Indecon Review of the Enterprise Agencies Economic Appraisal Model in Ireland

Submitted to

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Prepared by

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Executive Summary

Introduction

Indecon Research Economists were appointed by the Department of Business, Enterprise and Innovation (DBEI) to undertake this independent review of the Enterprise, Economic Appraisal Model (EAM) on behalf of the Irish Government. The EAM is used in the grant decision-making process for projects supported by Enterprise Ireland and IDA (Ireland)[1] as part of their system of appraisal for investment projects. The model represents an important potential tool in ensuring the best use of scarce economic resources. The current version of the model has been in use since 2003, and reviews to update the cyclical elements of the model have been completed, most recently in 2014.

Economic and Policy Context

In examining the Economic Appraisal Model (EAM), it is relevant to note that the Irish economy has undergone significant changes which have implications for the model. Industrial policy has also evolved as Ireland has sought to 'move up the value chain' to areas increasingly associated with R&D which represent new challenges for the economic appraisal modelling. Since the model was developed an increased policy focus has been placed on regional development and ambitious targets have been set by the enterprise agencies for the expansion of economic activity in all of the regions. There have also been major policies introduced to address housing and other infrastructural shortages which are impacting on competitiveness and quality of life. In deciding on parameters in the model, account should be taken of labour market development. The timescale of investment projects may be such as to imply that future rather than current labour market issue are of most relevance. One other factor of note is the treatment of employment in the EAM. The current model gives a higher value to immigration than other aspects of employment. In Indecon's opinion, the key issue is the benefits of any increase in the labour force and not whether this is due to returning Irish emigrants, or new people attracted to Ireland, or increases in participation rates.

Existing Economic Appraisal Model

The Economic Appraisal Model attempts to calculate the costs and benefits of projects regardless of the scale of the state support. The aim is to identify if financial supports provided by the agencies are likely to yield economic benefits that are greater than the costs. The model involves calculating the discounted present value of costs and benefits over a period of seven years. A satisfactory cost-benefit ratio is, in general, a necessary but not sufficient condition for approval. The benefits included in the current Economic Appraisal Model include, direct wage bill (including taxes and adjusted for the opportunity cost of labour), indirect wage bill, Irish profits, direct and indirect (excluding the opportunity cost of Irish profits), tax on foreign profits (zero opportunity cost) and tax on Irish profits (same opportunity cost as the wage bill). All costs are adjusted for a shadow cost of public funds. Labour costs are adjusted for the opportunity costs of labour. The model assumes that to take account of wider externalities the costs of RD&I grants are reduced by 50%. Indecon, however, understands that in practice the model is not used by IDA (Ireland) to evaluate RD&I grants, and that an alternative approach is used. This means that while the model is used to evaluate even very small projects, the largest element of enterprise grant expenditures are not evaluated using the EAM.

[1] Indecon understands that the EAM is not used by Údaras na Gaeltacht who use an alternative approach to evaluate investments.

International Appraisal Models

While most developed countries use cost-benefit appraisals, the agency appraisal model used in Ireland is one of the most developed quantified models available to evaluate enterprise supports in any country. Many countries do not use such a formalised modelling approach to separately evaluate enterprise supports and instead use a standard cost-benefit approach for major investments. There are, however, a small number of enterprise agency appraisal models used in other countries and of particular relevance are those in Scotland and Northern Ireland. While the parameters used in these models are of interest, the overall structural model used in Ireland is more detailed. A key difference is that in Scotland and Northern Ireland the inputs to the models are more dependent on project judgements and less of the parameters are set as standard guidance.

Discount Rate and Risk

The Public Spending Code (PSC) has set a discount rate of 5% for use in all cost-benefit analyses of public sector projects. While there is some international research and evidence which suggest a lower rate may be justified, Indecon supports consistency with whatever rate is set in the Public Spending Code. The existing EAM also applies a risk weighting of 5% which is added to the Test Discount Rate which results in a very high annual discount rate of 10%.

Opportunity Cost of Labour

The Enterprise Appraisal Model includes different opportunity costs of labour for direct wage bill, indirect wage bill and for the immigration component of the wage bill. The shadow wage parameter values vary by region. The model also adjusts the shadow wages to account of the quality of jobs as measured by average wages. A possible unintended consequence of this is that the model implicitly assumes a lower opportunity cost for higher skilled employment, which Indecon believes is not aligned with labour market experience.

Congestion Costs and Regional Differences

The rapid growth of cities and other urban spaces can result in significant positive and negative externalities. For example, growth, which is not matched by the development of appropriate infrastructure, may result in shortages of housing and increases in traffic congestion. Traffic congestion has an economic cost and can damage competitiveness. Similarly, constraints on required infrastructure such as housing and office developments inevitably result in higher prices and can result in the need for significant increased public spending. While urbanisation also has positive externalities, regional differences in the levels of congestion and infrastructural shortages raise the issue of whether an explicit congestion cost factor should be integrated into the EAM.

Shadow Price of Public Funds and Opportunity Cost of Profits

International studies suggest a range of values for the shadow price of public funds with some recent research suggesting a case for not including a separate shadow price for public funds. The EAM includes a shadow price of public funds of 125%. It is important that the same shadow price for public funds is used in all public expenditure appraisals and this has been set at 130% in the Public Spending Code.

The EAM uses a shadow price of Irish profits equal to the shadow wage, and so implicitly assumes the shadow price of profit varies by region and by wage rates. Best practice would suggest that the shadow price of profit should reflect the opportunity cost of the capital in its best alternative use. This will generally involve a shadow price of 100%.

Corporation Tax Rate

The Economic Appraisal Model contains a parameter for the corporation tax rate of 12.5%, which is the statutory corporation tax rate in Ireland for trading income. Department of Finance research indicates a range of effective corporation tax rates in Ireland of between 8.4% and 10.4%. The Comptroller Auditor General has estimated an average effective tax of 9.8% for Ireland. The difference between the statutory and the effective rate is due to factors such as R&D credit. We note the costs of these credits are not included in the EAM.

Grant Deadweight

The parameter for grant deadweight included in the EAM ranges from between 60% and 80% based on the region of the project and the project type. For Greater Dublin this is set at 80% for expansion projects. For Rest of State the parameter equals 75% for expansions and 70% for start-ups. In the Border, Midlands and West region, grant deadweight is assumed to be 70% for expansions and 65% for start-ups. These are very high estimates of deadweight, but are aligned with some Irish and international research.

Appraisal Period

Best practice suggests that the appraisal timeframe should be the 'economically useful life of the project'. The current EAM uses an appraisal period of seven years. This is lower than used in project appraisals in other sectors and is lower than used to evaluate enterprise projects in other countries.

Conclusions and Recommendations

The analysis completed by Indecon suggests a number of conclusions as summarised in the table below.

Summary of Conclusions	
1.	**EAM is a very useful tool to assist agencies in evaluating projects and should continue to be used as part of the appraisal process.**
2.	**There is merit in allocating different levels of resources to approval of projects, depending on the scale of public resources.**
3.	**There is a need to align the model parameters with developments in Irish economy and with best international practice.**
4.	**Consistency with the Public Spending Code is required.**
5.	**The model should be extended to assist in the evaluation of R&D projects which now constitute one of the largest areas of enterprise grant expenditures. Benefits of R&D in terms of wider positive externalities for the Irish economy should be explicitly included in the model.**
6.	**Consideration should be given to model adjustments to take account of negative externalities including the cost of congestion and the impact of projects on infrastructural shortages, including housing. This should be reviewed every 5 years in the light of changes in infrastructural investment and economic and demographic developments.**

A number of practical recommendations are presented in the next table. These include changes to parameter values as well as structural changes to the model and the collection of some limited additional information to enhance evidence based policies. Indecon believes the proposed changes would enhance the effectiveness of the EAM in measuring the economic costs and benefits of agency assisted projects and assist in future planning and monitoring of industrial policy.

Summary of Recommendations	
1.	**Higher level of resources should be allocated to the evaluation of larger projects.**
2.	**Record of projects evaluated should be maintained.**
3.	**Bi-annual review of outcomes should be completed.**
4.	**Review of the model should be undertaken every 3-5 years.**
5.	**R&D investments should be evaluated using the EAM.**
6.	**A congestion cost to reflect housing and transport externalities should be included.**
7.	**The discount rate used should be changed from 10% to 5% in constant prices.**
8.	**Risk should be evaluated based on sensitivity and scenario analysis.**
9.	**The time period for appraisal should be extended to 10 years.**
10.	**The adjustment to the opportunity cost for skilled jobs should be removed.**
11.	**The model should include an adjustment for increases in the labour force.**
12.	**The shadow price of public funds to be changed to align with the Public Spending Code.**
13.	**The shadow price of profits to be changed to align with the Public Spending Code.**
14.	**The effective corporate tax rate to be reduced to 9.8%.**
15.	**A specific adjustment for social cost of carbon should not be included.**

Higher Level of Resources Should be Allocated to the Evaluation of Larger Projects

The scale of resources allocated to appraisal should reflect the different levels of public expenditures involved. This is something which is highlighted in the guidelines in the Public Spending Code and is aligned with the approach used in other sectors and in the evaluation of enterprise supports in other countries. In particular we recommend that a higher level of resources should be allocated to the testing of project assumptions for larger projects. Additional separate sensitivity and scenario analysis for larger projects should be completed.

Record of Projects Evaluated Should be Maintained

A small process improvement to involve the maintenance of a digital record of all projects evaluated by EAM would be desirable. This would enable ongoing examination of whether the EAM is acting as a filter for projects and help inform future planning and evaluations. It would also provide evidence to support any necessary adjustment to the measurement of risk and could assist agencies in deciding on sectoral priorities.

Bi-Annual Review of Outcomes Should be Undertaken

A bi-annual review of outcomes compared to the projected returns for projects should be completed. This would involve a look back at the previous seven or 10 years. This could represent an important source of insight for the agencies of how effective the model has been in estimating the net benefits.

Review of Model Should be Undertaken Every 3 – 5 Years

Given the importance of the use of the model it is necessary that the effectiveness of the model and whether it remains fit for purpose should be reviewed every 3 – 5 years. This is similar to the requirement for *ex post* reviews of tax expenditures and other programmes. This should include a review of the use and structure of the model, and the underlying parameter assumptions. The proposed process improvements involving a bi-annual look back and the maintenance of electronic records will assist in the work. The administrative and other costs of such reviews are tiny compared to the expenditures which are justified by the use of the model.

Research and Development Investments should be Evaluated Using EAM

Since the completion of the last review of the EAM in 2003, Government strategy has prioritised investment in the knowledge economy. This has been accompanied by a significant increase in the extent of R&D investment in Ireland over the last two decades, and grants for R&D combined with costs of R&D tax credit now represent the largest area of enterprise support. There are significant positive externalities associated with R&D and the social rate of return is substantially higher than the private rate of return. This was recognised in the last review of the EAM in 2003 which concluded that the social returns to R&D, while difficult to quantify, are likely to be significant. It recommended that positive spillovers amount to at least half the grant outlay, and that only 50% of the grants for R&D should be included in the costs attributable to a project. Indecon recommends that R&D projects of both IDA and Enterprise Ireland be subject to the EAM and that instead of adjusting costs, the positive externalities associated with R&D should be captured in the model. Specifically, we recommend that an additional annual social return of the spillover effects of **3.5% - 7.0% of the capital expenditures on R&D projects should be incorporated in the model. The decision on which of these two rates should apply for particular projects could be decided as part of the independent technical evaluation of R&D which is currently undertaken on all R&D investments**. Flexibility should be given to the technical assessors on the rates depending on their judgement on the nature of the project. The use of the EAM for R&D projects should be a complement to and not an alternative for the existing technical evaluation of R&D projects.

A Congestion Costs to reflect Housing and Transport Externalities Should be Included

The rapid growth of cities can result in significant positive and negative externalities. For example, growth, which is not matched by the development of appropriate infrastructure, may result in shortages of housing and increases in traffic congestion. Traffic congestion has an economic cost and can damage competitiveness. Similarly, constraints on required infrastructure such as housing and office developments inevitably result in higher prices and can result in the need for significant increased public spending. While the expansion of the Greater Dublin Region has positive externalities, the regional differences in the levels of congestion and infrastructural shortages indicates that there is a case for including an explicit congestion externality for increased employment in the Greater Dublin Region in the EAM. Specifically, we recommend adding a cost per employee per year of €5,000 in the model. This however should only apply to the percentage of employees who represent a net increase in the labour force which is assessed to be of the order of 50%. This implies an annual value per employee of €2,500 for projects based in the Greater Dublin Area. If housing shortages and congestion costs are eased in the Dublin region over time this cost could be reduced or omitted from the model. Indecon notes that in the case of IDA (Ireland) projects this will only be applicable to R&D grants as other IDA projects for Dublin are not grant aided.

The Discount Rate should be changed from 10% to 5%

The Test Discount Rate applied should be consistent with Public Spending Code, which is currently set at 5%. Risk should not be accounted for by any addition to the discount rate. All figures provided in the model should be inflation-adjusted. The discount rate should therefore be changed from 10% to 5%.

Risk should be Evaluated based on Sensitivity and Scenario Analysis

The PSC states that risk should not be accounted for through the discount rate, but that sensitivity and analysis should be completed when conducting an appraisal. Indecon fully supports the approach proposed in the PSC to evaluate risk and recommends that a sensitivity and scenario analysis should be undertaken on projects where public expenditure is €0.5m or more.

The Time Period for Appraisal should be Extended to 10 Years

An important aspect in terms of calculating the Net Present Value of a project is establishing the appropriate appraisal period, which is currently typically set at seven years. The international guidance highlights the fact that different projects are likely to have very different lifespans, and that **agencies should determine the length of the project based on its specific characteristics.** Indecon believes that a default 10-year appraisal period should be built into the model and this would involve adding a number of years to the project investment period. If there are reasons for assuming a shorter economically useful lifetime the lower estimate should be used.

The Adjustment to the Opportunity Cost for Skilled Labour to be Removed

The model adjusts the shadow wages to account of the quality of jobs as measured by average wages. A possible unintended consequence of this is that the model implicitly assumes a lower opportunity cost for higher skilled employment, which Indecon believes is not aligned with labour market experience. Indecon therefore recommends that this adjustment is removed.

The Model should include an Adjustment for Increases in the Labour Force

The model currently includes an assumption that between 50 – 60% of employment in agency assisted enterprises is due to immigration and that the tax on employment of this group should be included as a benefit. Indecon believes it is reasonable to assume of the order of 50% of the increase in employment represents a net increase to the labour force. This could be due to increased labour market participation or returning Irish emigrants or individuals attracted to Ireland. We, however, recommend that this variable is changed in the model to a wider labour force factor.

The Shadow Price of Public Funds to be Changed to Align with PSC

The PSC sets out the parameter to be used as the shadow price of public funds at 130%. The value of the shadow price of public funds in the EAM is 125%. While there are some arguments for using a low shadow price, Indecon believes the EAM should be consistent with the Public Spending Code.

The Shadow Price of Profit to be Changed to align with PSC

The Public Spending code states that the shadow price of profit should generally reflect the opportunity cost of the capital in its best alternative use. This will generally involve a shadow price of 100% unless a justification can be made for using a shadow price lower than 100%. The current EAM sets the shadow price of Irish profits equal to the shadow wage. Indecon believes that a shadow price of 100% for profits should be used. Our recommendation is consistent with what was previously used following the earlier Honohan review of the EAM.

The Effective Corporate Tax Rate to be Reduced to 9.8%

The existing model utilises the statutory corporation tax rate in Ireland which is 12.5% for trading income. The Office of the Comptroller and Auditor General estimate an effective corporate tax rate of 9.8% across all sectors in 2015, and the Department of Finance research indicated a range of effective corporation tax rates of 8.4% to 10.4%. Indecon believes that either the costs of R&D tax credit should be included as a cost in the EAM, or the effective tax rate should be changed to 9.8%. An assessment of an alternative option of including specific company information is discussed in the conclusions and recommendations chapter.

A Specific Adjustment for Social Cost of Carbon should not be Included

The current EAM does not include an explicit measure for the social cost of carbon. The 2003 review concluded that it was more appropriate to deal with these environmental considerations at the level of the generation and transmissions industries. Indecon also notes that the EU ETS emissions trading scheme is likely to cover most of the large energy using agency assisted companies and that including a measure of the social cost of carbon for other enterprises would be unlikely to have any material impact on the cost-benefit appraisal results. Indecon recommends that the social cost of carbon emissions should only be included in the EAM in exceptional circumstances if it is believed this is likely to be significant.

Acknowledgements

Indecon would like to thank a number of individuals and organisations for their valuable support throughout this review. In particular, we would like to thank the Steering Committee for the assignment including Professor John Fitzgerald, Ed Herne, Kevin Daly, Andrew Moloney and Andrew Colgan. In addition we would also like to thank Daniel O'Callaghan and Seán Prior of the Department of Public Expenditure and Reform. Particular thanks are due to the staff in the agencies who provided valuable data inputs and advice, including Rowena Dwyer, Jim Barry and Alexa Twomey of Enterprise Ireland; and Niamh Roddy and Breda O'Sullivan of IDA Ireland and to Eamonn Ó Neabhan and Fionán Ó hÓgan of Údarás Na Gaeltachta. We would like to acknowledge with thanks the attendees at an Indecon academic workshop of economists, including Professor Patrick Honohan, Professor John FitzGerald, Dr. Martina Lawless, Professor Frank Barry and Dr. Michael Collins, as well as subsequent inputs from Professor Helena Lenihan and Professor Peter Clinch, for sharing their expertise and research.

Indecon are also very appreciative of the insightful inputs provided by Professor Marc Cowling, University of Brighton, who provided input to the analysis on international developments in agency cost-benefit appraisal.

The usual disclaimer applies and the analysis and findings in this independent report are the sole responsibility of Indecon Research Economists.

1 Introduction, Background and Methodology

1.1 Introduction

This independent report is submitted to the Department of Business, Enterprise and Innovation (DBEI) by Indecon Research Economists. The report concerns a review of the Economic Appraisal Model (EAM) utilised by enterprise agencies in Ireland.

1.2 Background and Overview

The EAM is used in the grant decision-making process for projects supported by the enterprise development agencies (Enterprise Ireland, IDA Ireland)[2] as part of their system of appraisal for investment projects. The aim of the model is to identify whether specific supports by the agencies are likely to yield economic benefits in excess of the costs. The model represents an important potential tool in ensuring the best use of scarce economic resources.

The model involves estimating the anticipated costs and benefits of the proposed project (with adjustments for displacement and deadweight) and calculating the discounted present value of the net benefit of the project. A benefit-to-cost ratio of greater than 1:1 is in general required in order for a project to proceed; however, we understand that achieving this minimum threshold does not guarantee that a project will receive funding. The current version of the model has been in use since 2003, and reviews to update the cyclical elements of the model have been completed, most recently in 2014.

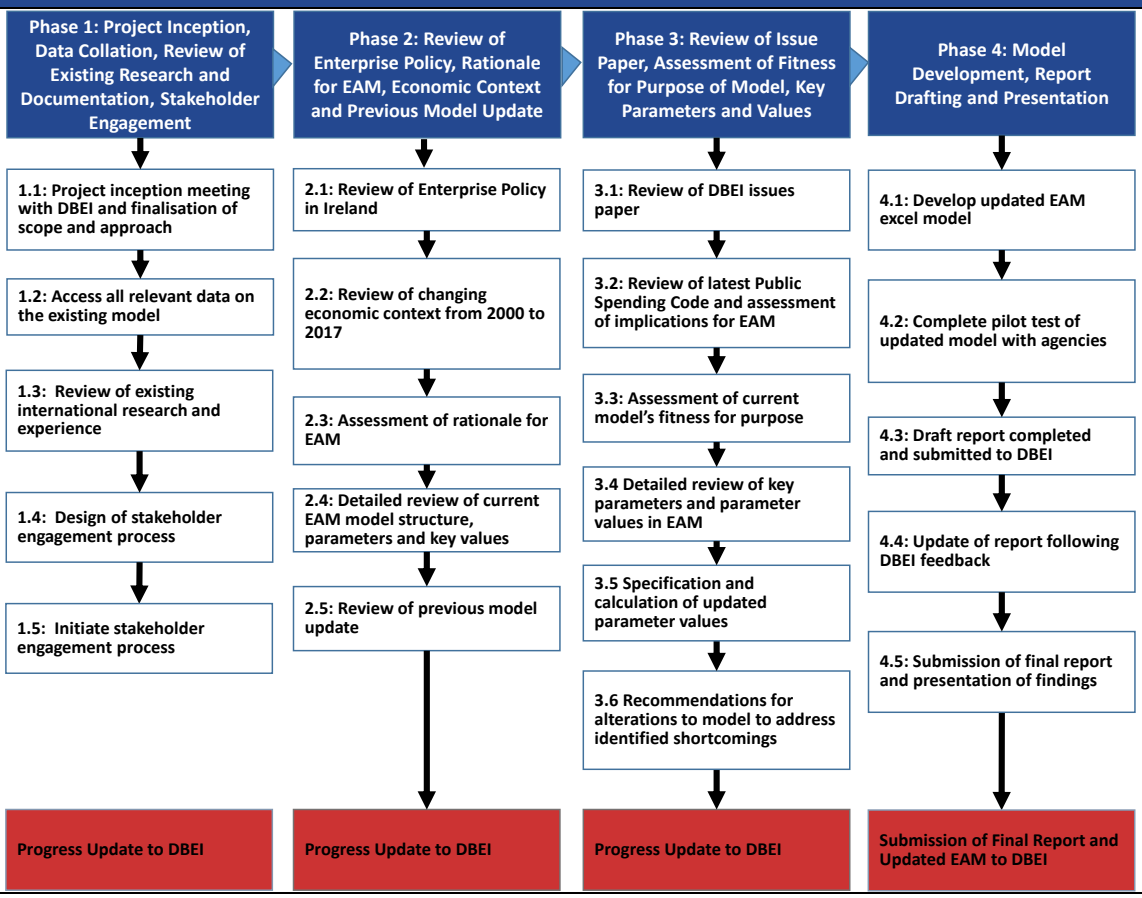
1.3 Scope and Methodology of Review

The scope of this study has involved a detailed review of the EAM, including an assessment of whether the model is fit for purpose, and whether revisions to the key parameter values are required. Indecon has undertaken a detailed four-phase methodological approach in completing this review. The methodology is summarised in Figure 1.1 overleaf. The review has also benefited from inputs from the Department and agency officials and from a Steering Committee established for the review. The study also benefited from a workshop with leading academic economists as well as new empirical research examining how the outturn for projects compared to what was originally anticipated in the cost-benefit appraisals. The analysis has built on the foundations of an important scoping paper prepared by the Department's Enterprise Programmes and Policies Evaluation Unit.[3] The methodological approach utilised in the review has taken account of the need for consistency with the Department of Public Expenditure and Reform's Public Spending Code, including guidance on Cost-Benefit appraisals.

[2] We understand that Údarás na Gaeltacht do not use the EAM and apply an alternative approach to the appraisal of projects.

[3] Review of the Enterprise Agency Economic Appraisal Model, Draft Scoping and Issues Paper – December 2016. Enterprise Programmes and Policies Evaluation Unit.

Figure 1.1: Summary of Methodology



Source: Indecon

1.4 Report Structure

The remainder of the report is structured as follows:

- Section 2 discusses the economic background policy context of this review;
- Section 3 describes the existing parameters and structure of the EAM;
- Section 4 investigates international models used in economic appraisal;
- Section 5 discusses the discount rate and the issue of optimism bias;
- Section 6 presents a discussion on the treatment of the opportunity cost of labour;
- Section 7 examines the treatment of potential congestion externalities in the model;
- Section 8 examines the shadow price of public funds and the opportunity costs of profit;
- Section 9 discusses the corporation tax rate assumed in the model;
- Section 10 considers grant deadweight;
- Section 11 considers the appraisal period of the model;
- Section 12 contains an analysis of how research and development is treated in the model; and
- Section 13 presents Indecon's independent conclusions and recommendations.

