DEMONSTRATING THE ECONOMIC VALUE OF

Scotland's Colleges

MAIN REPORT

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ANALYSIS OF THE SOCIAL & ECONOMIC IMPACT OF LEARNING

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Preface

Since 2000, Economic Modelling Specialists International (EMSI) has helped address a widespread need in the US and Canada to demonstrate the impact of education. We have conducted more than 1,100 economic impact studies for education institutions in the US and nearly 100 individual and province-wide studies for colleges in Canada.

In 2007, EMSI recognised a similar need in the UK for evidence of the true impact of further education and the expected returns on further investment. Working closely with Warwickshire College, we developed an impact model to quantify such measures, and by the end of 2010 more than 70 colleges had participated in the research.

EMSI set up permanent offices in the UK by early 2012, and we embarked on a second pilot effort to update our model and narrative. The reports underwent a reworking of the organisation and layout, and revisions to the model included the construction of a more robust data collection mechanism and updates to the data and assumptions to reflect the latest economic theory. Throughout this process, we received excellent support from our two pilot colleges, Middlesbrough College and South Staffordshire College, who ensured that the revisions we made reflected the key challenges and issues facing the further education sector. Rachel Jones, Vice Principal at Burton and South Derbyshire College, also provided us with valuable guidance and assistance.

As we release the results of this study, our hope is that they will initiate feedback from all perspectives – whether colleges, policy-makers, inspectors, employers, or learners. We encourage our readers to contact us directly with any questions or comments they may have about the study's findings so that we can continue to keep the public dialogue open about the positive impact of learning.

Acknowledgements

EMSI gratefully acknowledges the excellent support of those at Colleges Scotland in making this study possible. Special thanks go to Shona Struthers, Chief Executive who commissioned the study and the staff at Colleges Scotland who collated and organised much of the data and information requested. We also thank the Scottish Funding Council who provided the financial year 2013/14 data. Any errors in the report are the responsibility of the authors and not of any of the above-mentioned institutions or individuals.

Table of Contents

Introduction

Scotland's colleges create value in many ways. The colleges are committed to putting learners on the path to success and play a key role in helping them increase their employability and achieve their individual potential. With a vast range of courses and apprenticeships, the colleges' provision enables learners to acquire qualifications and develop the skills they need in order to have a fulfilling and prosperous career. The colleges also provide an excellent environment for learners to meet new people and make friends, while participation in college courses improves the learners' self-confidence and promotes their mental health. All of these social and employment-related benefits have a positive influence on the health and well-being of individuals.

However, the contribution of Scotland's colleges consists of more than solely influencing the lives of learners. The colleges' provision supports a range of employment sectors in Scotland and supplies employers with the skilled workers they need to make their businesses more productive. The expenditures of Scotland's colleges, along with the spending of their staff and learners, further support the local economy through the output and employment generated at local suppliers. Lastly, and just as importantly, the economic impact of Scotland's colleges extends as far as the Exchequer in terms of increased tax receipts and decreased public sector costs.

Objective of the Report

In this report we assess the economic value of Scotland's colleges on their key stakeholder groups: learners, society, taxpayers, and the local community. The fact that learning makes a difference to these groups is well known, but comparatively little research has been done to quantify the monetary value of these benefits. Some of the more recent studies include Fujiwara's (2012)[1] analysis of the impact of adult learning and the March 2010/11 study commissioned by the Department for Business, Innovation and Skills (BIS)[2] on the economic impact of the FE sector. Although the approaches used in these and other similar studies vary, they all contribute valuable information to the growing body of evidence that proves the value of investing in education.

The approach in this study is twofold. We begin with a standard investment analysis to determine how the investments in Scotland's colleges will perform for a given investor over time. The investors in this case are learners, society, and taxpayers, all of whom pay a certain amount in costs to support the activities at Scotland's colleges. The learners' investment consists of the opportunity cost of spending time learning as opposed to earning income through employment. Society forgoes government services and increased

[1] Daniel Fujiwara, 'Valuing the Impact of Adult Learning' (National Institute of Adult Continuing Education: Leicester, 2012).

[2] Rachel Beaven et al, 'Measuring the Economic Impact of Further Education' (Department for Business, Innovation and Skills, BIS Research Paper Number 38: London, March 2011).

business output that would have been generated had funds not been allocated to the colleges and learners been employed. Taxpayers contribute their investment through government funding via organisations such as the Scottish Funding Council. In return for these costs, learners receive a lifetime of higher earnings, society gains from higher output and income and a reduced tax burden, while taxpayers benefit from higher tax receipts and avoided public sector costs. To determine the feasibility of the investment, the model projects benefits into the future, discounts them back to their present value, and compares them to their present value costs. Results of the investment analysis for learners, society, and taxpayers are displayed in the following four ways: 1) net present value of benefits, 2) benefit/cost ratio, 3) rate of return, and 4) payback period.

The second component of the study focuses on the economic impacts created by Scotland's colleges on the business community in Scotland. Economic impact analysis is distinct from investment analysis in that it focuses on a single time period and does not project impacts into the future, nor does it factor in costs incurred by stakeholders. To derive results, we rely on a specialised input-output (IO) model to calculate the additional income created in Scotland's economy as a result of the increased consumer spending and added skills generated by Scotland's colleges and their learners. Results of the economic impact analysis are measured in terms of the added income created by the following two impacts: 1) impact of staff and college expenditure, and 2) impact of the skills acquired by learners still active in Scotland's workforce.

Data and assumptions used in the study are based on several sources, including the 2013-14 learner and financial data from Scotland's colleges, industry and employment data from Nomis official labour market statistics, demographic and earnings data from the Office for National Statistics (ONS), and EMSI's input-output model. The study applies a conservative methodology and follows standard practice using only the most recognised indicators of investment effectiveness and economic impact. For more information on the data used to derive the results, we encourage our readers to contact Colleges Scotland.

Organisation of the Report

This report has four chapters and three annexes. Chapter 1 provides an overview of Scotland's colleges and the Scottish economy. Chapter 2 provides the investment analysis results from the learners' and taxpayers' perspectives. Chapter 3 considers the impact of the colleges on economic growth in Scotland. Finally, Chapter 4 provides sensitivity analyses of some of the key variables.

The annexes include a list of resources and references in Annex 1, a glossary of terms in Annex 2, and a discussion of the EMSI input-output model in Annex 3.

Key Findings

The results of this study show that Scotland's colleges have a significant positive impact on their main stakeholder groups: learners, society, and taxpayers. Using a two-pronged approach that involves an investment analysis and an economic impact analysis, we calculate the benefits to each of these groups. Key findings of the study are as follows:

Investment Analysis

Benefits to Learners

- Learners as a whole invested a total of **£1.2 billion** to attend Scotland's colleges in 2013-14. The majority of these costs, around **£1.1 billion**, represent foregone earnings that they would have generated had they been working instead of learning.
- In return for the monies that learners invest in Scotland's colleges, they will receive a present value of **£7.4 billion** in increased earnings over their working lives.
- Every £1 that learners pay for their education at Scotland's colleges yields **£6.30** in higher future wages. This translates to a **14.8%** annual rate of return on their investment.

Benefits to Society

- Society as a whole invested **£3.2 billion** in Scotland's colleges through direct outlays and the loss of potential output from learners who spent time at the colleges rather than working.
- In return, society will receive a present value of **£19.9 billion** over the course of the learners' working lives, in the form of an expanded tax base and a variety of social benefits related to reduced crime, lower unemployment, and increased health and well-being.
- Society will receive **£6.30** in benefits for every £1 invested in Scotland's colleges. The average annual rate of return on investment is **16.4%**.

Benefits to Taxpayers

- Taxpayers paid **£598.3 million** to support the operations of Scotland's colleges in 2013-14.
- The net present value of the added tax revenue stemming from the learners' higher lifetime incomes and the increased output of businesses amounts to **£3.0 billion** in benefits to taxpayers. Avoided costs to the public sector add another

£358.3 million in benefits due to a reduced demand for government-funded social services in the UK.

- Taxpayers see an average annual return of **15.6%** on their investment in Scotland's colleges. The corresponding benefit-cost ratio is **£5.70** in benefits returned for every £1 in costs.

Economic Impact Analysis

Impact of Staff and College Expenditure

- Scotland's colleges employed **10,238** full-time equivalent faculty and staff in 2013-14. Staff costs amounted to **£392.9 million**, much of which was spent in Scotland to purchase groceries, clothing, and other household goods and services.
- The colleges are buyers of goods and services and spent **£272.9 million** to support their operations in 2013-14. College expenditure further benefited many local suppliers in Scotland.
- The net impact of staff and college expenditure in Scotland comes to approximately **£700.8 million** in added income in the Scottish economy each year.

Impact of Added Workforce Skills

- Many learners attending Scotland's colleges stay in Scotland. Their enhanced skills and abilities bolster the output of local employers, leading to higher Scottish income and a more robust economy.
- The accumulation of former learners from Scotland's colleges who are currently employed in the Scottish workforce amounts to **£14.2 billion** in added income in Scotland's economy each year.

Total Impact on the Scottish Business Community

- Altogether, the economic impact of Scotland's colleges to the business community in Scotland is **£14.9 billion** each year.
- Total added income created by Scotland's colleges and their learners was approximately equal to **8.8%** of the total economic output of Scotland in 2013-14 and roughly **593,246** average wage jobs.

Chapter 1 : Profile of the Colleges and the Scottish Economy

The input data in this analysis falls under three categories: data from the Scottish Funding Council, Scottish economic conditions, and research (e.g., reports, journal articles and data releases conducted by ONS, NHS, etc.). This chapter discusses these data, providing context for the subsequent analysis and assumptions utilised in evaluating Scotland's colleges.

Data from the Colleges

Data provided by the Scottish Funding Council includes information on staff, location, revenue and expenditure, learner demographics, and learner achievements. The colleges' staff data appear in Table 1.1 for full-time equivalent staff. Also shown are aggregated data on place of work and place of residence, which is used to isolate the portion of consumption income that remains in the local economy.

Table 1.1: Staff Data, 2013-14

	Total / %
Full-time equivalent staff (FTE)	10,238
% of staff that live in Scotland	100%
% of staff that work in Scotland	100%

Source: Data supplied by the Scottish Funding Council.

Financial Data

Revenues

Table 1.2 shows revenues of Scotland's colleges by funding source in 2013-14, totaling £657.9 million. Public funding from funding council grants, tuition fees and education contracts, and research grants and contracts represented 91%. Other income, including endowment and investment income, represented the remaining 9%.

Table 1.2: Revenue Data, 2013-14 (£ Thousands)

Funding Source	**Amount**	**%**
Funding council grants	£481,217	73%
Tuition fees and education contracts	£114,583	17%
Research grants and contracts	£2,465	<1%
Other income	£56,243	9%
Endowment and investment income	£3,347	<1%
Total	£657,855	100%

Source: Data supplied by the Scottish Funding Council.

Expenditures

Table 1.3 provides expenditure data, with total expenditures of Scotland's colleges totaling £665.8 million in 2013-14. Staff costs represented 59%, while non-wage spending amounted to 33% of total expenditures. Depreciation of capital and interest payable on debt composed the final 8%.

Table 1.3: Expenditure Data, 2013-14 (£ Thousands)

Function	Amount	%
Staff costs	£392,920	59%
Exceptional restructuring costs	£16,446	2%
Non-restructuring exceptional costs	£10,587	2%
Other operating expenses	£195,658	29%
Depreciation	£46,881	7%
Interest payable	£3,294	<1%
Total	£665,786	100%

Source: Data supplied by the Scottish Funding Council.

Learner Demographics

Scotland's colleges served an unduplicated headcount of 267,226 learners, with an average learner representing roughly 50% of an FTE. Included within these learners are 2,322 learners for whom Scotland's colleges contracted with other institutions to carry out provisions.

The average age of learners attending Scotland's colleges was 17 years old. The breakdown of these learners by gender was 48% male and 52% female, and the breakdown by ethnicity was 85% white and 15% minority. Data on ethnicity and gender becomes important in the calculation of marginal earnings change since earnings by gender and ethnicities differ, sometimes widely, depending on the area under analysis.

Learner Achievement

Learner achievement data are used to determine the value of the learning provided by the colleges. To do this, we use data provided by the Scottish Funding Council to determine the notional level of the learners and their weighted student unit of measurement (WSUMs).[3] It is worth noting that the notional level of the learner will not always match the notional level of the WSUMs they are taking, but all WSUMs will contribute to the terminating qualification.

