CAPTURING THE OVERALL ECONOMIC IMPACTS OF HEIS

Literature review

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Executive summary

This report evaluates the current state of knowledge on the overall economic impacts of higher education in Scotland. By overall impacts we mean both demand-side and supply-side impacts. We summarise work on individual elements of the demand and supply-side impacts of HEIs. We also report on the use of approaches that attempt to identify the full impact of these institutions. Wherever possible we use Scottish studies.

Individual impacts and overall measures defined

Demand-side impacts are the expenditure effects of Higher Education Institutions (HEIs) as employers and purchasers of goods.

Supply-side impacts are the various channels through which higher education affects the productive capacity of the economy. These include:

- Knowledge and skill (human-capital) accumulation;
- Geographical redistribution generated through the spatial pull that HEIs exert on highly skilled labour and knowledge activities;
- Indirect benefits of education such as through improved public health and reduced crime rates.

Integrative approaches have been used to draw all the demand and supply-side influences together to estimate, within a single framework, the overall impact of education. These are:

- Statistical approaches using regressions analysis to estimate the influence of education on national economic growth;
- Cost benefit analyses which assigns consistent monetary values to the social benefits attributable to HEIs and weighs these against the social costs of running the institutions;
- Multi-sectoral modelling techniques which simulate the economic impact of both the demand- and supply-side changes generated by HEIs.

Key headline findings

The standard measure of the demand impact of Scottish HEIs (for 2006) is that they generate directly or indirectly (knock-on expenditures)
£4 billion output and 55,135 FTE jobs in Scotland. This is 2.28% and 2.76% respectively of the Scottish output and employment totals. Student's consumption spending supports an additional 0.44% of Gross Output and 0.18% of employment in the region. Once displacement of Scottish Government funding has been accounted for, the balanced expenditure impact of the Scottish HEIs (for 2006) becomes £1.7 billion output and 22,573 employment or 0.94% and 1.13% of Scottish output and employment totals.

In Scotland, the impact of having an undergraduate degree is to increase the wage by 80% above that of an individual with no qualifications at all. The increase above individuals with at least 3 highers is around 33%.

The impact of maintaining the existing proportion of graduates amongst young people coming into the labour force will increase the Scottish GDP by 4.6% by 2051. On average over the 45 year simulation period (2006-2051) this process of human capital accumulation will add about 0.1% each year to annual GDP. This is generated by the improvement in labour productivity as a result of acquiring higher education. This implies that the GDP is permanently higher than it would have been as a result of the Scottish labour force being more effective.

Findings on key issues

Examples of a wide range of views on the economic importance of higher education can be found in the published literature. The weight of evidence points towards a positive but qualified conclusion. That is to say there are well established instances where the economic impact of HEIs might be overstated, but the scale of these potential errors is significantly smaller than the scale of the expected benefits. However, strong negative assertions about the economic impact of HEIs (sometimes encountered in less formal

publications, e.g. media, think tanks, etc) are refuted or challenged by existing evidence. On balance, the evidence cautions against over optimism but rejects strong negative assertions. In particular:

- **"Crowding out" of expenditure impacts**. This is the notion that the expenditure impacts of HEIs in Scotland should be discounted because they only displace other expenditures funded by the Scottish Government which would have similar knock on effects. The Scottish Government provides just over half of the HEIs funding with the remainder coming from other sources. Hence their stated impact under conventional assumptions is approximately halved once the displacement of Scottish Government funding is accounted for.

- **The additional wage benefit for the marginal student is falling**: This is thought to hold as the proportion of graduates in the labour force rises. The thinking underpinning this is a simple application of supply and demand. However, historical data show that the graduate wage premia in the UK has remained stable over the recent past despite increasing graduate participation. The rationale is that technical progress is skill intensive.

- **Pure signalling effects of education**: The extreme interpretation of signalling theory is that whilst highly educated workers receive higher wages, this does not reflect any skill increase generated through education. Rather, in this theory, being able to tackle an undergraduate degree is a signal of pre-existing personal characteristics highly valued in the labour market. The extreme versions of this approach have been rejected on both theoretical and empirical grounds. However, there is some evidence to support a relatively small signalling effect.

- **Insignificant aggregate growth impacts of education**: Well publicised early cross-country econometric studies claimed that the education variable was not a significant factor in explaining differences in economic growth. These studies have been refuted on methodological grounds and more recent work, based on improved data, has upheld a (cautiously) contrary view.

The remainder of this summary will highlight the main findings in the order that they appear in the report.

Demand side impacts

Many studies have been conducted that estimate the impacts of HEIs as employers and purchasers of goods and services within the local/regional economy. Scotland is very well served by such studies, undoubtedly aided by the availability of appropriate data. The most rigorous approach to these studies, which has become the standard, is to identify the exogenous expenditure attributable to HEIs and then derive the knock-on expenditure impacts. This reveals the impact of the relevant institution in terms of output, GDP, employment, etc. For Scotland HEIs are measured as generating, through direct and knock-on effects, £4 billion output and 55,135 employment. This is 2.28% and 2.76% respectively of the Scottish output and employment totals.

However, a criticism of these studies is that they do not consider the source of the HEIs initial income. Doing so gives rise to issues of "displacement", as a significant part of HEIs income, and some student support, is derived from public funding. This funding would be spent on public services had it not been spent on HEIs. Hence the expenditure impact of HEIs is more limited than traditional impact studies reveal. But a significant portion of Scottish HEIs income is not funded by the Scottish Government: Examples are competitive research funding at the UK and world levels and the tuition fees of incoming students. Therefore even after adjusting for these displacement effects, HEI and student expenditure contribute 1.08% (£1.1 billion) to Scottish GDP and 1.31% (app. 26,200 FTEs) to Scottish employment.

Furthermore, although consideration of the share of government funding in HEIs income limits their measured impact at the Scottish level, the same does not necessarily apply at the local level. The HEIs impacts are fully felt in their local economy, whereas the displacement effects are realised through Scotland-wide public expenditures. In principle displacement could affect

services in an entirely different sub-region from the one where the positive impact is felt.

From a demand-side policy point of view, a major issue in this context is how far government funding affects the HEIs' efforts and/or success at drawing in funding from other sources. For this question we are missing both theory and empirical evidence and conclude that future work is needed.

Wage premium/returns to education

There is overwhelming evidence of a link between an individual's wage income and their level of education. The existing evidence on the wage premia related to education and the returns to investment in education clarify some important concerns of policy makers. The empirical evidence suggests that there are high returns to education generally, but that these do vary across subjects and, to a lesser extent, institutions. Furthermore, the evidence supports the view that in terms of the wage impact of education, the Scottish and UK labour market are broadly similar.

Table 1: Wage premia for academic qualifications in Scotland. Source: Walker & Zhu (2007b)

	Male	Male [cumulative]	Female	Female [Cumulative]
<5 GCSE, General Standard Grade	17%	17%	18%	18%
5+ GCSEs at A-C, 'O' Grades, Credit Standard Grade	12%	29%	12%	30%
2+ A-levels/3+Highers	19%	48%	13%	43%
Undergraduate degree	31%	79%	34%	77%
More than undergraduate qualification	12%	91%	13%	90%

Table 1 presents a breakdown of the wage premia for academic qualifications in Scotland as found by Walker & Zhu (2007b)[1]. The figures reveal strong income benefits for each successive stage of qualification. On average an individual with post-graduate qualifications can be expected to earn 90% more than an individual with no educational qualifications. The graduate

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[1] Their findings reveal wage premias of similar orders of magnitude as other studies conducted for the UK and Scotland. Variations are typically due to differences in the definition of the base reference and what constitutes each education level.

wage premia, that is the difference in earnings between those eligible for higher education and those that have completed a degree, are 31% for male undergraduate qualifications and 43% for males completing both undergraduate and postgraduate qualifications. These effects are stronger for women who can be expected to earn a 34% wage premium on an undergraduate qualification and a 47% wage premium as a combined effect of undergraduate and postgraduate qualifications. Furthermore, there is some international evidence to suggest that the return to education is higher than average for students from disadvantaged backgrounds.

Though the labour market impacts of education have been widely researched, there are questions as to the interpretation of these results, especially with regards to establishing the causality between education and earnings. Observational data inevitably have limitations and the inability to conduct experiments means that identifying the skill enhancing effect of education (as opposed to the innate factors that might be correlated with education) will perhaps never be established beyond all doubt. However various different approaches have been used to corroborate findings and there is consensus that on balance wage premia estimates are reasonable indicators of the private labour market benefits of education.

Spells of graduate unemployment (which typically follow cyclical downturns) are sometimes presented as anecdotal evidence of oversupply of skilled labour. However, this is not backed up by data covering longer time periods. Scottish studies reveal that the probability of being in employment rises steadily with the level of education attained. Even if there is a portion of the graduate population that is employed in jobs traditionally not regarded as graduate ones, they are rewarded for their education with a significant wage premia – albeit not of the same magnitude as for those in traditional professional employment.

Further, there is no evidence of wage premia declining over time with rising participation in higher education. On the contrary, available observations of the graduate wage premium reveal it as being high and stable over time. Diminishing returns to education cannot be assumed by default, especially

over longer time horizons, as the demand for skilled labour is increasing simultaneously with the supply of graduates. Therefore the notion that graduate labour is in oversupply is not backed up by evidence from either Scottish graduate unemployment or wage premia studies.

Looking at the figures there is evidence of high return to investment in higher education. However, if these are primarily captured by individuals it raises questions as to what extent this investment should be publicly funded.

Wider (supply side) effects

The wider impacts of HEIs refer to both non-monetary impacts captured by the educated individuals themselves, such as improved health, and also to monetary and non-monetary benefits accruing to the wider society, for example lower crime rates. These impacts are much less widely studied than direct impacts and more difficult to measure. Although there is some history of examining the linkages between education and various socioeconomic indicators, bringing these together in a systematic framework to capture the overall impact of education is a nascent development. Based on this work it is argued that the wider impacts of HEIs are of a similar magnitude as the private benefits reaped through wage premia in the labour market.

It is clear though that much further work is needed to clarify the nature and size of these wider impacts. Taking a bottom up approach, adding up individual effects imposes problems with regards to double counting of impacts as well as disentangling the effects of education from the effects of other socioeconomic developments. Taking a top down perspective imposes various measurement difficulties as illustrated in the discussion of aggregate regressions. Furthermore, as in the wage premia literature, there are inherent difficulties in establishing causality using observational data.

Local supply side effects/spillovers

International evidence indicates a range of effects of HEIs that can be detected at regional or local levels. These are only partially captured in

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microeconomic labour market estimates or macro/overall approaches. They affect the geographical (spatial) arrangement of the benefits of HEIs to a greater extent than the level of benefits *per se*. Examples of these spatial effects are where the presence of HEIs affects the location of R&D or highly skilled labour. In addition there is evidence of local spillover effects of HEIs, where HEI activity is found to boost innovation rates in its vicinity. As far as the spatial pull effects of HEIs can trigger or reinforce agglomerations, it is quite possible that such agglomerations can be powerful enough to exert their attractive powers over borders and in such a way have a positive national impact.

However, regardless of the potential national impacts of these effects, there are indications that HEIs can have a more decisive impact on their local host regions than national level averages imply. On the whole, there are strong indications that effects of this type are very important. The literature documenting the spatial impact of HEIs upon research activity, innovation and skilled labour suggests that potentially strong and divergent local effects are masked within the national average impact of HEIs. Examining these localised effects is a relatively young field, however, and more systematic evidence is needed. In particular, there is little evidence yet explicitly for the UK and so far as we are aware, no Scottish-specific studies.

An important condition for reaping the economic benefits of HEIs, both in terms of knowledge spillovers and productivity benefits, is to retain or attract graduates. Scotland retains a large proportion of its graduates. This is in contrast to individual US states, for which most studies have been conducted, where graduates are footloose. At the UK level, retention rates in Scotland are the second highest, only after London. This has been attributed to the different institutional features of the Scottish education system.

It is clear that HEIs can attract highly skilled labour, thus making the local labour market more attractive to employers. There is also supportive evidence for a localised effect of HEIs where they seem to attract private R&D into its spatial proximity. Furthermore there is a link between research activity within HEIs and regional innovation activity measured as patent

registrations. However most of the studies mentioned were based on observations from the U.S. The lack of studies with a wider geographical scope makes it hard to predict how generally these results can be applied to other countries.

In US studies statistical regularities indicate that HEI activity has beneficial impacts on innovation at the local level, as measured by patent registration. The strength of this effect varies depending on sectors and local characteristics. Furthermore university research is found to be positively associated with private research at the state level.

There is evidence of distance decaying local knowledge spillover effects from HEIs. Sometimes this is associated with formal technical activities, but Kitson et al argue for a more pluralistic view, where HEI–industry interactions occur through a variety of sources, both formal and informal and across a range of disciplines.

The evidence supporting spatial pull effects of HEIs and local spillovers raises issues about the spatial equity of HEI funding. The evidence suggests HEIs benefit their local economy more strongly than the regional or national economy as a whole. This supports the geographical dispersion of HEIs. A further concern is the migration of graduates. If regional governments are funding HEIs, it is clear that regional economy does not stand to benefit from out-migrating graduates. However, this net-migration must be considered as there is return migration of graduates, which evidence suggests may be re-enforced by the presence of local HEIs.

Overall Impacts

The approaches available to draw together the different strands of economic impact of HEIs into an overall impact are quite disparate. This report examined three approaches that have been applied in practice.

The approach most widely applied hitherto is the use of statistical techniques to conduct cross country comparisons based on national aggregate data,

where inferences are made about the link between education and economic growth. To begin, there are difficulties involved in constructing accurate and consistent datasets to conduct these analyses. Further, as with any analysis of observational data, it is difficult to establish causality. On balance, therefore, this line of research has provided somewhat ambiguous results. Earlier studies found little impact of education on economic growth and were widely cited as evidence undermining the economic role of education. These have subsequently been refuted on methodological grounds and the current mainstream consensus is that aggregate econometric growth studies cannot be interpreted as evidence of negative or negligible economic impact of education. If anything they seem to corroborate findings of a positive role of education in economic growth.

Although Cost Benefit Analysis (CBA) is widely used to derive an estimate of the social net-benefit of various publicly funded activities, hitherto relatively few studies have applied this methodology to the case of higher education. CBA involves enumerating and evaluating the total social costs and total social benefits of a project or activity. Typically the costs are relatively easy to gauge with a wealth of accounting data available from which total social costs can be derived. The main challenge is in estimating a monetary value for the benefits of HEIs. In principle a wide range of benefits can be identified and valued, though practitioners have focussed on a narrower range of benefits that are most amenable to monetary valuation. These are in particular skills in the labour market and spillovers from research. This evaluation process utilises estimates from microeconometric studies such as those reviewed in Chapters 3 and 4. The existing, very limited, work identifies a high positive value to HEIs using this criterion. As CBA is essentially a partial equilibrium technique, it is appropriate for analysing the effect of changes at the margin, such as expansion or cut-back of a particular institution. However, applying it to estimate the net-benefits of the whole sector would be problematic.

A recent development is the application of multisectoral Computable General Equilibrium (CGE) models to simulate the potential economic impact of HE policies. CGE models incorporate the supply and demand

sides of the economy, with sectors and transactors linked together using standard economic principles to represent a stylised view of the circular flow of economic activity. Studies of this kind draw on a wide range of evidence establishing the expenditure pattern of HEIs (such as is summarised in Chapter 2) as well as the linkages between HEIs activity and the supply side of the economy (as reviewed in Chapters 3-5). This approach is particularly useful for integrating the demand- and supply-side elements of HEIs actvitiy and can in principle link outcomes to funding although gaps in the evidence base still limit the robustness of such linkages.

The application of CGE models to HE policies is a nascent development with only one academic publication at present on the subject for the University of Tasmania. However, further work is under way at the University of Strathclyde to model HE policies in the UK regions. Initial results suggest significant long-term improvements in productivity providing a GDP stimulus for the Scottish economy. Whilst the outcome is a strong positive stimulus to Scottish GDP, the potential range of outcomes is quite wide. This reflects different views about how to interpret existing evidence and different perspectives on how the transmission mechanisms within the economy function.

Conclusions

This report brings together and reviews evidence on the overall economic impacts of HEIs. Its contribution is threefold: It affirms the generally positive economic impacts of higher education. It summarises in an accessible way the various economic impacts of HEIs on their host economies. Finally it serves to highlight some of the gaps in our knowledge.

In particular three gaps emerge; lack of understanding or modelling of how the HEIs themselves respond to changes in funding; a lack of systematic study of how HEI impacts are interrelated with wider public policy such as early childhood development, public health and social protection (in particular there could be synergies in data collection); and a weak evidence base with regards to the geographical/spatial impacts of HEIs.

A system-wide view is taken here. That is, we have not examined the role of the individual institutions but of the HEIs system as a whole. Some care must be taken when translating the broad results to the level of the individual institution. There is a high degree of heterogeneity between individual HEIs in terms of teaching and research, the pool within which they recruit students and the labour markets they provide graduates for. Hence different types of HEI they could have quite different costs and benefit for their host economies.

Preface

When bidding for this commission the authors envisaged a shorter report that would not elaborate as much on technical detail as is the final outcome. However, when considering the nature of the academic and policy debates that are ongoing and the state of available evidence it seemed obvious that a more elaborate treatment was necessary if the document was to aid in informing policy debates and be credible.

Many of the main policy questions on the economics of education are controversial and even if there is a mainstream consensus to be found, influential counter-arguments are frequently cited. Furthermore, publications contesting (and possibly shifting) the main-stream academic opinion can be expected for years to come. In such a volatile environment where controversial findings are likely to find a strong reaction from the media, the public and political pressure groups, it is not sensible to report stylised findings without due acknowledgement of the full complexities involved.

On fundamental issues such as, for example, the macroeconomic impact of education or the link between institutional quality and labour market outcomes, the evidence base is relatively underdeveloped. There are conflicting findings and a limited popular perception of the state of affairs. Any conclusion or recommendation that does not embrace the underlying complexities can easily be unduly countermanded with a reference to one or more peer-reviewed academic publication.

From the point of view of the consumer a more complicated report is of course not an ideal state of affairs. However, it was seen as the better option to expose policy makers to a more nuanced but robust discussion rather than presenting highly stylised findings that could subsequently be discredited to those not familiar with the details of the academic literature.

This undertaking has benefitted greatly from academic synergies with the Impacts of Higher Education Institutions on Regional Economies Initiative[2]. We gratefully acknowledge comments from participants in the Initiate and related workshops, as well as comments from our colleagues within the Department of Economics at the University of Strathclyde.

1 Introduction

The aim of this report is to summarise the literatures which deal with economic impacts of Higher Education Institutions (HEIs) in such a way that a broad understanding of current knowledge can be obtained in a single accessible source. The focus is therefore on breadth and clarity of presentation. We will attempt to identify the methodological strengths and limitations of different approaches without burdening the presentation with too much detail. In any case, most of the sub-literatures discussed here have been comprehensively reviewed in the past so we can refer to those sources for methodological detail. Hitherto various survey articles, and even books, have been produced which capture one or more of the strands of literature concerned with the impacts of HEIs. These include: a wide ranging work by The Centre for Public Policy for Regions' (CPPR) Network on the Overall Impact of HEIs on Regional Economies (CPPR, 2006)[3]; a comprehensive report commissioned by Universities Scotland (McClellan et al, 2006), McMahon's (2002, 2009) contributions to our understanding of the wider economic impacts of education; and various chapters in the International Handbook on the Economics of Education (Johnes & Johnes eds., 2004). None of these however can serve as a 'one stop shop' for policy makers and others interested in obtaining a holistic overview of the current understanding of the economic impacts of HEIs.

The structure of the paper moves from discussing the various partial effects of HEIs upon their host economies to considering recent attempts to draw on these to estimate the overall impact of HEIs. We adopt the taxonomy of dividing the overall impact of HEIs into demand and supply side impacts. In looking at the benefits of higher education we follow McMahon (2009) in classifying these along two axes, private or public and market or non-market.

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[3] The report includes four review articles: I. The overall impact of Higher Education Institutions on Regions: A Critical Review (P McGregor, K Swales and D McLellan) II. University-to-Industry-to Regional Economy Knowledge Transfer: A Literature Review and Gap Analysis (D McLellan, I Turok and R Botham). III. Graduate Labour Market Issues (R. Wright) IV. Determinants of Regional Growth (R Harris)

It is evident that the literatures documenting the economic impacts of HEIs have evolved around the data that are available for researchers to analyse. Some of these fields are very rich and include numerous studies for different geographies and times periods, such as work on the demand side impact and the rates of return to human capital. Other fields are less rich and in some cases there are examples of one-off studies which have not been repeated in other settings such as the spatial econometric work of Andersson et al (2004, 2005) documenting the impact of HEI activity upon regional labour productivity.

2 Demand side impacts

Demand side impacts of HEIs refer to the economic impacts (employment, output etc) contingent upon the spending of the institutions, their students and visitors. These type of studies account for the relevant direct spending and then use a demand driven economic model (i.e. Keynesian multiplier, Input-Output) to estimate the knock-on impacts of the HEIs' activity. These models identify exogenous final demand which drives additional endogenous activity through a multiplier process. In this restricted approach, HEIs are simply an exogenous demand stimulus to their local economies.

Scottish HEIs are non-profit organisations, which are funded from a variety of sources. The biggest single funder is the Scottish Government, which contributes a little over half of their income. The remainder comes from other public sources as well as private institutions and household, both within Scotland and further afield. In the remainder of this section we outline the methodology of HEI impact studies and summarise their findings, especially with regards to Scotland. Finally we will critically examine some of the assumptions underlying these impact studies, the selection of appropriate counterfactuals and the interpretation of their results.

Estimating the demand side impact of HEIs two main issues; determining the multiplier and identifying to what extent the spending of the HEIs is additional to the economy under consideration. From the latter point it follows naturally that the way the HEIs are financed has to be considered.

