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The demographic challenge facing Scottish Higher Education Institutions: a computable general equilibrium analysis

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Abstract

Higher Education Institutions (HEIs) are generally regarded as important actors in regional economic development. A large literature exists on their demand side impacts as employers and as purchasers of intermediate inputs and, more recently, work has been undertaken to explore their impacts on the supply side, for example, through labour market and knowledge transfer effects. A growing evidence base suggests that HEIs have a positive impact upon the development of their host regions. However the HEI sector faces a challenge that might have significant impact on the fortunes of its host regions and has hitherto received limited attention. The populations of most developed countries are ageing and the age cohort from which university students are traditionally drawn is expected to shrink.

This paper uses an HEIs-disaggregated Computable General Equilibrium (CGE) model to simulate the economic impacts of a shrinking student population upon Scotland. In the analysis we use scenarios presented in a recent Universities UK report.

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1. Introduction and background

In a recent report on the future size and shape of the higher education sector in the UK, Universities UK (UUK, 2008a, 2008b) present projections of student numbers conducted on their behalf. These projections demonstrate that UK Higher Education Institutions (HEIs) face a "demographic challenge" in that the number of 18-20 year olds, who traditionally constitute more than 70% of undergraduate students, is projected to fall markedly between 2009 and 2019 before rising again until 2027. The impact of this decline across UK regions is uneven. Northern Ireland is hardest hit, facing a 13.2% fall over the earlier period that is sustained right through to 2027. England is least at risk with a projected fall in the key age group of 4.8% over the earlier period and a modest increase (of 2.7%) over the period as a whole. Scotland's 18-20 age group is projected to fall significantly by 10.9% (as compared to a UK-wide fall of 5.9%) to 2019 and to recover to a fall of 8.4% over the whole period to 2027. In this paper we focus on the Scottish projections, although our analysis does, we believe, have implications for other regions of the UK.

Of course, UUK recognises that these purely demographic projections may provide a misleading impression of what is likely to happen to student numbers in each region. This is so even if the population projections are accurate in themselves, an unlikely outcome given their sensitivity to migration assumptions (Lisenkova et al, 2009). UUK explore three main scenarios. These reflect alternative views about factors such as: current trends for more young people to enter higher education; the impact of student debt on participation; pressures on public funding; likely developments in international markets for students and the nature of employer engagement. UUK then identify the likely consequences of these three scenarios for student numbers in the regions of the UK.

In this paper we seek to determine the likely impact of these alternative projections of Scottish HEI student numbers for the Scottish economy. Studies of the overall, system-wide impact of HEIs generally have typically adopted a multiplier approach. While valuable in terms of understanding universities as businesses, they are likely to be rather less useful in evaluating changes at the margin, including variations in student numbers in circumstances where the supply side of the economy is unlikely to be entirely passive. Instead we here use a specially constructed, HEI-disaggregated, computable general equilibrium (CGE) model of Scotland to explore the likely consequences of the projected decline in student numbers. This has the advantage of explicitly building in induced supply-side reactions to the changes in student numbers, though for simplicity here we concentrate on the impact of these changes on the demand side of the economy. In a companion paper we consider the supply-side impacts of HEIs on host regional economies that operate through their impact on the stock of graduates within the region (Lisenkova et al, 2009).

2. The demographic challenge

Figure 1 summarises the 2006 Government Actuary Department (GAD) projection for the Scottish population aged 18-20 over the period to 2026/27. The decline between 2010 and 2021 is striking (nearly 17%), although there is a projected recovery to a drop of 11% by the end of the period. Figure 1 also gives UUK projections for Scottish student numbers. These show a more moderate decline in (full time equivalent) student numbers. In their "baseline" demographic-based projection, student numbers decline by 11% to 2021 and by 7% to 2026/27. This reflects a judgement that HEIs will partially compensate for loss of recruitment from the 18-20 age group by increasing recruitment from other age groups (partially through part-time routes) and by increasing the share of foreign students.