Table 1.4 shows the colleges' total enrolments by qualification, with rows representing the notional level of the enrolment categorised by whether the enrollee completed the qualification in 2013-14 or if the enrollee only partially completed the qualification. The latter category also includes all other learners, such as those who are non-assessed or on

[3] We then convert the WSUMs into planned notional hours (planned hours) by taking into account the ratio of WSUMs to raw sums and assuming one SUM is equivalent to 40 hours of learning.

non-credit bearing courses. The table includes enrolments provided by the Scottish Funding Council for other contracting FE and HE institutions. Note that in Table 1.4, the sum is greater than the total unduplicated headcount given above. This is due to possible duplication between the categories, as learners may take multiple courses.

Table 1.4: Enrolments by Qualification, 2013-14

ENROLMENTS	TOTAL
Achieved Full Qualification	
Entry Level	6,913
Degree	677
Membership of Professional Body	304
HND - Higher National Diploma	7,565
HNC - Higher National Certificate	10,090
Adv Cert/Diploma	6,667
SVQ/NVQ 3 - (Scottish Vocational Qualification)	5,006
SVQ/NVQ 2 - (Scottish Vocational Qualification)	5,816
SVQ/NVQ 1 - (Scottish Vocational Qualification)	994
Other Non-advanced Certificate - (National Qualifications)	95,970
Non-recognised Qualification (e.g. College Certificate)	3,492
Achieved Partial Qualification	
Entry Level	1,494
Degree	440
Membership of Professional Body	226
HND - Higher National Diploma	11,522
HNC - Higher National Certificate	6,938
Adv Cert/Diploma	3,055
SVQ/NVQ 3 - (Scottish Vocational Qualification)	6,911
SVQ/NVQ 2 - (Scottish Vocational Qualification)	4,461
SVQ/NVQ 1 - (Scottish Vocational Qualification)	379
Other Non-advanced Certificate - (National Qualifications)	33,909
Non-recognised Qualification (e.g. College Certificate)	58,176
Total	***271,005***

Source: The Scottish Funding Council provided the total number of enrolments and the number of enrollees who completed a qualification in 2013-14. EMSI calculated the remaining number of enrollees who did not complete their qualification in the analysis year.

Table 1.5 shows the WSUMs completed by the associated enrolments from Table 1.4. Similar to Table 1.4, this table includes WSUMs provided by the Scottish Funding Council. This detail on the instructional activity allows us to capture the economic activity that colleges deliver and not the activity that colleges claim for learners served by other institutions.

Table 1.5: WSUMs Activity by Qualification, 2013-14

WSUMs	TOTAL
Achieved Full Qualification	
Entry Level	65,556
Degree	6,368
Membership of Professional Body	750
HND - Higher National Diploma	115,364
HNC - Higher National Certificate	140,959
Adv Cert/Diploma	21,748
SVQ/NVQ 3 - (Scottish Vocational Qualification)	61,415
SVQ/NVQ 2 - (Scottish Vocational Qualification)	89,170
SVQ/NVQ 1 - (Scottish Vocational Qualification)	20,413
Other Non-advanced Certificate - (National Qualifications)	852,067
Non-recognised Qualification (e.g. College Certificate)	7,793
Achieved Partial Qualification	
Entry Level	28,023
Degree	2,452
Membership of Professional Body	775
HND - Higher National Diploma	175,705
HNC - Higher National Certificate	80,676
Adv Cert/Diploma	10,361
SVQ/NVQ 3 - (Scottish Vocational Qualification)	75,121
SVQ/NVQ 2 - (Scottish Vocational Qualification)	53,033
SVQ/NVQ 1 - (Scottish Vocational Qualification)	8,831
Other Non-advanced Certificate - (National Qualifications)	376,413
Non-recognised Qualification (e.g. College Certificate)	86,428
Total	***2,279,422***

Source: The Scottish Funding Council provided the total number of WSUMs and the number of WSUMs for those who completed a qualification in 2013-14. EMSI calculated the remaining number of WSUMs for enrollees who did not complete their qualification in the analysis year.

Scottish Economic Conditions

Scotland's residents are served by Scotland's colleges. Scotland serves as the backdrop against which the relative impacts of the colleges and their learners are measured. Since Scotland's colleges first opened their doors, they have been serving Scotland by creating jobs and income, providing area residents with easy access to further education opportunities, and preparing learners for highly-skilled, technical professions. The availability of quality education and training in Scotland also attracts new industry to Scotland, thereby generating new businesses and expanding the availability of public investment funds.

Table 1.6 summarises the breakdown of Scotland's economy by major industrial sector, with details on employment and value added for each. Value added refers to the earnings, profits, and taxes that together represent the total value the industrial sector has added. The final column in Table 1.6 shows the percentage of total value added in Scotland for which each sector is responsible.

Table 1.6: Employment and Value Added by Major Industrial Sector in Scotland, 2013-14

	Jobs	Value Added (Millions)	% of Total Value Added
Agriculture, forestry and fishing	64,891	£3,014	2%
Mining and quarrying	33,276	£36,543	22%
Manufacturing	174,927	£7,559	4%
Electricity, gas, steam and air conditioning supply	16,166	£5,140	3%
Water supply; Sewerage, waste management and remediation activities	15,506	£1,919	1%
Construction	139,938	£9,003	5%
Wholesale and retail trade; Repair of motor vehicles and motorcycles	366,717	£9,700	6%
Transportation and storage	98,023	£5,202	3%
Accommodation and food service activities	196,939	£6,013	4%
Information and communication	58,407	£8,893	5%
Financial and insurance activities	84,887	£6,304	4%
Real estate activities	33,577	£17,347	10%
Professional, scientific and technical activities	177,260	£14,630	9%
Administrative and support service activities	191,840	£9,050	5%
Public administration and defence; Compulsory social security education	140,140	£5,832	3%
Education	189,438	£7,221	4%
Human health and social work activities	401,218	£10,960	6%
Arts, entertainment and recreation	72,411	£3,046	2%
Other service activities	63,939	£2,304	1%
Totals	*2,519,500*	*£169,680*	*100%*

Source: EMSI.

In Table 1.7 and Figure 1.1, the average earnings in Scotland at the midpoint of an individual's working career are broken out by education level.[4] In return for the costs of education, learners receive a stream of higher future earnings that continues to grow throughout their working lives. Mean income levels at the midpoint of the average-aged worker's career increase as individuals attain higher levels of education. The marginal differences between education levels form the basis for determining the earnings benefits that accrue to learners in return for their education investment. For example, the average Level 3 achiever in Scotland will see an increase in earnings of £7,604 each year compared to someone with no formal qualifications. This amounts to approximately £342,176 in higher earnings (undiscounted) over a working lifetime.

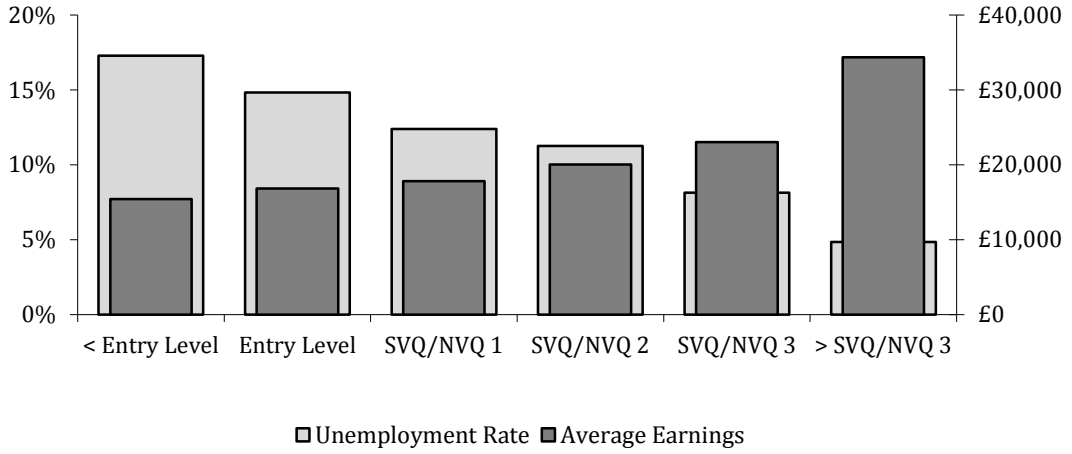
[4] Education levels are reported in more aggregated form in Table 1.7 and throughout the rest of this analysis compared to the qualifications reported in Table 1.5. This is due to how earnings data is reported in our background data sources.

Table 1.7: Average Scottish Earnings and Unemployment Rates by Education Level in Scotland, 2013-14

Education Level	Earnings*	Unemployment
< Entry Level	£15,417	17%
Entry Level	£16,820	15%
SVQ/NVQ 1	£17,787	12%
SVQ/NVQ 2	£20,006	11%
SVQ/NVQ 3	£23,021	8%
> SVQ/NVQ 3	£34,354	5%

* Earnings are weighted by gender and ethnicity demographics supplied by the Scottish Funding Council.
Source: ONS Labour Force Survey and Nomis Annual Survey of Hours and Earnings.

Figure 1.1: Average Income at Career Midpoint



Just as average earnings increase as they attain more education, employment prospects also increase. Table 1.7 shows the unemployment rate by highest qualification attained in Scotland. The highest unemployment rates occur among workers with no qualifications or an entry level qualification.

Research

The data and methodology collected from research largely come from government studies and are usually treated as constants or parameter values in the analysis. For example, *The Green Book* issued by HM Treasury reports the following table in Annex 6.

Table 1.8: The Declining Long-term Discount Rate

Period of years	0-30	31-75	76-125	126-200	201-300	301+
Discount rate	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%

Source: The 2012 Green Book Table 6.1

In accordance with this, we apply a 3.5% discount rate to the cash flows for the first 30 years and a 3% discount rate for the cash flows greater than 30 years.[5] Many of the research sources, along with the constants or parameter values drawn from them, will be referenced throughout this report, but a short list of the most prominent sources are provided here.

Table 1.9: Research Sources

Research Data	Source
Scottish employment and earnings	Annual Survey of Hours and Earnings - ONS (NOMIS)
Earnings by education level and ethnicity	Labour Force Survey - ONS
Population	Population Estimates - ONS
Attrition	
Retirement	Gov.UK, Life Tables - NHS
Unemployment	Labour Force Survey - ONS
Social variables	
Smoking	NHS, ASH
Mental Health	Sainsbury Centre for Mental Health (SCMH), NHS
Crime	National Literacy Trust, Home Office Online Report
Unemployment	Labour Force Survey - ONS, Department of Work and Pension
Obesity	NHS, Department of Health
Learner spending	National Union of Students

Conclusion

This chapter summarises key data and facts on Scotland's colleges and the area they serve. The figures presented in the tables above represent the broader elements of the database used to determine the results. Additional detail on data sources, assumptions, and general methods underlying the analyses are conveyed in the remaining chapters and appendices. The core of the findings is presented in the next two chapters. The annexes detail a collection of miscellaneous theory and data issues.

[5] The time horizon does not extend beyond 75 years since it is limited to the learner's working life.

Chapter 2 : Investment Analysis

Investment analysis is the process of evaluating total costs and measuring these against total benefits to determine whether or not a proposed venture will be profitable. If benefits outweigh costs, then the investment is viable. If costs outweigh benefits, then the investment will lose money and is thus considered infeasible.

In this chapter we analyse the benefits and costs of investing in Scotland's colleges from the perspective of the learners, society at large, and lastly the public sector. The backdrop for the analysis is the entire nation.

Learner Perspective

Analysing the benefits and costs of education from the perspective of learners is the most obvious—they give up time and money to go to college in return for a lifetime of higher income and improved employment opportunities. These occur regardless of whether learners enter the private or public sector. The benefit component of the analysis thus focuses on the extent to which learner incomes and employment probabilities increase as a result of education, while costs comprise all learners' direct outlays (books and supplies) as well as their opportunity costs (wages and income forgone while at college).

Education, Earnings and Employment

The correlation between education, earnings, and employment is well documented and forms the basis for determining the learners' benefits stream and future cash flows. Table 1.7 (Chapter 1) shows the mean income and unemployment rate by education level weighted by the gender and ethnicity of the learner population.[6]

The differences between income levels and unemployment rates begin to define the marginal value of moving from one education level to the next. For example, moving from SVQ Level 2 or equivalent to SVQ Level 3 yields an additional £3,015 per year and increases employment probability by 3%.