2 Economic and Policy Context

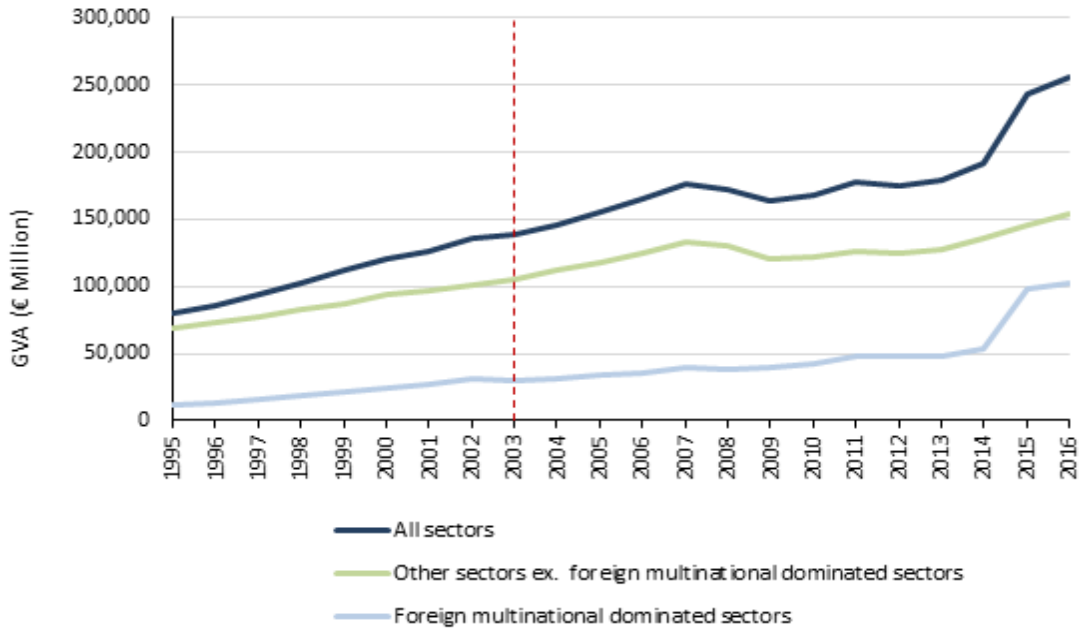
2.1 Introduction

In reviewing the Economic Appraisal Model (EAM), of note is that the Irish economy has undergone significant changes since the structural parameters in the EAM were last defined in 2003. Industrial policy has also evolved as Ireland has sought to 'move up the value chain' to areas of economic activity increasingly associated with R&D and innovation.

2.2 Review of Structural and Cyclical Changes in the Economy

Since 2003 there has been a significant increase in Irish national income and changes in the structure of the economy. The changes in Gross Value Added (GVA) before and after 2003 are presented in Figure 2.1. Despite a fall in GVA following the economic crisis, the size of the economy as measured by gross value added in 2016 was almost 85% higher than in 2003.

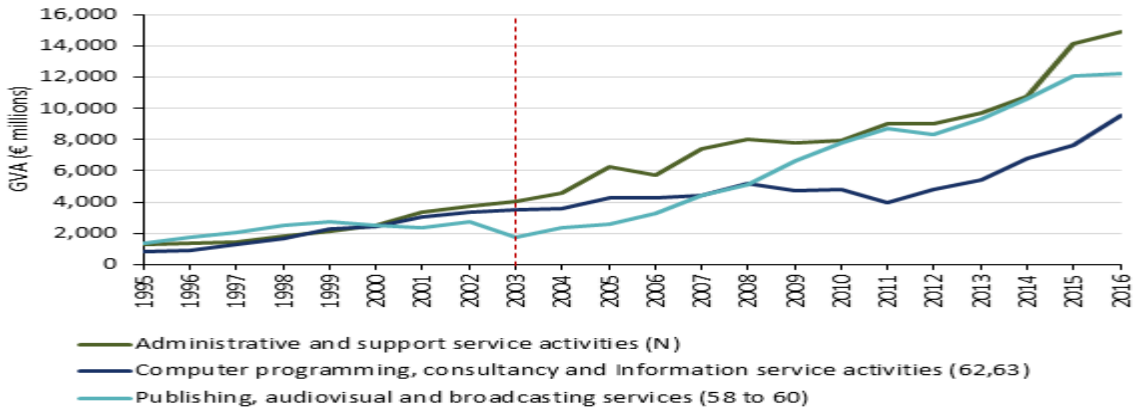
Figure 2.1: Gross Value Added (1995-2016)



Source: Indecon analysis of CSO data.
Note: The figures are at Constant Factor Cost, Chain Linked Annually Referenced to 2015

Over the period, three of the fastest growing sectors (in terms of GVA) included administrative and support services, computer programming, consultancy and information service activities, and publishing, audio-visual and broadcasting services. This in part reflects the success of the industrial development agencies in supporting high tech internationally traded services.

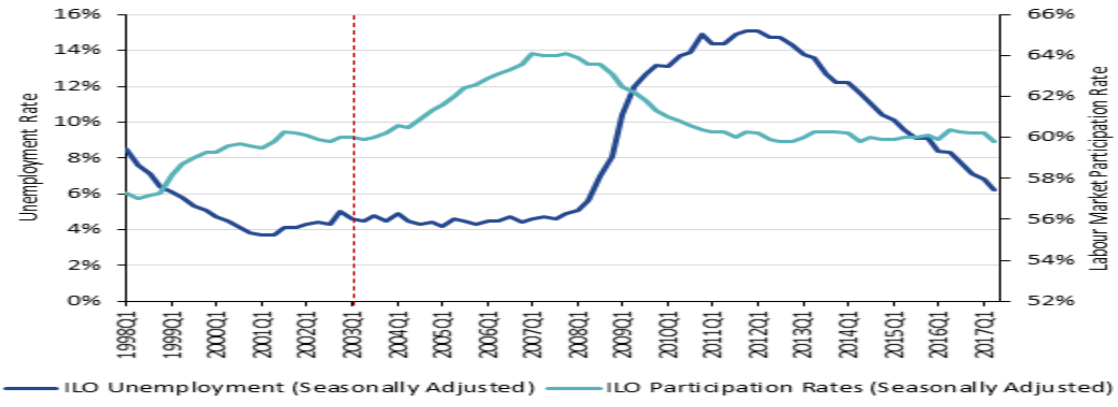
Figure 2.2: GVA of selected NACE 2 Sectors, from 1995 to 2016



Source: Indecon analysis of CSO data
Note: The figures are at Constant Factor Cost and Chain Linked Annually Referenced to 2015

In deciding on parameters in the appraisal model, account should be taken of labour market developments even though the timescale of investment projects may be such as to imply that future rather than current labour market developments are of most relevance. Changes in the labour market since the 2003 model are illustrated in the next figure. In 2003, the labour market participation rate was approximately 60% and unemployment just over 4%. Labour market participation increased up until Q1 2007, followed by a decline during the economic crisis. The unemployment rate increased dramatically during the economic crisis period, reaching a peak of over 15% in 2011. Since 2012, there has been a marked reduction in unemployment. This has implications for the model assumptions on the opportunity cost of labour.

Figure 2.3: Unemployment and Labour Market Participation (1998-2017)



Source: Indecon analysis of CSO data

The distribution of sectoral employment across regions has also changed significantly in the period post 2003. For example, while the Dublin region accounted for a higher share of financial services employment over the period, the capital's share of employment in the information and communication sector declined. In considering the regional concentration of employment in different sectors, we examined quantified measure of regional concentration. The Herfindahl-Hirschman Index which is commonly used in competition economics can be of use in providing a measure of the degree to which employment in various sectors is concentrated. The Herfindahl-Hirschman Index (HHI) is calculated as follows:

$$HHI = \sum_{i=1}^{n} s_i^2$$

where s_i represents the share of total employment in a given sector that is based region *i.*

The HHI can be interpreted as follows:

- HHI < 0.01 indicates employment is highly dispersed across regions
- HHI < 0.15 indicates employment is unconcentrated
- HHI > 0.15 and HI < 0.25 indicates moderate degree of concentration
- HHI > 0.25 indicates high concentration

While there is a high degree of concentration of employment in financial services and sectors such as information and communication, the evidence also suggests a wide dispersion of employment in industry between regions. This in part reflects the work of the agencies in supporting sectoral clusters in different regions.

Table 2.1: Herfindahl-Hirschman Index of Concentration of Sector Employment across Regions

	HHI Q1 2003	HHI Q2 2017
Financial, insurance and real estate activities	0.303	0.328
Information and communication	0.344	0.309
Professional, scientific and technical activities	0.249	0.234
Administrative and support service activities	0.225	0.210
Transportation and storage	0.217	0.207
Other NACE activities	0.176	0.174
Human health and social work activities	0.170	0.169
Public administration and defence, compulsory social security	0.177	0.169
Accommodation and food service activities	0.176	0.167
Education	0.168	0.161
Wholesale and retail trade, repair of motor vehicles and motorcycles	0.171	0.160
Agriculture, forestry and fishing	0.150	0.151
Construction	0.143	0.149
Industry	0.143	0.138

Source: Indecon analysis of CSO data

The Herfindahl-Hirschman Index can also be calculated to provide a measure of the degree to which employment in a region is concentrated in a particular sector. The figures suggest that Ireland has achieved a broad based dependence on different sectors in each region in terms of share. This is despite certain regions developing particular strengths in some sectors such as pharmaceuticals or financial services. The data also reflect the fact that internationally-traded agency-assisted employment represents only one component of employment opportunities and that many other sectors create significant employment in each of the regions.

Table 2.2: Herfindahl-Hirschman Index of Concentration of Regional Employment across Sectors

Region	HHI Q1 2003	HHI Q2 2017
West	0.100	0.097
South-East	0.108	0.095
South-West	0.103	0.094
Border	0.105	0.093
Midland	0.106	0.093
Mid-East	0.096	0.091
Mid-West	0.102	0.091
Dublin	0.086	0.083

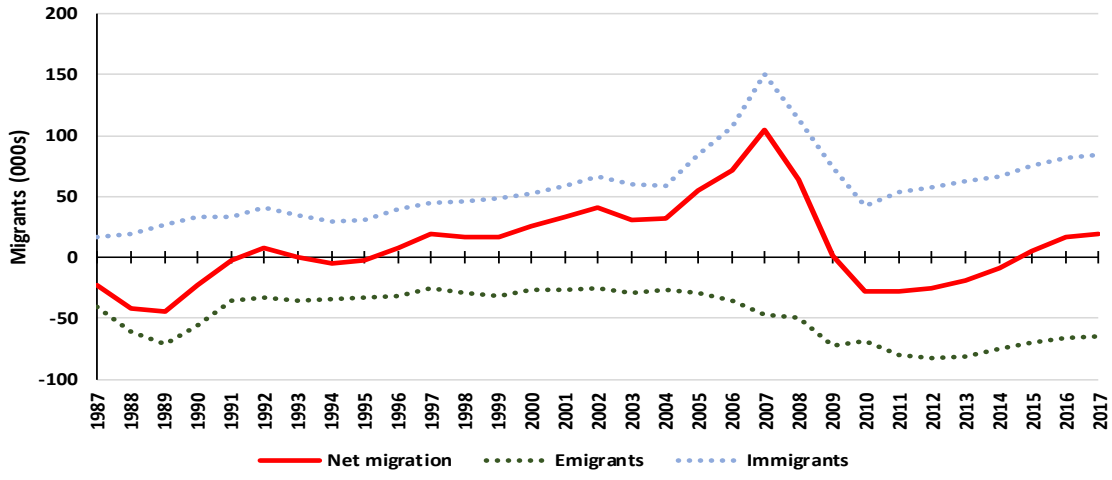
Source: Indecon analysis of CSO data

One aspect of relevance to the appraisal model is the treatment of increased employment due to attracting individuals to come and live in Ireland. This is important as the model gives a higher economic value to immigration than other aspects of employment. Figure 2.4 overleaf shows that immigration peaked in 2007 prior to the economic crisis, with a sharp decline until 2010. This coincided with an increase in emigration from Ireland, leading to net emigration between 2010 and 2014. Emigration has decreased in the last five years and Ireland returned to net immigration in 2015. Migration flows are particularly important in the Irish labour market. For example, Bergin and Kelly (2018) noted that: *"Essentially, when unemployment rises, some people decide to emigrate rather than stay in Ireland and be unemployed, thus preventing unemployment from rising further. In this sense, migration acts as a "safety valve" or an alternative to unemployment."*[4] Fitzgerald (2014) previously identified the safety valve of migration which "*moderated the inflationary pressures of the boom and it has also moderated the rise in unemployment in the recession."*[5] Similarly, in an expanding economy, inward migration has been critical in meeting required skills. From an economic perspective, however, the issue is not whether a project has attracted increased immigration but is the impact on the overall labour force.

[4] Bergin, A., Kelly, E. (2018). The labor market in Ireland, 2000–2016. *IZA World of Labor 2018*. Available at: https://wol.iza.org/uploads/articles/410/pdfs/the-labor-market-in-ireland.pdf?v=1

[5] Fitzgerald, J. (2014). Ireland's Recovery from Crisis. Economic and Social Research Institute. Available at: https://www.esri.ie/pubs/JACB201418.pdf

Figure 2.4: Net Migration (1987-2017)



Source: Indecon analysis of CSO data
Note: Figure for 2017 is a preliminary estimate

2.3 Review of Enterprise Policy

As well as examining changes in the economy and in the labour market, Indecon considered developments in enterprise policy which may have implications for the economic appraisal model. The Enterprise Strategy Group Report (2004) argued that "*future economic development will be strongly influenced by …. the increasing role of knowledge as a driver of economic development and an influencer of new products.*"[6] Since then, Government strategy has prioritised investment in the knowledge economy. *Innovation 2020*, Ireland's strategy for research, development, science and technology, sets out the Government's commitment to supporting greater engagement in RD&I in both indigenous and foreign-owned enterprises and in both SMEs and large-scale enterprises. This strategy set a target for RD&I for Ireland at 2.5% of GNP. The European Union's research and innovation policy agenda states that the EU should spend 3% of gross domestic product (GDP) on RD&I, two-thirds of which should come from the private sector.

Current Irish enterprise policy objectives are set out in the Department of Business, Enterprise and Innovation *Statement of Strategy Enterprise 2025 Renewed* and are underpinned by a number of other Government frameworks, including as *Enterprise 2025*, the *Regional Action Plans for Jobs*, the *National Skills Strategy* and *Foodwise 2025*, as well as the strategic plans of the development agencies. The fundamentals of Ireland's enterprise policy include a focus on export-led growth, underpinned by innovation and talent to drive economic growth and deliver quality jobs throughout Ireland. Policy action is focused on building resilience in the enterprise base in the face of global challenges.

[6] Enterprise Strategy Group (2004). Ahead of the Curve: Ireland's Place in the Global Economy. Available at: https://dbei.gov.ie/en/Publications/Publication-files/Forf%C3%A1s/Enterprise-Strategy-Group-Report-Full-Report.pdf

A key aspect of enterprise policy relevant to the review of the agency model include the focus on high quality enterprises and employment, and the objectives set for expanding RD&I in order to position Ireland as a global innovation leader.[7,8,9] Since the model was developed an increased policy emphasis has also been placed on regional development and ambitious targets have been set by the enterprise agencies for the expansion of economic activity in all of the regions. There have also been major policy initiatives to address housing and other infrastructural strategies which are impacting on competitiveness and on the quality of life.

2.4 Summary of Findings

The key findings from the review of economic and policy context are as follows:

- The Irish economy has undergone significant changes. Industrial policy has also evolved as Ireland has sought to 'move up the value chain' to areas of economic activity increasingly associated with R&D and innovation.
- It is necessary to take account of labour market development even though the timescale of investment projects may be such as to imply that future rather than current labour market developments are of most relevance. The very significant decline in the unemployment rate has implications for the assumptions on the opportunity cost of labour. Indecon, however, notes that over the medium term there are domestic and international risks to these positive labour market developments including in the context of Brexit.
- One other issue of relevance to the appraisal model is the treatment of increased employment due to attracting individuals to come and live in Ireland. The current existing agency model places a higher value on immigration than other aspects of employment. In Indecon's opinion the key issue is the increase in the labour force.

[7]Department of Jobs, Enterprise and Innovation (2016). Statement of Strategy 2016-2019. Available at: https://dbei.gov.ie/en/Publications/Publication-files/Statement-of-Strategy-2016-2019.pdf

[8] Enterprise Ireland (2016). *Enterprise Ireland Strategy 2017-2020.* Available at: https://www.enterprise-ireland.com/en/Publications/Reports-Published-Strategies/Strategy-2017-to-2020.pdf

[9] IDA Ireland (2015). *Winning: Foreign Direct Investment 2015-2019*. Available at: https://www.idaireland.com/docs/publications/ida_strategy_final

3 The Existing Economic Appraisal Model

3.1 Introduction

The Economic Appraisal Model is used by the enterprise development agencies to calculate the costs and benefits of investment projects. Two important independent reviews of the model by leading economists were previously undertaken in 1998 and in 2003 and our analysis builds on this work.

3.2 Development of the Economic Appraisal Model

The development agencies began using cost-benefit analysis to evaluate the efficacy of projects in the context of grant decision-making in the late 1970s. The Economic Appraisal Model was first independently reviewed in detail by Professor Patrick Honohan of the ESRI in 1998. This review noted that "*the formal cost-benefit appraisal system operated up to now by the industrial development agencies has been based on a standard criterion function which expresses the discounted present value of the project benefits as a multiple of the grant paid.*" [10] This paper recommended adjustments to the model in three areas. These included an increase the shadow wage to around 80%. The review also recommended a fuller treatment of taxation, including tax revenue as a benefit offsetting grant costs and also applying the shadow prices of public funds before adding revenue benefits to private benefits. Finally, the review highlighted the need to take explicit account of deadweight. This deadweight factor was designed to take account both of the response elasticity of projects and jobs to grant levels and the degree to which an increase in grants can be confined to those projects that are dependent on securing the assistance.

A 2003 review[11] was subsequently commissioned by Forfás and completed by Professor Anthony Murphy, Professor Brendan Walsh and Professor Frank Barry. This considered the changing labour market and regional issues and makes a number of recommendations for changes in parameter values, and in the structure of the model. The principal proposed changes in the model concerned regional differentiation of the shadow wage and a factor for immigrant additionality and for regional differences in grant deadweight. Also of significance was an adjustment of the shadow wage to take account of the quality of jobs generated. This had the impact of assuming a lower opportunity cost for higher value jobs. An important proposed change in parameter values recommended by the 2003 review was to introduce a higher shadow wage rate of 90% for Dublin, 80% in the BMW region, and 85% in the rest of the country. The review also recommended reduction in the immigrant component of additional employment, an increase in the discount rate and a reduction in grant deadweight.

[10] Honohan, P. (1998). "Key Issues of Cost-Benefit Methodology for Irish Industrial Policy". Economic and Social Research Institute, Dublin.
[11] Murphy, A., B. Walsh, and F. Barry (2003). The economic appraisal system for projects seeking support from the industrial development agencies, Dublin: Forfás.

In addition to the previous formal reviews of the EAM of note was the introduction of guidelines arising from the Public Spending Code which were updated in 2013. The cyclical elements of the EAM were updated in 2014. In 2016, the Department of Jobs, Enterprise and Innovation produced an important scoping and issues paper reviewing the design of the EAM and the values of the parameters. This paper noted that it was timely for a full review to be undertaken, "*given the extent of structural change and other factors in the economy.*"[12]

3.3 Key elements and Use of the EAM

The Economic Appraisal Model attempts to calculate the costs and benefits of projects regardless of the scale of the state support. The aim is to identify if financial supports provided by the agencies are likely to yield economic benefits that are greater than the costs. The model involves calculating the discounted present value of costs and benefits over a period of seven years. A satisfactory cost-benefit ratio is, in general, a necessary but not sufficient condition for approval. All costs are adjusted for a shadow cost of public funds. Labour costs are adjusted for the opportunity costs of labour. The model assumes that the costs of RD&I grants are reduced by 50%, and the costs of training grants are reduced by 25%. The 2016 scoping and issues paper states that "*The reduction in costs for RD&I/Training grants is underpinned by the rationale that there are positive externalities associated with these types of grants*."[13] Indecon, however, understands that in practice the model is not used by IDA (Ireland) to evaluate RD&I grants, and that an alternative approach is used. Indecon recommends changes to the treatment of RD&I grants as discussed in Chapter 12, but deems the approach to reduce the cost of training grants by 25% to be appropriate.

The benefits included in the current Economic Appraisal Model include:

- Direct wage bill (including taxes and excluding the opportunity cost of labour);
- Indirect wage bill;
- Irish profits, direct and indirect (excluding the opportunity cost of Irish profits);
- Tax on foreign profits (zero opportunity cost); and
- Tax on Irish profits (same opportunity cost as the wage bill).

The benefits also include projections for:

- Jobs to be created;
- Projected sales;
- Payroll to be paid; and
- Post-tax profit.

The costs included in the current Economic Appraisal Model include:

- Site, buildings, equipment and machinery;
- Employment;
- RD&I grants;

[12] Department of Jobs, Innovation and Enterprise, Enterprise Programmes and Policies Evaluations Unit (2016). *Review of the Enterprise Agency Economic Appraisal Model: Scoping and Issues Paper – December 2016.*

[13] Ibid.

- Equity investments;
- Capital, training and employment grants.

A summary of the parameters that are included in the current Economic Appraisal Model is provided in Table 3.1.

Table 3.1: Elements of the Enterprise Appraisal Model (2003)

Element	Description	Parameter Values	
Shadow wage	Reflects regional variation in unemployment	Greater Dublin Rest of State BMW	100% 95% 90%
Adjusted shadow wage	Accounts for high-quality jobs (i.e. wages higher than regional average)	Greater Dublin Rest of State BMW	80% ≤ *w* ≤ 100% 70% ≤ *w* ≤ 100% 66% ≤ *w* ≤ 100%
Indirect wage	Assumes indirect employment is spread evenly across state	State	95%
Shadow price of direct Irish profits	Reflects opportunity cost of project (same as adjusted shadow wage)	Greater Dublin Rest of State BMW	90% ≤ *w* ≤ 100% 85% ≤ *w* ≤ 100% 80% ≤ *w* ≤ 100%
Shadow price of indirect Irish profits	Reflects opportunity cost of project	State	95%
% of opportunity cost of net additional employment attributable to immigration	Determines the proportion of taxes on the direct and indirect wage bill that is regarded as a benefit	Greater Dublin Rest of State BMW	50% 55% 60%
Grant deadweight	Reflects regional variation and difference between project types (expansions v. start-ups)	**Expansions** Greater Dublin Rest of State BMW **Startups** Greater Dublin Rest of State BMW **HPSU**	 80% 75% 70% 80% 70% 65% 60%
Shadow price of public funds	Reflects the distortionary impact of taxation	State	25%
Marginal tax rate (wage bill)	Includes reduction in social welfare transfers and reflects the relatively high wages paid in industrial projects	State	35%
Corporate tax rate	All of taxes paid by foreign companies are treated as a benefit	State	12.5%
Discount Rate	Risk free rate in line with Dept. of Finance recommendation	State	5% risk free 5% for risk
I/O weights	Indirect benefits resulting from the purchase of material and services by project firms	Based on 1993 CSO I-O table	
Training grants cost reduction	Reduces cost of training grant by 25% to account for positive spillovers of training and development	State	25%

Source: Indecon Analysis of Murphy, A., B. Walsh, and F. Barry (2003)

The rationale for the current Economic Appraisal Model *"is to identify whether specific supports by the Agencies are likely to yield benefits in excess of the associated costs and to ensure that the State gets value for money."*[14] This is consistent with the Public Spending Code which indicates that: "*Economic analysis aims to assess the desirability of a project from the societal perspective. This form of appraisal differs from financial appraisal because financial appraisal is generally done from the perspective of a particular stakeholder e.g. an investor. Sponsoring Authority or the Exchequer. Economic analysis also considers non-market impacts such as externalities."*[15]

In addition to the Excel-based methodology, a parallel qualitative assessment process is used as part of the overall economic appraisal system.

3.4 Summary of Findings

The key findings in this section from the review of the existing model is as follows:

- The Economic Appraisal Model is used to calculate the costs and benefits of projects assisted.
- The Economic Appraisal Model involves calculating the discounted present value of a project's benefits over a period of seven years. Because the EAM is only one part of an appraisal process, a satisfactory cost-benefit ratio is in general a necessary but not sufficient condition for approval.
- The benefits included in the current Economic Appraisal Model include:
  - Direct wage bill (including taxes and excluding the opportunity cost of labour);
  - Indirect wage bill;
  - Irish profits, direct and indirect (excluding the opportunity cost of Irish profits);
  - Tax on foreign profits (zero opportunity cost); and
  - Tax on Irish profits (same opportunity cost as the wage bill).
- The costs included in the current Economic Appraisal Model include:
  - Site, buildings, equipment and machinery;
  - Employment;
  - RD&I grants;
  - Equity investments;
  - Capital, training and employment grants.
- All costs are adjusted for a shadow cost of public funds. The model assumes that the costs of RD&I grants are reduced by 50%, and the costs of training grants are reduced by 25%. Indecon, however, understands that the practice and model is not used by IDA (Ireland) to evaluate RD&I grants, and that an alternative approach is used.

[14] Murphy, A., B. Walsh, and F. Barry (2003). The Economic Appraisal System for Projects Seeking Support from the Industrial Development Agencies, Dublin: Forfás.

