NRA
An tÚdarás um Bóithre Náisiúnta
National Roads Authority

Transport Research & Information Note

The Employment Benefits of Investment Projects

October 2013

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1. Introduction

1.1. In order to better inform investment decisions, it is important to understand all of the potential benefits of projects, both direct and indirect. Given that a key feature of government policy is the creation of jobs, an analysis of the employment impact of investment projects would clearly be of assistance in the formulation of budgetary decisions. This note estimates the employment impact of a range of possible infrastructure projects.

1.2. A number of previous reports and submissions have estimated the level of employment associated with specific types of investment. The purpose of this note is to provide clarity on the short-term employment effects of a range of potential investment projects. This is the employment generated specifically during the construction phase of projects. The long-term employment effects (i.e. during the operational phase of the projects) are not examined.

1.3. There are three distinct employment effects that are evaluated. These are the direct, indirect and induced employment effects. These effects are divided as follows:

- Direct effect: Employment generated specifically as part of the project
- Indirect effect: Employment generated by the intermediate products and services used in the construction of the project
- Induced effect: Employment generated in the economy as a whole as a result of the increases in employment (from the direct and indirect effects above)

1.4. This note uses two separate methods for estimating the employment effects. The first uses a combination of industry and economic data to carry out an economic evaluation of the effects. The second method carries out a review of previously published Irish and international research.

1.5. Section 2 of this note presents a brief overview of the methodology used. In Section 3, the results of the economic evaluation are presented. Sections 4 and 5 analyse previous Irish and international research in this area. Section 6 draws conclusions.

2. Methodology

2.1. Two separate methodologies are used to evaluate the employment effects of potential investment projects. The first carries out an economic evaluation and the second method analyses previously published research.

Economic Evaluation

2.2. The economic evaluation is carried out using a combination of industry and economic data. The methodology involves the selection of a representative range of projects. Industry expertise is then used to provide an outline cost breakdown for each project. Finally, published economic data is used to model the employment effects.

2.3. The potential projects selected are theoretical projects and not based on any specific design or location. However, they are across the main areas likely to see government investment in the near term and so provide a representative group. The potential new construction projects are:

- Road
- Rail
- School
- Hospital
- Social housing
- Drinking / wastewater treatment
- High voltage power line
- Gas power station

In addition, road improvement works have been studied.

2.4. For each project, the level of employment is evaluated. This includes the level of direct employment (people employed on the project), indirect employment (people employed in the supply of goods or services to the project) and induced employment (the additional employment generated due to the increase in consumption as a result of the direct and indirect employment increases).

2.5. In order to quantify the direct employment element of each potential project, an estimate is generated based on industry experience.

2.6. The Central Statistics Office (CSO) compiles an overall picture of the way in which the output of the economy is built up. This is referred to as an Input-Output model of the economy. This model shows how the output of each sector of the economy is used as inputs for the other sectors of the economy, and how an increase in the output of one sector of the economy will lead to an increase in the demand for the outputs of the other sectors of the economy. This information is presented in a variety of formats by the CSO in its periodic publication of Input-Output tables for the Irish economy. The Central Statistics Office published the most current set of these Input-Output tables in

March 2009[1]. One version of these tables captures the full ripple effect described above. This allows calculation of the indirect employment effect based on the level of expenditure in each of the elements of the project.

2.7. Using the same sources of industry experience, a breakdown of the non-labour elements of projects is evaluated. This breakdown includes components such as plant, materials, equipment etc. The employment element of these components can then be estimated using the Input-Output data giving the indirect employment effect.