Of course, several other factors such as ability, socioeconomic status and family background also correlate with higher earnings. Failure to account for these factors results in what is known as an 'ability bias'.[7] To account for the implicit bias in the data, EMSI commissioned a meta-analysis to ascertain the degree of bias and the amount by which the marginal gains should be reduced. Doctors Molitor and Leigh (2005)

[6] Earning and unemployment rates are shown for Scotland. Although not all learners settle in Scotland, the majority does; it is these earnings rates that are used to generate the learner's future cash flows.

[7] Ability bias in data was recognised as early as Adam Smith, but was formally acknowledged as a biasing factor in human capital data by J.R. Walsh in 1935.

concluded that a 10% reduction in the earnings gain was necessary to account for such innate characteristics of the learners.[8]

Marginal Earnings Value per Planned Learning Hours

Not all learners who attended Scotland's colleges in the 2013-14 reporting year obtained a qualification or certificate. Some may have returned the following year to complete their education goals, while others may have taken a few units and entered the workforce without achieving a qualification. Since the education of such learners still carries value, though not the weight of a full SVQ, we must look deeper than qualification completion to measure the value of intermediary education provision. The most consistent way of capturing the intermediary activity of the colleges and learners is through planned notional hours (planned hours).[9]

It is important to remember that from an economics perspective, learners will eventually be paid according to their marginal value of product. Therefore, we link such output metrics to marginal gains in educational attainment. Attributing value to full qualifications alone assumes no increase in marginal value of product from intermediary education. According to prevailing human capital theory, such an assumption is flawed. It is more appropriate to utilise a quasi-continuous step function where learners increase their marginal value of product, and thus income, for every planned hour received. The sheepskin effect, or more generically the signaling effect, resulting from the full qualification is the cause for the step function nature of the earnings curve. A qualification signals to employers the marginal value of product a learner can generate. Thus, a full SVQ has additional value over a unit in terms of increased earnings and the employment premia. These two things combined represent the sheepskin effect.

We calculate the value of the learners' planned hour production through a process that divides the education ladder into a series of individual steps, each equal to one planned hour. We then spread the income differentials from Table 1.7 over the steps required to complete each education level, assigning a unique monetary value to every step in the ladder.[10] Next we map the learners' planned hour production to the ladder, depending on their level of achievement and the average number of planned hours they achieve. Finally, we multiply the volume of planned hours at each step in the ladder by the marginal earnings gain attributable to the corresponding step to arrive at the learners' average annual increase in income. Under this framework the annual change in earnings, ΔE , is

[8] The BIS adopted the approach of looking at earnings differences between cohorts with similar characteristics but where the educational levels differed. While this approach is useful and does not require explicit discounting, it cannot be used at a Scottish level since the earnings differ from national averages.

[9] The Scottish Funding Council originally reported WSUMs. We converted the WSUMs into planned hours by taking into account the ratio of WSUMs to raw sums and assuming one SUM is equivalent to 40 hours of learning.

[10] Learners who obtain their first full qualification during the reporting year are granted the income boost derived from the signaling effect of the credential.

computed simply as: $\Delta E = \sum_{i=1}^{n} e_i h_i$ where $i \in 1,\ 2,...n$ and n is the number of steps in the education ladder. Variables e_i and h_i represent the marginal earnings gain and number of planned hours completed by the learner body for each step *i*. Total earnings change divided by the total planned hours completed by the learners gives the average value per planned hour for the 2013-14 cohort of learners.

Table 2.1 displays the aggregate annual higher income for the learner population of Scotland's colleges. Also shown are the total planned hours generated by learners and the average value per planned hour. Note that although each step in the education ladder has a unique value, for the sake of simplicity only the total and average values are displayed.

Table 2.1: Higher Annual Earnings, Planned Hour Production, and Value per Planned Hour, 2013-14

Total increase in earnings	£426,789,569
Total completed planned hours	76,486,440
Average value per planned hour	£5.58

Source: EMSI.

Here a qualification must be made. Data show that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also indicates that the earnings increment between educated and non-educated workers grows through time. This means that the aggregate annual higher income presented in Table 2.1 will actually be lower at the start of the learners' careers and higher near the end of them, gradually increasing at differing rates as the learners grow older and advance further in their careers.

Generating the Stream of Cash Flows

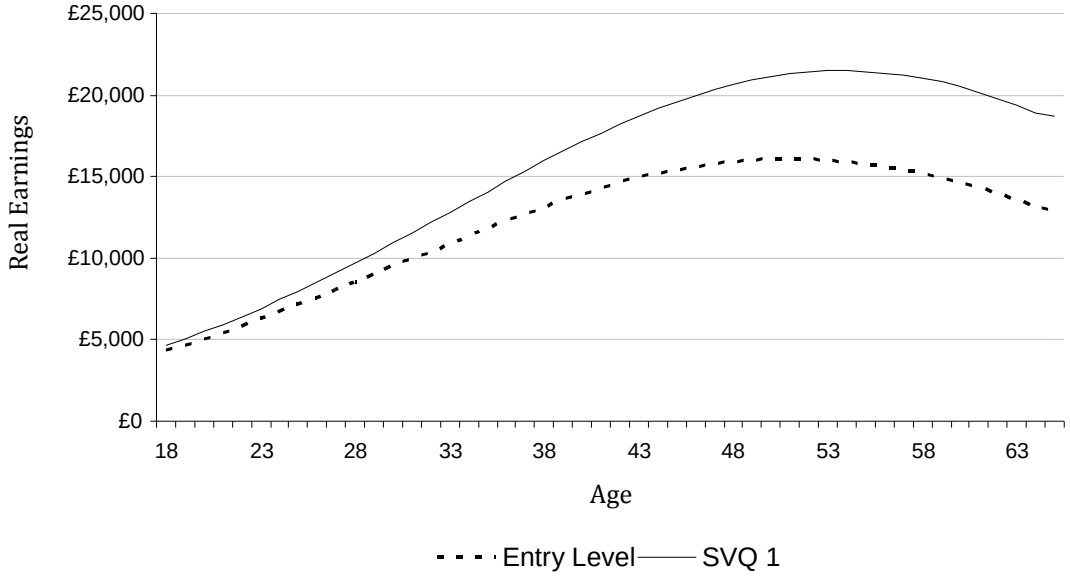
The two names most often associated with human capital theory and its applications are Gary Becker and Jacob Mincer.[11] The standard human capital earnings function developed by Mincer appears as a three-dimensional surface with the key elements being earnings, years of education and experience. Figure 2.1 shows the relationship between earnings and age, with age serving as a proxy for experience. Note that, since we are using the graph strictly for illustrative purposes, the numbers on the axes are not specific to Scotland. Also, the graph uses the difference between entry level and SVQ 1 as an example. Similar differences are expected and modelled across higher levels of education.

Figure 2.1 illustrates several important features of the Mincer function. First, earnings initially increase at an increasing rate, later increase at a decreasing rate, reach a maximum

[11] See Gary S. Becker, *Human Capital: a Theoretical Analysis with Specific Reference to Education* (New York: Columbia College Press for NBER, 1964); Jacob Mincer, 'Schooling, Experience and Earnings' (New York: National Bureau of Economic Research, 1974); and Mincer, 'Investment in Human Capital and Personal Income Distribution,' *Journal of Political Economy,* vol. 66 issue 4, August 1958: 281–302.

somewhere after the midpoint of the working career, and then decline in later years as individuals ease into retirement. Second, at higher levels of education, the maximum level of earnings is reached at an older age. And third, the benefits of education, as measured by the difference in earnings for two levels, increase with age.

Figure 2.1: Lifetime Earnings Profile for Entry Level and SVQ 1 Qualification Recipients



In the model, we employ the Mincer function as a smooth predictor of earnings over time[12] for as long as learners remain active in the workforce. Using earnings at the career midpoint as our base (Table 1.7), we derive a set of scalars from the slope of the Mincer curve to model the learners' increase in earnings at each age within their working careers. The result is a stream of projected future benefits that follows the same basic shape as the Mincer curve, where earnings gradually increase from the time learners enter the workforce, come to a peak shortly after the career midpoint, and then dampen slightly as learners approach retirement at age 67.

The benefits stream generated by the Mincer curve is a key component in deriving the learners' rate of return. However, not all learners enter the workforce at the end of the reporting year, nor do all of them remain in the workforce until age 67. To account for this, we discount the learners' benefit stream in the first few years of the time horizon to allow time for those who are still studying at the colleges to complete their educational goals and find employment. This is referred to as delaying the onset of the benefits. Next, we discount the entire stream of benefits by the estimated number of learners who will

[12] The Mincer equation is computed based on estimated coefficients presented in Robert J. Willis, 'Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Function' in *Handbook of Labor Economics*, Vol. 1 (Amsterdam: Elsevier Science Publishers, 1986): 525–602. These are adjusted to current year dollars in the usual fashion by applying the GDP implicit price deflator. The function does not factor in temporary economic volatility, such as high growth periods or recessions. In the long run, however, the Mincer function is a reasonable predictor.

die, retire or become unemployed over the course of their working careers.[13] The likelihood that learners will leave the workforce increases as they age—so the older the learner population is, the greater the attrition rate will be. The resulting benefits stream can be found in Table 2.3.

Learner Investment Costs

Having calculated the learners' benefits stream and adjusting it for attrition, we next turn to learner costs, displayed in Table 2.2. The learners' costs of investment are composed of direct outlays and opportunity costs. Direct outlays represent any out-of-pocket expenses to the learner, such as those for books and supplies.[14] For the purposes of this analysis, we just look at the total direct outlays incurred by the learner body as a whole.

Opportunity costs apply to all learners and represent forgone income. We assume that every hour a learner is in the classroom or engaged in an educational activity is an hour they could have been receiving a wage. Since direct outlays simply capture the payments made by learners and their families for attending Scotland's colleges, measuring costs and benefits through planned hours creates a more accurate representation.

Table 2.2: Learner Investment Costs, 2013-14 (£ Thousands)

	Total
Learner Direct Costs	
Books and Supplies	£77,073
Working Learners	
Opportunity Costs - Non-Apprenticeships	£227,452
Non-working Learners	
Opportunity Costs - Non-Apprenticeships	£865,908
Total Learner Costs	*£1,170,433*

Source: EMSI model.

The majority of costs, however, are not captured in the direct outlays of the learners but rather through their opportunity costs. These costs are a function of learner employment rates, the number of planned hours taken by the learners, prior education level, and the associated earnings by education level. Recall that Table 1.7 displays earnings at the midpoint of the individual's working career, not immediately upon exiting a college. To arrive at the full earning potential of learners while enrolled, we must condition the earnings levels to the learners' age, which we accomplish simply by applying a scalar derived from the Mincer curve described above. Another important factor to consider is

[13] These data are based on the ONS life tables and net Scottish migration data following a log linear trend line.

[14] Direct outlays often include tuition and fees. However, tuition fees are paid on behalf of learners by the Government via the SAAS agency. While some learners may pay tuition fees themselves, this amount was determined to be too small to break out. Also, learners spend money on room and board, personal expenses, etc. We do not factor these costs into the analysis however because learners would have spent these monies regardless of whether they were attending college.

the time that learners actually spend at college since they would only be giving up earnings for the period in which college is in session, and then only for the hours they are in class. We use the volume of planned hours taken by the learners as a proxy for working hours forgone. Beginning with the conditioned average annual incomes by education level and the learners' education levels at the start of the reporting year, we determine the potential lost income to two distinct categories of learners: students that are employed while attending college, and students that are not working. Scotland's colleges had 79,099 working enrolments and 188,127 non-working enrolments.

Since learners in both apprentice programmes and those otherwise engaged in the labour force receive some portion of what their income would be otherwise, their opportunity costs are mitigated. They also forgo leisure, which Becker (1974) attributes value to. As the majority of the learners are not engaged in the labour force and because they forgo the entirety of their would-be income, it is not surprising that they represent the bulk of the learner body's opportunity costs. Opportunity and auxiliary costs total £1.1 billion. Learners employed while attending the colleges do a great deal to mitigate their opportunity costs and thus will have higher than average benefit-cost ratios and correspondingly higher rates of return.