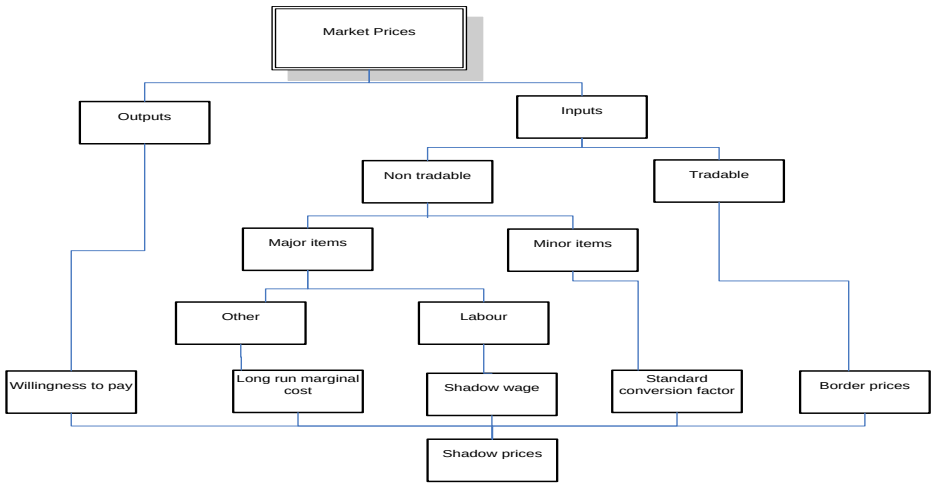
[15] Department of Public Expenditure and Reform, 2012. The Public Spending Code. Available at: http://publicspendingcode.per.gov.ie/wp-content/uploads/2012/09/The-VFm-Code-except-D-03-Print-Version.pdf

4 International Appraisal Models

4.1 Introduction

While most developed countries use cost-benefit appraisals to evaluate significant investments, the enterprise agency appraisal model used in Ireland represent one of the most developed quantified models used to evaluate enterprise supports in any country. The approach used in many countries is to follow guidelines such as those pursued in the European Commission. The European Commission's *Guide to Cost-Benefit Analysis of Investment Projects* highlights the need for shadow prices which "*reflect the social opportunity cost of goods and services, instead of prices observed in the market, which may be distorted.*"[16] These distortions include inefficient markets, prices including items such as VAT, and impacts which have no available market. Figure 4.1 outlines the approach to estimating shadow prices as part of a cost-benefit appraisal.

Figure 4.1: Approach to Cost-benefit Appraisal



Source: European Commission Guide to Cost-Benefit Analysis of Investment Projects

4.2 The Scottish Enterprise Economic Appraisal Model

One of the few agencies internationally to use a separate model to evaluate enterprise projects is the Scottish Enterprise. This model focuses on evaluating the expected impact of a project or programme on the following key factors:[17]

- Gross Value Added;
- Employment;
- The impact ratio, which is the GVA of Scottish Enterprise expenditure; and
- The cost of creating a job.

[16] European Commission, 2014. Guide to Cost-Benefit Analysis of Investment Projects. Available at: http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/cba_guide.pdf

[17] Scottish Enterprise (2014). Economic Impact Assessment for Appraisal, Monitoring and Evaluation – A Guidance Overview.

Table 4.1 below outlines the logic model and key elements used by Scottish Enterprise appraisal model. The focus on impacts is aligned with the approach used in the agency appraisal model in Ireland. The Scottish Enterprise guidance, however, suggests that economic impact assessment is not always appropriate. [18]

Table 4.1: Scottish Enterprise Logic Model		
Logic Model Stage	**Definition**	**Example**
Inputs	Public sector resources needed to deliver the project.	Money, staff, premises.
Activities	Actions needed to deliver the project.	Products/services delivered, research undertaken, workshops delivered.
Outputs	Measurable direct results of the activities.	Leverage of business Research & Development, qualifications gained, development of new products and services.
Outcomes	Changes that occur to the beneficiaries and the medium-term benefits on the economy.	Increased sales, IP generated and protected, export markets entered.
Impacts	The quantitative effect upon the Scottish economy.	Net additional GVA and employment.
Source: Scottish Enterprise Guidance [19]		

In the cases where it is appropriate to conduct an economic impact assessment, the Scottish Enterprise guidance provides a list of items and procedures to be followed as presented in Table 4.2 overleaf. Many of the elements evaluated by Scottish Enterprise are included in the EAM. Two issues of note, however, are the focus on ensuring that prices are set are consistent and also of the need to ensure an adjustment for optimum bias. A key difference in the Scottish Enterprise model, however, is that many of the parameter values appear to be based on judgement rather than set as parameters in the model.

[18] Scottish Enterprise (2014). Scottish Enterprise Economic Impact Guidance.

[19] Scottish Enterprise (2014). Scottish Enterprise Economic Impact Guidance: Logic Model.

Table 4.2: Scottish Enterprise Summary Check List	
Develop gross impact estimates	
Time period set	▪ Ensure an appropriate time period is set for the EIA ▪ Ensure a clear base year has been set
Annual impacts presented	▪ Ensure all impacts are presented on an annual basis ▪ Ensure all impacts are discounted
Constant prices	▪ Ensure impact values are presented in a consistent price basis
GVA method	▪ Check method for assessing GVA has been clearly stated
Employment method	▪ Check method for assessing jobs has been clearly stated
Adjust for additionality	
Deadweight	▪ Ensure deadweight has been adjusted for ▪ Check the range against appropriate benchmarks
Displacement	▪ Ensure displacement has been adjusted for ▪ Check the range against appropriate benchmarks
Leakage	▪ Ensure leakage has been adjusted for ▪ Check the range against appropriate benchmarks
Multipliers	▪ Ensure multiplier has been adjusted for ▪ Check that the multiplier is based on the appropriate sector ▪ Check the range against appropriate benchmarks
Optimism Bias	▪ Ensure optimism bias has been adjusted for ▪ Check the method used to assess optimism bias
Use of standard template	▪ Check the standard template has been used for additionality calculations
Develop cost estimates	
Annual SE Costs	▪ Ensure all appropriate SE costs have been collected and presented on an annual basis
Annual wider public-sector costs	▪ Ensure all appropriate wider costs have been collected and presented on an annual basis
Constant prices	▪ Check all costs have been converted to a consistent price basis
Apportion Impacts	▪ Ensure impacts are apportioned based on discounted costs across partners (where relevant)
Impact ratios for milestone years	▪ Ensure milestone year impact investment ratios have been calculated
Cost per job for milestone years	▪ Ensure milestone year cost per job estimates have been calculated
Source: Scottish Enterprise Guidance [20]	

In estimating the net economic benefit, the focus in the Scottish Enterprise model is on estimating gross value added (GVA). The Scottish Enterprise guidelines for the treatment of GVA suggest two methods of calculating GVA.

- Method 1: GVA = Before tax operating profit plus employee costs plus depreciation plus amortization; and,
- Method 2: GVA = Turnover less the cost of goods and services bought in (excluding employee costs).

[20] Scottish Enterprise (2014). Scottish Enterprise Economic Impact Guidance: Summary Check List.

On the issue of the appraisal time period the Scottish Enterprise guidance suggests using a 10-year impact assessment profile where possible, and longer in the case of infrastructure projects which may require an appraisal period of 20 years. The Scottish Enterprise Economic Appraisal Guidance recommends a discount rate of 3.5%, to be used when calculating the net present value of a project. The Scottish Enterprise Economic model also recognises the need to take account of deadweight. The parameter used for deadweight by the Scottish Enterprise Model unlike the EAM appears to be based on judgements rather than set as a parameter in the model.[21] An example of the calculation of the net present value as applied in the Scottish Enterprise model is presented in Table 4.3.

Table 4.3: Discount Rate and Calculation of Net Present Value

	Year 0	Year 1	Year 2	Year 3	Total
GVA (£000s in constant prices)	100	100	100	100	**400**
Intervention costs (£000s in constant prices)	50	50			**100**
Present values of GVA (£000s)	100.00	96.62	93.35	90.19	**380.16**
Difference in present values (£000s)	50.00	48.31	0.00	0.00	**98.31**
Net present value (£000s)	**281.85**				

Source: Scottish Enterprise Guidance [22]

4.3 The Invest Northern Ireland Economic Appraisal Model

The other agency which uses a formalised enterprise appraisal model is Invest NI. The approach taken by Invest NI in their economic appraisal model centres around two perspectives: the private view (the viability, profitability and risks of an investment project from the perspective of the applicant firm) and the public view (the potential wider economic impacts of the proposed project). Invest NI economic appraisal methodology utilises a standard Economic Efficiency Test (EET) that is adapted based on the level of assistance sought in order to balance commensurate effort and the level of expenditure. In total, there are three adaptations of the EET with the following funding thresholds:

- Qualitative efficiency test (QET) – small projects of between £1 and £250,000
- Standard efficiency test (SET) – medium projects of between £250,000 and £1,000,000
- Full economic appraisal (FEA) – large projects of over £1,000,000

As outlined in the Invest NI economic appraisal methodology, the broader standard Economic Efficiency Test (EET) is composed of three parts: firstly what is refined to as an RCA test, secondly, an assessment of the direct regional costs and benefits, and finally, an assessment of wider (indirect) costs and benefits. The RCA test which refers to replacement chain analysis is an approach to attempt to derive quantified measures of economic benefit but is based on a judgement of what would be the outcomes with and without funding.

[21] Scottish Enterprise (2014). Scottish Enterprise Economic Impact Guidance: Standard Question Set.

[22] Ibid.

The RCA test uses replacement chain analysis (RCA) to calculate a standardized measure of NPV along a uniform time horizon, allowing comparisons to be drawn between projects with different time horizons. This test examines the projected cashflow of the company in the case that the project receives funding and compares this to the projected cashflow of the company in the case that the project does not receive funding.

The analysis of regional costs and benefits focuses on the direct impacts of the proposed project on economy of Northern Ireland. The direct impacts include those that can be valued quantitatively and supported by a 'value narrative' including:

- Employment quality and longevity;
- Value added element of supply chain;
- Regional credibility and visibility;
- Reduction of 'brain drain';
- Indirect job creation;
- Number of new higher managers;
- Innovation;
- R&D; and
- Impact on unemployed, inactive and areas of disadvantage.[23]

The analysis of wider costs and benefits focuses on the wider indirect impacts on the Northern Irish economy, which are inherently more difficult to quantify. These wider costs and benefits include impacts such as:

- University/industry linkages;
- Skills development;
- Knowledge transfers;
- Entrepreneurship; and
- Encouraging FDI.[24]

A summary of the elements in the economic efficiency tests used by Invest NI is provided in Table 4.4 overleaf. These include many of the factors included in the EAM but a key difference is that some of the underlying assumptions are based on project judgements rather than set by a standard parameter value, although certain assumptions must be within central guidance levels.

The application of standard assumptions as used in the EAM makes project appraisal easier and ensures consistency. However, this reduces flexibility to tailor the analysis for specific projects. On balance, Indecon believes the approach applied on the EAM is appropriate but for large projects the testing of the impact of changes in underlying assumptions may be appropriate.

[23] Ibid.

[24] Ibid.

Table 4.4: Summary of Invest NI Economic Efficiency Tests			
Element of Efficiency Test	**Qualitative ET** (£1 - £250k)	**Standard ET** (£250k - £1m)	**Full Economic Analysis** (£1m+)
Discounted cost of project (public and private contributions)	✓	✓	✓
NPV test		✓	✓
Productivity test		✓	✓
Wage test		✓	✓
Skills test		✓	✓
Wage levels / employment longevity	✓	✓	✓ (quantitative)
Unemployment / Inactivity (including local labour market impacts and whether it is an Area of Disadvantage)	✓	✓	✓ (quantitative)
Added value (Labour market impact)	✓	✓	✓ (quantitative)
Value added element of supply chain and indirect job creation	✓	✓	✓ (quantitative)
Research, Development and Innovation	✓	✓	✓ (quantitative)
Skills and Training	✓	✓	✓ (quantitative)
Environment	✓	✓	✓ (quantitative)
Real option value of future projects, including halo effects	✓	✓	✓ (quantitative)
Reduction or reversal of 'brain drain'	✓	✓	✓
University and/or industry linkages	✓	✓	✓
Knowledge transfers	✓	✓	✓
Entrepreneurship	✓	✓	✓
Project-specific discount rate			✓ (only when funding > £6m)
Source: Summary of Annexes 1-3 in Invest NI (2011)			

The other noteworthy feature of the Invest NI approach is that a different level of analysis is undertaken dependent on the size of the project. This is aligned with the recommended approach in the Public Spending Code.

4.4 Summary of Findings

The key findings from this review of international appraisal models are contained are as follows:

- While most developed countries use cost-benefit appraisals to evaluate significant investments, the agency appraisal model used in Ireland is one of the most developed quantified models available to evaluate enterprise supports.
- Many countries do not use such a formalised modelling approach to separately evaluate enterprise supports and instead use a standard cost-benefit approach for major projects. The more usual approach is to follow guidelines such as those published by the European Commission. The approach used in Ireland is more developed and is tailored to the specific characteristics of enterprise development. This may reflect the importance given to industrial development projects in the Irish economy. There could be a case for not applying the model to small projects but Indecon understands that the agencies believe the model is helpful and can be very easily applied even for small projects.
- There are, however, a small number of enterprise agency appraisal models used internationally and of particular relevance are those used in Scotland and Northern Ireland. While the parameters used in these models are of interest, the overall structural model used by the agency in Ireland is more detailed. A key difference in these models is that they are more dependent on specific project judgements and less of the parameters are set as standard guidance.

5 Discount Rate and Risk

5.1 Introduction

The EAM uses a discount rate to estimate the net present value of the costs and benefits of assisted projects. This involves the application of a risk weighting of 5% which is added to a Test Discount Rate of 5% to give a total discount rate of 10%. While all discount rates should be set in constant real terms it is not clear whether the existing EAM model always uses real or nominal prices or a combination of both.[25] This is an issue where a consistent approach is required to ensure that constant prices are used. Discounting allows benefits and costs that occur in different time periods to be comparable by expressing their values in present terms. Net Present Value (NPV) is calculated by summing the total discounted benefits and subtracting the total discounted costs.

$$\text{NPV} = \sum_{\text{t}=0}^{\text{n}} \frac{(\,Benefits_{real} - Costs_{real})\text{t}}{(1 + r_{TDR} + r_{risk})\text{t}}$$

There are a number of elements which are important in calculating the NPV: including r_{TDR} = Test Discount Rate. r_{risk} = Allowance for project risk. $Benefits_{real}$ / $Costs_{real}$ = Benefits/Costs adjusted for inflation. n = Appraisal Timescale. Whether a specific variable for risk (*r*) should be set as part of the NPV calculation is discussed later in this chapter. The PSC guides that the same discount rate should be used in all cost-benefit analyses of public sector projects and the discount rate for cost-benefit analysis of public sector projects has been set at 5%.

5.2 Evaluation of Discount Rate

The theoretical underpinnings of Social Discount Rates is based on work completed by Ramsey (1928), who developed a model of the social rate of time preference based on a 'representative' agent who had rational expectations. Approaches to the calculation of an appropriate discount rate have since been analysed by many economists, (see Weitzman, 2001). A more recent study by Drupp et al (2015) based on an expert survey of economists, sought to provide policy guidelines on the term structure of SDRs. The findings are shown in Table 5.1 and indicated mean discount rates for SDR of between 1.70% and 2.25%. Indecon believes that these rates may be too low in an Irish context and we understand that a review is currently underway of the PSC. Indecon supports consistency on the discount rate in the EAM with whatever rate is set by the PSC.

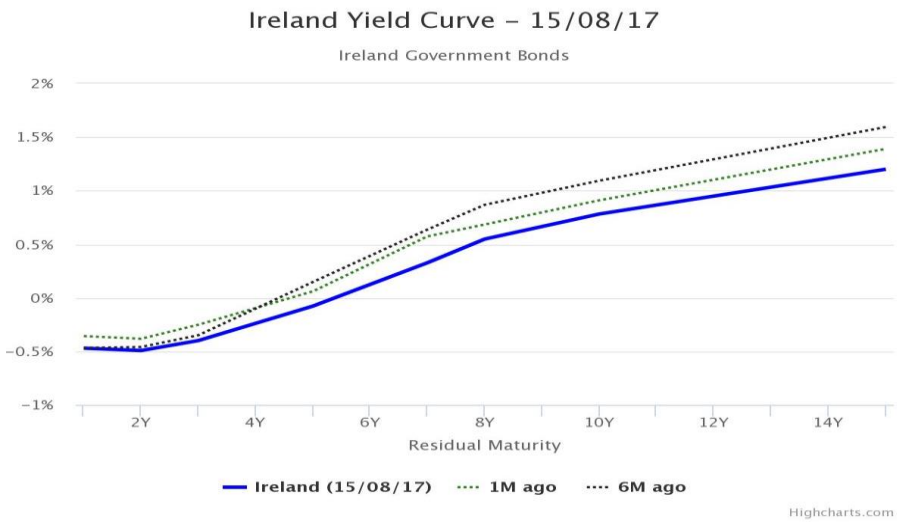
[25] For example, we understand that in many cases projections on key inputs are provided by enterprises for a number of years and these are then extended at the same level for the remainder of the 7 year period.

Table 5.1: Private Capital Flows for Two Notional Capital Projects					
Variable	**Mean**	**Std Dev**	**Median**	**Mode**	**Min**
Real Growth rate per capita	1.70	0.91	1.60	2.00	-2.00
Rate of Societal pure time preference	1.10	1.47	0.50	0.00	0.00
Elasticity of marginal utility	1.35	0.85	1.00	1.00	0.00
Real risk-free interest rate	2.38	1.32	2.00	2.00	0.00
Social discount rate (SDR)	2.25	1.63	2.00	2.00	0.00
Source: Drupp et al (2015)					

Apart from deciding on the rate it could be argued that using the same discount rate over the full project appraisal period may not be the best approach (see Bullock et al. (2015). The research by these economists has argued that "*A declining discount rate is considered to better reflect actual perceptions of the distribution between near and long-term benefits.*"[26] However, Indecon believes that for practical purposes a consistent discount rate may be the best approach in the EAM and other public sector appraisals in Ireland.

In considering the appropriate discount rate for Ireland it is useful to consider empirical calculations based by the government bond yield. Figure 5.1 shows Irish Government bond yields for bonds of different residual maturities. The discount rate is determined, however, not just by bond yields but also by normative issues and therefore a rate in excess of bond yields is likely to be justified. The trend in government bond yields may however be relevant in deciding on any changes in the discount rate.

Figure 5.1: Ireland Yield Curve, 2017



Source: Highcharts.com

[26] Bullock, C., Feely, R., Clinch, P., and O'Shea, R. (2015) ADAPT: Quantifying the costs and benefits associated with climate change risks and adaptation. *Environmental Protection Agency.*

Figure 5.2 shows the 10-year bond yield for Ireland from 1986 to 2017. Of note is the marked volatility in the rate. This highlights the importance of the discount rate taking account of likely variance over time particularly given the estimated lifetime of enterprise projects.

Figure 5.2: Ireland 10-Year Bond Yield, 1986-2017

Source: NTMA

5.3 Approach to Handling Risk

As well as the issue of the test discount rate of 5%, as noted previously the EAM includes an added 5% for risk which results in a very high discount rate of 10%. The Public Spending Code suggests that the discount rate should not be used as a method to account for risk, and risk should be addressed separately in a sensitivity and scenario analyses. In terms of sensitivity analysis, the PSC states that an important feature of a CBA is the inclusion of a risk assessment, allowing users to challenge the robustness of the results to changes in the assumptions made (i.e., discount rate, time horizon, estimated value of costs and benefits, etc.). This allows one to identify those parameters and assumptions to which the outcome of the analysis is most sensitive and therefore, allows the user to determine which assumptions and parameters may need to be re-examined and clarified.

In terms of risk, it is also important to note that the agencies have performance criteria and clawback provisions in case a project does not deliver in line with original expectations. The importance of considering risk was highlighted in appraisals by Gray (1995) who noted that inappropriate project assumptions such as overestimation of benefits can be more important than any differences between economists on technical assumptions such as shadow pricing. Gray suggests a range of approaches to the treatment of risk and in most cases a sensitivity analysis was recommended as part of the approach to the handling of risk. This is aligned with the subsequent recommendation in the Public Spending Code. A number of potential approaches to handling of risk are presented in Table 5.2 overleaf, and while an increase in discount rates are sometimes used, this is not in our opinion best practice.

Table 5.2: Approaches to the Treatment of Risk
Research on key demand and cost variables
Reduction in annual net benefits
Reduction in assumed lifespan
Increase in discount rate
Scenario Analysis
Sensitivity Analysis
Statistical simulation
Estimation of probabilities
Use of pay-back as well as NPV estimates in decision making
Threshold analysis
Source: Gray (1995), A Guide to Evaluation Methods, Gill and MacMillan.

The existing approach in the EAM to risk of increasing of adjusting the discount rate raises a number of theoretical issues. It assumes the same level of risk or uncertainty for each of the components of costs and benefits, and assumes that these increase with time in a precise manner. This could bias investments in certain directions, for example against long-term projects.

One aspect of risk in cost-benefit appraisals of enterprise projects is the potential for optimism bias. It is useful to note that because of the significance of this the UK Government's Green Book has provided separate supplementary guidance on what adjustments are needed to take account of potential optimism bias.[27]

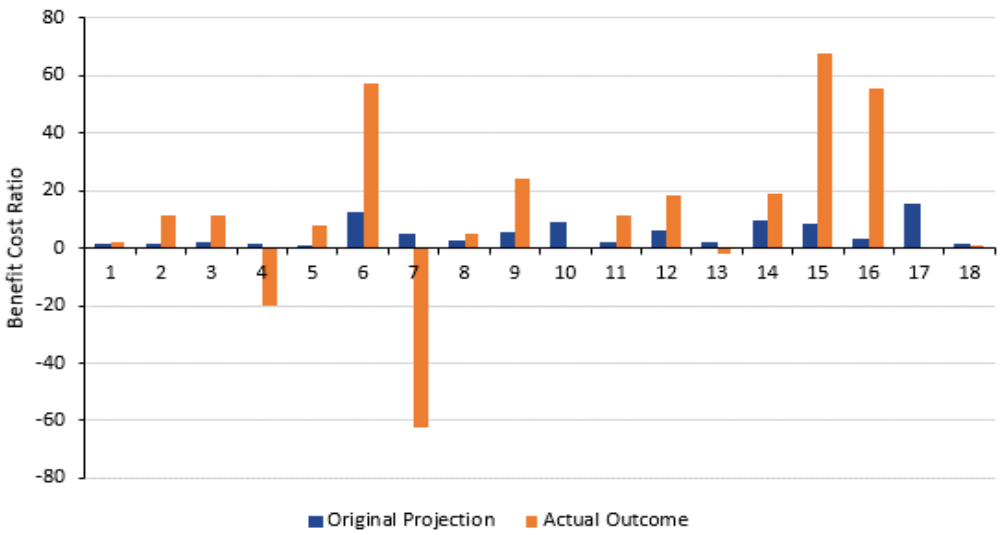
This is also recognised by Scottish Enterprise which defines optimism bias as "*the tendency for those involved in projects, as funders, managers or beneficiaries, to be too optimistic in terms of forecasting project costs, scale, timing and benefits.*"[28] Scottish Enterprise guidance therefore suggests adjusting forecasts for an optimism bias. Scottish Enterprise provides a rule-of-thumb adjustment for a reduction in net impacts of between (20-40%) to take account of such risks. An issue, however, in deciding on whether a specific factor should be included in the EAM for risk is to examine results on how project outcomes compare to the original cost-benefit calculations made.

An analysis of key projects supported by IDA in 2005 has enabled Indecon to examine how the benefit cost ratio compared to the original projection. The results show that for over half of these projects the cost-benefit ratio exceeded the original estimates. This is in part due to the lower levels of grants paid due as assistance is structured on a phased basis depending on performance. From an appraisal perspective this suggests that the structure of payments has an inbuilt mechanism to reduce the costs where anticipated benefits are not achieved.

[27] HM Treasury (2008). Intergenerational wealth transfer and social discounting: Supplementary Green Book guidance. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/193938/Green_Book_supplementary_guidance_intergenerational_wealth_transfers_and_social_discounting.pdf

[28] Scottish Enterprise (2014). Scottish Enterprise Economic Impact Guidance: Optimism Bias in Non-Infrastructure Projects.

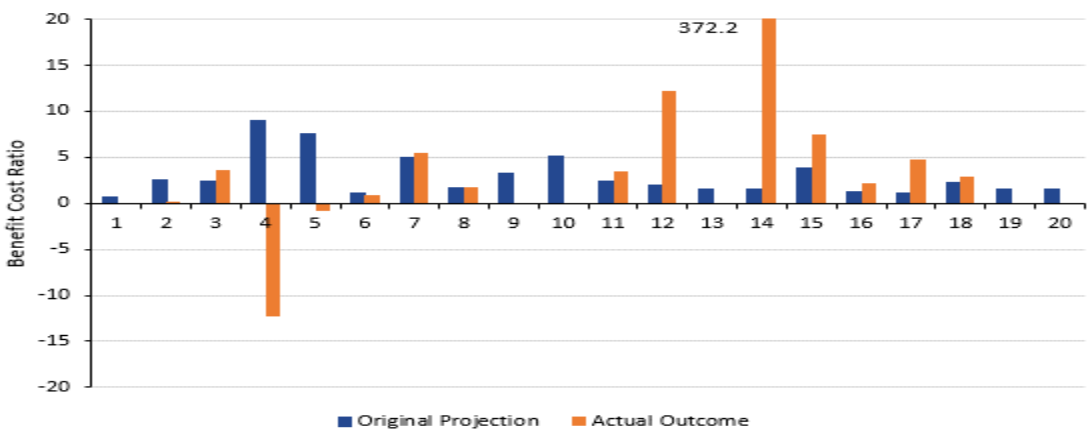
Figure 5.3: Comparison of Expected Benefit Cost Ratio Compared to Actual Outcome, IDA Firms 2005 Cohort



Source: Indecon analysis of IDA data

In the case of a 2010 sample of IDA firms, nine of the firms had benefit cost ratios that were higher than the forecasted ratios. This suggests that including an additional 5% annual risk factor may result in underestimating the net benefits and could result in misinformation on how these vary by type of project.