To determine the multiplier we use the Scottish IO table. An important qualitative finding is that HEIs have slightly greater knock-on effects than other public activities in Scotland due to a lower import propensity. Secondly we discuss with the issues involved in determining the degree of additionality of HEI related spending to the Scottish economy. Here we face challenges both with regards to institutional as well as student spending. To what extent would the spending of HEIs be lost to the Scottish economy in their absence? It is clear that HEI funding from the Scottish Government is not additional, whereas the tuition fees of foreign students or research council grants are. Similarly it is even more difficult to disentangle to what extent student spending is additional to the economy. Clearly the consumption spending of foreign students is, but are local students non-additional? Would at least some of them have taken their term time spending to university towns in the rest of the UK or elsewhere? In the absence of Scottish HEIs? Finally the value of the multiplier and the appropriateness of a particular injection will depend on the parameters of the study, the spatial area under consideration, funding setup and so on. As we will see, the geographical boundaries applied will affect both the multiplier value and the appropriateness of assumptions. The funding setup in Scotland also affects how public expenditure on HEIs should be treated. If a new HEI were to be setup in Scotland based entirely on Scottish Government funding this would have very limited net demand-side impact for Scotland as the money would simply be a redistribution of the available public spending. If on the other hand a new HEI were to be set up, based entirely on public funding, in a region with non-devolved finances, this would be additional to the particular region as the funding would be a redistribution of central government expenditures. For example, new public expenditures in the English region of Yorkshire would be additional to that region but a re-distribution from the rest of England.

Finally, before reviewing the practicalities of HEI impact studies, we should sound a note of caution about assigning causality between HEI spending and related activities and between one type of HEIs funding and another. It is common practice, and a reasonable one (given previously mentioned

qualifications about the additionality of student expenditure), to associate student spending to HEI spending. Extending this association however can be problematic. An example would be the expenditure of conference visitors. Their visits to Scotland are in some cases clearly due to academic events organised and initiated by Scottish HEIs. In other cases, however, conferences, possibly using the universities facilities, are not caused by the HEIs themselves. On balance it can be argued that off-model associations of this kind can be legitimate in principle, however it is a difficult judgement to what extent associated activity of this sort is truly additional.

Another issue is that since public funding is only part of the HEIs income sometimes causality is assigned from income from recurring public funding to other forms of income for HEIs. This is sometimes done in HEI impact studies published by the institutions themselves, where the multiplier is amplified as each £1 of recurring public funding is assumed to draw in a given amount of matching funds from other sources[4]. There may be an element of truth in this. It is certainly the case for Scotland that the HEIs which receive the largest amount of Scottish Government funding also draw in the largest amount of funding from outwith Scotland. However, apart from such observations, there is not enough evidence to support this kind of linkage to justify its inclusion in economic impact studies of a rigorous academic standard.

2.1 Mainstream practice in HEI Impact studies

An extensive literature estimates the impact of HEI spending on the host economy solely through demand side effects. Florax (1992) lists over 40 studies of the regional economic impact of HEI expenditure and much has been published since. McGregor et al (2006) summarise the methods and findings of the main UK studies. A number of studies have been conducted for Scottish HEIs, as is shown in Table 1, and the most recent work is ongoing within the Overall Impact of Higher Education Institutions on

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[4] See for example: Welsh National Assembly (2009).

Regional Economies project at the University of Strathclyde[5] (see Hermannsson et al 2010a,b,c).

Almost all of these studies have been conducted using models that imply an entirely demand driven economy with a passive supply side. Most, especially earlier ones, are based on Keynesian income-expenditure models e.g. Brownrigg (1973), Bleaney et al (1992), Armstrong (1993) and Battu, et al (1998) whilst a smaller number use straightforward or extended Input-Output (IO) modelling and extensions thereof, e.g. Blake & McDowell (1967), Harris (1997), Kelly et al (2004) and most recently Hermannsson et al (2009). McGregor et al (2006) argue that, although less frequently applied, the IO analysis is methodologically superior to Keynesian income-expenditure models. However, the latter might be used in circumstances where rough estimates are considered sufficient or IO accounts are not available or cannot be constructed with the resources available.

The fundamental relationships on which demand driven models rest is the interrelation between local businesses and households and their links to the rest of the economy. In this case a university is a source of spending in a region. It buys supplies, either locally (from suppliers who themselves have a certain propensity to import) or imports them directly from external suppliers. Most of the university's staff reside locally and spend a part of their income on local services, which in turn will generate more activity. Furthermore, a university will attract students from outwith the region whose spending will be a fresh source of demand.

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[5] It is one of nine projects conducted under the Impact of Higher Education Institutions on regional economies initiative. The initiative runs for 3 years from 2007- 2010 and is supported by the Economic and Social Research Council (ESRC) in partnership with the Scottish Funding Council (SFC), Department for Employment and Learning (DEL) in Northern Ireland, the Higher Education Funding Council for England (HEFCE) and the Higher Education Funding Council for Wales (HEFCW).

Table 2 Overview of main Scottish HEI impact studies

Subject of study	Multiplier value	Geographic boundary	Source of multiplier value
St. Andrews University (Blake & McDowall, 1967)	1.45 (Household income)	St. Andrews (pop. 10,000)	Input Output table
Stirling University (Brownrigg, 1973)	1.24 - 1.54 (Income)	Parts of Sterling and Perth (pop. 96,000)	Brown et al (1967), Greig (1971)
Strathlcyde, Stirling and St. Andrews Universities (Love & McNicholl, 1988)	1.34, 1.43, 1.36 (student spending)	Scotland	Brownrigg & Greig (1975), McNicholl (1981)
Aberdeen, Dundee and Stirling Universities (Love & McNicoll, 1990)	2.18 (output), 1.75 (GDP), 1.95 (employment)	Scotland	Scottish Input Output Tables (1979)
Aberdeen University (Battu et al, 1998)	1.46 (spending), 1.61 (employment)	North East of Scotland	Greig (1971), Brownrigg (1971), McGuire (1983), Harris et al (1987)
Strathclyde University (Kelly et al, 2004)	1.63 (output), 1.38 (employment)	Scotland	Input Output table
Strathclyde University (McNicholl, 1993)	2.15 (output), 1.66 (Income)	Scotland	Scottish Input Output Tables (1989), Survey
Scottish HEIs (1) 1995	1.76 (output), 1.7 (employment)	Scotland	Scottish Input Output Tables (Hybrid, 1994-5)
Scottish HEIs (2) 1999	1.73 (output), 1.42 (employment)	Scotland	Scottish Input Output Tables (SLMI, 1997)
Scottish HEIs (3) 2004	1.6 (output), 1.4 (employment)	Scotland	Scottish Input Output Tables (2004)
HEI impacts projects 2009	1.3 (output type I), 2.1 (output type II)	Scotland	Scottish Input Output Table (2004)

The table above presents a summary of multiplier values found in major Scottish studies. These studies differ in the type of multiplier they report, the approach used to derive the multiplier values and the geographical definitions of the studies. Unsurprisingly therefore, the multiplier values generated differ somewhat and are in most cases not directly comparable[6]. A variety of multipliers can be derived to link a particular exogenous change to changes in a number of economic outcome metrics. The Output multipliers relate changes in final demand to the change in gross output. Therefore, an output multiplier of 1.76 implies that a unit increase in the final demand of the HEIs sector leads to an economy-wide change in output of 1.76. The stated employment multipliers show the economy-wide change in employment caused by a unit increase in direct employment. The household income multiplier used by Blake & McDowell (1967) is slightly unusual, but appropriate for their small borough application, where they relate changes in the total output of the University of St. Andrews to changes in local household income. The income multipliers used by Brownrigg (1973) relate exogenous changes in regional income to the overall change in regional income[7].

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[6] Except perhaps in the most recent studies based on the Scottish Input-Output tables.

[7] Where regional income is equivalent to GDP as derived by the expenditure method. For further details on Keynesian multiplier models see Chapter 1 in Armstrong & Taylor (2000).

The spending of HEIs and their students generates demand for the outputs of different sectors in the economy, which will in turn generate knock on effects in other sectors. There will be an increase in the demand for intermediate inputs plus increased consumption demand as employment and household income rise. These further sources of expansion are known as the indirect (intermediate demand) and induced (consumption demand) effects. Type I multipliers incorporate only indirect effects whilst Type II multipliers encompass both indirect and induced impacts.

The impacts are typically stated in terms of Output, GDP and employment. Output and GDP are two different metrics to gauge the overall activity in the economy. Output constitutes the total value of <u>all</u> goods and services produced within the boundaries of an economy and can be thought of as the 'turnover' in the economy. GDP (expenditure view) is defined as the total value of all <u>final</u> goods and services produced within an economy and thereby counts the 'value added'. The small qualification of 'final' is important in this context as by this GDP cancels out the double counting where the output of a sector is used as an intermediate input as products and services move between producers in the supply chain. GDP (income view) can also be defined as the total factor incomes (wages and other value added) generated in the economy.

The first step in the impact study process is to estimate the relevant direct spending of the institution and its students. This is essentially an accounting exercise. Available data are used to determine the amount of direct spending in the local economy that can be attributed to the presence of the HEI in question and to identify what that money is spent on, in terms of the employment of labour and capital, imports or intermediate inputs from other sectors. Typically with HEIs the largest part of spending is on wages.

The extent of student spending should ideally be based on survey evidence, but sometimes finance office estimates are used as a proxy. Ideally surveys should be used to determine to which sectors student spending is directed and to what extent it is carried out locally. Alternatively, information on

general household spending can be used as a proxy. Tuition spending is typically excluded to avoid double counting as this has already been included as part of the institutional spending. The amount and pattern of expenditure by a 'representative' student can be multiplied by the overall number of students at an institution to derive the overall direct spending of the student population. However, there is often a valid case for estimating the impact of individual student groups separately.

Local students are generally expected to have a different expenditure impact than incoming students. As incoming students are unambiguously 'additional' to the local economy, their spending can be treated as an exogenous stimulus. For various reasons it is argued that the spending of local students is different in both nature and magnitude (e.g. because many live with parents). But it is also questioned to what extent, if at all, such expenditure should be counted in an impact study. At one extreme, the counterfactual can be adopted that in the absence of an HEI all local students would have chosen to reside within the local community anyway and to forego higher education, either entering the labour market or becoming unemployed. Under such an assumption their net impact within a demand driven model is limited if not entirely zero[8]. At the other extreme it could be assumed that in the absence of an HEI the local students would have moved away to obtain higher education elsewhere. In this case, the expenditure by local students would have otherwise been removed from the local economy. Therefore if a local HEI acts to retain them, their spending can be counted as additional to the local economy.

Hermannsson et al (2010b) propose as a solution to the treatment of local students to identify only their additional (exogenous) expenditures. Drawing on student expenditure survey by Warhurst et al (2009) they subtract non-

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[8] In principle, for those students that would be retained within Scotland irrespective of the availability of higher education, one could explore the differences in their impacts as students or as recipients of unemployment benefits (as under IO-assumptions overall employment is unaffected by supply side conditions). However, at the margin, this would provide extra complexity with ambiguous benefits for the accuracy of the results.

additional (endogenous) incomes from student expenditures (further details are presented in the next section).

Some studies have gone beyond student impacts to estimate the spending of visitors (i.e. conference guests) whose arrival can be attributed to the presence of the HEIs (see Kelly et al, 2004). Although there can be examples where this is relevant, as previously noted, caution should be applied when attributing impacts of wider activities to HEIs.

Armstrong (1993) stresses the importance of estimating the direct expenditures of HEIs accurately as when spending leakages from the region are big these direct first round expenditures come to dominate the demand impact. The geographical scope affects the level of leakages and therefore the magnitude of the multiplier. In cases where the impact is estimated for a narrowly defined geographical area the multiplier values will, ceteris paribus, be lower than if the same study was conducted within a model of a larger region. For example, the multiplier impacts of the University of Strathclyde will be significantly lower when measured only in terms of Glasgow impacts rather than the impacts on Scotland as a whole. Generally the more narrow the definition of the study region, the higher the expenditure leakage and the smaller the multiplier values. Conversely, the bigger the region of study the more of the final demand of the HEIs and their students can be met 'locally' and hence the greater the knock on impacts. Similarly the more diversified and developed the local economy the larger the multiplier is likely to be as more of the inputs can be obtained locally. However, the degree of additionality is greater for a smaller area. For example, increased Scottish Government spending on the University of Edinburgh would be additional spending to the City of Edinburgh, whilst at a Scottish level it would simply be a redistribution of Scottish Government spending.

2.2 *HEI impacts at the national (UK) level*

Even under the most restrictive assumptions demand side studies show HEIs as producing an unambiguously positive economic stimulus at the regional level. HEIs bring in spending to the local economy, if not from

incoming students then at least from central government. It has been argued however that at a national level (in this case the UK) their long run net demand side impact is precisely zero due to crowding out effects. This conclusion is based on economic models which maintain a fixed natural rate of employment. McGregor et al (2006) point out that while this limiting view can be challenged the broad consensus is that supply side restraints are significant for national economies. Whilst national IO tables may provide some useful descriptive analyses of linkages they are inappropriate to derive national impacts. For this an explicit account has to be taken of supply side constraints for example within a Computable General Equilibrium (CGE) framework.

Although it can be concluded that IO-modelling is inappropriate at the national level due to resource constraints (binding supply side), these constraints do not bind (at least not to the same degree) at the regional level. Therefore Input-Output models are a relevant tool for estimating impacts at the regional level given the assumptions of a passive supply-side underlying the Input-Output model. This might be appropriate in the short-run for an economy with unemployment problems or for a regional economy in the long-run where inter-regional migration and additional investment can relax labour market and capacity constraints[9]. This makes IO a relevant approach for analyses at the Scottish level.

A similar point is sometimes raised that HEIs do not have a net impact at the national level (or at the regional level under devolved spending as in Scotland) as their funding stems from public sources and therefore could as well have been spent on some other public services in the HEIs absence (the expenditure is therefore non-additional). That argument only partially applies to HEIs, due to their diverse income sources. But it does apply to the public sector-supported part.

Even if HEIs are often perceived as part of the public sector it should be noted that they are in fact classified as non profit institutions serving

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[9] For a further discussion of these points see Hermannsson et al (2010a).

households (NPISH). The biggest share of income of Scottish HEIs, approximately 54%, comes directly from the Scottish Government. Around 29% comes from export earnings, 13% from the rest of the UK and 16% from overseas. This is in addition to export earnings from the consumption spending of incoming students. The remaining income is from various services rendered, including research, to both public and private parties. Therefore it is clear that in terms of the income structure, HEIs differ from public sectors.

Table 3 Scottish HEIs, Income by origin 2005/2006, £000's (the percentages are calculated as % of row totals). Own calculations based on source data from HESA (2007)

	Scottish Government		External income		Other income		Total	
Aberdeen	85,193	54%	45,487	29%	26,303	17%	156,983	100%
Abertay	22,870	70%	7,363	23%	2,222	7%	32,455	100%
Bell College	17,558	88%	1,564	8%	801	4%	19,924	100%
Dundee	83,218	51%	49,090	30%	31,664	19%	163,971	100%
ECA	10,272	70%	3,566	24%	869	6%	14,707	100%
Edinburgh	186,111	43%	162,550	37%	86,909	20%	435,569	100%
Caledonian	74,046	76%	15,609	16%	7,988	8%	97,644	100%
GSA	11,250	71%	3,580	23%	970	6%	15,799	100%
Glasgow	160,766	51%	84,297	27%	67,309	22%	312,372	100%
Heriot-Watt	46,403	47%	36,204	36%	16,937	17%	99,545	100%
Napier	58,978	72%	13,080	16%	9,293	11%	81,351	100%
Paisley	46,942	80%	6,346	11%	5,193	9%	58,481	100%
QMUC	19,199	70%	5,662	21%	2,709	10%	27,570	100%
Robert Gordon	50,072	67%	11,536	15%	13,475	18%	75,084	100%
RSAMD	6,812	66%	2,009	19%	1,557	15%	10,378	100%
St Andrews	40,200	37%	56,107	52%	12,456	11%	108,762	100%
SAC	22,349	51%	12,546	29%	8,763	20%	43,659	100%
Stirling	46,862	56%	24,194	29%	12,608	15%	83,663	100%
Strathclyde	110,682	58%	44,385	23%	35,987	19%	191,054	100%
UHI	25,017	71%	8,769	25%	1,579	4%	35,365	100%
Total	**1,124,802**	**54%**	**593,942**	**29%**	**345,592**	**17%**	**2,064,336**	**100%**

Furthermore, there is a slight difference between HEIs and other sectors strongly supported by public expenditure (Public Administration, Education, Health) in terms of structure of expenditures. Both HEIs and public sectors tend to have bigger knock on impacts than most other sectors as a relatively large part of their direct spending is on wages, which reduces leakages. However, this pattern is even stronger within the HEIs sector. Hermannsson et al (2010b,c) found that in Scotland HEIs had a higher multiplier value than the public sectors on average due to their lower import propensity.

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Therefore if public expenditure were to be allocated solely on the basis of possible knock-on impacts, spending on HEIs would generally be more effective than spending on other publicly funded activity.

Table 4 Spending impact of Scottish HEIs and their students, net of Scottish Government funding, 2005/2006 (Type-II impacts with Scottish Government funding (HEIs and student support) returned and spent on other public services).

	Output £ m					GDP £ m					Employment FTE				
	HEI spending	Student impacts			Total	HEI spending	Student impacts			Total	HEI spending	Student impacts			Total
		SCO	RUK	ROW			SCO	RUK	ROW			SCO	RUK	ROW	
Aberdeen	127	17	10	16	169	74	3.8	2.3	3.5	84	1,816	100	59	93	2,069
Abertay	18	6	2	7	33	10	1.3	0.4	1.5	14	265	35	11	39	350
Bell College	4	7	0	0	11	3	1.5	0.0	0.0	4	69	40	1	0	110
Dundee	141	20	12	16	189	82	4.7	2.6	3.7	93	2,068	122	69	98	2,357
ECA	8	2	2	4	16	5	0.4	0.6	0.9	7	125	10	14	23	172
Edinburgh	456	21	46	33	556	249	4.7	10.5	7.5	272	5,755	123	275	196	6,349
Caledonian	42	27	4	9	82	25	6.1	0.9	2.1	34	594	161	24	55	835
GSA	9	2	3	3	16	5	0.4	0.6	0.6	7	133	10	16	15	175
Glasgow	257	31	15	19	322	150	7.0	3.4	4.3	164	3,320	185	90	112	3,707
Heriot-Watt	98	8	8	17	131	55	1.9	1.9	3.8	62	1,263	50	49	99	1,461
Napier	39	14	4	19	77	22	3.3	1.0	4.4	31	525	86	26	116	753
Paisley	20	15	1	6	41	11	3.4	0.2	1.3	16	279	90	4	35	408
QMUC	15	6	4	7	31	9	1.3	0.8	1.6	13	215	34	21	43	313
Robert Gordon	41	15	3	16	75	23	3.5	0.6	3.7	31	569	92	15	98	774
RSAMD	6	1	1	1	9	4	0.2	0.2	0.2	4	91	6	5	5	108
St Andrews	134	5	16	20	175	77	1.2	3.6	4.5	86	1,862	31	96	118	2,107
SAC	37	1	0	0	39	21	0.3	0.1	0.1	21	544	8	2	1	555
Stirling	66	12	6	7	92	38	2.6	1.5	1.6	44	971	69	39	42	1,121
Strathclyde	137	30	4	15	187	78	6.8	0.9	3.4	89	1,845	180	23	91	2,139
UHI	21	8	0	1	30	12	1.8	0.1	0.2	14	263	47	3	6	318
Total impact	**1,677**	**247**	**141**	**215**	**2,279**	**952**	**56**	**32**	**49**	**1,089**	**22,573**	**1,479**	**842**	**1,286**	**26,181**
% of SCO total GDP/employment	**0.94%**	**0.14%**	**0.08%**	**0.12%**	**1.28%**	**1.08%**	**0.06%**	**0.04%**	**0.06%**	**1.23%**	**1.13%**	**0.07%**	**0.04%**	**0.06%**	**1.31%**

Hermannsson *et al* (2010c) examined the expenditure impact of each of Scotland's HEIs and found their spending multipliers to be almost identical across the board. However, as shown in Table 2, the institutions differ significantly in terms of the source of their income – with export intensity varying from approximately 8% to 52% – suggesting that their effective impact net of Scottish Government funding may differ significantly from their gross impacts[10].

Table 4 shows the spending impact of Scottish HEIs and their students for the year 2006, allowing for the non-additionality of Scottish Government funding, both in terms of HEIs income and student consumptions driven by Government student support. The results are based on traditional IO-methodology in that they are the product of the final demand of Scottish HEIs and their Type-II multiplier, which incorporates indirect and induced (household consumption) knock-on effects. However, an important qualification is made in the analyses above in that the impact of the HEIs income from the Scottish Government is not included. The conventional regional multiplier analysis implicitly assumes that the financing of the HEI expenditures in Scotland comes from outwith the country (i.e. the Westminster Government), with no ramifications for other elements of government expenditure. The Scottish Government's income is restricted each year to the block grant it receives from Her Majesty's Treasury as it has limited means of collecting taxes independently. If the Scottish Government were to allocate additional funds to HEIs it would imply less would be allocated to other public expenditures. An impact study therefore cannot treat the Scottish Government's funding of HEIs as an exogenous stimulus to the regional economy (although that is the typical practice hitherto).

The impacts of students' consumption spending are reported separately for each student group. For Scottish students the impacts are net of Scottish Government-provided income support. The treatment of students' consumption expenditures is based on Hermannsson *et al* (2010b) where a

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[10] This point is explored in detail for the HEI sector as a whole in Hermannsson *et al* (2010b) and for individual institutions in Hermannsson *et al* (2010c)

novel approach is applied to identify the additional (exogenous) spending of the student population. This significantly curtails the impact of local students as so much of their income represents a transfer within the local economy (within household transfers, wage income, Scottish Government funded student support) rather than an addition to it. However, there are some elements of local students' incomes that are additional to the local economy. This includes student loans and new commercial credit that students take out to support their term time spending[11].