Learner Investment Outcomes

Since the benefits to learners do not all occur in the current year like the costs, we must discount the future benefits to their present value. As stated in *The Green Book,*

> *Discounting is a technique used to compare costs and benefits that occur in different time periods. It is a separate concept from inflation, and is based on the principle that, generally, people prefer to receive goods and services now rather than later. This is known as 'time preference'.*

In accordance with *The Green Book,* we apply a 3.5% discount rate for the first 30 years and a 3% discount rate for subsequent years. Standard investments tend to have a much shorter time horizon and use only one discount rate. However, education is a long-term investment and the different discount rates are used to account for any uncertainty resulting from the extended time horizon. Though the discount rate used is provided by *The Green Book,* it is not an observed value. Thus, in Chapter 4, a sensitivity analysis is provided to show how the results vary in accordance with the discount rate.

Discount Rate

The discount rate is a rate of interest that converts future costs and benefits to present values. For example, £1,000 in higher earnings realised 30 years in the future is worth much less than £1,000 in the present. All future values must therefore be expressed in present value terms in order to compare them with investments (i.e., costs) made today. The selection of an appropriate discount rate, however, can become an arbitrary and controversial undertaking. As suggested in economic theory, the discount rate should reflect the investor's opportunity cost of capital, i.e., the rate of return one could reasonably expect to obtain from alternative investment schemes.

Column 1 of Table 2.3 shows the number of years beyond the analysis year (i.e., year zero is the analysis year where costs are incurred and net benefits are negative). Columns 2 through 4 show the gross cash flows received each year, the percent of learners active in the workforce (including the employment premia) and the net higher earnings that are projected to be realised. Column 5 shows one year's worth of costs to the learners.[15] Lastly, Column 6 shows the net cash flows.

The average learner age at Scotland's colleges while enrolled is 17. Adding one year to this (the analysis year) and subtracting from the retirement age of 67[16] yields a time horizon of 50 years. The last four rows in the table show learner investment results of Scotland's colleges: net present value (NPV), benefit/cost ratio (B/C), internal rate of return (IRR),[17] and payback period. Equations and definitions of these terms may be found in the glossary provided in Annex 2.

The 2013-14 Scotland's colleges' learner cohort is expected to see the present value of their lifetime incomes rise by £7.4 billion, while the costs of obtaining these gains is only £1.2 billion. This means learners receive a net gain of £6.2 billion and, on average, their benefits are 6.3 times larger than their investment. Put another way, for every £1 learners invest in direct outlays and opportunity costs, they receive £6.30 in return. This translates into a 14.8% average annual rate of return, with all of the learners' costs recovered in 10 years.

[15] The £1.2 billion in costs is already in present value since it occurs in the current year and does not need to be discounted.

[16] We recognise that not all learners will retire at age 67 - some may exit the workforce early or remain in until they are older. The retirement age of 67 is an average based on the State Pension age and is useful in calculating an average time horizon for the average learner.

[17] The IRR is used for investments where the principle invested is not recaptured at the sale or maturity date of the investment, such as is the case with stocks or bonds.

Table 2.3: Learner Perspective (£ Millions), 2013-14

Year	Gross Higher Earnings	% Active in Workforce	Net Higher Earnings	Cost	Net Cash Flow
0	110.1	10%	10.8	1170.4	-1159.6
1	121.2	31%	37.0	0.0	37.0
2	133.0	48%	64.2	0.0	64.2
3	145.5	63%	91.1	0.0	91.1
4	158.6	72%	115.0	0.0	115.0
5	172.3	79%	136.7	0.0	136.7
6	186.7	84%	157.0	0.0	157.0
7	201.5	88%	176.7	0.0	176.7
8	217.0	89%	193.3	0.0	193.3
9	232.9	90%	209.8	0.0	209.8
10	249.4	90%	225.2	0.0	225.2
11	266.2	90%	240.4	0.0	240.4
12	283.4	90%	256.0	0.0	256.0
13	300.9	90%	270.7	0.0	270.7
14	318.7	90%	286.7	0.0	286.7
15	336.7	90%	302.9	0.0	302.9
16	354.8	90%	319.1	0.0	319.1
17	372.9	90%	335.4	0.0	335.4
18	391.0	90%	352.5	0.0	352.5
19	409.0	90%	368.8	0.0	368.8
20	426.8	90%	384.8	0.0	384.8
21	444.3	90%	400.6	0.0	400.6
22	461.5	90%	416.1	0.0	416.1
23	478.2	90%	429.6	0.0	429.6
24	494.4	90%	444.2	0.0	444.2
25	510.0	90%	458.2	0.0	458.2
26	524.9	90%	471.6	0.0	471.6
27	539.1	90%	484.3	0.0	484.3
28	552.3	89%	491.4	0.0	491.4
29	564.7	89%	502.4	0.0	502.4
30	576.1	89%	512.5	0.0	512.5
31	586.5	89%	521.8	0.0	521.8
32	595.8	89%	530.0	0.0	530.0
33	603.9	87%	526.9	0.0	526.9
34	610.8	87%	532.9	0.0	532.9
35	616.5	87%	537.9	0.0	537.9
36	621.0	87%	541.8	0.0	541.8
37	624.2	87%	544.6	0.0	544.6
38	626.0	85%	532.1	0.0	532.1
39	626.6	85%	532.6	0.0	532.6
40	625.9	85%	532.0	0.0	532.0
41	623.9	85%	530.3	0.0	530.3
42	620.7	85%	527.5	0.0	527.5
43	616.2	83%	514.1	0.0	514.1
44	610.5	83%	509.4	0.0	509.4
45	603.6	83%	503.6	0.0	503.6
46	595.6	83%	496.9	0.0	496.9
47	586.5	83%	489.4	0.0	489.4
48	576.4	76%	440.2	0.0	440.2
49	565.4	76%	431.8	0.0	431.8
NPV			*£7,387.2*	*£1,170.4*	*£6,216.7*
B/C ratio					*6.3*
IRR					*14.8%*
Payback (yrs)					*9.9*

Social Perspective

Looking at investment from the social perspective is structurally no different than the learner perspective, although the breadth of the costs and benefits captured is much larger. From society's perspective, we are looking at all costs and benefits due to the operations of Scotland's colleges, regardless to whom the costs and benefits accrue.

Capturing the social perspective provides proof that Scotland's colleges act as social enterprises. The higher levels of education their learners gain enable the community to overcome social problems, such as by lowering crime rates and improving health. In particular, Scotland's colleges improve their learners' life chances by giving them the tools they need to succeed in their careers. The higher incomes the learners receive as a result expand the economic base, thereby creating wealth and providing a way for people to be invested in their economy. These demonstrate that, while Scotland's colleges operate as businesses, they ultimately serve a social mission.

Social Costs

As shown in Table 2.4, social costs also break down into direct outlays and opportunity costs. Direct outlays to Scotland's colleges in the analysis year are the sum of operating and non-operating revenues (£657.9 million). Learners, as previously discussed, give up earnings that they could have otherwise earned. Private businesses have a smaller pool of labour to draw from since individuals are engaged in education rather than business sector output, thus GDP is, in the short run, not as large as it may otherwise have been. Similarly, society experiences a loss in government services that would have been undertaken had taxes been collected on the earnings that learners forgo. All of these represent opportunity costs to society as a whole.

Notice the implicit and conservative assumption being made in regards to the opportunity costs. We assume all labour and resources would have been employed (i.e., the assumption of no idle resources). This is a conservative assumption since it increases the costs being captured. We know that in the absence of high-skilled labour, low-skilled, and possibly unemployed labour can be substituted. Alternatively, high-skilled labour could be imported from other countries, increasing output back to 'expected' levels.

These opportunity costs to society all stem from lower labour and output. To capture social opportunity costs then, we take the learner opportunity costs and run them through a multiplier matrix to see what additional labour and non-labour impacts are being forgone. These additional losses stemming from the learners' decision not to be employed in the workforce are added to learner opportunity costs and total revenues of the colleges to derive the total costs to society of £3.2 billion.

Table 2.4: Present Value Social Costs (£ Thousands), 2013-14

	Total
Direct outlays	£657,855
Opportunity costs of learners	£1,093,360
All other opportunity costs	£1,418,241
Total	*£3,169,456*

Source: EMSI model.

Social Benefits

Any benefits that accrue within the UK as a result of Scotland's colleges—whether they accrue to learners, employers, taxpayers, or private residents—are claimed under the social perspective. These benefits are subdivided into two components: (1) increased income, and (2) social externalities stemming from the improved lifestyles of learners.

Increased Income

Income growth occurs as the output of learners increases as a result of their education. Capital, such as machinery and buildings, is made more productive through the increased skills derived from education. This in turn raises profits and other business property income. Together, increases in labour and capital income are considered the effect of a skilled workforce. Estimating the effect of Scotland's colleges on income growth begins with the projected higher learner income from Table 2.3 above. Not all of these benefits may be counted as benefits to the public. However, some learners may emigrate during the course of their careers, and any benefits they generate leave with them. To account for this dynamic, we use estimates on migration patterns to calculate the number of learners who leave the workforce over time. Note that death, retirement, and unemployment have already been captured in the learners' NPV calculation.

Next we derive a stream of cash flows that accrue to the public. These comprise the direct effect of Scotland's colleges on income growth. Indirect effects occur when learners spend more money on consumer goods, while the increased output of businesses that employ them also creates a demand for inputs and, consequently, input spending. The effect of these two spending items (consumer and business spending) leads to still more spending and more income creation, and so on. To quantify these several rounds of spending, we apply a knock-on (multiplier) effect derived from EMSI's specialised input-output (IO) model, described more fully in Annex 3.

With an increase in labour income (both direct and indirect) comes an increase in capital investment, thereby generating even more growth in the non-labour (or 'non-earnings') share of the economy. Non-labour income consists of monies gained through investments (dividends, interests and rent). To derive the growth in non-labour income, we multiply the direct and indirect labour income figures by a ratio of GDP (equal to labour income plus non-labour income) to total labour income.

Next, rather than adjusting for attrition, which is already captured in the learners' net higher earnings, we adjust for the alternative education variable. This variable looks at the degree to which learners would be able to obtain education and the increased role industry would play in providing workforce training if public funding for education did not exist. That is, Scotland's college learners would substitute towards other educational opportunities (e.g., private education, on-the-job training, etc.) if colleges did not exist. Scotland's colleges cannot claim benefits that would still have been generated in their absence. The top row of Table 2.5 below displays the present value of the added income that occurs in the UK over the lifetime of learners attending Scotland's colleges.

Social Externalities

In addition to higher income, education is statistically correlated with a variety of lifestyle changes that generate social savings, also known as external or incidental benefits of education. These social savings represent avoided costs that would have otherwise been drawn from private and public resources absent the education provided by Scotland's colleges.

It is important to note that calculating social externalities is not a straightforward task of counting actual monies saved. The process is difficult because of the uncertainties about what data to include, what methodologies to employ and what assumptions to make. Because of this, results should not be viewed as exact, but rather as indicative of the impacts of education on health and well-being. Social externalities stemming from education break down into three main categories: 1) health savings, 2) crime savings, and 3) national insurance savings.

Table 2.5: Present Value Social Benefits (£ Thousands), 2013-14

	Total
Increased Income	£18,389,150
Social Externalities	£1,485,784
Health	£300,350
Smoking	£99,464
Obesity	£33,042
Mental health	£167,845
Crime	£1,120,171
National Insurance	£65,262
Total	*£19,874,934*

Source: EMSI model.

In the model, we quantify the effect of social externalities first by calculating the probability at each education level that individuals will have poor health, commit crimes or claim national insurance transfers. Deriving the probabilities involves assembling data at the national level, breaking them out by gender and ethnicity, and adjusting them from a UK level to a Scottish level. We then spread the probabilities across the education ladder and multiply the marginal differences by the corresponding planned hour

production at each step. The sum of these effects counts as the upper bound measure of the number of individuals who, due to the education they received at Scotland's colleges, will not have poor health, commit crimes, or claim welfare and unemployment benefits.

Of course, there are other influences that impact an individual's behaviour, and separating these out from the non-economic benefits of education is a challenging task. For the purpose of this analysis, we dampen the results by the 'ability bias' adjustment discussed earlier in this chapter to account for other influences besides education that correlate with an individual's quality of life, such as socioeconomic status and family background. We also apply the same alternative education adjustment used above for the added income.

The final step is to express the results in financial terms by multiplying them by the associated costs per individual, based on data supplied by national studies and surveys. These comprise the overall savings to society. Present value results of the analysis are displayed in Table 2.5 above.

