The Economic Impact of Higher Education Institutions in Ireland

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I would like to thank Deputy Tuffy for the opportunity to contribute to this important discussion by presenting recent evidence relating to the economic impact of higher education institutions in Ireland.

In summary we have found that the higher education sector represents very good value for money for the Irish taxpayer. In most circumstances it will return much more than €1 for every €1 invested. In 2010-11, for example, the gross income of Irish higher education institutions was €2.6 billion, generating gross output nationwide of €10.6 billion. Investment in higher education in Ireland generally has greater impact than similar investment in the UK. These results are illustrated in the accompanying appendix, figures A1.1 and A1.2.

This testimony is supported by four written appendices. Appendix I provides summary materials and diagrams. Appendices II and III are academic papers offering two methodologies for measuring economic impact, input-output analysis, my focus today, and the Keynesian multiplier method. Appendix IV is a brief biographical note. I will attempt to answer all questions to the best of my ability today, and I have provided contact details for any further queries.

May I state for the record that this research, entitled TIONCHAR, is funded by the Irish Research Council under the RPG2013-6 (SFI/HEA Assessing the Impact of Publically-Funded Research, Development and Innovation), Theme 2 grant, based in the Trinity College Dublin School of Business. This funding was granted to a consortium: Prof. Brian Lucey, TCD School of Business; Prof. Poul Holm, TCD School of History; Ms. Niamh Brennan, TCD Library and myself. The grant was directed towards a postdoctoral fellow, Mr. Qiantao Zhang, soon to receive his doctorate in economic geography from Cardiff University, and supervised there by Prof. Robert Huggins, Chair of Economic Geography and Director of the Centre for Economic Geography. Mr. Zhang is present today and I must say that this work would not have been possible without his great skill and unequalled work ethic.

I would also inform the Joint Committee that we have received generous assistance from many people within the higher education sector. Most notably, the Irish Universities Association, Institutes of Technology Ireland, Mr. Tom Boland of the Higher Education Authority and his

staff, Ms. Mary Doyle of the Department of Education and Skills, the presidents, secretaries and registrars of the IOTs and universities, Dr. Stephen Kinsella of the University of Limerick, Prof. Colm Harmon of the University of Sydney and Ms. Siobhan Phillips and Prof. Martin Hynes of the European Science Foundation.

What is economic impact?

Economic impact is a broad concept with many components. When discussing the economic impact of higher education, we usually refer to a component of national industrial policy, where higher education provides a method of improving an economy's human capital endowment. My contribution today will focus primarily on the role of higher education institutions as entities existing in the economy, which can then be considered in much the same way as other exchequer-financed investment products such as roads and public administration. This is exclusively concerned with the demand-side of the economy (aggregate demand measures).

I would warn that while this study highlights immediate value for money it does not comment on returns beyond the present. Since human capital returns are made manifest over a 45-65 year time horizon it would be unwise to consider immediate returns the entire result of investment in human capital. Policymakers should note that long-term horizons and information asymmetries present in all forms of education delay by many years the effects of policy changes on long-term economic growth. These impacts ultimately are about expanding the supply-side of the economy (aggregate supply measures) and yield long-run, non-inflationary and stable equilibrium expansions in output and employment.

Many analytical techniques exist to evaluate immediate returns. To offer the most accurate results in the time allowed, I will discuss only the "Input-Output" method. The most important results of our research so far are in Figures A1.1 and A1.2 in Appendix I. They illustrate that Irish higher education institutions as a body outperform most UK institutions, with the exception only of specialized London-based institutions. It is important to note that this final calculation takes into account the opportunity cost of government financial support of the sector (i.e. balanced budget effect).

The TIONCHAR project is a multidimensional research project examining the economic impact of higher education at several levels. As outlined in Figure A1.3 in Appendix I, the project will look at economic impact from "Keynesian", Input-Output, "Solow" and innovation and industrial policy dimensions. We have completed work on the "Keynesian" and Input-Output methods of analysis. Both methods treat look at Ireland's higher education institutions of Ireland as a sector or firm, as if discussing the construction industry or a particularly large firm in construction. We ask, for a given level of income and expenditure, what level of additional economic activity is generated in the economy. Higher education is considered solely as a sector of the economy made up of producers and consumers, with no comment on the wider "Solow"

effects on the economy's human capital endowment or on non-economic contributions of higher education to society.

The most accurate technique is the input-output method. This technique takes a matrix of raw economic data collected from the public and private sides of the economy to study the interdependencies between suppliers and producers and the economic impact of the import or export producer goods to meet consumer demand in the national and regional economy. The analysis illustrates that the output of one sector can in turn become an input for another sector. The technique was created by Prof. Wassily Leontief during the 1930s and it was for this which he received a Nobel Prize in 1973. This method treats all sectors in a linear fashion. The supply side is taken as exogenous. Firms function by consuming certain products from the economy, and produce outputs which are in turn consumed by other industries. The data we use here for Higher Education is of vastly better quality than that used for the Keynesian multiplier, but is still subject to some caveats. The data comes from the latest Central Statistics Office input-output tables, for 2010, and as such may still contain some of the after-effects of the Celtic Tiger period, and may not reflect current economic conditions following fiscal retrenchment and household and commercial deleveraging. This is the highest quality data currently available to the project, sourced from the Central Statistics Office, the universities and institutes of technology themselves, the Higher Education Authority and the Irish Universities Association.

The input-output technique has the advantage of permitting institutional measurement at a very precise level through the disaggregation of the national input-output tables. Figure A1.4 gives a basic outline of the key parameters for the Irish higher education sector. Figure A1.5 illustrates the sector's expenditure. As you can see, 68% of the costs for higher education institutions comes from staffing. The expenditure translates into largely domestically purchased goods and services with 77% being the absolute minimum by any one institution. Income is less diverse, with 65% of the sector's income coming from Irish exchequer sources. It is important to note a distinction between universities and institutes of technology with respect to diversity of income which has implications for the balanced budget multiplier. With this data, we can calculate the so-called Type I and Type II multipliers. Type I multipliers relate directly to the purchases of goods and services by the higher education institution itself. Type II multipliers are related to the "induced effect", which relates to how a household's consumption responds to changes in wage income. Type II output multipliers (see figures A1.7 and A1.8 for details) show results which are good for the institutes of technology and the universities with all being greater than 1 and much higher than the Scottish, Welsh, Northern Irish and London Type II multipliers (See Figure A1.10).

Since the higher education system is supported so extensively by the exchequer, it is important to calculate a "balanced budget multiplier". This figure takes into account the opportunity cost of exchequer funds. In any environment involving exchequer financing one must consider the effect of taxation in reducing the disposable income of those taxed. While Ireland continues to borrow for day-to-day finances, this is to end by 2018. As it stands the exchequer is in primary surplus, so that all public money expended on higher education crowds out funding to other areas of public expenditure unless tax receipts increase. The balanced budget effect subtracts the

government funding and associated multiplier effect. We use a relatively high multiplier effect to counteract public financing effects, and multiply that by the proportion of income derived from Irish exchequer funds (income from the EU constitutes an injection into the Irish economy).

As depicted in Figure A1.9, institutions heavily reliant on exchequer funding have their multiplier effects sharply reduced. Diversity of income in the university sector allows them to maintain strong (i.e. greater than one) multipliers. Table A1.2 gives the clearest comparative illustration of the performance of Irish higher education institutions compared to their UK counterparts. Irish institutions perform strongly, outpaced only by certain London specialist institutions, such as London Business School, the highest impact institution, the London School of Economics, the Courtauld Institute of Art, the London School of Hygiene and Tropical Medicine, and the Institute of Cancer Research. It is important to note that Irish universities, as comprehensive institutions, consistently perform above their UK counterparts. As Figure A1.11 illustrates, there is no clear relationship between overall income and the balanced budget multiplier but income diversity does seem to induce a larger multiplier effect.

The input-output technique also allows a statement on the employment multiplier effect. This can be thought of as the number of jobs generated for every €1 million of expenditure. Through direct effects (i.e. Type I) the sector creates an additional 1,731 jobs. Through induced effects (i.e. Type II) the sector creates an additional 66,470 jobs. This is in keeping with US studies and the fact that direct employees of the higher education sector are relatively well remunerated. I would urge caution with respect to these results.

Overall our investigations so far have found that the higher education sector represents value for money for the Irish taxpayer. In most circumstances it will return more than €1 for every €1 invested. When balanced for the opportunity cost of exchequer funds, it remains a very high return, especially compared with the UK sector. Ireland's higher education sector, purely as investment for economic activity, is a high value sector. I would like to highlight some caveats and concerns before I conclude.

The analyses to date consider the higher education sector as an industry. They do not look at some of the more important aspects of higher education investment and outputs. Also, it is important to note that economic processes in reality are not linear. Supply responds to demand and these responses most likely will not be in a linear fashion.

The TIONCHAR project hopes to progress towards a "Solow" analysis of the impact of higher education, which looks at how improved human capital will result in higher economic growth potential for the economy. Data limitations in the Irish context complicate prospects for a satisfactory and internationally comparative analysis. With the existing framework, we plan more comparative benchmark analysis vis-à-vis Continental European countries over the coming months but the poor quality of the Irish data naturally limits comparisons, whether direct or through reasonable proxies.

Our method says nothing of institutional efficiency, which is a reasonable concern for deputies and senators given the clear imperative to use public money effectively. Our later research will use the data envelopment free disposable hull technique, a form of operations research that looks at what is achieved versus potential. It is commonly used in health research. Figure A1.13 provides a visual representation of the technique.

Ultimately, the more complicated questions relate to individual returns to education and the non-monetary and societal returns to education. I highlight this since returns to investment in human capital are crucial for our understanding of the role of higher education in economy. Higher education does afford a wider return to society, though this is very difficult to capture in empirical data. Prof. Walter McMahon of the University of Illinois at Urbana-Champaign provides useful evidence of the non-monetary benefits to higher education. Most relate to the public health of the individual and their family, but Prof. Daron Acemoglu of the Massachusetts Institute of Technology and Prof Edward Glaeser of Harvard University have also reported on individual happiness, social cohesion and greater income equality. Ultimately analysis of the complete economic and non-economic returns to higher education is complex, data intensive and requires careful interpretation.

These brief comments highlight initial results of the first comprehensive study of the economic impact of Irish higher education institutions since the 1960s. It is clear they represent value for the taxpayer, with consistently strong multiplier effects and, even when accounting for the opportunity cost of government funds, performing at a level above their institutional peers in the United Kingdom subject to certain caveats. I look forward to your questions and comments.

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Appendix I – Supplementary notes and figures referred to in the text of the testimony

Keynesian Macroeconomic Impact Analysis:

What does one mean by "Keynesian" impact? This is the least precise method of approaching economic impact. We draw in expenditure data by the institutions, staff and students and then look at that in the context of the general government multiplier. It relies heavily of intermediate calculations of multipliers for the economy in general. If one to describe it in the vernacular, this is the view of the impact in the general sense looking at aggregate demand and not at the interconnectivity of firms. You have an impression of the ground but no real details. It is clear from our initial findings, as outlined in Appendix III, that all the higher education institutions generate a Keynesian multiplier greater than one. That means that for every Euro invested into a higher education institution that is generates more than one Euro in economic activity in the wider national and regional economy. The result from this would be to confirm that at a high level that investment in higher education institutions poses a strong value for money proposition as macroeconomic multipliers in Ireland tend to be small and less than one, as highlighted by the Irish Fiscal Advisory Council in their April 2013 report.

Human Capital Theory:

Human capital theory as we are treating it develops form the ideas of Gary Becker, Robert Lucas and Edmund Phelps on the role of human capital in economic growth. More recent economists, such as Joseph Stiglitz, Charles Jones, David Romer and Xavier Sala-i-Martin have continued to highlight the important role of innovation and human capital as being at the core of any national industrial policy. (As an aside I would like to note that it was a Trinity economist, John Kells Ingram, who was the first to articulate a concept of human capital.) In these models human capital is key to the advancement of the economy since what lies behind the "Solow residual" also known as total or multifactor productivity. This residual is exogenous. In an endogenized setting "applied human capital" acts as the engine of economic perpetual economic expansion, this is also known as the AK model. The endogenous growth model and the Solow-Swan growth models evolved from the application of the Cobb-Douglas production function, which was first articulated in an article entitled "The Theory of Production" in the March 1928 edition of the *American Economic Review*.

On the theoretical front in economics there are two main theories that deal with education and innovation: a macroeconomic one and a microeconomic one. In macroeconomics the main impetus for studying education is in the formation of human capital, which serves as an endogenous driver of economic growth. Without explicitly modelling the educational sector these models, which are associated with Nobel Prize winning economist Robert Lucas, assume that there is a one-to-one relationship between investment in and the stock/growth rate of human capital. Human capital, in turn, creates output in combination with capital goods. In other words human knowledge, when applied to machines, factories and other productive technologies has a material impact on the productivity of individuals. Growth in human capital is

an endogenous (systematically internal) driver of economic growth. So, from this perspective it is clear that higher spending on human capital increases to higher growth. This is, however, simply due to assumptions that link between human capital and production. A slightly different perspective takes a more Schumpeterian (creative destruction) stance. This modification of the endogenous growth model is characterised by the seminal work of Phillippe Aghion and Peter Howitt. This Schumpeterian model does not predict a smooth march of growth, but rather argues that growth takes place in fits and starts. The driver of economic growth is the number of increases in the productivity of capital and labour. These increases are stochastic, meaning that they take place at random intervals. This model's policy implication for investment into human capital is that the more resources directed towards investment in human capital development and R&D increases the expected number of innovations per unit of time.

In microeconomics the signaling role of education has been emphasised, notably by Michael Spence. (By signaling it is meant the process by which an item of information about an individual (or firm) is publicly imparted to the market in general and is used by that individual to differentiate him or herself from the rest of their respective cohort.) In these models one generally abstracts away from any productivity-enhancing effect education might have. Instead it is assumed that agents are heterogeneous in their productive abilities and knowledge of personal productivity is only know to the individual. Education then becomes a device for individuals (agents) to signal to employers what is their relative productivity vis-à-vis the rest of the labour market. The underlying idea is that it is easier for more productive agents to obtain a given level of education than it is for less productive agents.

For a mathematical and graphical note on the Solow-Swan model of economic growth please see Figure A1.14 below.

A note on proximity:

Impact multipliers can be quite useful outlining institutional impacts on the local economy. These diminish as the distances increase from the main campus. The importance increases where there is slack aggregate demand with less than full employment. The effect can be even stronger where financing is done through deficits or external funding such as from the EU. In the current economic context deficits are clearly not an option and the rules of a small open economy differ significantly from a larger economic system, but higher education institutions can act as a stimulus package on aggregate demand. The effects of graduates, especially when they remain in the locality can be very positive for the regional economy for financial and non-financial reasons. Large outflows of human capital, regionally or nationally, pose a drain on the national economy since all subsequent human capital gains are not harvested by the national or regional economy but by a third party.

Figure A1.1

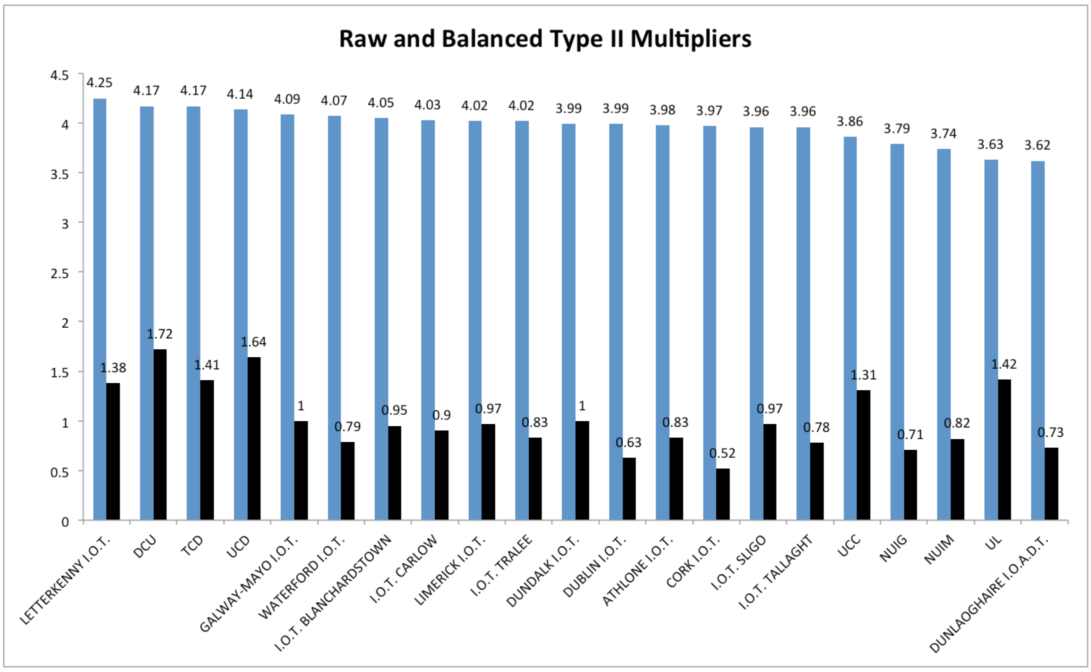

Raw and Balanced Type II Multipliers
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
4.25 1.38
4.17 1.72
4.17 1.41
4.14 1.64
4.09 1
4.07 0.79
4.05 0.95
4.03 0.9
4.02 0.97
4.02 0.83
3.99 1
3.99 0.63
3.98 0.83
3.97 0.52
3.96 0.97
3.96 0.78
3.86 1.31
3.79 0.71
3.74 0.82
3.63 1.42
3.62 0.73
LETTERKENNY I.O.T.
DCU
TCD
UCD
GALWAY-MAYO I.O.T.
WATERFORD I.O.T.
I.O.T. BLANCHARDSTOWN
I.O.T. CARLOW
LIMERICK I.O.T.
I.O.T. TRALEE
DUNDALK I.O.T.
DUBLIN I.O.T.
ATHLONE I.O.T.
CORK I.O.T.
I.O.T. SLIGO
I.O.T. TALLAGHT
UCC
NUIG
NUIM
UL
DUNLAOGHAIRE I.O.A.D.T.

Figure A1.2

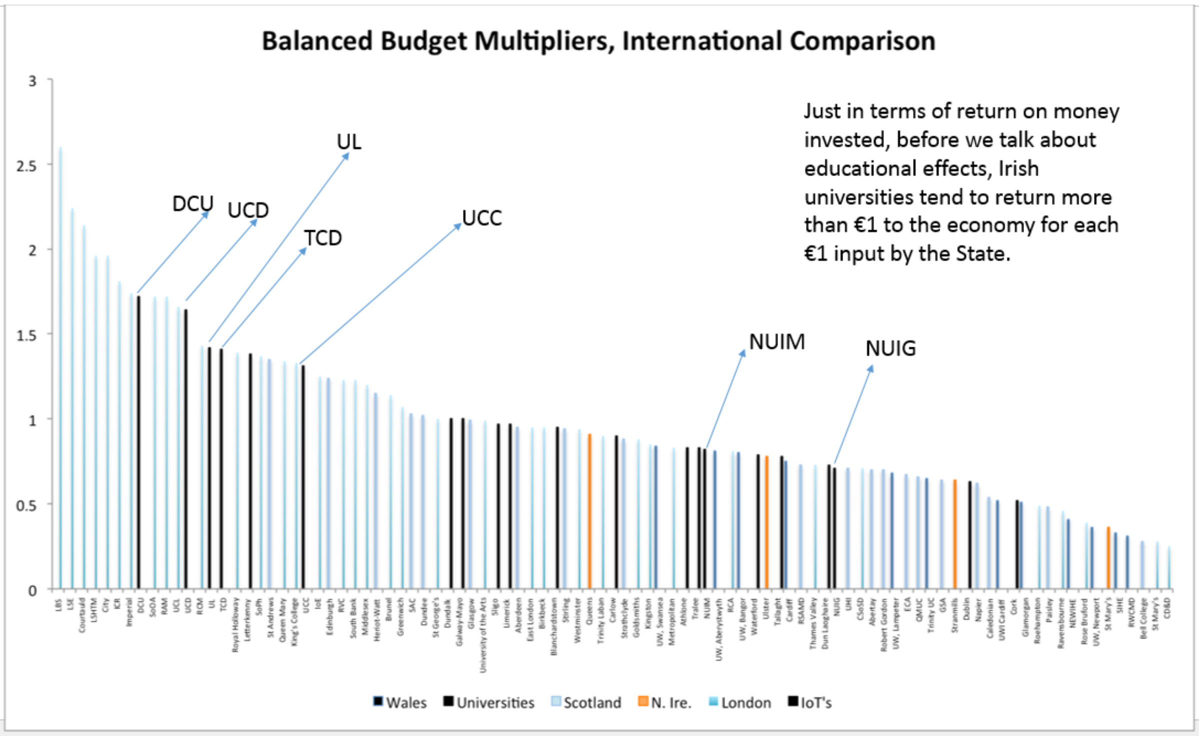

Balanced Budget Multipliers, International Comparison
3
2.5
2
1.5
1
0.5
0
DCU
UCD
UL
TCD
UCC
NUIM
NUIG
Just in terms of return on money invested, before we talk about educational effects, Irish universities tend to return more than €1 to the economy for each €1 input by the State.
Wales
Universities
Scotland
N. Ire.
London
IoT's

Figure A1.3: Approaches to measuring economic impact:

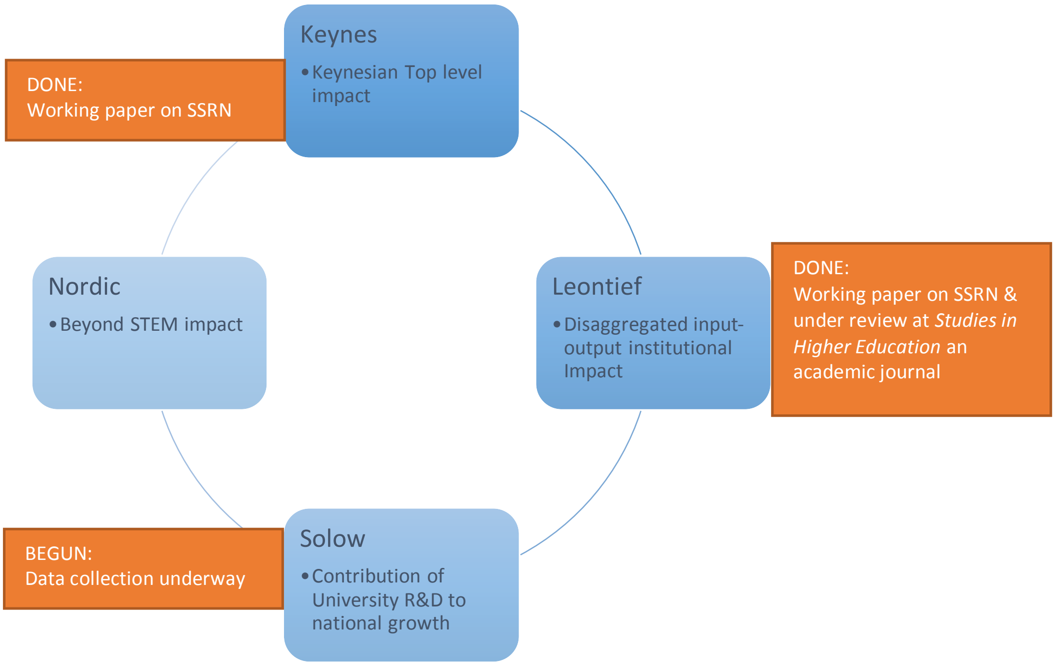


Figure A1.4

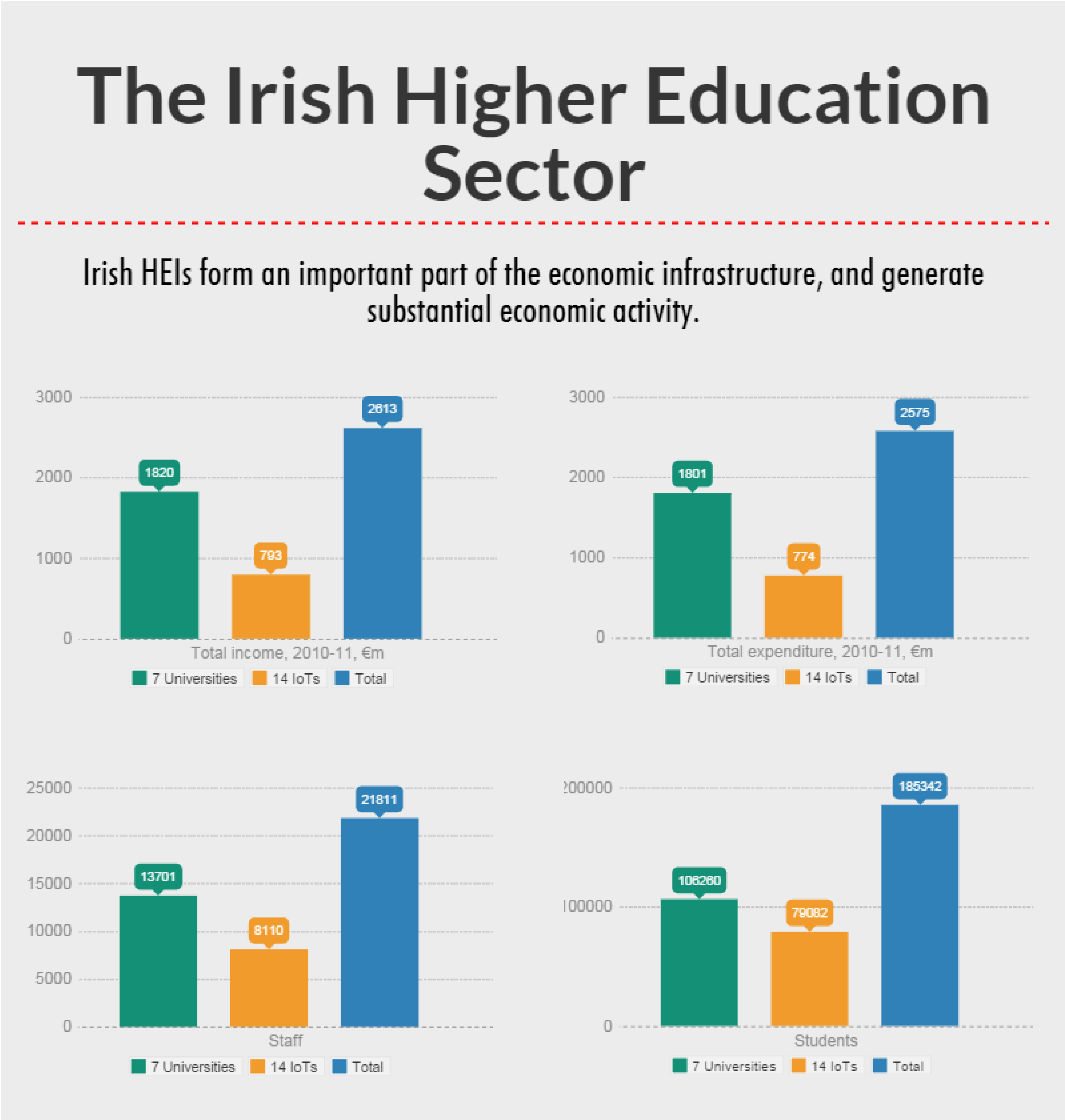

The Irish Higher Education Sector
Irish HEIs form an important part of the economic infrastructure, and generate substantial economic activity.
3000
2000
1000
0
1820
793
2613
Total income, 2010-11, €m
7 Universities
14 IoTs
Total
3000
2000
1000
0
1801
774
2575
Total expenditure, 2010-11, €m
7 Universities
14 IoTs
Total
25000
20000
15000
10000
5000
0
13701
8110
21811
Staff
7 Universities
14 IoTs
Total
200000
100000
0
106260
79082
185342
Students
7 Universities
14 IoTs
Total

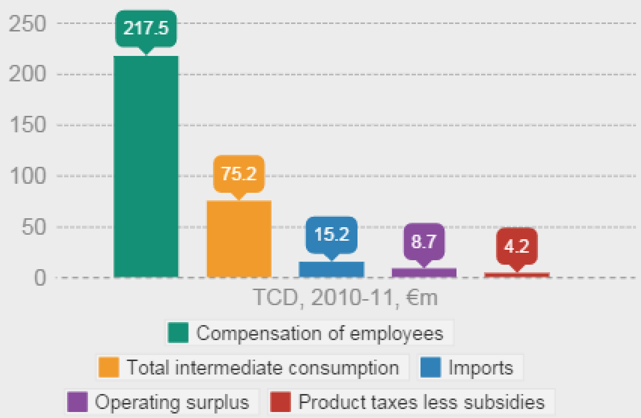
Figure A1.5

Constructing an HEI-disaggregated IO Table (Column)

In an IO table, a column reveals the total expenditure of a sector and how it is divided between intermediate inputs, imports and value added.

Data was sourced from the Higher Education Authority (HEA), the Irish Universities Association (IUA), and the Central Statistical Office (CSO).

Level of detail differs across column components and between universities and institutes of technology (IoTs).



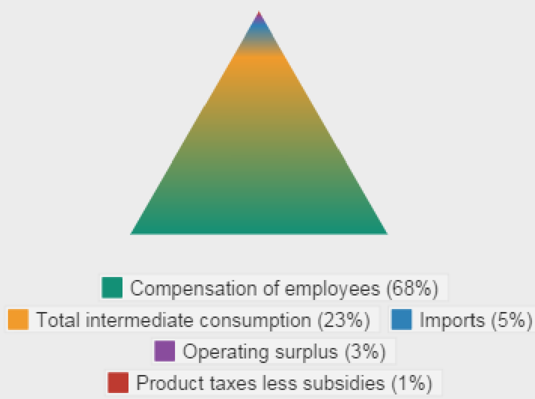


Table A1.6

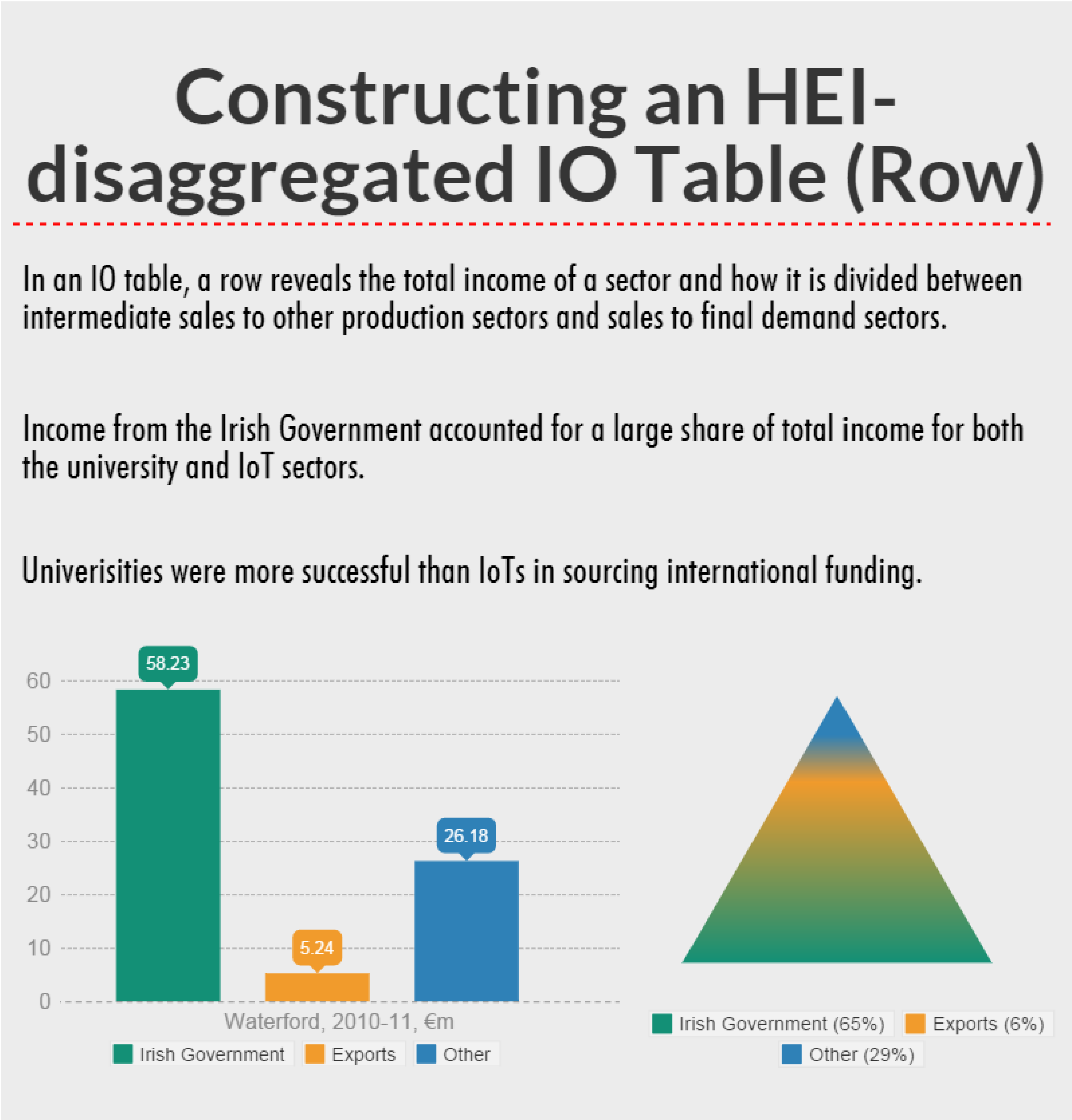

Constructing an HEI-disaggregated IO Table (Row)
In an IO table, a row reveals the total income of a sector and how it is divided between intermediate sales to other production sectors and sales to final demand sectors.
Income from the Irish Government accounted for a large share of total income for both the university and IoT sectors.
Univerisities were more successful than IoTs in sourcing international funding.
58.23
5.24
26.18
60
50
40
30
20
10
0
Waterford, 2010-11, €m
Irish Government
Exports
Other
Irish Government (65%)
Exports (6%)
Other (29%)

Figure A1.7

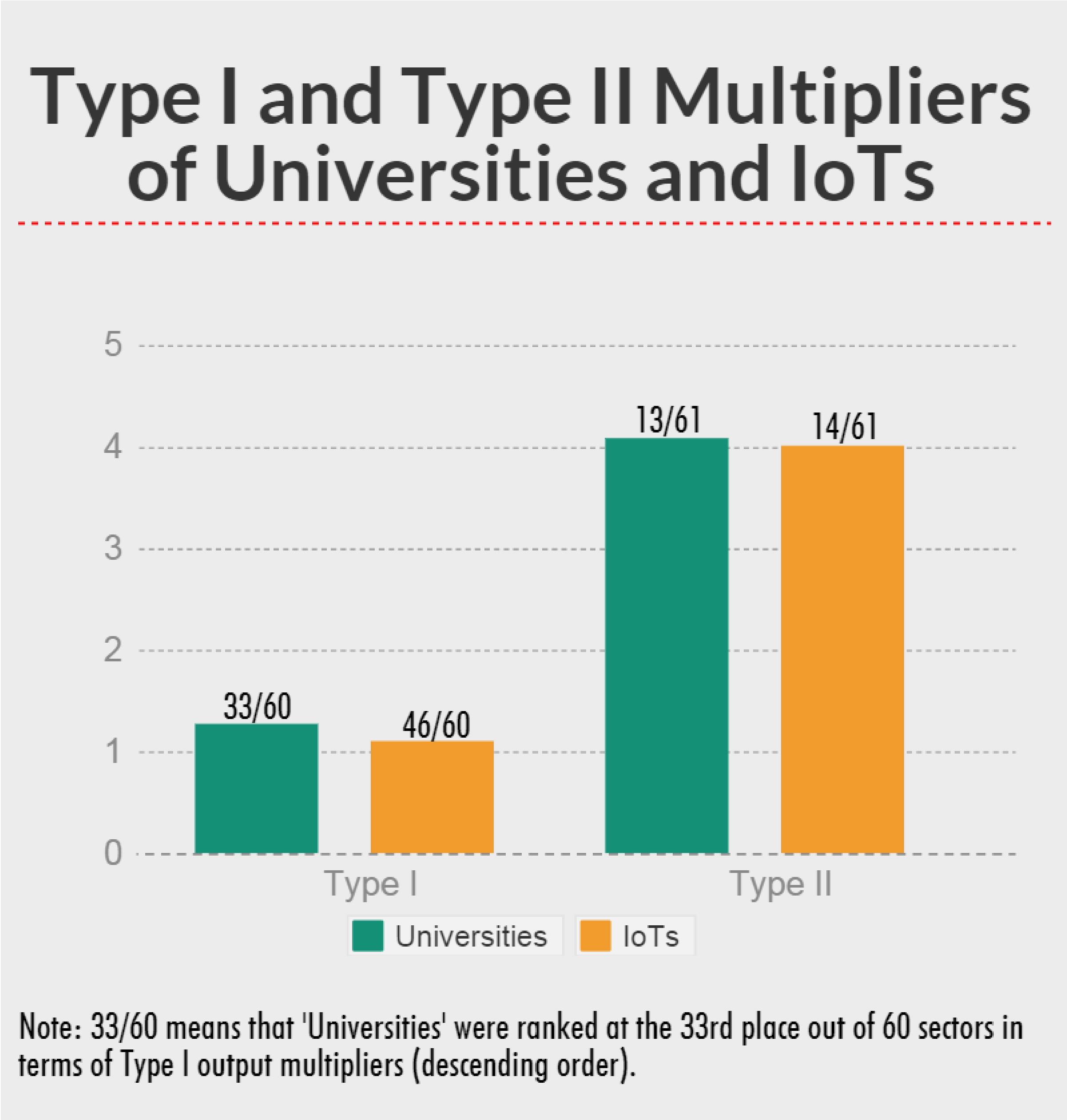

Type I and Type II Multipliers of Universities and IoTs
5
4
3
2
1
0
33/60
46/60
13/61
14/61
Type I
Type II
Universities
IoTs
Note: 33/60 means that 'Universities' were ranked at the 33rd place out of 60 sectors in terms of Type I output multipliers (descending order).

Figure A1.8

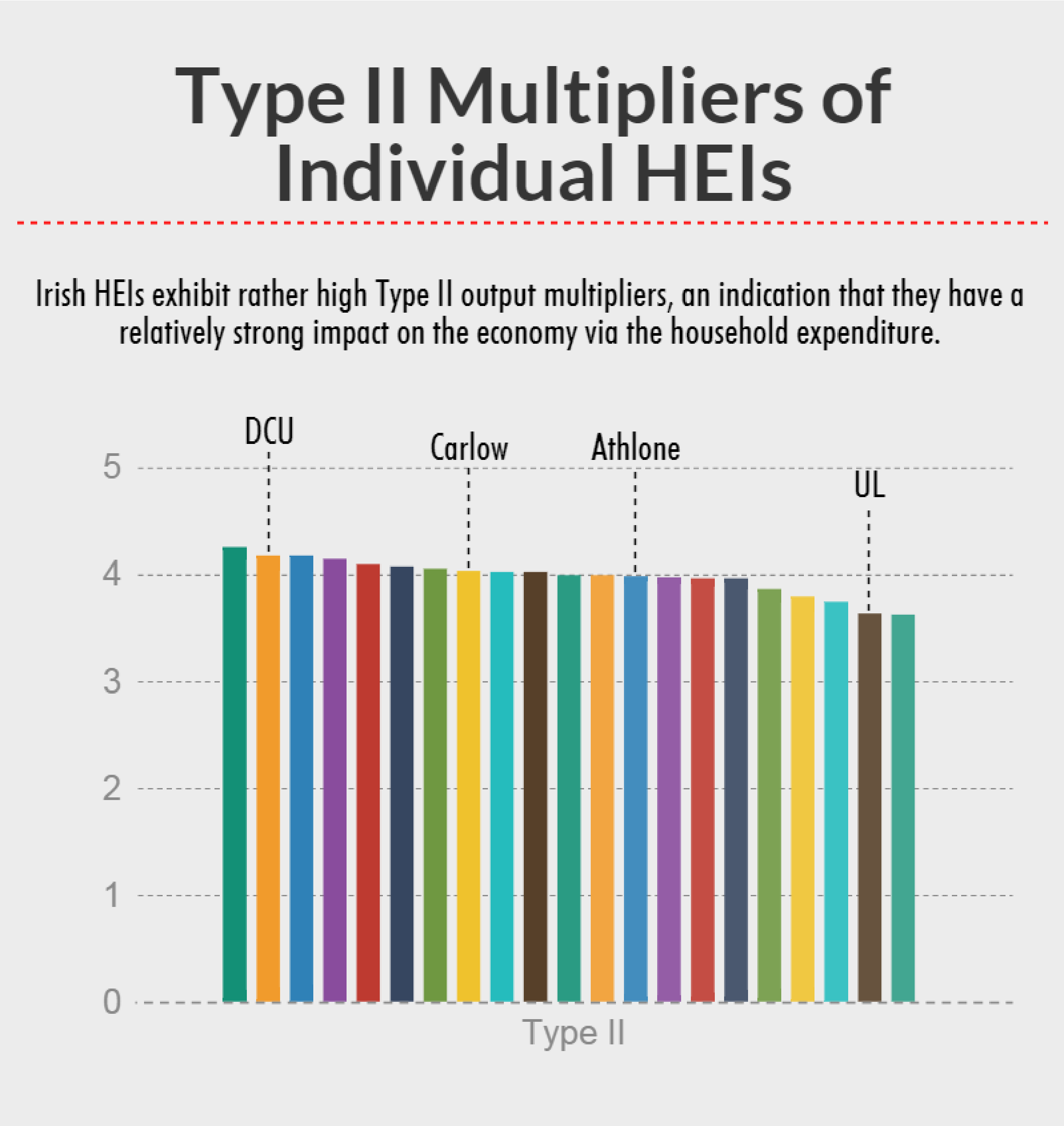

Type II Multipliers of Individual HEIs
Irish HEIs exhibit rather high Type II output multipliers, an indication that they have a relatively strong impact on the economy via the household expenditure.
DCU
Carlow
Athlone
UL
5
4
3
2
1
0
Type II

Figure A1.9

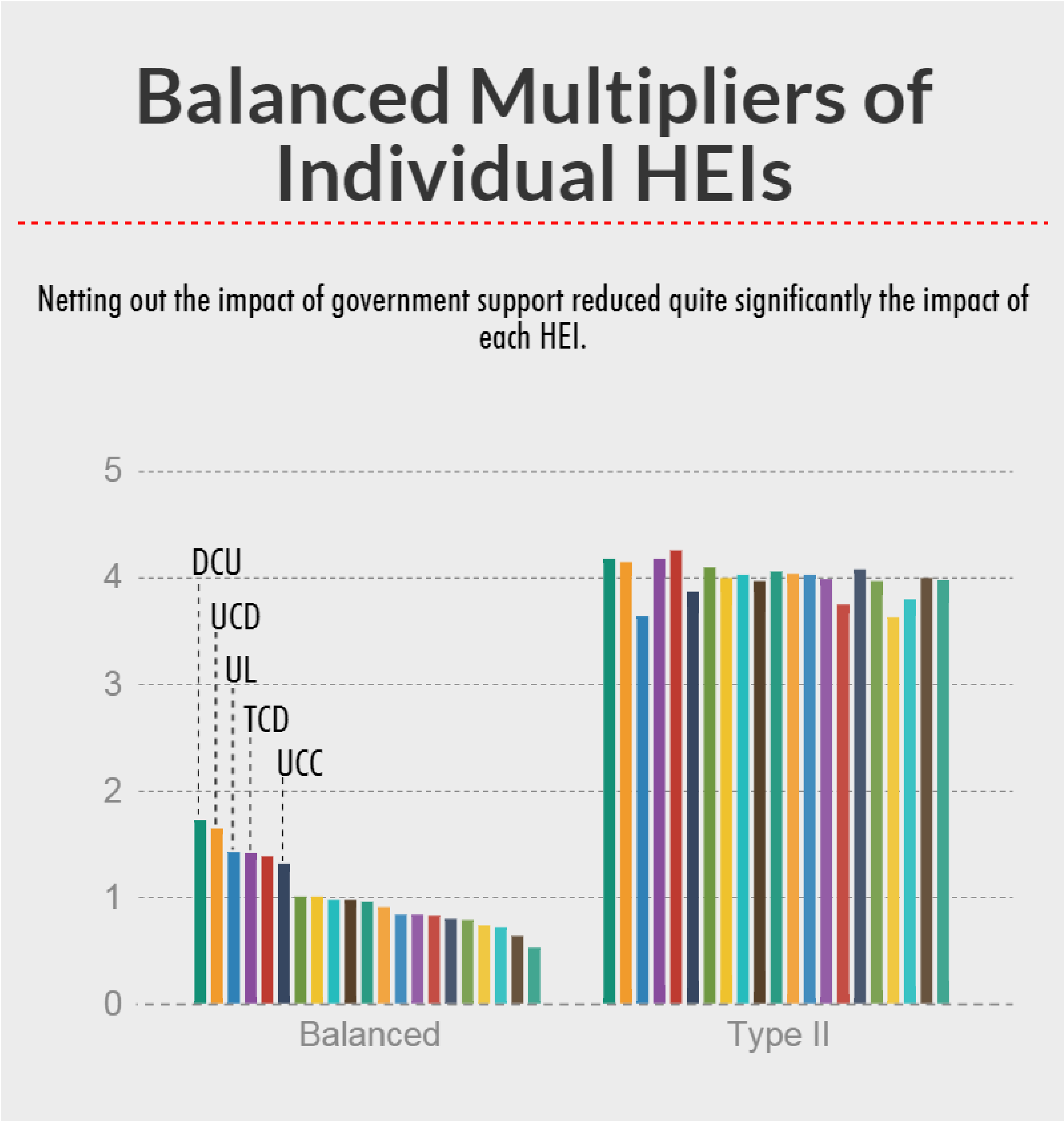

Balanced Multipliers of Individual HEIs
Netting out the impact of government support reduced quite significantly the impact of each HEI.
5
4
3
2
1
0
DCU
UCD
UL
TCD
UCC
Balanced
Type II