Based on this methodology, the net injection of consumption spending per student is £1,204 for a Scottish student, £3,554 for an incoming student from the UK and £4,872 for an incoming student from further afield. This methodology implies that the spending impact per Scottish student is lower than for an incoming student. However, as local students are by far the most numerous at Scottish HEIs, in aggregate their impact is greater than for each of the two groups of incoming students. However when added up, incoming students contribute more to the Scottish economy in terms of expenditure impacts than do local students.

Table 5 Net injection of spending into the local economy per student, disaggregated by student origin. Based on Hermannsson et al (2010b).

Location of domicile		Scotland	Rest of the UK	Rest of the World
Gross average student spending £	+	6,230	7187	7187
Income from employment £	-	1,945	1,945	
Within household transfers £	-	453		
Other income £	-	570		
Dissaving £	-	1,073		
Student expenditure supported by Scottish Government funding	-	759		
Spending attributable to new commercial credit £	+	346		
Exogenous average per student spending	=	**1,776**	**5,242**	**7,187**
Direct imports £ (32%)	-	572	1,688	2,315
Net change in final demand per student £	=	**1,204**	**3,554**	**4,872**
Number of students FTE's	x	115,398	22,630	25,737
Estimated net contribution to final demand by student population £ m	=	**138.9**	**80.4**	**125.4**

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[11] For details of how students' incomes are determined see Appendix in Hermannsson *et al* (2010b)

Under these restrictive assumptions, the spending of HEIs supports approximately 22,573 FTE jobs in Scotland or about 1.31% of total employment. On top of that, the consumption impact of students supports approximately 3,600 FTE jobs or about 0.2% of Scottish employment. At minimum, therefore, Scottish HEIs can be seen to support approximately 1.3% of regional economic activity, net of their activities funded from the Scottish Government.

2.3 Main findings

The spending impacts of HEIs have been widely studied, both in Scotland and elsewhere. We have reviewed the standard practice for estimating the impact of HEIs spending and the associated consumption spending of their students. Although estimating these impacts is a relatively straightforward exercise in principle, care must be taken to adapt credible assumptions and appropriate modelling approaches for the task at hand. In particular, we have emphasised how the geographical scope of studies affects the appropriateness of assumptions and approaches. At the local level it is easier to argue for additionality of spending than at a regional level, especially in the case of Scotland where public funding for HEIs is decided at a devolved level. At a national level there is the additional challenge of appropriate modelling approaches, since purely demand driven models cannot capture potential crowding out due to supply side rigidities.

HEIs constitute a significant sector in the Scottish economy, in terms of their direct spending impacts and subsequent knock-on impacts. Using the conventional demand-driven approach, Hermannsson et al (2010b) estimate that Scottish HEIs generate £4 billion output and 55,135 FTE jobs in Scotland. This is 2.28% and 2.76% respectively of the Scottish output and employment totals. However, when assessing the magnitude of that impact care must be taken in determining the additionality of various associated activities, as well as the additionality of their spending depending on the origin of their income. The Scottish Government's block grant imposes a binding budget constraint on government spending in Scotland and therefore changes in Scottish Government funding for Scottish HEIs implies

redistribution within that budget constraint rather than an exogenous spending stimulus.

Acknowledging the budget constraint, Scottish HEIs still have a significant impact at the Scottish level as they draw in their income from a variety of sources. Therefore we conclude that at minimum the spending of HEIs and their students supports about 1.3% of economic activity in Scotland.

This is of course, apart from potentially large supply-side benefits, accruing from increased skills in the labour force, knowledge exchange and other possible effects, which we turn our attention to in the next sections.

3 Labour Market Impacts

This and following chapters discuss the supply side impacts that occur as a result of the activities of HEIs. By supply-side impacts we mean effects that enhance the capacity of the economy to provide products and services, through augmenting technology and the factors of production[12]. The primary focus is on the beneficial supply side impacts of education through augmenting the skills of the labour force (with an emphasis on higher education). As we will see in subsequent discussions, skills can be used as quite a wide term, where education is not only seen as a source of practical skills but as a venue for socialisation and training of meta-skills. Other aspects of HEIs supply side benefits such as technological spillovers, innovation and spatial effects are discussed in Chapter 5 as most of the studies that can provide estimates of these are based on datasets at the local/regional level.

The nexus of the chapter is a review of the numerous studies examining education wage premia and the monetary returns to education. We start by analysing the basic approach and how estimates of the graduate wage premia

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[12] As discussed in 3.2.2 education not only affects production but also leisure. However, those effects will not be captured directly in output metrics (such as discussed in 5.1 and 5.3) but are registered only in as far as they contribute indirectly to production capacity. However, in principle, such effects can be valued in cost-benefit analyses (see 5.2).

have evolved over time. Section 3.1 presents a review of recent Scottish work. Subsequent sections analyse how returns can vary with the quality and subject of education and what recent trends can be observed in the returns to education. Long standing debates on the challenges involved in estimating the returns to education and how the results should be interpreted are examined in section 3.5. The topic of 'overeducation' is examined in 3.6 before a brief overview of the expansive literature on labour market sorting is provided in 3.7.

An extensive micro literature documents the rates of return to education at various levels of schooling, in different countries at different times. Sometimes further disaggregating the results by characteristics such as gender, discipline and social background. These studies reveal a clear correlation between education and income and provide rich information about the nature of this relationship. Due to an obvious inability to conduct controlled experiments in the field, verifying the causality between education and income has proven difficult. More recently a wealth of papers has been published utilising more advanced approaches, i.e. instrument variables, controlling for fixed effects (twin studies) and natural experiments, to clarify the issue.

The weight of evidence now sees education affecting income per se and not just as a proxy for unobserved ability. A further question we need to raise is to what extent the income benefits of education reflect underlying productivity improvements. Human capital theory would suggest education enhances human capital which in turn improves productivity. However an alternative explanation is derived from theories on sorting in the labour market, either based on signalling or screening, which suggest increased income is driven by the labour market signal provided by holding a degree and does not necessarily reflect real productivity gains through enhanced human capital. In this genre of models it is assumed that employers have limited ability to estimate a priori (at least in the short run) the potential of their job candidates. Instead they rely on education credentials as a signal of these abilities they cannot measure directly. The 'value' of the signal, that is

the wage premia gained by acquiring it, is then determined by the average job performance of those already employed with the same credentials.

As pointed out, even by advocates of signalling theory, there is a tendency to over interpret the implication of the theory by suggesting that under signalling education plays no role in raising an individual's productivity. "Such views are stereotypical and even the most vociferous proponents of sorting would concede the productivity-augmenting power of education", (Brown & Sessions, 2004, pp. 58). Recently, therefore, empirical efforts have been directed towards estimating the extent to which signalling determines income – suggesting a role for signalling, especially under shorter time horizons, but of a limited magnitude.

A further limitation of the graduate wage premia approach is that it captures only the private returns. However, there are both external feedbacks on economic output and non-market outcomes which have subsequent implications for the economy, environment, quality of life and development, although they are harder to quantify. For example, McMahon (2004) develops a taxonomy of 18 distinctive external impacts of education, which will be discussed in the section on wider impacts of HEIs.

The remainder of this sub-section reviews how the return to education is estimated and what insights are gained from examining the correlation between income and education. Furthermore we examine the long standing debate on the causal link between education and income and to what extent we can expect income to reflect true productivity.

Numerous reviews of the microeconomic literature on returns to education have been published. Recent examples include Checchi (2006), Blundell et al (2005), Psacharopoulos & Patrinos (2004, 2002), Harmon et al (2003) and Krueger & Lindahl (2001). From the outset the unconventional terminology of this literature should be noted: private returns are defined as the wage premia attributable to additional education over the private opportunity cost of that education; social returns constitute the direct private benefits as a return on both public and private costs, thereby ignoring any public benefits.

By these measures social returns are always lower then private return. Psacharopoulos & Patrions (2004) point out the historical reason for exclusion of social benefits as the lack of available data to quantify these. To clarify they suggest referring to the latter as narrow social returns but as broad social returns when public benefits are included in the calculation.

Estimating the rate of return to education draws on the same principles as used for calculating the rate of return to any investment: a rate of discount (r) is found that equalises the present value of outlays to the present value of incomes. In all these cases the rate of return to education is the value of r for which:

Private returns:
$$\sum_{t=1}^{42}\frac{(W_u-W_s)_t}{(1+r)^t}=\sum_{t=1}^{5}(W_s+C_{ud})_t(1+r)^t$$

Narrow social returns:
$$\sum_{t=1}^{42}\frac{(W_u-W_s)_t}{(1+r)^t}=\sum_{t=1}^{5}(W_s+C_{ud}+C_{up})_t(1+r)^t$$

Broad social returns:
$$\sum_{t=1}^{42}\frac{(W_u-W_s)_t+(E_u-E_s)_t}{(1+r)^t}=\sum_{t=1}^{5}(W_s+C_{ud}+C_{up})_t(1+r)^t$$

where W_u and W_s are the earnings of university and secondary school graduates and 42 the duration of working life after graduation, 5 is the length of the university cycle C_{ud} is the direct cost of attending university and C_{up} is the public cost of providing university education and E_u and E_s are the average external benefits of a university and secondary school graduate.

This discounting approach (often referred to as the elaborate method) requires detailed information about age-earnings profiles by education level, which is often not available (Psacharopoulos, 1981). In practice therefore, many researchers have resorted to a statistical approach, the fitting of Mincer earnings functions (Mincer, 1974). This is the dominant approach for UK studies, typically drawing on repeated cross-section data available in the Family Expenditure Survey, the General Household Survey and the Labour Force Survey (Blundell et al, 2005). An earnings function is estimated, whereby the logarithm of wages ($\ln W_i$) is explained by years of schooling (S_i), years of labour market experience (EX_i) and its square (EX_i^2):

$$\ln W_i = \alpha + \beta S_i + \gamma_i EX_i + \gamma_2 EX^2 + \varepsilon_i$$

This is referred to as a basic Mincerian earning functions and it is often augmented with a variable for the amount of work supplied (Psacharopoulos, 2004). The coefficient on years of schooling can be interpreted as the average private rate of return to one additional year of schooling. As $\beta = (\delta \ln W / \delta S)$ it represents the average proportional increase in wages following one extra year of schooling. In the basic format the function does not distinguish between levels of schooling. To capture the effect of each education stage independently it can be extended with dummy variables for each education stage (Psacharopoulos, 2004).

Typically these micro studies find higher returns to education in lower income countries where education levels are generally lower. This is seen as consistent with the notion of diminishing returns to education, with the return to education falling as the average education levels rise. However, the dynamism of these diminishing returns is more sluggish than might be expected. Rates of return to higher education in the UK have remained broadly stable for the last 15 years (Walker & Zhu, 2008) and have been increasing in the US over the last thirty years (McMahon, 2009). In cross sectional comparison institutional features of the labour market affect the wage premium. Over time, however, it is not only the relative supply of graduates that determines the wage premium but also demand. Demand for skilled labour has been gradually increasing hitherto – a fact typically attributed to technical change[13]. Goldin & Katz (2007) investigate the level of the graduate wage premium in the US over the 115 year period from 1890 to 2005, using estimates of supply and demand for graduate labour. They find that the graduate wage premium (vis-á-vis high school dropouts) was at a very similar value, around 65% at the beginning of the period as the end, albeit with intermittent fluctuations. Two troughs can be identified, around 1950 when it fell close to 30% and again in 1980 when it fell slightly below 40%.

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[13] For a review see: Machin (2004) and Acemoglu (2002).

Figure 1 US College and High School graduate wage premiums 1915 to 2005. Source: Goldin & Katz (2007), Figure 1, pp. 32.
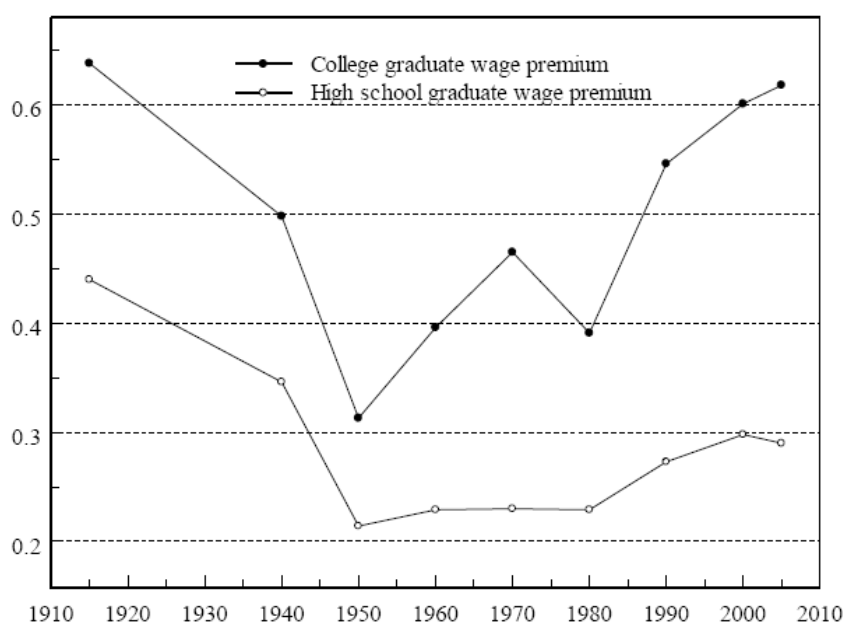
Acemoglu (2002) reviews evidence and theoretical perspectives on the links between technical change and skills premia in the labour market. He draws on economic history to argue that technological change can be skill biased (increasing the need for skilled labour) but can also be skill replacing (decreasing the need for skills). Whereas evidence from the United States in the 20th century suggests that technological change has been skill biased counterexamples are found in 19th century Britain where industrialization made highly skilled artisans redundant as they were substituted by low skill factory workers. He argues that this dual nature of technological change can be understood if it is recognised that the development and use of technology responds to profit incentives. In circumstances where it is profitable to develop and implement technologies which complement low skill workers technological change will tend to be skill replacing, however, when technological advances requiring high skill operators are more profitable technological change will tend to be skill biased.

I suggest that the early nineteenth century was characterized by skill-replacing developments because the increased supply of unskilled workers in the English cities (resulting from migration from rural areas and from

Ireland) made the introduction of these technologies profitable. In contrast, the twentieth century has been characterized by skill-biased technical change because the rapid increase in the supply of skilled workers has induced the development of skill-complementary technologies (Acemoglu, 2002, pp. 9).

Furthermore, Acemoglu (2002) argues that the acceleration of skill biased technical change is likely to have been a response to the increased supply of skilled workers. However, that point does not have to imply that the overall rate of technical change has increased, but rather that the types of technologies being developed has shifted.

In addition to technical change, the graduate wage premium has been affected by other factors such as changes in labour market structure, i.e. union power, changes in firm organisation and increasing trade between high skill and low skill countries. McMahon (2009) points out that the rise in the graduate wage premium in the US since 1980 can partially be explained by negative real term growth in the wages of unskilled labour. He attributes this fact to a relative abundance of unskilled labour, in part due to an effective increase in the supply of unskilled labour through increased integration of developing countries in the World economy. Furthermore, he suggests that automation has replaced many low-skill jobs and therefore reduced the demand for uneducated workers. Acemoglu (2002) suggests that all of these factors have amplified the effect of technical change upon the graduate wage premia and are likely causes for the real wage decline of low skill workers observed in the US.

3.1 Returns to education in Scotland

Recent and comprehensive studies (funded with grants from the Scottish Funding Council) document the return to different levels of education in Scotland. Furthermore for the United Kingdom as a whole there is further evidence on the returns to higher education by subject and on the robustness of returns estimates by examining identical twin pairs. Therefore it can be argued that a rich evidence base exists, which this sub-sections aims to summarise in a useful way.

Houston et al (2002) draw on a sample of 15,283 working age individuals resident in Scotland from the 1999 and 2000 labour force surveys to estimate the likelihood of employment and resulting wage rate by education level. Firstly they use a multinomial logit model to estimate how qualifications impact the likelihood of being in employment. They found that HE graduates have a higher probability of being in work than the FE qualified. For FE diploma holders the evidence was ambiguous with men being less likely to be employed than their counterparts possessing Highers only, whereas women were more likely to be employed. Completion of Highers however significantly increases the likelihood of employment. By fitting an earnings function to their data Houston et al (2002) estimate the wage premium of HE graduates over those with no qualifications at 51.33%, while the wage premium for Further Education and Highers was estimated at 17.68% and 15.25% respectively.

Table 6 Wage premia from Highest Qualification Models source: Houston et al (2002) pp. 32

	All	Next lower level	Males	Next lower level	Females	Next lower level
He Level	51.33%	33.65%	57.93%	41.76%	47.98%	29.78%
FE Level	17.68%	2.43%	16.17%	1.26%	18.20%	3.83%
Highers	15.25%	15.25%	14.91%	14.91%	14.37%	14.37%

Gasteen & Houston (2003) used an identical sample from the Labour Force Survey, as Houston et al (2002), to examine whether there was a wage differential among HE and FE graduates depending on their education route. Based on five levels of qualifications[14] they derived 32 ways in which an individual could combine these in education pathways. They reported that due to the high degree of variability within each pathway statistically significant results could not be obtained, suggesting that returns are driven

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[14] 'O' Standard Grades, Highers, Other FE qualifications, HNC/HND FE qualifications and HE degree.

by the individuals' own characteristics rather than different routes. However, they conclude that: "While none of the pathways proved to be statistically different from the others, non-standard education routes to both HNC/Ds and degrees (i.e. those that lacked lower level, formal school qualifications) were generally found to appear towards the lower end of the wage premia distributions. 'Second chance' educational routes may therefore not yield equivalent returns to orthodox HNC/D or degree routes" (Gasteen & Houston, 2003, pp. 8).

Bell & Sarajevs (2004) use both the National Child Development Survey (NCDS) and the Labour Force Survey to compare returns to education in Scotland and the rest of Great Britain (RGB). The NCDS is a longitudinal survey of a sample of Britons born in March 1958, which has been updated regularly and includes rich information about individual characteristics which allows detailed controls to be applied. The LFS on the other hand contains less detail and is not longitudinal but allows inference to be built on larger samples. Where comparable analyses could be performed on both datasets they produced broadly similar findings. The authors present 3 main findings from their results: Firstly, conditional on applied controls, the weekly wage of full time employees was not found to differ between those educated in Scotland and the Rest of Great Britain (RGB); those educated in Scotland who had obtained no formal qualifications were found to be worse off than their RGB counterparts and the marginal return to education was found to be lower in Scotland than the RGB. Furthermore they find that controls for both cognitive (literacy, numeracy) and non-cognitive skills (soft skill metrics) significantly impact labour market performance. The authors highlight this finding and argue, with reference to Heckman (2000) that since non-cognitive skills are more malleable than cognitive skills "policy interventions to influence these may yield a higher net social return than investment in formal education" (Bell & Sarajevs, 2004, pp. 4)[15]. However they treat non-cognitive (affective) skills as exogenous to schooling and thereby do not recognise that to a significant extent the graduate wage premia is driven by non-cognitive skills, partially developed through

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[15] See also discussion in Bell & Sarajev, 2004, pp. 9, column 1.

socialisation in institutions of formal education. Using controls for non-cognitive skills can therefore pick up some of the benefits from schooling.

Walker & Zhu (2007a) pool ten years of data from the Labour Force Surveys in 1996-2005 to construct a large enough sample to estimate wage premias by qualification level at a regional level within Great Britain. Their broad findings are in line with other work in the field; qualifications increase the likelihood of employment and more qualified workers generally earn higher wages. For both men and women they find the value of qualifications broadly similar to that experienced across Great Britain.

Table 7 Hourly wage premium of vocational and academic qualifications. Source: Walker & Zhu (2007b)

Vocational wage premium	Male	Male [cumulative]	Female	Female [Cumulative]
None	Base	Base	Base	Base
Level 1	9%	9%	11%	11%
Level 2	7%	16%	9%	20%
Level 3	19%	35%	9%	29%
Level 4	17%	52%	23%	52%
Above level 4	30%	82%	29%	81%

Academic wage premium	Male	Male [cumulative]	Female	Female [Cumulative]
None	Base	Base	Base	Base
Level 1	17%	17%	18%	18%
Level 2	12%	29%	12%	30%
Level 3	19%	48%	13%	43%
Level 4	31%	79%	34%	77%
Above level 4	12%	91%	13%	90%

Table 8 Examples of SVQ/NVQ Levels. Source: Walker & Zhu (2007b)

SVQ/NVQ level	Academic qualification	Vocations qualification
5	PhD, Masters degree	PGCE, Non-masters postgraduate quals
4	Undergraduate degree	HNC/HND
3	2+ A-levels/3+Highers	OND, ONC
2	5+ GCSEs at A-C, 'O' Grades, Credit Standard Grade	GSVQ/NVQ intermediate, RSA diploma
1	<5 GCSE, General Standard Grade	BTEC, SCOTVEC first or general cert

As is evident from the tables above, Walker & Zhu (2007a, 2007b) find strong wage premia effects for both vocational and academic qualifications in the Scottish labour market. Overall the academic qualifications yield a higher wage premia but what is also noteworthy is how the structure of the wage premia by levels of qualification differs between vocational and academic qualifications. The marginal effect of low level vocational qualifications is modest vis-á-vis low level academic qualifications, whereas the additional wage premia gained by postgraduate study is modest. From a human capital perspective these findings may not be surprising if the amount of schooling behind these education levels is examined. For example a Level 4 undergraduate degree typically takes four academic years to complete, whereas a common duration for masters degrees in Scotland is 12 months[16] so the wage premia earned per effective duration of study is broadly similar between Level 4 and Level 5.

