 years, of learning[2].

The gender balance of the student population is relatively even at 49% male to 51% female. At a subject level, some gender imbalances persist e.g. engineering and social care. The Scottish Funding Council (SFC) has developed a Gender Action Plan in partnership with key stakeholders to address this across the tertiary sector.

Table 5: Full-time (SFC Funded) students aged 16 to 24 by gender

	Full-Time Male	Full-Time Female	Full-time Other/Not Known
2014/15	28,053	30,151	21
2015/16	28,177	28,631	33

Source: Scottish Funding Council

Despite the overall drop in students numbers in recent years outlined above, the number of students from the 20% most deprived areas as measured by the Scottish Index of Multiple Deprivation (SIMD) coming on to college courses has increased year on year. This figure now stands at 27.7% for full-time higher education and 33.6% for full-time further education for 2015-16[3]. It is worth noting that college is a step towards university for many, especially students from more disadvantaged backgrounds.

According to the Sutton Trust, the improved access for disadvantaged students has been met almost entirely by the expansion of sub-degree programmes in Scottish colleges. 90% of the growth in Scottish higher education participation for disadvantaged students since 2006 has been through colleges (Hunter-Blackburn et al, 2016).

According to Audit Scotland, the number of students from an ethnic minority background increased from 13,563 in 2011/12 to 13,618 in 2015/16. The percentage of ethnic minority students has remained broadly stable at six per cent of the student population over time.

Table 6 shows the breakdown by enrolment (which will be higher than attendees).

2 SFC, College Statistics 2015-16.
3 SFC Report on Widening Access 2015/16, published 26 Sept 2017

Table 6: Enrolments for students from a minority ethnic background 2015/16

Ethnic background	Funded by SFC	Funded from other sources
African	4,385	838
Pakistani	2,588	246
Other ethnic background	2,435	547
Any other Asian background	1,841	174
Chinese	1,335	141
Any mixed background	1,127	194
Indian	815	1,234
Other black background	436	44
Bangladeshi	187	31
Caribbean	177	26
Total	15,326	3,375

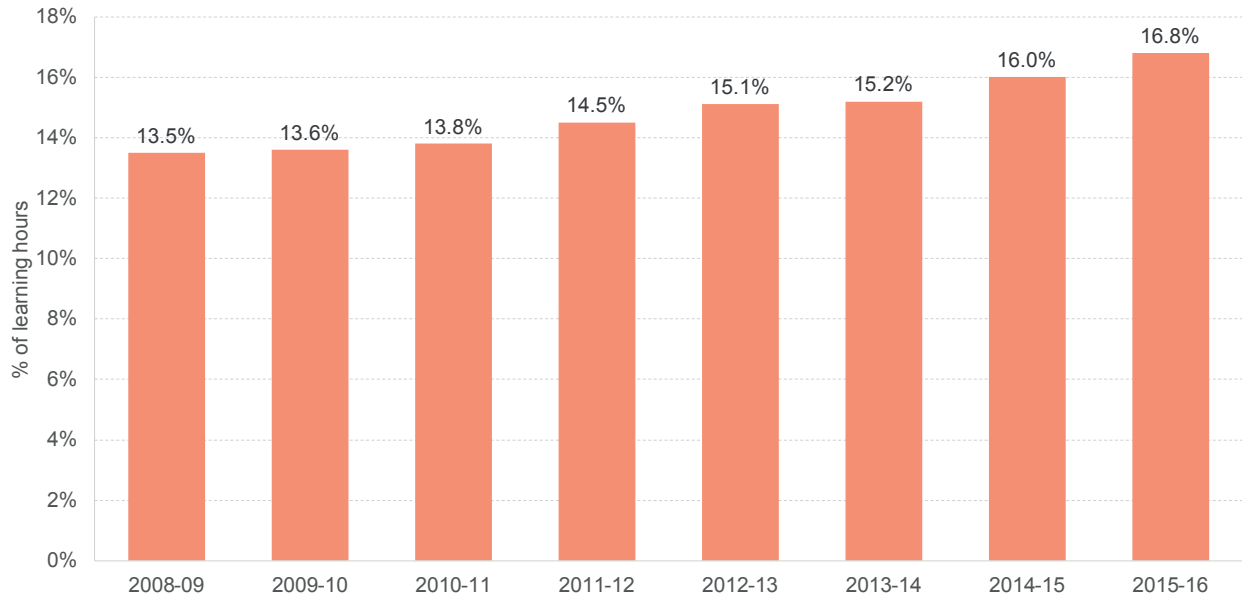
Source: Scottish Funding Council

In 2015/16, enrolments from students with a minority ethnic background accounted for 6.7% of total enrolments.

Colleges also offer accessible programmes for students requiring additional support, including those with a reported disability. In 2015/16, students with a recorded disability accounted for 16.8% of all learning hours (11.7 million hours).

Chart 1 shows that the percentage of learning hours delivered to students with a recorded disability has increased in each year between 2008/09 and 2015/16. Dyslexia is the most commonly reported disability.

Chart 1: % of Learning Hours delivered to students with a disability 2008/09 to 2015/16



Source: Scottish Funding Council

Colleges can also offer an accessible source of 'lifelong learning' for older students.

Table 7: Student numbers by age 2015/2016

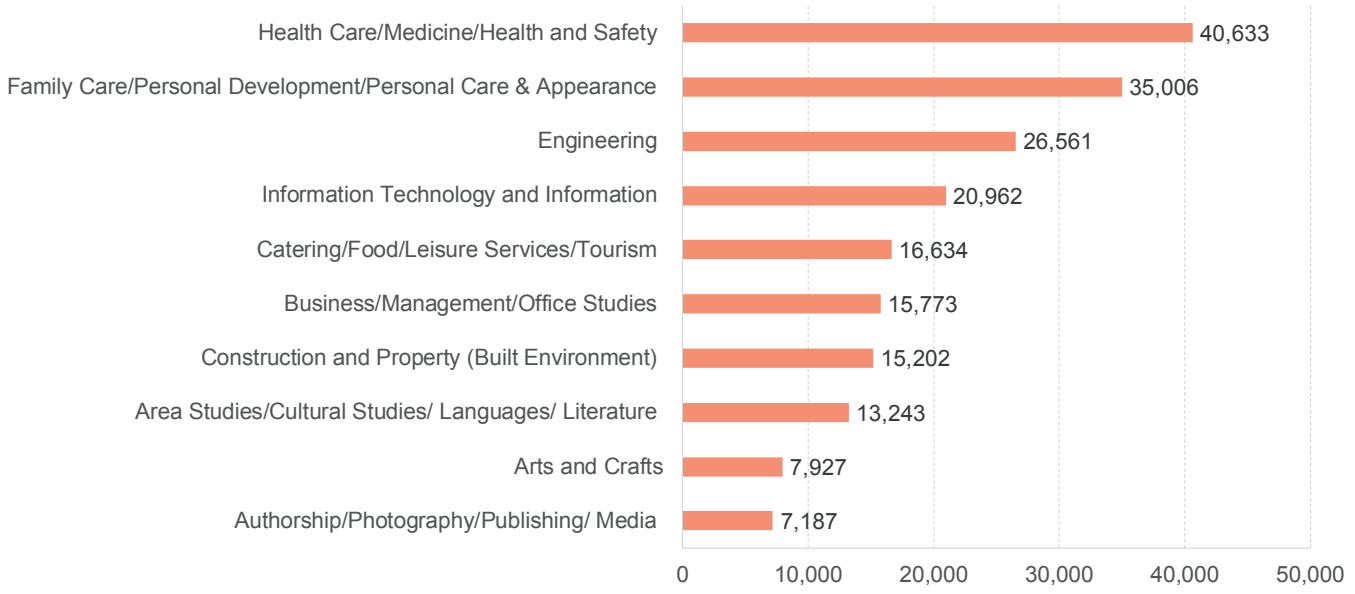
Student age	Full-time	Part-time
Under 16	423	20,685
16-17	12,850	19,642
18-19	26,552	14,339
20-24	18,325	21,747
Over 25	19,182	75,085
Total	77,332	151,498

Source: Audit Scotland

Almost half of part-time students in college are aged over 25 and a proportion of these students are likely to be in employment.

A key role for colleges is in helping people in employment – or in their business – to develop improvements to business processes through skilling, reskilling and upskilling.

Chart 2: Top ten subject areas by number of students for 2015/16



Source: Scottish Funding Council Infact Database

In the technical modelling that follows in Chapter 4, we focus upon the learner achievements of graduates completing college with a recognised qualification. We do this for two key reasons. Firstly, because the empirical evidence on the linkages between learning and the economy is strongest for this group. Secondly, the Scottish Government and the SFC continue to prioritise funding of nationally-recognised qualifications.

Table 8 summarises the key data on the number of students attaining each qualification since 2008-09.

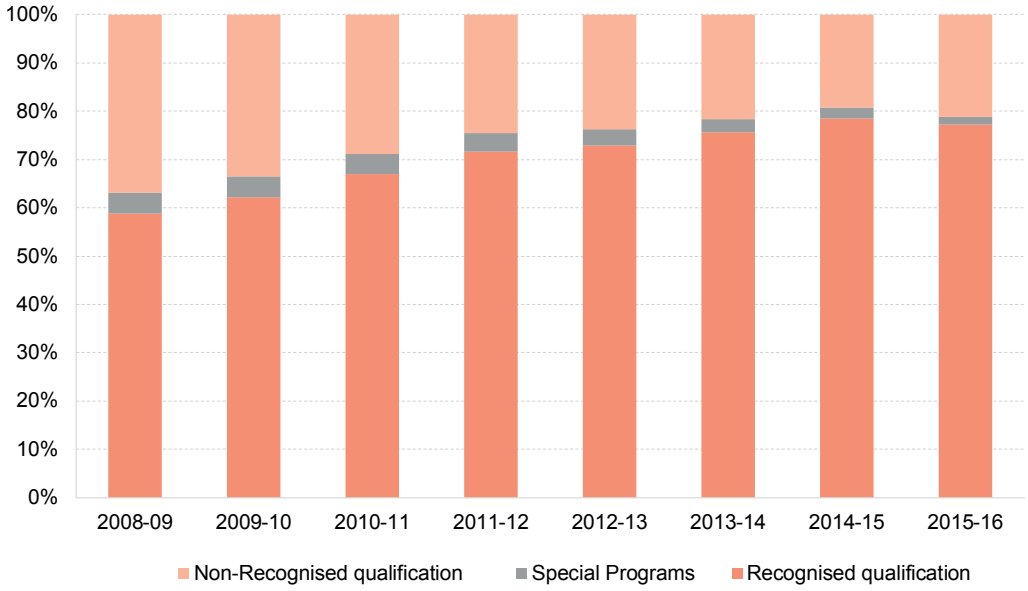
Table 8: Number of nationally recognised qualifications obtained by Scottish domiciled graduates and graduates from EU outside the UK per year by individual National Vocational Qualifications (NVQ). 2008/09-2015/16.