2.8. Finally, each potential investment will have what are referred to as induced effects. As described above, the investment will have both direct and indirect effects on employment, and so on wages and salaries paid to employees. These extra wages and salaries will be spent and will give rise to a further, induced, effect on the economy. This will represent a further round of spending effects on employment. This effect was estimated as follows:

- A value for the relevant "marginal propensity to consume" is calculated, i.e. the proportion of any extra income earned by Irish employees that would be spent, rather than taxed or saved;
- The estimates of the direct and indirect extra wages and salaries arising from the potential projects already calculated were multiplied by this marginal propensity to consume to give estimates of extra consumer spending;
- These estimates of additional consumer spending were split between the various sectors of the economy in line with current spending patterns; and,
- The effect of this extra spending on employment was calculated in the same way as the indirect effects discussed above.

Review of Previous Research

2.9. The second part methodology involves a review of Irish and international research in this area.

2.10. It should be noted that the level of research specific to Ireland is quite low. International research is more comprehensive with a large proportion being North American based.

2.11. It should also be noted that caution should be used when drawing conclusions from international studies. For instance housing construction in the USA is usually either timber frame based or high rise which is quite different to the likely construction of social housing in Ireland. The spending patterns and therefore the induced employment effects are also likely to be different.

[1] "2005 Supply and Use and Input-Output Tables" Central Statistics Office, March 2009. It should be noted that Supply and Use tables are available for 2009. Analysis of these tables confirms no significant changes in the period 2005 to 2009 thus justifying the use of the 2005 Input-Output data.

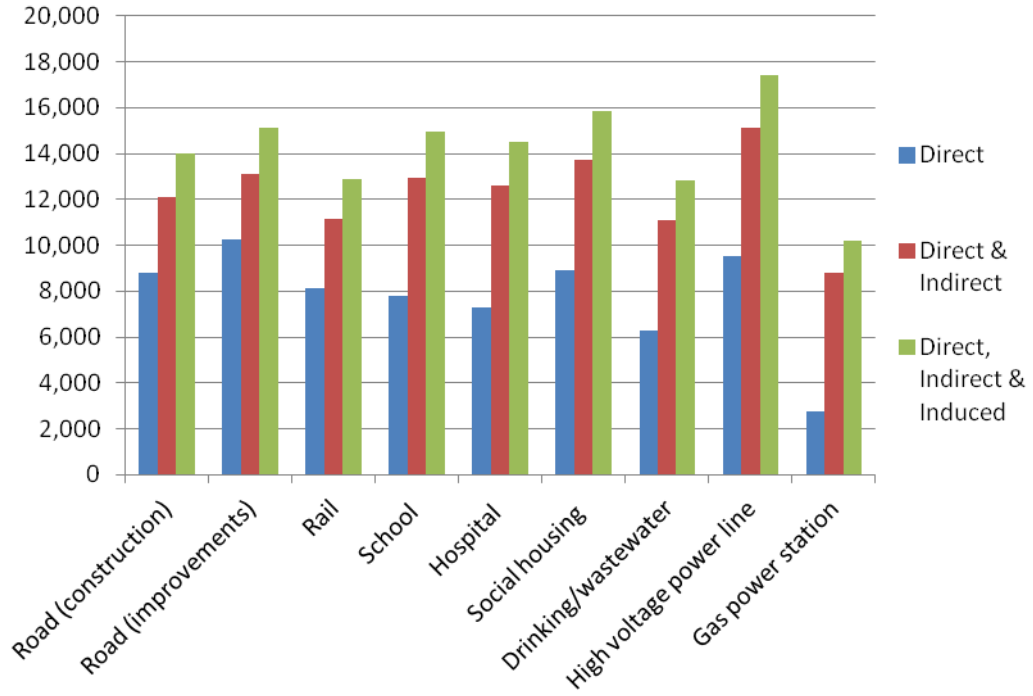
3. Economic Evaluation

3.1. Table 1 and Chart 1 below show the results of the economic evaluation that includes the direct, indirect and induced employment effects of each of the potential investments. In order to allow the projects to be easily compared, the figures are presented based on the number of annual equivalent jobs per billion euro invested (excluding VAT).