Beekeeper Analogy

A classic example of positive externalities (sometimes called 'neighbourhood effects') in economics is the private beekeeper. The beekeeper's intention is to make money by selling honey. Like any other business, the beekeeper's receipts must at least cover his operating costs. If they don't, his business will shut down.

But from society's standpoint, there is more. Flower blossoms provide the raw input bees need for honey production, and smart beekeepers locate near flowering sources such as orchards. Nearby orchard owners, in turn, benefit as the bees spread the pollen necessary for orchard growth and fruit production. This is an uncompensated external benefit of beekeeping, and economists have long recognised that society might actually do well to subsidise positive externalities such as beekeeping.

Educational institutions are in some ways like beekeepers. Strictly speaking, their business is in providing education and raising people's incomes. Along the way, however, external benefits are created. Learners' health and lifestyles are improved, and society indirectly enjoys these benefits just as orchard owners indirectly enjoy benefits generated by beekeepers. Aiming at an optimal expenditure of public funds, the impact model tracks and accounts for many of these external benefits and compares them to public costs (what taxpayers agree to pay) of education.

Social Investment Outcomes

Table 2.6 has the same structure and interpretation as Table 2.3, with the exception that this analysis provides the overall returns to the UK. Column 1 of Table 2.6 shows the number of years beyond the analysis year (i.e., year zero is the analysis year where costs are incurred and net benefits are negative). The time horizon is the same for the social perspective as in the learner perspective. Column 2 shows the gross social benefits received each year in the UK, while Column 3 outlines the portion of benefits estimated to be generated by the learners in the absence of Scotland's colleges. Column 4 is the difference of Columns 2 and 3, and represents the stream of cash flows used in

generating the outcome metrics. Costs and net cash flows are shown in Columns 5 and 6, respectively. It is also worthy to note that society benefits from the social externalities beyond the 40 years of working life derived from the learners, though these benefits are minor in comparison to the earnings and productivity effects derived from labour.

Table 2.6: Social Perspective (£ Millions), 2013-14

Year	Gross Social Benefits Attending College	Gross Social Benefits Not Attending College	Net Benefits	Costs	Net Cash Flow
0	112.1	11.2	100.9	3,169.5	(3,068.5)
1	195.6	19.6	176.0	-	176.0
2	281.3	28.1	253.1	-	253.1
3	364.9	36.5	328.4	-	328.4
4	438.0	43.8	394.2	-	394.2
5	503.1	50.3	452.8	-	452.8
6	563.1	56.3	506.8	-	506.8
7	620.4	62.0	558.4	-	558.4
8	667.1	66.7	600.4	-	600.4
9	713.0	71.3	641.7	-	641.7
10	755.3	75.5	679.8	-	679.8
11	796.2	79.6	716.6	-	716.6
12	837.6	83.8	753.8	-	753.8
13	875.7	87.6	788.1	-	788.1
14	917.3	91.7	825.6	-	825.6
15	958.8	95.9	862.9	-	862.9
16	1,000.0	100.0	900.0	-	900.0
17	1,040.8	104.1	936.7	-	936.7
18	1,083.5	108.3	975.1	-	975.1
19	1,122.9	112.3	1,010.6	-	1,010.6
20	1,161.2	116.1	1,045.1	-	1,045.1
21	1,198.3	119.8	1,078.4	-	1,078.4
22	1,233.9	123.4	1,110.5	-	1,110.5
23	1,263.5	126.3	1,137.1	-	1,137.1
24	1,295.6	129.6	1,166.0	-	1,166.0
25	1,325.7	132.6	1,193.1	-	1,193.1
26	1,353.7	135.4	1,218.3	-	1,218.3
27	1,379.4	137.9	1,241.4	-	1,241.4
28	1,388.8	138.9	1,250.0	-	1,250.0
29	1,409.4	140.9	1,268.4	-	1,268.4
30	1,427.2	142.7	1,284.5	-	1,284.5
31	1,442.3	144.2	1,298.1	-	1,298.1
32	1,454.6	145.5	1,309.2	-	1,309.2
33	1,435.8	143.6	1,292.3	-	1,292.3
34	1,442.2	144.2	1,298.0	-	1,298.0
35	1,445.7	144.6	1,301.1	-	1,301.1
36	1,446.2	144.6	1,301.6	-	1,301.6
37	1,443.9	144.4	1,299.5	-	1,299.5
38	1,401.4	140.1	1,261.3	-	1,261.3
39	1,393.6	139.4	1,254.2	-	1,254.2
40	1,383.0	138.3	1,244.7	-	1,244.7
41	1,369.8	137.0	1,232.9	-	1,232.9
42	1,354.1	135.4	1,218.7	-	1,218.7
43	1,311.5	131.2	1,180.4	-	1,180.4
44	1,291.4	129.1	1,162.3	-	1,162.3
45	1,269.2	126.9	1,142.2	-	1,142.2
46	1,244.9	124.5	1,120.4	-	1,120.4
47	1,218.7	121.9	1,096.9	-	1,096.9

48	1,090.1	109.0	981.1	-	981.1
Year	**Gross Social Benefits**	**Alt Ed**	**Net Benefits**	**Costs**	**Net Cash Flow**
49	1,063.1	106.3	956.8	-	956.8
NPV			*£19,874.9*	*£3,169.5*	*£16,705.5*
B/C ratio					*6.3*
IRR					*16.4%*
Payback (yrs)					*8.7*

As demonstrated in Table 2.6, society benefits from the presence of Scotland's colleges and their learners. The learners themselves see increased wages, businesses see increased output and profits, and government receives higher tax revenues as a result of the broader tax base. Society also saves money as learners engage in more acceptable social behaviours. For example, a reduction in crime reduces the demand for police, freeing public funds to be allocated to other programmes. It will also save money for individuals in the private sector through reduced property damages and various other victim costs. The present value of these benefits is equal to £19.9 billion.

These benefits are achieved through society's £3.2 billion investment in Scotland's colleges. The net gain to society in present value terms is £16.7 billion. The associated benefit cost ratio is £6.30 for every £1.00 spent and averages a return of 16.4% annually. All costs to society are recovered in 9 years.

Taxpayer Perspective

Benefits and costs under the taxpayer perspective are restricted to the monetary gains and losses accruing to the public (i.e., government) sector. Benefits include increased tax revenues realised as a result of the higher income of learners, and cost savings from social programmes. Whereas total income gains were claimed in the social perspective, only the associated tax revenues are claimed in the taxpayer perspective. The savings that stem from improved learner lifestyles are limited to public sector savings and do not include such things as reductions in private property damages since those savings are not realised by government.

The purpose of this analysis is to treat a public investment as if it were private to analyse whether the government recovers all costs. Even if government did not recover all costs the investment might still be justified under the social perspective since society as a whole is improved by the investment. The case is made much stronger if, by virtue of the investment, the government recovers all costs and can use any excess revenues from the investment to subsidise other publicly desired projects.

Taxpayer Benefits

The same alternative education adjustment applied in the social perspective is applied again in the taxpayer perspective and for the same reason (i.e., taxpayer benefits that would have been realised in the absence of Scotland's colleges cannot be claimed by the colleges).

The present value of the added tax revenue derived from increased learner and business income amounts to £3 billion, roughly £60.7 million annually over the learners' working lifetimes. Avoided social costs extend beyond the learners' working lifetimes and into retirement but tend to be small, only amounting to £358.3 million in present value terms in the case of Scotland's colleges.

Table 2.7: Taxpayer Benefits (£ Thousands), 2013-14

	Present Value	Annually
Increased tax receipts	£3,035,113	£60,702
Avoided social costs	£358,316	£7,166
Total	*£3,393,429*	*£67,869*

Source: EMSI.

Taxpayer Costs

Taxpayer costs are limited to pounds withdrawn from local and national treasuries. As per the colleges' revenue table in Chapter 1, taxpayer costs amount to £598.3 million.

Taxpayer Investment Outcomes

Table 2.8 has the same structure and interpretation as Table 2.6, with the exception that this analysis provides the returns to the government sector. Column 3 of Table 2.6 outlines the portion of benefits estimated to be generated by the learners in the absence of Scotland's colleges. The difference between Column 2 and Column 3 represents the stream of cash flows used in generating the outcomes and is reflected in Column 4. Columns 5 and 6 show costs and net cash flows.

Table 2.8: Taxpayer Perspective (£ Millions), 2013-14

Year	Gross Taxpayer Benefits Attending College	Gross Taxpayer Benefits Not Attending College	Net Benefits	Costs	Net Cash Flow
0	24.4	2.4	21.9	598.3	-576.3
1	38.1	3.8	34.3	0.0	34.3
2	52.2	5.2	47.0	0.0	47.0
3	66.0	6.6	59.4	0.0	59.4
4	78.0	7.8	70.2	0.0	70.2
5	88.7	8.9	79.8	0.0	79.8
6	98.6	9.9	88.7	0.0	88.7
7	108.0	10.8	97.2	0.0	97.2
8	115.6	11.6	104.1	0.0	104.1
9	123.2	12.3	110.9	0.0	110.9
10	130.1	13.0	117.1	0.0	117.1
11	136.9	13.7	123.2	0.0	123.2
12	143.7	14.4	129.3	0.0	129.3
13	149.9	15.0	134.9	0.0	134.9
14	156.7	15.7	141.0	0.0	141.0
15	163.5	16.4	147.2	0.0	147.2
16	170.3	17.0	153.3	0.0	153.3
17	177.0	17.7	159.3	0.0	159.3
18	184.0	18.4	165.6	0.0	165.6

19	190.5	19.0	171.4	0.0	171.4
20	196.8	19.7	177.1	0.0	177.1
Year	**Gross Taxpayer Benefits**	**Alt Ed**	**Net Benefits**	**Costs**	**Net Cash Flow**
21	202.9	20.3	182.6	0.0	182.6
22	208.7	20.9	187.8	0.0	187.8
23	213.5	21.4	192.2	0.0	192.2
24	218.8	21.9	196.9	0.0	196.9
25	223.7	22.4	201.4	0.0	201.4
26	228.3	22.8	205.5	0.0	205.5
27	232.5	23.3	209.3	0.0	209.3
28	234.0	23.4	210.6	0.0	210.6
29	237.4	23.7	213.6	0.0	213.6
30	240.3	24.0	216.3	0.0	216.3
31	242.8	24.3	218.5	0.0	218.5
32	244.8	24.5	220.3	0.0	220.3
33	241.5	24.2	217.4	0.0	217.4
34	242.6	24.3	218.3	0.0	218.3
35	243.1	24.3	218.8	0.0	218.8
36	243.2	24.3	218.8	0.0	218.8
37	242.7	24.3	218.5	0.0	218.5
38	235.6	23.6	212.0	0.0	212.0
39	234.3	23.4	210.8	0.0	210.8
40	232.5	23.3	209.3	0.0	209.3
41	230.3	23.0	207.3	0.0	207.3
42	227.7	22.8	204.9	0.0	204.9
43	220.5	22.1	198.5	0.0	198.5
44	217.2	21.7	195.5	0.0	195.5
45	213.5	21.3	192.1	0.0	192.1
46	209.5	20.9	188.5	0.0	188.5
47	205.1	20.5	184.6	0.0	184.6
48	183.5	18.4	165.2	0.0	165.2
49	179.1	17.9	161.2	0.0	161.2
NPV			*£3,393.4*	*£598.3*	*£2,795.2*
B/C ratio					*5.7*
IRR					*15.6%*
Payback (yrs)					*9.0*

Even under the more narrowly defined scope of the taxpayer perspective, the returns are positive. The public sector recovers the investment of £598.3 million in 9 years and generates an additional £2.8 billion (NPV) over the remainder of the learners' working life. The average annual return to the Exchequer is 15.6%, which exceeds many public investments (e.g., public parks) from a financial perspective. The important thing to note with the benefit-cost ratio is that for every public pound invested in Scotland's colleges, a total of £5.70 is returned. This return can then be used for other investments, meaning that Scotland's colleges subsidise other public services.

Conclusion

The major stakeholders in Scotland's colleges see reasonable returns on their investments of time and money. Learners are more productive and realise increased earnings as a result of their time spent at college. Businesses that are able to hire locally trained

individuals see increased productivity and profits without having to import labour and strain existing public infrastructure. Society benefits from a broadened tax base, lower crime and other improved long run social behaviours. The increased tax receipts and reduced social burden frees the government to invest in new and more diverse ways.