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Total
NVQ1	3,017	3,278	3,160	2,770	3,315	2,735	3,281	6,271	27,827
NVQ2	6,811	6,991	8,315	7,112	7,356	7,711	7,373	10,215	61,884
NVQ3	24,009	25,077	26,545	25,867	25,313	27,021	27,138	31,412	212,382
NVQ4	8,053	8,044	9,028	9,571	9,843	9,809	10,079	10,105	74,532
NVQ5	49	45	58	11	26	25	12	20	246
Total	41,939	43,435	47,106	45,331	45,853	47,301	47,883	58,023	376,871

Source: Scottish Funding Council (mapped to NVQ from SCQF).

Colleges are also responsible for the provision of some non-recognised qualifications. These may include introductory courses and access courses. For the purpose of the modelling, we have excluded courses such as English for speakers of other languages. It is important to note however, that they account for a small percentage of total learning hours. Chart 3 shows recognised qualifications and special programmes by percentage of enrolments 2008/09 to 2015/16.

Chart 3: Recognised Qualifications and Special Programmes by % of enrolments 2008/09 to 2015/16



Source: Scottish Funding Council

Furthermore the percentage of learning hours leading to a recognised qualification has increased. In 2007/08, 89.4% of learning hours led to a recognised qualification and this has risen to 97.2% in 2015/16.

This is not to diminish the role of non-recognised qualifications. They can be extremely useful and are often a stepping stone to further study and to recognised qualifications. Moreover, they can also help to close immediate skills gaps in an individual business or sector.

They are also useful for employees who need short courses to upskill or address a lack of knowledge or experience. In this regard, a more flexible form of learning is likely to become increasingly important in a time of rapid technological change, as it can help establish a culture of continuous development of technical, professional and vocational education. This can create not only a more productive workforce, but one that is more dynamic and responsive to change.

2.4 Conclusions

Scotland's colleges contain a broad mix of students in terms of age and they have a relatively high proportion of students from more challenging backgrounds. They provide a flexible learning route for their students and play a crucial role in promoting economic and social inclusion.

They are not just vital to more disadvantaged individuals, but to a range of people including those who may prefer a more supportive learning environment, or those who want to study for a technical, professional or vocational qualification, or to study part-time, to study closer to home. Also colleges are important to those who may have a more limited access to higher educational establishments and feel able to maximise their potential in a college as compared to a school or university.

In such a time of significant economic change, the role that colleges play in helping to develop a more productive and flexible workforce is all the more essential.

Delivering the Economic Strategy

Chapter 3

3.1 Introduction

The Scottish Government has set out an ambition to deliver faster sustainable economic growth. A more inclusive, resilient and robust economy is an ambition shared by many people in Scotland.

Colleges play a crucial role in Scotland's growth potential by enhancing human capital – whether that be through the provision of routes from school through college, work, further training or progressing to university; continuous skills-development (in conjunction with employers); or re-training people for new opportunities.

In this chapter, we discuss the contribution that colleges are believed to make to our economy through the lens of both an individual and – via the Scottish Government's Economic Strategy – the national economy.

First of all we review current economic conditions in Scotland.

3.2 Scottish Economic Conditions

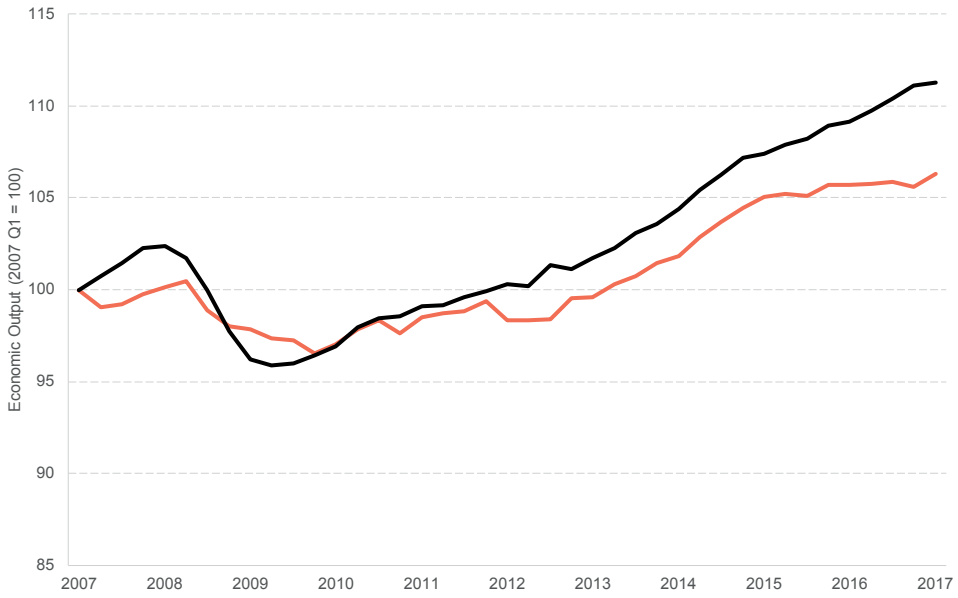
Scotland's college sector underpins economic activity in Scotland. This economic backdrop – in turn – sets the context for any analysis of college activity.

In recent years, the Scottish economy has had to respond to a number of significant economic challenges. This includes the 2008 financial crisis, the period of significant fiscal consolidation and now the uncertain outlook arising from Brexit.

As Chart 4 highlights, Scotland's economy showed resilience through the financial crisis, however it has had a challenging recovery. A key reason for this has been the downturn in the oil and gas industry. This has had a particularly significant impact on the North East and in industries tied to the North Sea.

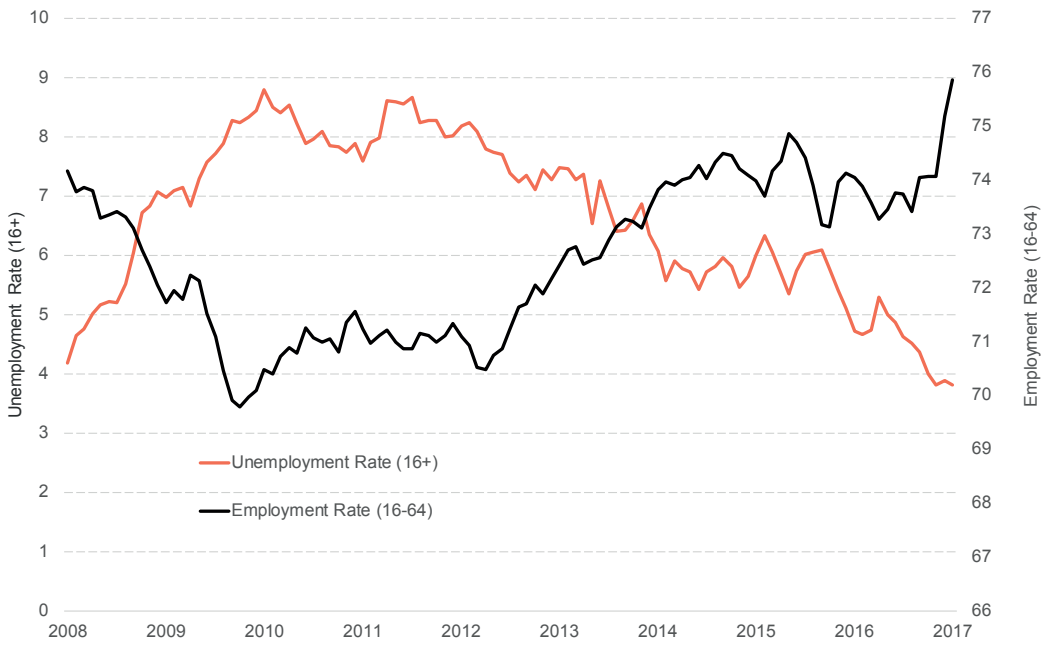
Despite this, the labour market has held up remarkably well. Both unemployment and employment rates are now the best they have been since records began. The employment rate in Scotland now stands at 75.2% up 1.1 percentage points on a year ago. Meanwhile the unemployment rate has fallen to 3.9% down 1.2 percentage points since last year.

Chart 4: Scottish and UK economic growth in GDP performance since 2007



Source: Scottish Government

Chart 5: Scottish employment rate and unemployment rate best since records began



Source: ONS, Labour Force Statistics, September 2017

Compared to the UK, Scotland now has a marginally higher employment rate and a lower unemployment rate.

Table 9: Employment, unemployment and inactivity rates in Scotland and UK

	Employment (16-64)	Unemployment (16+)	Inactivity (16-64)
Scotland	75.8%	3.8%	21.2%
Quarterly Change	+1.8	-0.2	-1.6
Annual Change	+1.8	-0.9	-1.0
UK	75.3%	4.3%	21.2%
Quarterly Change	+0.5	-0.2	-0.3
Annual Change	+0.8	-0.5	-0.3

Source: ONS, Labour Force Statistics, September 2017

While headline indicators are good we need to bear in mind that, as always, the health of the labour market is more complicated than the headline numbers suggest. In particular, there has been a rise in less-traditional forms of employment in Scotland – including a rise in part-time and temporary work and, perhaps most significantly, self-employment. Many of these changes can be characterised as being part of the 'gig economy' with people having temporary and freelance work rather than permanent jobs.

With output growth relatively weak, but strong employment indicators, it is no surprise that earnings and productivity growth have been weak.

3.3 Economic Outlook

Most economists predict that the outlook for the next few years will remain challenging. Uncertainty around Brexit is likely to be the key feature, although other factors such as rising inflation are likely also to play a role. Table 10 highlights the outlook from the leading respected economic forecasting bodies in Scotland.

Table 10: Growth forecasts in the Scottish economy

	2017	2018	2019
Fraser of Allander	1.2%	1.4%	1.6%
PWC	1.3%	1.1%	n/a
EY	0.9%	0.7%	1.1%
Scottish Fiscal Commission	1.0%	1.3%	1.6%*

Source: various

*Scottish Government forecasts are for financial years

3.4 Benefits to the Individual

The benefits to the individual from investment in education, skills and training to the individual are well documented, see for example Schuller et al (2004). Gaining a qualification from a college can help learners develop the skills to enable them to fulfil their economic potential. At the same time, the experience of going to college can help learners develop life skills and boost their employability prospects. More specifically, there is evidence which highlights that by investing in their own development, an individual will benefit from higher average wages, better employment prospects and a lower likelihood of entering unemployment than would otherwise be the case. These findings are described in Chapter 4 of this report supporting evidence can also be found in numerous publications including academic articles and publications by the Department for Business, Innovation and Skills[4].