The scenarios developed by UUK are summarised in Table 1. All scenarios start from the baseline demographic projections. The difference between scenarios is determined by the reaction of governments, employers and institutions to the demographic challenge.

Scenario 1 is called "Slow adaptation to change". This can be viewed as a status quo scenario. The key differences from the demographically driven baseline are in age-specific participation rates. There is a modest increase in part-time undergraduate students, post-graduate and international students. Total funding per student remains constant, while there will be a further increase in the concentration of research funding by the councils. These changes will push universities to greater flexibility, investigation of niche-markets and wider introduction of e-learning.

Scenario 2 is labelled "Market-driven and competitive". There is a significant increase in the demand for the part-time undergraduate education from all age groups. There is also higher demand for post-graduate education. Employers recruit a higher proportion of 18-20 year-olds and finance their part-time studies. This leads to a decrease in the number of full-time students. Public funding per student remains at its current level but total investment in higher education increases. Fees are largely deregulated, which leads to differentiated fee system. A UK-wide credit accumulation and transfer system is introduced. By the end of the period the HEIs are much more differentiated in terms of the type and quality of education they provide. Higher diversity leads to loss of the clear brand of UK higher education and, as a consequence, decreased overall international demand for UK education, except for a limited number of elite institutions.

Scenario 3 is called "Employer-driven flexible learning". Demographic changes result in greater competition among employers and HEIs for young people. There is a shift to life-long learning. Public funding of higher education significantly decreases and tuition fees are deregulated. The role of employers in financing higher education increases, they also can influence the distribution of public funds. The difference between full-time and part-time students decreases. Students move in and out of higher education as their circumstances change. Full higher education awards can be constructed from the selection of modules from different HEIs. Virtual learning systems are introduced and allow 24/7 education environment. Apart from several elite institutions UK higher education becomes less attractive for traditional international students. However, e-learning technology allows wide participation in borderless education, although this generates lower margins than traditional education.

The implications of each scenario for student numbers are summarised in Figure 2.

3. Analysing the impact of projected student numbers

We would expect that, in general, changes in the ability of HEIs to attract students would have both demand and supply side impacts on the host region. We consider each of these in turn, although our empirical analysis presented in this paper abstracts from supply-side impacts.

3.1 Impacts on demand within the host region

Consider first the likely impacts on the demand side of the regional economy. Other things being equal, the smaller the size of the cohort from which undergraduate students, in particular, are drawn, the more difficult it will become for Scottish HEIs to maintain the numbers and quality of undergraduate students. This has a number of implications for the host region. First, the income flow to Scottish universities is driven by a limited number of factors, one of which is numbers of undergraduate students recruited. If these were to fall, then so too would this source of income. In fact, university financial settlements may effectively cap student recruitment, but if HEIs cannot recruit up to this level they lose a source of revenue. Furthermore, financial settlements for HEIs would be adjusted in the face of falling student numbers, so the link to finances is fairly direct. This would in turn impose limitations on Scottish HEIs expenditures and therefore on their impact on demand within the regional economy. We assume, for simplicity, that the loss of even home students reduces demand. In fact, government funds so released may be employed for other demand-generating purposes. Population-driven changes in the Barnett formula complicate matters further, however. (See e.g. Ferguson, et al, 2007.) We shall explore the impact of this issue in subsequent research. This reduction in demand in the economy will have the kind of "knock on" effects that are associated with indirect (occurring through intermediate purchases) and induced effects (occurring through consumption –income linkages) that are associated with traditional "impact analyses" of HEIs. (See Hermannsson et al, 2009 in this issue of the Fraser Economic Commentary.) However, in this case the supply side of the economy is not entirely passive and responds to this demand stimulus. In particular, as demand

declines, this tends to lead to a slacker labour market and so downward pressure on Scottish wages and prices, and therefore to some gain in competitiveness and moderation of the adverse "multiplier" impacts. Over the longer-term however, this is likely to lead to some outmigration and further losses of output.