In addition Walker & Zhu (2007a, 2007b) undertook some further analysis to verify their findings. To test the possibility that the wage premia does not reflect education but simply unobserved attributes of the workers they draw on a natural experiment, the raising of the national school leaving age in the 1970's. Since these institutional changes added a year of schooling, which the individuals did not choose themselves, it can be used to estimate the causal effect of education upon earnings without picking up effects of

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[16] Presumably respondendts with masters degrees dominate the sample as the PhD graduates are far less common.

individual characteristics[17]. Applying both instrument variable and a Heckmann two-step selection model, they conclude that estimates broadly confirm their OLS results for Scotland as well as England and Wales.

3.1.1 Is Scotland reaching further and further into the ability barrel?

A somewhat common perception is that the democratisation of higher education has gone so far that a greater share of the population is now graduating from higher education than is economically sensible. This has primarily two manifestations. That there is an oversupply of graduates leading to a scramble for the few graduate jobs available with subsequent unemployment and fall in wages. Secondly, that the increases in HE attainment has driven HEIs to accept candidates ever less capable of participating in higher education. Presumably there are many ways of addressing if this observation is correct and if it is a concern via pedagogic, sociological or other approaches. Here we will attempt to address this based on the evidence for labour market outcomes in Scotland presented in the previous section.

What has been repeatedly confirmed in Scottish and UK studies is that despite the increase in higher education attainment the graduate wage premium has not changed significantly. Furthermore, anecdotal evidence on graduate unemployment (which typically follows cyclical downturns) is not backed up by the data as Scottish studies reveal that the likelihood of employment steadily rises with level of education attained. Even if there may be a portion of the graduate population that is employed in professions traditionally not regarded as graduate they are awarded for their education with a significant wage premia – albeit not of the same magnitude as traditional professional employment. Therefore the notion that graduate labour is in oversupply is not backed up by evidence.

On the question of student and graduate quality, a university professor that does not wish for a more eager and hard working student body is hard to

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[17] For details of methodology see Walker & Zhu, 2007a, pp 46-48.

find. In the labour market, graduates are on average as successful as they have ever been. However, as the work of Walker & Zhu (2008) suggests, it may well be that the dispersion of graduate quality has increased. Based on the empirical evidence they hypothesise three developments have occurred simultaneously. Graduate supply has increased; at least partially that increase has been met by an intake of less able students, while at the same time demand for graduate labour has increased. This manifests itself in a stable average wage premia but a wider dispersion. High quality graduates are now earning more than their counterparts of a previous generation. The average graduate is now of a slightly lesser quality than before, but due to increased demand maintain the same wage premia and the tail end of the distribution earns a positive wage premia but less than the average. In short, even if it may be the case that a proportion of HE graduates are of lesser quality than in previous generations it does not seem to be a serious problem. They still earn a substantial wage premia and are better off than they would have been with lesser education.

Whether education attainment should be increased and at what education levels is a complex matter and not what this review set out to address. However, reviewing the existing evidence for Scotland and the worldwide literature provides some qualitative points. Perhaps most importantly, Scottish evidence suggests increasing attainment offers benefits at all levels[18]. Theory suggests marginal students can be either 'better' or 'worse' depending on whether ability bias or cost bias dominates. However, based on observations where policy interventions have increased the uptake of education by students from disadvantaged background, return to education has been found to be higher for students for those groups. For a discussion of this point see Krueger & Lindahl (2001, pp. 1106-1107).

Recently it has been argued that education policy needs to consider what might be seen as a Human Capital Supply Chain view. Heckman & Carneiro (2005) draw on pedagogic science and present an argument along two

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[18] Apart from individual benefits, it might be the case that social benefits are best served by increasing completion rates at the bottom end of the qualification scale.

dimensions. Firstly, that education and job market performance does not only depend on cognitive skills but also wide ranging non-cognitive skills (these constitute a wide range from personality traits like conscientiousness to soft skills like social skills). Secondly, (drawing on longitudinal data) that ability begets ability over time. This is based on American observations where children who were found to be equally 'smart' based on test scores at early age diverged over time – with those from lesser social circumstances typically falling behind. As a policy conclusion they argue that in order to increase university attainment earlier education levels need to be strengthened creating more high ability individuals that will pursue higher education. Furthermore, they argue policy interventions should not necessarily be focussed on education institutions but may need to enter the realm of social and family policies to be effective.

The policy conclusion reached by Heckman & Carneiro (2005) is that in order to increase HE attainment, policies should not focus so much on enabling secondary school graduates to enrol in HEIs (as is arguably a mainstream view) but to address the conditions of lesser performers at early stages of schooling. In their view, as ability begets ability, intervening at pre-school and early primary levels could feed up the human capital supply chain with subsequent increases in higher education attainment as more high ability students come out of the school system. Furthermore, it could be added, that ceteris paribus one should expect the average quality of the HEIs potential intake to grow over time through well documented social feedbacks, i.e. the next generations parents will be more educated than the current's and so on.

In short, higher education attainment levels in Scotland should not be seen as a cause for alarm. Available observations of the graduate wage premia reveal it as being high and stable over time. Diminishing returns to education cannot be assumed by default, especially over longer time horizons, as the demand for skilled labour changes as well.

3.2 Returns to education and quality

The bulk of the literature examining education quality and graduate outcomes is US based and has focused on links between measures of school quality and either test scores or labour market outcomes. A later development is a proliferation of studies examining the link between higher education quality and labour market outcomes – results of which will be summarised below. However the influential/mainstream US school quality literature inevitably forms a backdrop for any other application, to different geographies and different levels of the education. Therefore we shall very briefly summarise the broad results of that debate. If only to prevent confusion of these two closely related literatures.

A mainstream interpretation of much of the earlier literature was that a higher level of school resources, such as class sizes had little or very limited influence on academic achievement as measured by test scores. Card & Krueger (1996) refer to the conclusions of Hanushek (1986) as an example of an influential survey maintaining this.

> The results are startlingly consistent in finding no strong evidence that teacher-student ratios, teacher education, or teacher experience have an expected positive effect on student achievement. According to the available evidence, one cannot be confident that hiring more educated teachers or having smaller classes will improve student performance. Teacher experience appears only marginally stronger in this relationship (Hanushek, 1986, pp. 1162).

This view has come under scrutiny on methodological grounds, where it is argued that negative results have been over weighted. Hedges, Laine & Greenwald (1994) conduct a meta-analysis of the studies surveyed by Hanushek (1986) and find that "Reanalysis with more powerful analytic methods suggests strong support for at least some positive effects of resource inputs and little support for the existence of negative effects", (Hedges et al, 1994, p.15). Furthermore, studies that focus on the links between school resources and educational attainment and future earnings provide stronger results. However Card & Krueger (1996) conclude that it

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would be an over statement to say that the literature proved beyond a doubt that resources matter as the "available evidence is not unambiguous or ubiquitous, and it suffers from all the standard criticisms of drawing causal inferences from observational data" (Card & Krueger, 1996, p. 47).

A growing literature, hitherto primarily based on US data, examines the link between earnings and various proxies for university quality (e.g. Dale & Krueger 2002, Black & Smith 2004). As Hussein et al (2009) point out; generally these studies find positive effect of quality proxies on subsequent wages of graduates. However, these studies are not unanimous and there are widely recognised methodological challenges, in particular how to proxy quality and how to control for unobserved ability of the graduates. More recently similar studies have been undertaken outside the US, including several based on UK data (Hussein et al 2009, Chevalier 2009, McGuinnes 2003, Chevalier & Conlon 2003, Belfield & Fielding 2001).

Belfield & Fielding use a survey of the 1985 and 1990 graduate cohorts and find expenditure per student and the student staff ratio affect graduate wages. However, they conclude that resources effects are modest relative to individual effects, such that factors relating to each individual explain about 10 to 15 times more of the wage variation than do institutional resource effects. The upper bound of their estimate is that a £1,000 increase in per undergraduate student per annum can result in a 1.8% increase in wages after graduation (with average spending per undergraduate per annum in the study at £6,218)[19].

McGuinnes (2005) uses a small (and potentially unrepresentative) sample of all Northern Ireland domiciled students who entered higher education in

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[19] Although the results appear quite modest they do suggest there might be a positive rate of return to quality, which could be a competive choice vís-a-vís other investment options. A back of an envelope calculation assuming a fixed age/earnings profile, 4 years of study, 40 years of labour market participation after graduation and a graduate wage of £20,000 p.a., yields a return of 7.6%. Furthermore, returns might vary among individuals, so that for some individuals paying more in tuition fees might make good business sense at the margin.

1991-92 surveyed in 1999 (with potential work experience of 2-4 years). Of an effective sample of 837 just over 60% studied at Northern-Irish institutions, while the majority of the rest opted for institutions in the rest of the UK. He finds that that teaching assessments score has no effect on wages or overeducation[20]. However when using the Guardian research score as indicator of quality there is a positive impact on wages, but only for the students with the lowest grades.

Chevalier & Conlon (2003) use propensity score matching to control for individual ability effects based on three cohorts of graduates (1985, 1990 and 1995). They group the institutions by prestige into Russel Group, old universities and modern universities and find a 1% to 6% premium for attending a Russel Group institution over a modern university. They conclude that as the financial benefit of attending a Russel Group university is neither dependent on previous academic achievement nor parental background, these universities level the playing field internally among their students. However, they point out that heterogeneity between Russel Group institutions is large, with returns varying up to 10%.

Recent work in progress (Hussein et al 2009, Chevalier 2009) broadly corroborates the findings by Chevalier & Conlon (2003) with estimates of wage premium to institutional quality[21] ranging from approximately 2% to 6%. Based on findings using a subject level quality indicator Chevalier (2009) argues that the quality-wage effect is non-liner, with most of it occurring at the edges of the quality distribution. Most benefits are reaped from not going to an HEI at the very bottom of the quality ranking or going to those few institutions at the highest end.

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[20] Whether they held what is perceived to be a graduate-job or not.

[21] Chvelaier (2009) uses the subject level quality indicator published annually by the Guardian newpspaper. The Guardian teaching quality score is an index containing six dimensions, i.e. teaching inspection, spending per student, staff/student ratio, job prospects, value added (link between entry score and graduation mark) and entry score.

3.3 Returns to education by subject

A perennial question is whether the returns to education differ between subjects. Strong views on this can be found in popular perception but a quantitative confirmation of differing returns to subjects is harder to provide. The bottleneck for statistical estimates is the samples available. When searching for detailed patterns the precision of the statistical results is decreased. This is probably why no individual subject level results are found in Scottish studies because when region and subject specific effects are analysed simultaneously, the sample is too small to provide meaningful results. Blundell et al (2000) report some individual subject findings at the UK level based on the National Child Development Survey. For most subjects differences were found to be insignificant. For men a significant negative effect was found for biology, chemistry, environmental sciences and geography. However, for women the pattern is somewhat different, as they were found to earn higher returns in education, economics, accountancy and law, and an 'other social sciences' category. To control for the quality of the student intake into the subjects they included A-level results in their regressions. Inclusion of this variable did not alter the results.

O'Leary & Sloan (2005) analyse returns to higher education degree subjects. To obtain a sufficiently large sample for this breakdown they pool observations from the Labour Force Survey from 1994 to 2002. Examining men, for undergraduate degrees they find the lowest wage premia (in effect negative) accrues to holders of arts degrees, -2.5% vís-a-vís those who have completed two A-levels. Based on an earnings index where earnings of Arts degree holders were fixed at 100 the highest wage premias accrue to accountancy, medicine, engineering and maths and computing (>130). Next in line (130>125) are law, business and finance and education, followed by geography and architecture (125>120). Lower wage premias (120>110) are earned in nursing, biology, psychology, other social sciences, English, history and languages. Interestingly no subject falls in the range between 100 and 110, implying there is a significant jump in wage premia from holding an arts degree to the next tier above.

Table 9 Index number of returns to narrow first degree subjects for men and women: LFS 1994Q1-2002Q4. Source: O'Leary & Sloane (2005) Tables 7 & 8, pp. 82-83.

	Men				Women			
	n	index no	SE	rank	n	index no	SE	rank
Medicine and related	336	132.06+	0.0474	5	597	127.52+	0.0305	2
Nursing	25	114.39+	0.0358	20	220	113.93+	0.0301	9
Sciences	1327	125.22+	0.0335	12	696	106.13+	0.0261	17
Biology	130	115.87+	0.0482	18	188	101.6	0.0356	22
Psychology	125	118.66+	0.0454	17	303	101.98	0.0262	21
Geography	298	123.42+	0.0477	13	261	104.34	0.0398	19
Maths and computing	975	137.23+	0.031	3	346	118.10+	0.037	7
Engineering and technology	650	131.85+	0.0313	6	97	113.54+	0.0556	12
Civil engineering	411	129.25+	0.0325	7	24	113.7	0.095	11
Mechanical engineering	524	133.71+	0.0339	4	19	113.84+	0.0286	10
Electrical engineering	682	140.73+	0.0313	2	28	119.04+	0.0233	5
Architecture and related	410	120.97+	0.0288	15	83	118.70+	0.037	6
Social sciences	132	114.20+	0.0451	21	286	113.45+	0.0313	13
Sociology	126	110.83+	0.0394	24	269	106.50+	0.0292	16
Politics	118	115.70+	0.0477	19	72	99.09	0.0508	25
Law	315	128.04+	0.041	9	302	123.97+	0.0372	3
Business and financial studies	827	126.53+	0.0266	11	691	114.34+	0.0234	8
Economics	430	128.57+	0.0445	8	110	109.68++	0.0508	14
Accountancy	193	142.15+	0.047	1	95	137.12+	0.0504	1
Arts	804	100	n.a.	25	1091	100	n.a.	24
English	213	110.84+	0.0423	23	468	106.65+	0.0322	15
History	306	111.69+	0.041	22	318	110.95	0.0365	23
Languages	110	119.22+	0.054	16	291	103.3	0.0386	20
Education	490	126.73+	0.0316	10	1283	122.40+	0.0223	4
Combined	2529	122.41+	0.0241	14	3135	105.58+	0.0187	18

Notes: All returns are measured relative to an arts degree (base = 100); return to an arts degree relative to 2+ A-levels is -3.25% (men) and 19.29% (women); + (++) denotes a statistically significant difference in returns at the 95% (90%) confidence level; na denotes not applicable

A different pattern emerges for women. Compared to those who have completed two A-levels women earn a significant wage premia on arts degrees (19.29%). Again, based on an earnings index where holders of arts degrees are set at 100, fewer of the subjects were found to earn a statistically significant wage premia vís-á-vís an arts degree. Of statistically significant differences the biggest wage premia for women is earned in accountancy (137). The next tier (130>120) is composed of medicine, law and education. Many subjects fall on the range between 120 and 110, including nursing, maths and computing, engineering, architecture and business and financial studies. In the range closest to arts (110>100 we find sciences, sociology, economics and English.

O'Leary & Sloan (2005) base the disaggregation of the subjects on what was feasible with the available data, with popular fields allowing more disaggregation due to larger samples. In their regressions they include a control for the quality of the student intake[22]. This affects the final ranking of the subjects; the wage premia is downwards suppressed if it has a relatively high quality student intake, but inflated (in relative terms) if the student intake is of a relatively low quality.

3.4 Recent trends in returns to education

Another burning question is if recent increases in higher education attainment have led to a fall in the wage premia earned by graduates. In a UK or Scottish context these studies are based on the labour force survey. Developments over time are based on different samples so that unless trends are quite distinct they are difficult to confirm statistically. Walker & Zhu (2008) point out that at a UK level, although the average return to higher education has remained stable the distribution has widened with increased attendance, where higher ability people are earning further beyond the average and lower ability people are falling farther behind the average. They argue that this might be the joint effect of increasing demand for skilled workers and growing heterogeneity in the HEIs student intake. They argue that strong candidates (high unobserved abilities) are earning a greater wage premium than people of similar abilities in previous generations. However, the number of graduates with relatively lesser abilities has increased and these individuals are earning a below average wage premia.

Some work in progress argues for falling wage premias. See for example McGuinnes & Bennet (2005). However, these are subtle effects, which might as well be coincidental. Consistency over a longer term is needed to ascertain that there is in fact a trend of falling graduate wage premia.

3.5 Potential estimation bias

An obvious weakness of the link drawn between education and earnings is that it cannot be verified by means of a controlled experiment, where

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[22] Leslie's degree acceptance quality variable see: O'Leary & Sloan, 2005, p. 77.

randomly selected individuals would be given different education treatments and their labour market outcomes subsequently compared. Instead we have to rely on analyses of actual observation.

Various adjustments to the basic specification (presented at the beginning of the chapter) have been used in the literature to identify biases in estimates of the rates of return to education. These include adjustment for the anticipated growth in earnings, mortality, unemployment, taxes and innate ability. Authors of various recent surveys (Checchi 2006, Psacharopoulos 2004, Bonjour et al 2003, Krueger & Lindhahl 2001) have pointed out, following Card (1999), that application of various adjustments has led to the conclusion that the pluses and minuses effectively cancel so that the end result is a net benefit almost equal to the unadjusted one. Therefore the use of unadjusted returns has become prevalent. In the following paragraphs we will examine the sources of these biases and how they can exert both a positive and negative bias on estimates of the returns to education. Furthermore, a brief summary will be made of a wave of recent papers applying novel approaches which underpin the emerging consensus.

In his survey Checchi (2006) identifies three types of weaknesses of the estimated returns to education which could bias the results: omitted variables, measurement error and heterogeneity of returns in the population.

The case of omitted variables can apply when the researcher is unable to control for characteristics that might raise earnings independently of education, such as family background or individual ability. "A typical example is by unobservable ability: more talented persons achieve more education because it is easier for them to do so, and at the same time they are more productive when working" (Checchi, 2006, pp. 201). The sign of the bias is ambiguous. It could be positive since more intelligent and disciplined people also perform better as students, thus achieving longer schooling. However the bias could also be negative if better endowed individuals face a higher opportunity cost of schooling and may therefore leave education earlier. Further ambiguity stems from considering the fact that parents may take decisions on educational investment. On the one hand,

they may do so on basis of efficiency where more is invested in abler individuals, which should produce a positive bias. On the other, they may be driven by equity considerations where more is invested in less able individuals to compensate for their shortcomings result in a negative bias.[23]

Measurement errors are a second source of bias. It has been observed that self reported schooling is not completely accurate and that the measurement errors do not cancel out as the least educated cannot underreport and the most educated cannot over report. "Research in the U.S. over the past three decades has concluded that the reliability of self reported schooling is 85-90 percent (Angrist and Krueger (1999, Table 9)), implying that the downward bias is on the order of 10-15 percent – enough to offset a modest upward ability bias" (Card, 2001, pp. 1135).

The third source of bias stems from the heterogeneity of the coefficient to be estimated in the population. Card (1995) points to two potential sources of the heterogeneity – ability bias and cost bias. The first is driven by the fact that differences in abilities result in difference in productivity so that more able individuals can expect a higher payback for any level of education achieved. The second originates from financial market imperfections, where people of different family backgrounds face different marginal cost in acquiring education, so that poor families face higher cost.

> The consequence of both distortions is that the subset of the population with low educational attainment will be composed of individuals with lower returns (less able) and by individuals facing higher costs (poorer backgrounds). Since the underlying model implies that each individual will optimally select the amount of education that will equate his/her expected returns to his/her marginal cost, the population estimate of the return on education will depend on sub-group composition. If the group of less able individuals prevails, we observe a positive correlation between education and error component ε in the wage function, and therefore the OLS estimate will be upwardly biased. Otherwise when the group of individuals

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[23] For details see Checchi (2006) pp. 201-202.

from poorer families prevails, the opposite situation will occur, and we will observe a downward bias (Checchi, 2006, pp. 202-203).

3.5.1 Twin studies

Although the returns to education have been systematically studied for over 40 years, there have always been difficulties in determining to what extent the observed wage premia is reflecting the treatment effects of education and to what extent social circumstances and individual ability. More recent publications describe research where new approaches have been utilised, which support the notion, widely held by proponents of human capital theory, that there is indeed a treatment effect from schooling as such, even when individual abilities and circumstance have been allowed for. The most prominent of these are studies of samples of identical twins. Because the twins share biological and social backgrounds analysing variation within twin-pairs controls for the fixed effects of genetics and the home, which is seen as (at least partial) controls for individual ability bias.

> There is wide agreement that identical twins studies offer probably the best basis for estimating the pure returns to education since they provide highly controlled conditions for the identical abilities and family backgrounds of monozygotic twins (McMahon, 2009, p. 332).

McMahon (2009) summarises US studies utilising within twin-pairs differences in earnings and education to estimate 'net-ability bias' in estimates of return to education. He points out these studies have found evidence of significant ability bias, but that these are partially offset by a downward biased measurement error. Early studies found a wide range of estimates for net ability bias but McMahon (2009) argues that in more recent studies, with larger samples and methodological advancement, estimates have converged on a more narrow range from 0.9% to 13.7%[24].

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[24] These are percentage (not percentage point) deviations so that if a graduate wage premia of say 50% were to be revised downwards it would become 49.55% (50/1.009) or 43.97% (50/1.137) for the lower and upper bounds respectively.

Perhaps the most prominent twin study based on data from UK twins is Bonjour et al (2003) who corroborate findings of previous authors that there is indeed an upwards ability bias in estimates for returns to education, but that this is offset by a downwards bias caused by measurement error. They conclude that these roughly cancel out.

3.6 Overeducation

Following the increase in the supply of educated workers in most OECD countries, over the recent decades, a concern, if not a perception, has arisen that the demand for graduate labour (the supply of graduate jobs) might not keep up with supply of graduates. The result would be overeducation in the labour market where ever more graduates have to take on jobs for which their skills exceed the skills required for the job. In this section we will briefly summarise attempts to measure the extent of overeducation and assess what the economic implications of overeducation might be[25]. The broad finding advocated here is that studying changes in overeducation across cross sections or over time can be a useful tool for understanding the state and development of the labour market. However interpreting the level of overeducation is problematic. This is due both to issues about the concept of overeducation and the way it is measured.

Critics have pointed out that even if graduates enter jobs which have traditionally been seen as non-graduate positions, employers may alter the way work is undertaken to utilise the increase in workers skills. A number of such examples are given in McMahon (2009).