However some of these benefits move beyond 'traditional' economic factors; one such benefit is the positive effects on health and wellbeing. For example, Chevalier and Feinstein (2004) report positive impacts on mental health outcomes and mental illness from participation in adult learning. In addition there is evidence of wider benefits to an individual such as better physical health outcomes with longer life expectancy (Schuller et al., 2002).

Furthermore, the education benefits are not simply transformational to the individuals themselves, but can also have a sustaining effect on peoples' lives. There is research indicating that parental education plays an important factor in their child's educational outcomes. There is also a wide range of research highlighting improved social mobility associated with gaining new qualifications – see, for example the Office for National Statistics Longitudinal Survey of 2002.

3.5 Benefits to the Wider Economy

It is not just the individual who benefits from any upskilling – the wider economy as a whole benefits as well. A skilled workforce is vital for long-term economic growth as it is a key driver of productivity.

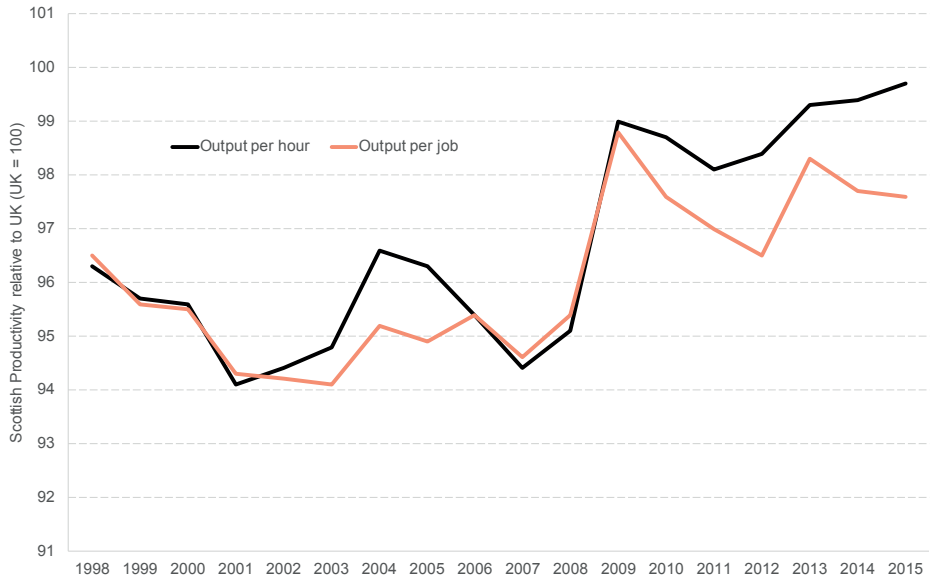
Colleges are vital in providing work-based upskilling of staff for example, the new Flexible Workfroce Development Fund (FWDF) which was launched in September 2017, aims to boost productivity by bringing the college sector and the business community together to provide in-work training. The FWDF will be delivered through colleges and the colleges will work with employers to identify specific requirements and deliver tailored training.

4 Department for Business, Innovation & Skills was replaced by Department for Business, Energy & Industrial Strategy in July 2016

A more productive economy is able not only to produce more goods and services over time but also better quality goods and services. A more productive economy is also one that is able to invest more in public services. It is a key driver therefore of living standards and national prosperity.

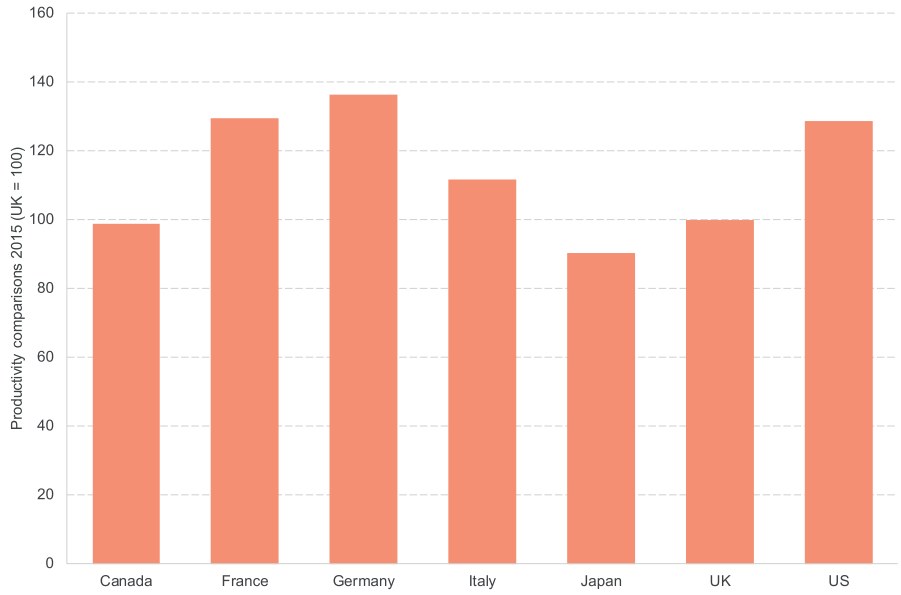
The latest figures show that Scotland has caught up in recent years with the UK in terms of productivity - Chart 6.

Chart 6: Scottish productivity relative to the UK – catching up since 1999



Source: Scottish Government

Chart 7: International productivity comparisons - 2015



Source: ONS

That being said, most other advanced economies perform better than the UK (and Scotland). As Chart 7 highlights for example, the UK (and Scotland's) productivity rates are around 15% below the G7 average.

At the same time, the Scottish Government has argued that many other comparable nations have performed better not just in terms of productivity, but also on measures of equality, wellbeing and sustainability.

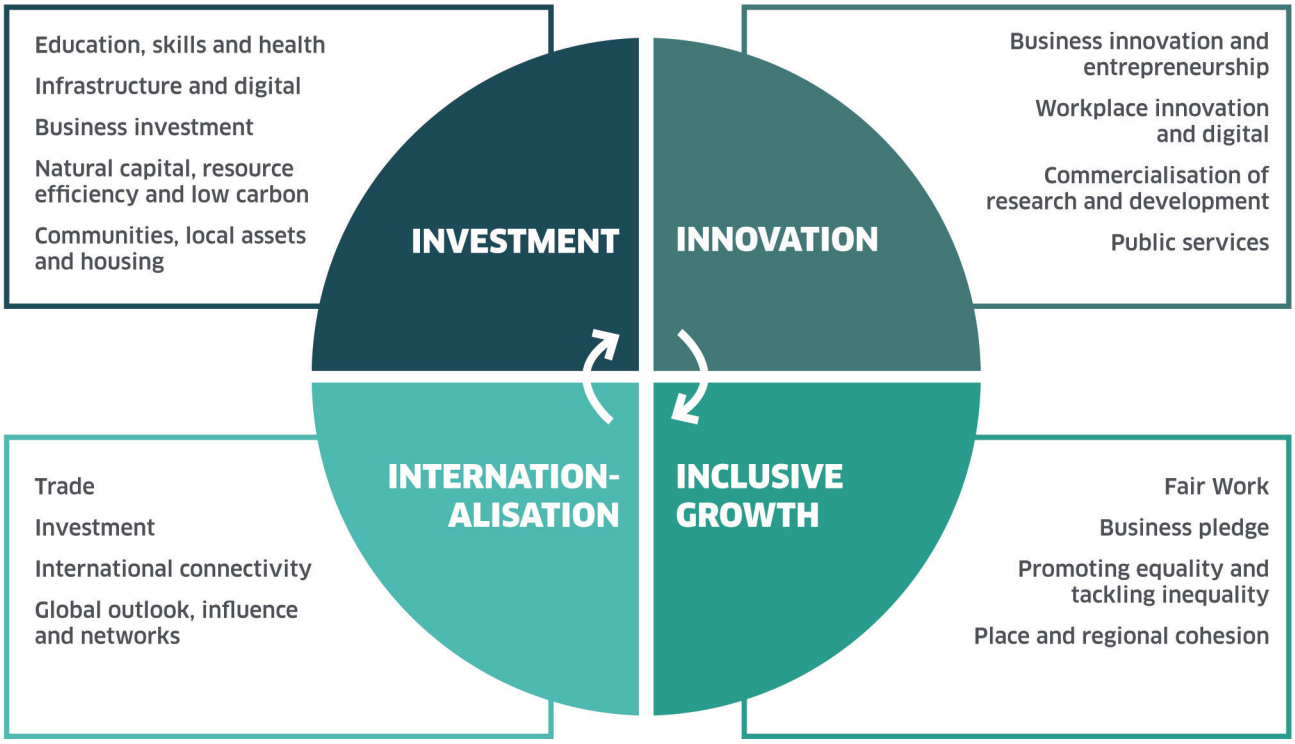
The Scottish Government's Economic Strategy – and supporting Labour Market Strategy - together set out how they intend to tackle these objectives. Education, skills and training are central to achieving that ambition.

3.6 The Scottish Government's Economic Strategy

The Scottish Government's Economic Strategy has two 'mutually supportive goals' of increasing competitiveness and tackling inequality with fair work at the centre of that approach. Diagram 1 shows how the various components of the Strategy – and in particular the ambition for inclusive growth – are linked.

Investing in colleges has an important role in all of these priorities. However, as with all policy interventions, there will be some areas where the impact is greater than others.

Diagram 1. Components of the Scottish Government's Economic Strategy



Source: Scottish Government

Investment

This is the direct route through which colleges can impact on Scotland's long-term growth potential.

The focus tends to be mainly on investment which is seen as spending on infrastructure and other capital projects. It is true that these are vital for delivering high-value public services, boosting connectivity and supporting businesses. However, human capital is just as vital as physical capital in boosting productivity.

By investing in a more productive and skilled workforce, a country can, for example, deliver faster sustainable growth. At the same time, in a world of increased automation and technological change, a more productive and skilled workforce can also boost economic resilience.

Colleges contribute to inclusive economic growth by widening access to education and vocational training opportunities, which boost labour market participation. By working directly with business and industry, colleges also help supply businesses with the skilled workers they need to be successful and to address skills gaps.

Innovation

Innovation encompasses the development of new processes, products, services, workforce design and business models. Innovation is a fundamental driver of long-term competitiveness and sustainable growth, and more innovative economies are also more likely to succeed in international markets.

Colleges – by supporting a highly skilled workforce – are crucial to achieving this:

- Firstly, a skilled workforce is needed to help deliver an innovative economy, not just in terms of undertaking Research & Development directly and supporting the commercialisation of its outputs, but also by creating more dynamic and inclusive workplaces and effective management practices.
- Secondly, a skilled workforce is needed to enable the economy to apply new technologies into our everyday economic lives. For example, we are seeing how global digital technologies are transforming the way in which consumers and businesses interact. Equipping the workforce to adapt in such an environment is crucial.
- Thirdly, colleges are often the key source of process innovation for small businesses across the country helping them to become more efficient and productive[5].