Furthermore, any decline in home student numbers would appear to reduce demands for Scottish goods from this source, and so further depress regional demand. However, in order to explore this notion properly, we need to: think a bit more carefully about the appropriate treatment of students' expenditures, and in particular critically review their treatment within past multiplier studies of HEIs; consider the overall impacts of a decline in population. We turn first to the appropriate treatment of student expenditures.

In the conventional IO literature, there appear to be two alternative treatments of students' expenditures, depending in part upon the students' region of origin. In most IO studies of HEIs impacts on the host region, home students' expenditure tends to be excluded from estimates of impacts, because of a presumption that these expenditures would, for some reason, not be lost in the event of a university closure. Only the expenditures of students attracted from outwith the area are included as a stimulus to regional demand on the grounds that these would be lost in the absence of the HEI. However, Harris (1997) takes the opposite perspective and includes all student expenditures in his estimate of the impact of HEIs on Portsmouth economy. In the present context the assumption is that student numbers are varying primarily due to demographics (though also due to some behavioural change in the case of UUK's baseline scenario), and to changes in the margin in student numbers. In these circumstances the appropriate focus is on all changes in student expenditures, including those of home students. In fact, in this case the impact of student expenditures is very modest, though, of course, negative and we do not discuss it further here.

3.2 Impacts on the supply side of the host region

HEIs may exert a wide range of impacts on the supply-side of regional economies, for example on culture and health, and there are many possible external benefits that could be associated with education in general and higher education in particular (McMahon, 2004, 2009). However, most analyses of economic impacts focus on at most two key issues: the impact of HEIs on regional economies through the skills of their graduates; the potential impact of technology and other knowledge spillovers e.g. through spin-out companies.

A major potential impact is through the contribution HEIs make to the skills of the host region's labour force. There is a vast literature in this area relating both to microeconomic issues, specifically relating to rates of return to higher education, and macroeconomic, relating, for example, to the impact of human capital on growth. Both areas have been recently reviewed: e.g. Psacharopoulos and Patrinos, 2004 on returns; Stevens and Weale, 2004, and McMahon, 2004 on growth models. The key issues here include: the ability of the region to retain the graduates of its HEIs and absorb them into the local labour force; the scale of the regional graduate wage premium, and the extent to which the premium genuinely captures productivity differentials. There is now a huge literature relating to knowledge transfer. While much of this is based on case studies and is qualitative and impressionistic, there have been a number of quantitative studies that suggest that HEIs may indeed have important effects on innovation within the host region. However, Faggian and McCann (2006) sound a note of caution in that they find little evidence of an independent effect once graduate migration flows are controlled for. This is not to deny a knowledge transfer impact, but rather to suggest that the main mechanism through which such effects occur is the employment of graduates.

Possible student impacts on the supply-side of host regional economies are typically neglected, as indeed are the possible wider effects of the presence of significant student communities (Munroe et al, 2009). They may have a significant impact on the supply side of host regions' labour markets, given their high participation rate in part-time employment, for example.

In the present paper we abstract from these potentially important supply-side impacts to focus exclusively on the demand-side disturbance that the projected changes in student numbers may have. (In Hermannsson et al, 2009b, we explore the likely impacts of HEIs through upgrading the skills of the host labour force.) However, we analyse the impact of these disturbances in the context of a model in which the supply side reaction to these disturbances is important.

4. The CGE model

For detailed discussion of the model see Harrigan et al (1990). AMOS is a CGE model of Scotland. It is essentially an empirical, regional general equilibrium variant of the Layard, Nickell and Jackman (1991) model where the bargained real wage in Scotland is (negatively) related to the Scottish unemployment rate (the assumption underlying the results reported in Table 2 below). However, we also explore the consequences of "real wage resistance" in which labour bargains simply to maintain the real wage. There are 25 goods markets, which are assumed to be perfectly competitive. Demands are fairly conventionally modelled, with trade flows being sensitive to relative prices (and so regional competitiveness). The model is calibrated on a 2006 Scottish Social Accounting Matrix (SAM) in which HEIs are identified as a separate sector. The model is recursively dynamic with capital stocks updated through sectoral investment functions and the labour force is updated via a Harris-Todaro net migration function according to which in-migration is