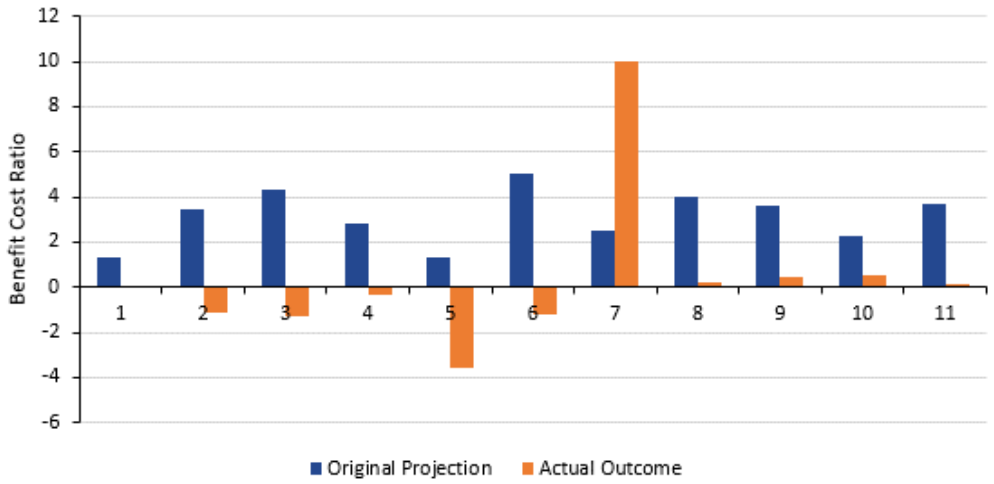
Figure 5.4: Comparison of Expected Benefit Cost Ratio Compared to Actual Outcome, IDA Firms 2010 Cohort



Source: Indecon analysis of IDA data

A similar analysis was undertaken of the larger projects supported by Enterprise Ireland. Figure 5.5 shows the outturn and expected BCR for Enterprise Ireland firms supported in 2007. The figures show that for this sample of firms the BCRS were lower than the original expectation. This is not surprising given the depth of the subsequent recession in the Irish economy.

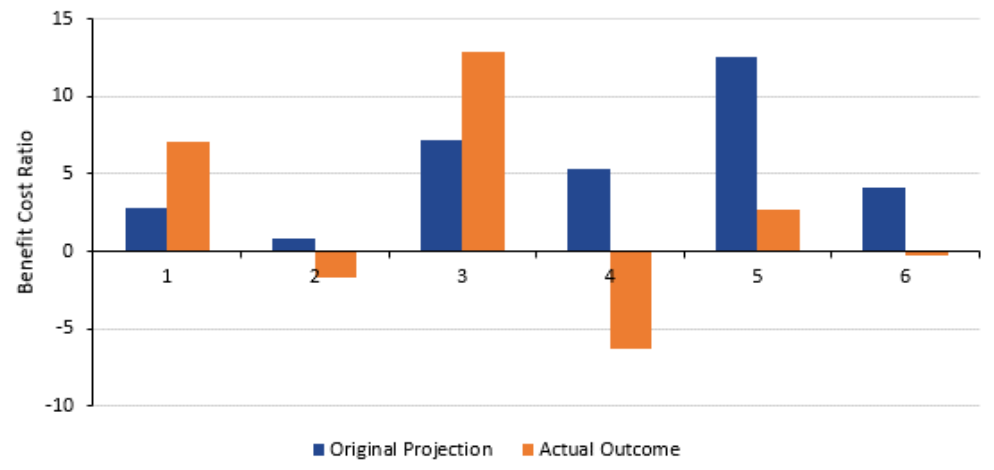
Figure 5.5: Comparison of Expected Benefit Cost Ratio Compared to Actual Outcome, Enterprise Ireland Firms 2007 Cohort



Source: Indecon analysis of Enterprise Ireland data

An analysis for Enterprise Ireland supported firms in 2010 shows that the average BCR for four out of six projects examined was lower than originally expected. It is however possible that some of these firms will generate additional benefits in subsequent yeas which may impact on the cost-benefit ratios. Further ongoing analysis of project outcomes compared to original projections would be of assistance in setting any parameters to account for risk.

Figure 5.6: Comparison of Expected Benefit Cost Ratio Compared to Actual Outcome, Enterprise Ireland Firms 2010 Cohort



Source: Indecon analysis of Enterprise Ireland data

5.4 Summary of Findings

The key findings of the discount rate and risk are as follows:

- The Public Spending Code guides that a discount rate of 5% should be used in all cost-benefit analyses of public sector projects.
- The existing EAM also applies a risk weighting of 5% which is added to the Test Discount Rate of 5% to give a total discount rate of 10%. PSC argues that risk should be addressed separately in a sensitivity and scenario analyses.
- Indecon believes it is important that all cost benefit appraisals take account of risk. We also note that an implicit adjustment of risk is built into enterprise agency grant agreements. Specifically, in terms of risk, the agencies have performance criteria and claw-back provisions in cases where a project does not deliver in line with original expectations.

6 Opportunity Cost of Labour

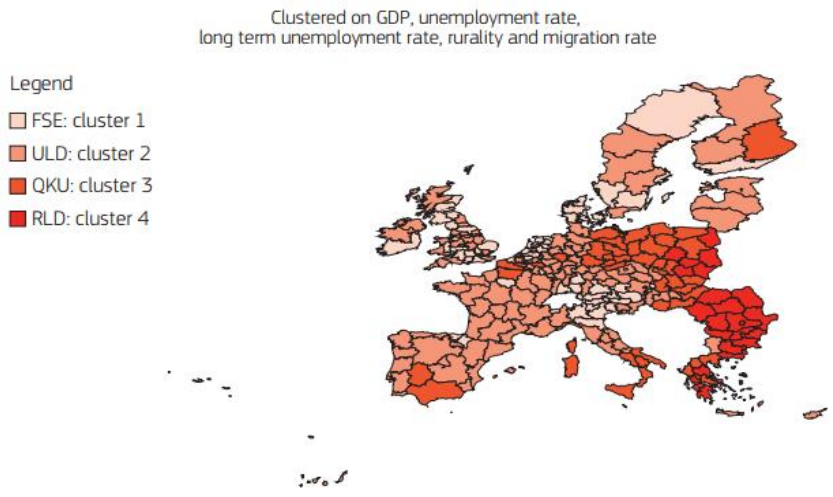
6.1 Introduction

An important component of the benefit assessment in the EAM concerns the value of increased employment. The gross benefits of employment are adjusted for the opportunity cost of labour. The Public Spending Code (PSC) Technical Reference E sets out guidelines for the treatment of the shadow price or opportunity cost of labour.[29] The PSC sets 80% as the minimum opportunity cost of labour to be applied in appraisals. The PSC states that sensitivities must be conducted using 100% when conducting an appraisal.[30] The EAM includes different opportunity costs of labour depending on the nature of project and its location. The model also adjusts the shadow wage to account for the quality of jobs and estimates of 66% – 100% of the market wage rate are included in the model parameters.

6.2 Evaluation of Opportunity Cost of Labour

Extensive international research confirms the need to include an adjustment in economic appraisal for the opportunity cost of labour. This is reflected in the European Commission guidelines which suggest that for skilled workers previously employed in similar activities, the shadow wage can be assumed equal or close to the market wage. The treatment of skilled or higher value jobs is important as this is dealt with in a specific way in the current EAM. For unskilled workers drawn to the project from unemployment, the EU guidelines suggests that the opportunity cost is equal to the value of unemployment benefits. The EU Commission cite Del Bo, Fiorio and Florio (2011), who investigated the opportunity cost of labour for EU regions. This research presented in Figure 6.1 suggested a conversion factor of 1.0 for the Southern and Eastern parts of Ireland and a factor of 0.8 for the BMW region.

Figure 6.1: Regional Labour Market Conditions



Source: Del Bo, Fiorio and Florio (2011) [31]

[29] Public Spending Code. *E. Technical References – Shadow Price of Labour: 80%-100%.* Available at: http://publicspendingcode.per.gov.ie/wp-content/uploads/2015/09/E3.pdf

[30] Ibid.

[31] Del Bo, Chaira, Carlo Fiorio, and Massimo Florio (2011). "Shadow wages for the EU Regions." *Fiscal Studies*, 32(1), 109-143.

An alternative approach to estimating the opportunity cost of labour would be to examine differences by occupational type. For example, Saleh (2004) investigated the shadow wage rate (SWR) by occupation type in Australia. Table 6.1 outlines the results of the major occupation groups examined. The calculation of the shadow wage involved the use of the average market wage rate of the occupation as well as the probability of job change both within and between occupational groups. The difference between the market wage rate and the SWR suggested that some occupations have larger distortions than others. The estimated conversion factor between the market wage rate and the shadow wage rate however do not suggest much occupational variance. Indecon considered whether such an approach would be appropriate in estimating EAM parameters but due to the absence of available data in Ireland this would not currently be feasible. It is also unlikely to significantly alter cost-benefit ratios for enterprise projects.

Table 6.1: Relationship Between Opportunity Cost of Labour and Wage Rate by Occupation

	Estimated SWRs	Market Wage Rates (MWRs)	Conversion Factors (CFs)
1. Managers and Administrators	1379.7	1418.5	0.97
2. Professionals	845.6	880.5	0.96
3. Associate Professionals	817.8	854.2	0.96
4. Tradepersons and Related Workers	691.9	722.2	0.96
5. Advanced Clerical and Service Workers	595.7	618.3	0.96
6. Intermediate Clerical, Sales and Service Workers	513.7	544.7	0.94
7. Intermediate Production and Transport Workers	702.3	747.5	0.94
8. Elementary Clerical, Sales and Service Workers	368.5	366.2	1.01
9. Labourers and Related Workers	482.6	508.9	0.95

Source: Saleh (2004)

The EAM provides a reference shadow wage rate with different parameter values based on the region in Ireland, with the Greater Dublin Area having a parameter value of 100% for the opportunity cost of labour. The opportunity costs in the BMW region and the rest of the State are lower to reflect regional variation in employment. Of significance, however, is that the reference shadow wage is then adjusted to take account of the quality of job offered by the project, as measured by the average wage offering relative to the average wage of the region. If the average project wage is equal to the average regional wage the reference shadow wage applies; if the average project wage is greater than the average regional wage then a lower 'adjusted' shadow wage applies; and if the average project wage is lower than the average regional wage then a higher 'adjusted' shadow wage applies. While this approach may have been designed to reflect Ireland's attempts to attract higher value activities, an unintended consequence of this is to imply a lower opportunity cost for higher skilled, higher wage jobs. In Indecon's opinion, this is not aligned with labour market experience.

For the Greater Dublin Area, the reference shadow wage is the current model is also adjusted by one third of a percentage point for each percentage point difference between the project wage and the average regional wage. For BMW and Rest of State regions, the reference shadow wage is adjusted by a percentage point for each percentage point difference between the project wage and the average regional wage. This is illustrated in Table 6.2 overleaf which shows the shadow wage rates used in the EAM in the different regions.

Table 6.2: Regional and Job Quality Guidance on Opportunity Cost of Labour			
Element of EAM	**Description**	**Parameter Values**	
Reference (or benchmark) shadow wage	Reflects regional variation in unemployment	Greater Dublin	100%
		Rest of State	95%
		BMW	90%
Adjusted shadow wage	Accounts for high-quality jobs (wages higher than regional average)	Greater Dublin	$80\% \leq w \leq 100\%$
		Rest of State	$70\% \leq w \leq 100\%$
		BMW	$66\% \leq w \leq 100\%$
Source: Economic Appraisal Model			

A particular feature of the opportunity costs of labour in the EAM is also a different treatment of direct and indirect wage bill and of the immigrant component of labour. Direct wage bills are calculated using an opportunity cost of labour that varies by region, sector and/or occupation and includes a cyclical adjustment component. The indirect wage bill assumption is that indirect employment is spread evenly across Ireland. Finally, for the immigration component of the wage bill, the model's parameter assumption is that a higher value is attached to net additional employment attributable to immigration, namely that the taxes on the direct and indirect wage bill of all of such employees are regarded as a benefit. The following table outlines the immigrant component of the wage bill on both the opportunity cost portion and the non-opportunity cost portion, for each region currently included in the EAM. The basis for assuming a percentage of the tax on the non-opportunity cost proportion of the wage bill included in the existing model is not clear to Indecon. Our proposed approach is to only include the tax element on the wages which are deemed to be additional, namely, after adjustment for opportunity costs.

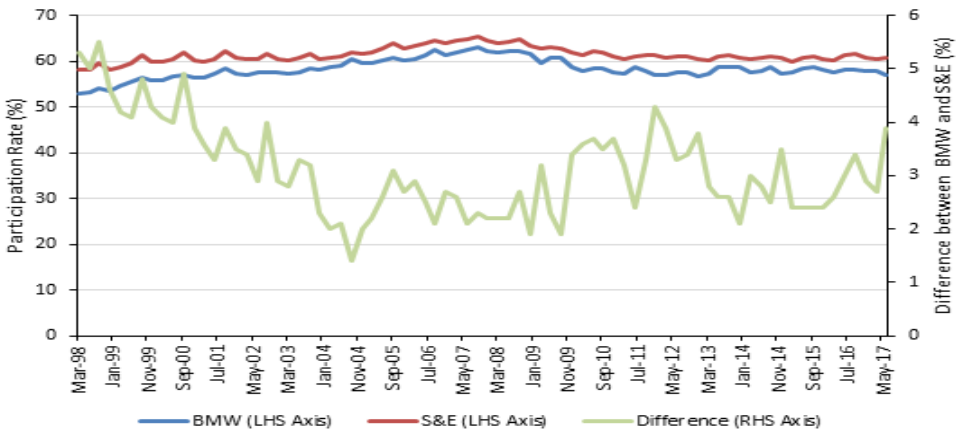
Table 6.3: Impact of the Guidance on Immigration Component of the Wage Bill				
Region	**Immigration component parameter**	**Adjusted shadow wage rate**	**Proportion of tax on the opportunity cost portion of the wage bill treated as a benefit**	**Proportion of tax on the non-opportunity cost portion of the wage bill treated as a benefit**
Greater Dublin	50%	90%-100%	45%-50%	0%-10%
Rest of State	55%	85%-95%	47%-52%	5%-15%
BMW	60%	80%-90%	48%-54%	10%-20%
Source: Economic Appraisal Model				

In considering the appropriate treatment of the opportunity cost of labour in the EAM it is useful to review recent labour market developments. The participation rates of NUTS 3 regions in the second quarter of 2017 can be seen in the Table 6.4 overleaf. Dublin has the highest participation rate at 62.9%. In the case of regions in Ireland, the unemployment rate was below 10% in each of the NUTS 3 regions in the second quarter of 2017. Unemployment in the Midlands was higher than any other region at 8.3%.

Table 6.4: ILO Unemployment Rate by NUTS 3 Region, Q2 2017		
Region	**Participation Rate**	**Unemployment Rate**
Dublin	62.9%	6.3%
Mid-East	61.4%	5.8%
South-West	59.8%	4.8%
Mid-West	58.6%	6.7%
Midland	58.6%	8.3%
West	58.4%	6.9%
South-East	58.0%	8.1%
Border	54.7%	6.6%
State	**59.9%**	**6.4%**
Source: CSO data		

The two NUTS 2 regions have had similar participation rates since 1998. The BMW region has been between two and four percentage points lower than the S&E region as outlined in Figure 6.2. The difference in participation rate between region appears to be at least partially due to differences in demographic composition. For example, Dublin has a lower concentration than the rest of the state in those age categories which report very low participation rates, i.e., 15-19 and 65+. As such, when broken down by age groups, Dublin's age-specific participation rates do not differ as much as the overall reported aggregate difference in participation rates. Reflecting these labour market developments, an update of the shadow wage rate was implemented in 2010 and incorporated values for the opportunity price of labour for Greater Dublin of between 80-100%, for BMW of between 66–100% and rest of state between 70–100%.

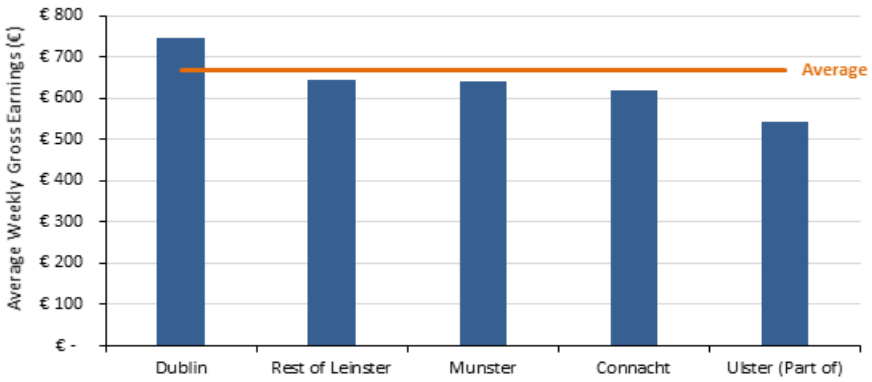
Figure 6.2: Labour Market Participation by Region (1998-2017)



Source: Indecon analysis of CSO data

It is also useful to identify any regional variation in wages. Figure 6.3 overleaf shows the average gross earnings by region in 2014. At approximately €750 Dublin had the highest of all the regions and so the adjustment to the opportunity costs which is based on relative wage would be higher. This could conceivably give a higher weight to certain employment in Dublin in the EAM modelling than to projects in other regions.

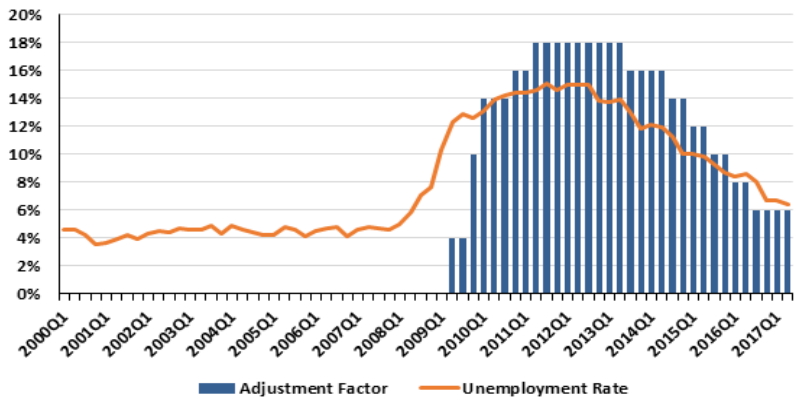
Figure 6.3: Average Gross Earnings by Region (2014)



Source: Indecon analysis of CSO data

A cyclical adjustment component is also included in the model to capture the impact of significant changes in unemployment, on the basis that higher involuntary unemployment would result in a lower shadow price for labour. The rate of adjustment included is that the shadow price of labour should be reduced by two percentage points for every percentage point by which the unemployment exceeds 6%. As such, the rate of unemployment has to reach 7% before the model is adjusted. Figure 6.4 shows the quarterly unemployment rate in Ireland from 2000 to 2017, as well as the adjustment factor that would be applied to the shadow wage rate for each region based on the mechanical rule as applied above. For example, in 2011 when the unemployment rate was 14%-16%, the adjustment factor would have been as high as 18%. Indecon believes that any adjustments for cyclical changes to shadow price should be considered within the context of revisions to the Public Spending Code and should not be determined within an enterprise agency model.

Figure 6.4: Relationship Between Adjustment Factor and Unemployment (2000-2017)

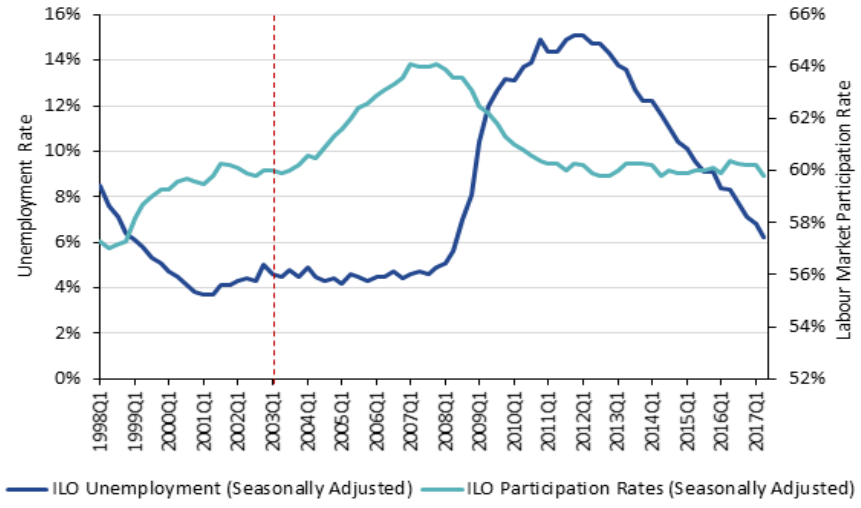


Source: Indecon

While the adjustment factor appears to closely track the unemployment rate as shown above, there is a question as to the efficacy of this approach in practice for a number of reasons. Apart from the merits of considering this within the context of the PSC, we note the significant lag between the initial planning for an industrial project, and the creation of employment. The length of economic cycles, can also vary significantly. For example, the NBER estimates that for the US from 1945 to 2009 the average expansion was approximately 58 months, and the average contraction was approximately 11 months.

Also as referred to earlier, of significance is the treatment of immigrant wages in the EAM. The primary justification for the inclusion of an immigration component of the wage bill in the 2003 EAM was that the combination of a low unemployment rate/near-full employment and a high net immigration rate implied that the some of the employment generated by projects was a net addition to the level of the labour force. The changes in the labour market since 2003 model are illustrated in the figure below. In 2003, the labour market participation rate was approximately 60%. There was an increase in labour market participation until Q1 2007, followed by a decline during the economic crisis. The unemployment rate increased dramatically during the economic crisis period, reaching a peak of over 15% in 2011. Since 2012, there has been a downward trend in unemployment since 2008. Indecon believes that the treatment of immigration was designed to address the beneficial impact of an increase in the labour force and that this remains valid. It would however be better to structure this as a labour force factor. The model assumes that 50% – 60% of employment is due to this factor. Our analysis suggests this can vary significantly over time and between sectors but we would be supportive of continuing with an assumption that around 50% of employment in agency firms represents an increase in the labour force[32]. Further empirical research on this should be undertaken on an ongoing basis.

Figure 6.5: Unemployment and Labour Market Participation (1998-2017)



Source: Indecon analysis of CSO data

[32] For example, in the industrial sector over the period 2015 – 2016 there was an increase in employment of 9,750. While 3,042 of these were non-Irish, of more relevance is that 4,561 were resident outside of Ireland one year previously, representing 46.8% of the increase in employment in industry.

6.3 Summary of Key Findings

The main findings from the review of the opportunity cost of labour are as follows:

- The Public Spending Code set 80% as the minimum opportunity cost of labour to be applied in appraisals, with a requirement that a sensitivity assessment of 100% is also used.
- The European Commission guidance on the shadow wage argues that for skilled workers the shadow wage can be assumed equal or close to the market wage; for unskilled workers it can be assumed equal to the value of unemployment benefits.
- The existing appraisal model includes different opportunity cost of labour for direct wage bill; indirect wage bill; and the immigration component of the wage bill.
- The EAM specifies reference shadow wage parameter values that vary by region to reflection regional variation in the labour market.
- The model also adjusts the shadow wages to account for high/low quality jobs that can be directly attributed to the project. An unintended consequence of this is that the current model implicitly assumes a lower opportunity cost for higher skilled employment.
- The EAM includes an assumption that half of the taxes on the opportunity cost component of the wage bill should be treated as net additional benefit. This is based on an assumption that the immigrant component of wages is given a higher weighting due to the linkage with expanding the Irish labour force. Indecon believes the key issue is the increase in the labour force.
- An update of the shadow wage rate implemented in 2010 incorporated an opportunity price of labour for Greater Dublin of between 80-100%, for BMW of between 66–100% and rest of state between 70–100%.
- Indecon believes that the opportunity costs of labour should be consistent with any revisions on guidelines in the Public Spending Code taking account of recent and expected labour market developments.

