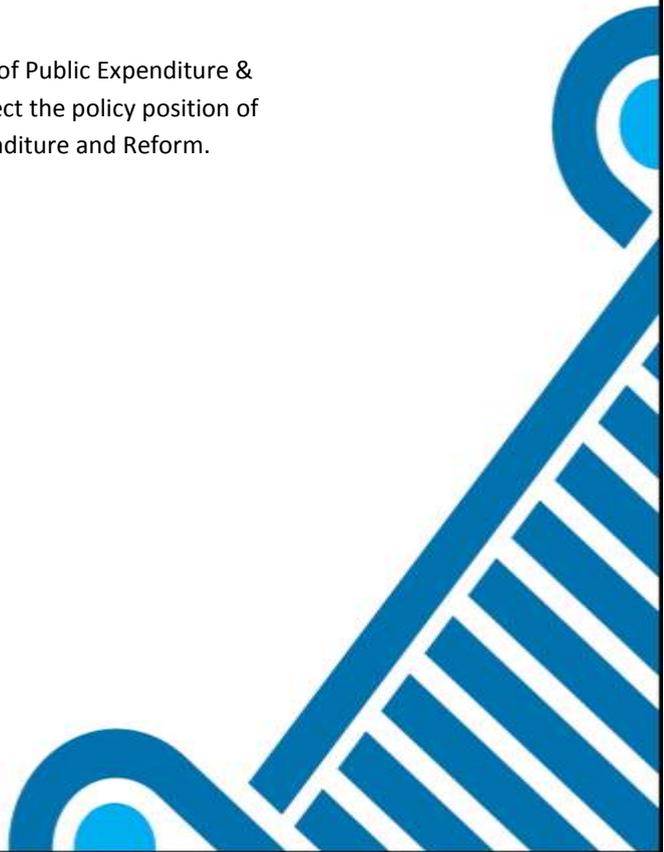


Public Capital Programme 2016 to 2021: Labour Intensity of Public Investment

Irish Government Economic & Evaluation Service

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This paper has been written by the Department of Public Expenditure & Reform's IGEES Unit. It does not necessarily reflect the policy position of the Government or the Minister for Public Expenditure and Reform.



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THIS IS ONE OF A NUMBER OF DISCUSSION, POLICY AND ANALYSIS PAPERS WHICH ARE BASED ON MATERIAL PREPARED AS PART OF THE CAPITAL REVIEW PROCESS. THEY HAVE NOW BEEN UPDATED FOR PUBLICATION. THE CAPITAL REVIEW BEGAN IN 2014 AND CULMINATED IN THE GOVERNMENT AGREEING A NEW 6-YEAR CAPITAL ENVELOPE AND PUBLISHING "BUILDING ON RECOVERY: INFRASTRUCTURE AND CAPITAL INVESTMENT 2016-2021"

Summary

The main employment benefit of public capital investment relates to the long term impacts through increases in productivity, growth and job creation; however, there are also short-run beneficial impacts from the construction or implementation phases of capital projects. Understanding the relative labour intensities of public capital expenditure in different sectors can help to verify the robustness of business cases and their assertions about short term job creation, allowing comparison of the relative potential labour impact between investments in different sectors.

This paper examines the short-run labour impacts in Ireland in various areas of public capital investment, including construction, machinery and equipment. The labour intensity analysis in this study is based on Input-Output data from the Central Statistics Office (CSO) and other CSO data sources. The intensities reported are estimates of the potential job impacts.

The estimates are for direct and indirect jobs. For example, in construction a direct job is an increase in on-site construction work; and an example of indirect jobs is employment in the cement manufacturer supplying the construction site. Induced jobs are not included in the analysis; for example jobs in local shops and restaurants used by employees of the construction firm and the cement manufacturer.

A number of issues should be borne in mind when considering the labour intensity of capital investment:

- By definition, capital projects are short-term and once-off, with associated jobs occurring during the construction or implementation phase of a project;
- 'Labour intensity' refers to jobs supported through the undertaking of the capital projects – it is difficult to distinguish between existing jobs that are sustained and new jobs created;

- There are variations in intensity by sector and within sectors, and each project can also be different and therefore actual labour intensities from one project to the next may well vary;
- The estimates presented in this analysis relate to jobs supported in Ireland only. Some sectors may have a high import content and this is reflected in the low estimates of job impact; and
- The labour intensities reported refer to 'job-years'. Where capital expenditure projects occur over longer time periods, then job estimates for a project should be adapted to reflect the capital expenditure profile.¹

Construction

For construction in general, the analysis presented in this paper estimates that for a **€1 million** increase in construction expenditure, direct and indirect employment in construction will increase by approximately **12 job years**.

There may be a moderate underestimation of construction job impacts because those who are self-employed, including sub-contractors in the construction sector, are not captured in the analysis.

Machinery and Equipment

For non-construction capital investment, such as transport vehicles, machinery and computers, the analysis estimates that for every **€1 million** invested in capital goods, direct and indirect employment will increase by between **0.05 and 3 job years**. This reflects the high import level and low labour content typically associated with machinery and equipment investment.