Figure A1.10

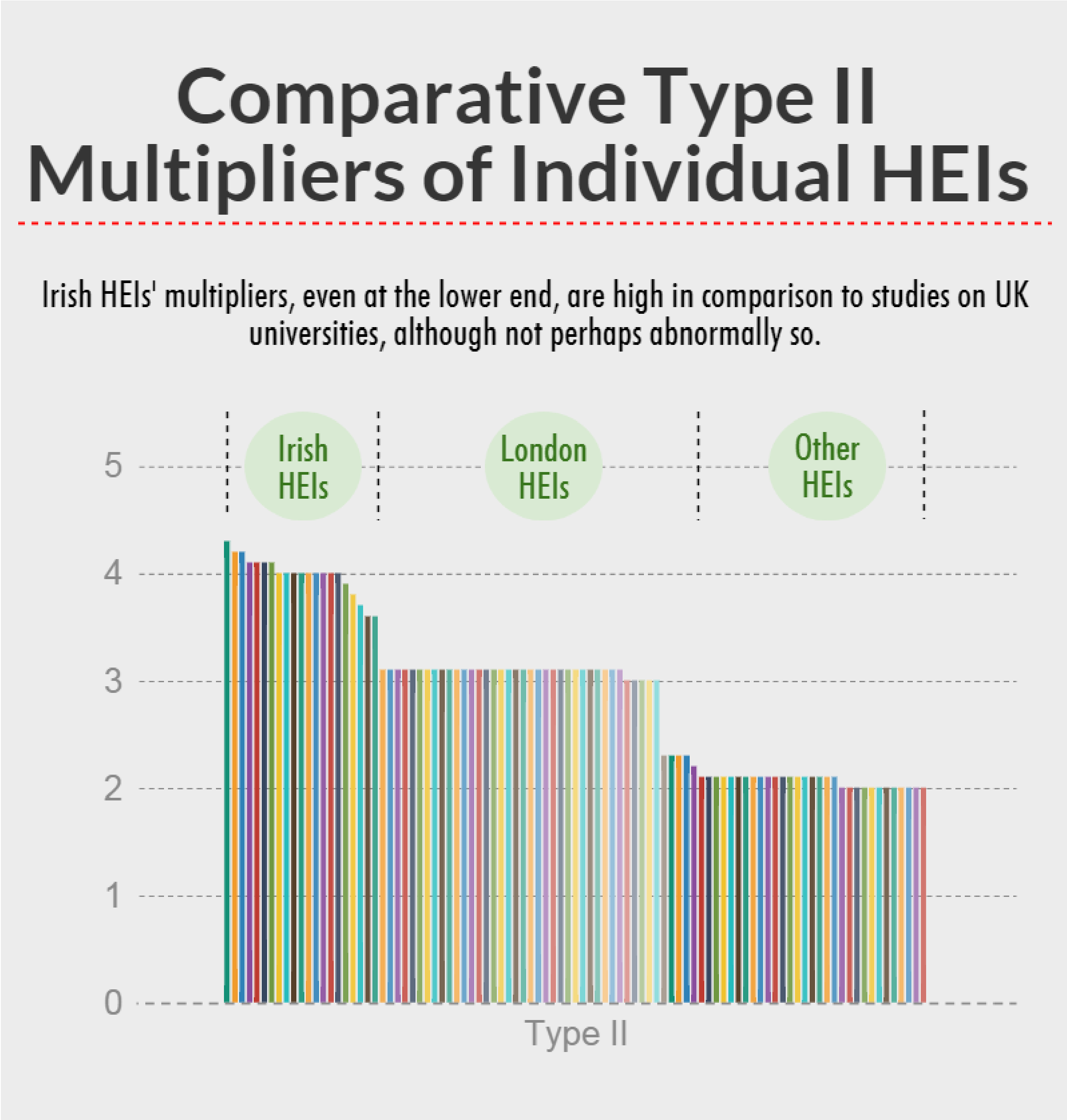

Comparative Type II
Multipliers of Individual HEIs
Irish HEIs' multipliers, even at the lower end, are high in comparison to studies on UK universities, although not perhaps abnormally so.
Irish HEIs
London HEIs
Other HEIs
5
4
3
2
1
0
Type II

Figure A1.11

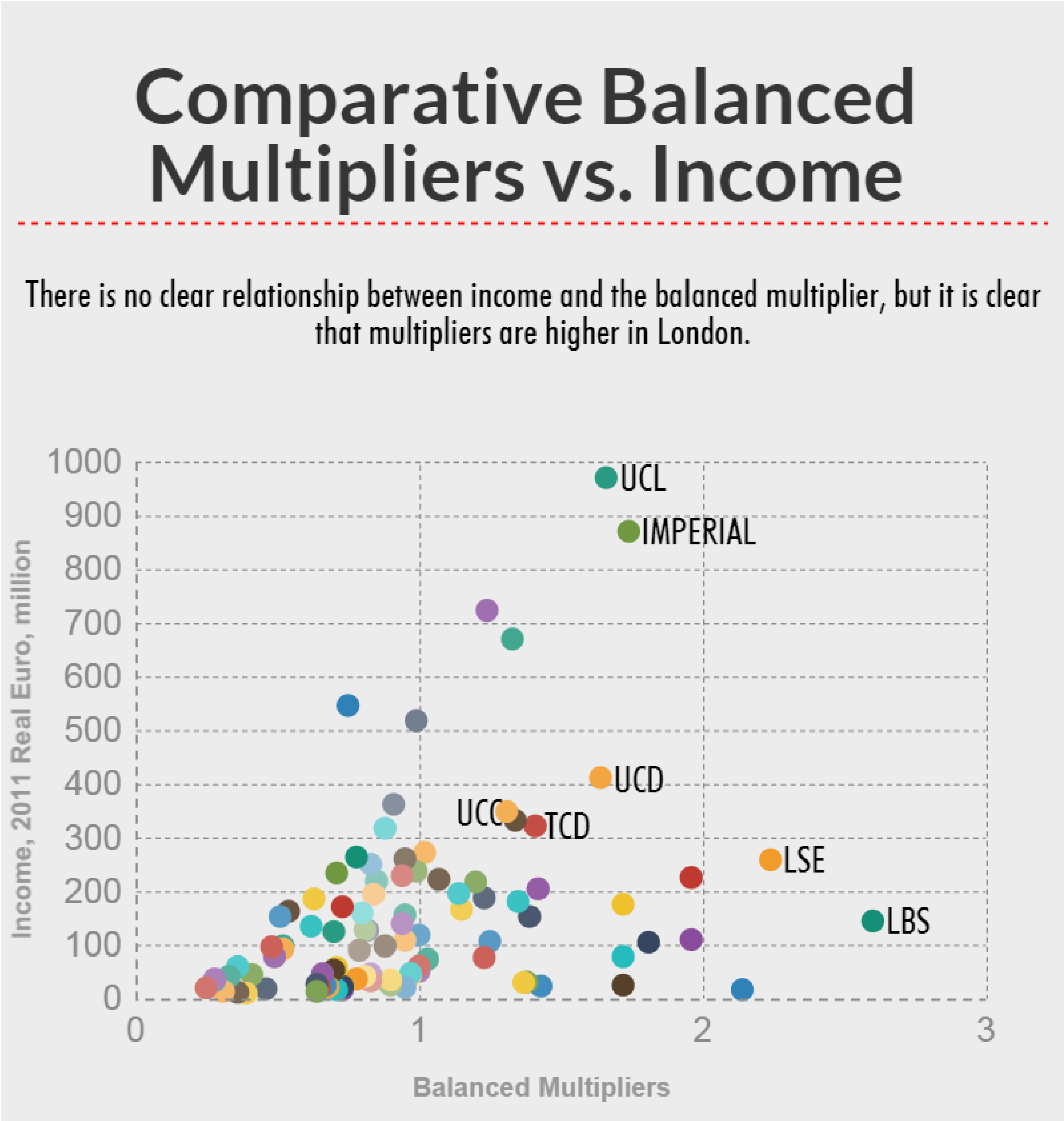
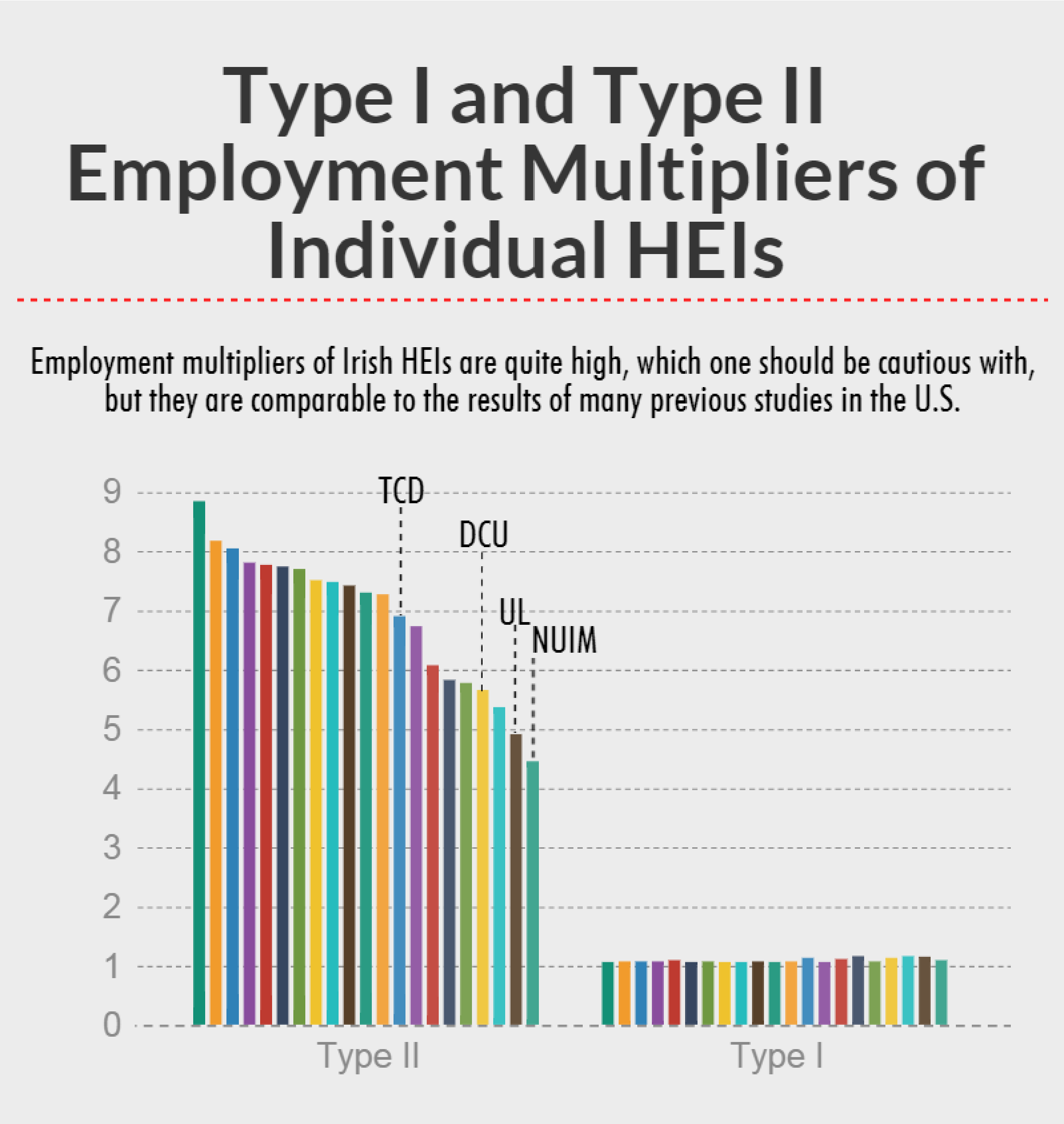

Comparative Balanced Multipliers vs. Income
There is no clear relationship between income and the balanced multiplier, but it is clear that multipliers are higher in London.
Income, 2011 Real Euro, million
1000
900
800
700
600
500
400
300
200
100
0
0
1
2
3
Balanced Multipliers
UCL
IMPERIAL
UCD
UCC
TCD
LSE
LBS

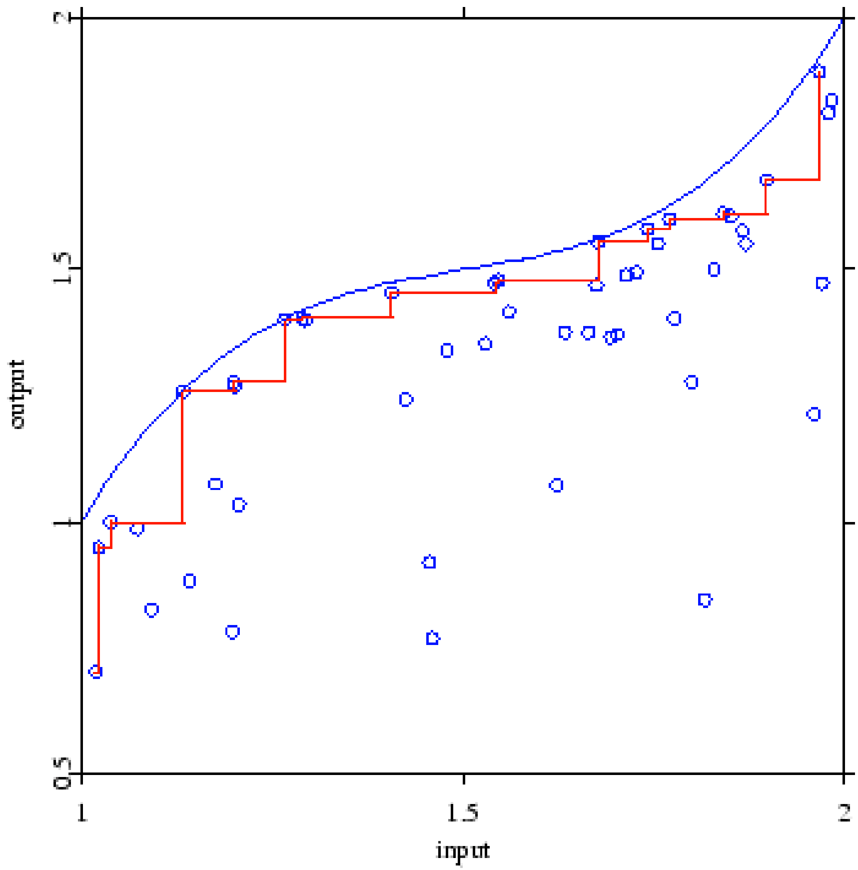
Figure A1.12


Type I and Type II Employment Multipliers of Individual HEIs
Employment multipliers of Irish HEIs are quite high, which one should be cautious with, but they are comparable to the results of many previous studies in the U.S.
9
8
7
6
5
4
3
2
1
0
TCD
DCU
UL
NUIM
Type II
Type I

Next steps:

- "Solow" economic impact analysis
- Analysis of the effectiveness of the higher education – innovation policy – firms triple helix.
- Sector efficiency analysis using the method of Data Envelopment Free Disposable Hull (known as FDH in DEA). This is a form of operations research which benchmarks actual versus potential

Figure A1.13



- Blue – parametric but may not be achievable
- Red – Nonparametric, FDH, observationally achievable
- Objective is to evaluate for universities and for innovation offices
  - Returns to scale
  - Input efficiency
  - Output efficiency

The Solow-Swan model outlined:

Solow-Swan equations

$Y = Af(K, L)$ (production function)

Y = GDP, A = technology,

K = capital, L = labour

$$\frac{dK}{dt} = sY - \delta K \quad \text{(capital accumulation equation)}$$

s = proportion of GDP saved $(0 < s < 1)$

δ = depreciation rate (as proportion) $(0 < \delta < 1)$

Solow-Swan analyse how these two equations interact.

Y and *K* are endogenous variables; *s*, δ and growth rate of *L* and/or *A* are exogenous (parameters).

Outcome depends on the **exact** functional form of production function and parameter values.

Neoclassical production functions

Solow-Swan assume:

a) diminishing returns to capital or labour (the 'law' of diminishing returns), and

b) constant returns to scale (e.g. doubling *K* and *L*, doubles *Y*).

For example, the Cobb-Douglas production function

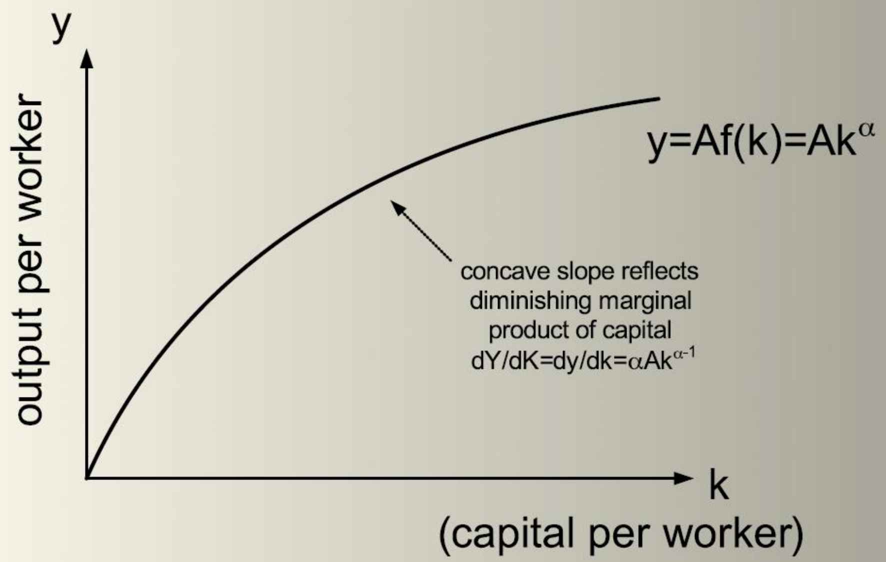
$$Y = AK^{\alpha}L^{1-\alpha} \qquad \text{where } 0 < \alpha < 1$$

$$y = \frac{Y}{L} = \frac{AK^{\alpha}L^{1-\alpha}}{L} = \frac{AK^{\alpha}}{L^{\alpha}} = A\left(\frac{K}{L}\right)^{\alpha} = Ak^{\alpha}$$

Hence, now have *y* = output (GDP) per worker as function of capital to labour ratio (*k*)

GDP per worker and *k*

Assume *A* and *L* constant (no technology growth or labour force growth)



Accumulation equation

If *A* and *L* constant, can show*

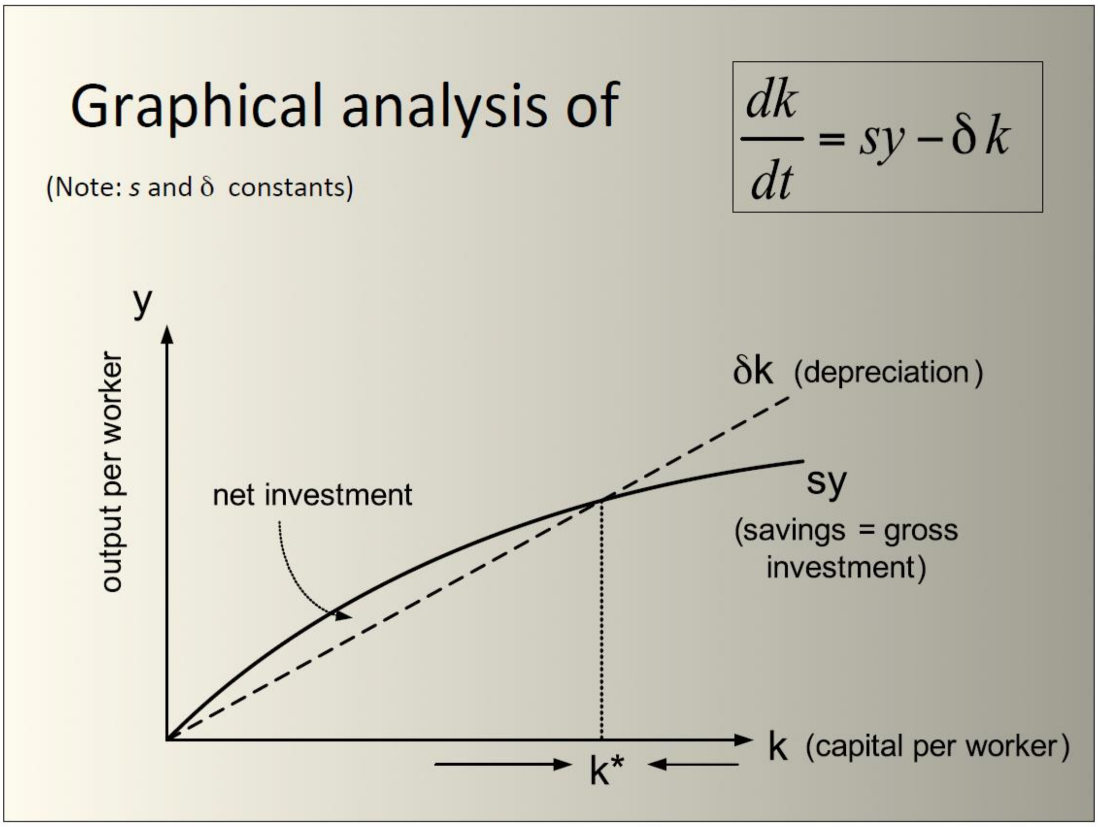
$$\frac{dk}{dt} = sy - \delta k$$

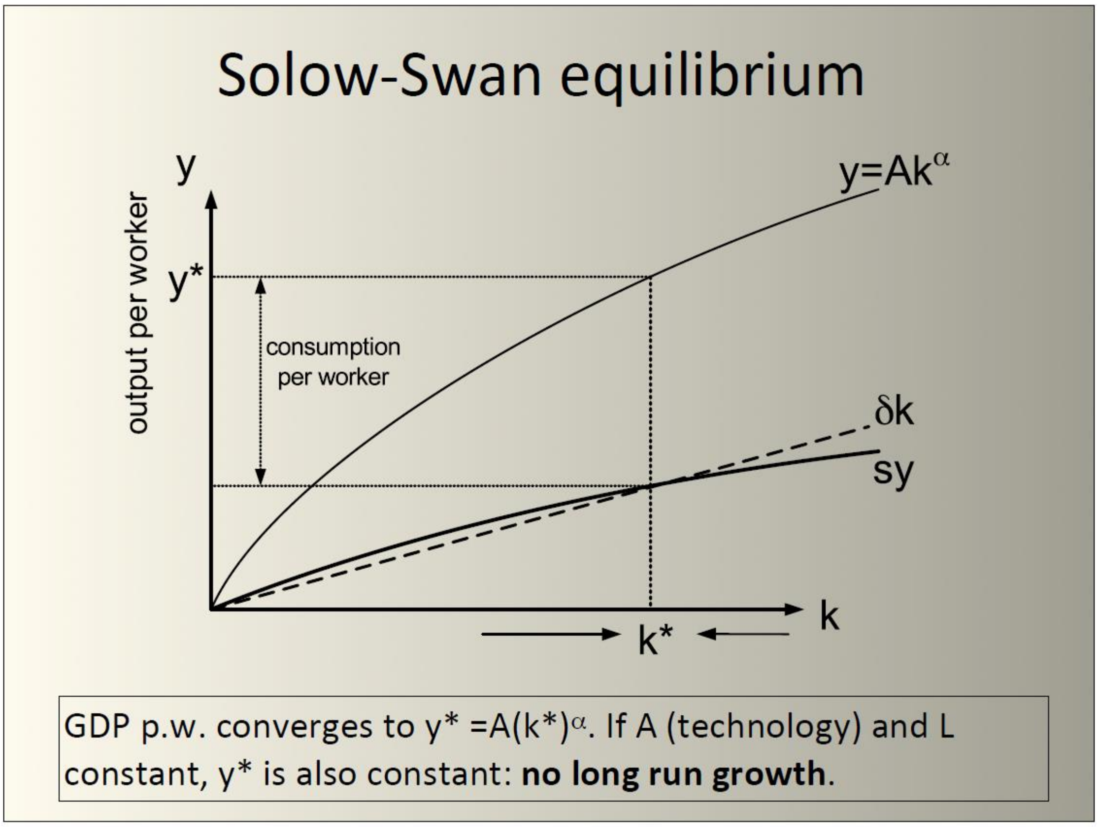
This is a differential equation. In words, the change in capital to labour ratio over time = investment (saving) per worker ***minus*** depreciation per worker.