7 Congestion Costs and Regional Differences

7.1 Introduction

The rapid growth of cities can result in significant positive and negative externalities. For example, growth, which is not matched by the development of appropriate infrastructure, may result in shortages of housing and increases in traffic congestion. Traffic congestion has an economic cost and can damage competitiveness. Similarly, constraints on required infrastructure such as housing and office developments inevitably result in higher prices and can result in the need for significant increased public spending. While the growth of cities can have positive externalities, the regional differences in the levels of congestion and infrastructural shortages raises the issue of whether an explicit congestion cost factor should be integrated into the EAM. Indecon notes that the grant support rates as per the EU Regional Aid Rules are differentiated by region. This may be to reflect the potential negative externalities but such externalities are not included in the existing model. This is particularly relevant as many of the positive externalities of increased investment in Dublin and other cities are already implicitly captured in the existing model. For example, assuming only 50% of R&D grants should be included, as well as including additional corporate tax for projects in Dublin and including increased employment as a benefit in the model. A recent ESRI study on the prospects for Irish regions has pointed out that while agglomerations are pervasive due to efficiency impacts, they also note that economic activity can be excessively concentrated in one centre with more negative economic impacts. The ESRI concluded that the Irish urban system is dominated by the sale of Dublin which implies that second tier cities are unable to provide the range of functions seen in cities of similar ranking.[33] An important issue is how to deal with this economic reality in the appraisal of enterprise projects.

7.2 Evaluation of Congestion Costs and Regional Differences

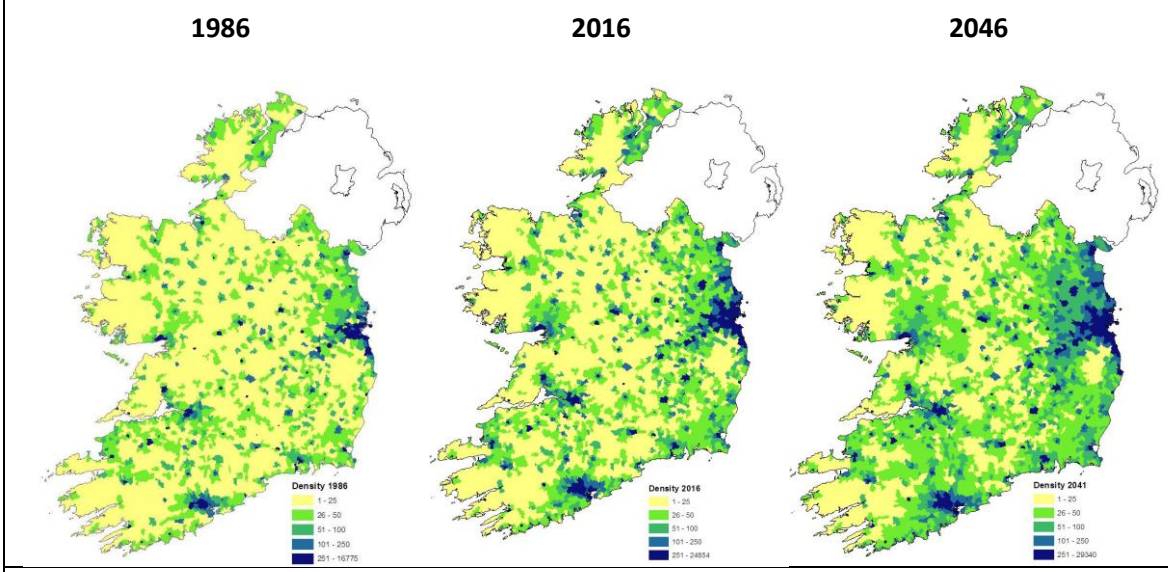
In considering congestion costs and regional differences, of note is that the Irish population has grown significantly over the last number of decades. This provides significant opportunities for the development of Ireland's enterprise base as well as raising the challenge of ensuring infrastructure matches the social and economic needs of this expansion. Table 7.1 overleaf shows the rate of population growth in Ireland in the inter-censual periods from 1981 to 2016. The data indicates that while population expanded over this period by 38%, the Greater Dublin area has seen even higher growth of 48%. Of the total population growth in the State since 1981, 47% was accounted for by population growth in the greater Dublin area.

[33] Morgenroth, E. (2018). Prospects for Irish Regions and Counties – Scenarios and Implications. *ESRI Research Series Number 70, January 2018.* Available at: https://www.esri.ie/pubs/RS70.pdf

Table 7.1: Regional Population Growth in Ireland, 1981-2016									
	81-86	86-91	91-96	96-02	02-06	06-11	11-16	81-16	(000s)
State	3%	0%	3%	8%	8%	8%	4%	38%	1,318
Greater Dublin Area	4%	1%	4%	9%	8%	9%	6%	48%	617
Dublin	2%	0%	3%	6%	6%	7%	6%	34%	344
Meath	9%	1%	4%	22%	22%	13%	6%	104%	100
Wicklow	8%	3%	6%	12%	10%	8%	4%	63%	55
Kildare	12%	6%	10%	21%	14%	13%	6%	114%	118
Cork	3%	-1%	2%	6%	7%	8%	5%	35%	140
Galway	4%	1%	5%	11%	11%	8%	3%	50%	86
Limerick	2%	-2%	2%	6%	5%	4%	2%	21%	33
Carlow	3%	0%	2%	11%	9%	8%	4%	43%	17
Kilkenny	3%	1%	2%	7%	9%	9%	4%	40%	28
Laois	4%	-2%	1%	11%	14%	20%	5%	66%	34
Longford	1%	-4%	0%	3%	11%	13%	5%	31%	10
Louth	4%	-1%	2%	10%	9%	10%	5%	46%	40
Offaly	3%	-2%	1%	8%	11%	8%	2%	34%	20
Westmeath	3%	-2%	2%	13%	10%	9%	3%	44%	27
Wexford	4%	0%	2%	12%	13%	10%	3%	51%	51
Clare	4%	0%	3%	10%	7%	6%	1%	36%	31
Kerry	1%	-2%	3%	5%	6%	4%	2%	20%	25
Tipperary	1%	-3%	1%	5%	7%	6%	1%	18%	24
Waterford	3%	1%	3%	7%	6%	5%	2%	31%	28
Leitrim	-2%	-6%	-1%	3%	12%	10%	1%	16%	4
Mayo	0%	-4%	1%	5%	5%	5%	0%	14%	16
Roscommon	0%	-5%	0%	3%	9%	9%	1%	18%	10
Sligo	1%	-2%	2%	4%	5%	7%	0%	18%	10
Cavan	0%	-2%	0%	7%	13%	14%	4%	41%	22
Donegal	4%	-1%	1%	6%	7%	9%	-1%	27%	34
Source: Indecon analysis of CSO data									

The ESRI has calculated regional population projections to 2046 as presented in Figure 7.1 overleaf. Given the assumptions used, the Irish population is set to increase by one million over the period 2011 to 2040, with the growth expected to be faster post-2016 than during the 2011 to 2016 period. The data suggests that only the Mid-East and Dublin regions are expected to grow significantly above the national average rate of growth.

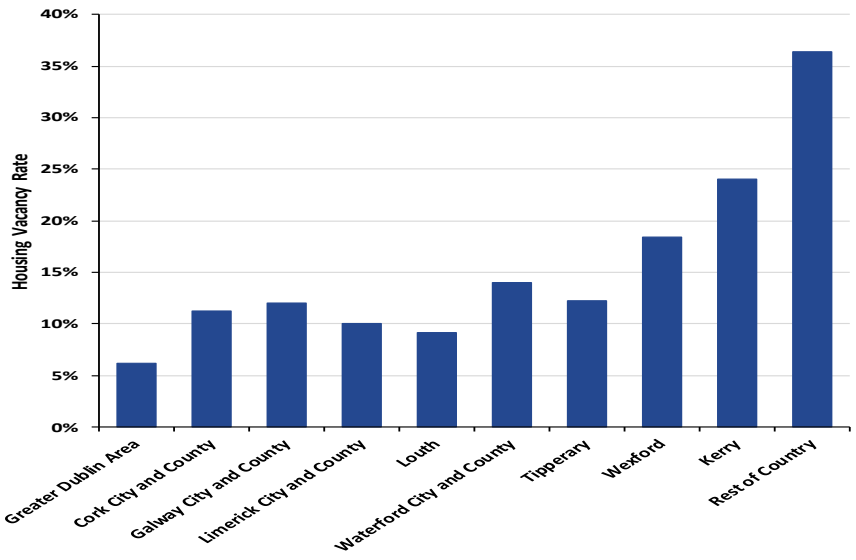
Figure 7.1: Population Density (Actual and Forecast)



Source: ESRI

The fact that one area is recording a fast rate of growth does not in itself imply any negative externalities. Such problems tend to arise only if infrastructure or other capacity constraints result in increases in factors such as commuting times or housing shortages. One potential measure of housing shortages can be seen from examining housing vacancy rates. Figure 7.2 shows the vacancy rate for Irish regions with an aggregate town area population greater than 50,000, ordered in terms of size. The figures show that the Greater Dublin Area has very low levels of household vacancy and this has implications for housing shortages and public expenditure. It also impacts on housing costs and on competitiveness for foreign and indigenous firms.

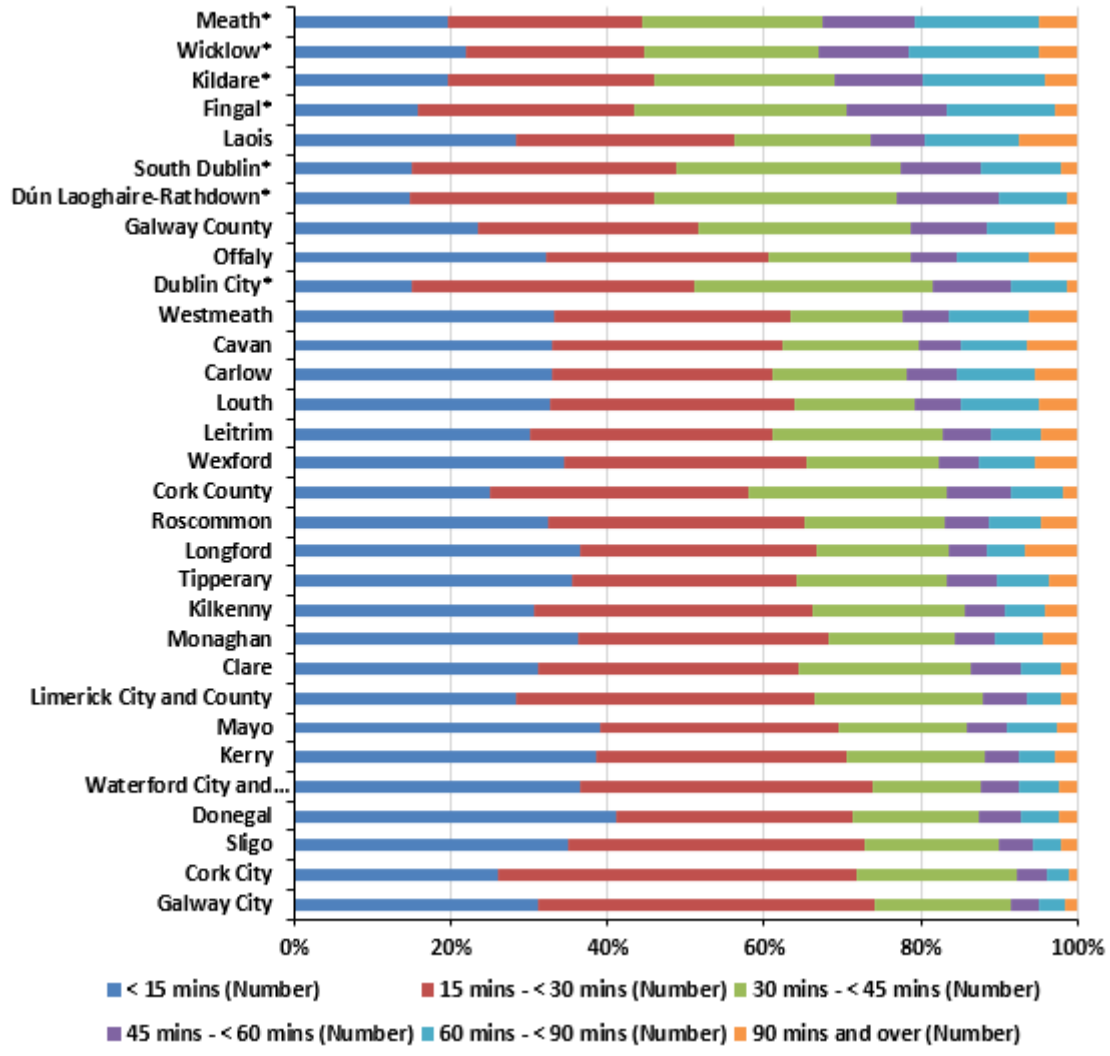
Figure 7.2: House Vacancy Rate for Regions with Aggregate Town Area >50,000



Source: Indecon analysis of CSO data

Another aspect of potential congestion costs, particularly in the Greater Dublin Area, can be seen from the evidence on commuting times. Figure 7.3 shows the percentage of the population in terms of length of daily commute by region. Importantly, the seven regions which constitute the Greater Dublin Area are all in the top ten of Irish regions as ranked by length of commute. It is also notable that the three regions which face the longest commute are all in the GDA. The expansion of the Dublin region has induced significant levels of inter-county commuting which, given current infrastructure, is resulting in the longest commute times. There is a direct economic cost arising from higher travel to work times.

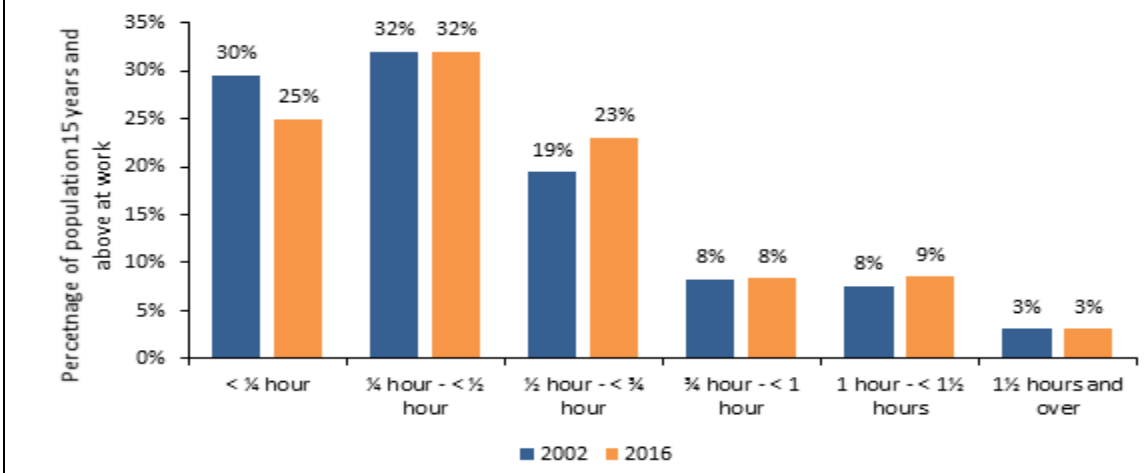
Figure 7.3: Average Commute Times by Region



Source: CSO Census.
Note: The regions which constitute the Greater Dublin Area are indicated with an asterix.

Since the last EAM was updated, the average length of commute has increased significantly and this is likely to be associated with negative externalities. Figure 7.4 shows travel times to work in 2016 compared to in 2002. 23% of people at work in 2016 travelled for 30-44 minutes, compared to 19% in 2002. Whilst average commuting time has only increased marginally, of note is that 40% of those at work in 2002 travelled for less than 15 minutes to work, but this percentage fell to 25% by 2016.

Figure 7.4: Travel Time to Work (2002 v 2016)



Source: Indecon analysis of CSO data

The evidence on the pattern of economic growth suggests that there are likely negative externalities arising from housing shortages and traffic congestion of additional economic activity in certain regions where capacity constraints are severe. This suggests that the net benefits of a project in Dublin may be different to the same project locating in a regional area. A key issue is whether it would be feasible to include a specific congestion cost factor in the model to take account of this. The EAM currently includes some factors for certain externalities such as R&D and while precise estimates of externalities are not feasible, it is useful to consider some innovative approaches to developing indicative estimates of such costs.

7.3 Estimation of Potential Congestion Cost

In considering the feasibility of estimating a potential congestion factor in the EAM it is useful to consider the economic cost of commuting for employees based in the Greater Dublin region. The average commuting time is estimated to be 30.5 minutes for those in Dublin. Using the value of an hour of commuting time based on the DTTAS Common Appraisal Framework's transport parameters and an estimated average number of working days worked per year of 235, Indecon estimates a cost to the economy of commuting time for an individual in Dublin of around €4,000 per year as indicated in Table 7.2 overleaf.

Table 7.2: Value of Travel Time for an Individual in Dublin	
Average commute time Dublin (minutes) (A)	30.5
Total commute time per day (minutes) (B = A*2)	61.0
Value of an hour of commuting time (C)	€16.85
Value of Dublin commuting time (D = B*C)	€17.12
Average days worked in a year (E)	235
Value of travel time for an individual (F = D*E)	€4,022
Source: Indecon analysis of CSO, DTTAS and OECD data Note: Commuting times based on Census 2016, Value of commuting time taken from DTTAS Common Appraisal Framework and Average days worked in a year based on OECD statistics on annual hours worked and an assumption of an eight-hour working day.	

The estimate of €4,000 per year compares with an implied value of around €3,000 for the UK Government's Congestion Charges in the UK.[34] There are a number of factors of relevance in considering whether the €4,000 estimates may or may not be an accurate measure of the additional externalities associated with commuting times of increased employment in the Greater Dublin Area. These include the fact that there are likely to be economic costs of commuting in all regions and it is only the differential costs which are relevant for the individual concerned. However, this may be more than compensated for by the fact that additional congestion also impacts on other commuters.

Another aspect of increased congestion in GDA in terms is the impact on housing costs. This can be seen by examining rental differences. Indecon have calculated the difference in rent between Dublin and the State per annum which indicates there is an average rental price difference of €6,542.

Table 7.3: Rental Prices in Dublin and the State	
Dublin monthly average	€1,772
National monthly average	€1,227
Difference between Dublin and the State	€545
Annual difference Dublin and the State	€6,542
Source: Indecon analysis of Daft data	

The estimated economic cost of commuting congestion combined with the differential in rental costs would suggest a possible externality for additional employees in the Greater Dublin Area of around €10,000 per annum. However given that there is significant uncertainty on the precise measures of these externalities we believe a prudent approach would be to reduce these costs by 50% suggesting an annual congestion factor of the order of €5,000 per annum. This however should only apply to the percentage of employees who are assumed to represent an increase in the labour force which is suggested to be approximately 50%. This would indicate an annual congestion factor of around €2,500 per employee based in the Greater Dublin Area. We also considered whether this should vary by specific areas in Dublin but believe that this would not be appropriate. This is not only because of practical operational issues in the model, but because of the impact of an expansion in one part of Dublin on adjoining areas.

[34] Assuming £11.50 sterling cost for London Congestion charge multiplied by 235 working days at exchange rate of £1 = €1.14 equals €3,081.

7.4 Summary

In this section we reviewed the potential for the inclusion in the model of an allowance for a 'congestion' weighting given the emerging bottlenecks in some other key findings are of Ireland regarding housing, transport and other infrastructure.

- The growth of cities can result in both positive and negative externalities. While the model incorporates some of the benefits such as R&D externalities and increased corporation tax, negative externalities are not included. For example, rapid city growth, which is not matched by the development of appropriate infrastructure, may result in shortages of housing and increases in traffic congestion. Traffic congestion has an economic cost and can damage the competitiveness of locating economic activity in a particular region. Similarly, constraints on required infrastructure such as housing and office developments inevitably result in higher prices which impact on competitiveness.
- The Greater Dublin Area has the lowest household vacancy rate in Ireland, which is one measure of housing strategies.
- The seven regions which constitute the Greater Dublin Area are all in the top ten of Irish regions as ranked by length of commute. The expansion of the Dublin region has induced significant levels of inter-county commuting.
- Indecon believes there is a case for including an explicit congestion cost externality for increased employment in the Greater Dublin Area in the EAM. Specifically, we recommend adding a cost per employee per year of €5,000. This however should only apply to the percentage of employees who represent a net increase in the labour force which is assessed to be of the order of 50%. This suggests a cost per employee of €2,500 for projects based in the GDA.
- We accept that it is difficult to derive definition estimates of negative externalities. The same issues apply to positive externalities which are included in the model and indeed to many of the underlying assumptions in the model. While the final decision on this and other parameters is a matter for policymakers, we believe that it is appropriate to include a specific congestion factor in the modelling.

8 Shadow Price of Public Funds and Opportunity Cost of Profits

8.1 Introduction

The Public Spending Code (PSC) sets out the parameter to be used as the shadow price of public funds.[35] The value of the shadow price of public funds is set at 130% in the evaluation of enterprise projects. This shadow price of public funds in the EAM is currently 125%. This is based on estimates from Murphy, Walsh and Barry (2003)[36] and previously Honohan (1998)[37] had recommended a shadow price of 150%.

The Public Spending code also provides guidance on the treatment of profits in project appraisals and recommends that this "*should generally reflect the opportunity cost of the capital in its best alternative use. This will generally involve a shadow price of 100% unless a justification can be made for using a shadow price lower than 100%."*[38] The current Economic Appraisal Model applies a shadow price for profits equal to the shadow wage rate.

8.2 Evaluation of Shadow Price of Public Funds

Significant academic research has been undertaken on the estimates of the shadow price of public funds. Early research for example was completed on this issue by Pigou (1928).[39] Estimation of the costs of taxation was subsequently undertaken by Harberger (1964),[40] followed by Stiglitz and Dasgupta (1971),[41] Atkinson and Stern (1974),[42] Browning (1976),[43] and Squire (1989).[44] More recently Devarajan, Squire, and Suthiwart-Narueput (1996),[45] argued that the marginal social cost of public funds should be included in evaluations of publicly-funded projects.

From a theoretical perspective, there are two major approaches to estimating the marginal cost of public funds (MCF), formalised by Ballard and Fullerton (1992).[46] While the Pigou-Harberger-Browning approach assumes the MCF depends primarily on substitution effects, the Stiglitz-Dasgupta-Atkinson-Stern approach assumes the MCF depends primarily on income effects. However, as Bird (2003) notes, "*in reality, of course, both income effects and effects on labor supply often accompany fiscal changes, so in principle the MCF ultimately depends not just on the tax, but also on the nature of the government expenditure under consideration.*"[47]

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[35] Public Spending Code Part E4: *Technical References – Shadow Price of Public Funds*. http://publicspendingcode.per.gov.ie/wp-content/uploads/2015/09/E4.pdf

[36] Murphy, A., B. Walsh, and F. Barry (2003). The economic appraisal system for projects seeking support from the industrial development agencies, Dublin: Forfás.

[37] Honohan, P. (1998). *Key issues of benefit-cost methodology for Irish industrial policy*. Dublin: Economic and Social Research Institute.

[38] Public Spending Code Part D3: Guide to Economic Appraisal – *Carrying Out a Cost Benefit Analysis*. Available at: http://publicspendingcode.per.gov.ie/wp-content/uploads/2012/08/D03-Guide-to-economic-appraisal-CBA-16-July.pdf

[39] Pigou, Arthur C. (1928). *A Study in Public Finance*¸3rd ed. Reprint, London: Macmillan, 1947.

[40] Harberger, Arnold C. (1964). "The Measurement of Waste." *American Economic Review*. 54: 58-76.

[41] Stiglitz, Joseph E., and Partha Dasgupta (1971). "Differential Taxation, Public Goods, and Economic Efficiency." *Review of Economic Studies* 38: 151-74.

[42] Atkinson, Anthony B., and Nicholas H. Stern (1974). "Pigou, Taxation, and Public Goods." *Review of Economic Studies* 41: 119-28.

[43] Browning, Edgar K. (1976). "The Marginal Cost of Public Funds." *Journal of Political Economy* 84: 283-98.

[44] Squire, Lyn (1989). "Project Evaluation in Theory and Practice." In *Handbook of Development Economics*, vol. 2, ed. Hollis Chenery and T. N. Srinivasan, 1093-137. Amsterdam: North-Holland.

[45] Devarajan, Shanta, Lyn Squire, and Sethaput Suthiwart-Nareuput (1996). "Project Appraisal at the World Bank." In *Cost-Benefit Analysis and Project Appraisal in Developing Countries*, ed. Colin Kirkpatrick and John Weis, 35-53. Cheltenham, UK: Edward Elgar.

[46] Ballard, Charles L., and Don Fullerton (1992). "Distortionary Taxes and the Provision of Public Goods." *Journal of Economic Perspectives* 6: 116-216.

[47] Bird, Richard (2003). "Evaluating Public Expenditures: Does It Matter How They are Financed?" In *Ensuring Accountability When There Is No Bottom Line*, Vol. 1 of *Handbook on Public Sector Performance Reviews*, ed. Anwar Shah. Washington, DC: The World Bank.