Ancillary services, such as the repair and installation of machinery and computer consultancy, have also been included in the analysis as these form an important element of infrastructure delivery. The analysis estimates that for every **€1 million** spent on repair/maintenance and installation, direct and indirect employment will increase by between **8 and 10 job years**.

¹ Example: based on the results of this labour intensities analysis a construction project worth €10 million is estimated to support around 120 full-time equivalent job years. If the €10 million construction project takes one year to complete then it would be expected to support 120 construction jobs for the year. If the €10 million project lasts for two years then it is estimated to support around 60 construction jobs for a two-year period. In both cases the investment would be said to support 120 full-time equivalent job years.

Outline of Paper

Section 1 sets out the context and rationale for the analysis and identifies the different types of public capital expenditure.

Section 2 reports the results of the analysis and provides an overview of the methodology. It uses the labour intensities to estimate the potential construction-related jobs arising from the recently announced Capital Plan 2016-2021.

Section 3 provides a further breakdown within the construction estimates to sub-sectors within construction and highlights previous literature.

As well as outlining how the analysis was used to estimate the potential construction-related jobs arising from the Capital Plan, **the appendices** provide additional detailed methodology and the caveats and limitations of the analysis.

1 Introduction and Context

1.1 Background and Rationale for Study

There is considerable interest in the jobs impact of the State's capital investment programmes, particularly in light of Ireland's recent experience with high unemployment levels especially in the construction sector. In presenting a new Capital Plan, therefore, it is useful to provide evidence on the employment intensity arising from both construction projects and other categories of capital spend within the investment programme.² Having information about the labour intensities of various types of capital-funded activity gives an insight into the impacts of Government expenditure and also facilitates comparisons between projects and sectors.

Work by the Department of Finance in 2009 found the labour intensity range of public capital investment to be between 8-12 direct jobs per €1 million expenditure on capital projects.³ Other estimates made around that time by the Construction Industry Council, DKM Economic Consultants and Goodbody Corporate Finance included direct and indirect jobs.⁴ In the context of the Capital Review and a new Capital Plan it is timely to review this matter.

1.2 What Types of Capital Does Government Invest In?

In 2015, just over 80 percent of total Exchequer capital expenditure by Departments was allocated to five main Vote groups: Transport; Environment; Education; Enterprise; and Health.⁵ A closer look at the investment in these areas shows that capital spend by Government can be divided into three broad categories:

- Construction, including maintenance;
- Equipment, including office equipment, transport; and
- Supports for Enterprise and for Research and Development.

² Department of Public Expenditure and Reform (2015) *Building on Recovery: Infrastructure and Capital Investment 2016-2021*

³ Department of Finance (2009) *Labour Intensity and Infrastructure Investment* Unpublished (See answer to Parliamentary Question 12526/09: <http://debates.oireachtas.ie/dail/2009/03/26/unrevised2.pdf>)

⁴ DKM on behalf of CIC (2009) *Jobs and Infrastructure - A Plan for National Recovery* <http://dkm.ie/uploads/downloads/CIC%20Submission%20to%20Government.pdf>

⁵ Calculated from Revised Estimates for Public Services 2015

As this paper sets out to look at the short-run labour impacts of public capital investment in infrastructure, the analysis relates to the capital spend on the first two of these three groups only, that is, construction and equipment investments.⁶

⁶ The main State enterprise development agencies regularly publish information about the level of State investment they provide to support private enterprise, and relate this to the level of job creation in their client companies. There are significant methodological differences between the analysis in this paper and the statistics prepared by the enterprise agencies, which mean that the data are not directly comparable.

2 Input-Output Analysis

Input-Output data, produced by the Central Statistics Office (CSO) as part of its work on the National Accounts, provide an overview of the structure of the economy and the linkages between sectors.⁷ The CSO's Input-Output tables are extremely useful tools to explore relationships and the magnitude of relative impacts. This paper's analysis of labour intensities relating to capital infrastructure investment uses these CSO data to explore the relative potential impacts of public infrastructure investment across different areas of activity and spend. The methodology is explained in Section 2.1 below. The analysis is illustrative in that it looks at expected or likely labour impacts – based on data in the CSO tables – rather than tracking the actual labour impacts of specific projects.

2.1 Methodology and Background Notes

Multipliers

The CSO produces multipliers that are derived from the Domestic Input-Output table. These multipliers show the overall increase in direct and indirect demand in the rest of the Irish economy that arises from an increase in final demand of a domestically-produced good or service. Direct demand – the increase of demand for a product – is met by increased supply of the finished product. Indirect demand refers to the knock-on effect in related parts of the supply chain due to increased supply of inputs to the finished product.

Direct/indirect/induced impacts

As shown in Table 1 below, in employment terms, the direct employees are employed in the production of the final product; indirect employment arises in the production of intermediate inputs; and induced employment occurs as a result of growing demand arising from the overall growth in incomes from the increase in direct and indirect employment. The multipliers constructed by CSO are for the direct and indirect impacts only; any induced impacts are not included.