> Janitors were normally illiterate early in the history of the United States and the European Union countries, and still are in the poor less developed countries. But in the United States now they are called building custodians, and most have high school and even college degrees. They can do many things in maintaining and protecting buildings that the illiterates before them could not do, can see what needs to be done and do it on their own,

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[25] For more detailed overview of the literature see recent surveys: Battu (2007), McGuinnes (2006).

and have more responsibility and more equipment to operate and maintain. Hence, they are more productive (McMahon, 2009, p. 110).

As Battu et al (2000) point out, this employer behaviour enhances productivity and goes against the notion that there is a set qualification level for doing a particular job.

Undoubtedly there are individuals in the labour market who are significantly over qualified for their work but providing a metric that can give a credible estimate of the level of overeducation is more difficult. There are broadly four approaches to measuring overeducation, two subjective and two objective. These are summarised in McGuinnes (2006). First of the subjective approaches it to ask respondents about the minimum qualification required for their job and then compare these with the acquired qualification of the respondent. The second approach is to simply ask workers whether they are overeducated or not. Harmon et al (2003) are critical of these methods as they are suspect to measurement error. Furthermore, they point out that educational requirements for new workers may exceed those of older workers to compensate for inexperience.

An alternative and more objective measure can be derived from comparing years of education of the worker with the average for the occupation category as a whole. Harmon et al (2003) point out that this approach is often criticized as the choice of classification for the occupation may mix workers in jobs requiring different levels of education depending on the level of detail in the industry classification. The second of the objective approaches is to compare observed qualifications with professional assessments of the required skill level of the occupation such as provided in the Standard Occupational Classifications in the UK or the Dictionary of Occupational Titles in the US (McGuinnes, 2006).

A criticism of both of these objective measures is that the required level of education is typically the minimum required, which may not reflect the education level of those successful in the job (Harmon et al, 2003). Furthermore, Harmon et al (2003) are critical of poor definition of

overeducation in datasets used, which are often based on subjective responses of surveyed workers. They point out that in studies using more comprehensive definitions, such as applying job satisfaction as a proxy for goodness of match, the incidence of overeducation is much reduced and when controls for ability are included overeducation loses its significance altogether.

Returns to education in excess of requirements are significant. A consistent finding in the literature is that overeducated individuals earn more than someone with appropriate qualifications doing the same job, but less than a similarly educated individual doing an appropriate job (McIntosh, 2005). Chevalier (2000) points out that the pay penalty for over education is typically found to increase the greater the extent of overeducation, i.e. the gap between education obtained and education required. Walker & Zhu (2005) estimate the college wage premia (relative to holding 2 A-levels) on recent graduates (25-29 years old) in two periods (1996-1999 and 2000-2003) using the Labour Force Survey. The college wage premium for those holding non-graduate jobs was found as ranging 0%-13%, whilst the range of estimates for those identified as holding graduate jobs was 29%-38%. Some authors have argued that the average masks a more polarised situation where a relatively small proportion of graduates pull the average down by achieving little or no wage premia (Chevalier, 2000).

How does overeducation affect labour market performance? Harmon et al (2003) conclude that where a more comprehensive definition is used (based on job satisfaction) and ability controls are included, the apparent negative effect of overeducation is eliminated. However, when overeducation appears to be genuine, the penalty may be much larger than was first thought.

> This has important implications for the variance in the quality of graduates produced by the higher education system. Firstly, a degree is not sufficient to ensure a graduate job — other complementary skills are expected by graduate employers. Secondly, since genuine overeducation can emerge it is clear that the labour market does not adjust fast enough. A degree of

manpower planning may be required to ensure that particular types of graduate are not produced excessively (Harmon et al, 2003, pp. 149).

Unobserved heterogeneity further complicates overeducation studies. Battu et al (2000) point out that most studies implicitly assume individuals with a given qualification are of the same quality, whereas studies who do allow for heterogeneity have found differing results.

Chevalier (2000) examines the coincidence of overeducation, job satisfaction and returns to education. He argues that 'true', as opposed to 'perceived', overeducation should result in lower wages or lower job satisfaction than those similarly qualified appropriately placed in the job market. Furthermore, he suggests that graduates with similar qualifications are not homogeneous in their endowment of skills and that this variation of talent has led to the over-estimation of overeducation.

Chevalier (2000) draws on a sample of two cohorts of UK graduates, collected by a postal survey, conducted in 1996, of graduates from 30 HEIs covering the range of UK institutions. Firstly respondents were divided into well matched and overeducated based on a pre selected classification of what constitutes a graduate job. The study further sub-divided those considered overeducated based on job classification into 'apparently' and 'genuinely' overeducated. This was done using reported job satisfaction as a proxy for matching – whereby it is implicitly assumed that those who are well matched (but 'apparently' overeducated) are satisfied in their jobs, while those who are 'genuinely' overeducated are less satisfied. He found that the apparently over-qualified group was paid nearly 6% less than well-matched graduates. However, this pay penalty disappears when a measure of ability is introduced. The 'genuinely' overqualified suffered from a pay penalty reaching as high as 33%. Based on this he concludes that 'genuine' over-education appears to be associated with a lack of skills that can explain 30% to 40% of the pay differential. According to this much of the workers picked up in overeducation metrics are modestly affected by their status. However, within that group there is sub-group which fares significantly worse in the

labour market and drives the negative average of those perceived as overeducated based on job classification.

Reviewing the literature it is not entirely clear what overeducation means exactly and from the various different approaches applied a range of estimates can be arrived upon. It is worth asking therefore if it is a worthwhile exercise trying to obtain metrics for some sort of a technical fit between a worker's training and what is perceived to be the appropriate level of training for his job. The output of such an exercise is an intermediate metric, which has to be interpreted carefully in light of methodological challenges. Surely what matters in the end is the final labour market outcome, to what extent workers are being compensated for their training. We know that if the extent of overeducation were on the increase this should be reflected in the average return to education. However, studies applying simultaneously measures of overeducation and the returns to education have found that the return to education in excess of the perceived required level of education for the particular job is positive but less than the return to education up to the required level. Still the approach can be valuable in cross-sectional comparisons. For example Battu & Sloane (2004) study the incidence of overeducation across ethnic groups in Britain. They find that incidence of overeducation is higher among non-white ethnic groups and that these groups receive a lower return to required education, although they do not attempt to explain the causes of the relatively weak labour market results for this group. Thus, there is vindication for overeducation as a valuable and relevant metric when used in comparison, provided that the studies are based on clear methodology and results are carefully interpreted.

3.7 Signalling and screening

An often raised concern is that education may have a value in the labour market not because of the positive effects of formal education upon productivity but for some 'spurious' reasons. Particularly it is stressed that education may act as a signal of ability or other characteristics that employers value but cannot easily observe. In the extreme case, these abilities are unaffected by education altogether. That is to say, education

signals, but does not contribute to, the workers' inherent productivity. As already stressed there is some tendency to over-state, or even dramatize, the role of signalling (see Brown & Sessions, 2004). However, as noted by Harmon et al (2003), there is a fundamental difficulty in unravelling the extent to which education is a signal of existing productivity or truly enhances productivity. This is because both theories suggest that there is a positive correlation between earnings and education, but for very different reasons. As we will see though, progress has been made on the empirical front. This indicates that there is a role for signalling in explaining the returns to education but it is of a modest magnitude. The idea that education is a non-productive signal is rejected but there remain indications that some of the value of education may be in overcoming information problems in the labour market by means of signalling.

Brown and Sessions (2004) refer to the theory which proclaims education 'signals' or 'screens' intrinsic productivity as the 'sorting' hypothesis. Signalling and screening refer to two related genres of models which describe this process from opposite starting points. Signalling models (Spence 1973, Arrow 1973) describe the process from the point of view of the employee obtaining a signal to enhance his labour market performance whilst screening models turn the game around to have employers screening the labour market by setting a required signal their applicants need to obtain (Stiglitz, 1975). The formal models[26] have their origins in well known fields of economic theory on asymmetric information and market imperfections. Their elegance and pedigree undoubtedly enhances the standing of these literatures although empirical results are mixed.

Signalling and screening models can explain the graduate wage premia at a theoretical level. However, even when adopting the extreme assumption that formal education neither enhances graduates cognitive nor affective skills, but merely acts as an elaborate sorting mechanism, the process can still be productive for the overall economy. If it is the case that formal education

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[26] We will not elaborate on the models here, but refer interestes readers to Brown & Sessions (2004) and Checchi (2006).

allows high ability individuals to move from low paying jobs requiring low skills to high paying jobs requiring greater ability, then a signal that improves matching is in itself productive for the overall economy.

Much of the previous literature on asymmetric information, on which the education applications were based, built its examples on cases where a single transaction took place between the buyer and the seller and therefore asymmetric information could be used to the sellers advantage[27]. An employment relationship is continuous however and firms can revise their employment and wage decisions. Even if firms are paying their wages purely on the basis of credentials in the short run, over time they gather their own information about the employee and can change wages, through redundancy or promotion. Therefore under longer time horizons employers should correct for a potential initial effect of signalling. Arrow (1973) acknowledges the need to extend signalling and screening models to include employers learning[28].

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[27] See Akerlof (1970).

[28] Examples of signalling models with employer learning can be found in contemporary work, see for example Lange & Topel (2006). Furthermore, a review of empirical evidence, including studies allowing for learning, see Brown and Sessions (2004).

Figure 2 Informational feedback in the job market. Source: (Spence, 1973, figure 1, pp. 359)
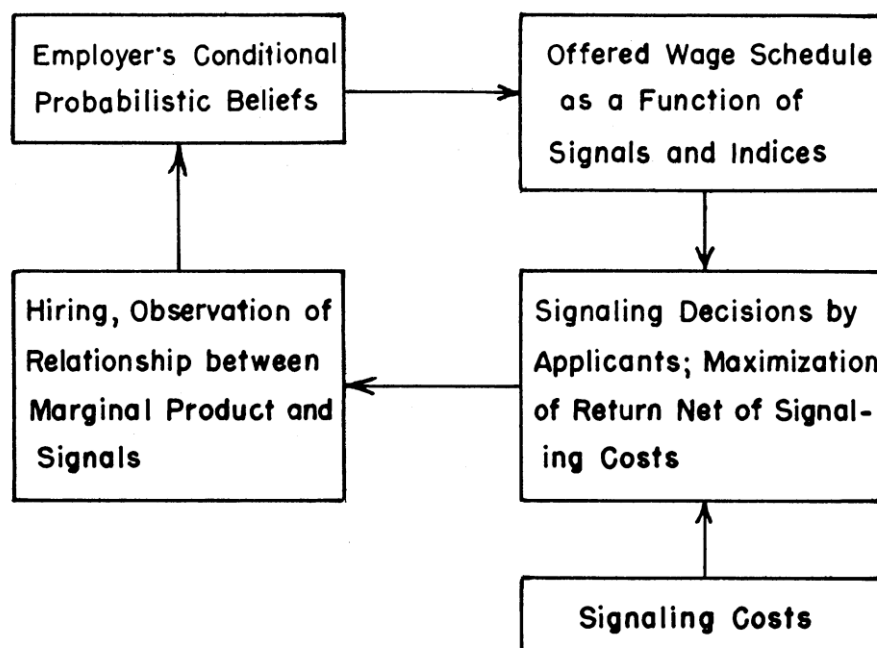
Spence (1973) gives a dynamic description of how signalling might work in that observed labour quality feeds into the value assigned to education signals in the labour market. See Figure 2. Over time therefore, the signal is not static but reflects recent observations of actual labour productivity by education level. A scenario where graduates are overpaid relative to their actual productivity can only occur under quite restrictive assumptions. The quality of new graduates entering the labour force has to be worse than in previous periods and the informational feedback sluggish enough not to adjust the wage premium assigned to a particular education level based on new observations of productivity. Needless to say, such overpayment relative to productivity cannot persist indefinitely. Sooner or later, market participants will discover that the quality of new graduate entrants is not the same as before and adjust the wage premia assigned to the education signal accordingly.

As summarised by Harmon et al (2003)[29] there are various ways of finessing the problem of estimating empirically the extent of signalling in the labour

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[29] For a further review of empirical evidence on sorting hypothese see Brown & Sessions (2004).

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market. One of the ways suggested is to compare the wages of the employed and self-employed[30]. It is argued that education has no value as a signal for the self-employed as individuals know their own productivity and therefore do not need to signal it to themselves. Therefore the difference in returns to education of the self-employed and employees should reflect the value of education as a signal. They find, based on British Household Panel Survey data, that the rates of return to education is quite comparable between the two groups and this implies that the signalling component is quite small. They note a potential problem in that self-employment is not random and that individuals with specific and often unobservable characteristics choose to be self-employed. However their results are robust to estimation methods controlling for unobserved characteristics[31].

Another approach that has been used to distinguish between signalling and productivity is to directly include ability measures in the regressions. However, a difficulty with this method is that the ability measures need to be 'uncontaminated' by the effects of education or they will pick its productivity enhancing effects. "Moreover, the ability measures need to indicate ability to make money rather than ability in an IQ sense. It seems unlikely that any ability measure would be able to satisfy both of these requirements exactly" (Harmon et al, 2003, pp. 134).

Furthermore, Harmon et al (2003) test for signalling by using the longitudinal National Child Development Survey (NCDS), applying controls for ability obtained at ages 7, 11 and 16. They find, as expected, that using ability controls at later ages than 7 confounds the effects of education on ability scores, amplifying the apparent bias. Thus, they conclude that the results at age 7 are probably the most accurate estimates of the extent to

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[30] Some studies compare returns to education in the public and private sectors but these have been found less credible. See Harmon et al (2003) pp. 134.

[31] Harmon et al (2003) use a Heckmann two-step method to control for unobservable differences between the employed and self-employed. For this they draw on information on parents' self-employment and household equity, "both of which are likely to be associated with self-employment but are not likely to be very correlated with current wages" pp. 134.

which education picks up innate ability. At this age they observe a small difference whether ability controls are included or not, which they claim suggests little signalling value to education.

> It is possible that the return to education actually reflects the underlying ability that education signals — in other words education is a signal of inherent productivity of the individual rather than a means to enhance the productivity. Estimates presented here of the signalling component of the returns suggest that the effect is quite small. Based on datasets where direct measures of ability are available the inclusion of ability measures lowers the return to schooling by less than one percentage point. This can be higher where the ability measure is taken at an older age — this is likely to be because, at older ages, the ability measure is almost certainly contaminated by the effect of schooling (Harmon et al, 2003, pp. 149-150).

Further evidence has been sought from the literature based on comparing the returns to education of twins. As twins share the same or similar hereditary traits, financial background, family and peer influence, etc, the comparison should circumvent unobserved variable bias (see 3.5.1.). Little work has been undertaken hitherto to address sorting issues using twin datasets. Brown & Sessions (2004, pp. 91-93) summarise the methodological challenges involved in testing sorting hypotheses using twin data and results so far. Their only reference is to Miller et al (2004) who test a sorting model of education for Australia.

Miller et al (2004) implement an argument set forth by Wise (1995) that if sorting holds the returns to education measured in terms of twin pairs (controlling for ability and social background) should fall over time relative to returns estimated using uncontrolled approaches. This is based on the notion that at time of labour market entry employers have little to judge candidates on and therefore use level of education as a proxy for other personal traits that may be desired in the workplace, i.e. conscientiousness, punctuality, etc. If it is the case that education mostly serves as a signal of innate abilities it should be a weaker explanatory variable for wages of older workers, for whom employers can base their remuneration decisions on more direct information relating to performance (track-record), rather than

younger workers who have less of an employment history and therefore the education signal will have more weight in determining their wage.

Using samples of Australian twins that are split by age group they find results in support of signalling as the returns to education fall with age. However, their study has some methodological shortcomings and has hitherto not been repeated[32]. Miller et al (2004) do not have direct observations of the earnings of the individuals in the sample and therefore have to assign each earnings according to the average of his occupation. Unfortunately they do not disclose how detailed their occupational classification is. Although earnings differences between occupations may be far greater than differences within occupations, this is particularly problematic for twin-samples, which due to self-selection, tend to be disproportionately middle-class. The variation within a pair may already be very limited. So if studying marginal differences in education levels driving earnings differentials, assigning occupational averages may significantly blunt the study. In the future this approach might prove beneficial in establishing a potential value for signalling, however, as of yet these should be seen as tentative results.

Furthermore, even if it is established empirically that the relative strength of education diminishes with age, vís-a-vís other personal characteristics, an alternative explanation might simply be that the value of education as a direct driver of earnings is at its greatest shortly after graduation as then the skills picked up in formal training are 'fresh'. And over time, a wider range of attributes begins to weigh more heavily in determining labour market success, i.e. on job training, etc.

To conclude, as of yet there is not a widespread consensus on how best to reconcile Human Capital and Sorting theories as explanations of graduate wage premia. However, most well informed readers of both views will

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[32] McMahon (2009) summaries twin studies addressing ability bias. Amongst his findings is that whereas early studies found strong qualitatively diverging results, over time as the methodology evolved findings have converged on being qualitatively identical within a much more narrow range than suggested in early work.

conclude that the perceived incompatibility of the two is hyperbole. Indeed, in the International Handbook on the Economics of Education, Brown & Sessions (2004) strongly refute what they see as the common misinterpretation that that sorting implies that education only signals productivity and therefore cannot cause it as such.

> But the pioneering theoretical work of Spence (1973), Arrow (1973) and Stiglitz (1975) only abstracted from an augmenting role for education to clarify their analysis. Indeed Arrow explicitly stated that he was merely applying Occam's Razor while, in his later work, Spence allowed for both a human capital and an informational role (see Spence 2002). (Brown & Sessions, 2004, p. 94).

Therefore, a pure signalling view indicating education as unproductive is completely rejected (see for example Brown & Sessions, 2004). As Arrow (1973) states he did not believe education was unproductive; rather, that a priori assumption was adopted as the extreme view made the modelling process easier.

In any case, as suggested from the outset in Spence (1973), if signals are not backed up by productivity on average this should feed back to the wage premium over time. The value of the signal is based on observed productivity in the labour market. If new graduate cohorts start entering the labour market which are revealed to perform worse than previous cohorts observed productivity will be lower and therefore the value of the signal will be revised downwards. As the empirical evidence reveals returns to education in the UK have been found to be high and stable despite a large increase in higher education attainment. If this results is to be interpreted within a pure signalling view, either innate abilities of the population increased in line with increased attainment or the education signal was 'productive' in the sense that it allowed high-ability individuals to increase their productivity by entering graduate employment.

> Overall, we may conclude this section by stating that education may have a return in the labour market as a signal for unobservable components. However, the empirical evidence in support of this view is not entirely

convincing, and we should limit ourselves to saying that educational credentials convey information to potential employers who do not have the time or ability to assess all self-declared competences." (Checchi, 2006, pp. 185).

The current state of the academic debate about the value of education is not about either seeing education as productivity enhancing or just a signal, but to narrow the range for which education may have a true treatment effect on worker productivity as reflected in wages (apart from any wider impacts of course). The recent application of twin data sets is bringing that objective closer, so that a range for the returns to education can be established that is quite robust to ability bias or potential signalling effect.

3.8 Main findings

This subsection has surveyed the relatively rich microeconometric evidence there is on returns to higher education and graduate wage premias, with particular emphasis on Scotland. Furthermore, we have examined the international literatures, which seek to address the various issues that arise in terms of measuring the returns to education and how those data should be interpreted. Finally, we have attempted to reconcile the empirical findings with the literatures on labour market sorting and overeducation. As intermediate results have been provided with individual topics as needed this summary focuses on the broad findings.

The empirical evidence suggests that there are high returns to education generally, but that these do vary across subjects and institutions to a lesser extent. There is no reason to believe, from evidence that Scotland's performance differs from the RUK (at least in recent past). Similarly, there is no evidence that the return is falling or that marginal returns are less than average (over time). However, see 3.1.1 for a more detailed discussion. In section 6.3 we will demonstrate how the microeconometric evidence can be used to simulate system-wide impacts using Computable General Equilibrium (CGE) modelling.

4 Wider impacts of HEIs

Most of the academic effort hitherto has focused on the more direct impacts of education for the economy; in particular institutional demand-side impacts and private returns to education. However, these may only constitute a part of the overall impact of education for the economy. It has been argued that these wider impacts are quite significant but measurement problems make them difficult to pin down. Many of these impacts only reveal themselves with long time lags and there is an inherent difficulty in disentangling the impact of education per se from the impact of other development. For example, education increases income and socioeconomic advancement, but rising income also has a beneficial impact on many socioeconomic metrics. Determining causation is therefore difficult, as is attributing outcomes to particular actions or developments. Many of these effects are particularly relevant for developing countries, i.e. birth rates, political stability, rule of law. But potentially very significant benefits can be reaped by developed economies i.e. through education's impacts on health and crime rates.

In relation to the topics surveyed in the previous chapters where much has been published over several decades, systematic analysis of the wider impacts of education is an emerging and relatively underdeveloped theme. Much of the analysis of the economic impact of wider effects of education hitherto is found in the pioneering work of McMahon (2004, 2009). These provide a conceptual framework for the wider impacts of education, where impacts are classified using two dimensions, Public-Private and Monetary-Non-Monetary. McMahon (2004, 2009) summarises the literature attempting to estimate a potential value to the wide range of possible effects captured in the framework. This taxonomy is adopted here to guide the review of the wider impacts of education. These benefits occur either as a direct consequence of education or indirectly. Indirect effects refer to any subsequent round impacts of the direct impacts. For example McMahon (2009) explains that education can improve someone's health (a direct effect) and subsequently improved health can increase that persons' income (indirect effect). An element of further complexity in the diagram is that

some indirect benefits are private while most of them are expected to be social.

Figure 3 Total net benefits of education. Source McMahon (2004) Figure 6.1, p. 215.