Chapter 3 : Economic Impact Analysis

Scotland's colleges promote economic growth in Scotland in a variety of ways. The colleges are employers and buyers of goods and services. In addition, Scotland's colleges are primary sources of education to local residents and suppliers of trained workers to local industry and public sector.

In this section we examine the economic impacts of Scotland's colleges on the business community through the increased consumer spending and enhanced business productivity generated by the colleges and their learners. The impacts reflect the economic relationships among Scotland's industries and are calculated using EMSI's proprietary input-output (IO) model. The model uses NUTS3 area data from the Office for National Statistics' (ONS) Supply and Use Tables (SUTs), as well as Scottish and national industry jobs totals and national sales-to-jobs ratios, to calculate how much each industry purchases from every other industry. The factor of change that occurs from this economic activity is known as the knock-on (multiplier) effect. For more information on the EMSI IO model, please refer to Annex 3.

We express the results in terms of income, as opposed to sales, in order to present a more accurate picture of the colleges' actual impacts. While sales tend to be the more common measurement, they do not account for monies that leave the local economy and therefore overstate the results. Income, on the other hand, only captures the monies remaining in Scotland, providing a more conservative calculation of the colleges' true impacts in Scotland.

The following pages present the results of the analysis broken down according to the following two impacts: 1) impact of staff and college expenditure, and 2) impact of the added skills of former Scotland's colleges learners still employed in Scotland's workforce.

Impact of Staff and College Expenditure

Scotland's colleges are important employers in Scotland, providing jobs for a wide range of staff across a number of occupations. In 2013-14, Scotland's colleges employed 10,238 full-time equivalent staff. Of these, 100% of employees worked within Scotland, and around 100% were Scotland residents. Total staff costs at Scotland's colleges in 2013-14 amounted to £392.9 million and contributed to Scotland's economy. Staff expenditure on groceries, eating out, clothing, and other household costs also helped support local shops and businesses.

In addition to their staff, Scotland's colleges are large-scale buyers of goods and services. In 2013-14, the colleges spent £272.9 million to support their operations. Much of this expenditure benefited local suppliers in Scotland, creating a multiplier effect that generated additional employment and income throughout the Scottish economy.

Calculating the Impacts

The impact of the colleges' payroll and purchases is subdivided into the following two main effects: the direct effect and the indirect effect. The direct effect comprises the colleges' payroll and employee benefits, less monies paid to individuals working outside of Scotland. As seen in Table 3.1, this amounted to £392.9 million. The indirect effect refers to the additional income created in the economy as employees and suppliers of Scotland's colleges spend money in Scotland to purchase even more supplies and services.

To calculate the indirect effect, we first remove any expenditures occurring outside of Scotland. We calculate this through regional purchase coefficients (RPCs) derived from the IO model, which are based on Scotland's economic characteristics and tell us the proportion of goods and services purchased in Scotland. For example, an RPC for a particular industry of .90 tells us that 90% of the demand for that industry is purchased from within Scotland; the remaining 10% is imported into Scotland. In other words, we can say that 90% of the colleges' expenditures for that industry stay within Scotland, whereas the remaining 10% leaks outside Scotland.

We map these remaining expenditures occurring within Scotland to the 19 top-level industry sectors as classified by the 2007 UK Standard Industrial Classification (SIC), which classifies industries according to the type of economic activity they engage in. We use these same sectors to classify industries in our IO model. In the mapping process, we take general categories provided by the colleges of their typical expenditures and place them into the top SIC sectors. Figure 3.1 displays this process.

Figure 3.1: College Expenditure Mapping Process

For example, the expenditures of the colleges on electricity and natural gas are mapped into the SIC top-level sector *D. Electricity, Gas, Steam and Air Conditioning Supply*. Overall, this mapping process enables us to funnel the colleges' expenditures through the IO model's multiplier matrix so we can estimate how the spending of the colleges and staff affects the output of other industries in Scotland.

Since expenditures of Scotland's colleges funnelled through the IO model are in sales terms, the model initially reports the impacts in sales terms. As mentioned above, sales tend to overstate impacts (see textbox), so we convert the sales figures to income. We do

this through value added-to-sales ratios for each top-level sector, also provided by the IO model.

Sales vs. Earnings example

Two visitors spend £,50,000 each in Scotland. One visits a local auto dealer and purchases a new luxury automobile. The other undergoes a medical procedure at the local hospital. In terms of direct economic impact, both have spent £,50,000. However, the expenditures will likely have very different meanings to the local economy. Of the £,50,000 spent for the luxury automobile, perhaps £,10,000 remains in Scotland as salesperson commissions and auto dealer income (part of Scotland's overall earnings), while the other £,40,000 leaves the area as wholesale payment for the new automobile, ending up in Japan or the U.S. perhaps. Contrast this to the hospital expenditure. Here perhaps £,40,000 appears as physician, nurse, and assorted hospital employee wages (part of Scotland's overall earnings), while only £,10,000 leaves the area to pay for hospital supplies, or to help amortise building and equipment loans. In terms of sales, both have the same impact, while in terms of earnings, the former has one-fourth the impact of the latter.

Table 3.1 shows the results, equal to £,729 million in gross impacts attributable to the direct effect of staff costs plus the indirect effect that occurs as the colleges and their staff spend money in Scotland.

Table 3.1: Impact of Staff and College Expenditure (£ Thousands), 2013-14

	Total
Total income in Scotland	£169,680,054
Direct effect of staff costs	£392,920
Indirect effect	£336,093
Gross total impact	*£729,013*
Alternative use of funds adjustment	-£28,187
Net total impact	*£700,826*

Source: EMSI model.

One adjustment must be made to the gross impact before deriving the net impact of staff and college expenditure. Scotland's colleges received an estimated 9.5% of funding from local sources in Scotland, whether from local residents or from other private and public sources located in Scotland. Given this phenomenon, a portion of the income that the colleges create in Scotland's economy is offset by the income that they withdraw from the economy. As such, not all of the impacts generated by Scotland's colleges and their staff can be considered new monies brought to Scotland.

To determine the 'net' impact of payroll and purchases of Scotland's colleges, we convert the portion of college funding that originated from local sources to spending. We do this by summing together two specific components. The first component involves the amount of local funding the colleges received from Scottish residents that they could have used instead for their own consumption. Here we use the amount of funding the colleges received from government funding bodies that was paid by taxpayers. We

multiply this total local taxpayer funding by the average propensity to consume as reported by the ONS to find the amount they could have used instead for consumption. The second component looks at non-taxpayer local sources of college funding. This includes the amount of direct outlays paid by learners originating from within Scotland, as well as private (non-governmental) revenue. For the private revenue, we assume that 50% reported by the colleges comes from local sources. The total amount of these two components amounts to £62.3 million.

Since we assume the Scottish residents would have used the £62.3 million for their own consumption, we funnel this spending through the consumption vector of the IO model to calculate the multiplier effect for the individual sectors. Again, this is in sales terms at this point, therefore we convert the amounts to income using the value-added-to-sales ratios for each top-level sector. The result, equal to £28.2 million, allows us to see what income would have been created in Scotland even if Scotland's colleges did not exist.

Subtracting the £28.2 million in alternative uses of funds from the £729 million in gross impacts yields a net impact of £700.8 million in added income in the Scottish economy. This value appears in the bottom row of Table 3.1. Assuming that Scotland's colleges employ approximately the same number of people and spend approximately the same amount each year, this value may be considered an annual figure.

Impact of Added Workforce Skills

The strong focus of Scotland's colleges on workforce development manifests itself at all levels of the colleges' provision. In addition to delivering specific training and consultancy solutions to businesses, the colleges maintain close links with local employers in order to target the type of employee training that best meets their growth strategies. Further, the colleges' vocational learning programmes and apprenticeships allow employers and the colleges to work together to develop industry-specific training schemes that benefit both the learners and employers. All of these services provide valuable resources to businesses and help sharpen the skills of the existing Scotland labour force.

Employee training and development is just one way that employers benefit from the presence of Scotland's colleges. By aligning their provision with key employment sectors, Scotland's colleges help produce the skilled workers that are needed to support Scotland's labour market. Table 3.2 presents the percentage breakdown of the colleges' instructional activity by top-level sector categories. Health comprises the highest percentage of instructional activity (16%), followed by Special Programmes (10%) and Engineering (9%).

Table 3.2: Breakdown of Instructional Activity by Sector, 2013-14

Sector Subject Area	% of Total
Health	16%
Special Programmes	10%
Engineering	9%
Construction	9%
Social Studies	9%
Art & Design	9%
Computing	5%
Sport & Recreation	5%
Business & Management	5%
Food Technology & Catering	4%
Social Work	4%
Transport	4%
Agriculture & Horticulture	3%
Science & Maths	3%
Office & Secretarial	2%
Personal Development	1%
Minerals & Materials	1%
Printing	<1%
Total	*100%*

Source: Data supplied by the Scottish Funding Council.

Many learners attending Scotland's colleges stay in Scotland and are more productive because of the quality education they attained at college. Over time, the skills of these former learners accumulate, steadily increasing the training level and experience of Scotland's workforce. As the skills embodied by former learners stockpile, a chain reaction occurs: higher learner incomes generate additional rounds of consumer spending, while new skills and training translate to increased business output and higher property income, causing still more consumer purchases and multiplier effects. The sum of all these direct and indirect effects comprises the total impact of the learners' added skills in Scotland's economy.

Note that this total impact of the additional learner skills is unique from the previously discussed impact of college and staff expenditures. Hypothetically speaking, if Scotland's colleges were to cease their operations, then the impacts from staff and college expenditures would immediately disappear. However, the impact from additional learner skills would continue to contribute to the economic growth of Scotland's economy as former learners remain actively engaged in the Scottish workforce. While the supply of learner skills would slowly dissipate over time, it would be several years before all learner impacts would fully disappear.

Calculating the Direct Effect

Assigning a monetary value to the added skills acquired by learners still active in Scotland's workforce requires data on the historical enrolments and corresponding achievement levels of Scotland's colleges learners over the past 15-year period. Planned hours are used to determine the achievement levels of learners from Scotland's colleges, and serve as a proxy for the level of skills learners contribute to the Scottish workforce.

If we are unable to obtain historical enrolment data over the past 15-year period, our model projects the historical enrolment for the missing years using data from the available years.

Of course, not all learners remain in the workforce until retirement age, nor do all learners enter the workforce immediately upon exiting the colleges. Other learners leave Scotland and find employment outside Scotland. In the model, we adjust for these factors by applying yearly attrition rates derived from the probability that individuals will die, retire, or become unemployed over the course of their working careers. To these we combine migration data supplied by the colleges to estimate the number of learners who leave Scotland over time. This allows us to estimate the net number of former and current learners from Scotland's colleges still active in Scotland's workforce in the 2013-14 analysis year, as displayed in Table 3.3.

Table 3.3: Number of Planned Hours Still Active in the Scottish Workforce, 2013-14

Year	Active enrolments, Scotland	Active planned hours, Scotland
2000	279,452	67,100,067
2001	276,332	66,351,101
2002	302,628	72,664,955
2003	331,841	79,679,416
2004	320,290	76,905,784
2005	311,257	74,737,029
2006	303,296	72,825,408
2007	298,669	71,714,504
2008	299,826	71,992,195
2009	297,064	71,329,093
2010	270,328	64,909,272
2011	217,269	58,796,271
2012	148,246	45,063,557
2013	79,280	24,467,295
2014	25,999	7,337,649
Total, gross	*3,761,776*	*925,873,595*
Alternative education adjustment (10%)		(92,587,360)
Substitution effect adjustment (10%)		(92,587,360)
Number of planned hours in workforce, net		*740,698,876*

* Numbers may not add due to rounding.
Source: EMSI model.

The next step is to multiply the net number of former learners still working in Scotland by the average number of planned hours achieved per learner per year. According to data received from the colleges, the average planned hours per enrolment was around 282 in 2013-14. We use this average as a starting point for estimating the average planned hours per learner over the previous 15-years. Using this methodology, the estimated number of Scotland's colleges planned hours in the Scottish workforce comes to 925.9 million (see Table 3.3). These are the planned hours that accumulated in the workforce over the past 15-year period and were still active in the 2013-14 analysis year.