⁷ Central Statistics Office (2014) *Supply and Use and Input-Output Tables for Ireland 2011* (<http://www.cso.ie/en/releasesandpublications/ep/p-sauio/supplyanduseandinput-outputtablesforireland2011/>)

Table 1 Illustration of Multipliers

<i>Effect</i>	<i>Impact in economy</i>	<i>Examples of jobs</i>
Direct	The increase in supply of the final product demanded	Increase in on-site construction work
Indirect	Increase in the rest of the supply chain for intermediate goods that go towards the production of the final product demanded	Increase in jobs in cement manufacturer supplying the construction site
Induced (not included in this analysis)	The wider impact in the rest of the economy as a result of increased incomes from those directly and indirectly employed as a result of increased production	Increase in jobs in local shops and restaurants used by employees of the construction firm and the cement manufacturer

Direct and Indirect Multipliers for Other Inputs: Compensation of Employees

To explore the potential labour impact of Government capital expenditure, the *direct and indirect multipliers of other inputs* were examined. The multiplier for the compensation of employees indicates by how much the total compensation of employees increases as demand in a sector rises. Compensation of employees includes employers' contribution to social insurance and other labour costs.

Using only compensation of employees may underestimate the jobs impact because some sectors, including construction, have large numbers of self-employed engaged in the sector that would not be captured by the data for compensation of employees. To overcome this, the net operating surplus should be incorporated into the analysis to reflect the earnings of the self-employed. However, the net operating surplus in the construction sector was negative in the 2011 Input-Output tables; therefore it was not possible to calculate an estimate for the jobs impact among self-employed owing to the negative total figure.

Time lag on data, but little price movement in recent years

Over time, due to price inflation in the economy the State can purchase less with the same level of money. In general, it would be expected that, for €1 million of investment, the jobs impact will decline over time. Nonetheless, the low level of movement in prices in Ireland over the last number of years means that any indicators constructed from 2011 Input-Output data remain relevant. However, a lift in prices in the economy or in subsectors in the future would mean that the job intensities reported here will overestimate any likely job impact as time moves on.

2.2 Assumptions

'Expected sourcing' – adjusting for imports – capital investment by Government will include imported final goods as well as goods produced domestically

Unlike construction, in which labour largely occurs on-site, machinery and equipment can either be produced domestically or imported. Many inputs to construction are imported, but the construction activity itself must by necessity be 'produced domestically'. However, for other areas of capital investment final goods can be imported, and so may have little jobs impact in Ireland apart from perhaps some jobs from retail or distribution activity or installation. The multipliers produced as part of the CSO Input-Output tables relate only to domestic production; these have been used to estimate the number of additional direct and indirect jobs from an additional €1 million spent in a given sector. An illustrated example of the analysis is given in Appendix 3.

To report the estimated job impact arising from additional expenditure on goods produced domestically only would overestimate the potential impact of public capital investment in machinery and equipment. It is highly unlikely that all investment would be in domestic goods only. However, the origin of capital goods cannot be known in advance of the implementation of a capital programme and in advance of procurement processes.

To take account of this, estimates have been made for the expected sourcing of goods and services based on the data for domestic production and imported final use goods from the Input-Output tables. Without knowing if a particular good is imported or produced domestically, it is possible to estimate how much on average is likely to be sourced in Ireland within a given sector or area of activity. This averaged data has then been applied to the job intensity estimates to give an 'expected' estimate for additional direct and indirect jobs in Table 2 below. An illustrated example is given in Appendix 4. No adjustment has been made to underlying CSO Input-Output tables or the import multipliers.

Increased compensation of employees input will lead to increased jobs

It is assumed that the increase in compensation of employees will lead to an increase in jobs in proportion to the average labour cost in the particular area of activity. For example, if the average labour cost in an area of activity is €50,000 and the total compensation of employees increases by €100,000 due to an investment of €1 million, and where all the investment is in

domestically produced final goods, then the analysis suggests that two jobs are created as a result of the investment.

In reality though, different sectors/areas and, indeed, firms will respond differently, and it depends in large part on the nature of the industry. Some industries may have spare capacity and so there may not be any increase in labour required. Others may deliver the increased demand with overtime. Actual sectoral responses to public capital investment may reflect the nature of any investment and its anticipated longevity.

2.3 Summary Results of Input-Output Analysis

Table 2 below shows the results of the labour impact analysis of CSO Input-Output data and their related multipliers, using also some additional data from CSO labour cost statistics.⁸ The categories shown have been aggregated to reflect Exchequer capital spend/activity; more detailed categories are shown in Appendix 2. The categories of capital activity chosen capture the types of capital investment that the Government typically undertakes, including areas of capital spend outside construction activity. For example, computer consultancy, while a service, has been included because the roll-out of ICT infrastructure and systems will involve large elements of computer consultancy in its implementation and not just physical ICT infrastructure. Illustrated examples of the methodology are contained in Appendices 3 and 4.