Internationalisation

Scotland's economic success will be increasingly realised through strengthening its global links with new opportunities from trade, investment and collaboration. Whilst Scotland has an established network of global connections it lags behind many other comparable countries in terms of the degree of internationalisation.

Like innovation, a skilled and productive workforce is a crucial underpinning of any attempt to expand Scotland's export base and/or to attract new investment. Export markets are notoriously difficult to operate in, with the level of competition particularly fierce.

At the same time, skills are consistently seen as a key consideration for international investors.

For example, the 2017 EY Attractiveness Survey asks potential and actual investors what the key investment criteria they consider when investing in regional locations within the UK.

The ability and skills of local workforce comes out consistently at (or near) the top in the ranking of criteria.

5 For a more detailed discussion see www.innovationcentres.scot

Chart 8: Investment criteria when considering investing in regional locations in the UK

Source EY's UK attractiveness survey 2017, sample (n=453). Two answers possible

Inclusive Growth

Inclusive growth and providing a fair and inclusive jobs market is a key objective of the Scottish Government. This includes the need to remove long-standing barriers to people being able to fulfil their economic potential.

Colleges have a key role here. They provide opportunities for people from different backgrounds – and education qualifications – to up-skill and boost their employment prospects.

As previously stated, the number of students from the 20% most deprived areas as measured by the Scottish Index of Multiple Deprivation (SIMD) coming on to college courses has increased year on year. This figure now stands at 27.7% for full-time higher education and 33.6% for full-time further education for 2015-16[6].

Evidence has also shown the importance of a workforce that is dynamic and able to adapt to emerging opportunities to inclusive growth. In this regard, colleges are a key player in the commitment to offer 'Opportunities for All' – and in particular opportunities for those who may face particularly tough barriers to accessing the labour market.

Colleges are important contributors to developing Scotland's young workforce – something that is vital given that unemployment rates among 16-24 year olds remain higher than for other age groups. Scotland's colleges are key in the Young Workforce Programme (Scottish Government, 2014).

Finally, there are colleges right across Scotland offering flexible learning opportunities for people in more remote and rural locations. This helps to deliver inclusive growth from a regional perspective.

6 SFC Report on Widening Access 2015/16, published 26 Sept 2017

3.7 Wider Benefits of College Learning

In addition to the economic benefits outlined above there are a number of wider social benefits. A number of studies have shown a link between improved education and learning outcomes and wider social objectives like reduced crime. (See, for example, McMahon, 2009). There is also some research indicating that education contributes to changes in attitudes and behaviour that enhance social cohesion. For example, Feinstein et al. (2002) found evidence of education increasing political awareness and voting.

Scottish Parliament's New Fiscal Powers

The importance of economic growth is all the more vital given the new fiscal powers of the Scottish Parliament. As Table 11 highlights, the Scottish Parliament is going through a major process of financial reform. Soon, around half of Holyrood's annual resource budget will depend upon the revenues that are raised in Scotland.

Table 11: Devolved, shared and assigned tax revenues in Scotland

Tax	Date of transfer/ devolution	Revenues raised 2016/17 (£m)	Degree of control by Scottish Parliament	Responsibility for collection
Land and Business Transactions Tax (LBTT)	2015	£466	Fully devolved; complete autonomy.	Revenue Scotland
Landfill Tax	2015	£149	Fully devolved; complete autonomy.	Revenue Scotland
NSND income tax	2017	£11,313	The Scottish Government can set the rates and bands. But the UK Government defines the tax base and sets allowances.	HMRC
Air Passenger Duty	2018	£264	Fully devolved; complete autonomy	Revenue Scotland
VAT	2019	£5,097	Assigned revenues; no autonomy	HMRC
Aggregates Levy	tbc	£59	Fully devolved; complete autonomy	Revenue Scotland

Source: Government Expenditure and Revenue Scotland (GERS)

This means that faster growth is now fundamental to the amount of money that the country has to spend on public services.

It also means that interventions that improve employment outcomes – and growth – bring added 'fiscal' benefits to Scotland. If someone can secure long-term work that is valued, then they will pay taxes – income tax and VAT – which will now directly feed into the Scottish budget.

Moreover, the public finances in Scotland (and the UK) are likely to continue to be under enormous pressure over both the short and long-term – including from increased demands for many public services from an ageing population.

This means that the importance of preventative spend – including investments in the economic potential of Scotland's workforce – is crucial.

3.8 Conclusion

In summary, colleges play a vital role at various stages of the process of improving human capital and therefore the objectives of the Scottish Government's Economic Strategy.

In the chapter that follows, we model what this actually amounts to in value terms.

Data and Methodology

Chapter 4

4.1 Introduction

As highlighted above, colleges play a vital role in achieving the objectives of the Scottish Government's Economic Strategy.

Scottish colleges provide a wide variety of professional, technical and vocational training geared towards a heterogeneous student body of varying demographic and social backgrounds.

In addition to widening access to educational opportunities – potentially improving income equality and inclusive growth – colleges contribute to national economic growth through increasing human capital.

There is a substantial body of evidence that measures the labour market benefits to an individual of education and training. These microeconomic studies find strong evidence that education and training, including that provided by Scottish colleges, results in the individual benefitting from a wage and employment "premium" relative to those with less education: individuals earn a higher wage and have a higher probability of employment as a consequence of their education and increased skills.

Much less emphasis has been placed on understanding how these effects impact on the wider economy. Where studies do seek to measure the system-wide or macroeconomic impacts of education, these typically take the form of traditional 'economic impact' studies where the knock on or "multiplier" effects of an institution's or sector's spend on the economy is assessed. The focus is solely on the institution's/ sector's (and sometimes their students') expenditures – that is, on the demand side of the economy. Very few studies recognise, and attempt to measure, the potential boost to the productivity of the economy from the more skilled workforce created by the institution / sector. Yet, as we have seen, this is an important supply-side mechanism through which Scotland's colleges could exert a significant impact on the Scottish economy.

In this study we quantify the effects of Scotland's colleges on the wider Scottish economy through its creation of a more highly skilled labour force, using a model of the Scottish economy developed by the Fraser of Allander Institute.

4.2 Overview of Our Approach

McGregor and Ross (2017) outline a number of possible approaches to conducting an analysis of the impact on the economy of increases in human capital. The "micro-to-macro" method is the most promising[7]. This approach uses relevant micro-econometric evidence of the returns to education to inform simulations which we run through a detailed economic model of the Scottish economy.

This allows us to capture the transmission mechanism from changes in an individual's productivity (the micro-level) through to nationwide output and employment impacts (the macro-level). It also enables us to incorporate the distribution of any gains/costs across households or sectors, and the dynamic transition paths of the benefits of a college education (or for that matter, any learning initiative).

7 This micro-to-macro approach was initially developed and applied for an ESRC-funded study of the regional impact of Higher Education Institutions (Hermannsson et al, 2014, 2016) where it was used to estimate the macroeconomic effects of labour productivity increases in response to projected increases in the share of graduates. It has subsequently been applied to assess the impacts of a single Scottish college graduation cohort for the year 2010/11 (Hermannsson et al, 2017).

The key steps are as follows:

- Step 1: We identify the latest robust econometric evidence measuring the private returns to college graduates in terms of wage premia[8]. In practice, this involves measuring the productivity enhancing effects associated with the additional human capital generated by a single college graduation cohort for the year 2015/16[9]. Appendix A details how the productivity impact of college graduates is estimated[10].
- Step 2: We use this evidence to inform the specification of a Computable General Equilibrium (CGE) model of Scotland (see below).

The CGE model we use is the latest version of the Fraser of Allander's AMOS[11] model[12] - see Harrigan et al. (1991), McGregor et al. (1991), Lecca et al. (2013) and Ross (2017). Appendix B gives a brief description of the AMOS model.

AMOS has been developed over three decades and been peer reviewed on a continual basis by academics and policy officials outside of the FAI. Its development has been supported by funding from a variety of sources including the Economic and Social Research Council, the Engineering and Physical Sciences Research Council, the UK Energy Research Centre, the Scottish Government and Skills Development Scotland.

AMOS is an example of a CGE model. These are detailed representations of the real-world economy which capture the inter-linkages between the private sector, government, trade, the labour market and households. In addition to providing important insights into how an economy operates, they are ideal for simulating the impact of policy. CGE models are the preferred mode of (macro)economic analysis within major policy institutions – including HM Treasury. The Scottish Government use a CGE model of Scotland that was initially developed by the Fraser of Allander Institute.

In terms of our focus, we limit our analysis to the impact of graduates obtaining nationally-recognised qualifications. This is for two reasons, one practical and the other more general. Firstly, whilst there is robust international evidence on the impacts of recognised qualifications on labour market outcomes, there is no such evidence for non-recognised qualifications and certificates[13]. Given the absence of such evidence it makes sense to focus primarily on the impacts of recognised qualifications. Secondly, the Scottish Government and the SFC have set out a clear policy that prioritises the funding of nationally-recognised qualifications. It is therefore appropriate to focus attention primarily on this key group.

We emphasise, however, that non-recognised qualifications generate a number of economic and non-economic benefits. Indeed, we believe that future research should seek to generate the data that would allow a full assessment of the contribution of such qualifications. For illustrative purposes, we provide an indicative assessment of the potential impact of non-recognised qualifications in our sensitivity analysis in Appendix C.

8 As is the standard practice in the absence of any direct measures of labour productivity effects, we assume that observed wage rates directly reflect labour productivity. See Becker (1964,1994), Mincer (1985), and Schulz (1960).

9 We extend the earlier analysis by developing the analysis to cover system-wide impacts of multiple graduation cohorts.

10 As in Hermannsson et al. (2014, 2016, 2017), we adopt an important simplifying assumption: we treat human capital as homogenous within each skill category, in an approach similar to that of Acemoglu and Autor (2012). This implies that the difference between skill categories is simply the average quantity of human capital possessed – where it takes more unskilled labour to perform the same task as skilled labour.

11 AMOS: acronym for A Micro-Macro Model of Scotland.

12 The model employed here is described in detail in Ross (2017). This model is an extension of the AMOS model that incorporates skill-disaggregation (AMSOKI). AMOSKI essentially extends the production structure of the standard AMOS model to incorporate skill and unskilled labour in nested CES functions using an elastivcity of substitution between the skill categories of 1.25.

13 It must be stressed that the modelling approach and framework employed here are capable of incorporating all of the qualifications, certificates, diplomas and other training initiatives that colleges engage in. However this would require robust empirical evidence on the private market benefits to individuals i.e. wage and employment premia.

System-wide Impacts of College Learners

Chapter 5

5.1 Economic Impact of a Single Graduation Cohort Analysis

Table 12 details the long-run effects of changes to labour productivity reflecting the impacts of a single graduation cohort of college students for the year 2015/16.