Figure 1: Projection of the Scottish population aged 18-20, and the total number of (FTE) students in the UUK baseline projection

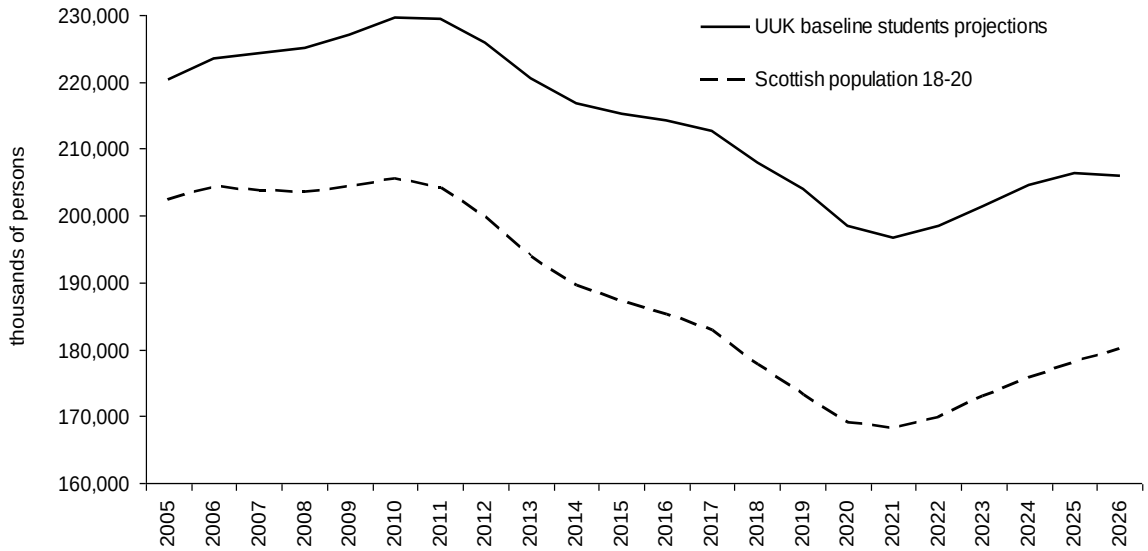

Figure 2: Projected total number of students in Scotland (FTE): UUK baseline and three scenarios