The multipliers produced by the CSO are for domestically-produced goods and services. Using the multipliers and shares of imports by sector, an estimate is made of the 'average' expected jobs intensity by activity. These are set out in Table 2 below.

⁸ Central Statistics Office (2015) *Earnings and Labour Costs Annual 2014*
(<http://www.cso.ie/en/releasesandpublications/er/elca/earningsandlabourcostsannualdata2014/>)

Table 2 Estimated Additional Direct & Indirect Jobs (FTE) per €1 million Additional Expenditure

Category of Spend	Estimated additional direct & indirect jobs (FTE) per €1 million additional expenditure
Construction	12
Architectural/engineering services	10
Repair and installation	8
Computer consultancy	2
Manufacturing	0.05 - 3
Transport equipment	<0.3
Computers and electronics	0.02

Source: CSO data (Input-Output tables and multipliers, labour costs), methodology adapted from unpublished National Transport Authority paper, CEEU/DPER calculations

Note: Here, intensities less than 1 have been rounded to an appropriate decimal place, all intensities above 1 have been rounded to the nearest whole number

Estimating the construction-related jobs in the Capital Plan

The Government's Capital Plan, *Building on Recovery: Infrastructure and Capital Investment 2016-2021*, published in September 2015, estimated that around 45,000 construction-related jobs that would be sustained through Exchequer investment in physical infrastructure. This jobs estimate was informed by the expected construction-related shares of the Departmental allocations and used 12.3, identified in this analysis, as the estimated additional direct & indirect jobs (FTE) per €1 million additional expenditure on construction activities. Further detail is given in Appendix 1.

The estimate of around 45,000 construction-related jobs relates only to the expected level of jobs arising from investment in construction projects in the direct Exchequer component of the Capital Plan. It does not include, for example, the jobs that will accrue as a result of infrastructure investment by the wider State-owned sector, such as infrastructure funded by the commercial State bodies – these would be additional. Nor does the estimate include employment as a result of Exchequer capital investment through the enterprise agencies or through funding for innovation.

3 Construction and its Sub-Sectors

3.1 Comparison with previous analysis

A previous paper by the Department of Finance (2009), *Labour Intensity and Infrastructure Investment*, collated and analysed data from a number of sources to aid comparison of the impacts of capital investment across a number of sectors. This work undertook a survey of Government Departments and found that the labour intensity of capital projects had a range of 8-12 direct jobs per €1 million of expenditure. This estimate was supported by a review of international literature.

Using CSO Input-Output tables for 2011, the analysis in this present paper estimates 12 direct and indirect jobs (FTE) per €1 million additional expenditure in construction. While this estimate is comparable to previous work, the 2009 analysis refers to direct jobs only, and the analysis here using Input-Output tables also includes indirect jobs. Despite differences in the jobs included in the estimates, the results are still within the same order of magnitude. Given that 2009 data was from a survey of Government Departments for government-funded construction projects, and the intensity calculated in this report uses Input-Output tables and related multipliers for the whole economy, it is reasonable to expect that there may be some differences in overall results.

3.2 Input-Output Analysis – Applying to Sub-Sectors

The Input-Output tables do not provide a detailed breakdown of sub-sectors in the construction sector. Relative intensities for construction sub-sectors were calculated using additional CSO data and then applied to the overall job intensity for the overall construction sector.⁹ The intensities in Table 3 below add a further degree of estimation.

Specific projects will have specific labour requirements and will also depend on the import content of the project. For example, a civil engineering project in which an imported structure accounts for a significant share of the project budget is likely to have a very low job intensity for the given project cost.

⁹ Building and Construction Inquiry and the Business Demography

Table 3 Estimated Additional Construction Jobs per €1 million Additional Expenditure: Direct and Indirect, Full-Time Equivalent

	Estimated additional direct and indirect full-time equivalent jobs per €1 million expenditure
Construction - overall	12
<i>Breakdown by subsector:</i>	
Building completion and finishing	20
Demolition and site preparation	13
Electrical, plumbing and other installation activities	10
Construction of residential and non-residential buildings	10
Construction of roads and railways	7
Construction of utility projects	7
Construction of other civil engineering projects	5

Source: Data from CSO (2013) Building and Construction Inquiry 2011; Business Demography; Quarterly National Household Survey, CSO Input-Output Tables, methodology adapted from unpublished National Transport Authority paper, CEEU/DPER calculations and analysis¹⁰

As highlighted above in Section 2.2, due to the large numbers of self-employed sub-contractors in the construction these figures underestimate the jobs impact. The net operating surplus for construction was negative in the 2011 Input-Output tables; in addition, there are methodological difficulties in splitting out what are considered 'labour costs' from the operating surplus. The net operating surplus should be revisited in future work on labour intensities of investment when the net operating surplus returns to a more normal and positive level.