As detailed in Appendix A, the increase in the productivity of the Scottish labour force generated by the Colleges' graduation cohort in 2015/16 is 0.166%. This increase in productivity is fed into our model of the Scottish economy and is maintained from year 1 to year 40, when the stimulus to productivity is removed, reflecting the expected 40 year working lifetime of the average college graduate. The long run is defined as time-period 40, after which the labour productivity improvement is removed, and where impacts have reached a stable (maximum) level.

The increase in labour productivity is the only exogenous change introduced, so that the results represent the deviation from what would have occurred if labour productivity had remained unchanged; so they indicate, for example, how much higher Scottish GDP is as a consequence of the increase in human capital created by the graduates of Scotland's colleges.

It is useful to consider the general impacts that productivity improvement of this kind exert on the labour market. Essentially, the increase in productivity allows the same amount of output to be produced with fewer workers, decreasing the effective cost of labour.

There are conflicting forces working to change employment. Since fewer workers are now required to produce a given output, this tends to reduce the demand for workers. But against that, the reduction in the effective cost of labour tends to stimulate employment demand by inducing a substitution in favour of labour, and by improving Scottish competitiveness and stimulating exports.

In the short-run the adverse effects on employment predominate, so the increase in labour productivity is associated with an initial fall in employment, an increase in unemployment, and a fall in both the real and the nominal wage. Prices fall, exports rise, and GDP increases. The initial negative effects experienced in the labour market, however, do not prevail in the long-run, over which period the positive substitution and competitiveness effects dominate

These kinds of forces are reflected in the results of our model simulations reported in Table 12. The net effects of the productivity improvement unambiguously stimulates economic activity, through, for example, the increasing export demand in response to improved competitiveness.

Table 12: Single cohort analysis for 2015/16: long-run effects of a change in labour productivity. (In percentage changes from base year values.)

	Long-run
GDP (and GDP per capita)	0.17
Consumer price index (CPI)	-0.10
Unemployment rate (pp difference)	-0.02
Total employment	0.01
Nominal gross wage	-0.07
Real gross wage	0.02
Households consumption	0.03
Investment	0.16
Capital stock	0.16
Export RUK	0.16
Export ROW	0.17
GDP in present value terms (£billion)	3.4
GDP in present value terms per graduate (£thousands)	59

Long-run at t = 40. GDP present value up to t = 85.
Source: Fraser of Allander Institute

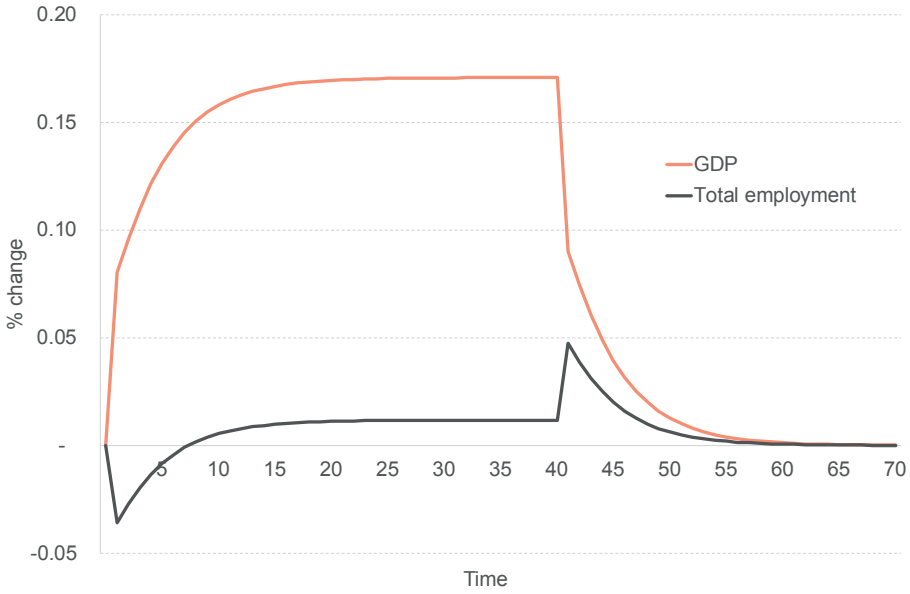
As a result of the increase in human capital, the long run sees the Consumer Price Index below its base level, exports increased due to competitiveness effects, and GDP is also above its base. In the labour market, employment levels are above base year values over the long run and unemployment has falls. The real wage also rises marginally.

Chart 9 shows the evolution of GDP and employment, as percentage changes measured against their base-year levels. GDP reaches an equilibrium level around time-period 15 with an increase of 0.17%, which is sustained until time-period 40. Employment changes see an initial fall but turn positive (and remain positive thereafter). Once the graduation cohort leaves the labour force in period 41, there remains a 'legacy effect', including a further stimulus to employment. In that period, labour productivity returns to its base-year value but the physical capital stock is higher than its original level. This generates a further increase in employment, the size of which is reduced over time as disinvestment gradually brings the capital stock back to its original absolute level and sectoral configuration. Such legacy effects have not been identified in previous impact assessments.

The employment impacts across all simulation periods are captured in present value (PV) terms[14]. The increase in FTE employment generated by the system-wide impacts of the single college graduation cohort amounts to 2,178 FTE jobs in present value terms as compared to the base year.

14 The present values are calculated using a 3.5% real discount rate as recommended in the HM Treasury (2013) Green Book.

Chart 9: The impact on Scottish GDP and employment of an increase in labour productivity generated by a single 2015/16 college graduation cohort. (In percentage changes from base year values.)



Source: Fraser of Allander Institute

Table 12 shows that the GDP impact of the single graduation cohort for 2015/16 is £3.4 billion in present value terms. This corresponds to £59 thousand per college graduate in this particular graduation year (obtained by dividing GDP present value by the total number of graduates e.g. £3.414 million/58,023).

It is also possible to calculate the increased tax take that the expansion in economic activity would generate. The present value of the increase in the Government budget is £1.14 billion from the single graduation cohort[15].

The percentage increase in GDP as detailed in Table 12 can also be expressed as an increase in GDP per capita (as the effective total labour force remains fixed). GDP per capita therefore increases in the long run by 0.17% due to this college graduation cohort.

The costs to the Scottish Government, through the SFC, for 2015/16, attributable to the nationally-recognised qualifications included in this assessment, is £336 million[16]. These costs are around 30% of the discounted sum of the increase in the Government budget, and around 10% of the discounted sum of the increase in GDP.

Since the number of college graduates and their skill composition change from year-to-year, our results are to some extent dependent on the choice of the base year analysed. Moreover, the working age population also changes from year-to-year, providing another source of variation in the relative impact of graduates within the base year analysed. It is therefore useful to take into consideration the potential impacts of multiple college graduation cohorts. Such an analysis is outlined in the following section.

15 The previous study of the 2010/11 graduation cohort estimated a £2.3bn PV impact on GDP, and a £764m PV impact on the the Government budget (Hermannsson et al., 2017). Following the same approach we estimate the impact to be £2.8bn and £943m respectively for the graduation year 2010/11. The difference can be explained by the fact that we are using a more up-to-date base year SAM, revised figures for the working age population, and more complete data on the number of graduates (we include 47,106 qualifications, whilst Hermannsson et al. (2017) include 36,136 qualifications). We consider this to be a useful validation check on our model, and the approach taken to calculate the impact in terms of efficiency units. Notably, Hermannsson et al. (2017) were able to split out Acdemic and Vocational qualifications which we were not able to do in the present study.

16 This includes Teaching Funding and SAAS tuition fees (£229m), fees from other sources (£35m), student support funding (£61m), capital, and strategic funding (£12m). This is 58% of total costs when including non-recognised qualifications. Total costs including these of non-recognised qualifications is £580m. It must be noted that capital and strategic funding might include grants from other sources e.g. European Funds. Figures provided by SFC.

5.2 Economic Impact of Multiple Graduation Cohort Analysis

The potential sensitivity to the graduation year analysed suggests that it is useful, where data permit, to provide a multi-cohort analysis.

In our multiple cohort analysis we repeat the calculations to identify the Scottish Colleges' impact on labour productivity for each of the years from 2008/09-2015/16 following the same procedure as detailed above.

These labour productivity shocks are then entered, and removed, in a staggered way. For example, the estimated increase in labour productivity for the 2008/09 graduation year is 0.128%, and 0.131% for 2009/10. The shock entered into the model is 0.128% in period one, and 0.258% in period two (0.128+0.131) and so on.

Table 13 details the effects of changes to labour productivity reflecting the impacts of multiple graduation cohorts for the years 2008/09-2015/16. The interpretation of the results is the same as above.

As outlined previously, the change in labour productivity is associated with an initial fall in employment, an increase in unemployment, and a fall in both the real and the nominal wage. Prices fall, exports rise, and GDP increases. The initial negative effects experienced in the labour market, however, do not prevail in the long run. Here we see a substantial rise of 0.08% in total employment, unemployment has fallen correspondingly and real wages increase by 0.16%.

Charts 10 and 11 summarise the long-run impacts of the college graduation cohorts.

Chart 12 shows the evolution of GDP and total employment, as percentage changes measured against their base-year levels, for the impacts of the graduation years 2008-09-2015/16. The main adjustments follow these seen for the single graduation cohort. Here, however, each graduation cohort is entered and removed in a staggered way so that adjustments are smoothed. GDP increases throughout and reaches a plateau, indicating achievement of a long-run equilibrium, at around time-period 28 with an increase of 1.16%, where it is sustained until time-period 40. As seen previously, there is an initial fall in employment but this turns positive from period 12 onwards.

Once the graduation cohorts gradually leave the labour force from period 41, there is an interval over which a legacy effect occurs, including a stimulus to employment. In these periods, labour productivity returns to its base-year value but the physical capital stock is higher than its original level. This generates a temporary small increase in employment, whose size is reduced over time as disinvestment gradually brings the capital stock back to its original absolute level and sectoral configuration.

The present value increase in FTE employment generated by the multiple graduation cohorts is 13,896 FTE jobs as compared to the base year.

GDP (and GDP per capita) increases by 1.16% in the long run, exports increase to both the rest of the UK and the rest of the world, and there is a significant stimulus to investment.

The impact of the 2008/09-2015/16 college graduation cohorts on GDP is £20.6 billion in present value terms. This corresponds to a £55 thousand present value productivity contribution to the Scottish economy per graduate (£20,646 million/376,871). The present value of the increase in the government budget generated is £6.8bn. Across these graduation years, the impact on GDP in present value terms is £2.58 billion on average (£20.6billion/8).

The total costs to the Scottish Government - attributed to the provision of the nationally-recognised qualifications- paid through the SFC, for 2008/09-2015/16, was £2,365m[17]. These costs amount to around 35% of the discounted sum of the increase in the Government budget, and around 11% of the discounted sum of the increase in GDP.