Next we reduce the gross number of active planned hours to account for the learners' alternative education opportunities. For this analysis, we assume an alternative education variable of 10%, meaning that 10% of the learner population at Scotland's colleges would have generated benefits even without the colleges. Since the majority of institutions in Scotland receive public funding, we assume learners would have to leave the country to receive a private education or be limited to direct industry training through workforce experience to generate the impacts. A sensitivity analysis of this variable is provided in Chapter 4. The application of the alternative education adjustment reduces by 92.6 million the gross total of planned hours in the Scottish workforce.

We make one more adjustment to the gross number of planned hours by reducing this figure by 10% to account for substitution effects, *i.e.*, the substitution of out-of-area workers for in-area workers. The reason for this is that if Scotland's colleges did not exist and there were fewer skilled workers in Scotland, businesses could still recruit and hire some of their employees from outside Scotland. As with the alternative education variable, there is no way to precisely determine how many workers could have been recruited from outside of Scotland if Scotland's colleges did not exist.[18] With the 10% adjustment, the gross number of planned hours is reduced by another 92.6 million (as shown in Table 3.3). The net number of planned hours still active in the workforce thus amounts to 740.7 million.

Table 3.4 demonstrates the total direct added income to the Scottish economy due to the added skills from the colleges' former learners. First, we find the direct labour income. This calculation begins by taking the average value per planned hour of £5.58 and multiplying it by the roughly 740.7 million planned hours in the Scottish workforce. This yields a value of £4.1 billion in added labour income.

Added to the direct effect on labour income is another £3.8 billion in non-labour income, representing the higher property values and increased investment income stemming from the direct income of learners and enhanced productivity of the businesses that employ them. Non-labour income attributable to past learner skills is obtained by disaggregating higher learner income to the industrial sectors of the IO model and then multiplying these amounts by the associated value-added-to-earnings ratios. Summing labour and non-labour income together gives a direct effect of past learner skills equal to approximately £8 billion in 2013-14.

[18] For a sensitivity analysis of the alternative education variable and the substitution variable, please see Chapter 4.

Table 3.4: Direct Added Labour Income (£ Thousands), 2013-14

	Total
Direct labour income	£4,133,054
Direct non-labour income	£3,833,469
Total direct income	*£7,966,523*

* Numbers may not add due to rounding.
Source: EMSI model.

Calculating the Indirect Effect

Economic growth stemming from a skilled workforce does not stop with the direct effect. To calculate the indirect effect, we allocate increases in Scottish income to specific industrial sectors and augment these to account for both demand-side and supply-side multiplier effects.

Demand-side effects refer to the increased demand for consumer goods and services as the higher incomes of skilled workers and their employers are spent in the local economy. For example, the increased output of businesses is associated with an increased demand for inputs, which in turn produces a set of economic multiplier effects that are all captured as part of demand-side indirect effects. In the model, these are estimated by converting higher learner income into direct increased industry sales, running these through an indirect multiplier effect matrix, and converting them to Scottish income by applying earnings-to-sales and value added-to-sales ratios supplied by the Scottish IO model. Total demand-side effects amount to £5.2 billion in added income to Scotland.

Supply-side effects occur through a process of 'cumulative causation,' or 'agglomeration,' whereby growth becomes in some degree self-perpetuating. The presence of one industry, for example, attracts other industries that use the first industry's outputs as inputs, which produces subsequent rounds of industry growth, and so on.[19] To estimate agglomeration effects, we convert the direct income of past learners to industry value added and apply this to a set of supply-driven multiplier effects provided by the Scottish IO model. To increase the plausibility of this assumption, the model applies only direct effects associated with industries in the highest stages of development.[20] Total supply-side effects amount to £1.1 billion in added income to Scotland.

The sum of demand-side and supply-side effects constitutes the indirect effect of Scotland's colleges education, equal to £6.3 billion. Adding these to the direct effect

[19] For a more complete discussion of agglomeration and cumulative causation, see Masahisa Fujita, Paul Krugman, and Anthony Venables, *The Spatial Economy: Cities, Regions, and International Trade* (Cambridge: Massachusetts Institute of Technology, 1999).

[20] Parr (1999) describes the following four stages of economic development: primary production, process manufacturing, fabricative manufacturing, and producer services and capital export. The model applies 'development scores' to Parr's stages, *i.e.*, low scores for lower stage sectors and higher scores for higher development sectors. Only those industries with the highest scores are applied to the supply-driven multipliers of the IO model. For additional detail on the use of this approach for classifying industries by industrial stage, see Rutgers *et al*, 2002.

yields a grand total impact of £14.2 billion in added income attributable to the accumulation of former learners from Scotland's colleges who are currently employed in the Scottish workforce. These results appear in Table 3.5.

Table 3.5: Impact of Added Skills (£ thousands), 2013-14

	Total
Total income in Scotland	£169,680,054
Direct effect of added skills	£7,966,523
Indirect effect	£6,266,445
Total impact	*£14,232,968*

Source: EMSI model.

Note that the £14.2 billion omits the effect of educated workers on innovation and technical progress. To the extent there are such technological gains, and theory suggests that there are, the stated results can be considered conservative.

Total Impact on the Scottish Economy

Table 3.6 displays the grand total of the colleges' impact on Scotland in 2013-14. Altogether, the results of this study show that the economic impact of Scotland's colleges to the local community in Scotland is around £14.9 billion each year. This is approximately equal to 8.8% of Scotland's total economy and represents roughly 593,246 average wage jobs.

Table 3.6: Total Impact of Scotland's colleges (£ Thousands), 2013-14

	Total
Total income in Scotland	£169,680,054
Impact of staff and college expenditure	£700,826
Impact of added skills	£14,232,968
Total impact	*£14,933,794*

Source: EMSI model.

Conclusion

These results demonstrate several important points. First, Scotland's colleges promote economic growth through their own operations spending and through the increase in productivity as former Scotland's colleges learners remain active in the Scottish workforce. Second, the impact of added skills in the Scottish workforce is by far the largest and most important impact of Scotland's colleges, stemming from higher incomes of learners and their employers. And third, income in Scotland would be substantially lower without the educational activities of Scotland's colleges.

Chapter 4 : Sensitivity Analysis

The purpose of a sensitivity analysis is to 1) see how sensitive the results are to a change in the primary assumptions, and 2) provide the reader with a plausible range wherein the true results will fall. Since we are not providing a statistical analysis of the assumptions, we will not provide a 90% confidence interval, but the concept is similar in that the range generated by the sensitivity analysis gives the most probable outcome.

These types of studies often use assumptions that do not stand up to rigorous peer scrutiny and generate results that overstate benefits. The approach here is to set this study apart from those undertaken strictly for advocacy purposes and provide a true economic audit of the colleges' investment viability and Scottish impacts. The sensitivity analysis covers five variables. For the investment perspective we test the alternative education variable and the discount rate. On the impact side we test the alternative education variables again, value per planned hour, substitution effects, and alternative use of funds.

Sensitivity Analysis of Investment Assumptions

It is worth noting that while the alternative education variable is an assumption based on the educational potential of the learners in the absence of public funding, the discount rate comes to us from *The Green Book*. These rates are calculated by HMS Treasury, but they do vary by individual and are closely related to an entity's risk aversion. So, while these data are published and incorporate the public's willingness to accept risk, we still provide a sensitivity analysis since different areas and sub-cultures in the UK may have different risk tolerances.

Learner Perspective

The alternative education variable does not affect the learners' stream of cash flows from Table 2.3 and thus is not included here. However, the discount rate for learners will vary far more than it will for the social and taxpayer perspectives. As can be seen, Table 4.1 below alters the assumed 'base case' values for the discount rate by first reducing it by 25% and 50% and then increasing it by the same.

Table 4.1: Learner Perspective Discount Rate

	-50%	-25%	Base Case	25%	50%
Discount Rate	1.8%	2.6%	3.5%	4.4%	5.3%
NPV (£ millions)	£10,341	£7,991	£6,217	£4,863	£3,818
B/C	9.8	7.8	6.3	5.2	4.3

Source: EMSI.

The IRR is not shown here because it is unaffected by the discount rate (see E.J. Mishan 1976). As the discount rate is varied, the NPV ranges from £3.8 billion to £10.3 billion and the B/C from 4.3 to 9.8. Even with a much higher discount rate, learners still see a return above the threshold of 1.0, receiving £4.30 for every pound of their investment.

Social Perspective

As can be seen in Table 4.2, reducing the alternative education variable increases the returns since more of the benefits may be claimed by Scotland's colleges. Similarly, reducing the discount rate increases the net present value and the benefit/cost ratio since future monies are not discounted as heavily.

Table 4.2: Social Perspective Alternative Education Variable

	-50%	-25%	Base Case	25%	50%
Alternative Education Variable	5.0%	7.5%	10.0%	12.5%	15.0%
NPV (£ millions)	£17,810	£17,258	£16,705	£16,153	£15,601
B/C	6.6	6.4	6.3	6.1	5.9
IRR	17.1%	16.7%	16.4%	16.1%	15.8%

Source: EMSI.

Table 4.3: Social Perspective Discount Rate

	-50%	-25%	Base Case	25%	50%
Discount Rate	1.8%	2.6%	3.5%	4.4%	5.3%
NPV (£ millions)	£27,011	£21,159	£16,705	£13,278	£10,611
B/C	9.5	7.7	6.3	5.2	4.3

Source: EMSI.

If our assumption of the alternative education variable is off by 50% in either direction, the expected social NPV will range between £15.6 billion and £17.8 billion. The associated B/C ranges between 5.9 and 6.6, while the IRR occurs within 15.8% and 17.1%. The magnitude of the range is smaller than that of the discount rate, implying that the results are less sensitive to the alternative education variable. When varying the discount rate between plus or minus 50% of the base case, the NPV is greater than £10.6 billion and less than £27 billion, while the B/C is between 4.3 and 9.5.

Taxpayer Perspective

The taxpayer sensitivity analysis shows similar trends to those of the social perspective, though with a smaller magnitude of variance in results since the benefits are a subset of those seen in the social analysis.

Table 4.4: Taxpayer Perspective Alternative Education Variable

	-50%	-25%	Base Case	25%	50%
Alternative Education Variable	5.0%	7.5%	10.0%	12.5%	15.0%
NPV (£ millions)	£2,984	£2,889	£2,795	£2,701	£2,607
B/C	6.0	5.8	5.7	5.5	5.4
IRR	16.3%	16.0%	15.6%	15.3%	15.0%

Source: EMSI.

Table 4.5: Taxpayer Perspective Discount Rate

	-50%	-25%	Base Case	25%	50%
Discount Rate	1.8%	2.6%	3.5%	4.4%	5.3%
NPV (£ millions)	£4,536	£3,548	£2,795	£2,216	£1,764
B/C	8.6	6.9	5.7	4.7	3.9

Source: EMSI.

As seen above, taxpayer investments in Scotland's colleges are still viable investments with extremely high discount rates and large alternative education adjustments. Under the most conservative conditions, the alternative education variable will generate NPV, B/C, and IRR of £2.6 billion, 5.4, and 15%, respectively. Under the most favourable assumptions on the alternative education variable, taxpayers will see a NPV of £3 billion, B/C of 6.0, and IRR of 16.3%. Again the results are more sensitive to the discount rate, with the NPV ranging from £1.8 billion to £4.5 billion and the B/C ratio from 3.9 to 8.6.

Sensitivity Analysis of Impact Assumptions

Impact of Added Workforce Skills

Three assumptions feed into the primary impact measure of the impact of added workforce skills. The alternative education variable accounts for the growth in impacts that would have been generated in Scotland even if Scotland's colleges had never been established. The value per planned hour, though calculated based on Scottish earnings, may vary from year to year and is highly dependent on current economic conditions. The substitution effect assumes that some of the productivity in Scotland would have occurred without the colleges through the importation of non-local labour. This is in contrast to the alternative education variable, where local labour is able to obtain some education in the absence of Scotland's colleges.

Table 4.6: Added Workforce Skills Assumptions

	-50%	-25%	Base Case	25%	50%
Alternative Education Variable	5.0%	7.5%	10.0%	12.5%	15.0%
Impact (£ thousands)	£15,023,688	£14,628,328	£14,232,968	£13,837,607	£13,442,247
Value Per Planned Hour	£2.09	£4.18	£5.58	£6.97	£10.46
Impact (£ thousands)	£5,337,363	£10,674,726	£14,232,968	£17,791,210	£26,686,814
Substitution Variable	5.0%	7.5%	10.0%	12.5%	15.0%
Impact (£ thousands)	£15,023,688	£14,628,328	£14,232,968	£13,837,607	£13,442,247

Source: EMSI.