Job-years

The estimates above are annual figures and reflect the direct and indirect jobs per additional €1 million of construction output in 2011. Where capital projects have an expenditure profile over a number of years it may be appropriate to reflect the numbers of jobs sustained or to refer to them as job-years. For example, if a construction project worth €10 million lasts for one year then it supports around 120 construction jobs for a one-year period. If a project worth €10 million lasts for two years then around 60 construction jobs would be supported

¹⁰ Rounding: Precision has been maintained in all underlying analyses throughout this study, however, the findings have been reported to the nearest whole number. By rounding to the nearest whole number the intention is to highlight that these are estimates only.

for a two-year period. In both cases there would be 120 job-years supported by the investment.

3.3 Other Estimates

Schools Building Programme Ireland

The National Development Finance Agency tracks the numbers employed in the school building programme, which is currently underway. Recent estimates indicate that the weighted average across the school building programme is around 9 direct and indirect jobs per €1 million invested. This is broadly consistent with the analysis above, which estimates that the construction of residential and non-residential buildings has a labour intensity of about 10 jobs per €1 million, and it is expected that construction of residential buildings would be more labour intensive than the construction of larger projects such as schools.

Other construction job estimates

Previous analysis conducted by DKM Economic Consultants and Goodbody Corporate Finance¹¹ estimated 11 direct and indirect jobs per €1 million of investment for the period 2009-2010.¹² An estimate of 10 direct and indirect jobs per €1 million of investment in construction is currently used by construction professionals in Ireland.¹³

A Nevin Economic Research Institute report estimates the creation of 12.3 construction jobs per €1 million of investment. The analysis also shows that due to a fall in tender prices since the economic crisis the number of jobs per €1 million has increased, estimating it to have been around 7.2 per €1 million spent on construction in 2006.^{14, 15}

Transport-related construction job estimates

The National Transport Authority (NTA) recently looked at the job impacts across a number of recent transport projects in Ireland.¹⁶ The table below groups the nine projects studied by

¹¹ As part of the 2009 Construction Industry Council Submission to the Government, Jobs and Infrastructure – A Plan for National Recovery.

¹² Using man years worked, and the value of projects (Ex VAT).

¹³ Society of Chartered Surveyors in Ireland (2014) Pre Budget Submission.

http://www.scsi.ie/scsi_pre_budget_submission_2015_

¹⁴ Using the European Commission's AMECO database.

¹⁵ Rory O'Farrell (2012) NERI 'An Examination of the Effects of an Investment Stimulus' NERI WP 2012/No. 4

¹⁶ National Transport Authority internal analysis; unpublished.

the NTA according to their sub-sector. There is an average of just under 9 direct and indirect jobs/work-years per €1 million of investment. The costs exclude VAT, land, rolling stock and any imported materials. The overall order of impacts is similar to the analysis in this paper, with the difference largely explained by the project specific nature of the NTA analysis and possibly the VAT treatment.

Table 4 Job Intensities – Recent Irish Transport Projects

<i>Project type</i>	<i>Range of estimated direct and indirect jobs per €1 million invested. Excludes VAT, land, rolling stock</i>
Road projects	9.1 – 10.9
Rail/Light rail	8.2 – 9.2
Street improvement/QBCs	8.5 – 13.8
Average transport project	8.8

Source: Unpublished work by the National Transport Authority 'Employment Impacts of Transport Projects', 2013

International studies

It can also be useful to look at international analysis. The table below is drawn from international data highlighted in a recent study conducted on behalf of the National Roads Authority. The jobs intensities are higher than for those reported in Ireland or estimated from the analysis of Irish Input-Output tables. There are a myriad of factors why the estimates might be so different, including the methodology in the various studies. In addition, many of the projects cited in the study were American, and the higher job intensities will reflect the more closed nature of the American economy resulting in less 'leakage' through imports and more jobs created per €1 million.¹⁷

¹⁷ Morgenroth, E. 'Irish Public Capital Spending in a Recession' ESRI Working Paper No. 298 May 2009, p11

Table 5 International Data, Direct and Indirect Jobs per €1 million Invested

<i>Project Type</i>	<i>Direct & Indirect Jobs per million</i>
Highways	17.1
Roads and bridges (new)	16.2
Roads and bridges (repair)	18.9
Transportation	17.7
Rail	12.7
School (new)	18.3
School (repair)	17.6
Drinking/waste water	14.5
Electricity generation	12.6

*Source: National Roads Authority (2013) The Employment Benefits of Investment Projects p8 (various sources)
[http://www.tii.ie/tii-library/strategic-planning/transport-research-and-information-notes\(trins\)/The-Employment-Benefits-of-Investment-Projects.pdf](http://www.tii.ie/tii-library/strategic-planning/transport-research-and-information-notes(trins)/The-Employment-Benefits-of-Investment-Projects.pdf)*

4 Conclusion

The results of the analysis in this paper highlight the variations in labour intensities in Ireland across and within sectors and areas of capital activity. By definition, capital infrastructure projects are relatively short-term and once-off, with associated jobs occurring during the construction or implementation phase of a project.

In summary, for construction, the analysis estimates that for a €1 million increase in construction expenditure, direct and indirect employment in construction will increase by approximately 12 job years.