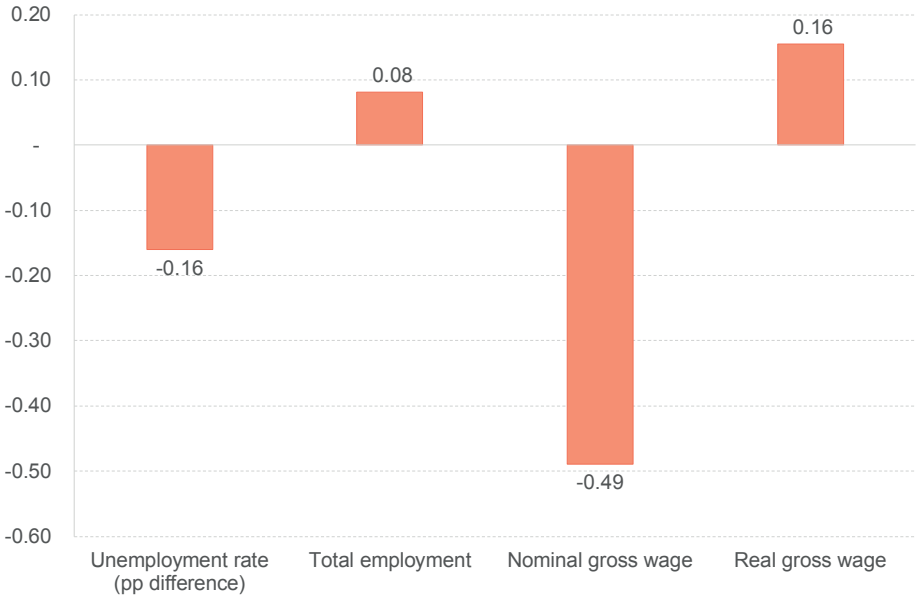
Table 13: Multiple cohort analysis for 2008/09-2015/16: long-run effects of a change in labour productivity. (In percentage changes from base year values.)

	Long-run
GDP (and GDP per capita)	1.16
Consumer price index (CPI)	-0.64
Unemployment rate (pp difference)	-0.16
Total employment	0.08
Nominal gross wage	-0.49
Real gross wage	0.16
Households consumption	0.22
Investment	1.10
Capital stock	1.10
Export RUK	1.10
Export ROW	1.15
GDP in present value terms (£billion)	20.6
GDP in present value terms per graduate (£thousands)	55

Long-run at t = 40. GDP present value up to t = 85.
Source: Fraser of Allander Institute

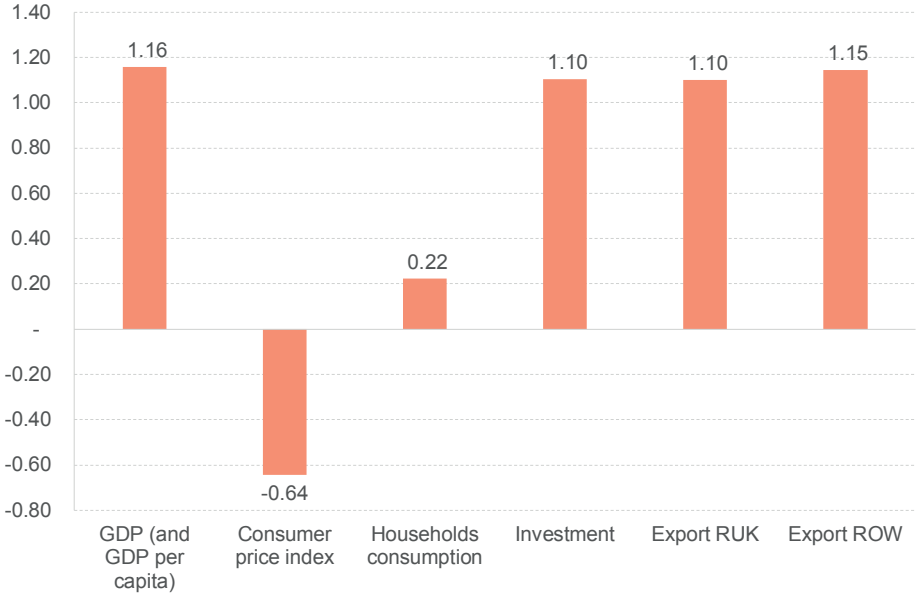
17 This includes Teaching Funding and SAAS tuition fees (£1,649m), fees from other sources (£241m), student support funding (£373m), capital, and strategic funding (£102m). This is 49% of total costs when including non-recognised qualifications. Total costs including these of non-recognised qualifications is £4,815m. It must be noted that capital and strategic funding might include grants from other sources e.g. European Funds. Figures provided by SFC.

Chart 10: The long-run impact on Scottish unemployment, employment, and the nominal/real gross wage of an increase in labour productivity generated by graduation cohorts from 2008/09-2015/16. (In percentage changes from base year values.)



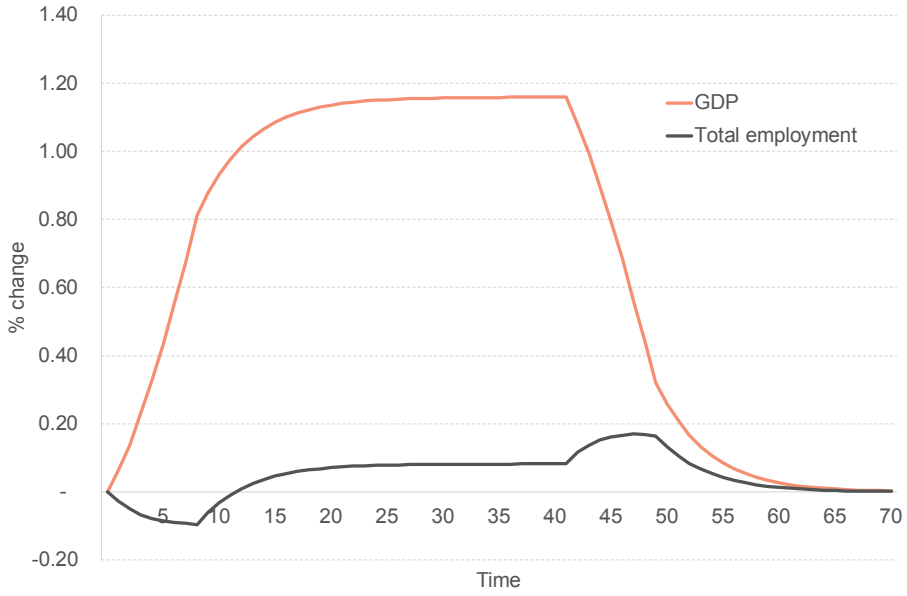
Source: Fraser of Allander Institute

Chart 11: The long-run impact on Scottish GDP (and GDP per capita), CPI, and RUK/ROW exports of an increase in labour productivity generated by graduation cohorts from 2008/09-2015/16. (In percentage changes from base year values.)



Source: Fraser of Allander Institute

Chart 12: The impact on Scottish GDP and employment of an increase in labour productivity generated by graduation cohorts from 2008/09-2015/16. (In percentage changes from base year values.)



Source: Fraser of Allander Institute

Appendices

Appendix A: Estimating the Productivity Impact of College Graduates

This appendix outlines the calculation required to identify the scale of the labour productivity 'shock' that is entered into the CGE model; this is simply the increase in the productivity of the Scottish labour force attributable to the college graduates in that year. The approach taken follows closely that of Hermannsson et al. (2017). The year selected in this analysis is 2015/16 (these are the most up-to-date data available at the time of writing this analysis). The following details the calculations necessary to identify the impacts of college graduates in terms of efficiency units of labour.

Hermannsson et al. (2017) follow Acemoglu and Autor (2012) in calculating the human capital stock (labour force) in efficiency units, N_E, for unskilled workers, U, and k types of skilled workers, S_i, as:

$$(1)\quad N_E = U + \sum_{i=1}^{k} \frac{w_i}{w_U} S_i = U + \sum_{i=1}^{k} m_i S_i$$

where w_U is the wage of unskilled workers, w_i, is the wage of skill group i and $m_i \left(= w_i / w_U\right)$ is the wage premium for skill group i. Colleges generate in one year, t, qualifications, $Q_{i,t}^{CS}$, at level, i.

The increase in human capital, $\Delta N_{i,t}^{CS}$, generated by colleges in that year is the sum of these qualifications, weighted by the addition to human capital that each graduate receives through acquiring the qualification, Δm_i, as detailed in equations 4 and 5.

$$(2)\quad \Delta N_{E,t}^{CS} = \sum_{i} \Delta m_i \, Q_{i,t}^{CS}$$

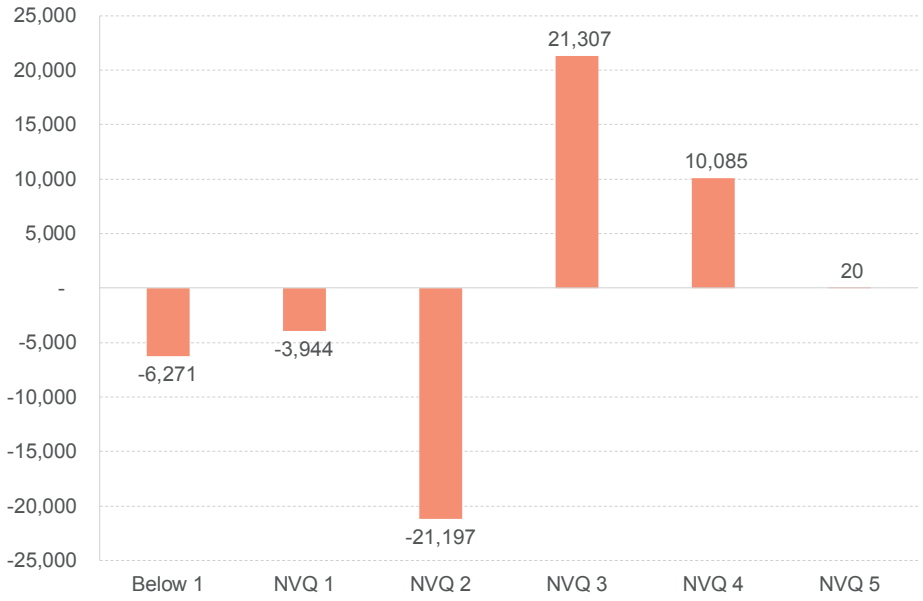
where

$$(3)\quad \Delta m_i = m_i - m_{i-1}$$

The qualifications are represented hierarchically, so that achieving an educational qualification raises the recipient one step on that hierarchy. The difference between the human capital for that qualification level and the human capital associated with the preceding qualification level is therefore the additional human capital generated when an individual achieves a particular qualification (Hermannsson et al., 2017).