Figure 6.1   Total net benefits of education
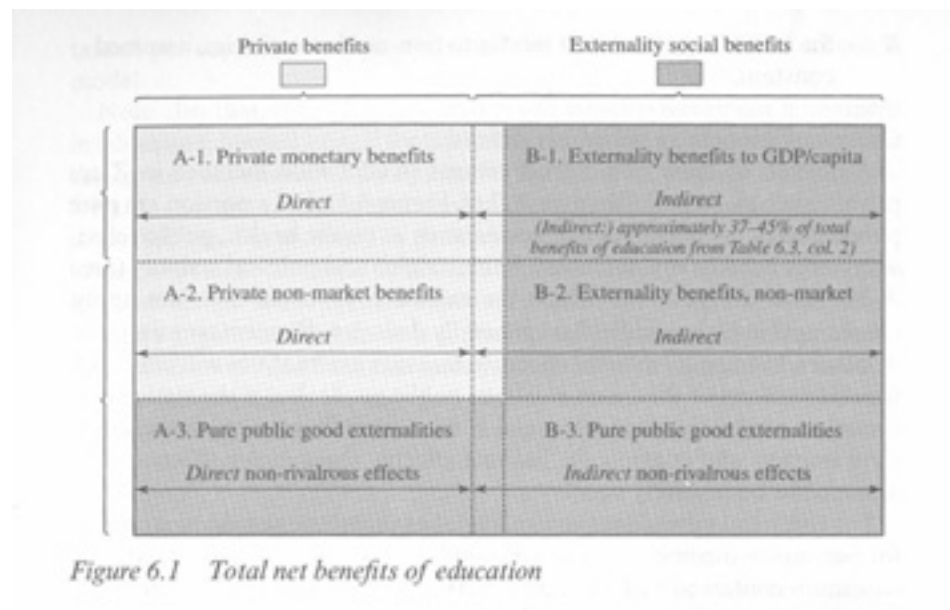
Before examining valuation of these effects it is useful to take a look at the individual sectors of the model and what they capture.

- A-1. Private monetary benefits (direct): These are the impacts of higher earnings from education as described by the returns to education literature summarised in 3.1.

- A-2. Private non-market benefits (direct): These include various non-monetary benefits that accrue to the educated individual himself. Probably the most important of these is improved health, but a range of effects have been explored in the literature, i.e. more successful marriages and improved happiness. For an overview see Oreopoulos & Salvanes (2009). These effects are strongly correlated with income, which is typically controlled for.

- B-1. Externality benefits for GDP/capita (indirect): Externalities that feed back to economic growth, especially over longer time horizons, i.e. effects via more investment in physical capital, more investment in education, adoption of technology, improved R&D & innovation, slower population (particularly relevant for LDE's).

- B-2. Externality benefits, non-market (indirect): These are non-monetary benefits that are captured at a social level as an indirect

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impact of the level of education in the community. These are distinct from B-1 in that they are not captured in measures of economic output but may improve other development indicators. This category would include education's contributions to various types of social advancement, such as the quality of culture or the rule of law, as reflected in quality of life metrics, for example happiness scales (independent of the effects of income on the same metrics to avoid double counting).

- A-3 & B-3. Pure public good externalities (direct and indirect non-rivalrous effects): A non-rivalrous externality is one whose value is not diminished the more people partake of it. An example would be an improvement in human rights. McMahon (2004) lists 13 examples of effects that contribute to non-market aspects of economic development and are non-rivalrous (see Table 6.1, pp. 218). These include improvements in public health, crime rates, civic institutions, environment, poverty reduction and less inequality. Many of these are seen as particularly relevant at earlier stages of economic development. As before the distinction between direct and indirect impacts is made in such a way that if education levels directly contribute to the externality it is considered a direct effects, whereas if some of the secondary impacts of education contribute to the externality then the linkage is considered indirect. For example a direct linkage is education↑→public health↑, whereas an indirect link would be education↑→ income↑→ public health↑.

To estimate the impact of wider benefits of education, cross-country macro regressions can be used (as described in 6.1). However, these are limited in that they include various controls for development indicators that are themselves influenced by education (i.e. political stability, fixed effect dummies) and therefore pick up some of the educational benefits. Furthermore, if these include time dummies or are conducted over a short time horizon many of the effects will not be picked up as they occur with long time lags of at least 10-20 years. These highly controlled regressions therefore risk underestimating the wider impacts of education If these controls are relaxed researcher are faced with the problem of potentially

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overstating impacts, as education starts to pick up the beneficial impacts of other closely related socioeconomic developments. Researchers have attempted to engage with this problem by applying different specifications, in which each has its potential positive or negative biases. These recent studies have provided a range of results which give an indication of the plausible magnitude of the wider impacts of education.

McMahon (2004) combines a variety of estimates for the social rate of return to education as found in macroeconometric studies and broad findings for private rates of return to provide a possible range for the magnitude of the wider impacts of education. Based on recent literature he argues a plausible social rate of return of education may vary from approximately 10% to 30%. The lower bound implies the returns to education are almost solely based on private market returns with limited or no wider impacts. The result is based on tightly controlled static regressions, which McMahon (2004) argues fail to attribute wider impacts to education, and therefore understate education's impact. The upper bound is based on dynamic, more loosely controlled specifications, which he conversely argues is probably overstated as the lack of controls means that the education variable picks up effects from other economic developments. Drawing on a number of empirical studies and simulations he presents "educated guesses" by economic development and education level.

Figure 4 Estimates of social returns to education in the OECD countries. Source: McMahon (2004), Table 6.5, p. 244.

	Conventional monetary social rates of return (A1+B1)	Non-market private returns (A2+B2)	Non-market education externalities (B-3)	Total social rates of return (includes non-monetary)
Primary	8.5	6.8	2.5	**17.8**
Secondary	9.4	7.5	2.8	**19.7**
Higher	8.5	6.8	2.5	**17.8**

These estimates reveal that the typically un-measured impacts of education are at least as big as the frequently estimated private returns to education. However, most of these wider impacts are in fact non-market benefits accruing to the educated individual himself. The externalities, although significant, are relatively small. As for education levels their economic

impacts seem to be broadly of the same order of magnitude. Implying that expansion of education at any level will have a high social rate of return[33].

Although notionally high on the agenda, academic work establishing the economic value of wider impacts of higher education (and education in general) is very much in its infancy. Pioneering work, such as McMahon (2004) and McMahon (2009) has indicated that potentially the wider supply side benefits of education are no less significant than the direct supply side effects. Verifying these micro-level effects with macro economic data has proven difficult (see 6.1), however, a nascent development is to simulate the system wide effects of developments at the micro level using modelling techniques such as Computable General Equilibrium analysis (see 6.3). A clearer picture should therefore gradually begin to emerge in coming years.

5 Regional/Local supply side impacts

A range of effects of HEIs may be at play at the regional or local levels and only partially captured in micro/labour market estimates as summarised in chapter 3 or macro/overall approaches as discussed in chapter 0. Examples of these are spatial effects, where the presence of HEIs affects the location of R&D or highly skilled labour. These may not be captured at the macro level as they may simply be causing a re-arrangement of existing R&D capacity or the existing stock of highly skilled labour. On the other hand it is quite possible that such agglomerations can be powerful enough to exert their attractive powers over borders and in such a way have a positive national impact. Another example is from econometric studies of the effects of HEIs in improving regional productivity. As before these studies can, to an extent, be identifying a re-location of existing productive people/businesses, but there can also be a positive national benefit. Regardless of the potential national impacts of these effects the studies reviewed reveal important impacts of HEIs for the region where they are located. This chapter aims to straddle somewhat dispersed academic work in

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[33] McMahon (2004) makes similar estimates for developing countries were social returns are sometimes twice as large, in particular for primary education.

a relatively brief summary. Inevitably, breadth has come at the expense of completeness. However, it is important to give a flavour of these works[34].

5.1 Spatial/Location effects on labour supply

The presence of HEIs has been shown to affect the location and migration choices of highly skilled labour at the regional and sub-regional levels. The broad findings suggest that an HEI's presence makes it more likely that a region will attract and retain highly skilled labour. In addition, there are examples of graduates being retained in their region of study. Varga (1997) argues that proximity to HEIs may affect the locational behaviour of the highly skilled workforce but not workers associated with mass production. He points out that the hypothesis is reinforced by studies showing that the spatial distribution of the relative share of scientists and engineers in the workforce is governed by university proximity. He points to Beeson and Montgomery (1993) for showing that not only does university research affect location of the highly qualified workforce but such a workforce is also attracted by local university teaching activity as measured by the number of degrees awarded in the fields of science and engineering.

For migration behaviour of the highly educated workforce Herzog, Schlottmann & Johnson (1986) found that university availability at the current location does not affect the out-migration choice of scientists and engineers. However, the presence of HEIs seems to be an important influence when deciding where to move to (Beeson & Montgomery 1993, Herzog et al 1986). As for the potential benefit of retaining graduates in the region, Florax (1992) points out that for the Netherlands alumni have tended to cluster around their institution of study. Groen (2004) in a study of US graduates found that there was a significant link between studying in a state and working in it, although the magnitude of the impact was quite modest with approximately 10 of every 100 students living in the state of study 10-15 years after graduation. Bound, Groen, Kézdi & Turner (2004) point out that graduates are quite mobile and find that at a state level in the US there

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[34] For a further discussion of these topics see McLellan (2006) and Drucker & Goldstein (2007).

is only a modest link between production of graduates within a state and the build up of a graduate work force.

5.1.1 Findings on student and graduate migration in Scotland and the UK

Wright & Mosca (2010) use the Destination of Leavers Survey to examine the migratory behaviour of graduates within the UK. The survey draws on a sample of recent graduates and asks them about their employment status and whereabouts 6 months after graduation. A follow up survey, taken 42 months after graduation, is available for some cohorts. The tables below show some of the details of their findings.

Half a year after graduation approximately 86% of those who studied in Scotland were found to be living in Scotland. However, this cannot be interpreted as a net retention-rate as students studying elsewhere also migrate into Scotland from elsewhere. When findings from the survey are used to estimate the graduate flows in terms of headcounts (Table 9), we see that on average for the five cohorts from 2002/03 to 2006/07 of the approximately 29,000 who graduated in Scotland per annum, a little less than 25,000 are retained within the country 6 months after graduation. However, almost 2,000 graduates who studied elsewhere in the UK move to Scotland, indicating a net out-migration of approximately 3,000 thousand graduates. This implies a net retention rate of about 93% for Scotland.

Table 10: Place of employment 6 months after graduation (estimated headcount, % of row total). Source: Wright & Mosca (2010).

		England		Scotland		Wales		N-Ireland		Total	
Place of study	England	246,222	97.8%	1,768	0.7%	2,908	1.2%	912	0.4%	251,810	100%
	Scotland	3,429	12.0%	24,738	86.4%	79	0.3%	379	1.3%	28,626	100%
	Wales	6,160	35.8%	101	0.6%	10,896	63.3%	50	0.3%	17,207	100%
	N-Ireland	419	4.7%	93	1.0%	15	0.2%	8,456	94.1%	8,983	100%
	Total	256,230		26,700		13,898		9,798		306,626	

When the follow up study from the Destination of leavers survey is analysed it reveals a further out-migration of those who studied in Scotland. The gross retention ratio has fallen from 86.42% as revealed in Table 8 to 80.72% as reported in Table 9.

Table 11: Place of employment 42 months after graduation (Based on destination of leavers survey 2002/2003m cohort). Source: Wright & Mosca (2010).

		England	Scotland	Wales	N-Ireland
Place of study	**England**	97.50%	0.89%	1.29%	0.32%
	N-Ireland	9.38%	1.05%	0.76%	88.81%
	Scotland	16.56%	80.72%	0.85%	1.87%
	Wales	41.56%	0.77%	57.17%	0.50%

Wright & Mosca (2010) emphasise that counting heads only tells a part of the story. They argue that migration is a selective process and that the characteristics of 'stayers' and 'movers' can differ significantly. They run a logit regression to analyse what kind of graduates are likely to migrate for work. Of those who study in their country of domicile they find that those who are more likely to out-migrate tend to be male, have studied full-time, are disabled, hold a first-class undergraduate degree, attended a Russell-Group University, studied science and have already moved in order to attend university.

Furthermore, Wright & Mosca (2010) examine the graduates labour market outcomes in terms of whether they hold what is commonly perceived to be a graduate job or not. They find that for Scottish domiciled students that study in Scotland approximately 75% of students hold a 'graduate' job 6-months after graduation and that this rises to approximately 82% when examined 42 months after graduation. Scottish students studying locally appear to be slightly more successful at obtaining 'graduate' jobs than their counterparts from elsewhere in the UK, although the difference is modest.

Table 12 % in a 'graduate' job 6 and 42 months after graduation. Source: Wright & Mosca (2010).

	% in a graduate job after 6 months (pooled cohorts)	% in a graduate job after 42 months (2002/03 cohort only) - weighted
English-domiciled studying in England	72.51%	80.50%
Northern-Irish students studying in NI	74.12%	79.31%
Scottish-domiciled studying in Scotland	74.85%	81.89%
Welsh-domiciled studying in Wales	70.28%	79.00%

Furthermore, Wright & Mosca (2010) use logit regression to analyse the characteristics of those who obtain 'graduate' jobs and those who do not. They find that of those who studied in their own country of domicile those who move to take up employment are more likely to occupy what is perceived to be a 'graduate' job.

In absolute terms Scotland 'looses' graduates, even when inflow from other regions has been considered. Compared to the US labour market (for which most of internationally published findings focus on) where graduates are footloose the net out-migration of graduates from Scotland appears to be modest. However, as Wright & Mosca (2010) point out the headcounts only tell a part of the story as there may also be quality differences between the out-flow and in-flow. Indeed, their findings indicate that high-potential graduates are over-represented among the out-migrants.

A similar conclusion is reached by Faggian, McCann & Sheppard (2010) who analysed graduate retention rates at the level of NUTS-1 and NUTS-2 regions in the UK. They find that Scotland has the second highest graduate retention rate in the UK, only after London, and attribute this to differences in the education system between Scotland and the rest of the UK.

5.2 HEI knowledge spillovers

A phenomenon of much interest is knowledge transfer from HEIs to industry. This proposed external benefit of HEIs results in various impacts which can be said to be related and are sometimes referred to under the heading of knowledge effects (Varga, 1997). This includes effects on firm's location decisions, R&D activity and innovation rates as will be explored in the following subsections.

According to Parker & Zilberman (1993) technological transfer from HEIs is seen as any process where understanding, information and innovations move from an HEI to industry. This occurs through various channels from seminars and scholarly publications to spin-offs and scientific parks. Varga points out that cooperation in R&D, faculty consulting, journal publications and industrial associates programs channel knowledge regardless of distance,

however, several means of technological transfer are more dependent upon spatial proximity.

Fischer & Varga (2002) used a spatial econometric approach on Austrian data and found a geographically mediated university spillover to be present and subject to a distance decay pattern.

Varga (1997) cites several sources which highlight the importance of the graduate labour market as a source of technology transfer. Firstly access to graduate students, trained graduates and scientists is seen as major university industry linkage. Therefore the local labour market for graduate level personnel promotes technology transfer. For one, faculty scientists and engineers are more likely to move to nearby firms when changing jobs and in addition trained graduates may seek jobs in the area of their university. He further points out that knowledge transfer can occur through seminars, industrial incubators, industrial parks and spin offs. More informally, technology transfer can occur through local professional associations or even by getting together in a local pub or restaurant.

Faggian, McCann & Sheppard (2010) point out that regional innovation in the UK is strongly linked to graduate migration flows and argue that a major channel for knowledge transfer is that embedded in human capital. They suggest that a cumulative causation mechanism is at work for high technology sectors (but not for manufacturing) where graduates migrate to regions with job opportunities, this inflow spurs innovation, which again reinforces job opportunities and human capital inflows.

> An endogenous process of feedback between inflows of graduate human capital and high technology innovation dynamism operates in all UK regions [...]. Relatively larger net inflows of human capital help foster high technology regional innovation, and high technology regional innovation further encourages such human capital inflows. A process of circular and cumulative causation appears to be operating in the case of high technology industries, but this is not [the] case for all manufacturing industries. For all manufacturing industries, inflows of

human capital are still essential for innovation (Faggian, McCann & Sheppard, 2010, pp. 287-288).

Ongoing work by Kitson et al (2009) reveals that interactions between academia and industry are more frequent, heterogeneous and dispersed than previously thought. Interactions are not only driven by STEM (Science, Technology, Engineering and Mathematics) subjects through licenses and spin-offs, but a wide range of subjects through various different channels, often informal.

5.3 Innovation and patent activity

At the national level HEIs role in contributing to innovation through the creation of new technologies or absorption of existing ones, and the contribution of these to productivity, is captured primarily in the growth theory literature summarised in 6.1. A review of the various potential mechanisms of knowledge exchange and innovation systems is beyond the scope of this study; however, we refer to McLellan et al (2006) and Harris (2006) for recent summaries of the literature. There is some work applying production functions to explain a link between knowledge stocks and total factor productivity, which we will briefly examine in 5.3 to illustrate the link between knowledge creation and productivity. Some of the best known studies providing quantitative evidence on innovation- and productivity links are based on observations at the local level. Therefore we will focus on these here.

Jaffe (1989) found a positive link between university research and the level of innovation activity within US states. Using patent registrations as a proxy for innovation he found a statistically significant relationship showing a 1% increase in spending on university research resulting in a 0.1% increase in the number of patent registrations within the state. The strength of the effect varied between sectors and was found to be almost quadruple in the drugs and electronics sectors compared to the overall impact.

Anselin et al (1996) built on the same dataset as Jaffe, using number of registered patents as a proxy for innovative activity, but expanded it

somewhat. They confirmed the positive link between university research and innovation activity both directly and indirectly through its effect on private R&D. At the MSA level their model for innovation activity used both university research and private R&D as explanatory variables. In addition, the research employed spatial lags including university research within 50 miles radius outwith the MSA and private R&D within 75 miles out of the MSA. Furthermore, they controlled for 3 local business characteristics: specialization in high tech industries, importance of business services and presence of large firms, in addition to the ranking of the university institution in question, which they considered a proxy for the institutions quality. University research up to 50 miles outwith the region was found to have a significant effect on innovation activity but the same did not hold for private R&D at up to 75 miles distance from the region. Furthermore, specialization in hi-tech industries and proliferation of business services were found to have a positive effect on innovation while large companies were found to have significant and negative effect on innovation activity. University ranking was found to be positively associated with innovation activity.

Anselin, Varga & Acs (2000) expand previous work in two directions. They examine whether innovation activity in US Metropolitan Statistical Areas (MSA's) is affected by proximity to other MSA's and if the drivers of innovation activity differ between sectors. In this case they used data for patent registration in the US for 1982 and examined four broad sectors regarded as high-technology: Drugs and Chemicals, Industrial Machinery, Electronics, and Instruments. The first extension is motivated by the idea that areas in proximity to each other may form a network within which knowledge externalities can operate. This is done by dividing the sample into connected and unconnected MSA's and testing for structural stability. Regional homogeneity was rejected in the cases of Industrial Machinery and Instruments but when examining Electronics and Drugs and Chemicals a significant difference was not found between the connected and unconnected samples.

When examining the drivers of innovation activity in the four broad sectors Anselin et al (2000) used a similar regression as before, including as explanatory variables Private R&D and University research in addition to controlling for the presence of high-tech firms, concentration of business services and large companies. The results differ between sectors. For some, most coefficients are significant while for others fewer are significant. As an example, for the Drugs and Chemicals sector the only significant coefficient is for industry R&D, indicating no knowledge spillovers for that sector, but for Electronics both university and industry research were found to have a significant and positive coefficient in addition to the variables representing a concentration of high tech companies and business services.

Anselin et al (2000) conclude that the findings have broadened the evidence for both sectoral and regional differences in the innovative process. As we have seen there is supportive evidence for a localised effect of HEIs where they seem to attract private R&D into its spatial proximity. Furthermore, there is a link between research activity at HEIs and regional innovation activity measured as patent registrations. However most of the studies mentioned were based on observations from the U.S. and unfortunately through lack of studies with a wider geographical scope, it is hard to predict how well these results can be carried over to other countries.

5.3.1 Spatial/Location effects on innovation

Studies that have analysed R&D location in the US give strong evidence of localised impacts of HEIs, where private research and development tends to concentrate around places where universities are conducting research. Such impacts have been found at state, metropolitan and intra metropolitan levels.

Jaffe (1989) uses data on private R&D expenditures in 29 US states over 8 years and university research expenditures over the same period. This study found that after controlling for population and economic activity there is an association where increased university research seems to drive increased private R&D.

Establishing causality with statistics is a tricky business, but it appears that university research causes industry R&D and not vice versa. Thus, a state that improves its university research system will increase local innovation both by attracting industrial R&D and augmenting its productivity (Jaffe, 1989, pp. 968).

More precisely his regressions showed that overall a 1% increase in university research spending should result in 0.7% increase in private R&D spending within the state. This association varied in magnitude and significance between sectors. Anselin, Varga & Acs (1997) extend the work of Jaffe by examining the relation between university and private R&D and innovation activity at a more localized level of a Metropolitan Statistical Area (MSA) in the United States. They confirmed the positive link between university research and private R&D.

5.4 Spatial econometric estimates of HEIs local productivity impact: A Swedish natural experiment

An interesting example of the regional effects of HEIs is that of Sweden, where a deliberate policy of spatial decentralization of higher education was undertaken, beginning in 1987 (Andersson, Quigley & Wilhelmsson, 2004). As late as 1977 11 established HEIs (universities and technical institutions) were operating in six Swedish cities in addition to 14 small colleges affiliated with universities. In 1977 11 new institutions were founded and status of the existing colleges was raised placing all 36 universities, institutes and colleges, which were located in 26 municipalities under one administration. In most cases the sites of new establishments were formerly occupied by teacher training schools or military training facilities (Andersson et al, 2004).

According to Andersson et al (2004) the new institutions developed relatively slowly until 1987 when a substantial expansion began, with student numbers growing faster than at the established institutions and an increase in resources. In 1998 84,000 students were enrolled at the new institutions, representing a third of the country's students of higher education. In addition, two new colleges were formed and four of the former established

colleges upgraded to university status. At the time of the study there were 13 universities and 23 colleges operating in Sweden (Andersson et al, 2004).