For non-construction capital investment, such as transport vehicles, machinery and computers, the analysis estimates that for every €1 million invested in capital goods, direct and indirect employment will increase by between 0.05 and 3 job years. This reflects the high import level and low labour content. While for every €1 million spent on repair/maintenance and installation, direct and indirect employment will increase by between 8 and 10 job years.

Appendix 1 shows how the labour intensities for construction were used to estimate the potential job impacts from the recently announced Capital Plan.

Appendix 2 sets out the jobs intensities by economic sector and aligns the sectors to areas of Exchequer capital expenditure, and also makes an adjustment for the level of imports within these economic sectors. Appendix 3 gives a step-by-step illustration of the analysis for construction. Appendix 4 gives a step-by-step illustration of the analysis for other sectors. The caveats and limitations of the analysis are set out in Appendix 5.

Understanding the relative labour intensities of public capital expenditure in different areas of spend can help to verify the robustness of business cases and their assertions about short term job creation and allow comparison of the relative potential labour impact between investments in different sectors.

Appendix 1

Estimate of construction-related jobs from Exchequer Investment 2016-2021

The Government's Capital Plan, *Building on Recovery: Infrastructure and Capital Investment 2016-2021* includes an estimate of around 45,000 construction-related jobs, sustained through Exchequer investments in physical infrastructure. The estimate of around 45,000 construction-related jobs relates only to the expected level of jobs arising from investment in construction projects in the direct Exchequer component of the Capital Plan. It does not include, for example, the jobs that will accrue as a result of infrastructure investment by the wider State-owned sector, such as infrastructure funded by the commercial State bodies – these would be additional. Nor does the estimate include employment as a result of Exchequer capital investment through the enterprise agencies or through funding for innovation.

The tables below show the basis for the construction-related job estimate in the Capital Plan. As a full project-level breakdown of Departmental allocations for the entire six-year period of the Plan was not known at the outset, some assumptions were made in assessing the share of the overall Exchequer allocation that is construction-related and a range was given for likely shares of construction-related spend based on available information. The estimated shares are given in Table 6 and Table 7 below. The analysis uses 12.3 as the estimated additional direct and indirect jobs (FTE) per €1 million additional expenditure on construction activities. While Table 3, earlier, provides a breakdown of construction activity, such as 'Building completion and finishing' and 'Construction of residential and non-residential buildings', using a single estimate for construction is more appropriate given the high-level nature of the allocations at this stage.

See Section 2.1 and Appendix 5 of this paper in relation to caveats and limitations of the analysis.

Table 6 Estimation of Construction-related Job-years from Exchequer Infrastructure Investment, by Department – LOWER Bound

	Exchequer Allocations 2016-2021, € million	Estimated construction-related share of allocation- Lower bound	Estimate construction job-years (direct & indirect)
Agriculture, Food & the Marine	1,257	0.40	6,184
Arts, Heritage & the Gaeltacht	302	0.50	1,857
Children & Youth Affairs	136	0.75	1,255
Communications, Energy & Natural Resources	927	0.80	9,122
Defence	437	0.30	1,613
Education & Skills	3,821	0.95	44,648
Environment, Community & Local Government	3,956	0.90	43,793
Finance Group	146	0.10	180
Foreign Affairs & Trade Group	20	0.15	37
Health Group	3,061	0.90	33,885
Jobs, Enterprise, & Innovation	3,010	0.05	1,851
Justice Group	875	0.80	8,610
Public Expenditure & Reform Group [Less OPW]	32	0.00	0
Office of Public Works	772	0.95	9,021
Social Protection	52	0.35	224
Transport, Tourism, & Sport	8,066	0.95	94,251
Unallocated	132	0.75	1,218
Total Exchequer Allocation	27,000		
Total construction-related job-years (direct & indirect)			257,748

Table 7 Estimation of Construction-related Job-years from Exchequer Infrastructure Investment, by Department – UPPER Bound

	Exchequer Allocations 2016-2021, € million	Estimated construction-related share of allocation- Upper bound	Construction job-years (direct & indirect)
Agriculture, Food & the Marine	1,257	0.50	7,731
Arts, Heritage & the Gaeltacht	302	0.65	2,414
Children & Youth Affairs	136	0.85	1,422
Communications, Energy & Natural Resources	927	0.85	9,692
Defence	437	0.60	3,225
Education & Skills	3,821	0.95	44,648
Environment, Community & Local Government	3,956	0.95	46,226
Finance Group	146	0.30	539
Foreign Affairs & Trade Group	20	0.40	98
Health Group	3,061	0.95	35,768
Jobs, Enterprise, & Innovation	3,010	0.10	3,702
Justice Group	875	0.85	9,148
Public Expenditure & Reform Group [Less OPW]	32	0.00	0
Office of Public Works	772	1.00	9,496
Social Protection	52	0.40	256
Transport, Tourism, & Sport	8,066	1.00	99,212
Unallocated	132	1.00	1,624
Total Exchequer Allocation	27,000		
Total construction-related job-years (direct & indirect)			275,200

By dividing the total job-years by 6, the length in years of the Capital Plan, an estimate was derived for the construction-related jobs sustained over the lifetime of *Building on Recovery*, as shown in Table 8 below.