Any positive change in *k* will increase *y* and generate economic growth. Growth will stop if *dk/dt=0.*

*accumulation equation is: $\frac{dK}{dt} = sY - \delta K$, divide by L yields $\frac{dK}{dt}/L = sy - \delta k$

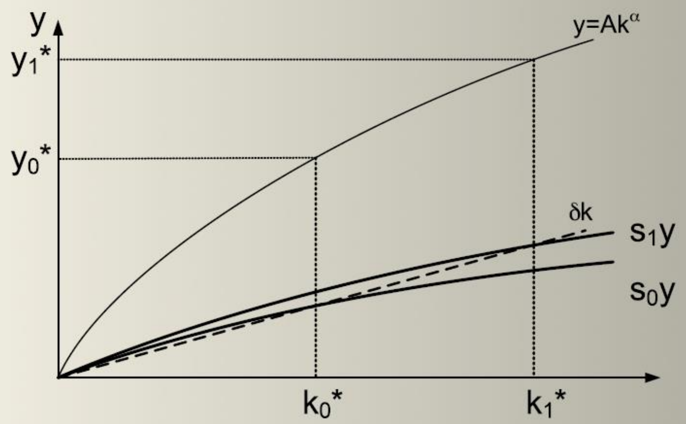
Also note that, $\frac{dk}{dt} = d\left(\frac{K}{L}\right)/dt = \frac{dK}{dt}/L$ since L is a constant.


Graphical analysis of
$\frac{dk}{dt} = sy - \delta k$
(Note: s and δ constants)
y
output per worker
δk (depreciation)
net investment
sy
(savings = gross investment)
k (capital per worker)
k*


Solow-Swan equilibrium
y
y=Akα
output per worker
y*
consumption per worker
δk
sy
k
k*
GDP p.w. converges to y* =A(k*)α. If A (technology) and L constant, y* is also constant: no long run growth.

What happens if savings increased?

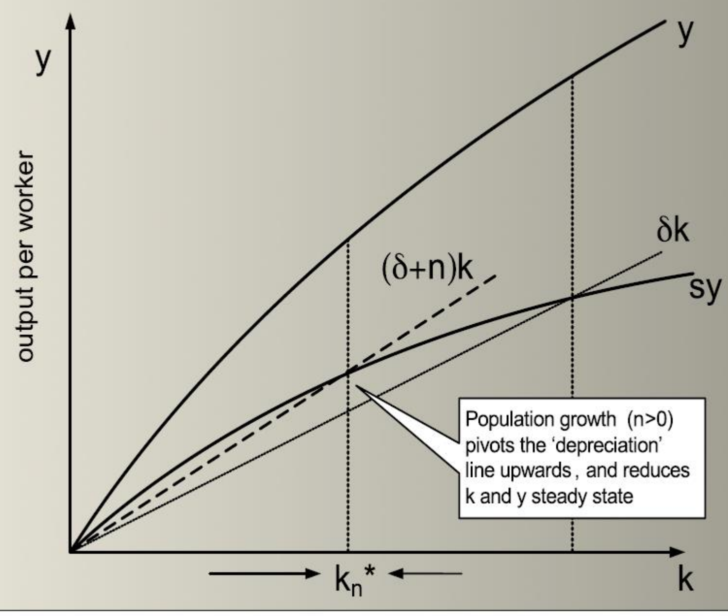
- raising saving increases k^* and y^*, but long run growth still zero (e.g. $s_1 > s_0$ below)
- call this a "levels effect"
- growth increases in short run (as economy moves to new steady state), but no permanent 'growth effect'.

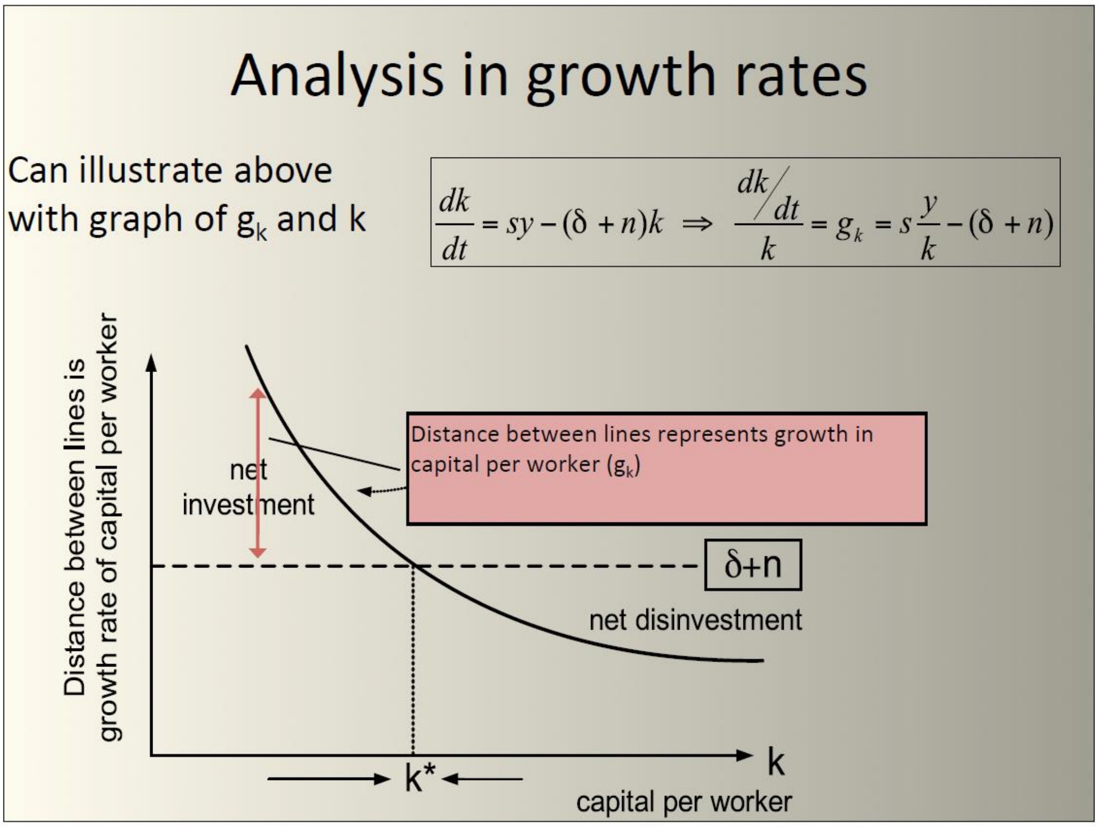


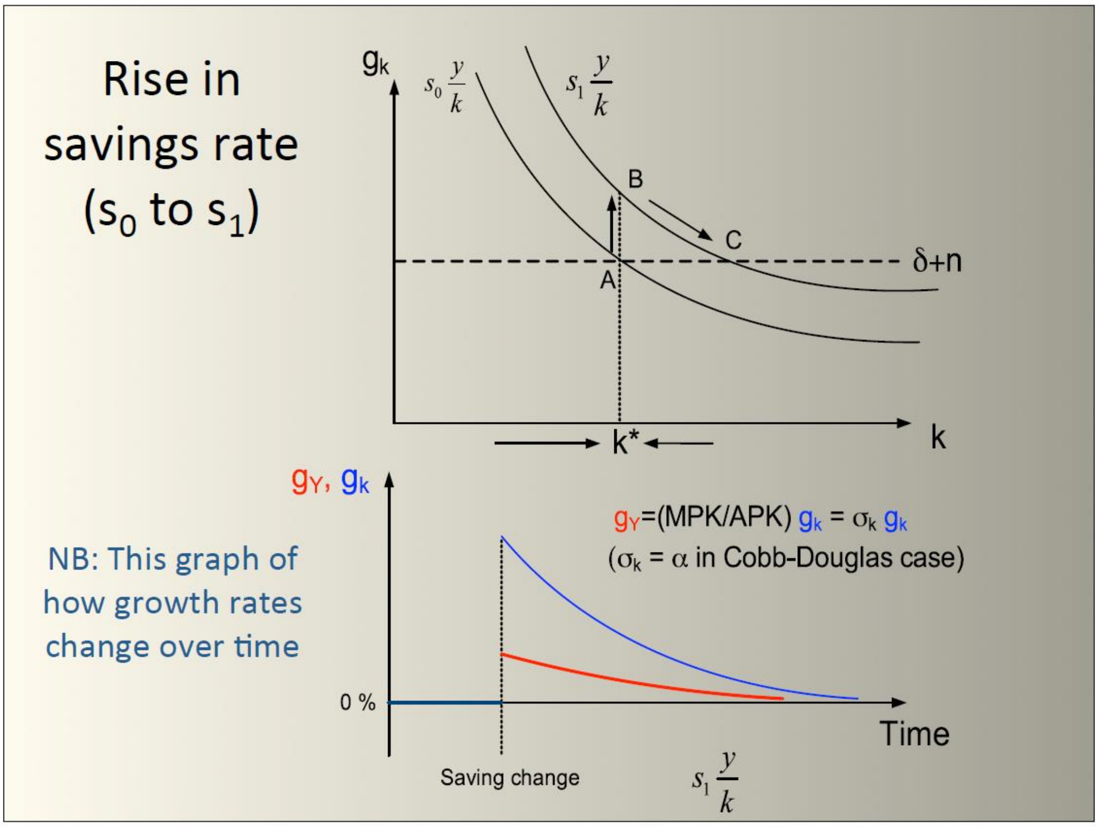
What if labour force grows?

Accumulation eqn now $\frac{dk}{dt} = sy - (\delta + n)k$ where $n = \frac{dL}{dt} / L$ (math note 2)

Population growth reduces equilibrium level of GDP per worker (but **long run growth still zero**) if technology static




Analysis in growth rates
Can illustrate above with graph of g_k and k
$\frac{dk}{dt} = sy - (\delta + n)k \Rightarrow \frac{dk/dt}{k} = g_k = s\frac{y}{k} - (\delta + n)$
Distance between lines is growth rate of capital per worker
net investment
Distance between lines represents growth in capital per worker (g_k)
δ+n
net disinvestment
k*
k
capital per worker


Rise in savings rate (s_0 to s_1)
g_k
$s_0\frac{y}{k}$
$s_1\frac{y}{k}$
B
C
A
δ+n
k*
k
g_Y, g_k
NB: This graph of how growth rates change over time
g_Y=(MPK/APK) g_k = σ_k g_k
(σ_k = α in Cobb-Douglas case)
0 %
Time
Saving change
$s_1\frac{y}{k}$

Golden rule

- The 'golden rule' is the 'optimal' saving rate (s_G) that maximises consumption per head.
- Assume *A* is constant, but population growth is *n*.
- Can show that this occurs where the marginal product of capital equals (δ + *n*)

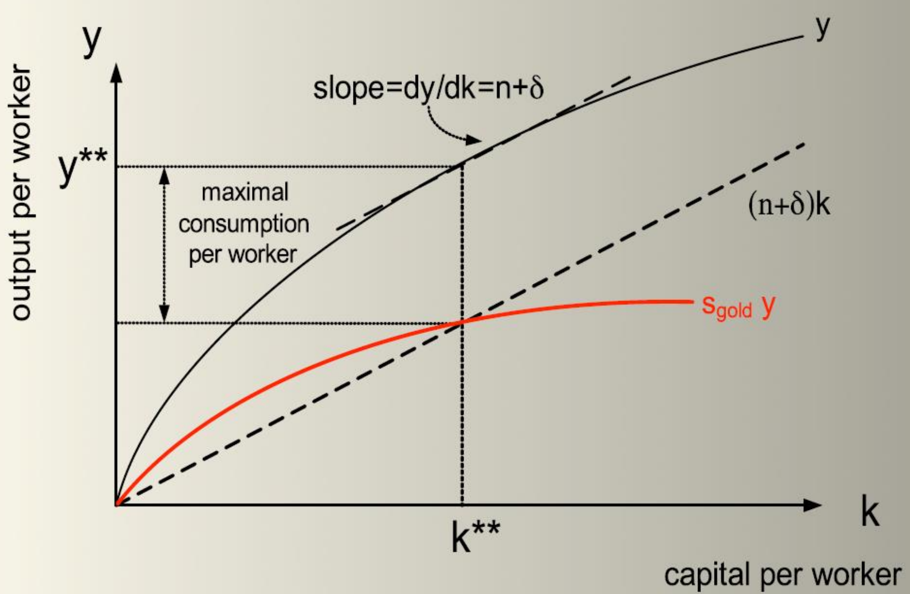
Proof: $\frac{dk}{dt} = sy - (\delta + n)k = 0$ at steady state,

hence $sy* = (\delta + n)k*$, where * indicates steady state equilibrium value

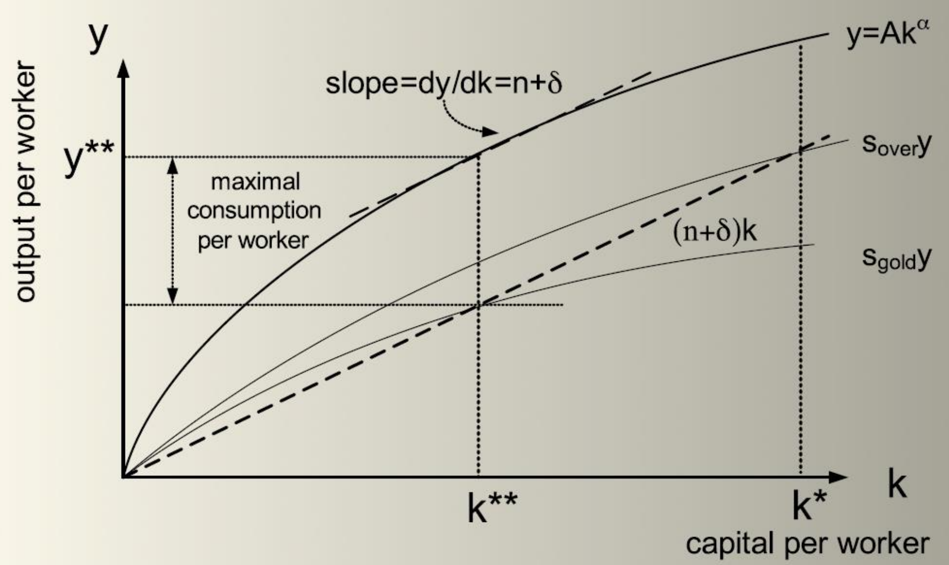
The problem is to: $\max_k c = y - sy = y^* - (\delta + n)k^*$

First order condition: $0 = \frac{dy^*}{dk^*} - (\delta + n)$ hence $MP_k = \frac{dy^*}{dk^*} = \delta + n$

Graphically find the maximal distance between two lines



… over saving



Economies can **over save**. Higher saving does increase GDP per worker, but real objective is consumption per worker.

Golden rule for Cobb Douglas case

- $Y=K^{\alpha}L^{1-\alpha}$ or $y = k^{\alpha}$
- Golden rule states: $MP_k = \alpha(k^*)^{\alpha-1} = (n + \delta)$
- Steady state is where: $sy^* = (\delta + n)k^*$
- Hence, $sy^* = [\alpha(k^*)^{\alpha-1}]k^*$

  or $s = \alpha(k^*)^{\alpha} / y^* = \alpha$

  Golden rule saving ratio = α for $Y=K^{\alpha}L^{1-\alpha}$ case

Assuming perfect competition, and factors are paid marginal products, α is share of GDP paid to capital (see C&S, p.481). Expect this to be 0.1 to 0.3.

Solow's surprise*

- Solow's model states that investment in capital cannot drive **long run** growth in GDP per worker
- Need technological change (growth in A) to avoid **diminishing returns to capital**
- Easterly (2001) argues that "capital fundamentalism" view widely held in World Bank/IMF from 60s to 90s, despite lessons of Solow model
- Policy lesson: don't advise poor countries to invest without due regard for technology and incentives

* This is title of Chapter 3 in Easterly (2001), which is worth a quick read for controversy surrounding growth models and development issues

What if technology (*A*) grows?

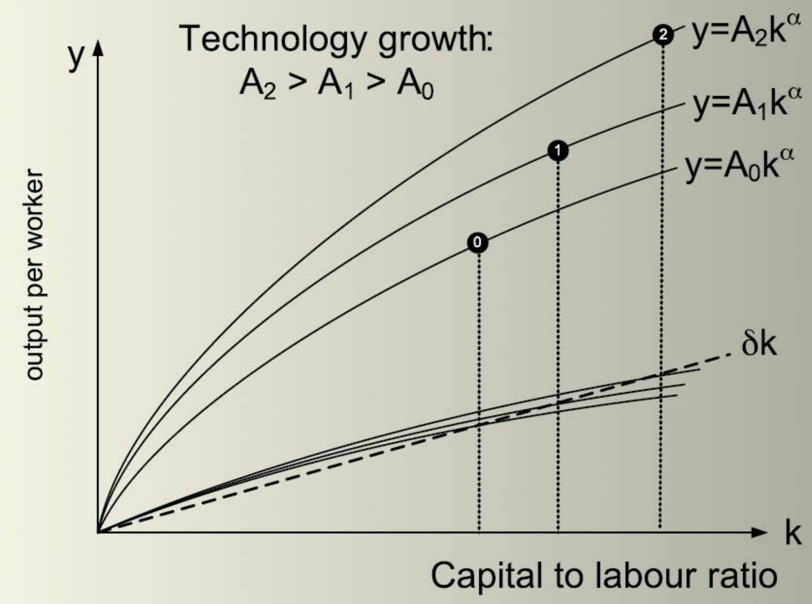
- Consider $y=Ak^{\alpha}$, and $sy=sAk^{\alpha}$, these imply that output can go on increasing.
- Consider marginal product of capital (MP_k)

$$MP_k = dy/dk = \alpha A k^{\alpha-1},$$

if *A* increases then MP_k can keep increasing (no 'diminishing returns' to capital)

- implies **positive long run growth**

…. graphically, the production function simply shifts up



…. mathematically

Easier to use $Y = K^{\alpha}(AL)^{1-\alpha}$ where $0 < \alpha < 1$

(This assumes A augments labour (Harrod-neutral technological change)

Can re-write $K^{\alpha}(AL)^{1-\alpha} = A^{1-\alpha}K^{\alpha}L^{1-\alpha}$

Assume $\frac{dA}{dt}/A = g_A$ (for reference this same as $A_t = A_0 e^{g_A t}$)

Trick to solving is to re-write as

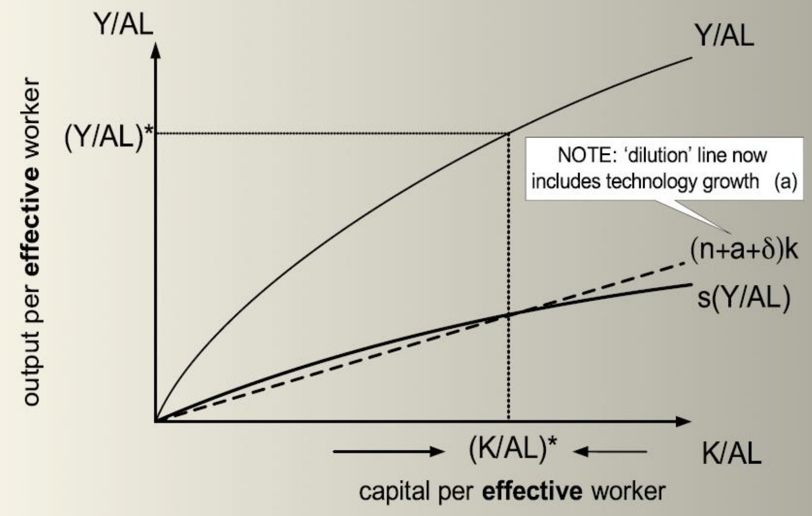
$$\tilde{y} = \frac{Y}{AL} = \frac{K^{\alpha}(AL)^{1-\alpha}}{AL} = \left(\frac{K}{AL}\right)^{\alpha} = (\tilde{k})^{\alpha}$$

where $\tilde{y}$=output per 'effective worker', and $\tilde{k}$ = capital per 'effective worker'

Can show $\frac{d\tilde{k}}{dt}/\tilde{k} = s(\tilde{k})^{\alpha} - (n + a + \delta)\tilde{k}$

This can be solved (plotted) as in simpler Solow model.

Output (capital) per effective worker diagram



If *Y/AL* is a constant, the growth of Y must equal the growth rate of *L* plus growth rate of *A* (i.e. *n*+*a*)

And, **growth in <u>GDP per worker</u> must equal growth in *A*.**

Summary of Solow-Swan

- Solow-Swan, or neoclassical, growth model, implies countries converge to steady state GDP per worker (if **<u>no growth</u>** in technology)
- if countries have same steady states, poorer countries grow faster and 'converge'
  - call this classical convergence or 'convergence to steady state in Solow model'
- changes in savings ratio causes "level effect", but no **long run** growth effect
- higher labour force growth, ceteris paribus, implies lower GDP per worker
- Golden rule: economies can over- or under-save (note: can model savings as endogenous)

Endnotes

Math note 1: $y_t = y_0 e^{gt}$ can be used to analyse impact of growth over time

Let y=GDP p.w., g=growth (e.g. 0.02 ≡ 2%), t=time.