Since the alternative education variable and substitution effects are the same rate, they move together. More interesting is the sensitivity of the results to the value per planned hour. The magnitude of change this variable has on the final results is large, demonstrating this variable's calculation is crucial to the analysis. It also proves why it is so critical to use Scottish rather than national earnings figures that are also weighted by the learner body demographics.

Impact of Staff and College Expenditure

We only perform a sensitivity analysis on one variable in regards to the operations of Scotland's colleges. The portion of the colleges' revenues received by local sources (e.g., resident fees and the portion of national taxes derived from local sources) may have been spent in a variety of ways, with different multiplier effects associated with that spending.

Table 4.7: Staff and College Expenditure Alternative Use of Funds

	-50%	-25%	Base Case	25%	50%
Alternative Use of Funds	4.7%	7.1%	9.5%	11.8%	14.2%
Impact (£ thousands)	£714,920	£707,873	£700,826	£693,779	£686,732

Source: EMSI.

Table 4.7 varies the amount of revenues received by Scotland's colleges from local sources. In the base case scenario, 9.5% of the colleges' revenues were derived from local sources. The larger the percentage, i.e. the more revenues derived from local sources, the lower the staff and college expenditures impact will be since a larger portion of the colleges' spending is not new money in the economy.

Conclusion

Even if the most conservative assumptions for each of the variables pertaining to the impacts of Scotland's colleges were adopted, the total impact on Scotland's economy would still be £5.4 billion, equivalent to 216,404 average wage jobs.

Based on this sensitivity analysis, the returns to learners, the public, and the government are reasonable. They even remain above investment profitability thresholds when the most conservative assumptions are in place. Similarly, the impact analysis continues to

generate modest results even when limiting by half the benefits that Scotland's colleges can claim.

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Annex 2: Glossary of Terms

Alternative education	A 'with' and 'without' measure of the percent of learners who would still be able to avail themselves of education if the publicly funded colleges and universities in the UK did not exist. An estimate of 10%, for example, means that 10% of learners do not depend directly on the existence of the colleges in order to obtain their education.
Alternative use of funds	A measure of how monies that are currently used to fund the colleges might have been if the colleges did not exist.
Asset value:	Capitalised value of a stream of future returns. Asset value measures what someone would have to pay today for an instrument that provides the same stream of future revenues.
Attrition rate:	Rate at which learners leave the workforce due to such factors as out-migration, retirement, or death.
Benefit/cost ratio:	Present value of benefits divided by present value of costs. If the benefit/cost ratio is greater than one, then benefits exceed costs and the investment is feasible.
Demand	Relationship between the market price of education and the volume of education demanded (expressed in terms of enrolment). The law of the downward-sloping demand curve is related to the fact that enrolment increases only if the price (learner tuition fees) is lowered, or conversely, enrolment decreases if price increases.
Direct effect	Jobs and income directly generated by the colleges and their learners.
Discounting:	Expressing future revenues and costs in present value terms.
Economics:	Study of the allocation of scarce resources among alternative and competing ends. Economics is not normative (what ought to be done), but positive (describes what is, or how people are likely to behave in response to economic changes).
Elasticity of demand	Degree of responsiveness of the quantity of education demanded (enrolment) to changes in market prices (learner tuition fees). If a decrease in fees increases total revenues, demand is elastic. If it decreases total revenues, demand is inelastic. If total revenues remain the same, elasticity of demand is unitary.

Externalities:	Impacts (positive and negative) for which there is no compensation. Positive externalities of education include improved social behaviours such as lower crime, reduced unemployment, and improved health. Colleges do not receive compensation for these benefits, even though education statistically correlates with improved social behaviours.
Gross Domestic Product:	Measure of the final value of all goods and services produced. Alternatively, GDP equals the combined incomes of all factors of production, e.g., labour, land, and capital. These include wages, salaries, profits, rents, and other.
Indirect effect	Jobs and income that result from the direct spending of the colleges and their learners.
Input-output analysis:	Relationship between a given set of demands for final goods and services, and the implied amounts of manufactured inputs, raw materials, and labour this requires. In an educational setting, as colleges pay staff and spend money for supplies in the local economy, they also generate earnings in all sectors of the economy, thereby increasing the demand for goods, services, and jobs. Moreover, as learners enter or rejoin the workforce with added skills, they earn higher salaries and wages. In turn, this generates more consumption and spending in other sectors of the economy.
Internal rate of return:	Rate of interest which, when used to discount cash flows associated with investing in education, reduces the net present value to zero (i.e., where the present value of revenues accruing from the investment are just equal to the present value of costs incurred). This, in effect, is the breakeven rate of return since it shows the highest rate of interest at which the investment makes neither a profit nor a loss.
Labour income	Income which is received as a result of labour, e.g., wages.
Multiplier:	Measure of overall local earnings per pound of college earnings (i.e., on- and off-campus earnings divided by on-campus earnings). Multiplier effects are the result of in-area spending for goods and services and of everyday spending by college staff. The analysis also includes added local earnings attributable to past learners still active in the workforce. The local economy is larger because of learner skills, added spending associated with higher learner incomes, and enlarged output of industries where past learners are employed.

Net cash flow:	Benefits minus costs, *i.e.*, the sum of revenues accruing from an investment minus costs incurred.
Net present value:	Net cash flow discounted to the present. All future cash flows are, in this way, collapsed into one number, which, if positive, indicates feasibility. The result is expressed as a monetary measure.
Non-labour income	Income that is received from investments (such as rent, interest, and dividends) and transfer payments (payments from governments to individuals).
Opportunity cost:	Benefits forgone from alternative B once a decision is made to allocate resources to alternative A. For example, if an individual chooses not to attend college, he or she forgoes higher future earnings associated with further education. The benefit of education, therefore, is the 'price tag' of choosing not to attend college.
Payback period	Length of time required to recover an investment – the shorter the period, the more attractive the investment. The formula for computing the payback period is: Payback period = cost of investment/net return per period.

Annex 3: EMSI Input-Output Model

Introduction and Data Sources

EMSI's UK Regional Input-Output model represents the economic relationships among a region's industries, with particular reference to how much each industry purchases from each other industry. Using a complex, automated process, we can create regionalised models for any geographic area comprised of NUTS 3 areas.

Our primary data sources are the following:

1. Regional and national jobs-by-industry totals, and national sales-to-jobs ratios (derived from EMSI's industry employment and earnings data process).
2. The Office for National Statistics' (ONS) Supply and Use Tables (SUTs).

Creation of the Z Matrix

The SUTs show which industries make or use which commodity types. These two tables are combined to replace the industry-commodity-industry relationships with simple industry-industry relationships. This is called the national 'Z' matrix, which shows the total amount (£) each industry purchases from others. Industry purchases run down the columns, while industry sales run across the rows.

Table A3.1: Sample Z matrix (£ millions)

	Industry 1	*Industry 2*	. . .	*Industry 645*
Industry 1	3.3	1,532.5	. . .	232.1
Industry 2	9.2	23.0	. . .	1,982.7
. . .	. . .	. . .	. . .	. . .
Industry 645	819.3	2,395.6	. . .	0

In looking at the table above, the value 1,532.5 means that Industry 2 purchases £1,532,500,000 worth of commodities and/or services from Industry 1. In other words, the whole table is basically an economic double-entry accounting system, configured so that all money inflows have corresponding outflows elsewhere. All regular industries (such as 'oil and gas exploration,' 'machinery manufacturing,' 'supermarkets,' 'hospitals,' and so on) are captured in the Z matrix.

Disaggregation of the Z Matrix

The initial national Z matrix is then 'disaggregated' (or *extended*) from around 120 industries to approximately 645 industries. The disaggregation is performed by using probability matrices that allow us to estimate industry transactions for the more detailed sectors based on the known transactions of their parent sectors. The probability matrix is created from detailed EMSI industry earnings data, which are available for the approximately 645 industries and generated using a separate process.

Creation of the A Matrix

The national disaggregated 'Z' matrix is then 'normalised' to show purchases as percentages of each industry's output rather than total £ amounts. This is called the national 'A' matrix.

Table A3.2: Sample 'A' matrix

	Industry 1	*Industry 2*	. . .	*Industry 645*
Industry 1	.001	.112	. . .	.035
Industry 2	.097	0	. . .	.065
. . .	. . .	. . .	. . .	. . .
Industry 645	.002	.076	. . .	0

Each cell value represents the percentage of a column industry's total input purchases that goes toward purchasing inputs from each row industry. Thus, the cell containing .112 means that Industry 2 spends 11.2% of its total input purchases to obtain inputs from Industry 1.

Regionalisation of the A Matrix

To create a regional input-output model so that each region can be analysed on its own, we regionalise the national A matrix using that region's industry mix. The core regionalisation method is based on the work of University of West England economist A.T. Flegg[21] and uses cross-industry location quotients. In general, location quotients

[21] Flegg, A.T. and C.D. Webber, 2000. 'Regional Size, Regional Specialisation and the FLQ Formula,' ***Regional Studies*** 34(6): 563-569; Flegg, A.T. and C.D. Webber, 1997. 'Regional Size, Industrial Location and Input-Output Expenditure Coefficients,' ***Regional Studies*** 32(5):435-444; Flegg, A.T. and C.D. Webber, 1997. 'On the Appropriate Use of Location Quotients in Generating Regional Input-Output Tables: Reply' ***Regional Studies*** 31(8): 795-805; Flegg, A.T. and C.D. Webber, 1994. 'On the Appropriate Use of Location Quotients in Generating Regional Input-Output Tables' ***Regional Studies*** 29(6): 547-561.

provide regional insight by determining the proportion of regional employment in a specific sector compared to the proportion of national employment in that same sector. In an effort to produce the best estimates, we calibrated the Flegg location quotients (FLQs) in our model with respect to 2007 data from the Scottish Government Input-Output Model. We calculate the FLQs using the following equation:

$$FLQ_{i,j} = \left(\frac{\frac{J_i^R}{J_i^N}}{\frac{J_j^R}{J_j^N}} \right) \times \left(\log_2 \left(1 + \frac{\sum J^R}{\sum J^N} \right) \right)^{0.1}$$

Where:

J = Jobs
i = row industry
j = column industry
R = Region
N = Nation
0.1 = Calibration

We create a separate matrix for the FLQs of all industries, as displayed below in Table A3.3. For example, the cell containing the FLQ of .12 was calculated by using Industry 1 as the row industry (or *i* in the equation above) and Industry 2 as the column industry (or *j* in the equation above).

Table A3.3: Sample FLQ matrix

	Industry 1	*Industry 2*	. . .	*Industry 645*
Industry 1	1	.12	. . .	.47
Industry 2	.98	1	. . .	.09
. . .	. . .	. . .	. . .	. . .
Industry 645	.20	.76	. . .	1

One other important aspect of the FLQ matrix is that we can use each FLQ as a regional purchase coefficient (RPC). RPCs are useful in estimating the percentage of industry demand that is met by purchases from other industries within the region. In this way, we can see how much money for industry purchases stays within the region and how much leaks out of the region.

Since the FLQ matrix has the same dimensions as the A matrix, it can be used to scale the national A matrix to the region using the Hadamard (i.e., element-by-element) product. The result is the regionalised A matrix, represented by the following equation:

$$A^R = A^N \otimes F^R$$

Where:

$\otimes$ = Hadamard multiplication
A^N = UK IO coefficients matrix
F^R = FLQ matrix
A^R = Regional IO coefficients matrix

The A-matrix regionalisation process is automated for any given region for which industry data are available. Although partially derived from national figures, the regional A matrix offers a best possible estimate of regional values without resorting to costly and time-consuming survey techniques, which in most cases are completely infeasible.

Creating Multiplier Effects and Using the A Matrix

Finally, we convert the regional A matrix to a regional B matrix using the standard Leontief inverse:

$$B^R = (I - A^R)^{-1}$$

The B matrix consists of inter-industry sales multiplier effects, which can be converted to jobs or earnings multiplier effects using per-industry jobs-to-sales or earnings-to-sales ratios. The resulting tables and vectors from this process are then used in the actual end-user software to calculate regional requirements, calculate regional economic base, estimate sales multiplier effects, and run impact scenarios.