Chart 13 gives the resulting net changes by individual NVQ level the 2015/16 graduation cohort generates given the assumption of hierarchical ordering. There are 6,271 graduates at Level 1, who were previously below Level 1. As such, there is a reduction of 6,271 from below Level 1, and a 6,271 increase in the Level 1. Similarly, there are 10,215 graduates from Level 2, who were previously at Level 1. Level 1 therefore sees a reduction of 10,215 graduates and Level 2 sees a 10,215 increase. The change to Level 1 is thereby the net effect of the 6,271 increase and the 10,215 fall, which is equal to a net fall at Level 1 of 3,944. The 2015/16 graduation cohort thereby reduces the number of individuals with qualifications below Level 3, and increases these at Level 3 and above. The single largest shift is in the decrease in individuals at Level 2, and the increase in Level 3.

Chart 13: Net changes by individual NVQ level generated by the 2015/16 graduation cohort. In absolute numbers.



Depending upon their skill level, workers contribute different amounts of efficiency units of labour to the production process (as detailed in Equation 3). In keeping with Hermannsson et al. (2017), the efficiency level of workers with qualifications below Level 1 is set to unity, and the efficiency units of workers at other levels are then increased in accordance with the evidence on the levels of the relevant wage premia (Walker & Zhu, 2007).

To identify the economic benefit of achieving an increment on the NVQ scale, and therefore the appropriate $\Delta N_{i,t}^{CS}$ values, Scottish wage premia by qualification are used (Walker & Zhu, 2007). A draw-back of using these wage premia is that they are based on older data (pooled Labour Force Survey observations for the years 1996 to 2005) and wage premia could have changed since then. Historically, however, wage premia have evolved slowly[18]. Moreover, using these wage premia is in keeping with previous analyses.

Following this approach it is possible to calculate the efficiency units that graduates contribute to the Scottish labour market. Initially, however, we are solely interested in analysing the extent to which the graduates' efficiency has increased as a result of completing a qualification. As such, the focus is on the additional skills provided by colleges, $\Delta N_{i,t}^{CS}$, and not the skills already possessed.

Table 14 details the calculations required to identify the increase in efficiency units associated with a single graduation cohort for the year 2015/16. The first column gives the number of graduates for 2015/16 by individual NVQ level. The second column gives the net changes across the educational levels (as also depicted in Chart 13). The third column gives the corresponding vocational wage premium for each level, as given by Walker and Zhu (2007). The fourth columns give the associated efficiency level (as described previously), where, for example, a worker at Level 1 contributes 1.10 efficiency units, someone with a Level 2 qualification contributes 1.18 efficiency units, and so on. The net efficiency gain is that achieved when moving to a higher educational level where, for example, a graduate completing a Level 1 qualification adds 0.10 (1.00-1.10) efficiency units to human capital, a Level 2 graduate adds 0.08 efficiency units (1.18-1.10), and so on.

18 See Hermannsson et al. (2017) for a discussion of this point.

Colleges create 6,271 Level 1 graduates with an efficiency level of 1.10. We presume these were below Level 1 previously with an efficiency unit weighting of 1.00. The total increment by level, as measured in efficiency units, reflects the net effect of two changes. There is a fall of -6,271 (-6,271*1.00) of these below Level 1, and a rise of 6,891 (6,271*1.10) as they graduate in Level 1. As FECs create 10,215 graduates at Level 2, who we presume were at Level 1 previously, there is a fall of 11,237 (10,215*1.10) at Level 2. The net change at Level 1 is thereby a fall of 4,338 efficiency units (6,898-11,237 i.e. the rise in efficiency units generated by Level 1 graduates minus the fall generated by Level 2 graduates). These calculations are repeated for the remaining levels.

Table 14: College qualifications at NVQ level completed and the associated increase in labour efficiency units, Scotland, 2015/16.

	Number of qualifications $Q_{i,t}^{CS}$	Changes by level $\Delta Q_{i,t}^{CS}$	Wage premium [1] (%)	Efficiency level	Net Efficiency gain Δm_i^{CS}	Efficiency units $\Delta N_{i,2016}^{CS}$
Below 1	-	-6,271	-	1.00	-	-6,271
Level 1	6,271	-3,944	0.10	1.10	0.10	-4,338
Level 2	10,215	-21,197	0.18	1.18	0.08	-25,012
Level 3	31,412	21,307	0.32	1.32	0.14	28,125
Level 4	10,105	10,085	0.52	1.52	0.20	15,329
Level 5	20	20	0.82	1.82	0.30	36
Total	58,023					7,869

[1] Vocational NVQ wage premia adapted from Walker & Zhu (2007,2008).

Source: Fraser of Allander Institute

Following this approach it can be calculated that the 2015/16 graduation cohort reduces the efficiency units below Level 1 by 6,271 efficiency units, by 4,338 efficiency units in Level 1, 25,012 efficiency units in Level 2, and increases the efficiency units in Levels 3, 4, and 5 by 28,125, 15,329, and 36 efficiency units respectively. Colleges thereby contribute a total of 7,869 efficiency units of labour in that given year. These figures are used to calculate the proportionate impact of the graduation cohort.

Following Hermannsson et al. (2017) the proportionate impact of the graduation cohort on the human capital stock can be calculated by drawing on the Annual Population Survey (APS) to identify the Scottish working age population (16-64) and their corresponding NVQ levels[19]. These figures are used along with the wage premia reported by Walker & Zhu (2007) to calculate the efficiency units at each individual NVQ level across the whole working age population. Accordingly it can be calculated that the Scottish working age population could supply 4,751,158 efficiency units of labour.

Using the total efficiency units that the working age population can supply as a denominator we can calculate that the 2015/16 graduation cohort has increased the amount of available efficiency units of skilled labour by 0.166% (7,869/4,751,158). This is the labour productivity shock that is entered into the CGE model[20]. The changes in labour productivity are modelled from period one for 40 periods when the shock is removed, as workers are expected to leave the workforce within that time-frame. Simulations are run for 85 periods in order to identify potential legacy effects that may occur after the 40 periods arising from e.g. induced changes in investment and capital stocks.

19 APS (Nomis, 2017) gives 3,403,800 working age adults at individual NVQ level.

20 This is a simplified approach. We assume full labour market participation of graduates. However, participation patterns across time and skill category may diverge. Also, the simplifying assumption is adopted that the age-earnings profile is flat over the lifecourse and newly qualified workers are given the average wage premium of identical workers. Notably, we can model more complex assumptions. This would, however, requires robust empirical evidence not available in the required form.

Appendix B: The AMOS Model

The AMOS model has three domestic transactors: households, corporations, and government; four major components of final demand: consumption, investment, government expenditure, and exports; and 25 industrial sectors. Domestic production goes to intermediate demand and to all elements of the final demand categories. In the period-by-period simulations each period is taken to be a year. Real government expenditure is exogenous. Financial flows are not explicitly modelled and we assume that Scotland is a price-taker in financial markets. The demand for Scottish exports to the Rest of the UK (RUK) and the Rest of the World (ROW) is determined via conventional export demand functions where the price elasticity of demand is set at 2.0. Imports are obtained through an Armington (1969) link and therefore relative price-sensitive with trade substitution elasticities of 2.0.

In the model production takes place in perfectly competitive industries using multi-level production functions. This means that in every time period all commodity markets are in equilibrium, with price equal to the marginal cost of production (Lecca et al., 2013). Value-added is produced using capital and labour via standard production function formulations so that, in general, factor substitution occurs in response to changes in relative factor-prices. Constant elasticity of substitution (CES) technology is adopted with elasticities of substitution of 0.3 (Lecca et al., 2013). In each industry intermediate purchases are modelled as the demand for a composite commodity with fixed (Leontief) coefficients. These are substitutable for imported commodities via an Armington link, which is sensitive to relative prices.

It is assumed that any change in government expenditure does not change the composition of that expenditure (Lecca et al., 2013). This assumption is also made for Tourism expenditures. That is, both Tourism and Government expenditures are treated as exogenous. It must be noted that there are versions of the AMOS model in which these assumptions are relaxed.

Capital stock is fixed both in total and in its sectoral composition in the first period but each sector's capital stock is subsequently updated between periods through investment. In the present paper the model is run under the multi-period variant, where capital stocks are updated according to recursive capital stock adjustment procedure[21].

The CES total labour demand, L, in the value-added production function for activity j is given as:

$$(4)\quad L_{j,t} = \left(\phi^{Y\rho_j^Y} \cdot \delta_j^l \cdot \frac{PY_{j,t}}{w_t} \right)^{\frac{1}{1-\rho_j^Y}} \cdot Y_{j,t}$$

where ϕ is an exogenous labour augmenting efficiency parameter, δ is the labour share parameter in the value added function, PY is the price of value added, w the nominal price to producers of the composite labour input, ρ the elasticity of substitution between capital and composite labour, and Y is value added.

Based on work by Layard et al. (1991, 2005) and Nickell and Bell (1995), a regional bargained real wage function is used for wage setting[22]. The regional real consumption wage is positively related to workers bargaining power, and therefore inversely to the regional unemployment rate:

$$(5)\quad \ln\left(\frac{w_t}{cpi_t}\right) = \beta - \dot{o}\ln\left(un_t\right)$$

where cpi is the Consumer Price Index, un is the regional unemployment rate (6%), $\dot{o}$ is the unemployment rate elasticity (0.113), and β is a calibrated parameter.

21 A forward looking variant of the AMOSKI model is also available. See Lecca et al. (2013) for a detailed discussion of this model variant.

22 Alternative closures available in the model are the National Bargaining clouse in which the nominal wage is set exogenously, and the Fixed Real Wage closure in which the purchasing power of wages remains unchanged.

This empirical relationship between wages and the local unemployment rate is based on the 'wage curve' (Blanchflower & Oswald,1995; Minford et al., 1994).

In the variant of the CGE model used in this paper, the labour force is fixed but employment is variable over time (calibrated in the base year to sectoral total full-time equivalent employment), the unemployment rate can change, and labour is mobile across sectors. We assume that there is no endogenous migration generated by the change in activity following the labour productivity shock. This is in keeping with the approach taken by Hermannsson et al. (2014, 2016, 2017) as such migration would endogenously change the characteristics of the labour supply. However, we do discuss the likely impact of endogenous migration, as appropriate.

Emonts-Holley et al. (2014) provide a detailed overview of the Scottish Social Accounting Matrix. A full list of equations is given in Lecca et al. (2013) and Ross (2017) along with a detailed description of the model.

Appendix C: Sensitivity Analysis

As in Hermannsson et al. (2017), we refer to the region as open, with financial capital perfectly mobile and exports taking a large share of output. In the simulations reported here firms face an infinitely elastic supply of finance. Any restrictions on the availability of finance could inhibit, and in the limit prevent, the capital stock adjustment process. An indication of the implication of a more restricted capital supply would be in the short run where capital stocks are fixed. The period in which physical capital is restricted generates around half of the GDP impact of that seen when the capital stock is fully adjusted.