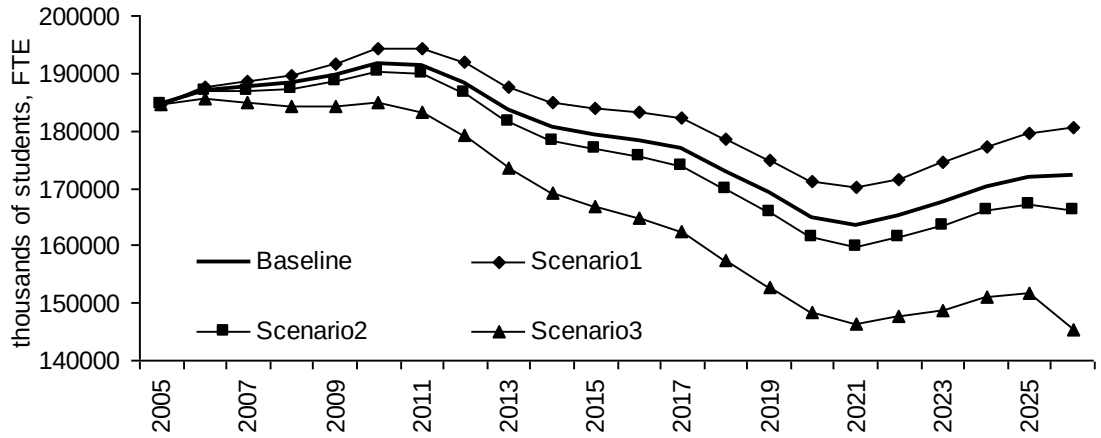

Figure 3: GDP impact of the loss of income by HEIs : all scenarios

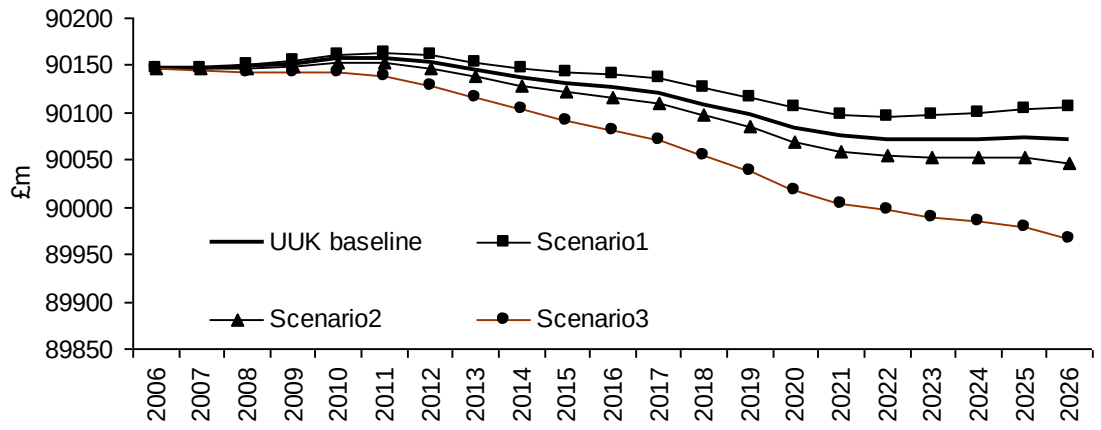

Table 1: Description of the UUK scenarios

	Scenario 1	Scenario 2	Scenario 3
	Slow adaptation to change	Market-driven and competitive	Employer-driven flexible learning
Participation of young people	As now but with some switch from full-time to part-time	Reduced participation in full-time but increased participation in part-time	Substantial reduction in full-time, but on headcount basis participation at current level
Participation of older people	Modestly increased	Substantially increased	Substantially increased
Employer engagement	Modestly change, mainly through increased influence on the curriculum	Increased but not necessarily primarily with publicly funded HEIs	Substantially increased – employers are the primary drivers of large proportion of public funding
Competition (UK)	Increased competition amongst publicly funded providers	Significant expansion of the range of private providers – fierce competition for UK students	Highly stratified and polarised system with only limited competition
Competition (International)	UK HEIs compete effectively despite increased competition	UK HEIs compete less well	With the exception of elite HEIs, UK HEIs compete less well. However, they engage with technology-based borderless education
Technology-based learning	Some increase in e-learning, but face-to-face learning is the predominant mode	Substantial increase in e-learning	E-learning is the predominant mode
Academic staffing	As now with academic staff undertaking teaching and research	Two streams: one – research and teaching in large HEIs, the other – teaching in small HEIs	Flexible academic workforce. Increased movement between academia and business. Significant part of academic staff becomes self-employed, contracting work at several HEIs

Table 2: Impact of the loss of income by HEIs: all scenarios

	2006	2010	2015	2020	2025	2026
UUK baseline						
GDP (£m)	0.000	10.434	-15.325	-62.043	-73.158	-74.869
Employment ('000)	0.000	0.261	-0.378	-1.633	-2.020	-2.051
CPI (%change)	0.000	0.016	-0.029	-0.063	-0.017	-0.016
Scenario1						
GDP (£m)	0.000	15.015	-2.767	-40.618	-42.942	-39.913
Employment ('000)	0.000	0.379	-0.042	-1.057	-1.210	-1.123
CPI (%change)	0.000	0.022	-0.019	-0.052	-0.004	0.002
Scenario2						
GDP (£m)	0.000	7.359	-23.555	-75.941	-93.255	-98.651
Employment ('000)	0.000	0.182	-0.598	-2.007	-2.558	-2.680
CPI (%change)	0.000	0.012	-0.035	-0.070	-0.025	-0.029
Scenario3						
GDP (£m)	0.000	-3.808	-53.704	-127.030	-165.986	-179.044
Employment ('000)	0.000	-0.104	-1.402	-3.380	-4.506	-4.822
CPI (%change)	0.000	-0.003	-0.059	-0.097	-0.055	-0.065

positively related to real wage differentials and negatively to unemployment rate differentials.