Hence, for $g = 0.02$ and $t = 100$, $y_t / y_0 = e^2 = 7.39$

Math Note 2:

Start with $\frac{dK}{dt} = sY - \delta K$, divide by L yields $\frac{dK}{dt} / L = sy - \delta k$

Note that $\frac{dk}{dt} = d\left(\frac{K}{L}\right) / dt = \left[\frac{dK}{dt} L - \frac{dL}{dt} K\right] / L^2$ (quotient rule)

simplify to $\frac{dK}{dt} / L - \left(\frac{dL}{dt} / L\right)\frac{K}{L}$ or $\frac{dK}{dt} / L - nk$ (since n is labour growth and $K / L = k$)

hence $\frac{dk}{dt} + nk = \frac{dK}{dt} / L = sy - \delta k$

hence $\frac{dk}{dt} = sy - (\delta + n)k$

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Appendix II – Input-Output Analysis Academic Paper

The economic impact of higher education institutions in Ireland: Evidence from disaggregated input output tables

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Abstract

While there has been a long history of modelling the economic impact of higher education institutions, little research has been undertaken in the context of Ireland. This paper provides, for the first time, a disaggregated input output table for Ireland's higher education sector. The picture painted overall is a higher education sector that adds considerable gross value to the national economy, whether via state or other income. In 2010-11, the gross income of Irish higher education institutions, as a total of €2.6 billion, generated gross output nationwide of €10.6 billion. This study is a first step in forming an evidence base for policy decision, and could also contribute to the major challenges facing the sector in a post-Bailout environment.

Keywords

Input output analysis, economic impact, Ireland, universities, institutes of technology

JEL classification

C67, H52, I23, I26

1. Introduction

In the last decades, numerous studies have examined the economic impact of such diverse actions such as sports events (Badde & Dye, 1990; Crompton, 1995; Oxford Economics, 2012), large scale cultural projects (Saayman & Saayman, 2006; Travers, 2006), and industrial sectors (Hall,

Hodges & Haydu, 2006; OECD, 2004). Generally, an economic impact analysis is conducted when there is public concern about the impacts of those actions. In the context of the fiscal crisis since 2008, there has been mounting pressure on recipients of exchequer funding to ensure value for money, as many nations have been faced with a government budget constraint. Deriving a large proportion of income from official sources, higher education institutions (HEIs) are not immune to these challenges. Nevertheless, the modern history of modelling the impact of HEIs goes back to as early as the 1970s. In the U.S., Caffrey and Issacs (1971) outlined a template which has been followed by much of the work examining the regional impact of American universities and colleges, often in the context of budgetary negotiations. Outside the U.S. the largest extant set of studies is on the UK, where the foundational work is that of Brownrigg (1973) on the University of Stirling, followed by Bleaney, Binks, Greenaway, Reed and Whynes (1992) on the University of Nottingham. In the UK and Europe, similar studies have also been conducted on many other universities such as the University of Portsmouth (Harris, 1997), Izmir University of Economics (Sen, 2011), and the University of Aberdeen (Battu, Finch & Newlands, 1998).

The evaluation of the economic impact of HEIs has mainly been undertaken in two methodological strands. While most early studies used a Keynesian multiplier approach, more recent work has tended to concentrate on input output modelling. Developed by Leontief in the late 1930s, the input output framework aims to analyse the interdependence of industries in an economy at many geographic levels – local, regional, national, and international. The seminar paper is Leontief (1936) and a discussion of the importance of the approach is given in Baumol (2000). When constructing the Leontief input output model, one is concerned with the flows of products from each industrial sector, considered as a producer, to each of the sectors, itself and others, considered as consumers. Dependent on specific sector classifications, the number of industries considered in practice may vary significantly. Nevertheless, input output analysis has become one of the most widely applied methods in economics and been recognised as a useful tool to understand the impact of individual industries in the whole economy.

In the UK, there have seen analyses of HEIs via the input output model over the last 15 years (see e.g., Kelly & McNicoll, 1997; Universities UK, 2014). The model has further been extended to construct an HEI-disaggregated input output table, with each HEI being considered as a separate sector (Hermannsson, Lisenkova, McGregor & Swales, 2010a, 2010b, 2010c). To our knowledge, little research of this kind has been undertaken in the context of Irish higher education sector. In this paper, we provide an economic impact analysis of the majority of the Irish tertiary education sector, representing one of the first public attempts to analyse the higher education space in Ireland. Indeed, while there has been a lot of talk about the financial sustainability of

higher education and the search for new funding models in universities and other third level institutions in Ireland, little empirical evidence exists to guide policy-making. Our analysis serves as the first step in forming an evidence base, which could also inform the major challenges facing the sector in a post-Bailout environment.

For an institution, sector or industry, its overall impacts are most likely to be multifaceted and greater than what an economic impact analysis could measure. It has been widely recognised that universities generate a wide range of benefits with impacts on the economy, society, and their nation's cultural life (Felsenstein, 1996; Glasson, 2003; Goddard & Vallance, 2013; Huggins & Johsnton, 2009). Our analysis does not incorporate the human capital, research and development (R&D), and entrepreneurial economic returns generated by the sector, neither does it looks at the non-economic returns of education. To this effect, the study attempts to answer a direct question: Does the economy receive more than one euro's worth of economic activity for every euro it spends on tertiary education in Ireland?

The paper starts from recognition that the economic impact of Irish HEIs has hitherto not been examined in any detail. It has five further sections. The next section gives an overview of the historical development of the tertiary education sector in Ireland and highlights the recent policy context in which the sector is operated. The third section briefly introduces the previous research on measuring the economic impact of HEIs before outlining the methodology. Section four describes the data we use and how they are collected. The fifth section presents the main findings, including the output multipliers, balanced-budget multipliers, and employment multipliers, which are also compared to those of UK universities. The paper concludes with a discussion of the potential contributions our study could make to the current policy debates in Ireland.

2. Historical development of the Irish tertiary education sector and the policy context

The Irish educational sector follows the traditional Western format of primary, secondary and tertiary education, the latter of which is the focus of this study. However, this does not include all post-secondary education if the institutions in questions are engaged in certain aspects of delivery of post-secondary but not tertiary education courses. In the National Framework of Qualifications, levels 7-10 are outlined as tertiary education and they roughly equate to the obtaining of a bachelor degree through to a higher doctorate. The delivery of higher education has since the early 1970s been split between the Institutes of Technology (IoTs) and the universities, with the Higher Education Act 1971 providing a regulatory framework and structure of a 'sector' as opposed to a loose grouping of institutions in receipt of State funds. As of 2014 the sector is made up of seven

universities, 14 IoTs, and six colleges which are institutions with specialised course delivery in the areas of education and medicine.

The oldest institution in the Republic of Ireland is the University of Dublin, Trinity College, founded in 1592. Though of a relatively old foundation, Ireland does not have truly ancient foundations such as those that exist in the UK or in continental Europe. Until the 1970s there was relatively strict segregation between the National University of Ireland (founded in 1908) and Trinity College. Teacher training colleges were, and to a large extent are, aligned to the religious patron. University College Dublin, though a secular foundation, had its origins in Cardinal Newman's failed Catholic university of mid-nineteenth century. Similar foundations – the so-called Queen's Universities at Galway, Cork and Belfast – were made at the same time. What was to become the National University of Ireland at Maynooth was founded in 1795 as a Catholic seminary. The Royal College of Surgeons, Ireland was founded in 1784. Two national institutes of higher education were also formed in the 1970s and were to become Dublin City University and the University of Limerick during the courses of the 1980s.

The Dublin Institute of Technology (DIT), the oldest and largest of the IoTs, dates back to 1887, with the majority of the IoTs dating from the mid-1960s onwards. During most of this time, the IoTs were largely engaged in further education and apprenticeship activities with some of the larger institutes gradually taking on an active role in higher education delivery. DIT was at the forefront of this with a relationship with Trinity College dating from 1977. At present the IoTs are primarily engaged in higher education delivery with a number aiming to transit to the new status of technological university, pursuant to the Technological Universities Bill current being drafted by the Government.

Following the expansion of Irish secondary education in the mid-1960s, which is a result of the introduction of free secondary education by Minister for Education Donogh O'Malley, TD in 1969, the massification of higher education began (see e.g., Hyland, 2014; O'Connor, 2014). The continuous increase in student numbers was to continue from the early 1970s to the present day with at present in excess of 60 per cent of school leavers entering the sector. The national target, as stated in the *National Plan for Equity of Access to Higher Education* released in July 2008, was 72 per cent of school leavers by 2020 (HEA, 2008).

Though universities and education have been considered to be an important part of the national manpower and economic strategies, they only began to be considered as part of a national innovation, research and development industrial policy towards the late 1990s. This was following the milestone event of introducing free third level education in 1996 by Minister for Education Niamh Bhreathach, TD. The period between 1996 and the present has been one of great activity

in terms of national policy, with the passage of the Universities Act 1997 and the Institutes of Technology Act 2006, the establishment of Science Foundation Ireland in the Industrial Development Act 2003 and the creation in 2001 of the Irish Research Councils for Humanities and Social Sciences and Science, Engineering and Technology (now merged into the Irish Research Council). In 2006 the Department of Enterprise, Trade and Employment published the *Strategy for Science Technology and Innovation* aimed at placing research and higher education at the core of the Irish economic policy (DJEI, 2006). This was followed up by the Innovation Task Force, which reported in 2010, again placing the universities and their role in R&D at the core of the Irish industrial policy. Despite all this and a multitude of official and other reports on the finances and structures of the sector, little in the way of formal economic impact analysis has been undertaken.

Our analysis is confined to a single base year – 2010-11 – at which time the sector was only in the beginning of a process of downsizing staff and re-evaluating budgetary positions as a result of the Employment Control Framework and in the wider context of fiscal austerity imposed by the IMF-ECB-EU Bailout of December 2010. For the academic year 2010-11, the sector had a total of 185,342 students enrolled and employed 21,811 staff. The overall expenditure of the institutional side of the sector, not including the expenditure of staff and students, was €2.61 billion of which €1.45 billion was provided by government sources directly. Irish HEIs form an important part of the economy infrastructure, and generate substantial economy activity.

Among the overall expenditure of the State, education is one of the major expenditure heads, along with Health and Social Welfare. For the financial year ending 31 December 2010, Ireland spent €8.28 billion on education. The estimate by the Department of Public Expenditure of the amount of money that was spent by Third Level and Further Education was €1.7 billion, which represented 3.2 per cent of the total spend (Comptroller and Auditor General statement of total expenditure: €53.8 billion). In terms of overall revenue, using the Comptroller and Auditor General statement of total revenue (€35.6 billion), it absorbed 4.8 per cent of the annual tax intake. With regard to total public sector employees, noting that not all staff working in the third level sector would be considered members of the civil and/or public service, the sector represented 7 per cent of the total employees of the State in 2010. In 2011 the figures of the overall expenditure were essentially constant, with a change of approximately -3 per cent taking place year-on-year before rounding. Over the duration of the crisis (2008-present), it should be noted that, there has been a reduction of 2,246 staff from the sector and state expenditure per student has reduced from €8,897 in 2007-08 to €5,212 in 2013-14.

According to the 2014 edition of the OECD's *Education at a Glance* Ireland has around 80 per cent of those with a tertiary qualification are in employment, lower than the OECD average but

in the same grouping as other distressed economies such as Japan, Hungary, Greece, Italy and Spain. Ireland's level of enrolment of school leavers is very high with 47 per cent of 25-34 year olds holding a third level qualification. Ireland has entry rates of 24 per cent of school leavers into vocational third level education and 51 per cent of them into university-style third level education (OECD, 2014). It has also been found that the net private and public returns to education in Ireland are the highest in the OECD countries. In 2010 a male third level graduate in Ireland would expect returns over a secondary education of $454,223 privately and $283,815 to the public at large, more than twice the OECD average and followed, only distantly, by the U.S. These financial returns exclude certain non-monetary outcomes that the OECD has begun to track for third level graduates, such as improved health outcomes, increased level of trust and higher levels of social and political engagement. All of this must be seen within the context of Ireland's difficult domestic labour market situation, outward migration and a worrying increase in the number of persons under 30 who are classified as NEETs (neither in employment nor in education or training). This challenging external macroeconomic environment must also be acknowledged while evaluating the results of this study.

3. Measuring the economic impact of higher education institutions

In the context of evaluation of the economic impact of HEIs, a comprehensive review of some of the methodological and interpretational challenges can be found in Siegfried, Sanderson and McHenry (2007). More recent discussions include McHenry, Sanderson and Siegfried (2012), Garrido-Yserte and Gallo-Rivera (2009), Pastor, Pérez and Fernández de Guevara (2013), which papers all in effect urge caution over grandiose claims for impact. Particularly, universities have significant downstream effects on society and on the economy from skill enhancement, which are both conceptually and empirically difficult to measure. Private and public benefits are clearly identified from attainment of higher education – see Kelly, O'Connell and Smyth (2011), Long (2010), and Oppedisano (2014) as examples of studies that focus on different aspects of this measurement issue. In this paper we, as already mentioned, concentrate on a high-level macroeconomic impact.

The methodology employed in this paper for the construction of the input output table follows the normal approaches that have been clearly defined in previous studies. In general, input output modelling assumes two types of spending – exogenous and endogenous. Exogenous spending is assumed to be independent of the sectors being modelled, while endogenous spending is determined within and reacts to shocks to the sectors. Government spending, exports and

investment are typically taken as exogenous. Household spending can be treated as either exogenous or endogenous. If endogenous, the system is said to be 'closed' to the household sector and a system that is so closed yields Type II multipliers. A key assumption underlying input output modelling is that the system is demand not supply determined, thus the supply side is passive, fixed. We can justify this either by suggesting we are in a situation of excess capacity and negative output gap (as was certainly the case in Ireland in 2008-13), or if we concern ourselves with long-run scenarios where such limitations are non-binding, that the system can draw in more than sufficient labour and capital to eliminate capacity constraints.

There are a variety of multiplier effects one could derive from the input output analysis, including output, income, employment or gross domestic product (GDP). The output multiplier for each sector refers to "*the change in total output for the economy as a whole resulting from a unit change in the final demand for that sector*" (Hermannsson, Lisenkova, McGregor & Swales, 2014). The Type I output multiplier for a particular industry is defined to be "*the total of all outputs from each domestic industry required in order to produce one additional unit of output*" (Scottish Government, 2011), while the Type II output multiplier incorporates "*not only the increase in demand for intermediate inputs but also induced household consumption effects*" (Hermannsson et al., 2014). In other words, the Type I multiplier can be defined as direct and indirect effects, and the Type II multiplier can be defined as direct, indirect and induced effects. As this paper is concerned with high level economic impact of Irish HEIs, it is mainly the Type II output multipliers that are presented.

3.1. Constructing Type I and Type II output multipliers

In the standard input output model endogenous final output is determined by exogenous final demands via the Leontief inverse. Let:

$$X_i + f = q \qquad (1)$$

$$i^T X + y^T = q^T \qquad (2)$$

where X is an nxn matrix of intermediate sector to sector transactions with x_{ij} being the individual element of transactions from sector i to j, q the nx1 vector of output and y^T the 1xn vector of value adding inputs. If we replace x_{ij} with $a_{ij}q_j$, where

$$a_{ij} = {}^{x_{ij}}/_{q_j} \qquad (3)$$

then we can express the system as

$$Aq + f = q \tag{4}$$

where A is an nxn matrix of the technical coefficients. Subtracting Aq from both sides we get

$$f = q - Aq \tag{5}$$

If we then multiply both sides by the inverse of the $(I - A)$ matrix yields

$$q = (I - A)^{-1}f \tag{6}$$

where $(I - A)^{-1}$ is the Leontief inverse matrix, *q* is the endogenous vector of final outputs, and *f* the endogenous vector of final demands. The Leontief inverse shows the induced effects of any change in exogenous demand. Indirect effects arise from an increased demand for intermediate goods and, with Type II multipliers, induced effects arise via the impact of increased household income being directed to increased consumption demand.

The output multiplier for each sector *i*, m_i, is derived from the above. It is the change in total economic output from a unit change in final demand for that sector and is estimated as the sum of the entries in the relevant column of the Leontief inverse. This gives gross output q^i attributable to the final demands for the output of sector *i* as

$$q^i = m_i f_i \tag{7}$$

A further exposition of input output modelling is provided by many authors; see Miller and Blair (2009) for a pedagogical demonstration.

3.2. Constructing balanced Type II output multipliers

As mentioned earlier, a large proportion of HEI income is derived from official sources. Government budgets are limited, thus a euro spent on higher education is, at the limit, a euro that cannot be spent on other public sector activities. In 2013, an investigation of the financial health of the Irish higher education sector was undertaken by an international accounting firm Grant Thornton (2013). They noted the financial strains the system is under, and believed that this sector had reached "an inflection point", highlighting the continual decline of state support since 2008.

Appendix A shows however that there is considerable variation in the degree of state support across institutions. Therefore it is useful to consider disaggregation of these multipliers to reflect this. Doing so allows us then to construct 'balanced' multipliers. Consider the following as being the impact for an HEI *i*, where *G* and *O* stand for the share of total funding from government and other sources respectively and *m* is the multiplier.

$$impact_i = m_i(G_i + O_i) \quad (8)$$

This is intuitive – the impact comes from both forms of expenditure. If we subtract the impact that comes from the government funding, $m_G G_i$, where m_G is the multiplier for general government we can see the 'balanced' impact as

$$Balanced\ impact_i = m_i(G_i + O_i) - m_G G_i = O_i m_i + G_i(m_i - m_G) \quad (9)$$

Dividing this through by total spend, $(G_i + O_i)$, we get a 'balanced multiplier' of

$$m_i^{balanced} = (1 - \alpha_i)m_i + \alpha_i(m_i - m_{G)} = m_i - \alpha_i m_G \quad (10)$$

where α_i is the government share in total final demand of the institution.

3.3. Constructing Type I and Type II employment multipliers

We can also calculate employment multipliers, analogously with the gross output multipliers. Instead of the output flows being included in the *A* matrix, we include job numbers, scaled by output. As with the output multipliers we can create both Type I and Type II employment multipliers. Due to space limitations, this section does not include detailed discussions of the mathematical process of employment multipliers, which could be found in Scottish Government (2011).

4. Data

Our analysis draws on a number of data sources, both primary and secondary. Due to data limitation we exclude the colleges of education and the private HEIs such as Hibernia College and Royal College of Surgeons in Ireland. The main focus of our analysis is therefore on the seven

universities and the 14 IoTs, where the bulk of third level public and private spending and students are located, and the results are reported for the university sector and the IoT sector respectively. To implement the input output analysis for each institution, the first and foremost thing to do is to construct an HEI-disaggregated input output table, which views each institution as a separate sector and captures its income and expenditure under different categories.

The HEI-disaggregated input output table was developed based on the 2010 Input-Output Table for Ireland with an individual row and column being created for each institution. The 2010 Input-Output Table for Ireland was published by the Central Statistical Office (CSO) in January 2014, providing a detailed picture of the transactions of goods and services by industries and consumers in the Irish economy (CSO, 2014). An essential task was to separate out the HEIs from the 'Education Service' sector as a whole from the National Accounts. The disaggregation was proceeded in two steps. Firstly, we disaggregated the 'Education Service' sector in the national table into a University sector, an IoT sector, and a residual education sector. Secondly, we further disaggregated the two new sectors into each individual institution. After that, we had an augmented input output table as the basis for our analysis.

4.1. Creating separate columns for each HEI (HEI expenditure)

In an input output table, a column reveals the total expenditure of a sector and how it is divided between intermediate inputs, imports and value added. Table 1 below describes the data sourced in creating a separate column for each HEI, with the level of detail differentiating universities and IoTs. Data on the institute expenditure in 2010-11 was sourced from the Higher Education Authority (HEA), the statutory planning and policy development body for higher education and research in Ireland. Both the university and IoT sectors include institutions that vary significantly in terms of size measured by expenditure (HEA, 2014). The HEA accounting data also shows the compensation of employees, consisting of all payments in cash as well as in kind.

Table 1

Summary of HEI columns

Column component	Level of detail: Universities	IoTs	Data source
Total expenditure	Individually determined	Individually determined	HEA (2014)
Imports	Individually determined	Proxied by assuming ratios for the university sector as whole hold for IoTs	IUA (2014)
Operating surplus	Proxied by assuming ratios for the education service sector as whole hold for universities	Proxied by assuming ratios for the education service sector as whole hold for IoTs	CSO (2014)
Compensation of employees	Individually determined	Individually determined	HEA (2014)
Product taxes less subsidises	Proxied by assuming ratios for the education service sector as whole hold for universities	Proxied by assuming ratios for the education service sector as whole hold for IoTs	CSO (2014)
Intermediate expenditures	Determined as a residual item and distributed uniformly across all universities in the same pattern as the education service sector as whole	Determined as a residual item and distributed uniformly across all IoTs in the same pattern as the education service sector as whole	CSO (2014)

To estimate imports for each institution, we used data provided by the Irish Universities Association (IUA) through an analysis of university supplier information in 2010-11. As indicated by IUA (2014), the proportion of goods and services purchased by Irish universities from nationally based businesses ranges from 77 per cent for University of Limerick to 97 per cent for University College Cork. While there is no comparable detailed information on the supplier base of IoTs, we used the average ratio for the university sector as a proxy for IoTs in the estimation of their imports. Therefore, we assume that imports to each IoT accounted for 10 per cent of the value of total output in the year of 2010-11, although it could be expected that many IoTs, in particular those smaller ones, would be more likely to purchase goods and services from proximate businesses.

Operating surplus and product taxes less subsidies were determined for each university and IoT as the same proportion of overall expenditure as in the education service sector as a whole. These elements represent a small share of overall expenditure: 2.7 per cent for operating surplus, and 1.3 per cent for product taxes less subsidies. Finally, the amount of intermediate purchases from Irish industries was determined as the residual after deducting all the above cost elements from the total

expenditure. It was assumed that the university and IoT sectors purchase from other industries in the same way shown by the education service sector as a whole.

We could demonstrate the calculation using Trinity College as an example. In 2010-11, Trinity College spent €82.6 million on the purchase of goods and services from external suppliers, with 18.5 per cent of that amount (€15.2 million) being imported from overseas businesses. Operating surplus and product taxes less subsidies, using the same shares as in the education service sector, were €8.7 million and €4.2 million respectively. Compensation of employees, according to the HEA data, cost Trinity College a total of €217.5 million. Deducting all these cost elements from the total expenditure gives us total intermediate consumption of €75.2 million.

4.2. Creating separate rows for each HEI (HEI income)

In an input output table, a row reveals the total income of a sector and how it is divided between intermediate sales to other production sectors and sales to final demand sectors such as households, government and exports. Table 2 below describes the data sourced in creating a separate row for each HEI, and in Table 3 we show, in more detail, the input output rows which reflect the particular structure of the university and IoT sectors. Appendix B illustrates at the institutional level how income of Irish HEIs is divided by source. It is clear that income from the Irish Government accounted for a large share of total income for both the university and IoT sectors. In comparison, universities were more successful than IoTs in sourcing international funding, e.g. international student tuition fees, research grants and industry funding. The category 'Other income' under 'Exports' was allocated by the share of the number of international students, based on data released by Education in Ireland (2011).