Estimates for the MCF are typically determined using a computable general equilibrium (CGE) model containing interactions between relevant sectors of a country's economy. The shadow price of public funds however is influenced by the type of taxation and for example Barrio et al. (2013)[48] utilised the GEM-E3 – an applied general equilibrium model developed by the European Commission to estimate the value of the marginal cost of public funds for labour taxes and energy taxes across EU countries.[49,50] These estimates suggest a MCFs for labour taxes in the range 1.3 – 2.0, and for green taxes were typically in the range 0.6 – 1.2. More specifically, the MCF for labour taxes in Ireland was 1.33, and the MCF for green taxes in Ireland was 0.62.

Table 8.1: Barrios et al. (2013) Marginal Cost of Public Funds for Labour Taxes and Energy Taxes

Country	Labour Taxes	Green Taxes
Austria	1.82	0.87
Belgium	1.98	0.63
Bulgaria	1.56	0.62
Czech Republic	1.49	0.81
Germany	1.96	1.14
Denmark	2.31	0.86
Estonia	1.30	0.79
Greece	1.59	0.85
Spain	1.79	0.89
Finland	1.61	0.63
France	2.41	1.42
Hungary	1.53	0.86
Ireland	1.33	0.62
Italy	1.68	1.10
Lithuania	1.45	0.84
Latvia	1.42	0.82
Netherlands	1.57	0.83
Poland	1.63	1.26
Portugal	1.82	0.93
Romania	1.43	0.89
Sweden	2.06	0.87
Slovenia	1.66	0.95
Slovakia	2.19	1.06
United Kingdom	1.81	1.13
EU average (GDP weighted)	**1.90**	**1.08**
EU average (simple average)	**1.73**	**0.90**

Source: Table 2 on page 27 of Barrios et al. (2013). "The marginal cost of public funds in the EU: The case of labour versus green taxes." European Commission Taxation Papers Working Paper N. 35-2013. Luxembourg: Publications Office of the European Union.

[48] Barrios et al. (2013). "The marginal cost of public funds in the EU: The case of labour versus green taxes." *European Commission Taxation Papers*. Working Paper N. 35-2013. Luxembourg: Publications Office of the European Union.

[49] European Commission (2016). General Equilibrium Model for Economy-Energy-Environment (GEM-E3). Available at: https://ec.europa.eu/jrc/en/gem-e3/model

[50] European Commission (2012). The GEM-E3 Macro-economic Model. Available at: http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=EC4MACS_GEM3_Methodologies_Final.pdf

A recent analysis by Holtsmark and Bjertnaes (2015) notes that "*estimates of MCF are highly sensitive both to the parameters of the applied model and to the exact model of the tax system.*"[51] [52] This is indicated by the data in Table 8.2. Holtsmark and Bjertnaes suggest that, in the context of the various methodological challenges, a first-best solution is to set the MCF equal to 1. This is the approach used in a number of countries and in some international guidance documents. For example, the European Commission's 2014 Regional and Urban Policy cost-benefit analysis guidelines state: "*If there are no national guidelines on this issue, MCPF=1 is the default rule suggested in this guide*".[53]

Table 8.2: Holtsmark and Bjertnaes (2015) Overview of MCF Estimates in Different Studies

	Results – estimate of MCF
Browning (1987)	1.1 – 4.0
Stuart (1984)	1.07 – 1.2
Ballard (1990)	1.001 – 1.2
Ballard & Fullerton (1992)	Flat tax: 0.936 – 1.147 Progressive tax: 1.54 – 1.989
Sandmo (1998)	Primarily a theoretical work. Concludes that distributional concerns could draw in the direct of MCF close to 1, or even below one.
Feldstein (1999)	2.65
Kleven and Kreiner (2006)	With use of the traditional model with no entry-exit to the labour market: 0.85 – 0.93. With use of a model with entry-exit: 1.26 – 2.20.
Dixon et al. (2012)	CGE-study of Finland. 1.30 – 2.22 depending on model version and tax source.
Dahlby and Ferede (2012)	Results apply to Federal Government of Canada Corporate Income Tax: 1.71. Personal Income Tax: 1.17 General Sales Tax: 1.11
Barrios et al. (2013)	Labour taxes: 1.30 – 2.41 Energy taxes: 0.62 – 1.42

Source: Table 1 on page 24 of Holtsmark and Bjertnaes (2015). "The size of the marginal cost of public funds: A discussion with special relevant to Norway." Statistics Norway Rapporter Reports 2015/13. Oslo, Norway: Statistisk sentralbyrå.

An important recent paper by Bos, van der Pol and Romijn (2018) provided a comprehensive overview of the theoretical, empirical and practical arguments both in favour of and against a MEB correction. The authors conclude that, in general, the cost of taxation is broadly counterbalanced by the benefits of the redistribution of taxes. Therefore, "*the preferred approach is to assume in general that the marginal cost of public funds is equal to one and then no correction is needed.*"[54] Indecon, however, accepts that this is an issue for decision for the Public Spending Code and that consistency between the EAM and whatever is decided is essential.

[51] Holtsmark and Bjertnaes (2015). The size of the marginal cost of public funds: A discussion with special relevant to Norway. *Statistics Norway Rapporter Reports 2015/13*. Oslo, Norway: Statistisk sentralbyrå.

[52] Ibid.

[53] European Commission (2014). *Guide to cost-benefit analysis of investment projects: Economic appraisal tool for Cohesion Policy 2014-2010*. Luxembourg: Publications Office of the European Union.

[54] Bos, F., T. van der Pol, and G Romihn (2018). "Should CBA's include a correction for the marginal excess burden of taxation?" *CPB Discussion Paper 370*. CPB Netherlands Bureau for Economic Policy Analysis.

8.3 Evaluation of Opportunity Cost of Profits

The inclusion of an opportunity cost for profits of indigenous enterprises below 100% and based on the assumed shadow wage raises a number of issues. Indecon also notes that this is a change from the parameter in the model following the 1998 review by Professor Honohan where the shadow price was 100%.

The EAM by applying an opportunity cost to profits to some projects below 100% also gives a higher assumed value to profits based on the absolute levels of profits. This does not account for differences in the levels of capital investment or the percentage return on investment. This can be seen by examining two illustrative investments. Project A requires a €1,000m capital investment and secures a 10% return and project B involves €2,000m investment but only secures a 7.5% annual return on the investment.

If it is assumed that Project B has a shadow wage rate of 66% and Project A has an assumed shadow wage rate of 100% then no value is given to the profits of Project A. This is despite the fact that Project A has a higher rate of return on the capital employed. Even if the same shadow wage was assumed, a higher value would be implied by the EAM for the project with the lower percentage return. This highlights one of the difficulties of assuming an opportunity cost price of profits below 100%.

Table 8.3: Impact of Capital Investment on Project Profitability

Time Period	Project A Profit	Assumed Benefit in EAM (Project A)	Project B Profit	Assumed Benefit in EAM (Project B)
Year 1	€100m	0	€150m	€51m
Year 2	€100m	0	€150m	€51m
Year 3	€100m	0	€150m	€51m

Source: Indecon Analysis

8.4 Summary of Key Findings

- The Public Spending Code (PSC) sets out the parameter to be used as the shadow price of public funds. The value of the shadow price of public funds is set at 130%.
- There is some recent academic evidence which suggests that there should be no specific adjustment for the shadow price of public funds. Indecon, however, believes that it is important that the EAM is consistent with whatever level is set by the Public Spending Code.
- The current EAM applies a shadow price for profits equal to the shadow wage rate.
- This approach does not take account of the level of capital investment and as a result could apply a higher value to a project with a lower percentage rate of return on the investment compared to an alternative project.

9 Corporation Tax Rate

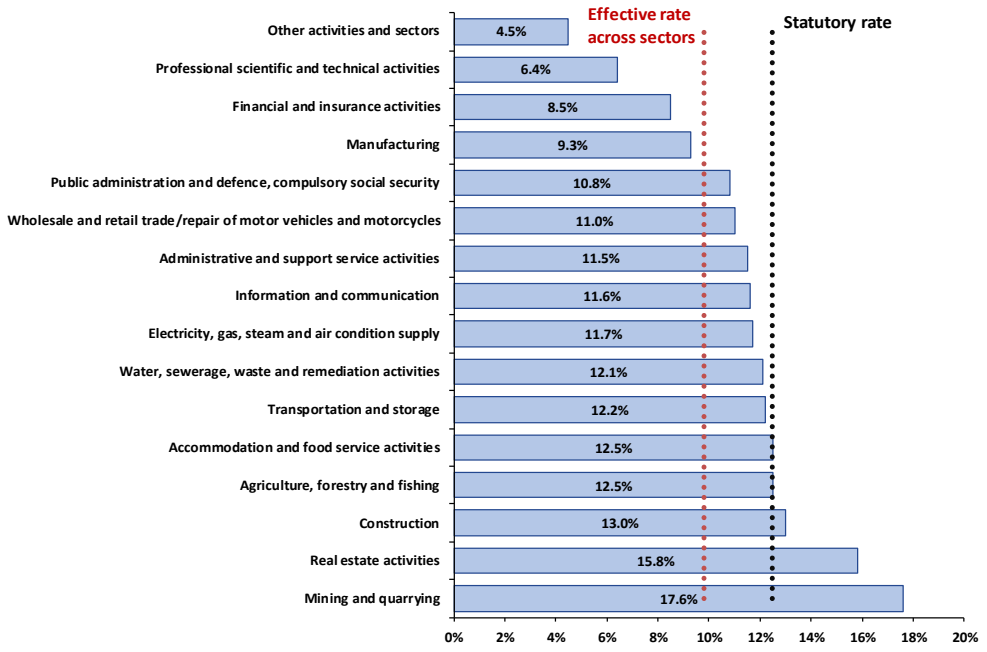
9.1 Introduction

In this section Indecon discusses the corporation tax rate in Ireland. The parameter used in the EAM model is based on the headline corporation tax rate in Ireland which is 12.5% for trading income.

9.2 Evaluation of Corporation Tax Rate to Use in EAM

The Comptroller and Auditor General's Report on the Account of Public Services 2016 included estimates of the effective corporate tax rate in Ireland.[55] The following figure outlines the effective corporation tax rate across NACE sectors. The majority of sectors had effective tax rates below the statutory rate, with an average effective rate across sectors estimated at 9.8%. The figures also suggest that many key sectors supported by the enterprise agencies have effective corporate tax rates below 12.5%.

Figure 9.1: Sectoral Effective Corporation Tax Rates, 2015



Source: Revenue Commissioner data in Comptroller and Auditor General report

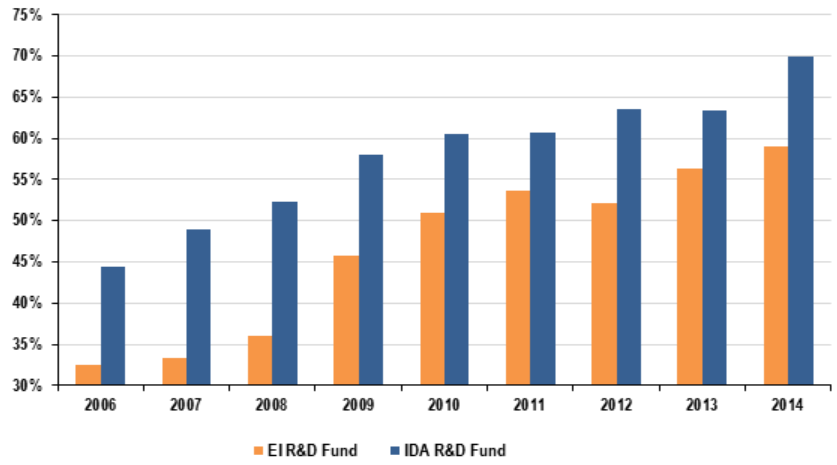
[55] Comptroller and Auditor General, 2017. Chapter 20 Corporation Tax Receipts – Report on the Account of Public Services 2016. Available at: http://www.audgen.gov.ie/documents/annualreports/2016/report/en/Chapter20.pdf

Research completed by the Department of Finance presented estimates from a range of other studies on the effective corporation tax rate in Ireland. This indicated estimates ranging from 2.2% to 15.5%. The Department judged that the best approach was to use the effective tax rate based on operating surplus or based on the approach which estimated tax due as a proportion of taxation income. These approaches suggested effective corporate tax rates for Ireland of between 8.4% and 10.4%.

The differences between the statutory corporate rate and the effective tax rate is due to the impact of a number of significant credits/allowances that apply to companies. One important example of this is the R&D tax credit by enterprises in Ireland. Available evidence indicates that the cost of R&D tax credit which was introduced in Finance Act 2004 is very significant. Of particular relevance to the EAM is the increase in the usage of R&D tax credit by agency assisted firms.

The next figure shows the extent of which firms who avail of either the IDA Ireland R&D Programme or the Enterprise Ireland R&D Programme also avail of the R&D Tax Credit. This highlights the importance of taking account of the tax incentives as part of any evaluation as to the merit in supporting any particular project. In order to accurately measure the net benefits of enterprise firms either the cost of the R&D tax credit should be included or an adjustment made to use an estimate of effective corporate tax rate.

Figure 9.2: Take-up of R&D Tax Credit by Firms Availaing of EI and IDA R&D Programmes



Source: Indecon analysis of ABSEI data

9.3 Summary of Findings

The key findings in this chapter are contained below:

- The current Economic Appraisal Model contains a parameter for the corporation tax rate of 12.5%, which is the statutory corporation tax rate in Ireland for trading income.
- Using Revenue Commissioner data, the Office of the Comptroller and Auditor General estimated an average effective corporation tax rate of 9.8% in 2015.

10 Grant Deadweight

10.1 Introduction

The Public Spending Code (PSC) states that "*deadweight occurs when public expenditure is incurred to achieve benefits which would have been achieve in the absence of the project scheme being funded.*"[56] The EAM as noted in Section 3 includes a range of very high estimates for deadweight of 60%-80% depending on the region and whether the project is an expansion, start-up or high potential start-up project.

10.2 Evaluation of Grant Deadweight

There has been significant empirical work undertaken in Ireland and internationally on potential levels of deadweight for enterprise programmes. Table 10.1 contains the results of an analysis conducted by Forfás into estimates of deadweight for different enterprise supports for research, development and innovation.[57] The range of estimates presented are broadly aligned with the parameters used for deadweight in the existing EAM. An alternative estimate from a Department of Finance review of the R&D tax credit scheme[58] suggested deadweight for that scheme of approximately 40%.

Table 10.1: Estimates of Deadweight for Enterprise Supports for R&D and Innovation

Enterprise Support	Estimate of Deadweight
EI Commercialisation Fund (2003-2009)	62-64%
Intellectual Property Assistance Scheme (2005-2009)	66%
Innovation Partnerships (2004-2006)	93-95%
IDA R&D Fund	63%
Scottish Enterprise Commercialisation Programme	75-77%
Innovation Vouchers Programme (2007-2011)	90%

Source: Forfás

A study of Enterprise Ireland supported firms (Lenihan and Hart, 2004) suggested estimates of deadweight of around 50%. Lenihan (1999) also provided estimates of deadweight for grant supports given by Shannon Development to indigenous Irish firms, which suggested potential deadweight of 78.4%. Separately, Lenihan and Hart (2006) estimate a deadweight for foreign-owned companies in the Shannon region of 71.3%. These rates are high compared to some other international research estimates and we note the difficulties in providing definitive estimates of the levels of deadweight.

[56] Department of Public Expenditure and Reform, 2012. The Public Spending Code – Guide to economic appraisal: Carrying out a cost benefit analysis (D.03). Available at: http://publicspendingcode.per.gov.ie/wp-content/uploads/2012/08/D03-Guide-to-economic-appraisal-CBA-16-July.pdf

[57] Forfás, 2014. Evaluation of Enterprise Supports for Research Development and Innovation.

[58] Department of Finance, 2016. Report on Tax Expenditures (October 2016). Available at: www.budget.gov.ie/Budgets/2017/Documents/Tax_Expenditures_Report%202016_final.pdf

Tokila and Haapanen (2012) examined regional variations in Finland on measures of deadweight which suggested lower levels of overall deadweight than used in the EAM. Also of note is that partial deadweight may be a feature of many projects.

Table 10.2: Deadweight in Finnish Regional Enterprise Funding	
Deadweight	**Estimated % of Projects Financed**
Zero	16.8
Reduced scale project	39.4
Reduced qualitative scale project	28.6
Project delayed	13.8
Full deadweight	1.4
Total	100.0
Source: Tokila, A., & Haapanen, M. (2012)	

The specific design of the programme can also influence the likelihood of deadweight. Allinson, Robson and Stone (2013) found that in that case of the Enterprise Finance Guarantee (EFG) Scheme in the UK, 83% of borrowers in the scheme would not have been able to obtain finance through other means.[59] Cowling (2010) also suggested that the SFLG scheme was also well targeted with 76% of the loans through the scheme classed as additional finance. His research suggests that an estimated half of the projects would not have gone ahead without the loan, and more would have been delayed or reduced in scale.[60]

The existing EAM includes very high parameters for deadweight ranging between 70-80% for expansions and 65-80% for start-ups with 65% for HPSU. The PSC notes that measures of deadweight can be difficult to source and its application within the EAM presents methodological challenges. However, the existing model assumptions on deadweight are aligned with upper estimates of the main existing empirical research studies in Ireland and somewhat higher than estimate internationally. There may therefore be a case for reducing the deadweight estimates for certain types of projects. On balance, our conclusion is that any adjustment should be informed by new empirical research on deadweight parameters and how they might vary by region and enterprise type. This is outside the scope of the current project and would involve a significant research programme over time. Given the importance of this issue we would recommend that the Department of Business, Enterprise and Innovation should consider such an initiative.

[59] Allinson, G., Robson, P. and Stone, I. (2013). Economic Evaluation of the Enterprise Evaluation Finance Guarantee (EFG) Scheme. Department for Business Innovation & Skills. Available at: http://fenjoyl.com/pdf/13-600-economic-evaluation-of-the-efg-scheme.pdf

[60] Cowling, M. (2010). Economic Evaluation of the Small Firms Loan Guarantee (SFLG) Scheme. Department for Business Innovation and Skills. Available at: http://www.employment-studies.co.uk/system/files/resources/files/bis10512.pdf

10.3 Summary of Findings

Indecon's main findings from this review of grant deadweight are contained below:

- Deadweight occurs when public expenditure is used to secure benefits which would have been achieved in the absence of the intervention.
- The EAM includes a range of very high estimates of deadweight of 60%-80% depending on the region, and the type of project supported.
- Previous Irish and international research including research on IDA (R&D) grants and EI projects suggests a wide range of estimates for deadweight which are broadly aligned with the parameters used in the existing EAM, although we accept that the estimates in the model are at upper levels of available research.

11 Appraisal Period

11.1 Introduction

An important aspect in terms of calculating the Net Present Value of a project is establishing the appropriate appraisal period. The PSC guides that the appraisal timeframe should be the 'economically useful life of the project'. The EAM currently uses an appraisal period of seven years.

11.2 Evaluation of the Appraisal Period

The European Commission guidelines on cost-benefit analysis suggest an appraisal period for projects as shown in Table 11.1, ranging from 10 to 30 years. For research and innovation projects a period of 15 – 25 years was proposed and for business infrastructure and other sectors a 10 – 15-year period was indicated. As noted earlier, Scottish Enterprise use levels of 10 – 20 years. In Indecon's experience, ten years would be the minimum used in major enterprise and other appraisals internationally.

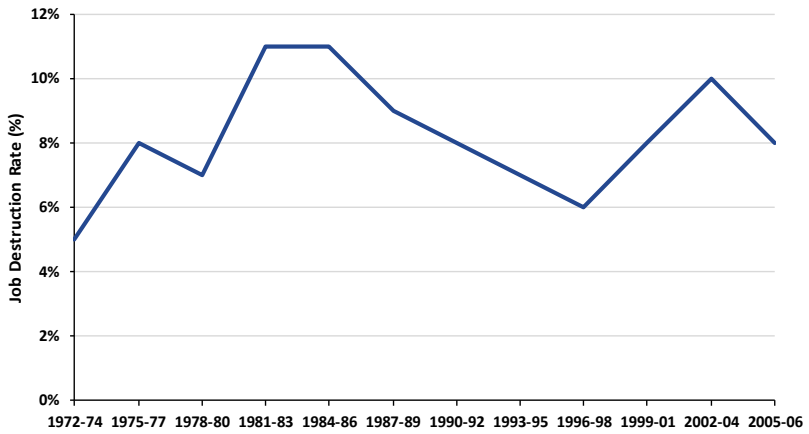
Table 11.1: EU Guidelines on Sectoral Reference Periods

Sector	Reference period (years)
Railways	30
Roads	25-30
Ports and airports	25
Urban transport	25-30
Water supply/sanitation	30
Waste management	25-30
Energy	15-25
Broadband	15-20
Research and Innovation	15-25
Business infrastructure	10-15
Other sectors	10-15

Source: EU Commission (2014)

In evaluating the appropriate appraisal period it is necessary to consider the economic useful life of a project. Lawless and Murphy (2008) provide evidence on the job destruction rate of agency projects over a very long period. While this shows significant variance, it may suggest a longer lifespan than 17 years used in the EAM. (See Figure 11.1 overleaf.)

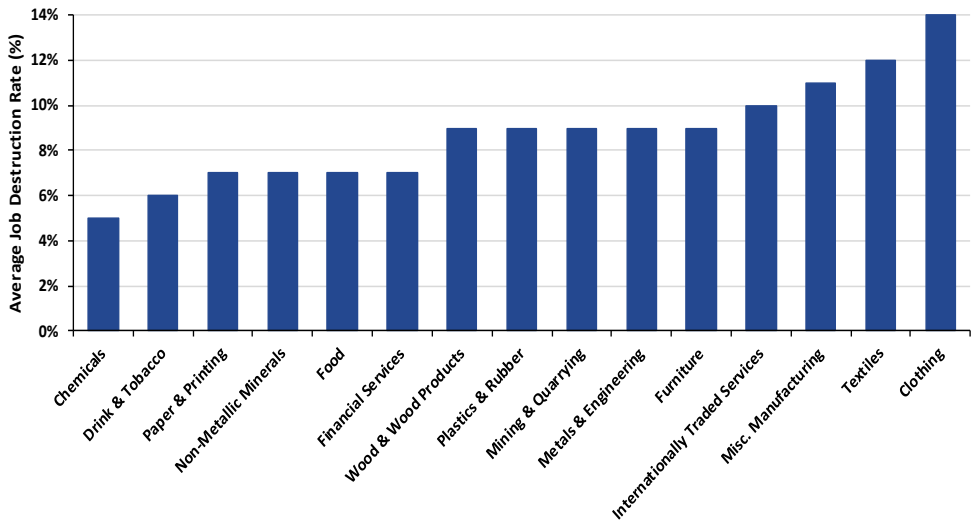
Figure 11.1: Job Destruction Rate for Firms Covered by ABSEI



Source: Indecon analysis of Lawless and Murphy data

Data on job destruction rate over time is presented in Figure 11.2. The figure shows significant differences in job destruction rates across sectors. For most of the sectors currently supported by the enterprise agency the average job destruction data provides some tentative evidence that the economically useful life of companies may be high in many cases.

Figure 11.2: Average Job Destruction Rate by Sector for Firms Covered by ABSEI, 1972-2006



Source: Indecon analysis of Lawless and Murphy data

11.3 Summary of Findings

This section reviewed the appraisal period which should be employed when calculating the Net Present Value of projects. The key findings are as follows:

- The PSC guides that the appraisal timeframe should be the 'economically useful life of the project'.
- The current EAM appraisal period is seven years.
- Evidence from international guidelines and form the data on job description in agency assisted firms suggests that the seven-year appraisal period may underestimate the NPV of the net benefits of projects assisted.

12 Research and Development

12.1 Introduction

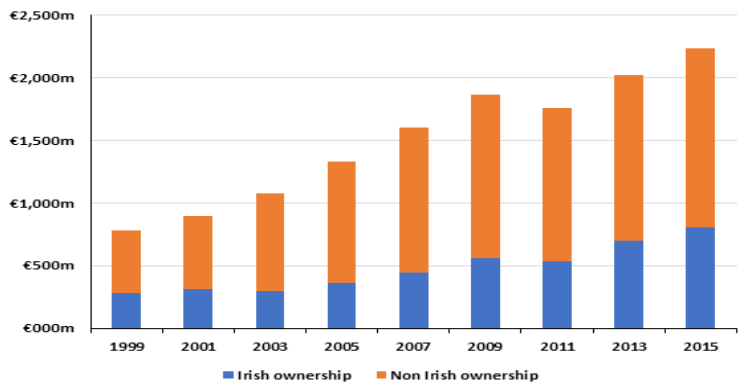
The EAM currently recognise the need to include some measure to reflect the positive externalities arising from spillover benefits of R&D. The 2003 review concluded that the social returns to R&D, while difficult to quantify, are likely to be significant, and presented evidence that plants which were high-tech R&D performers contributed to the upgrading of skill levels and consequently wage rates in the economy. Data was presented to show that R&D performing plants pay higher wages than non-performers. Further, the 2003 review noted that R&D active firms make a larger contribution to the economy than R&D inactive firms, both in terms of the length of time they are likely to survive and in terms of the quality of the employment they provide. To measure the benefits of R&D expenditures, the 2003 EAM review paper suggested that: *"Given the range of positive externalities, it seems plausible to assume that positive spillovers amount to at least half the grant outlay. We propose therefore following consideration of the views of the Steering Group to include only 50% of the grants for R&D in the costs attributable to a project."*[61] While the model by reducing the assumed exchequer costs by 50% for R&D projects takes account of spillover benefits, we understand that in practice, IDA (Ireland) do not use the EAM model to evaluate R&D projects but that the EAM is used by Enterprise Ireland for such projects.