Table 8 Estimate of Construction-related Jobs Sustained by Exchequer Investment, 2016-2021

	Lower	Upper
Total construction-related job-years (direct & indirect)	257,748	275,200
Length of Capital Plan (years)	6	6
Estimated construction-related jobs sustained (direct & indirect)	42,958	45,867
Average	44,412	

Appendix 2

Expected Sourcing

As the multipliers produced by the CSO refer to final goods and services produced domestically, additional analysis has been conducted to estimate the likely jobs intensity from elements of the capital programme that will be comprised of capital goods that are imported and produced domestically. Table 9 below reflects the potential job estimates from domestic production and the jobs impact adjusted for imports.

Table 9 Estimated additional direct & indirect jobs (FTE) per €1 million additional expenditure for selected sectors

<i>Sector for capital plan</i>	<i>NACE Sector</i>	<i>Number of direct and indirect jobs (FTE) per €1 million additional expenditure</i>	
		<i>Produced domestically</i>	<i>Adjusted for estimated imports</i>
Construction	Construction and construction works	12	12
Manufacturing	Petroleum; furniture; other manufacturing	2.6	0.3
Manufacturing	Fabricated metal products	7.5	3
Computers and electronics	Computer, electronic & optical products	2	0.02
Manufacturing	Electrical equipment	4	0.1
Manufacturing	Other Machinery and equipment	5.1	0.05
Transport equipment	Motor vehicles, trailers and semi-trailers	4.5	0.3
Transport equipment	Other transport equipment	4.6	0.001
Repair and installation	Repair/installation of machinery & equipment	8.2	8
Computer consultancy	Computer consultancy; data processing	2.1	2
Architectural/engineering services	Architectural and engineering services	12	10

Source: CSO data (Input-Output tables and multipliers, labour costs), methodology adapted from unpublished National Transport Authority paper, CEEU/DPER calculations

Note: Here, intensities less than 1 have been rounded to an appropriate decimal place, all intensities above 1 have been rounded to the nearest whole number.

Appendix 3

Illustration of Methodology – Construction

Table 10 below provides a narrative of the methodology for a €1 million increase in final demand in the construction sector. Unlike other sectors, construction is intrinsically linked to its place of delivery. In Input-Output tables, therefore, there are no imports or exports in construction in its finished form. Of course, inputs to construction are traded, but here the concern is final demand only.

Table 10 Estimated increase in direct and indirect jobs from an additional €1 million expenditure in Construction

An additional €1 million is spent on construction:			
Additional construction demand	1,000,000	A	Additional demand
From the 'Direct and indirect multiplier for other inputs', the multiplier for the Compensation of Employees is 0.575. So for the additional domestic supply resulting from the increased demand of €1 million, there will be an estimated increase in total Compensation of Employees of €574,621:			
Compensation of employees multiplier (direct and indirect)	0.575	B	Table 12 CSO Input-Output Tables
Estimated increase in total Compensation of employees due to additional €1m in purchases	574,621	C	A*B
The average labour cost for a full-time equivalent in the Manufacturing sector was €46,735 in 2014:			
Average labour cost (2014)	42,790	D	CSO Earnings Hours and Employment Costs Survey Annual
Share of Full-time (2014), %	83	E	QNHS via Eurostat
Share of Part-time (2014), %	17	F	QNHS via Eurostat
Average FTE Labour costs (2014)	46,735	G	$D/(E+(F/2))$; Average Labour Cost/(Share of Full Time+(Share of Part-time/2)); assume average part-time is half full-time
Dividing the estimated increase in Compensation of Employees by the average full-time equivalent labour cost gives the estimated number of direct and indirect jobs in the sector in question:			
Number of additional direct and indirect jobs (FTE) per €1 million additional expenditure	12.3	H	C/G The total increase in compensation of employees divided by the average FTE labour cost

Source: CSO data (Input-Output tables and multipliers, labour costs), methodology adapted from unpublished National Transport Authority paper, DPER calculations

Note: some rounding occurs in the presentation in the table but full accuracy was maintained in the underlying analysis.

Appendix 4

Illustration of Methodology – Other Sectors

The table below provides a narrative of the methodology for a €1 million increase in final demand. For illustrative purposes the jobs intensity for Electrical Equipment (NACE code 27) is worked through.

As discussed above, the multipliers produced as part of the CSO Input-Output tables refer only to domestic production. To report the estimated job impact arising from additional expenditure on goods produced domestically only would grossly overestimate the potential impact of public capital investment in machinery and equipment, as it is highly unlikely that all investment would be in domestic goods only. To take account of this, estimates have been made for the expected sourcing of goods; that is, adjusted for imports. Without knowing if a particular good is imported or produced domestically, it has been estimated how much on average is likely to be sourced in Ireland within a given sector. In addition, as part of this expected sourcing adjustment, an adjustment is also made for exports to reflect the total domestic supply, both imports and produced domestically. Goods produced domestically for export are excluded. This is particularly important for sectors such as computer equipment that are mostly export-oriented. The adjustment gives the share of total supply that remains in Ireland that is also produced in Ireland.