Table 2

Summary of HEI rows

Row component	Level of detail		Data source
	Universities	IoTs	
Income from exports	Individually determined	Individually determined	HEA (2014)
Income from Irish Government	Individually determined	Individually determined	HEA (2014)
Income from other final demand categories and intermediate demand	Income apart from exports and Irish Government funding is uniformly distributed along the row based on proportions of the overall education service sector	Income apart from exports and Irish Government funding is uniformly distributed along the row based on proportions of the overall education service sector	CSO (2014)

Table 3

Attribution of income sources for the university and IoT sectors, 2010-11

	% of total income		
Income category	Universities	IoTs	Note
Irish Government			
State grants	20.3%	43.9%	
Academic fee income	16.0%	12.7%	Amount paid by the HEA
State and semi-state research grants	15.1%	7.1%	
Contribution in respect of overheads	0.5%	0.0%	Amount paid by SFI (Science Foundation Ireland)
Exports			
Academic fee income	9.5%	2.3%	Amount paid by international students
European Union research grants	2.2%	1.3%	
Industry income	0.6%	0.0%	Amount paid by international companies and allocated as 50% of total income from industry
Other income	2.6%	0.4%	Amount paid by international students and allocated by the share of the number of international students
Other	33.3%	32.3%	Determined as a residual item

Taking Letterkenny Institute of Technology as an example, each row is created as follows. The Institute generated the total income of €30.7 million from all types of sources in 2010-11. State grant income, which mainly relates to recurrent grants from the HEA, amounted to €14.8 million, while fees arising from public funding paid directly from the HEA were €3.4 million. The institute was also able to secure research grants of €869,000 from the State and other semi-state agencies. In total, the Irish Government contributed €19.1 million to Letterkenny Institute of Technology in 2010-11, accounting for as high as 62.6 per cent of its total income. Export income includes tuition fees paid by international students and international research grants, which in combination was €944,000 for the Institute. Income apart from exports and Irish Government funding is determined as a residual item and distributed along the row in the input output table based on proportions of the overall education service sector.

5. Results

5.1. Output multipliers

With the application of the modelling, we find IoTs with a Type I output multiplier of 1.1 and universities with a Type I output multiplier of 1.27. These may seem low by comparison with other sectors, for example 'Warehousing' at 1.7 or 'Retail Trade' at 1.4. The relatively small Type I output multipliers of universities and IoTs might suggest that they tend not to source much intermediate inputs from other industrial sectors in the country. These figures are however in line with comparable studies. Hermannsson et al. (2010b) suggest a Type I output multiplier for Welsh universities of 1.33, and for Scotland and Northern Ireland they find the same multiplier of 1.30 (Hermannsson et al., 2010a, 2010c).

Of perhaps more interest are Type II multipliers as these show the direct, indirect and induced output effects. Figure 1 below displays conventional Type II impact estimates for individual Irish HEIs, with the use of the HEI-disaggregated input output table. An overall impression is that Irish HEIs, either universities or IoTs, exhibit rather high Type II multipliers, indicating that they have a relatively strong impact on the economy via the household expenditure. Among the 21 HEIs considered in the analysis, the lowest conventional Type II output multiplier is 3.62, associated with Dún Laoghaire Institute of Art, Design and Technology, while Letterkenny Institute of Technology shows the highest multiplier of 4.25.

After determining the Type II output multipliers for the higher education sector, it is able to report the overall economic impact of universities and IoTs in Ireland. In 2010-11, with a gross income of €2.6 billion, the 21 institutions included in the analysis generated a gross output nationwide of €10.6 billion. Of the €10.6 billion, €7.4 billion was contributed by the university sector and €3.2 billion by the IoT sector. Irish HEIs thus form an important part of the economic infrastructure, and generate substantial economic activity.

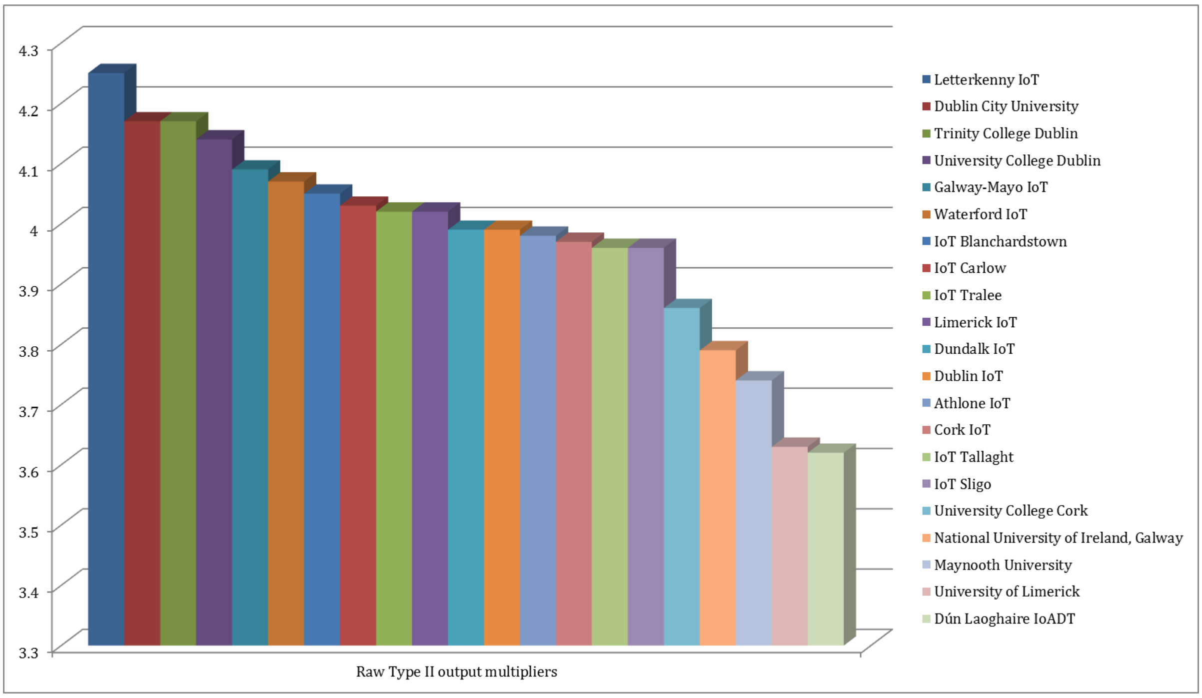

Fig. 1. Raw Type II output multipliers for Irish HEIs

There is a distinction between Dublin-based universities and those universities situated elsewhere with regard to their Type II multipliers. In particular, the three universities in the capital city – Dublin City University, Trinity College Dublin, and University College Dublin – are among the top institutions for impact, with multipliers between 4.14 and 4.17. By comparison, the other four universities are lower with the highest multiplier of the group at 3.86. However, the IoT sector does not seem to show the same geographic split, with Letterkenny Institute of Technology, located in County Donegal which borders Northern Ireland, having the biggest economic impact of all third level colleges in Ireland.

In comparison to the other industrial sectors in Ireland, the individual HEI Type II multipliers are not the highest, but all of them are above the median value of the expanded input output table which has a total of 79 sectors. These multipliers, even at the lower end, are high by comparison to other studies, although not perhaps abnormally so. Kelly, McNicoll and McLellan (2004) in a study of the impact of the University of Strathclyde founded multipliers of between 1.2 and 1.7. Examining the impact of the University of Portsmouth, in the 1990s, Harris (1997) estimated multipliers of 1.66. A study of Scottish universities by Hermannsson, Lisenkova, McGregor and Swales (2013) puts typical multipliers at just over 2, while individual HEI Type II multipliers of 2 to 2.2 were estimated for Northern Irish HEIs (Hermannsson, Lisenkova & McGregor, 2011) and of between 1.9 and 2.2 for Welsh HEIs (Hermannsson et al., 2010b).

In comparison, a study of London HEIs by Hermannsson et al. (2014) provided typically higher figures than those found in other UK studies, with most institutions having a multiplier of around 3. London however is unique in that its 43 universities form the largest concentration of higher education in Europe. Universities and colleges in London employ about 20 per cent of the country's total staff and win around a quarter of the national total research funding. Thus, it is highly probable that factors such as economies of co-production across the city are at play in the generation of these high multipliers. In the case of Ireland, this effect seems to be more apparent in the university sector than in the IoT sector, the reason for which needs further investigation.

It should also be noted that, although not strictly comparable, these multipliers of Irish HEIs are higher by a significant margin than the overall national fiscal multiplier of 0.5 as used by the IMF and the Irish Fiscal Advisory Council (IFAC, 2013) and those of the Economic and Social Research Institute (ESRI), which range from 0.3 to 1.2 (Bergin, Conefrey, Fitzgerald, Kearney & Žnuderl, 2013). Our estimates here are closet but greater than the overall expenditure multipliers in O'Farrell (2013), ranging from 1.06 to 1.76. One should also notice the short-run government investment multiplier of 1.8, which is of a similar magnitude, as found by Clancy, Jacquinot and Lozej (2014).

It is also possible to look at the sectoral impact by examining the intra-sectoral multipliers (recall that the overall multiplier is made up of the sum of the individual column elements of the Leontief inverse). From Table 4 we can see that an injection of one euro into the university/IoT sector results in an increase mainly in 'Distribution, Transport and Communication' of 54c/52c, in 'Business Services' of 68c/63c, in 'Other Services' of €1.36/€1.26 and an increase in overall economic output via increase income and concomitant spending of €1.18. See Appendix C for details of each HEI.

Table 4

Sectoral Type II impacts of universities and IoTs

Sector	Universities	IoTs
Agriculture, Forestry and Fishing	0.026	0.026
Business Services	0.683	0.633
Construction	0.018	0.015
Distribution, Transport and Communication	0.542	0.526
Manufacturing	0.256	0.215
Other Services	1.363	1.291
Income Effect	1.188	1.180

5.2. Balanced output multipliers

Figure 2 shows balanced multipliers for each HEI. As can be expected, netting out the impact of government support reduces quite significantly the impact of each HEI. The range of impact is now also expanded from its previously highly condensed distribution. Raw multipliers vary, but slightly, with the lowest being 85 per cent of the highest. Taking into account government expenditure the lowest being 30 per cent of the highest.

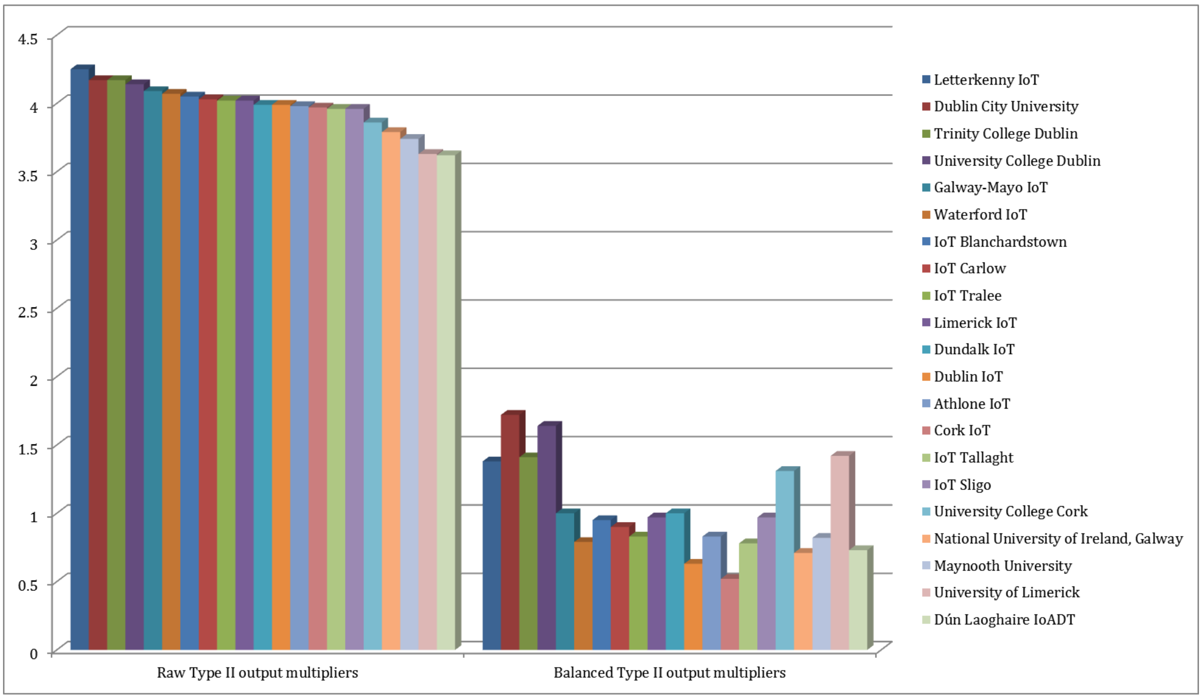

Fig. 2. Raw and balanced Type II output multipliers for Irish HEIs

As shown in Figure 3, the balanced multipliers for Ireland (both sectors) are compared to 73 UK HEIs across England, Scotland, Wales and Northern Ireland. We note that the Irish institutions are well distributed. Five institutions rank in the top 20 for balanced expenditure multipliers – Dublin City University, University College Dublin, Trinity College Dublin, University of Limerick and Letterkenny Institute of Technology. Only two rank in the lowest quartile, namely Dublin Institute of Technology and Cork Institute of Technology. Looking at an all-island comparison, we see the Irish HEIs performing well, with only Queen's University Belfast showing a balanced budget multiplier above the median.

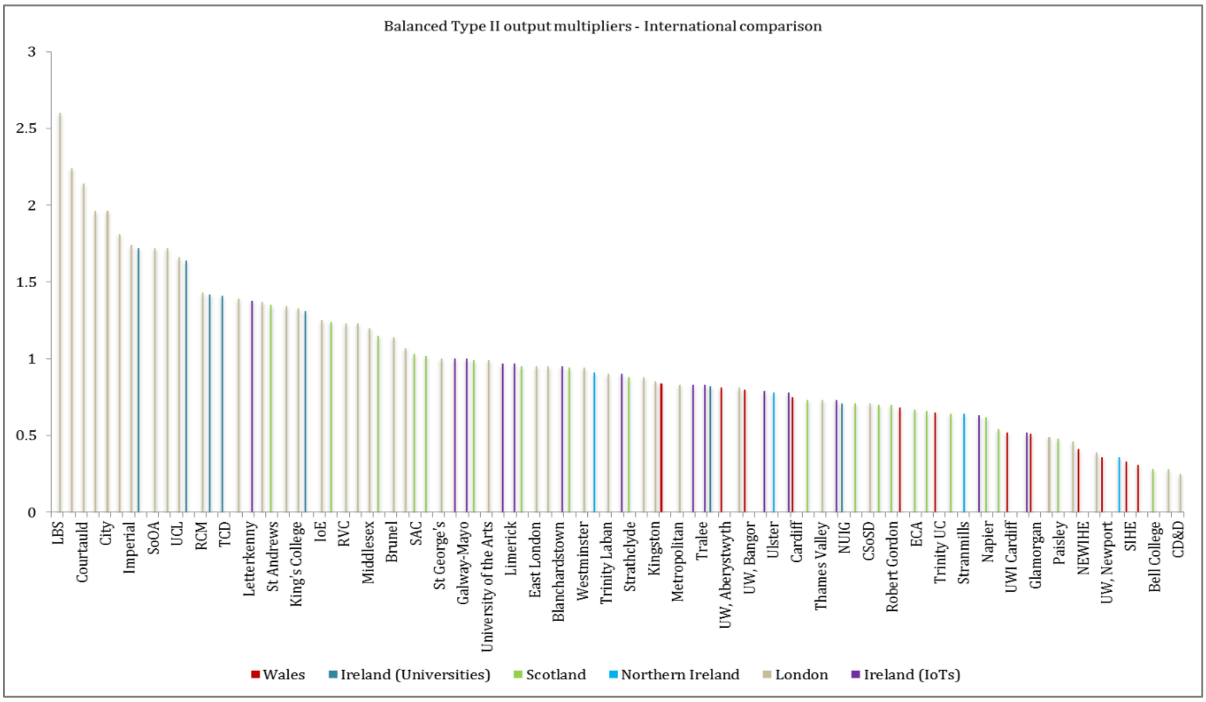

Fig. 3. Balanced Type II output multipliers for Irish and UK HEIs

When we compare the balanced budget multipliers against income, a somewhat different picture emerges, as per Figure 4. There is no clear relationship between income and the multiplier. The very largest multipliers belong to specialist institutions – London Business School (LBS), London School of Economics and Political Science (LSE) and London School of Hygiene and Tropical Medicine (LSHTM). Amongst comprehensive institutions the Irish HEIs, namely University College Cork, University College Dublin and Trinity College Dublin stand out. It is noteworthy that in reality only these three institutions, together with the University of St Andrews, can be described as fully comprehensive universities in the top 20, by which we mean covering all aspects of higher education inclusive of the arts and humanities, social sciences, physical and life sciences, mathematics, medical and para-medical disciplines. This is important since the 1997 Universities Act orientates itself towards comprehensive institutions when allowing the use of the title university. An additional matter is that the status of the HEI does matter. IoTs and small universities tend to have low balanced multipliers, reflecting the limited diversity of income sources that exist for these HEIs. A greater diversity of income sources allows for a higher balanced Type II multiplier.

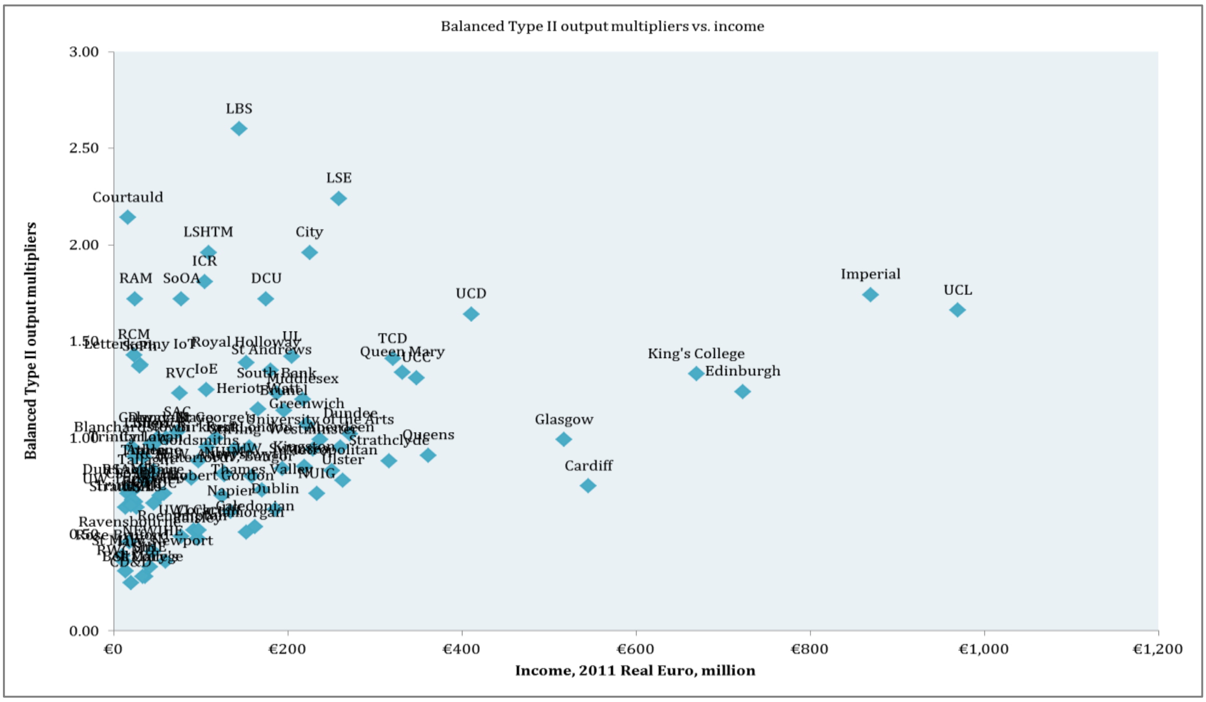

Fig. 4. Balanced Type II output multipliers vs. income, Irish and UK HEIs

5.3. Employment multipliers

Table 5 shows both Type I and Type II employment multipliers for each Irish HEI. One may interpret these as being the effects of an additional one million euro on employment. On average, the investment on the universities supports, in addition to the employment in the sector of 13,701, an additional 1,781 persons through indirect effects and an additional 66,470 persons via induced demand. These figures are high, but are in line with the findings of some U.S. studies (Siegfried et al., 2007). Cautions are needed in the interpretation of such high employment multipliers. That said, it is well recognised that the high salary levels paid to high skilled workers can result in high sectoral (and institutional) multipliers (see e.g., Moretti, 2010; Moretti & Thulin, 2013). Also, Type I employment multipliers compare well in magnitude for other Irish economic sectors calculated from disaggregated input output tables. For example, Morrissey and O'Donoghue (2013) disaggregated the 2007 input output table and obtained information for marine industries with an employment multiplier of 2.9.

Table 5

Employment multipliers for Irish HEIs

Formal name	Type I employment multipliers	Type II employment multipliers
University College Dublin	**1.16**	5.82
University College Cork	**1.16**	5.36
National University of Ireland, Galway	1.11	6.07
Trinity College Dublin	1.13	6.90
Maynooth University	1.09	4.45
University of Limerick	**1.15**	4.91
Dublin City University	1.13	5.65
Cork Institute of Technology	1.06	7.51
Dundalk Institute of Technology	1.07	7.27
Institute of Technology, Sligo	1.07	7.70
Limerick Institute of Technology	1.07	7.80
Waterford Institute of Technology	1.06	7.48
Dublin Institute of Technology	1.07	7.42
Institute of Technology, Carlow	1.06	7.74
Athlone Institute of Technology	1.07	**8.04**
Institute of Technology, Tralee	1.06	7.30
Galway-Mayo Institute of Technology	1.07	**8.17**
Dún Laoghaire Institute of ADT	1.07	5.77
Institute of Technology Tallaght, Dublin	1.06	6.73
Institute of Technology, Blanchardstown	1.07	7.77
Letterkenny Institute of Technology	1.06	**8.84**

Note: In each column, bold letters refer to the top three institutions with the highest multipliers.

6. Discussion and conclusions

In this paper, we have explored issues surrounding the expenditure impacts of Irish HEIs on the economy of Ireland by applying an input output analysis. Our empirical exercise estimates the output, balanced, and employment multipliers for each of the 21 third level institutions in Ireland. In overall, the results suggest that Irish HEIs have significant economic impacts on the national economy, and compare favourably with their counterparts in the UK.