We assume that all Scottish domiciled students and students from the European Union outside the UK are retained in Scotland. Research suggests that highly skilled workers are more geographically mobile as compared to low skill workers (Brown & Sessions, 1997; Dixon, 2003; Hatton & Tani, 2005; McGregor et al., 2000). Migration in Great Britain has been shown to respond to differences in employment opportunities. Migrants tend to move towards regions with higher than average rates of employment growth. Migration is thereby strongly driven by economic incentives, which appear to be higher for better educated workers. As such, we would expect that some graduates out-migrate. This is investigated in more detail by Hermannsson et al. (2014) for HEIs. The implications are that the qualitative impacts remain unchanged but their magnitude is proportionately reduced.

We assume that there is no endogenous migration generated by the change in activity following the labour productivity shock. This is because such migration would endogenously change the characteristics of the labour supply in a way that we presently cannot model. Essentially, the size of the labour productivity change would vary endogenously with the extent of migration and capturing this would require detailed longitudinal data. However, from extensive work with the model, we do know that the impact on Scottish GDP and employment would be increased if migration were allowed. Ultimately, the real wage and unemployment rate changes would be even closer to zero, generating lower unit costs and thereby increasing regional competitiveness.

From extensive analysis with the AMOS model we know that increasing the regional openness to trade (by increasing Armington trade elasticities which increases the sensitivity of the Scottish economy to changes in competitiveness) GDP and employment impacts tend to be more positive[23]. This is discussed in more detail in Hermannsson et al. (2014, 2017), and Ross (2017).

As discussed previously, our analysis focuses on graduates that obtain nationally recognised qualifications. This excludes a relatively large proportion of college students that obtain non-recognised qualifications. As noted above, the reason for this is a lack in empirical evidence on wage and employment premia of these non-recognised qualification. We explore the potential implications of excluding these qualifications by running a number of illustrative simulations. For this we include in the analysis 'Other non-advanced diploma or equivalent' and 'Other non-advanced diploma or equivalent' diploma[24] in addition to the recognised qualifications. We assume that they obtain the full wage premia (as corresponding to individual levels) upon graduation in the same way that nationally recognised qualifications obtain their wage premia. It must be stressed, that this is for illustration only as there is no empirical evidence to support such an assumption. Table 15 details the long-run results of this sensitivity analysis. The implications are that the qualitative impacts remain unchanged as compared to these results presented in Table 12 and 13 but their magnitude is increased. Notably, the GDP impact per graduate is now decreased.

23 To recall, the demands for Scottish goods are determined via an export demand function according to which the quantity of goods exported is related to the relative regional price, given constant prices and income for the RUK and the ROW. Domestic and imported inputs are obtained in the AMOSKI model via an Armington (1969) link and are relative-price sensitive. The Armington trade elasticities thereby measure the extent to which a relative price change in the domestic market, compared to the price in the foreign market, affects the relative amount of imports to domestically produced goods sold in the domestic market.

24 This includes courses such as: access to STEM, applying make up, health and safety cetificates, barista skills, computing classes, European computer driving license etc.

Table 15: Sensitivity analysis. Multiple cohort analysis for 2008/09 - 2015/16: long-run effects of a change in labour productivity. (In percentage changes from base year values.)

	Long-run: single cohort	Long-run: multiple cohort
GDP (and GDP per capita)	0.23	1.63
Consumer price index (CPI)	-0.13	-0.90
Unemployment rate (pp difference)	-0.03	-0.23
Total employment	0.02	0.12
Nominal gross wage	-0.10	-0.68
Real gross wage	0.03	0.22
Households consumption	0.04	0.31
Investment	0.22	1.55
Capital stock	0.22	1.55
Export RUK	0.22	1.55
Export ROW	0.23	1.61
GDP in present value terms (£billion)	4.6	29.0
GDP in present value terms per graduate (£thousands)	55	50

Source: Fraser of Allander Institute

References

Acemoglu, D. (2002). Technical change, inequality, and the labor market. Journal of economic literature, 40(1), 7-72.

Acemoglu, D., & Autor, D. (2012). What does human capital do? A review of Goldin and Katz's The race between education and technology. Journal of Economic Literature, 50(2), 426-63.

Armington, P. (1969). A theory of demand for products distinguished by place of production. Statis-tics Papers IMF, 159-178.

Audit Scotland, Scotland's Colleges 2017

Becker, G.S. (1964). Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education. University of Chicago Press, Chicago, IL.

Becker, G.S. (1994). Human capital revisited. In Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education (3rd Edition) (pp. 15-28). The University of Chicago Press.

Blanchflower, D. G., & Oswald, A. J. (1994). The wage curve. MIT press.

Brown, S., & Sessions, J. G. (1997). A profile of UK unemployment: Regional versus demographic influences. Regional Studies, 31(4), 351-366.

Chevalier, A. and Feinstein, L., 2004. Healthy returns to education.

Dixon, S. (2003). Migration within Britain for job reasons. Labour Market Trends, 111(4), 191-202.

Emonts-Holley, T., Ross, A. G., & Swales, J. K. (2014). A social accounting matrix for Scotland. Fraser of Allander Economic Commentary, 38(1), 84-93.

EMSI (2015) Demonstrating the Economic Value of Scotland's Colleges. Available from: http://collegesscotland.ac.uk/Demonstrating-the-Economic-Value/demonstrating-the-economic-value-of-scotlands-colleges.html

Feinstein, L., Hammond, C., Woods, L., Preston, J., & Bynner, J. (2003). The Contribution of Adult Learning to Health and Social Capital. Wider Benefits of Learning Research Report. The Centre for Research on the Wider Benefits of Learning, Institute of Education.

Harrigan, F., McGregor, G. P., Dourmashkin, N., Perman, R., Swales, K. J., & Yin, Y. P. (1991). AMOS: A macro-micro model of Scotland. Economic Modelling, 8(4), 424-479.

Hatton, T. J., & Tani, M. (2005). Immigration and Inter□Regional Mobility in the UK, 1982–2000. The Economic Journal, 115(507), 342-358.

Hermannsson, K., Lisenkova, K., McGregor, P. G. & Swales, K. J. (2013a). 'Policy Scepticism' and the Impact of Scottish Higher Education Institutions on their Host Region: Accounting for a Regional Budget Constraint under Devolution. Regional Studies, vol 48, (2), 400-417.

Hermannsson, K., Lisenkova, K., McGregor, P. G. & Swales, K. J. (2013b). The Expenditure Impacts of Individual Higher Education Institutions and their students on the Scottish Economy: Homogeneity or Heterogeneity?. Environment and Planning A, vol. 45 (3), 710-727.

Hermannsson, K., Lecca, P., Lisenkova, K., McGregor, P. G. & Swales, K. J. (2014). The Regional Economic Impact of more Graduates in the Labour Market: A "Micro-to-Macro" Analysis for Scotland. Environment and Planning A, vol.46, pp. 471-487.

Hermannsson, K., Lecca, P., Lisenkova, K., McGregor, P. G. & Swales, K. J. (2016). The External Benefits of Higher Education. Regional Studies, (Accepted for Publication) forthcoming.

Hermannsson, K., Lecca, P., & Swales K. J. (2017). How much does a single graduation cohort from further education colleges contribute to an open regional economy?. Spatial Economic Analysis, (Accepted for Publication) forthcoming.

Hunter Blackburn, L. H., Kadar-Satat, G., Riddell, S., & Weedon, E. (2016). Access in Scotland: Access to Higher Education for People from Less Advantaged Backgrounds in Scotland. Sutton Trust.

HM Treasury. (2013). The Green Book. Treasury Guidance, 1-114.

Layard, R., Nickell, S., & Jackman, R. (1991). Unemployment: macroeconomic performance and the labour market. Oxford University Press.

Layard, R., Nickell, S., & Jackman, R. (2005). Unemployment: macroeconomic performance and the labour market. 2nd Edition. Oxford University Press.

Lecca, P., McGregor, P. G., & Swales, J. K. (2013). Forward-looking and myopic regional Computable General Equilibrium models: How significant is the distinction? Economic Modelling, 3(6), 160-176.

McGregor, P. G., Swales, J. K, & Yin, Y. P. (1991). Regional Public Sector and Current Account Deficits: Do They Matter? in Bradley, J (ed.); The Two Economies of Ireland, Dublin, Oak Tree Press.

McGregor, P. G., McVittie, E. P., Swales, J. K., & Yin, Y. P. (2000). Skill-biased Demand Shifts: A Regional CGE Analysis. University of Strathclyde, Department of Economics.

McGregor, P. G. & Ross, A. G. (2017) Assessing the impact of work-based learning initiatives. Fraser of Allander Institute, report for Skills Development Scotland.

McMachon, W. (2009). Higher learning, greater good: The private and social benefits of higher education. Baltimore: John Hopkins University Press.

Minford, P., Stoney, P., Riley, J., & Webb, B. (1994). An econometric model of Merseyside: validation and policy simulations. Regional Studies, 28(6), 563-575.

Mincer, J. (1958). Investment in human capital and personal income distribution. Journal of political economy, 66(4), 281-302.

Nickell, S., & Bell, B. (1995). The collapse in demand for the unskilled and unemployment across the OECD. Oxford Review of Economic Policy, 11(1), 40-62.

Nomis (2017). Annual Population Survey. Retrieved 01.02.2017, from https://www.nomisweb.co.uk/articles/676.aspx

Office for National Statistics, National Educational Longtidudinal Survey, 2002.

Ross, A. G. (2017). Household and skill disaggregation in multi-sectoral models of the Scottish economy (Doctoral dissertation). Department of Economics, University of Strathclyde.

Schuller, T., Brassett-Grundy, A., Green, A., Hammond, C., & Preston, J. (2002). Learning, Continuity and Change in Adult Life. Wider Benefits of Learning Research Report. The Centre for Research on the Wider Benefits of Learning, Institute of Education.

Schuller, T., Preston, J., Hammond, C., Brassett-Grundy, A. and Bynner, J., (2004). The benefits of learning: The impact of education on health, family life and social capital. Routledge.

Scottish Funding Council, College Leaver Destinations 2014-15

Scottish Funding Council, College Performance Indicators 2015-16

Scottish Funding Council, College Staffing Data 2015-16 (Experimental Statistics: data being developed)

Scottish Funding Council, College Statistics 2015-16 (previously Scotland's Colleges: Baseline Report)

Walker, I., & Zhu, Y. (2007). The Labour Market Effects of Qualifications: Summary Report. Futureskills Scotland - Research Series. Available from: http://www.scotland.gov.uk/Resource/Doc/919/0065443.pdf

Walker, I., & Zhu, Y. (2008). The college wage premium and the expansion of higher education in the UK. The Scandinavian Journal of Economics, 110(4), 695-709.

Scottish Funding Council, Higher Education Students and Qualifiers at Scottish Institutions 2015-16

Scottish Government (2014). Education Working for All!: Commission for Developing Scotland's Young Workforce Final Report.

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