They maintain that expansion of the regional colleges has generally been considered an important part of the government's regional policy. The policy can be seen simply as a fiscal policy where by expanding higher education the government brings a fiscal stimulus to the regions. However, a second effect is the possibility of supply-side benefits which would improve the regional business environment or induce innovation and increased regional activity, what the authors refer to as the Silicon Valley model. They point out that a policy of this sort is likely to have effects only after some lags, as it may take considerable time to build up a research environment and it will take 3-4 years to educate the students before they will be productive in postgraduate employment. In addition, they argue that the effects are most likely contingent upon the research and educational focus of the individual institutions, the existing economic activity in the region and the migratory response of the newly educated students.

Andersson et al (2004) used econometric methods to study the effects of this decentralisation upon regional labour productivity. They use the number of full time researchers as an indication of the institutions research activity and the number of full time students as a measure of their overall scale. As has been mentioned both the number of students and researchers increased greatly from the 1980's onwards. These exogenous changes in educational policy are related to productivity (output per worker) measured at the community level. This is possible since annual data are available on gross regional product for each of Sweden's 285 municipalities from 1985. Andersson et al (2004) conduct their regressions using panel data from 1985 to 1998, enabling them to hold constant unmeasured region specific characteristics.

Their model implies that the level of HEI activity (measured in number of students or researchers) is related to the level of productivity per worker for that community and year. They found a statistically significant link between university activity and regional labour productivity. Interpreted literally an

increase of 100 students is associated with an increase in labour productivity amounting to 0.00098% per annum. Research activity, however, appears to be more important, as an increase of 100 researchers is associated with an additional annual improvement in regional productivity of 0.00774%[35]. Furthermore, there is a statistically significant difference between the marginal effect of additional students or researchers in favour of the new institutions over the established ones, as the effect is roughly twice as large for students and eight times as large for researchers.

A weakness of the study is that it assumes the effect is isolated to the resident community of each institution and ignores spillovers between regions. Indeed Anderson et al (2004) could not reject the hypothesis of spatial dependence and resorted to augmenting their analyses by adding a gravity variable representing the distance of each community to all students and researchers based in other communities. The results for the explanatory variables confirmed earlier results and a significant gravity variable provided strong evidence of spillovers between regions. When spatial lags are included the result changes somewhat. The lags are highly significant as are the gravity variables suggesting that a region's productivity depends on that of its neighbouring regions. Using spatial autocorrelation models reduces the significance of the relationship between student numbers and productivity to the point that it is only significant at 0.2 levels. The association between number of researchers and regional productivity is still found to be significant and of similar magnitude.

They conclude that there is systematic evidence that the average productivity of labour is higher in regions that received larger university investment. As a possible explanation of why there is much stronger association between university researchers and productivity than the number of students Andersson et al (2004) argue this may arise for several reasons. Researchers are bound to the geographical area where they have tenure whereas the

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[35] On the face of it therefore a single researcher drives an 8-fold impact relative to a student. However, the average student researcher ratio for the period was 17 implying that the aggregate of students is about double that of researchers.

graduates are not. It takes at least 3-5 years until a student enters the workforce and many graduates are without technical expertise, whereas researchers are productive as soon as they are recruited. Furthermore, as a possible explanation why investment in the new institutions returned more productivity gains than that of the established institutions they argue this could arise if the new institutions are more vocational and technical in nature. Of course, some of the new institutions are, in fact, upgrades of former technical colleges. So this may explain some of the differences. (Andersson et al, 2004, p. 386).

As noted before the productivity boost also extends to communities located near the HEIs. Andersson et al find that this effect is highly localised with more than half of the reported productivity gain occurring within 20 kilometres of the municipality containing the HEI and about 75% occurring within 100 kilometres of it.

5.5 Impact of US HEIs on regional development

Using data on all 312 US MSA's (Metropolitan Statistical Areas) from 1969 to 1998 Goldstein & Renault (2004) analyse the impact of HEIs on regional development (measured as change in average earnings) while controlling for regional factors such as size, location, industry structure, entrepreneurial activity and accessibility. For the first half of the period, from 1969 to 1986, their hypothesis that research universities contribute significantly to regional economic development is not supported. However, it was found to be a significant factor in the second period from 1986 to 1998.

Goldstein & Renault (2004) argue this is in line with the view that the role of the university has changed since the beginning of the 1980's in that it has taken on the additional task of facilitating economic development, what they refer to as the "entrepreneurial university period" (p. 741). In addition, they argue that the economy was more knowledge intensive in the latter period. For the period from 1969 to 1986 they find that the variables which significantly explain variation in the MSA"s development (change in average earnings) are location in the Midwest and West (negatively related), MSA size (positive) and a presence of large airport hub (positive). Therefore they

conclude that the general regional macroeconomic conditions, agglomeration economies (significance of size) and industrial structure are most important for explaining regional economic development in the period.

For the latter period the results are quite different. Total university R&D activity has a significant and positive effect on the dependent variable (relative change in earnings per worker) while the total number of degrees awarded is significant but negative and university patent activity is insignificant. Location is significant and positive for the Northeast. As before size is significant and positive. University patent activity is insignificant however, which Goldstein & Renault view as an indication that "the mechanisms by which university R&D activity stimulates economic development are much broader and diverse than just patenting and licensing activity" (p. 744).

They conclude that the evidence points towards university research activity as the foremost source of positive externalities.

> That the presence of universities did not matter either way in 1969-86 supports the view that the teaching and milieu functions are not as important as the research and economic development functions of universities, since the former functions did not change appreciably over the full period, while research activity and economic development increased dramatically from the early to the later period (Goldstein & Renault, 2004, pp. 744).

Furthermore, the coefficient for teaching activity (number of degrees awarded) was significant and negative for the period 1986-1998, which Goldstein & Renault suggest could be interpreted as saturation of highly educated workers in the average regional labour market. Such interpretations should, however, be approached with caution as there is a clear risk of multicolinearity between the research and teaching output variables undermining the validity of the regression. Teaching output (measured in number of degrees awarded) is likely to be closely associated both with the

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scale of institutions and their research output, therefore, the robustness of the results should be accepted with caution.

Goldstein & Renault (2004) address the question if agglomeration economies are more important for regional economic development than research universities and whether universities can act as substitutes for agglomeration economies. They conclude that the present evidence is mixed. MSA size was a positive and significant factor in affecting regional average earnings in both periods indicating that agglomeration economies matter irrespective of university activity. However, when results on the impact of university R&D were disaggregated according to size of MSA it was only significant for small MSA"s. This can be seen as an indication that HEIs can provide external benefits for small MSA that urban agglomeration generally provide (Goldstein & Renault, 2004). They conclude that even though university R&D was found to have a statistically significant effect on regional economic development the order of magnitude was small.

> Controlling for other factors, it would have taken an increase of US$10 million in research expenditure among universities in „average" MSA to increase the index of average earnings per job by 0.36. To give these numbers some perspective the average MSA had US$30.7 million in R&D expenditures in 1986. If the universities in this hypothetical MSA had increased their R&D expenditures by US$10 million more (about a 33% increase), the MSA would have increased its index from 100.00 to only 100.36 (Goldstein & Renault, 2006, pp. 744).

5.6 Conclusions

Scotland retains a large proportion of its graduates. This is a contrast to the US state level, for which most studies have been conducted – where graduates have been found to be footloose. However, ongoing work by Wright & Mosca (2010) on graduate mobility in Scotland warns that Scotland

may lose in terms of the quality of the net-migration flows, as early findings indicate that graduates with good credentials are more likely to out-migrate[36].

The literature documenting the spatial effects of HEIs upon research activity, innovation and skilled labour suggests that potentially strong and divergent local effects are masked within the national average impact of HEIs.

It is clear that HEIs can attract highly skilled labour, thus making the local labour market more attractive to employers. There is also supportive evidence for a localised effect of HEIs where they seem to attract private R&D into its spatial proximity. Furthermore, there is a link between research activity at HEIs and regional innovation activity measured as patent registrations. However, most of the studies mentioned were based on observations from the U.S. and unfortunately through lack of studies with a wider geographical scope, it is hard to predict how well these results can be carried over to other countries.

US studies have found statistical regularities indicating that HEI activity has beneficial impacts on innovation at the local level as measured by patent registration. The strength of this effect varies depending on sectors and local characteristics. Furthermore, university research is found to be positively associated with private research at the state level.

There is evidence of distance decaying local knowledge spillover effects from HEIs. Sometimes this is associated with formal technical activities, but Kitson et al argue for a more pluralistic view, where HEI –industry interactions occur through a variety of sources, both informal and across a range of disciplines.

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[36] However, in-migrants tend to hold better than average credentials as well. Therefore we must await the release of more detailed analysis before reaching an unequivocal conclusion.

Availability of rich dataset enables evaluation of the economic impacts of the decentralisation of higher education in Sweden. Those findings indicate that increased HEI activity enhances local labour productivity and that these effects are contagious over space. Stronger impacts were derived from research intensive institutions and new institutions had stronger marginal impacts than established ones.

Study of cross sectional data for US MSA's gives mixed results. When the sample is split by periods significant results are found after 1986 but not between 1968 and 1986. Similarly when split by the size of the MSA, results indicate universities are more important for smaller region, than big ones, where it is hypothesised they act as a substitute for agglomeration economies, enjoyed by more populated regions.

6 Overall Impact Approaches

Previous sections have reviewed various approaches used to estimate partial economic impacts of education and in particular higher education. Section 2 covers demand-side or spending impacts of HEIs, whereas sections 3 to 5 summarise supply side benefits of HEIs and how HEIs affect the location of other activities and actors within a region or nation. In this section, however, we analyse methods that can potentially be used to derive the system-wide or overall economic impact of HEIs. A natural starting point is to review how HEI activity affects macroeconomic indicators identified in the literature on macroecononometric estimates of the determinants of economic growth. We also briefly examine cost-benefit analysis, which is an approach to enumerate in monetary terms the total social costs and benefits of an activity, often applied in public policy settings. Finally, we consider the potential of Computable General Equilibrium (CGE) models for simulating the system-wide economic impact of HEIs.

6.1 Macro measures (GDP and growth)

This section briefly summarises the literature that applies econometric approaches to macro level data in order to estimate an empirical link between education and economic growth. The microeconometric work reviewed in Chapter 3 shows that at a pecuniary level, education enhances the productivity of individual workers. Furthermore, we provide evidence for productivity externalities, whereby the level of education positively affects the productivity of the non-educated. Furthermore, from the work on wider benefits, we know that education brings non-pecuniary private benefits, such as better individual health. Furthermore, we know that the level of education can bring external benefits such as improved population health, greater democracy and lower crime rates. A range of external benefits may be particularly important at the early stages of economic development, such as its role in stabilizing population growth.

In theory, estimates of the magnitude of these effects at the micro-level could be added up to give an estimate of the overall impact of education,

which could then be corroborated by comparison to similar estimates made at the macro level. By its very nature, using macroeconomic data should be better able to capture the wider economic impacts of education, whereas the micro measures are suited to assess individual impacts. Reconciling micro and macro measures of the impacts of education is seen as fundamental to the economics of education research agenda (Psacharapoulos, 2004). However, there are significant methodological difficulties in conducting macroeconometric studies of the growth impacts of education and in many ways this literature lags behind its microeconometric counterpart. But the macroeconomic approach has produced some valuable broad findings which partially reinforce or complement the understanding gained from the microeconometric literature.

The theoretical underpinning to empirical studies that link education and economic growth is provided by growth theory - a range of models which describe the output potential of economies in terms of their supply side[37]. These are taken to be appropriate tools for longer time horizons where economic management has countered shorter term demand disturbances so that the economy is at its full potential output.

Growth theory has two broad strands. The earlier 'neo-classical' models treat technological development as exogenous and emphasize factor accumulation as the path that policy makers can pursue in order to stimulate growth. The standard textbook example traces back to Solow (1956). A later development, usually labelled 'new' or 'endogenous' growth theory, models the level of technological advancement as a function of human capital therefore making technology an endogenous variable that can be affected by policy. This new theoretical outlook provides a much wider frame for the potential impact of human capital policies.

Under the neo-classical view human capital affects the level of output in the same way as any other factor input, i.e. physical capital or labour[38]. The more

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[37] Although export lead models still consider the role of demand.

[38] For examples of these extended ´Solow´ models see: Mankiw, Romer & Weil (2002).

of it, the higher the maximum level of output attainable with a given state of technology. Endogenous growth theory, however, maintains that the accumulation of human capital not only raises the level of output, but also the speed of technological development, therefore enabling, in theory, a permanent increase in the rate of growth of economic output. To estimate empirically the validity of these theories there are broadly two approaches: growth accounting and regression using macroeconomic data. Both come with serious health warnings[39].

The first approach is essentially an accounting exercise, where the factor inputs that contribute to the level of economic output are counted and multiplied by the role of each input in generating output changes (marginal social product). The growth that can be explained or attributed to factor accumulation in this way is then compared to actual growth to reveal a residual, or unexplained growth, (total factor productivity), which is sometimes attributed to technological change. Methods for measuring inputs have been extended to allow for differing quality of inputs, which has lead to factor accumulation being able to explain a larger part of economic growth, reducing the unexplained residual. The contribution of each input to growth is typically estimated based on the assumption that market prices accurately reflect marginal product.[40] Even if growth accounting is a reasonable way to get some quantitative feel for the role of each factor input, it is not an independent empirical verification as it rests on parameter assumptions which can be varied to produce a range of results.

But the available statistical approaches are also not without faults, both in terms of the data and methods applied. Sianesi & Van Reenen (2003) survey over 20 macro growth regressions and argue that overall these provide valuable evidence on the link between education and economic output, especially in terms of qualitative findings, but in light of methodological complications they urge caution in using results to quantify the magnitude of

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[39] For overview see Siansei & Van Reenen (2003) and Krueger & Lindahl (2001).

[40] For a general discussion of growth accounting see: Barrro & Sala-Martin (2004, Ch. 10).

such links. Sianesi & Van Reenen (2003) identify five types of methodological difficulties:

1. Data: There are various difficulties involved in defining and measuring human capital. The quality of the available data has been challenged. Furthermore, the data needed come from a variety of sources which may not be internally consistent. This is in addition to difficulties caused by potential differences in data definitions and accuracy between countries.

2. Endogeneity bias: As education is potentially both a cause and effect of economic growth, regressions can be affected by simultaneity bias.

3. Parameter heterogeneity: Cross-country growth studies typically included countries at different levels of economic development and there are indications that the effect of inputs differ at different development stages. This can be solved by splitting the sample into groupings defined by the countries level of development. But this reduces sample size, leading to less accurate parameter estimates than could, in principle, be obtained by using the full sample.

4. Model uncertainty: Parameter significance and sign have been found to be precarious with regards to model specifications, i.e. the other regressors that are included.

5. Non-linearities: Typically a linear relationship is assumed between human-capital accumulation and growth. However, there is no strong a priori reason to assume a linear relationship (Sianesi & Van Reenen, 2003).

Taking the studies as a whole however, Sianesi & Van Reenen (2003, pp. 159) argue that "there is compelling evidence that human capital increases productivity suggesting that education really is productivity-enhancing rather than just a device that individuals use to signal their level of ability to the employer". They find that the empirical literature is largely divided over whether the stock of education affects the long-run level (neo-classical approach) or long-run growth rate (new growth theories) of the economy.

Increasing average education in the population by one year would raise the level of output per capita by between three and six percent according to the former approach, while it would lead to an over one percentage point faster growth according to the latter — an extraordinarily large effect. We think the effect is overstated due to methodological problems such as correlation with omitted variables and the imposition of restrictions that are rejected by the data. We conclude, therefore, that the evidence in favour of the new growth theories (especially for OECD countries) is quite weak due to a whole host of problems (Sianesi & Van Reenen, 2003, pp. 159).

Sianesi & Van Reenen (2003) point out some broad qualitative implications supported by the macroeconometric literature. Confirming findings from the microeconometric literature the macroeconomic studies suggest that schooling returns are generally higher in less developed countries than for the OECD and that the quality of education matters for generating a positive impact on growth. Furthermore they argue that; the impact of increased education appears to greatly depend on the level of a country's development with tertiary education being the most relevant for OECD countries; education yields additional indirect benefits to growth, in particular, by stimulating physical capital investments, technological development and adoption; the efficiency with which resources are allocated to the different levels of education also matters considerably.

As for quantitative results, Sianesi & Van Reenen (2003) conduct simulations to give readers a feel for the potential magnitude of effects under both the exogenous and endogenous growth model approaches. Using a number of parameter estimates located within the range found in major studies, they simulate the impact on national output of increasing the human capital stock in an economy with the basic features as the UK. For the exogenous growth approach Sianesi & Van Reenen (2003) draw on an augmented neoclassical growth model and estimates of production function parameters from Mankiw, Romer & Weil (1992). They estimate that a doubling of the level of human capital would lead to an increase in output per capita of one third. Furthermore, using different endogenous growth models, Sianesi & Van Reenen (2003) obtain a wide range of results depending on the modelling framework and the parameter values applied. Assuming a 1.5% increase in

the human capital stock, with the adjustment occurring over a 40 year period, the outcome of their simulations range 76-fold (in present value terms) depending on the simulation setup[41]. The biggest difference lies in whether the models are set up in term of a level specification (where human capital affects output levels) or a growth specification (where human capital affects the rate of growth). They conclude that the growth specifications yield incredibly large impacts and that a levels specification is more credible for long run impacts, although both yield similar results under typical public policy planning horizons (approximately 4 years).

Some earlier macroeconometric studies have been cited as evidence for the irrelevance of human capital for economic growth. Krueger & Lindahl (2001) point to the studies by Benhabib & Spiegel (1994) and Sala-i-Martin (1995) as examples of this. Krueger & Lindhal (2001) argue that these negative findings were driven by measurement errors in education data. To illustrate this they replicate Benhabib & Spiegel (1994) and find that by adjusting for measurement error the impact of education is in fact bigger than that typically found in micro studies. They suggest that this result may either reflect significant external effects of education or be driven by omitted variables.

> Although the micro-econometric evidence in several countries suggests that within countries the causal effect of education on earnings can be estimated reasonably well by taking education as exogenous, it does not follow that cross-country differences in education can be taken as a cause of income as opposed to a result of current income or anticipated income growth. Moreover, countries that improve their educational systems are likely to concurrently change other policies that enhance growth, possibly producing a different source of omitted-variable bias in cross-country analyses (Krueger & Lindhahl, 2001, pp. 1131).

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[41] Taking the present value of simulated GDP changes over a 40 year period due to a 1.5% one-off increase in the human capital stock, Sinanesi and Van Reenen (2003) find impacts ranging from £bn 14.4 to £bn 1,061.2. For details see Sianesi & Van Reenen(2003, p. 186).

The literature on macroeconometric studies of the impacts of education and human capital upon output and growth rates is at an early stage of development. Although many interesting studies have been conducted the range of results is wide and there are significant methodological challenges to be overcome. As of yet there is not a widespread consensus on the most appropriate specifications or a plausible central range of results[42]. For a period of time sceptics argued that macroeconometric studies showed no impact of education and the studies referred to making this argument have become well known and widely cited. However, their conclusion has been refuted on methodological grounds. The current consensus is that macroeconometric work confirms the positive economic impact of education or at least cannot be used to refute it (Sianesi & Van Reenen 2003, Temple 2001, Krueger & Lindahl 2001).

6.2 Cost-Benefit applications

Cost-benefit analysis (CBA) is widely used to derive an estimate of the social net-benefit of public projects by enumerating and evaluating the total social costs and total social benefits. To this end a range of methods and rules are applied. Perhaps the most common use of CBA is for valuing public infrastructure projects, although in principle the technique can be applied to any investment or activity. Hitherto relatively little use has been made of CBA in estimating the impacts of HEIs. Undoubtedly this is due to perceived difficulties valuing the non-market benefits of education in monetary terms. Recently however, work has been undertaken to systematically address the issue of identifying the outputs of HEIs and valuing them in monetary terms, see: Kelly et al (2005, 2008). Furthermore there are some examples of attempts to derive the social net-benefit of an HEI, e.g. Feehan, (1995).

CBA is a bottom up approach which includes identifying the relevant costs and benefits (including externalities), assigning each a monetary value and

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[42] One could review existing studies and pass a judgement as to what methods and results are most credible, in order to establish a central range of results. Such an undertaking would be beyond the scope of this report but interested readers are referred to McMahon (2004) or the summary of his results in section 3.2.2.

applying an appropriate discount rate to derive a present value of future cost and benefit streams. As with any method in applied economics (i.e. IO-impact studies or CGE-modelling) each of these steps requires careful consideration and should not be treated as a mechanical exercise. Costs and benefits have to be identified so that there is neither under- or over attribution of costs or benefits to the activity being evaluated. Various techniques are used to assign prices depending on circumstance and available information and no single discount rate is universally appropriate or accepted. However, sensitivity analyses can be applied around critical parameters to produce a range of plausible outcomes. One of the benefits of CBA is that it is a well established approach with well know qualities and limitations. If done in a transparent way users should be reasonably able to draw their own judgements as to the validity of assessment for the valuation of individual components and adjust their interpretation of conclusions accordingly.

CBA approaches are outlined in broad brush terms in the Green Book on Appraisal and Evaluation in Central Government. Typically in practice public institutions, adopt a simplified "formula" for CBA which is deemed appropriate and useful within their field of work. However, at a more general level, the methods involved raise some significant theoretical and practical challenges[43].

In general it can be said that results on the cost side of HEIs are relatively straightforward to estimate on the basis of accounting data and the results of such exercises are widely accepted. The difficulties arise when assigning a monetary value to the benefits provided by HEIs[44].

In their case study of Strathclyde University, Kelly et al (2008) identified over 220 separate outputs, which could subsequently be valued on CBA basis, as part of 6 broad activity categories undertaken at the university:

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[43] For an overview straddling both the applied and theoretical challenges of CBA see Layard & Glaister (1994).

[44] These include all outputs of the university education.