While HEIs show average Type I output multipliers, they are among the sectors with the highest Type II output multipliers. A possible explanation for this could be that, compensation of employees forms a larger share of expenditure of HEIs and might be, on average, at a higher level in comparison to other industrial sectors. At the institutional level, there seems a clear distinction between universities in Dublin and those outside in terms of their economic impacts. More specifically, Dublin-based universities show relatively higher multipliers than those situated elsewhere in the country, a finding which needs further investigation but is consistent with results from London (Hermannsson et al., 2014).

It has also been found that Irish HEIs show significantly different balanced multipliers, which essentially net out the impact of government support. It's the universities that lead the rankings of balanced multipliers, while IoTs and small universities tend to have low multipliers, which might be in association with the limited diversity of their income sources. Irish HEIs are therefore not at the same level of resilience when now facing budget cuts from the Irish government. Those institutions which are more heavily dependent on the government funding will encounter more struggles than the ones with more diverse income sources. In other words, a greater diversity of income source of comprehensive universities probably insures them against the negative impacts the current budget environment could otherwise have.

To a certain extent, the 2010 input output table and associated employment and household expenditure data might reflect a society still transiting from an artificial environment, induced by the bubble, which is particularly when examining the high employment multipliers. The underlying assumption of input output modelling, apart from linearity of the economy, is that the linkages are stable and change slowly. This has been the case for Ireland to a great degree, but whether this held over the period around the boom and the bust is debatable (Keogh and Quill, 2009). It is a direction which future research could follow.

Whilst our analysis has the potential to contribute to the current policy debates about higher education in Ireland, a number of caveats need to be stated. Firstly, although there is considerable degree of certainty about the inputs and outputs of each individual HEI, this can always be refined. In particular, it would be useful to obtain greater depth of information on the expenditure on purchased goods and services for the majority of IoTs. Secondly, there might be potential data issues, as earlier argued, in relation to the 2010 input output table. This is not to question the validity of the data source, but to call for much more caution when interpreting the results, especially those of employment multipliers. Thirdly, the scope of this study is clearly defined by the method – input output analysis – which has been undertaken. Our analysis, while enabling a discussion of the effects of increasing or decreasing exchequer funding to HEIs in the immediate, does not provide a statement on the effects of that change towards a wider industrial policy. It is of necessity silent on issues of return-on-investment in education and quality in higher education, the evaluation of which is the matter for a different study. Lastly, we have yet to include the impact of students due to data limitation. It has been suggested by evidence from the UK that the impact of students is modest – around 1/10 of the magnitude of balanced Type II output multipliers (Universities UK, 2014). Nonetheless, this has not been captured.

Our results could provide clear counterfactuals on the effects of the presence or absence of an HEI on a local economy, which could be taken into account in the allocation of future budgets

for third level education in Ireland. Also, the results could be used to examine present debates of mergers and co-location of institutions and how their income diversity will result in desirable or undesirable policy outcomes. Empirical evidence about the impact that HEIs have on local employment and how many direct and indirect jobs an HEI can support in a locality could be derived from the analysis and taken further by the policymakers in building closer university-business partnerships.

Ultimately, this study is the first step in forming an evidence base for policy decision. Irish third level institutions, as a whole, provide the public exchequer with 'value for money' in that they have strong gross economic outputs, generate strong net economic outputs, and are commensurate, if not slightly superior in specific instances, with their UK counterparts. This result, in the context of a small open economy suffering a protracted and deep recession, should provide the Department of Public Expenditure and the leadership of the third level sector in Ireland with a source of pride.

Appendix A. Characteristics of Irish HEIs, 2010-11

Formal name	Total income, €m	Income from Irish Government, €m	Income from Irish Government as % of total	Total expenditure, €m	Expenditure on staff wages etc., €m	Expenditure on staff wages etc. as % of total	Staff FTE	Total income per staff FTE, €	Students	Total income per student, €
University College Dublin	411	204	49.5%	403	269	66.8%	2,978	138,079	23,600	17,424
University College Cork	348	175	50.4%	344	206	59.8%	2,507	138,771	17,366	20,033
National University of Ireland, Galway	234	142	60.9%	227	142	62.7%	2,003	116,675	16,479	14,182
Trinity College Dublin	321	175	54.6%	332	218	65.7%	2,819	113,799	16,486	19,459
Maynooth University	127	73	57.8%	123	76	61.3%	749	169,426	9,485	13,379
University of Limerick	204	89	43.7%	199	110	55.1%	1,436	142,201	11,890	17,174
Dublin City University	175	85	48.5%	173	117	68.0%	1,209	144,913	10,954	15,994
Cork Institute of Technology	92	63	68.4%	91	62	67.8%	963	95,639	9,189	10,023
Dundalk Institute of Technology	51	30	59.3%	48	34	71.7%	498	102,008	4,660	10,901
Institute of Technology, Sligo	43	26	59.1%	41	29	71.2%	461	93,926	5,275	8,209
Limerick Institute of Technology	47	28	60.4%	45	32	70.9%	494	95,142	4,984	9,430
Waterford Institute of Technology	90	58	64.9%	87	63	72.4%	890	100,787	8,074	11,110
Dublin Institute of Technology	185	123	66.5%	182	124	68.3%	1,888	98,199	15,459	11,993
Institute of Technology, Carlow	35	21	61.8%	34	24	70.8%	359	96,379	4,869	7,106
Athlone Institute of Technology	46	29	62.6%	48	31	65.2%	509	90,373	4,885	9,417
Institute of Technology, Tralee	33	21	63.1%	34	23	67.4%	319	102,821	2,711	12,099
Galway-Mayo Institute of Technology	60	37	61.3%	60	43	71.8%	647	93,354	6,523	9,260
Dún Laoghaire Institute of ADT	23	13	57.3%	21	13	61.6%	202	112,376	2,205	10,295
Institute of Technology Tallaght, Dublin	37	23	62.8%	34	24	70.9%	335	109,254	4,754	7,699
Institute of Technology, Blanchardstown	21	13	61.2%	20	15	72.4%	210	99,524	2,525	8,277
Letterkenny Institute of Technology	31	19	62.2%	31	23	75.4%	335	91,642	2,969	10,340

Source: HEA (2014).

Appendix B. Attribution of income sources for Irish HEIs, 2010-11, €m and %

	Irish Government		Exports		Other		Total
Formal name	€m	%	€m	%	€m	%	€m
University College Dublin	203.6	49.5%	63.5	15.5%	144.0	35.0%	411.2
University College Cork	175.2	50.4%	51.2	14.7%	121.5	34.9%	347.9
National University of Ireland, Galway	142.3	60.9%	34.0	14.6%	57.3	24.5%	233.7
Trinity College Dublin	175.0	54.5%	45.7	14.2%	100.2	31.2%	320.8
Maynooth University	73.4	57.9%	18.6	14.7%	34.8	27.5%	126.9
University of Limerick	89.2	43.7%	31.7	15.5%	83.3	40.8%	204.2
Dublin City University	85.0	48.5%	25.3	14.4%	64.8	37.0%	175.2
Cork Institute of Technology	63.0	68.4%	4.0	4.4%	25.1	27.2%	92.1
Dundalk Institute of Technology	30.1	59.2%	2.2	4.3%	18.5	36.4%	50.8
Institute of Technology, Sligo	25.6	59.1%	1.7	4.0%	16.0	36.9%	43.3
Limerick Institute of Technology	28.4	60.4%	1.7	3.6%	16.9	36.0%	47.0
Waterford Institute of Technology	58.2	64.9%	5.2	5.8%	26.2	29.2%	89.7
Dublin Institute of Technology	123.3	66.5%	6.6	3.5%	55.6	30.0%	185.4
Institute of Technology, Carlow	21.4	62.0%	1.3	3.7%	11.8	34.2%	34.6
Athlone Institute of Technology	28.8	62.5%	1.8	3.8%	15.5	33.7%	46.0
Institute of Technology, Tralee	20.7	63.3%	1.1	3.3%	10.9	33.4%	32.8
Galway-Mayo Institute of Technology	37.0	61.3%	2.0	3.4%	21.3	35.3%	60.4
Dún Laoghaire Institute of ADT	13.0	57.1%	0.9	3.8%	8.9	39.1%	22.7
Institute of Technology Tallaght, Dublin	23.0	62.9%	1.4	3.7%	12.2	33.4%	36.6
Institute of Technology, Blanchardstown	12.8	61.2%	0.7	3.2%	7.4	35.4%	20.9
Letterkenny Institute of Technology	19.1	62.2%	0.9	3.1%	10.7	34.8%	30.7

Source: HEA (2014).

Appendix C. Sectoral Type II impacts of Irish HEIs

Formal name	Agriculture, Forestry and Fishing	Business Services	Construction	Distribution, Transport and Communication	Manufacturing	Other Services	Income Effect
University College Dublin	0.027	0.665	0.016	0.554	0.224	1.407	1.245
University College Cork	0.025	0.604	0.015	0.502	0.205	1.379	1.127
National University of Ireland, Galway	0.025	0.593	0.014	0.497	0.198	1.342	1.118
Trinity College Dublin	0.028	0.672	0.016	0.563	0.224	1.397	1.267
Maynooth University	0.024	0.580	0.014	0.487	0.192	1.343	1.098
University of Limerick	0.023	0.549	0.013	0.459	0.184	1.370	1.033
Dublin City University	0.028	0.668	0.016	0.562	0.221	1.412	1.266
Cork Institute of Technology	0.026	0.627	0.015	0.529	0.206	1.333	1.193
Dundalk Institute of Technology	0.027	0.641	0.015	0.541	0.210	1.355	1.222
Institute of Technology, Sligo	0.026	0.631	0.015	0.533	0.207	1.352	1.204
Limerick Institute of Technology	0.027	0.649	0.016	0.548	0.213	1.358	1.238
Waterford Institute of Technology	0.027	0.657	0.016	0.554	0.215	1.350	1.251
Dublin Institute of Technology	0.026	0.634	0.015	0.534	0.209	1.342	1.205
Institute of Technology, Carlow	0.027	0.652	0.016	0.551	0.213	1.356	1.244
Athlone Institute of Technology	0.027	0.638	0.015	0.539	0.209	1.352	1.217
Institute of Technology, Tralee	0.027	0.650	0.016	0.549	0.212	1.354	1.239
Galway-Mayo Institute of Technology	0.028	0.672	0.016	0.567	0.220	1.368	1.281
Dún Laoghaire Institute of ADT	0.022	0.535	0.013	0.452	0.175	1.311	1.021
Institute of Technology Tallaght, Dublin	0.026	0.628	0.015	0.530	0.206	1.344	1.198
Institute of Technology, Blanchardstown	0.028	0.673	0.016	0.569	0.220	1.394	1.285
Letterkenny Institute of Technology	0.030	0.722	0.017	0.610	0.236	1.389	1.378

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Appendix III – Keynesian Macroeconomic Impact Analysis

The Economic Impact of Higher Education Institutions in Ireland: Some Preliminary Findings

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Abstract

This paper provides some preliminary evidence, via Keynesian-type a multipliers, of the economic impact of Irish higher education institutions. It is found that both Irish universities• and institutes of technology (IoTs) are a significant economic force in the economy. <> It is also found that there is a consistent negative relationship between the estimated multipliers and the size of institutions measured as total expenditure. In general, we find multipliers that are broadly line with international evidence.

Keywords: Multiplier, Keynesian, impact analysis, universities

JEL classifications: H52, I21

Previous research on university impact

Hundreds of papers and reports in the last decades have examined the economic impact of such diverse actions as sports events, large scale cultural projects, and of course the impact of geographical or industrial sectors of the economy. Two main methodological strands have been used, often concurrently – one relies on the use of input-output analysis, the other on a macroeconomic approach. To provide triangulation of results we use both approaches in this paper

In the context of evaluation of the economic impact of higher education institutions a comprehensive review of some of the methodological and interpretational challenges can be found in Siegfried *et al.* (2007). More recent discussions include McHenry, Sanderson, and Siegfried (2012), Garrido-Yserte and Gallo-Rivera (2009), Pastor, Pérez, and Fernández de Guevara (2013), which papers all in effect urge caution on over grandiose claims for impact. Modelling of university and college impact in the modern sense began with the work of Caffrey and Issacs (1971), who outlined a template which has been generally followed, especially in the USA. Much of the work in the USA has been in the context of regional impact analyses, whereby state and regional colleges and universities have produced analyses, often in the context of budgetary negotiations. We should note that the overall economic impact of an institution, sector or industry is multifaceted. In the context of universities for example there are significant downstream effects on society and on the economy from skill enhancement. These are both conceptually and empirically difficult to measure. Private and public benefits are clearly identified from attainment of higher education – see Kelly, O'Connell, and Smyth (2010), Long (2010), and Oppedisano (2014) as examples of studies that focus on different aspects of this measurement issue. In this paper we concentrate on a highlevel macroeconomic impact. Thus the overall impact will be greater than that which is implied here.

In the UK and European context the foundational work is that of Brownrigg (1973) on Stirling, followed by Bleaney et al. (1992) on Nottingham. Similar studies have been conducted on many other universities such as Portsmouth (Harris (1997)), public universities in Valencia (Pastor *et al.* (2013)), Izmir (Sen (2011)), Scottish universities (Hermannsson *et al.* (2013)), educational institutions in Canterbury (Canterbury City Council (2001)), Higher Educational institutions in London (Hermannsson et al. (2014)), Aberdeen (Battu *et al.* (1998)) etc..

Most early studies used a Keynesian multiplier approach while more recent work has tended to concentrate on Input-Output modelling. Outside the USA the largest extant set of studies is on the UK, and the drive to recent IO modelling may in part reflect the existence of earlier multipliers from Keynesian modelling. Here we first present Keynesian multipliers then triangulate these with IO analyses

1. Methodology

The analysis is undertaken using the model originally defined by Bleaney *et al.* (1992) and later by Armstrong *et al.* (1994), Huggins and Cooke (1997), and more recently by Sen (2011), all of whom have measured the economic impact of individual universities on the local and regional economy. In particular, our analysis is confined to a single base year, 2010-11, which reflects the latest year for which comprehensive comparable accounting data are available for all Irish higher educational institutions. As the results of any spending will propagate for a number of years therefore the results should be interpreted with caution. All these assumptions are noted.

Initial Injection (Expenditure Base)

At the outset, the model simply involves estimating the size of the initial monetary injection into the local economy.

This expenditure base is given as:

$$E = L + G$$

E = expenditure base, L = labour services bought by the university, G = goods and services bought from outside by the university. E excludes pensions (though not employees pensions contributions) and depreciation.

First-round Gross Local Output (GLO)

$$Y1 = L + A + hG$$

Y_1 = first-round GLO, h = the proportion of G generated locally, A = the additional labour incomes of university employees.

First-round Local Disposable Income (LDI)

$$D1 = (1 - t)(Y1 - hiG)$$

D_1 = first-round impact on disposable incomes of local residents, i = indirect tax rate (e.g. VAT), t = a direct tax rate (which allows for reduced unemployment benefits as well as income taxation).

Second-round Gross Local Output (GLO)

$$Y2 = vZ + wcD1$$

Z = total spending by students, v = proportion of student expenditures made on local produced goods and services, w = proportion of staff spending on locally produced and services, c = proportion of staff income consumed (the remainder being saved) – the marginal propensity to consume.

Second-round Local Disposable Income (LDI)

$$D2 = (1 - t)(1 - i)Y2$$

Assuming once more a rate of local re-expenditure of w, a third round of expenditure is obtained as:

$$Y3 = wcD2$$

$$D3 = (1 - t)(1 - i)Y3$$

Again assuming once more a rate of local re-expenditure of *w*, a fourth round of expenditure is obtained as:

$$Y4 = wcD3$$

$$D4 = (1-t)(1-i)Y4$$

The Full Multiplier for Gross Local Output (all rounds)

The gross local output multiplier is given as:

$$\frac{Yf}{Y1} = \frac{(Y1+Y2+Y3+\ldots)}{Y1}$$

$$= 1 + \frac{(1 + wc(1-t)(1-i) + \cdots)Y2}{Y1}$$

$$= 1 + Y2/[1 - wc(1-t)(1-i)]Y1$$

Y_f = the final GLO (after all rounds of the multiplier process).

The Full Multiplier for Local Disposable Income (all rounds)

The local disposable income multiplier is given as:

$$\frac{Df}{D1} = \frac{(D1 + D2 + D3 + \cdots)}{D1}$$

$$= 1 + \frac{(1-t)(1-i)(1 + wc(1-t)(1-i) + \cdots)Y2}{D1}$$

$$= 1 + \frac{(1-t)(1-i)Y2}{[1 - wc(1-t)(1-i)]D1}$$

D_f= the final LDI (after all rounds of the multiplier process).

2. Data

2.1. Data

Our analysis draws on a number of data sources, both secondary and primary. Ireland's higher education is provided in the main by seven universities, 14 institutes of technology (IoTs), including Dublin Institute of Technology and seven colleges of education. Due to data limitations we exclude the colleges of education and the private higher education institutions such as Hibernia College and Royal College of Surgeons in Ireland. There are also a number of third level institutions which provide specialist education in such fields as art and design, medicine, business studies, rural development, theology, music and law. The main focus of our analysis is on the seven universities and the 14 IoTs, where the bulk of third level public and private spending and students are located and we report the results for the university sector and the IoT sector respectively.

Data on the institute income and expenditure in 2010-11 was sourced from the Higher Education Authority (HEA), the statutory planning and policy development body for higher education and research in Ireland (Tables 1 and 2). Both the university and IoT sectors include institutions which vary significantly in terms of size measured by expenditure.

Table 1 Initial injection of universities

	L	*G*	*E (L+G)*
DCU	65,788	41,987	107,775
NUIG	105,644	71,075	176,719
NUIM	43,548	29,202	72,750
TCD	162,372	82,587	244,959
UCC	146,039	75,503	221,542
UCD	202,367	104,695	307,062
UL	65,461	61,140	126,601

Note: All data refers to €000s.

Source: Authors' own elaboration based on the HEA data.

Table 2 Initial injection of IoTs

	L	*G*	*E (L+G)*
Athlone	31,666	11,932	43,598
Blanchardstown	14,549	3,917	18,466
Carlow	23,862	7,504	31,366
Cork	61,674	23,278	84,952
Dublin	124,421	43,722	168,143
Dundalk	34,330	9,141	43,471
Dun Laoghaire	12,761	6,223	18,984
Galway-Mayo	42,893	13,475	56,368
Letterkenny	23,451	5,165	28,616
Limerick	32,199	10,275	42,474
Sligo	28,845	8,545	37,390
Tallaght	24,388	6,930	31,318
Tralee	22,586	8,036	30,622
Waterford	62,725	20,301	83,026

Note: All data refers to €000s.

Source: Authors' own elaboration based on the HEA data.

In order to analyse the regional impact of institutions, it is key to understand what a 'region' means in this context and how to define it. Our initial choice of regional classification followed the geographical locations of institutions, which in Ireland are defined at the base as local authorities. In that sense, there are three universities situated in Co. Dublin, while the rest four universities are situated in Co. Galway, Co. Kildare, Co. Cork and Co. Limerick respectively. This classification may not be the best way to capture the expenditure linkages of universities in Ireland which itself is a rather small country with the majority of its economic activities being concentrated in a few city-regions.

To capture this and for consistency with other data sources we use NUTS III regions, with the Dublin and Mid-East regions being combined, covering four universities (UCD, TCD, NUIM and DCU) and four IoTs (Blanchardstown, Dublin, Dun Laoghaire and Tallaght). We refer to this as GDA – Greater Dublin Area. We use NUTS Region III Mid-West for UL, covering Co. Clare and Co. Limerick. See Table 3 below for full details.

Table 3 Regional classification for institutions

NUTS3 Region	IoTs	Universities
	IT Dundalk	
	IT Letterkenny	
Border Region	IT Sligo	
West Region	IT Galway-Mayo	NUIG
Midlands Region	IT Athlone	
	IT Blanchardstown	DCU
	IT Dublin	NUIM
	IT Dub Laoghaire	TCD
Greater Dublin Area (GDA)	IT Tallaght	UCD
	IT Carlow	
South-East Region	IT Waterford	
	IT Cork	
South-West Region	IT Tralee	UCC
Mid-West Region	IT Limerick	UL

Source: Authors' own elaboration.

Based on the above classification, Tables 4 shows the proportion of good and services purchased by universities from regionally-based businesses and from nationally-based businesses.

Table 4 Proportion of *G* generated regionally and nationally (universities)

	h (regional)	*h* (national)
DCU	0.90	0.93
NUIG	0.33	0.95
NUIM	0.83	0.95
TCD	0.76	0.82
UCC	0.30	0.97
UCD	0.86	0.94
UL	0.29	0.77

Note: For all universities, *h* (national) refers to the proportion of *G* generated within Ireland.

Source: Authors' own elaboration based on the IUA data.

Data underlying Table 4 was based on an analysis of university supplier information in 2010-11, which has kindly been provided by the Irish Universities Association (IUA). The FAME (Financial Analysis Made Easy) database was accessed to geo-locate the businesses. Additional web searching was undertaken when it was difficult to determine the address of a business based on the results from the FAME. See Table 5 for a summary.

The number of top suppliers examined in our analysis varies from 96 for UL to 124 for TCD. The total expenditure made to this small band of top suppliers is substantial, ranging from over €15 million for NUIM to more than €43 million in the case of UCD. The value of expenditure covered in our list of firms represents 30% of the total expenditure of UL on goods and services, this increases to 40% for UCC and over 51% for NUIM. As suggested by the findings of Armstrong *et al.* (1994) and Huggins and Cooke (1997), universities tend to make a substantial number of small purchases from local businesses. It is reasonable for one to argue that our selection of top suppliers only could lead to an underestimation of the impact of universities on local economy.

Table 5 A summary of university purchases from top suppliers on goods and services

	Number of top suppliers	Total expenditure made to the top suppliers (€)	As % of total expenditure of the university	Largest purchase on the list (€)	Smallest purchase on the list (€)	Average purchase on the list (€)	Median purchase on the list (€)
DCU	104	18,458,777	43.96	2,641,758	27,513	177,488	74,827
NUIG	104	31,609,871	44.47	1,860,953	79,664	303,941	175,376
NUIM	106	15,006,403	51.39	2,664,908	25,668	141,570	58,795
TCD	124	37,387,925	45.27	2,799,452	87,138	301,516	167,958
UCC	98	30,414,296	40.28	2,835,664	80,728	310,350	164,804
UCD	99	43,465,472	41.52	4,434,444	137,061	439,045	302,004
UL	96	18,633,134	30.48	2,816,779	33,371	194,095	74,903

Source: Authors' own elaboration based on the IUA data.

We have no comparable detailed information on the supplier base of IoTs, however it was considered reasonable to use the university data as proxy for IoTs. In particular, as shown in Table

4, universities in GDA tend to report a much higher value of *h (regional)* than those situated elsewhere, a pattern we consider would also hold for IoTs. Therefore, we use the average value of *h* reported by the four GDA-based universities in the calculation of institutes of technology Blanchardstown, Dublin, Dun Laoghaire and Tallaght, and the average value of *h* reported by the other three universities in the calculation of institutes of technology located outside the Greater Dublin Area (Table 6).