12.2 Evaluation of RD&I in the EAM

In considering how to handle RD&I in the EAM of note is that there has been a significant increase in the extent of R&D investment in Ireland over the last two decades. Figure 12.1 shows the aggregate R&D expenditure (€ million) from 1999-2015 broken down by firm ownership. This demonstrates that there has been a significant increase in activity since 1999, with foreign and domestic firms spending €2.2bn in 2015. 64% of this expenditure was by foreign firms, while the remainder was by indigenous firms. Since the last update of the EAM model in 2003, R&D expenditure has more than doubled, with an increase of 169% in R&D expenditure by Irish firms, and an increase of 84% in R&D expenditure by foreign-owned firms.

[61] Murphy, A., B. Walsh, and F. Barry (2003). The economic appraisal system for projects seeking support from the industrial development agencies, Dublin: Forfás.

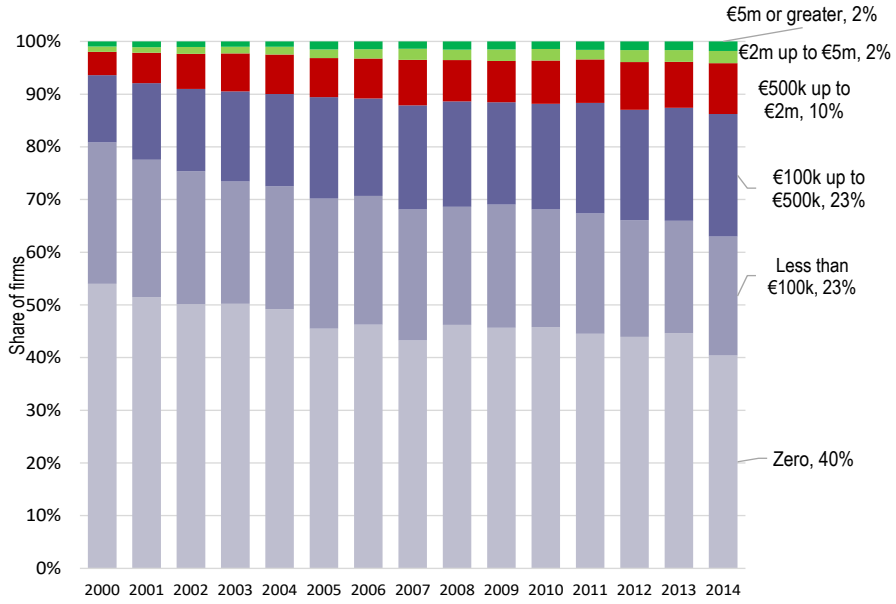
Figure 12.1: Aggregate R&D Expenditure in Ireland, 1999-2015



Source: CSO and Forfás data.

Figure 12.2 shows that there was a steady decline in the proportion of non-performers of RD&I since 2000. Widening the base of RD&I performers is a positive step in achieving Ireland's RD&I goal of 2.5% of GNP as this lessens the reliance on the large RD&I performers. It should be noted that the number of performers, in absolute terms, has doubled over the period, with growth being relatively evenly distributed across expenditure levels. For example, performers of RD&I expenditure of over €100,000 have doubled from 731 in 2000 to 1,464 in 2014. Average spend in the highest cohort (€5m+) has remained static; however, the number of performers in this category has doubled (2000: 37 firms, 2014: 71 firms).

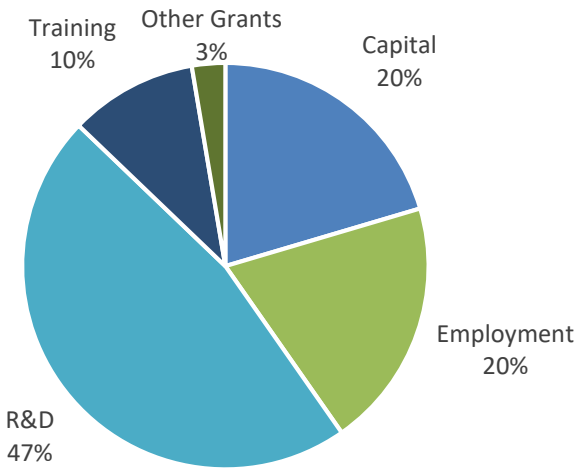
Figure 12.2: Number of RD&I Performers by Scale of Firm Expenditure, 2000 - 2014



Source: Indecon's analysis of ABSEI DEI Data

The growth in R&D activity among firms suggests that it is increasingly important that this is captured by the appraisal modelling. The issue of adjusting the EAM so that it is suitable to use by IDA (Ireland) in evaluating R&D projects is particularly significant given that R&D grants accounted for 47% of all grant payments in 2016 by IDA (Ireland) as evident in Figure 12.3. Expenditure on the area is likely to grow further in future years. Indecon believes the best approach is finding some way to measure the spillover benefits of R&D.

Figure 12.3: IDA Grants Payable by Type, 2016



Source: IDA Annual Report, 2016

R&D externalities are recognised by most economists as RD&I expenditures play a key role in determining the differences in productivity across firms and the evolution of firm-level productivity over time (Doraszelsk et al, 2013). Firm-level competitiveness promotes RD&I and technological development, leading to further productivity and profitability. The resultant increased effectiveness of RD&I investment, together with a higher propensity to invest in RD&I, allows for enhanced competitiveness of these firms (Mathieu and van Pottelsberghe de la Potterie, 2010).

The merits of attempting some measure of R&D benefits reflects the fact that many of the gains from RD&I are thought to be external to the firm. Knowledge spillovers are important aspect of agglomeration economies (Bottazzi and Peri, 2003). Evidence suggests that RD&I activities of one firm appear to have a positive influence on the productivity of RD&I by other firms. The existence of these knowledge spillovers can depend on the type of knowledge and activity that are being performed. For instance, research in Europe has estimated the spatial scope of knowledge spillovers to be around 250-300 km (Bottazzi and Peri, 2003). The clustering of laboratories may suggest that some knowledge spillovers are highly localised (Carlino et al, 2013).

The US Nobel Prize winning economist, Kenneth Arrow, in looking at the issue of knowledge and the RD&I in the Irish economy pointed out that many scholars believe the differences in economic performance can be attributed to variation in technological knowledge (Arrow, 1997). He also pointed out that if one country has some knowledge, it can pass to another without the first country losing it and, in a world, where many countries are engaged in science and technological development, a small country such as Ireland could argue that it can draw on scientific knowledge and development elsewhere. However, Arrow noted that "*knowledge developed elsewhere is not*

made useful to Ireland automatically" and "*It is necessary to have what development economists called 'absorptive capacity'.*"[62] He also highlighted the importance of the presence of scientists and technologists, and the domestic ability to perform R&D at high levels. The development of R&D enterprises in Ireland is likely to be of relevance to this objective.

Research investigating the UK's relatively low business RD&I to GDP suggests this was due in part to the inability of some firms to manage RD&I to generate value. It also suggests that in high-tech sectors were judged to be far ahead in terms of the impact on productivity of their RD&I investments.[63] Different firms in the same sector may exhibit large differences in the extent to which they can absorb RD&I and the extent to which they invest in RD&I. These differences can be thought to be 'intrinsic' to the firm. Becker and Hall (2013) has highlighted the intrinsic determinants of private-sector RD&I expenditures.

Numerous studies which have empirically examined both private and social rates of return to RD&I, suggest that the social rate of return is substantially higher than the private rate of return. Hill, Mairesse, and Mohnen (2009) examined econometric and other research measuring both economic and private returns to R&D and covering 50 years of economic research. The table below reports on a number of the studies which estimate the private and social returns to R&D.

Table 12.1: Sample of Recent Papers Estimating Rate of Return on R&D Investment

Private Rate of Return Estimate on R&D		
Study	**Sample**	**Estimated Return**
Bernstein and Nadiri (1990)	US, 35 firms	9% to 20%
Mohnen-Lepine (1991)	Canada, 12 manufacturing industries 1975, 77, 79, 81-83	5% to 275%
Mohnen-Nadiri-Prucha (1986)	1965-77	11% (US) 15% (Japan) 13% (Germany)
Bernstein-Mohnen (1998)	11 industries	44% (US) 47% (Japan)
Mohnen (1992)	OECD 5 countries	6% to 9%
Nadiri-Kim (1996)	7 countries	14% to 16%
Social Rate of Return Estimate on R&D		
Mansfield et al. (1977)	17 industrial innovations	Median social ROR: 56% Median private ROR: 25%
Tewksbury et al. (1980)	20 innovations	Median social ROR: 99% Median private ROR: 27%
Mohnen (1990)	Canadian manufacturing	29%
Mohnen (1992)	OECD 5 countries	4% to 18%
Coe-Helpman (1995)	22 countries	32%

Source: Hill, Mairesse, and Mohnen (2009)

[62] Arrow, K. J., (Stanford University), Economic Growth Policy for a Small Country, in International Perspectives on the Irish Economy, Ed., Gray, A. W., 1997, ISBN 0953131807

[63] Potters, L., Ortega-Argilés, R. And Vivarelli, M. (2008). R&D and Productivity. *IZA DP No. 3338.* Available at: http://ftp.iza.org/dp3338.pdf

In deciding what positive spillover benefits to include in the EAM it is not sufficient to simply identify the difference between social and private returns on R&D as many of the benefits of R&D will not be captured exclusively by Ireland and as noted by Arrow (1997) there is also potential for Ireland to capitalise on R&D undertaken in other countries. However, there is also a need for recognition that in practice R&D activity undertaken in Ireland may lead to subsequent manufacturing or internationally traded investment projects.

It could be argued that because of the scale of social rates of return as suggested by some previous studies that a very high percentage annual return should be included as a benefit. However, given the uncertainty with measuring such spillover benefits and the fact that only some of these benefits will be retained in Ireland, we believe that in the absence of further research, conservative assumptions should be used. We believe that a prudent approach would be to include an annual return of 3.5% - 7.0% as a percentage of capital spend on R&D as a benefit in the model. For example, if a project was completed in Year 3 and an additional 7 years was included in the appraisal period, this would represent an aggregate undiscounted benefit over the project life span for this externality of between 24.5% - 49% of the capital costs. These 3.5% - 7% estimates are much lower than suggested by some of the international research. This reflects the nature of the Irish economy and the uncertainty re the scale of these positive externalities. A similar prudent approach is taken in our review of negative externalities for congestion costs.

12.3 Summary of Findings

This section reviewed the treatment of R&D projects in the current model. The summary of findings is as follows:

- There are significant positive externalities associated with R&D. Available evidence suggests that the social rate of return is substantially higher than the private rate of return.
- There is a range of RD&I supports provided in the form of both agency supports and tax incentives. The two key tax incentive programmes are the RD&I Tax Credit and the recently introduced Knowledge Development Box. These are designed to build in company RD&I capacity and to ensure that Ireland's tax incentive offering is competitive.
- The last review of the EAM in 2003 concluded that the social returns to R&D, while difficult to quantify, are likely to be significant. It concluded that positive spillovers amount to at least half the grant outlay, and that only 50% of the grants for R&D should be included in the costs attributable to a project. This has the effect of doubling the benefit-cost ratio for R&D projects. Indecon believes that the benefits of R&D are more likely to be related to the levels of capital investment in the R&D projects rather than the percentage of grant aid provided and there is therefore merit in including an explicit annual social return for the spillover benefits in the EAM.

13 Conclusions and Recommendations

13.1 Conclusions

Detailed conclusions on each of the key issues examined in this independent review of the Economic Appraisal Model (EAM) were outlined in the individual chapters. A summary of key overall conclusions is presented in Table 13.1. These suggest that the model is a very useful technique and with some adjustments can continue to assist project decisions and wider policy development.

Table 13.1: Summary of Conclusions	
1.	**EAM is a very useful tool to assist agencies in evaluating projects and should continue to be used as part of the appraisal process.**
2.	**There is merit in allocating different levels of resources to approval of projects, depending on the scale of public resources.**
3.	**There is a need to align the model parameters with developments in Irish economy and with best international practice.**
4.	**Consistency with the Public Spending Code is required.**
5.	**The model should be extended to assist in the evaluation of R&D projects which now constitute one of the largest areas of enterprise grant expenditures. Benefits of R&D in terms of wider positive externalities for the Irish economy should be explicitly included in the model.**
6.	**Consideration should be given to model adjustments to take account of negative externalities including the cost of congestion and the impact of projects on infrastructural shortages, including housing. This should be reviewed every 5 years in the light of changes in infrastructural investment and economic and demographic developments.**

13.2 Recommendations

A number of practical recommendations are presented in Table 13.2 overleaf. These include changes to parameter values as well as structural changes to the model and the collection of some limited additional information to enhance evidence based policies. Indecon believes the proposed changes would enhance the effectiveness of the EAM in measuring the economic costs and benefits of agency assisted projects and assist in future planning and monitoring of industrial policy.

Table 13.2: Summary of Recommendations	
1.	Higher level of resources should be allocated to the evaluation of larger projects.
2.	Record of projects evaluated should be maintained.
3.	Bi-annual review of outcomes should be completed.
4.	Review of the model should be undertaken every 3-5 years.
5.	R&D investments should be evaluated using the EAM.
6.	A congestion cost to reflect housing and transport externalities should be included.
7.	The discount rate used should be changed from 10% to 5%.
8.	Risk should be evaluated based on sensitivity and scenario analysis.
9.	The time period for appraisal should be extended to 10 years.
10.	The adjustment to the opportunity cost for skilled jobs should be removed.
11.	The model should include an adjustment for increases in the labour force.
12.	The shadow price of public funds to be changed to align with the Public Spending Code.
13.	The shadow price of profits to be changed to align with the Public Spending Code.
14.	The effective corporate tax rate to be reduced to 9.8%.
15.	A specific adjustment for social cost of carbon should not be included.

Higher Level of Resources Should be Allocated to the Evaluation of Larger Projects

The scale of resources allocated to appraisal should reflect the different levels of public expenditures involved. This is something which is highlighted in the guidelines in the Public Spending Code and is aligned with the approach used in other sectors and in the evaluation of enterprise supports in other countries. In particular we recommend that a higher level of resources should be allocated to the testing of project assumptions for larger projects. There is a judgement required on what level of projects should be subjected to a more detailed testing and our suggestions is that this should apply to projects with Exchequer funding in excess of €0.5 million. We accept that a case could be made for increasing this to €1 million but very few projects would be captured by this higher level. Additional separate sensitivity and scenario analysis for larger projects should be completed. This will involve testing the impact on key project assumptions in line with the Public Spending Code guidelines.

Record of Projects Evaluated Should be Maintained

A small process improvement to involve the maintenance of a digital record of all projects evaluated by EAM would be desirable. This would enable ongoing examination of whether the EAM is acting as a filter for projects and help inform future planning and evaluations. It would also provide evidence to support any necessary adjustment to the measurement of risk and could assist agencies in deciding on sectoral priorities.

Bi-Annual Review of Outcomes Should be Undertaken

A bi-annual review of outcomes compared to the projected returns for projects should be completed. This would involve a look back at the previous seven or 10 years. This could represent an important source of insight for the agencies of how effective the model has been in estimating the net benefits and if data is captured electronically it would be feasible to easily complete this analysis.

Review of Model Should be Undertaken Every 3 – 5 Years

Given the importance of the use of the model it is necessary that the effectiveness of the model and whether it remains fit for purpose should be reviewed every three to five years. This is similar to the requirement for *ex post* reviews of tax expenditures and other programmes. This should include a review of the use and structure of the model, and the underlying parameter assumptions. The proposed process improvements involving a bi-annual look back and the maintenance of electronic records will assist in the work. The administrative and other costs of such reviews are tiny compared to the expenditures which are justified by the use of the model.

Research and Development Investments should be Evaluated Using EAM

Since the completion of the last review of the EAM in 2003, Government strategy has prioritised investment in the knowledge economy. This has been accompanied by a significant increase in the extent of R&D investment in Ireland over the last two decades, and grants for R&D combined with costs of R&D tax credit now represent the largest area of enterprise support. There are significant positive externalities associated with R&D and the social rate of return is substantially higher than the private rate of return. This was recognised in the last review of the EAM in 2003 which concluded that the social returns to R&D, while difficult to quantify, are likely to be significant. It recommended that positive spillovers amount to at least half the grant outlay, and that only 50% of the grants for R&D should be included in the costs attributable to a project. Indecon recommends that R&D projects of both IDA and Enterprise Ireland be subject to the EAM and that instead of adjusting costs, the positive externalities associated with R&D should be captured in the model. Specifically, we recommend that an additional annual social return of the spillover effects of 3.5% - 7.0% of the capital expenditures on R&D projects should be incorporated in the model. The decision on which of these two rates should apply for particular projects could be decided as part of the independent technical evaluation of R&D which is currently undertaken on all R&D investments. The use of the EAM for R&D projects should be a complement to and not an alternative for the existing technical evaluation of R&D projects.

A Congestion Costs to reflect Housing and Transport Externalities Should be Included

The rapid growth of cities can result in significant positive and negative externalities. For example, growth, which is not matched by the development of appropriate infrastructure, may result in shortages of housing and increases in traffic congestion. Traffic congestion has an economic cost and can damage competitiveness. Similarly, constraints on required infrastructure such as housing and office developments inevitably result in higher prices and can result in the need for significant increased public spending. While the expansion of the Greater Dublin Region has positive externalities, the regional differences in the levels of congestion and infrastructural shortages indicates that there is a case for including an explicit congestion externality for increased employment in the Greater Dublin Region in the EAM. Specifically, we recommend adding a cost per employee per year of €5,000 in the model. This however should only apply to the percentage of employees who represent a net increase in the labour force which is assessed to be of the order of 50%. This implies an annual value per employee of €2,500 for projects based in the Greater Dublin Area. If housing shortages and congestion costs are eased in the Dublin region over time this cost could be reduced or omitted from the model. Indecon notes that in the case of IDA (Ireland) projects this will only be applicable to R&D grants as other IDA projects for Dublin are not grant aided.

The Discount Rate should be changed from 10% to 5%

The Test Discount Rate applied should be consistent with Public Spending Code, which is currently set at 5%. Risk should not be accounted for by any addition to the discount rate. All figures provided in the model should be inflation-adjusted. The discount rate should therefore be changed from 10% to 5%.

Risk should be Evaluated based on Sensitivity and Scenario Analysis

The PSC states that risk should not be accounted for through the discount rate, but that sensitivity and analysis should be completed when conducting an appraisal. Indecon fully supports the approach proposed in the PSC to evaluate risk and recommends that a sensitivity and scenario analysis should be undertaken on all projects where public expenditure is €0.5m or more. This could involve testing the key benefit assumptions. For example, by examining the impact of a reduction of 25% in employment and a 25% reduction in corporate tax benefits. This could be implemented automatically as part of the modelling. For very large projects a separate scenario analysis and estimates of the switching value for key benefits which would reduce project NPV to zero may be useful. Indecon is in agreement that risk via sensitivity analysis is integrated within the model so that the issue of risk remains central to the overall consideration of projects.

The Time Period for Appraisal should be Extended to 10 Years

An important aspect in terms of calculating the Net Present Value of a project is establishing the appropriate appraisal period, which is currently typically set at seven years. The international guidance highlights the fact that different projects are likely to have very different lifespans, and that agencies should determine the length of the project based on its specific characteristics. Indecon believes that a default 10-year appraisal period should be built into the model and this would involve adding a number of years to the project investment period. If there are reasons for assuming a shorter economically useful lifetime the lower estimate should be used.

The Adjustment to the Opportunity Cost for Skilled Labour to be Removed

The model adjusts the shadow wages to account of the quality of jobs as measured by average wages. A possible unintended consequence of this is that the model implicitly assumes a lower opportunity cost for higher skilled employment, which Indecon believes is not aligned with labour market experience. Indecon therefore recommends that this adjustment is removed.

The non-adjusted opportunity cost of labour was updated in the model with a range for three different geographic areas. We are supportive of maintaining these assumptions unless there is alternative guidance provided by the revised Public Spending Code. However, we believe that to assist consistency and implementation, that a single value for each area should be used, in general aligned with the mid-point of the existing ranges. This would imply an estimate for Greater Dublin Area of 90%, for Rest of State 85% and a figure of 80% for BMW (slightly below the mid-point of 66-100% range currently used).

The Model should include an Adjustment for Increases in the Labour Force

The model currently includes an assumption that 50% – 60% of employment in agency assisted enterprises is due to immigration and that the tax on employment of this group should be included as a benefit. Indecon believes it is reasonable to assume of the order of 50% of the increase in employment represents a net increase to the labour force. This could be due to increased labour market participation or returning Irish emigrants or individuals attracted to Ireland. We, however, recommend that this variable is changed in the model to a wider labour force factor.

The Shadow Price of Public Funds to be Changed to Align with PSC

The PSC sets out the parameter to be used as the shadow price of public funds at 130%. The value of the shadow price of public funds in the EAM is 125%. While there are some arguments for using a low shadow price, Indecon believes the EAM should be consistent with the Public Spending Code.

The Shadow Price of Profit to be Changed to align with PSC

The Public Spending code states that the shadow price of profit should generally reflect the opportunity cost of the capital in its best alternative use. This will generally involve a shadow price of 100% unless a justification can be made for using a shadow price lower than 100%. The current EAM sets the shadow price of Irish profits equal to the shadow wage. Indecon believes that a shadow price of 100% for profits should be used. Our recommendation is consistent with what was previously used following the earlier Honohan review of the EAM.

The Effective Corporate Tax Rate to be Reduced to 9.8%

The existing model utilises the statutory corporation tax rate in Ireland which is 12.5% for trading income. The Office of the Comptroller and Auditor General estimate an effective corporate tax rate of 9.8% across all sectors in 2015, and the Department of Finance research indicated a range of effective corporation tax rates of 8.4% to 10.4%. Indecon believes that either the costs of R&D tax credit should be included as a cost in the EAM or the effective tax rate should be changed to 9.8%. There would be an alternative option to evaluate this on an individual company basis as some companies may not claim R&D or other tax credits while others may have much lower effective corporate tax rates than the average 9.8% proposed. Individual company assessments of effective corporate tax rates would make the model much more complex and if higher rates for some companies were used, lower rates for others would be necessary. On balance, we believe using an average rate as is the current practice in the EAM is the best option.

A Specific Adjustment for Cost of Carbon should not be Included

The current EAM does not include an explicit measure for the cost of carbon. The 2003 review concluded that it was more appropriate to deal with these environmental considerations at the level of the generation and transmissions industries. Indecon also notes that the EU ETS emissions trading scheme is likely to cover most of the large emerging using agency assisted companies and that including a measure of the cost of carbon for other enterprises would be unlikely to have any material impact on the cost-benefit appraisal results. Indecon recommends that the cost of carbon emissions should only be included in the EAM in exceptional circumstances if it is believed this is likely to be significant.

13.3 Summary of Proposed Changes

Indecon believes the proposed changes would enhance the effectiveness of EAM in measuring the economic costs and benefits of agency assisted projects. A summary of the key recommended changes to the EAM is presented in Table 13.3 overleaf.