Compared to conventional models of HEI impacts, this model is distinctive in having a fully specified supply side. However, in circumstances where the supply side would be expected to be passive e.g. for a highly open regional economy in the long-run, the model converges on what is essentially an extended input-output system.

5. The results

The disturbances that we model here reflect anticipated changes to Funding Council Grants and fees from EU and non-EU students. These are taken to be proportional to the numbers of students projected for each category in the baseline and alternative scenario simulations. These changes in revenue affect the resources available to Scottish HEIs and thus their demands for labour and other inputs, as explained above. We now consider the likely impacts of these changes on the Scottish economy by simulating the impact of reduced HEI expenditures.
The likely economy-wide impact of the student numbers projected in the UUK baseline is summarised in the first three rows of Table 2, for selected years, though these effects relate solely to the anticipated changes in HEI incomes and do not include the impact of changes in student expenditures (the impact of student expenditure is very small compared to the impact of the change in HEI income). Note that initially, to 2010, Scottish GDP and total employment actually increase since student numbers are projected to rise over this period. The implied demand stimulus tends to increase the real wage and CPI slightly given the tightening of the Scottish labour market. However, by 2015 there is a contraction in aggregate demand in Scotland as a consequence of the projected declines in student numbers, and the unemployment rate rises above its base level, and employment and GDP fall. Notice that, even though student numbers have begun to recover by 2025, GDP and employment contractions are worse than in 2015: it takes time for the full effects of the demand change to work through the system as, for example, capital stocks take time to adjust.

Table 2 also summarises the results of the main scenarios. The ranking of the scenarios in terms of their likely economic impact is exactly as we would expect. Under Scenario 1, slow adaption to change, employment and GDP losses are significantly lower than in the UUK baseline. Scenario 2 generates results that are universally more pessimistic than the UUK baseline, and Scenario 3 implies worse news, with a loss of nearly 5,000 in total employment and a contraction in GDP of nearly £180 million.

Figure 3 summarises the basic impact of the baseline case and the various scenarios on Scottish GDP. This reinforces the message that GDP impacts vary across scenarios in a systematic way. However, inspection of the scale of the vertical axis serves as a reminder that we are dealing with relatively moderate impacts.

Under the real wage resistance hypothesis the contractionary impact on GDP is up to 20% greater as in this case labour insists on maintaining the real wage despite the fall in demand, so there are no induced beneficial effects on competitiveness to mitigate the adverse consequences for the economy.

6. Conclusions

The macroeconomic consequences of the demand-side impacts of UUK's projections of student numbers entering Scottish HEIs appear fairly modest, though unambiguously bad news over the period to 2020 and 2025. Even under the worst UUK scenario, total employment falls by less than 5,000 and GDP by less than £180 million, and UUK's baseline suggests falls of well under half these levels. These effects are smaller than would be revealed by conventional "impact" or "multiplier" analyses, in which wage and price flexibility would be unable to insulate the real economy, as it does in this case at least to a degree, from demand side changes. However, recall that in this paper we do not include the adverse supply-side impacts of the projected contraction in student numbers, which we might expect to predominate over the longer term as these are reflected in the level of skills in the host region, and in the scale of knowledge transfer effects. In this respect, at least, the estimates represent a minimum estimate of the likely macroeconomic consequences of UUK's projections.
In future research we intend to explore the supply-side consequences of the "demographic challenge" facing Scottish HEIs. It will also be interesting to investigate the impacts on a regional basis, since the scale of the challenge varies significantly among the regions of the UK. Furthermore, the focus of this paper on host economy impacts neglects the potentially important interregional effects that are likely to be present in an integrated economy and HEI system. Finally, we intend to explore the wider economic and social impacts of HEIs.

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