Table 6 Proportion of *G* generated regionally and nationally (IoTs)

	h (regional)	*h* (national)
Athlone	0.31	0.90
Blanchardstown	0.84	0.91
Carlow	0.31	0.90
Cork	0.31	0.90
Dublin	0.84	0.91
Dundalk	0.31	0.90
Dun Laoghaire	0.84	0.91
Galway-Mayo	0.31	0.90
Letterkenny	0.31	0.90
Limerick	0.31	0.90
Sligo	0.31	0.90
Tallaght	0.84	0.91
Tralee	0.31	0.90
Waterford	0.31	0.90

Notes:

1. For Blanchardstown, Dublin, Dun Laoghaire and Tallaght, *h* (regional) refers to the average proportion of G generated within the Greater Dublin Area (Mid-East Region and Dublin Region) shown by the four universities in the area, and *h* (national) refers to the average proportion of G generated within Ireland shown by the four universities in the area.
2. For the other IoTs, *h* (regional) refers to the average proportion of G generated within its own region shown by each of the three non-Dublin-based universities, and *h* (national) refers to the average proportion of G generated within Ireland shown by each of the three non-Dublin-based universities.

Source: Authors' own elaboration.

2.2. Parameters

To implement the model we require a number of parameters. As is common in this area of research we find ourselves using parameters sourced from different data sources across a number of years, and these years do not necessarily align to the accounting data. The implicit assumption therefore is that that the parameters are constant, or slowly changing, across time. Given the relatively short time frame across which data are sourced in this study that seems a reasonable assumption.

The *additional labour income of university employees (A)* was set at 0, partly because of a lack of valid data. We contend that it is likely to be low in any case. Irish revenue data suggest that employees on Pay As You Earn taxation (which includes all staff covered here) have a typical additional income of approx. 1% per annum.[1] To this extent that there is additional income uncaptured this measurement means that our results represent the economic impact of Irish universities in a conservative way.

Data on the *direct tax rate (t)* and *indirect tax rate (i)* was sourced from the Nevin Economic Research Institute (NERI). Collins and Turnbull (2013) used data from the most recent Household Budget Survey (HBS), which was published in 2012 covering data for the period 2009-10, to estimate both the direct and indirect taxation contributions of households. According to the authors, on average, Irish households contribute 13.74% of their gross income in direct taxes and 10.3% of their income in indirect taxes, which values we use in our analysis.

To determine the *total spending by students (Z)* and the *proportion of student expenditures on goods and services in the locality (v)*, a student expenditure survey of was designed and circulated to students enrolled at two Irish universities. This was undertaken in late spring 2013[2]. For the purpose of this study part-time graduates were excluded when analysing the responses, as they were assumed to be from the locality and already be in residence. It was found that average weekly spending was €149.60 for a TCD student and €151.04 for a NUIG student, suggesting no significant difference between the expenditure of Dublin-based and non-Dublin-based students. Our results appear to be comparable to those of the fifth Irish Eurostudent survey 2013 – published by the HEA and Insight Statistical Consulting which claimed the average monthly expenditure met by the student themselves was €607 – see Harmon and Foubert (2014). In the absence of information from other institutions, we therefore used the TCD student results for the other Dublin/Kildare institutes, and applied the NUIG student results in the analysis of institutions situated outside GDA..

On examination of the academic calendars of Irish HEIs, it was decided to include 30 and 38 weeks in the calculation of total spending by undergraduates and full-time postgraduates respectively. The number of students enrolled at the universities was sourced from the HEA. Of total spending by TCD students, it was estimated that 86% took place within the Greater Dublin Area and 96% took place in Ireland. From the NUIG student survey, 83% of expenditure took

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[1] see http://www.revenue.ie/en/about/publications/statistical/2012/index.html for more information.

[2] With the help of the HEA and the IUA, we have been able to elicit 758 responses from TCD students and 482 responses from NUIG students, all of whom indicated their weekly expenditure during term time of 2013-14.

place within the same region), while only 2% of expenditure took place outside Ireland. Tables 7 and 8 show the findings of the student survey.

Table 7 A summary of student expenditure survey results (universities)

	Weekly expenditure (€)	Number of undergraduates	Weeks in residence (undergraduates)	Number of full-time postgraduates	Weeks in residence (postgraduates)	Total expenditure of students (€000s)	Proportion of total expenditure in the region	Proportion of total expenditure in the nation
DCU	149.60	7,186	30	1,538	38	40,994	0.86	0.96
NUIG	151.04	12,921	30	2,804	38	74,641	0.83	0.98
NUIM	149.60	6,469	30	1,274	38	36,275	0.86	0.96
TCD	149.60	11,492	30	3,331	38	70,512	0.86	0.96
UCC	151.04	13,400	30	2,938	38	77,581	0.83	0.98
UCD	149.60	16,597	30	4,524	38	100,205	0.86	0.96
UL	151.04	8,847	30	1,718	38	49,948	0.83	0.98

Source: Authors' own elaboration.

Table 8 A summary of student expenditure survey results (IoTs)

	Weekly expenditure (€)	Number of undergraduates	Weeks in residence (undergraduates)	Number of full-time postgraduates	Weeks in residence (postgraduates)	Total expenditure of students (€000s)	Proportion of total expenditure in the region	Proportion of total expenditure in the nation
Athlone	151.04	4,439	30	154	38	20,998	0.83	0.98
Blanchardstown	149.60	2,398	30	27	38	10,916	0.86	0.96
Carlow	151.04	4,701	30	33	38	21,491	0.83	0.98
Cork	151.04	8,771	30	295	38	41,436	0.83	0.98
Dublin	149.60	13,023	30	1,108	38	64,746	0.86	0.96
Dundalk	151.04	4,496	30	97	38	20,929	0.83	0.98
Dun Laoghaire	149.60	2,061	30	92	38	9,773	0.86	0.96
Galway-Mayo	151.04	6,323	30	154	38	29,535	0.83	0.98
Letterkenny	151.04	2,833	30	89	38	13,348	0.83	0.98
Limerick	151.04	4,816	30	113	38	22,471	0.83	0.98
Sligo	151.04	4,209	30	85	38	19,560	0.83	0.98
Tallaght	149.60	3,994	30	64	38	18,289	0.86	0.96
Tralee	151.04	2,642	30	30	38	12,144	0.83	0.98
Waterford	151.04	7,283	30	425	38	35,440	0.83	0.98

Source: Authors' own elaboration.

Alongside the student survey we also carried out a staff expenditure survey to measure the *spending pattern of employees in Irish universities (w)*[3]. Survey results indicated that 77% of TCD staff expenditure took place inside of the Greater Dublin Area and a further 12% of expenditure was spent in other Irish regions. For staff working at NUIG, around 73% of their expenditure was spent within Co. Galway, with only 10% of expenditure taking place outside Ireland. Similar to the student survey

[3] In total the survey generated 383 usable responses from TCD staff and 176 from NUIG staff.

results, the TCD staff results were also used for the other institutions situated within the Greater Dublin Area, while the NUIG staff results were applied when examining the case of those HEIs located outside Dublin/Kildare area.

The *marginal propensity to consume (c)* in Ireland was estimated as 0.31, based on the findings of an International Monetary Fund (IMF) study. Bhattacharya and Mukherjee (2010) used data from 18 OECD countries and showed a wide variation in the marginal propensity to consume across countries. Furthermore, the value of *c* in Ireland is, as we would expect for a small open economy which has very significant imported consumption, much smaller than that undertaken in the other studies: for example, *c* was estimated as 0.65 in the Izmir study of Sen (2011) and 0.90 in the Cardiff study of Huggins and Cooke (1997).

3. Results

3.1. Keynesian multipliers for the University Sector

A number of multipliers were found by applying the analysis above. We calculated sectoral and individual multipliers, of different types, for both regional and national impact. As discussed in the methodology section, we consider that the output measures are more appropriate for measuring impact. In the following, unless indicated otherwise, we will concentrate on these GLO-O-M measures. Full estimations of the expenditure elements are available on request.

In 2010-11, Irish universities had the effect of generating a gross local output nationally of €2.12 billion, with a concomitant generation of local disposable income nationally of €1.71billion. Overall, the gross local output multiplier on an output basis was estimated as 1.75. Every €1 of initial increase (decrease) in the expenditure base would result in a rise (fall) of €1.75 in gross local output in Ireland[4].

[4] For income, the local disposable income multiplier on an output basis was estimated as 1.70. Every €1 of initial increase (decrease) in the value of disposable income from universities would lead to a rise (fall) of €1.70 in local disposable income

Table 9 Keynesian Multipliers of Irish universities

		GLO-O-M	LDI-O-M
All	Ireland	1.75	1.70
DCU	Regional	1.66	1.62
	National	1.77	1.72
NUIG	Regional	1.81	1.75
	National	1.83	1.78
NUIM	Regional	1.81	1.75
	National	**1.91**	1.85
TCD	Regional	1.58	1.53
	National	1.67	1.62
UCC	Regional	1.70	1.63
	National	1.74	1.69
UCD	Regional	1.61	1.56
	National	1.70	1.65
UL	Regional	**1.84**	1.77
	National	1.85	1.80

Source: Authors' own calculations based on models in Section 3. GLO-O-M – Gross Local Output Multiplier from Output Approach, GLO-O-E the same from an expenditure approach, Bold indicates largest multiplier in that sector

Turning to the individual universities, we note that in all cases the impact nationally is greater than that regionally. This is as we would expect – the footprint of any industry or unit is diffuse geographically, and in a small country such as Ireland this diffusion is likely to be almost nationwide. People in the South West and in Donegal are suppliers to and consumers of the Dublin based universities, people in Dublin similarity for the western universities. There is a quite evident negative relationship in the estimated multipliers (Figures 1 and 2). The universities with lower spends are mostly those with the greatest multipliers. One possible explanation for this would be if universities exhibited decreasing returns to scale. Another correlate is that the smaller institutions are mainly outside Dublin, and thus any expenditure on these would be expected to have a larger impact than the same amount in Dublin. . Thus DCU for example demonstrates a lower multiplier than NUIG or UL despite having similar size, the impact of DCU in Dublin being more dilute than would be the case of the other two in Galway or Limerick respectively. This in part reflects

the slack macroeconomic conditions in those localities relative to Dublin. The three largest universities in terms of expenditure, UCD/TCD/UCC also show GLO-M metrics lower than the national, across all measures. This in part reflects the macroeconomic approach that is being taken in these analyses.

Figure 1 Relationship between the GLO Keynesian multiplier (regional) and expenditure base

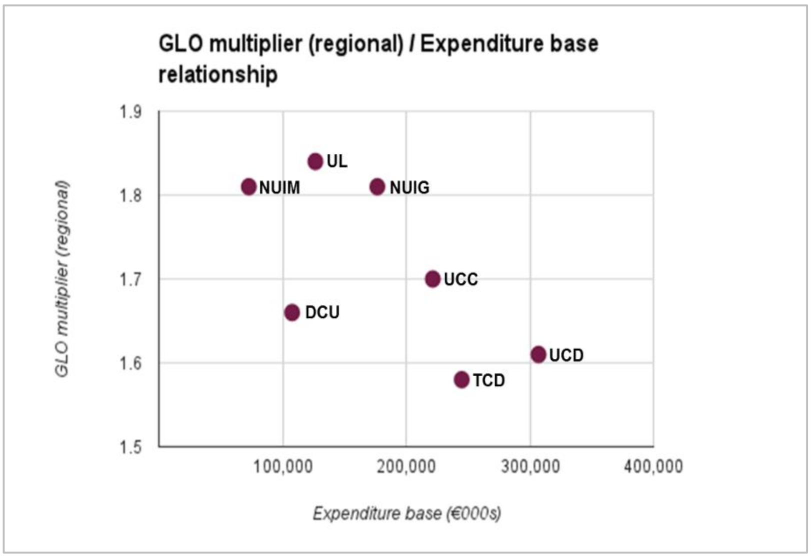
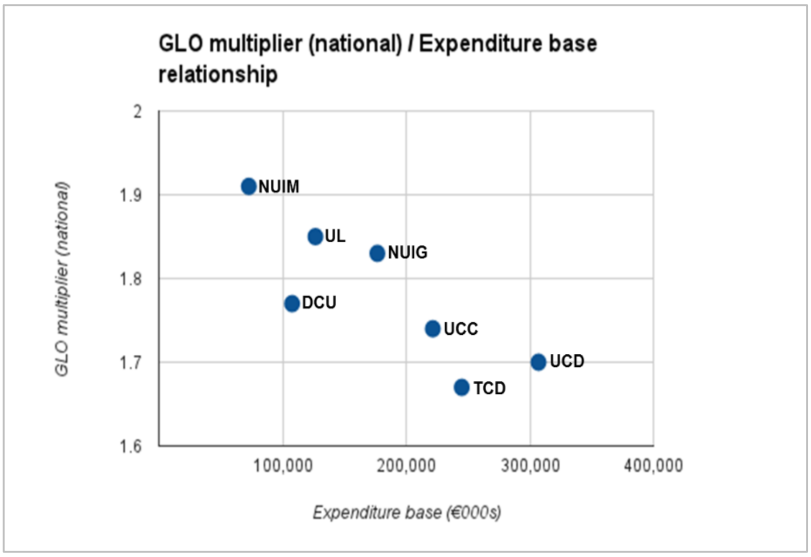


Figure 2 Relationship between the GLO Keynsian multiplier (national) and expenditure base



3.2. Keynesian Multipliers for the Institutes of Technology

This section presents the results for the IoT sector, for which we also calculated sectoral and individual multipliers (Table 10).

Table 10 Keynesian Multipliers of Irish IoTs

		GLO-O-M	LDI-O-M
All	Ireland	1.90	1.86
Athlone	Regional	1.83	1.76
	National	1.92	1.85
Blanchardstown	Regional	1.89	1.82
	National	2.03	1.95
Carlow	Regional	**2.06**	1.96
	National	**2.18**	2.08
Cork	Regional	1.84	1.76
	National	1.92	1.85
Dublin	Regional	1.67	1.62
	National	1.78	1.72
Dundalk	Regional	1.80	1.73
	National	1.91	1.84
Dun Laoghaire	Regional	1.82	1.76
	National	1.94	1.87
Galway-Mayo	Regional	1.87	1.79
	National	1.97	1.89
Letterkenny	Regional	1.77	1.70
	National	1.89	1.82
Limerick	Regional	1.87	1.79
	National	1.98	1.90
Sligo	Regional	1.86	1.78
	National	1.97	1.89
Tallaght	Regional	1.89	1.81
	National	2.02	1.94
Tralee	Regional	1.72	1.66
	National	1.81	1.75
Waterford	Regional	1.75	1.68
	National	1.85	1.78

Source: Authors' own calculations based on models in Section 3. GLO-O-M – Gross Local Output Multiplier from Output Approach, Bold indicates largest multiplier in that sector

In 2010-11, IoTs had the effect of generating a gross local output nationally of €1.33 billion, with a concomitant generation of local disposable income nationally of €1.08 billion. Overall, the gross local output multiplier on an output basis was estimated as 1.90. Every €1 of initial increase (decrease) in the expenditure base would result in a rise (fall) of €1.90 in gross local output in Ireland. For income, the local disposable income multiplier on an output basis was estimated as 1.86. Every €1 of initial increase (decrease) in the value of disposable income from universities would lead to a rise (fall) of €1.86 in local disposable income. These two multipliers of the IoT sector are both larger than those of the university sector.

Figures 3 and 4 show the association between the estimated multipliers and expenditure bases of IoTs. In comparison to the university sector, the IoT sector shows a more complicated pattern. We can see again however, particularly at the extremes, the size/regional issue. Carlow is a small town and as such the impact of a HEI such as the institute of technology is amplified, while the impact of the Dublin Institute of Technology is muted. This again reflects the macroeconomic conditions where you would have slack aggregate demand in a small regional townland and with that a high level of unemployment relative to the national average.

Figure 3 Relationship between the GLO Keynesian multiplier (regional) and expenditure base

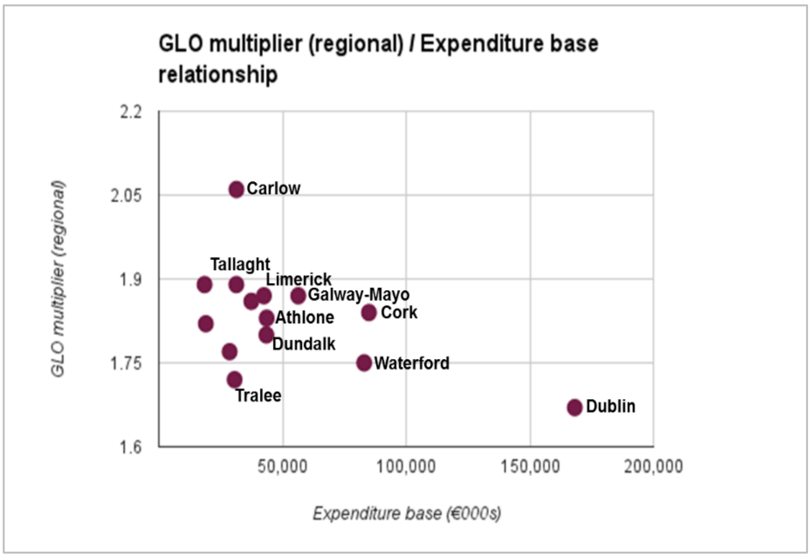
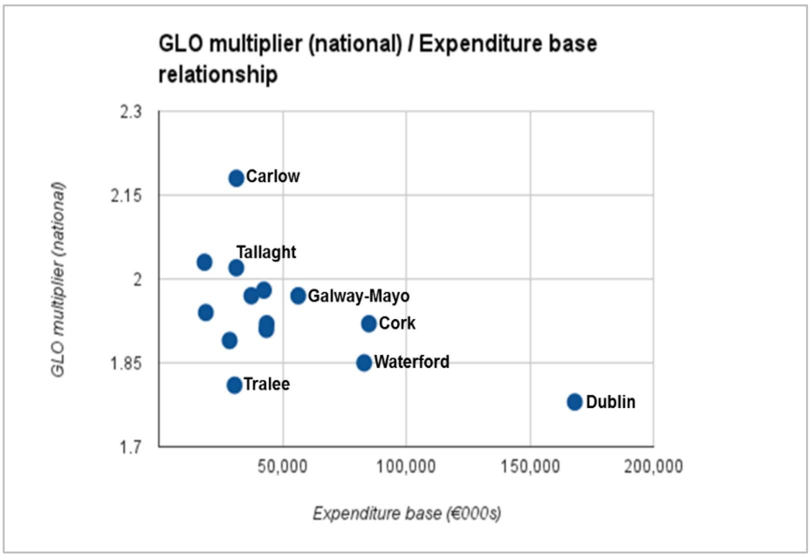


Figure 4 Relationship between the GLO Keynesian multiplier (national) and expenditure base



3.3. International Comparisons

We can benchmark these derived multipliers against those found elsewhere. Thus Hermannsson et al. (2012) Table 1 shows multipliers for a number of Scottish universities, derived from both Keynesian and Input-output models. These range from a high of 2.15 to a low of 1.24, with the great majority in the 1.5-1.75 range. In Hermannsson et al. (2014) a series of multipliers for London based higher education institutions are given, Figure 2, which tend to be in the region of 3. Sen

(2011) , examining turkey, finds a range of 2.5 to 3 for Keynesian multipliers; Also using Keynesian models Huggins and Cooke (1997) Table 1 provide a set of UK comparable multipliers, ranging from 3 to 1, with the majority in the 1.5-2 region and they themselves calculate a multiplier of the range of 1.2 (on an expenditure basis). Bleaney et al. (1992) calculate Keynesian multipliers of between 1.2 and 1.7 for their study.

Although not strictly comparable, the results of input-output multipliers are also instructive[5]. Kelly, McNicoll, and McLellan (2004) in a study of the impact of the University of Strathclyde found multipliers of between 1.2 and 1.7. Examining the impact of Portsmouth University, in the 1990s, Harris (1997) estimated multipliers of 1.66. Studies of London higher education institutes Hermannsson et al. (2014) by have provided typically higher figures, around 3. A study of Scottish universities by Hermannsson et al. (2013) puts typical multipliers at just over 2. The direct comparison between Irish input-output multipliers and those form the UK takes place in Appendix II of this document above.

We can thus see that the multipliers here are in broad agreement with the modal findings of other research, with the exception of the London universities. London however is a very concentrated market with over 50 higher education institutions in a very concentrated area, and thus it is highly probable that factors such as economies of co-production across the city are at play in the generation of these high multipliers. We should also note that although not strictly comparable these multipliers are higher by a significant margin than the overall national fiscal multiplier of 0.5 as used by the IMF and the Irish Fiscal Advisory Council and those of the Economic and Social Research Institute (see Kearney, Fitzgerald, and Bergin (2013) for the ESRI and Council (2013) for the IFAC assessment). The ESRI multipliers range from 0.3 to 1.2. Our estimates here are closer to but in most cases greater than the overall expenditure multipliers in O'Farrell (2013), Table 14 which range from 1.06 to 1.76. We should also notice the short-run government investment multiplier of Clancy, Jacquinot, and Lozej (2014), which are of a similar magnitude, 1.8 for the first quarter.

Overall our findings illustrate that there exists a positive and large macroeconomic impact of higher education institutions across Ireland. This is more pronounced in areas where the

[5] IO analyses typically produce two types of multipliers. The figures here are for what are termed "type II" multipliers, which are derived from an analysis that includes induced expenditure as well as direct expenditure.

macroeconomic conditions are less favourable, and as such exhibit slack aggregate demand. This largely explains why Dublin institutions, despite their large size, do have as large a Keynesian macroeconomic multiplier as those located in the regions. We would caution drawing too many conclusions from this exercise since the technique for the Keynesian multiplier is not as precise as that used for the input-output analysis. The results in Appendix II would be more important for immediate policy conclusions, taking into account the caveats that apply to the input-output analytical technique.

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Appendix IV

Biographical Note:

Charles J. Larkin, B.A. (Mod.), Ph.D. is a Research Associate and Adjunct Lecturer at the University of Dublin, Trinity College School of Business. Dr. Larkin is also associated with Cardiff Metropolitan University and with the office of Senator Sean D. Barrett (Ind.) (University of Dublin Panel, Seanad Éireann). Dr. Larkin has previously taught at the University of Dublin, Trinity College (TCD), National University of Ireland Maynooth and the ESC Toulouse School of Business in France. Dr. Larkin was awarded his Ph.D. in economics from the University of Dublin, Trinity College in 2008. His Ph.D. focused on the institutional and legal development of the International Monetary Fund. Dr. Larkin has won research funding from corporate and public bodies, including the FBD Trust, TCD, the Irish Research Council and the EU Framework 7 programme. Articles by Dr. Larkin have appeared in the national and international media over the past few years on matters related to public policy and the Irish economic crisis. Dr. Larkin is on the organizing committees of the International Financial Integration (INFINITI) Conference and the Dublin Economic Workshop conference (also known as the Kenmare Policy Conference) Dr. Larkin has presented his work to several international economic and financial policy conferences.