Table 13.3: Summary Recommended Parameters of Enterprise Appraisal Model				
Element	**Existing Parameter Values**		**Recommended Parameter Values (2018)**	
Shadow wage*	Greater Dublin	80-100%	Greater Dublin	90%
	Rest of State	70-100%	Rest of State	85%
	BMW	66-100%	BMW	80%
Adjusted shadow wage	Greater Dublin	$90\% \leq w \leq 100\%$	Not applicable	
	Rest of State	$85\% \leq w \leq 100\%$		
	BMW	$80\% \leq w \leq 100\%$		
Indirect Shadow wage**	State	95%	State	85%
Shadow price of direct Irish profits	Greater Dublin	$90\% \leq w \leq 100\%$	State	100%
	Rest of State	$85\% \leq w \leq 100\%$		
	BMW	$80\% \leq w \leq 100\%$		
Shadow price of indirect Irish profits	State	95%	State	100%
% of opportunity cost of net additional employment attributable to immigration	Greater Dublin	50%	50% should be applied for labour force increases	
	Rest of State	55%		
	BMW	60%		
Grant deadweight	**Expansions**		**Expansions**	
	Greater Dublin	80%	Greater Dublin	80%
	Rest of State	75%	Rest of State	75%
	BMW	70%	BMW	70%
	Startups		**Startups**	
	Greater Dublin	80%	Greater Dublin	80%
	Rest of State	70%	Rest of State	70%
	BMW	65%	BMW	65%
	HPSU	60%	HPSU	60%
Tax deadweight, shadow price of funds	State	25%	State	30%
Marginal tax rate (wage bill)	State	35%	No change proposed	
Corporate tax rate	State	12.5%	State	10%
Discount Rate	State	5% risk free 5% for risk	State	5% constant prices
I/O weights	Based on 1993 CSO I-O table		Based on latest 2011 CSO I-O table	
Research and Development	Not included as benefit only as cost reduction		3.5% - 7.0% annual social rate of return on R&D to be included	
Training grants cost reduction	State	25%	No change proposed	
Social Cost of Carbon	Not included		No change proposed unless specific project issues	
Cost of Congestion	Not included		€2,500 per employee in GDA	
Appraisal Period	7 years		10 years	
*Based on 2010 update; ** The previous review based indirect wage on the assumed opportunity cost of labour in the rest of State as the location of such expenditure was not known. It is not clear whether this linked variable was changed to align with the update in the shadow wage mode in 2010 but we recommend that it is aligned with the updated parameters for the shadow wage.				

14 Bibliography

Acemoglu, D. and J-S Pischke (1998). Why do Firms Train? Theory and Evidence. *Quarterly Journal of Economics*, 113 (1) 79-119.

Ackerman, F. and Stanton, E. (2012). Climate risks and carbon prices: Revising the social cost of carbon. *Economics: The Open-Access, Open-Assessment E-Journal*, 6(10).

Adler, M.D. and Posner, E.A. (1999). Rethinking Cost-Benefit Analysis. *Yale Law Journal*, 109, 165-247.

Allinson, G., Robson, P. and Stone, I. (2013). Economic Evaluation of the Enterprise Evaluation Finance Guarantee (EFG) Scheme. Department for Business Innovation & Skills.

Altenberg, P. (1999). Policy Competition and Foreign Direct Investment in the World Economy. Paper presented at OECD Conference on Fiscal Incentives and Competition for Foreign Direct Investment in the Baltic States.

Anselin, L, Varga, A. and Acs, Z. J. (2000). Geographic and sectorial characteristics of academic knowledge externalities. *Papers in Regional Science*, 79(4), 435-443.

Anselin, L, Varga, A. and Acs, Z. J. (1997). Local geographic spillovers between university research and high technology innovations. *Journal of Urban Economics*, 42(3), 422-448.

Arrow, J. L. (1997). Economic Growth Policy for a Small Economy. In Gray, A.W. (ed), *International Perspectives on the Irish Economy*.

Arrow and Lind (1970). Uncertainty and the evaluation of public investment decisions. *American Economic Review,* 60, 364-78.

Atkinson, Anthony B., and Nicholas H. Stern (1974). Pigou, Taxation, and Public Goods. *Review of Economic Studies* 41: 119-28.

Audretsch, D. B. and Feldman, M.P. (1996). R&D spillovers and the geography of innovation and production. *The American Economic Review*, 86(3), 630-640.

Audretsch, D.B. , Coad, A. and Segarra, A. (2014). Firm growth and innovation. *Small Business Economics*. 43(4), 743-749.

Australian Department of Treasury and Finance (2013). Economic Evaluation for Business Cases: Technical guidelines.

Bailey, D. and Lenihan, H. (2015). A Critical Reflection on Irish Industrial Policy: A Strategic Choice Approach. *International Journal of the Economics of Business*, 21 (1):47-71.

Bakhshia, H., Edwards, J., Roper, S., Scully, J., Shaw, D., Morley, L., and Rathbone, N. (2015). Assessing an experimental approach to industrial policy evaluation: Applying RCT+ to the case of Creative Credits. *Research Policy,* 44.

Ballard, Charles L., and Don Fullerton (1992). Distortionary Taxes and the Provision of Public Goods. *Journal of Economic Perspectives* 6: 116-216.

Barrios et al. (2013). The marginal cost of public funds in the EU: The case of labour versus green taxes. *European Commission Taxation Papers*. Working Paper N. 35-2013. Luxembourg: Publications Office of the European Union.

Barry, F., Görg, H and Strobl, E. (2000). Agglomerations and inward FDI in Ireland. Mimeo, UCD.

Barry, F. and Strobl, E. (2000). R&D spillovers in Irish manufacturing. Mimeo, UCD.

Becker, B., and Hall, S.G. (2013). Do RD&I strategies in high-tech sectors differ from those in low-tech sectors? An alternative approach to testing the pooling assumption. *Economic Change and Restructuring*, 46(2), 183–202.

Bergin, A., Conefrey, T, Duffy, D., FitzGerald, J., Kearney, I., Timoney, K. and Žnuderl, N. (2013). Medium-Term Review 2013-2020. Economic and Social Research Institute.

Bergin, A., and Kelly, E. (2018). The labor market in Ireland, 2000–2016. *IZA World of Labor 2018*.

Bergsmann, J. (1999). Taxation and tax incentives for foreign direct investment. Paper presented at OECD Conference on Fiscal Incentives and Competition for Foreign Direct Investment in the Baltic States.

Bird, Richard (2003). Evaluating Public Expenditures: Does It Matter How They are Financed? In *Ensuring Accountability When There Is No Bottom Line*, Vol. 1 of *Handbook on Public Sector Performance Reviews*, ed. Anwar Shah. Washington, DC: The World Bank.

Blundell, R., Dearden, L. and Meghir, C. (1996). *The Determinants and Effects of Work Related Training in Britain.* London: The Institute for Fiscal Studies.

Booth, A. and Snower, D., (1996). *Acquiring skills, Market failures, their symptoms and policy responses*. Cambridge: Cambridge University Press.

Borjas, G. (1995). The economic benefits from immigration. *Journal of Economic Perspectives*, 9, 3-22.

Bos, F., T. van der Pol, and G Romihn (2018). "Should CBA's include a correction for the marginal excess burden of taxation?" *CPB Discussion Paper 370*. CPB Netherlands Bureau for Economic Policy Analysis.

Bottazzi, L. and Peri, G. (2003). Innovation and spillovers in regions: Evidence from European patent data. *European Economic Review,* 47.

Boyle, G., McCarthy, T. and Walsh, J. (1998-99). Regional income differentials and the issue of regional income equalisation in Ireland. *Journal of the Statistical and Social Inquiry Society of Ireland XXVIII* (i), 155-211.

Bradley, J., Fitzgerald, J. and Kearney, I. (1993). Modelling supply in an open economy using a restricted cost function. *Economic Modelling,* 10(1), 11-21.

Brautzsch, H.U., Günther, J., Loose, B. Ludwig, U., and Nulsch, N. (2015). Can R&D subsidies counteract the economic crisis? Macroeconomic effects in Germany. *Research Policy*, 44(3), 623-633.

Browning, Edgar K. (1976). The Marginal Cost of Public Funds. *Journal of Political Economy* 84: 283-98.

Bullock, C., Feely, R., Clinch, P., and O'Shea, R. (2015) ADAPT: Quantifying the costs and benefits associated with climate change risks and adaptation. *Environmental Protection Agency.*

Caliendo, M. Hogenacker, J., Künn, S. and Weißner, F. (2015). Subsidised start-ups out of unemployment: A comparison to regular business start-ups. *Small Business Economics*, 45(1), 165-190.

Carlino, G., and Carr, J. (2013). Clusters of Knowledge: RD&I Proximity and the Spillover Effect. *Business Review*, Q3 2013.

Chodorow-Reich, G. and Karabarbounis, L. (2013). The cyclicality of the opportunity cost of employment (No. w19678). National Bureau of Economic Research.

Cohen, W.M. and Levinthal, D.A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 128-152.

Collins, M. (2016). Income Taxes and the Earnings Distribution. NERI Research inBrief, January 2016 (no 31).

Comptroller and Auditor General, 2017. Chapter 20 Corporation Tax Receipts – Report on the Account of Public Services 2016.

Cowling, M. (2012). Credit rationing, equity gaps', and policy solutions for financing entrepreneurial business in Europe: Theory, tests, evidence and the design and effectiveness of policy instruments. European Commission, Directorate-General Regional Policy.

Cowling, M. (2010). Economic Evaluation of the Small Firms Loan Guarantee (SFLG) Scheme. Department for Business Innovation and Skills.

Crescenzi, R. and Rodríguez-Pose, A. (2013). R&D, socio-economic conditions, and regional innovation in the US. *Growth and Change*, 44(2), 287-320.

Davenport, T.H. (2-13). Process innovation: Reengineering work through information technology. Harvard Business Press.

Del Bo, Chaira, Carlo Fiorio, and Massimo Florio (2011). Shadow wages for the EU Regions. *Fiscal Studies*, 32(1), 109-143.

Delgado, M., Porter, M.E., and Stern, S. (2014). Clusters, convergence, and economic performance. *Research Policy*, 43(10), 1785-1799.

Department of Finance (2016). Report on Tax Expenditures - October 2016.

Department of Finance (2007). Value for Money and Policy Review Initiative Guidance Manual.

Department of Business, Enterprise and Innovation, Enterprise Programmes and Policies Evaluations Unit (2016). Review of the Enterprise Agency Economic Appraisal Model: Scoping and Issues Paper – December 2016.

Department of Business, Enterprise and Innovation (2016). Statement of Strategy 2016-2019.

Department of Business, Enterprise and Innovation (2015). Innovation 2020, Ireland's strategy for research and development, science and technology.

Department of Business, Enterprise and Innovation (2014). Aid to SMEs and Star-Ups Scheme 2014-2020.

Department of Business, Enterprise and Innovation (2018). Project Discount & Inflation Rates.

Department of Public Expenditure and Reform, (2013). Public Spending Code: A guide to economic appraisal, carrying out a cost-benefit analysis.

Department of Public Expenditure and Reform (2012). The Public Spending Code – Expenditure Planning, Appraisal & Evaluation in the Irish Public Service: Standard Rules and Procedures.

Devarajan, Shanta, Lyn Squire, and Sethaput Suthiwart-Nareuput (1996). "Project Appraisal at the World Bank." In *Cost-Benefit Analysis and Project Appraisal in Developing Countries*, ed. Colin Kirkpatrick and John Weis, 35-53. Cheltenham, UK: Edward Elgar.

Doraszelsk, et al. (2013). RD&I and productivity: Estimating endogenous productivity. *Review of Economic Studies*, 80.

Drupp, M., Freeman, M., Groom, B., and Nesje, F. (2015). Discounting disentangled: an expert survey on the determinants of the long-term social discount rate. *Centre for Climate Change Economics and Policy Working Paper No.195*.

Economic and Social Research Institute, (1996). Appraisal for the Industrial Development Agencies. Dublin: Economic and Social Research Institute.

Enterprise Ireland (2016). Enterprise Ireland Strategy 2017-2020.

Enterprise Strategy Group (2004). Ahead of the curve: Ireland's place in the global economy. Forfás.

European Commission (2017). The economic rationale for public and R&I funding and its impact.

European Commission (2016). General Equilibrium Model for Economy-Energy-Environment (GEM-E3).

European Commission (2014). Guide to Cost-Benefit Analysis of Investment Projects.

European Commission (2012). The GEM-E3 Macro-economic Model.

European Investment Bank (2013). The Economic Appraisal of Investment Projects at the EIB.

Evanschitzky, H., Eisend, M., Calantone, R.J., and Jiang, Y. (2012). Success factors of product innovation: An updated meta-analysis. *Journal of Product Innovation Management*, 29(S1), 21-37.

Flyvbjerg (2002). Underestimating costs in public works projects – Error or lie. *APA Journal*.

Fitzgerald, J. (2014). Ireland's Recovery from Crisis. Economic and Social Research Institute.

Fitzgerald, J. (1999). Understanding Ireland's economic success. *ESRI Working Paper No. 111*.

Forfás (2014). Evaluation of Enterprise Supports for Research Development and Innovation.

Forfás (2008). Incorporating GHG emission costs in the economic appraisal model for projects seeking support from industrial development agencies.

Forfás (2000). Enterprise *2010* - New Strategy for the Promotion of Enterprise in Ireland in the 21st Century, Dublin: Forfás.

Fritsch, M. and Franke, G. (2004). Innovation, regional knowledge spillovers and R&D cooperation. *Research Policy*, 33(2), 245-255.

Fukagawa, N. (2013). University spillovers into small technology-based firms: Channel, mechanism, and geography. *The Journal of Technology Transfer*, 38(4), 415-431.

George, A., Meadows, P., Metcalf, H. and Rolfe, H. (2011). Impact of migration on the consumption of education and children's services and the consumption of health services, social care and social services. *National Institute of Economic and Social Research.*

Goos, M. Konings, J., and Vandeweyer, M. (2015). Employment growth in Europe: The roles of innovation, local job multipliers and institutions. *Local Job Multipliers and Institutions* (October 2015).

Görg, H. and Strobl, E. (1999). Multinational Companies and the Entry of Indigenous Firms: Panel Data Evidence for Ireland. *Working Paper WP99/8*. Centre for Economic Research, University College Dublin.

Gray (1995). *EU Structural Funds and Other Public Sector Investments*. Dublin: Gill and Macmillan.

Greene, F., (2008). Assessing the impact of policy interventions: the influence of evaluation methodology. *Environment and Planning C: Government and Policy 2009*, 27.

Griffith, R. (2000). How Important is Business R&D for Economic Growth and Should the Government Subsidise it? London: The Institute for Fiscal Studies, Briefing Note No.12.

Griffith, R., Redding, S., and Van Reenen, J. (2003). R&D and absorptive capacity: Theory and empirical evidence. *The Scandinavian Journal of Economics*, 105(1), 99-118.

Harberger, Arnold C. (1964). "The Measurement of Waste." *American Economic Review*. 54: 58-76.

Hart, M. and Gudgin, G. (1999). Small firm growth and public policy in Northern Ireland: Making the difference. *Environment and Planning*.

Heyes, A. Morgan, D., and Rivers, N. (2013). The use of a social cost of carbon in Canadian cost-benefit analysis. *Canadian Public Policy*, 39(Supplement 2), S67-S79.

Hill, Mairesse, and Mohnen (2009). Measuring the returns to R&D. In B. H. Hall and N. Rosenberg (Eds.), *Handbook of the Economics of Innovation*.

HM Treasury (2013). The Green Book - Appraisal and Evaluation in Central Government.

HM Treasury (2013). Supplementary Green Book Guidance – Optimism Bias.

HM Treasury (2008). Intergenerational wealth transfer and social discounting: Supplementary Green Book guidance.

Holtsmark and Bjertnaes (2015). The size of the marginal cost of public funds: A discussion with special relevant to Norway. *Statistics Norway Rapporter Reports 2015/13*. Oslo, Norway: Statistisk sentralbyrå.

Honohan, P. (1998). *Key issues of benefit-cost methodology for Irish industrial policy*. Dublin: Economic and Social Research Institute.

Honohan, P. and Irvine, I. (1987). The marginal social cost of taxation in Ireland. *Economic and Social Review,* 19, 15-41.

Honohan, P., and Walsh, B. (2002). Catching up with the leaders: The Irish hare. *Brookings Papers on Economic Activity*, *No. 1*. The Brookings Institution: Washington DC.

Houses of the Oireachtas (2017). Written Answers Nos. 242-255, Tuesday 28 February 2017.

Hughes, G., and Nolan, B. (1997). Segmented labour markets and earnings in Ireland. *Economic and Social Review*, 28 (1), 1-22.

IDA Ireland (2015). Winning: Foreign Direct Investment 2015-2019.

Invest NI (2011). Economic Appraisal Methodology.

Irish Strategic Investment Fund (2015). Economic Impact Framework – Implementation.

Kearns, A. and Ruane, F. (2001). The tangible contribution of R&D-spending foreign-owned plants to a host region; a plant level study of the Irish manufacturing sector (1980-1996). *Research Policy*, 30, 227-244.

Lane, P. and Lubatkin, M. (1998). Relative absorptive capacity and interorganizational learning. *Strategic Management Journal*, 19(5), 461-477.

Layard, R. and Glaister, S. (eds.) (1994). *Cost-Benefit Analysis*. Cambridge: Cambridge University Press.

Lenihan, H. (2011). Enterprise policy evaluation: Is there a 'new' way of doing it? *Evaluation and Program Planning,* 34.

Lenihan, H. (2004). Evaluating Irish industrial policy in terms of deadweight and displacement: A quantitative methodological approach. *Applied Economics*, 36(3), 229-252.

Lenihan, H. (1999). An evaluation of a regional development agency's grants in terms of deadweight and displacement. *Environment and Planning C: Government and Policy*, 17.

Lenihan, H. and Hart, M. (2004). The use of counterfactual scenarios as a means to assess policy deadweight: an Irish case study. *Environment and Planning C: Government and Policy*, 22.

Lenihan, H. and Hart, M. (2006). Evaluating the additionality of public sector assistance to Irish firms: A question of ownership? *Journal of Policy Studies*, 27(2), 115-133.

Leyden, D.P. and Link, A.N. (2013). Knowledge spillovers, collective entrepreneurship, and economic growth: The role of universities. *Small Business Economics*, 41(4), 797-817.

Lithander, J. (2017). Loan Guarantee Schemes as a policy instrument for financing entrepreneurial businesses. *Swedish Agency for Growth Policy Analysis*, 2016/084.

Little, I.M.D. and Mirrlees, J.A. (1994). Project appraisal and planning twenty years on. In Layard, R. and Glaister, S. (eds.), *Cost-Benefit Analysis*. Cambridge: Cambridge University Press.

Love, J.H. and Roper, S. (2015). SME innovation, exporting and growth: A review of existing evidence. *International Small Business Journal*, 33(1), 28-48.

Lynch, N., Lenihan, H. and Hart, M. (2009). Developing a framework to evaluate business networks: the case of Ireland's industry-led network initiative. *Policy Studies*, 30(2).

Marshall, A. (1920). Principles of Economics. London: Macmillan.

Martinez-Covarrubiasa, J., Lenihan, H., and Hart, M. (2017). Public support for business innovation in Mexico: a cross-sectional analysis*. Regional Studies*, 51(12).

Mathieu, A. and van Pottelsberghe de la Potterie, B. (2010). A note on the drivers of R&D intensity. *Research in World Economy*, 1(1).

McGuirk, H., Lenihan, H., and Hartcet, M. (2015). Measuring the impact of innovative human capital on small firms' propensity to innovate. *Research Policy,* 44.

McMorrow, K. and Roeger, W. (2000). Time-varying NAIRU/NAWRU estimates for the EU's Member States. European Commission Directorate-General for Economic and Financial Affairs. *Economic Papers Number 145*.

Michalek, J., Ciaian, P. and Kancs, D. (2013). Firm-Level Evidence of Deadweight Loss of Investment Support Policies: A Case Study of Dairy Farms in Schleswig-Holstein. European Commission.

Morgenroth, E. (2018). Prospects for Irish Regions and Counties – Scenarios and Implications. *ESRI Research Series Number 70, January 2018.*

Murphy, A., B. Walsh, and F. Barry (2003). The economic appraisal system for projects seeking support from the industrial development agencies, Dublin: Forfás.

New Zealand Treasury (2008). Public Sector Discount Rates for Cost Benefit Analysis: Estimation of Crown's Opportunity Cost of Capital.

Ng, Yew-Kwang (2000). 'Why do economists overestimate the costs of public spending?' *Royal Economic Society Newsletter* (July).

O'Connell, P. J. & F. McGinnity (1997) *Working Schemes? Active Labour Market Policy in Ireland*. Aldershot: Ashgate.

OECD (1998). Human Capital Investment: An International Comparison. Paris: OECD Publishing.

OECD (2016). Taxing Wages 2017 – Ireland.

OECD/Eurostat (2005). Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition. Paris: OECD Publishing.

O'Leary, E. (2001). Regional policy in the Celtic Tiger: Lessons from the past. *Irish Banking Review Spring*.

Oman, C.P. (1999). Policy competition for foreign direct investment: A study of competition among governments to attract FDI. Paper presented at OECD Conference on Fiscal Incentives and Competition for Foreign Direct Investment in the Baltic States.

Pigou, Arthur C. (1928). *A Study in Public Finance*¸3rd ed. Reprint, London: Macmillan, 1947.

Potters, L., Ortega-Argilés, R. And Vivarelli, M. (2008). R&D and Productivity. *IZA DP No. 3338.*

Propris, L. D. (2002). Types of innovation and inter-firm co-operation. *Entrepreneurship & Regional Development*, 14(4), 337-353.

Radicic, D., Pugh, G., Hollanders, H., Wintjes, R., and Fairburn, J. (2016). The impact of innovation support programs on small and medium enterprises innovation in traditional manufacturing industries: An evaluation for seven European Union regions. *Environment and Planning C: Government and Policy 2016*, 34(8).

Revenue Commissioners (2017). Budget Summary 2018.

Revenue Commissioners (2017). An analysis of 2015 Corporation Tax Returns and 2016 Payments.

Revenue Commissioners (2017). Notes for Guidance – Taxes Consolidation Act 1997 – Finance Act 2017 Edition – Part 7.

Roper, S., Hewitt-Dundas, N., and Love, J. H. (2004). An ex ante evaluation framework for the regional benefits of publicly supported R&D projects. *Research Policy*, 33(3), 487-509.

Sala-i-Martin X. (1996). The Classical Approach to Convergence Analysis. *Economic Journal,* (July) 1019-1036.

Saleh, Iraj (2004). Estimating Shadow Wage Rates for Economic Project Appraisal. *The Pakistan Development Review*, 253-266.

Scottish Enterprise (2014). Scottish Enterprise Economic Impact Guidance.

Scottish Government (2016). National Performance Framework.

Smith, S. and N. Braathen (2015). Monetary carbon values in policy appraisals: an overview of current practice and key issues. *OECD Environment Working Papers*, No. 92. Paris: OECD Publishing.

Squire, Lyn (1989). Project Evaluation in Theory and Practice. In *Handbook of Development Economics*, vol. 2, ed. Hollis Chenery and T. N. Srinivasan, 1093-137. Amsterdam: North-Holland.

Stiglitz, Joseph E., and Partha Dasgupta (1971). Differential Taxation, Public Goods, and Economic Efficiency. *Review of Economic Studies* 38: 151-74.

Strategic Policy Division, Department of Jobs Enterprise and Innovation (2015). Assessing the economic impact of exports.

Suire, R., and Vicente, J. (2009). Why do some places succeed when others decline? A social interaction model of cluster viability. *Journal of Economic Geography*, 9(3), 381-404.

Tokila, A., & Haapanen, M. (2012). Evaluation of deadweight spending in regional enterprise financing. *Regional Studies*, 46 (2), 185-201.

Tokila, A., Haapanen, M., & Ritsilä, J. (2008). Evaluation of investment subsidies - When is deadweight effect zero? *International Review of Applied Economics*, 22 (5), 585-600.

Tol, Richard S.J. and Lyons, S. (2008). Incorporating GHG Emission Costs in the Economic Appraisal of Projects Supported by State Development Agencies. *ESRI Working Paper No. 247*. Dublin: ESRI.

US Department of Justice (2015). The Herfindahl-Hirschman Index.

US Environmental Protection Agency (2010). Guideline for Preparing Economic Analyses.

UK Department for Business, Energy and Industrial Strategy (2017). Updated Short-Term Traded Carbon Values: Used for UK Public Policy Appraisal.

UK Department for Business, Energy and Industrial Strategy (2017). Valuation of Energy Use and Greenhouse Gas: Supplementary Guidance to the HM Treasury Green Book on Appraisal and Evaluation in Central Government.

UK Department of Business, Industry and Skills, (2014). *Rates of return to investment in science & Innovation.*

UK Department of Transport, Local Government and the Regions (2002). Economic Valuation with Stated Preference Techniques.

Van Cauwenberge, P., Vander Bauwhede, H., and Schoonjans, B. (2012). An evaluation of public spending: the effectiveness of a government-supported networking program in Flanders. *Environment and Planning C: Government and Policy 2013*, 31.

Walsh, B. The economic returns to education. *Journal of the Statistical and Social Inquiry Society of Ireland*, Vol. XXVII, Part V, 1997-98, 99-128.

Warwick, K. and A. Nolan (2014). "Evaluation of Industrial, Policy: Methodological Issues and Policy Lessons". *OECD Science, Technology and Industry Policy Papers, No. 16.* OECD Publishing.

Wilson, D. J. (2012). Fiscal spending jobs multipliers: Evidence from the 2009 American Recovery and Reinvestment Act. *American Economic Journal: Economic Policy*, 4(3), 251-282.

Zerbe, R.O. and Dively, D.D. (1994). *Benefit-Cost Analysis in Theory and Practice*. New York: Harper-Collins.

Zhuang, J., Liang, Z., Lin, T. and De Guzman, F. (2007). Theory and Practice in the Choice of Social Discount Rate for Cost-Benefit Analysis: A Survey. *Asian Development Bank*, ERD Working Paper, Series No. 94.