- Teaching
- Research
- Consultancy/Advisory work
- Cultural Outreach
- Community Outreach
- Other

Furthermore, they identified potential volume measures for these outputs. For pricing these outputs they suggests a schematic approach in line with recognised CBA approaches as summarised in Figure 5.

Figure 5 Pricing outputs for CBA. Source: (Kelly et al, 2008, pp. 14).
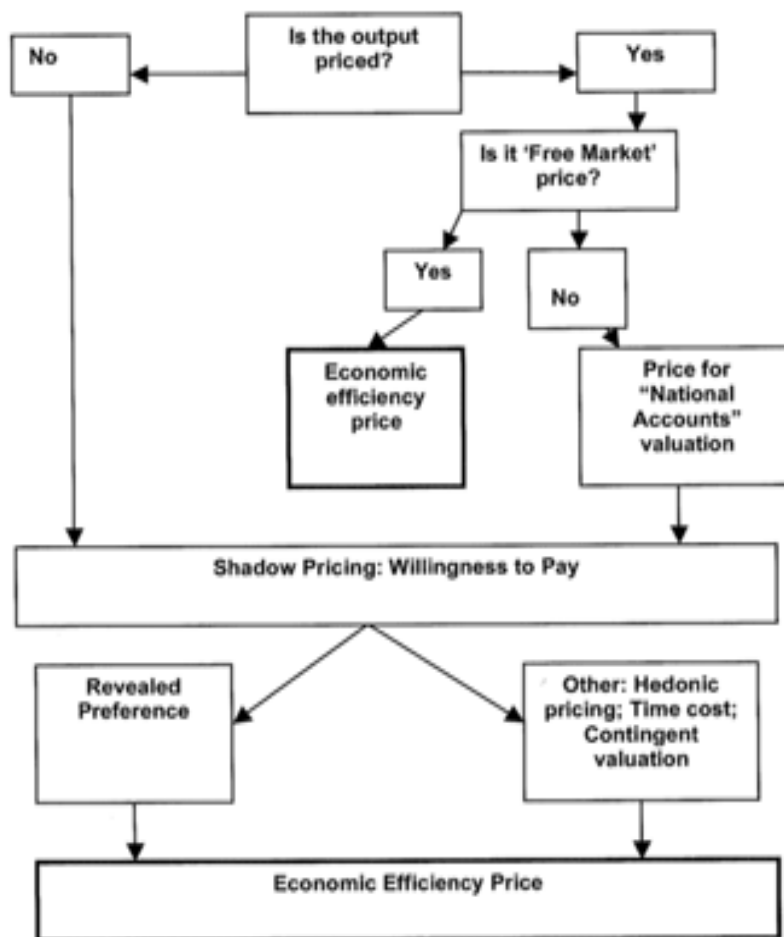
They point out that the price applied in a CBA context is not necessarily equivalent to the income received by the HEI for undertaking the considered activity, as for many activities there isn't a specific remuneration or this does

not reflect the economic value of the output. For example, academic's testimonials to parliamentary committees are typically unfunded.

> With some outputs it is relatively straightforward to identify the 'free market rate'. With 'Teaching', for example, the current 'overseas' full fee rate is likely to be the most appropriate 'free market rate' for a year's tuition, given that this is an area where HEIs operate in an open and competitive national and international market place and tend to pitch their fee rates at 'what the market will bear'. With government advisory work, an appropriate 'free market rate' could be the hourly consultancy rate charged by an equivalently qualified and experienced professional consultant. There are also a range of techniques such as 'willingness to pay' or 'willingness to spend time' which can be used to deduce prices where no 'free market rate' equivalent is easily identified (Kelly et al, 2008, pp. 13-14).

An interesting example of an HEI Cost-benefit analysis in practice is that of the Memorial University of Newfoundland (Feehan, 1995). The study identifies and values teaching and research as the main source of benefits from the universities activities. Although Feehan (1995) recognised and cites examples of externalities and public amenities provided by the university these are excluded from valuation in the study.

> There is considerable appeal to the notion that there are benefits to Memorial University research and teaching beyond what has already been attributed to them in this study. However, there is no accepted means of calculating the values of those externalities. Without such a methodology, any estimate could be criticized as highly speculative. Moreover, there is a severe credibility problem if one were to advocate expenditure on any activity on the basis of beneficial externalities when those externalities may be impossible to measure (Feehan, 1995, pp. 60-61).

Overall Feehan estimates that the present value of the universities benefits are equivalent to approximately 173% of total costs. The single biggest benefit, by far, is from education benefits (valued at 146% of total costs) and research (valued at 16% of total costs). The benefits of education provided by Memorial are estimated as the present value of the future wage premium

of memorial graduates (based on historical observations of wage premiums for Canadian graduates, less a 30% allowance for ability bias in wage premiums).

To estimate the value of research Feehan (1995) draws on some previous work on the returns to basic research and assumes a (rather conservative) 7% return. Furthermore, he makes the precautionary assumption that only 60% of research expenditures contribute to this return and that the remaining 40% contribute to duplication of existing research or educational benefits.

Feehan (1995) acknowledges the need to recognise the cost of obtaining the public funds, which finance 75% of the university's operations. Doing this is not straightforward (nor universal practice in CBA) due to both uncertainty about the level of the "excess burden of taxation" and how it is most appropriately treated. Feehan (1995) cites Musgrave et al (1987) who estimated that for Canada the "excess burden of taxation amounted to 33% of every dollar raised. Including this extra cost lowers the estimate of net benefits from approximately 73% of university expenditures to approximately 48%.

6.3 Modelling work

A recent development is the application of Computable General Equilibrium (CGE) models to simulate the potential economic impact of HE-policies. The use of such simulation models is particularly relevant where there are insufficient data to address a policy issue using statistical models or where the analytical potential of statistical observation has been exhausted. CGE models incorporate the supply and demand sides of the economy, with sectors and transactors linked together using well known micro- and macroeconomic principles to represent a stylised view of the circular flow of economic activity. The models are parameterised to recreate their base year values. They can then be subject to some exogenous disturbance that replicates the direct policy impact. The model then identifies the impact of subsequent interaction within the model on the endogenous economic variables (such as employment, GDP, etc.) The structure of these models

and level of detail is typically determined by the application they are designed for. Common applications include development policies, regional policies, taxation and trade analyses. With existing levels of computing power these models are an efficient way to provide answers to "what if" questions. Typically modellers will run a wide range of potential scenarios representing different views and assumptions about the direct impacts of the policy and its transmission mechanism within the economy. These provide a range of outcomes from limiting cases to scenarios that are judged to be more plausible. Often these simulations provide results which, at least for particular subsets of inputs, run counter to what would be expected from partial equilibrium analyses.

The application of CGE models to HE policies is a nascent development with only one academic publication being made on the subject, using the Australian Monash model. However, further work is under way at the University of Strathclyde applying the AMOS model to HE policies in the UK regions.

6.3.1 Application of the MONASH model to HE in Tasmania

Giesecke & Madden (2005) employ a dynamic multiregional computable general equilibrium (CGE) model to analyse both demand- and supply side impacts of the University of Tasmania in Australia. Typically impact studies have focused on the demand side impact HEIs have on the regional economy. CGE allows the effects of both demand- and supply-side stimuli to be examined while the dynamic features of the model enable subsequent effects on a region's population and capital stock growth rates to be incorporated (Giesecke & Madden, 2005).

In their estimation of the supply side impacts of the University of Tasmania Giesecke and Madden (2005) leave aside various effects that might be considered to contribute to the local economy but are difficult to quantify. Instead they model two supply-side effects they identify as the major ones amenable to quantitative analysis: the productivity impact of R&D and the increase in the skill level of the Tasmanian labour force.

R&D is assumed to translate into a productivity shock through its addition to the national stock of knowledge, which is seen to be positively related to primary factor productivity. That relationship has been estimated for Australia using econometric methods. They base their calculation of the productivity impact of the University of Tasmania on Dixon & Madden (2003) who estimated the social rate of return on research funded by the Australian Research Council to be approximately 50%. Where the social rate of return is defined as the increase in GDP as a percentage of the dollar cost of the investment that lead to the increase.

Dixon & Madden (2003)[45] base their calculation on an increase in GDP and cumulative research funding over a 10 year period. This is interpreted by Giesecke & Madden as meaning that 50% rate of return is on the stock of knowledge, which they point out is consistent with econometric work. They assume Tasmanians capture 25% of the benefits directly and the rest is enjoyed equally by all Australians. Hence, by virtue of their population fraction Tasmanians should enjoy roughly 2% of those benefits. In a nutshell, they calculate the rate of return from the stock of knowledge (which is measured as cumulative research funding, less 10% annual depreciation) and find the Tasmanian fraction of that based on the aforementioned assumptions. Change in total factor productivity is then found as the change necessary to bring about the estimated social benefit.

For the second productivity shock of increased skill level of the regional workforce they approach the issue in two steps, first by estimating the number of additional graduates living in the region as a result of the presence of University of Tasmania and then estimate what impact higher education has on the productivity of each worker. The latter is derived from the graduate wage premia. Citing Borland et al (2000) they claim the standard assumption is that 80% of the wage difference is due to higher education and 20% to innate abilities. Therefore returns to higher education are

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[45] Dixon, P.B. & Madden, J.R. (2003). Economic impact of continued ARC research funding. CoPS report for Allen Consulting Group. Centre of Policy Studies, Melbourne.

calculated as 80% of the difference between the graduate and non graduate wage (Giesecke & Madden, 2005).

They note that the supply side effect tends to be cumulative as R&D outcomes add to the stock of knowledge (as long as successful R&D outcomes exceed knowledge turning obsolete) and retention of students adds to the number of university graduates working in Tasmania. Based on their simulation of both supply- and demand-side effects they conclude that the macroeconomic impact of 100 EFTSU (equivalent full time student units) equals between 1.6 $m and 2.1 $m. Overall, they conclude that demand side impacts dominate over the supply side impact.

Giesecke & Madden's (2005) work on the demand-side impact of the University of Tasmania is very similar in approach to the impact studies summarised in Chapter 2. However, instead of using a purely demand-driven model, such as Keynesian multiplier or Input-Output, they use a CGE-model, which incorporates an active supply-side.

### 6.3.2 Scottish HEI applications using the AMOS model

Various applications are under development at the University of Strathclyde, which will eventually include the four regions of the UK. Preliminary results have been calculated for the case of Scotland. These simulations relate long term improvements in the skill base of the workforce to long run improvements in GDP[46] using a similar approach to that adopted in Giesecke & Madden (2005). That is, the graduate wage premia is used to derive estimates of improvements in labour productivity due to a higher average skill level of the labour force. The Scottish modelling work draws on new econometric evidence by Wright & Mosca (2010b) for the graduate wage premia and considers a range of scenarios accommodating a wide range of assumptions.

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[46] Other approaches are also under development, such as for estimating the supply side impacts of technology spillovers and the wider benefits of higher education.

The Scottish higher education graduation rate peaked at 37% in 2006. Hermannsson et al (2010d) simulate the economic impact of the potential increase in average skills in the labour market under two scenarios. Scenario 1 assumes that each year an additional age cohort containing 37% HEI graduates enters the labour market, whilst an age cohorts of less average formal education retires. Scenario 2, instead of focusing on graduate shares, concentrates on direct projection of the future number of graduates. For this scenario the central assumption is that Scottish universities will "produce" each year the same number of graduates as in the 2005/06 academic year. Furthermore, it is assumed that retention rates of graduates within the regional labour force will be constant. The long-run implications of these scenarios for the level of graduates in the labour force is illustrated in Figure 6 below.

In addition to these two scenarios on how skills accumulation might potentially occur in the Scottish labour market, a range of sensitivity analyses are conducted around the magnitude of the labour productivity improvement brought about by increasing skills. These relate to the response of the graduate wage premia to increases in the supply of skilled labour and the extent to which the wage premia captures a true treatment effect of education in terms of productivity improvement and to what extent it may be reflecting other factors such as innate ability. As is evident from Chapter 3 these issues represent a theoretical and empirical challenge and are difficult to pin down exactly. Therefore, an appropriate response for policy simulations is to explore the implications of the range of these potential outcomes identified in the literature.

Figure 6 Share of graduates in the Scottish labour force
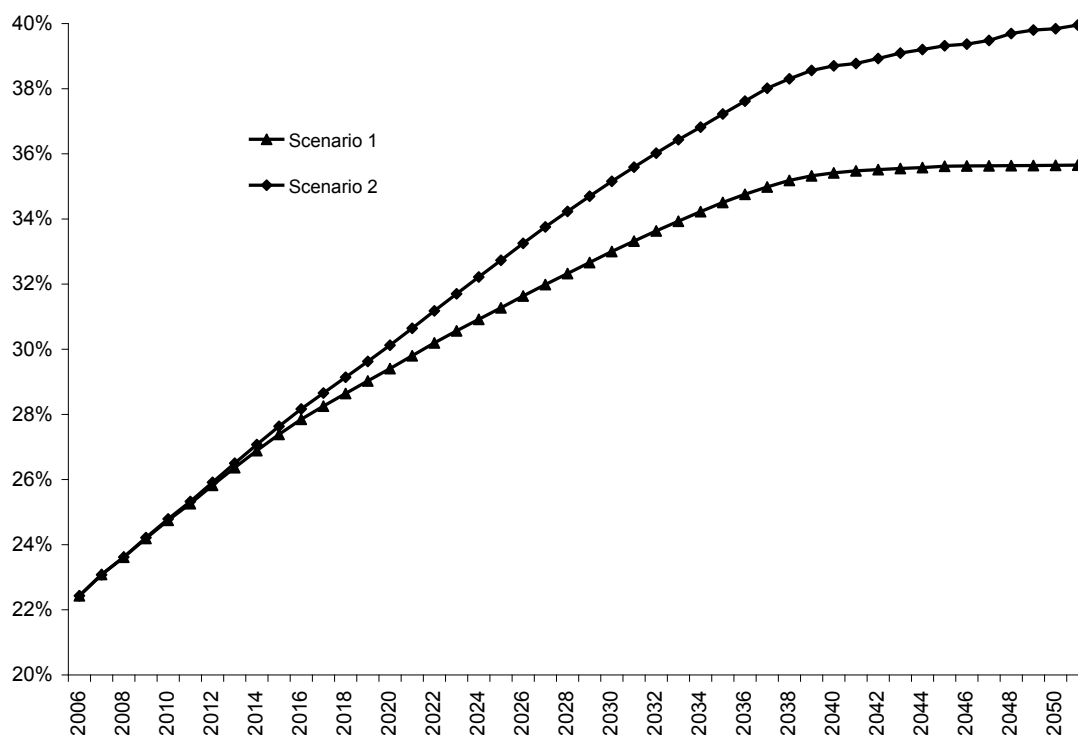
The results suggest that the long term improvement in GDP due to the gradual accumulation of skills in the labour market (based on the current scale of the HEIs sector) range from 2.2% to 6.9% based on various assumptions about the magnitude of the productivity impact. The best estimate of the impact of maintaining the existing proportion of graduates amongst young people coming into the labour force is that this will increase the Scottish GDP by 4.6% by 2051. This implies that on average, over the 45 year simulation period, (2006-2051), this process of human capital accumulation will add about 0.1% each year to annual GDP. A further range of sensitivities comes from various economic viewpoints and assumptions regarding the setup of the model, such as labour market structure, regional migration, and Scotland's integration into UK and World product markets. As the preliminary simulations are conducted under quite restrictive assumptions (such as no migration) the estimated impacts are likely to become larger as these restrictions are relaxed.

7 Conclusions & Future Outlook

In this report we link disperate literatures on the economic impacts of HEIs and provide a summary not currently available in one place. The aim is to make these academic literatures accessible to policy makers and other stakeholders of the higher education system. The end of each chapter has presented relatively detailed findings for the fields being summarised. Therefore, the emphasis here will be on providing broad conclusions.

Available evidence supports the view that higher education provides positive economic impacts. Demand-side impacts can be significant and positive although some qualifications have to be made when accounting for the impact of HEIs spending of public funds (subject to a binding budget constraint). The most important benefits of higher education are probably its supply side impacts – improving the productivity of individuals in the labour market as well as in household production.

Reviewing the academic literature, it is clear that as yet the understanding of the economic impacts of education leaves a lot to be desired. This is a difficult agenda to advance as the work cuts across many disciplines, the possibilities of using controlled experiments is limited and primary data collection is both very expensive and potentially very time consuming (as in the case of longitudinal data).

Promising work is being undertaken within Scotland, the rest of the UK and elsewhere to address these issues. However, to achieve significant progress governments may need to take an active role in encouraging interdisciplinary working and blue skies approaches to the study of HEI impacts. A retrospective view of the longest established strands of these literatures (such as the econometric work on wage premia surveyed in Chapter 3) suggests that developments have occurred in small increments with significant repetitions of previous work. Furthermore, limitations of available data have undermined the robustness of findings and generated prolonged periods of ambiguity. The danger it that potentially fruitful work may simply be too resource-intensive and risky to undertake given present

academic incentive structures. From the point of view of individual academics and departments, publication pressures means that the risk adjusted returns to incremental advancement can be much higher than for adopting highly original approaches.

For conventional demand-side work, some estimates revealing very high multiplier impacts of HEIs spending are probably based on overly optimistic methodology. However, claims that HEIs have no net-spending impact at the regional level are equally unrealistic.

We argue that even if public spending as a whole (the Scottish block grant) is additional to the Scottish economy it is not appropriate to claim an 'impact' for the particular institution spending that money. Public expenditures in a devolved region like Scotland face a binding budget constraint and if the money had not been spent on HEIs it could have been spent on some other beneficial public service. However, HEIs are only partially funded from the Scottish Government and they bring in funding that is additional to the Scottish economy. Furthermore, they provide the regional economy with the consumption spending of incoming students.

Theoretical and empirical studies suggest that increasing graduate supply can, in principle, both work to increase, as well as decrease, the rates of return to education (in terms of individuals' wages). This depends on whether the existing supply of graduates is primarily restricted due to academic ability or availability of finance. A long-run static view would suggest that returns to education would eventually diminish if the supply of graduates continued to rise over time. However, the world is not static and, as empirical evidence reveals, demand for education has grown together with supply, sustaining high returns to education for over a century in the USA (where the longest time series data are available).

The progress towards an empirical consensus on graduate wage premia has not been smooth. At each successive stage the notion that education as such improves labour market performance has been robustly criticised. This debate has been prolonged by a lack of datasets that would allow sufficiently

robust analyses. However, a number of studies drawing on natural experiments and twin datasets have underpinned the consensus view that education as such does independently improve skills important in the labour market. Conversely, if taken out of the context of the overall literature provided by more than 30 years of academic debate, individual published papers can be extracted to refute any economic benefits of education in the labour market.

In models of sorting in the labour market, students are thought to signal their ability, or firms screen job applicants, using academic qualifications. These models are theoretically elegant and boast a pedigree of some major names in economics (Arrow, Stiglitz). They offer a plausible explanation of the labour market in the short run. However, their implications have been over-interpreted to mean the demise of human capital theory and the productivity of education. Such a result requires a careful misunderstanding of the literature and a selective look at empirical evidence. However, this dismal interpretation of sorting hypotheses seems to attract a lot of attention.

In addition to the direct supply-side impacts of HEIs, there are wider benefits and longer term socioeconomic feedbacks, which are potentially much bigger than the impacts traditionally quantified hitherto. However, enumerating the value of these effects is an elusive task. In particular, it is doubtful to what extent they can be disentangled from other socio-economic advancements and to what extent they can be attributed solely to the direct effects of higher education.

At the regional and sub-regional levels, the impacts of HEIs are potentially much larger than at national levels. A significant body of academic research suggests HEIs exert gravity on people, knowledge and knowledge related activities, such as R&D, which can cause a spatial re-distribution of productive capacity within the national economy. This does not necessarily have a large affect on national output, but it may have much stronger impacts locally. However in principle, there is nothing to preclude such effects from working over national borders. Indeed, with increasing

economic integration it is highly likely that the national value of such HEI-associated pull effects will, if anything, increase.

Work on aggregate econometric estimates of the economy-wide impacts of HEIs (and education in general) has yet to resolve significant challenges regarding the precision and robustness of such analyses. This is in addition to classical concerns about inferring causality from observational statistics. Figuratively speaking, this field is likely to be the 'battleground' over the true economic impact of education for the coming decades.

Existing evidence suggests the overall economic benefits of education are potentially very large and certainly large enough to disregard pessimism about the returns to education. However, there is still much work to be done to establish definite answers from the point of view of public expenditure decisions. Firstly we need to ascertain whether more investment in education at the margin will justify the marginal cost of public funds and secondly how the substitution of education compares up with other public expenditure and investment opportunities.

A synthesis of different views can be advanced using simulation models. The policy simulation approach is agnostic in that it can accommodate different theoretical views and assumptions to address 'what if' questions. It offers a way of estimating the potential impacts of HEIs, whilst acknowledging the multitude of uncertainties and different views present under the current state of the art.

Existing challenges are unlikely to be fully resolved through theoretical or empirical means in the near future. Therefore it can be useful to take an agnostic stance and estimate the impacts of HEIs by asking a number of "what if" questions, reflecting the range of assumptions that can be reasonably motivated under the current state of knowledge.

On balance it can be concluded that Scotland has good potential for advancing the research agenda on the economic and social impacts of HEIs. There are a number of academics in different fields and in different

institutions with knowledge of the subject. There is a relatively good stock of base datasets to build on: Both regional economic data such as the Scottish Input-Output tables as well as education statistics collected by bodies such as the Scottish Government, the Scottish Funding Council and Universities Scotland. The civil service seems to be sophisticated in its approach to the subject as witnessed, for example, by the depth and range of work presented at the recent Lifelong Learning Statistics Users Conference. Furthermore, there is relatively short proximity between key people and a dialogue already under way between stakeholders, such as within the TAG-group. It could potentially be very beneficial for these parties to co-ordinate their efforts towards growing the evidence base so that significant and lasting progress can be made with the resources available.

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