Note that these adjustments are simple estimates carried out using the Input-Output analysis results, no adjustments have been made to the underlying multiplier calculations. This analysis does not take into account the impact of imported inputs to production.

Table 11 Estimated increase in direct and indirect jobs from an additional €1 million investment in Electrical Equipment (NACE 27), 2014

From the Input-Output tables, nearly 40 percent of Electrical Equipment supplied in Ireland is made in Ireland, the remainder is imported:			
Total domestic production, €m	970	A	
Imports of final goods, €m	1,615	B	From Table 8 of CSO Input-Output Tables
Total Supply of final goods, €m	2,585	C	
Exports of final goods, €m	910	D	
Expected domestic production of total domestic supply, %	3.6	E	$(A-D)/(C-D) * 100$ $((\text{Domestic Supply} - \text{Exports}) / (\text{Total Supply} - \text{Exports})) * 100$
If €1 million is spent on Electrical Equipment, then you would expect, on average, €35,570 to be spent on Electrical Equipment that was produced domestically:			
Estimated additional domestic Supply as a result of increased spend of €1 million	35,570	F	€1m * E
From the 'Direct and indirect multiplier for other inputs', the multiplier for the Compensation of Employees is 0.223. So for the additional domestic supply resulting from the increased demand of €1 million, there will be an estimated increase in Compensation of Employees of €7,928:			
Compensation of employees multiplier (direct and indirect)	0.22	G	Table 12 CSO Input-Output Tables
Estimated increase in Compensation of employees due to additional €1m in purchases	7,928	H	F * G
The average labour cost for a full-time equivalent in the Manufacturing sector was €56,362 in 2014:			
Average labour cost (2014)	53,710	I	CSO Earnings Hours and Employment Costs Survey Annual
Share of Full-time (2014), %	91	K	QNHS via Eurostat
Share of Part-time (2014), %	9	L	QNHS via Eurostat
Average FTE Labour costs (2014)	56,362	M	$I / (K + (L/2))$; Average Labour Cost / (Share of Full Time + (Share of Part-time/2)); assume average part-time is half full-time
Dividing the estimated increase in total Compensation of Employees by the average full-time equivalent labour cost gives the estimated additional number of direct and indirect jobs in the sector in question:			
Number of direct and indirect jobs (FTE) per €1 million additional expenditure	0.1	N	H/M = The total increase in compensation of employees divided by the average FTE labour cost

Source: CSO data (Input-Output tables and multipliers, labour costs), methodology adapted from unpublished National Transport Authority paper, DPER calculations

Note: some rounding occurs in the presentation in the table but full accuracy was maintained in the underlying analysis.

Appendix 5

Caveats and limitations

There are limitations to the analysis and several caveats should be applied when interpreting the results:

- Multipliers are useful for showing the impacts of small increases in final demand, but are not appropriate for large changes as there will be diminishing marginal returns to investment. For example, making large investments in a particular sector might drive up labour costs;
- Capital investments are one-off purchases and so the jobs associated with their production will not be sustained. Jobs associated with the operation and general maintenance of the capital produced have not been estimated here;
- Input-Output tables are static; they are a snapshot of a period in time and do not take account of any dynamic changes that may occur in the economy as a result of government expenditure on capital programmes. For example, a new motorway reduces the overall travel time and so will result in time savings for commuters. Such benefits of investment are excluded from this analysis. Estimating and appraising the longer-term impacts of individual capital investments are a matter for individual sponsoring authorities in the development of their appraisal methodologies and business cases for investment;
- In addition, because the analysis is static it does not take account of any structural changes in the economy arising from increased demand in a particular sector;
- The CSO makes assumptions around production in order to construct the Input-Output analysis;
- Imported goods for final use may include components produced in Ireland that have been previously exported in intermediate form. For example, imported computers may include data processors produced in Ireland. This may understate the jobs impact to some degree as imported finished products have been excluded from the analysis;
- The import adjustments made to identify the 'expected sourcing' are simple estimates carried out on the Input-Output analysis results; no adjustments have been made to the underlying multiplier calculations. This analysis does not take into account the impact of imported inputs to production as this is outside the scope of this study;

- Where labour is an imported component, for example, where firms bring workers from outside Ireland, this can impact on leakage from the economy depending on the level of expatriation of earnings; and
- Where sectors have high numbers of self-employed people, such as in construction, the Compensation of Employees is an under-estimate for the total labour costs in the sector, and the net operating surplus may be considered as the labour cost for self-employed sub-contractors. However, the operating surplus is negative for 2011 so including this in the analysis does not yield a sensible or useful result. As the sector returns to a more normal level and net operating surplus becomes positive then it should be incorporated into jobs estimates.