Table 1: Estimated Employment Effects (for €1bn invested) Invested

Project	Direct	Indirect	Direct & Indirect	Induced	Total
Road (construction)	8,773	3,349	12,122	1,861	13,983
Road (improvements)	10,267	2,862	13,129	2,016	15,145
Rail	8,146	3,001	11,147	1,711	12,858
School	7,798	5,150	12,948	1,988	14,936
Hospital	7,286	5,303	12,589	1,933	14,522
Social housing	8,912	4,816	13,728	2,108	15,836
Drinking/wastewater treatment	6,266	4,850	11,116	1,707	12,823
High voltage power line	9,525	5,569	15,094	2,317	17,411
Gas power station	2,757	6,062	8,819	1,354	10,173

Chart 1: Direct, Indirect and Induced Employment Effects (for €1bn) based on Economic Evaluation



3.2. Although there are significant differences in the direct labour content of many of the potential investment projects, it is noticeable that when both indirect and induced employment effects are taken into account the differences are not as pronounced.

3.3. When all effects are included, the projects that have high traditional construction content have the largest employment effects. The construction of power lines[2] generates the most employment followed by social housing, road improvements and school construction.

3.4. Projects with a high technology and equipment content such as water treatment and rail have lower employment effects. The construction of a gas power station is not thought to be a likely recipient of government investment but is included to show the lower level of employment generated during the construction phase by high technology investments.

[2] It should be noted that the inputs for the estimates of employment levels for power lines are based on data from the Indecon report for EirGrid "Evaluation of the Wider Economic Benefits of GRID25 Investment Programme" (2013)

4. Review of Irish Research

4.1. A review of previous research carried out in Ireland identified a number of studies of interest. Table 2 shows the direct employment impact estimated by each of the studies. The Department of Finance has also published an analysis of the direct employment impact of a number of different investment types. These are shown in Table 3. It should be noted that the figures in both tables pertain to direct employment only and do not include either indirect or induced employment effects.

Table 2: Direct Employment Effects (for €1bn invested) – Irish Research

Project Type	Direct Employment
Road improvement projects[3]	5,600
Construction[4]	10,600
Cutting public investment[5]	8,471
Cutting public investment[6]	10,671
Electricity Infrastructure[7]	9,946

Table 3: Direct Employment Effects (for €1bn) – Department of Finance[8]

Project Type	Direct Employment
HSE Capital	12,132
Regional and Local Roads	11,627
National Roads	10,110
Prisons	10,110
Schools	9,402
Housing	8,088
Public Transport	8,088
Water Services	8,088

4.2. The tables above show relatively large differences between different studies of similar projects. The largest outlier is the figure for road improvement projects of 5,600. This based on a 1993 study adjusted to current prices. It is not thought that this is a reliable figure given the changes that have occurred in Ireland in the last 20 years.

4.3. The difference in the two studies on the employment impact of cutting public investment is also noticeable. The first study was conducted in 2009 (8,471 jobs) and the second in 2013 (10,671 jobs). It is believed that this difference is due to the reduction in the cost of construction output between 2009 and 2013.

4.4. The figures from the Department of Finance study indicate differences between various types of project. Given these effects relate to direct employment only, caution is needed before drawing conclusions. It is likely that some projects (such as road building) could have a high level of direct employment due to the general nature of the

[3] DKM (1993) indexed to current prices
[4] Construction Industry Federation (2009) indexed to current prices
[5] Bergin et al. (2009) indexed to current prices
[6] FitzGerald and Kearney (2013)
[7] Evaluation of the Wider Economic Benefits of GRID25 Investment Programme (2013)
[8] Department of Finance (2010)

work. Alternatively, projects (such as water services) may require more specialist workers whose labour is provided via services purchased as part of the project. If so, the differences in employment levels of projects could be due to a spread of employment between direct and indirect effects.

4.5. It is noted that the Department of Finance estimation for housing (at the lower end of the scale) is somewhat surprising as it is believed that housing construction would have a labour content at least as large as road building.

5. Review of International Research

5.1. As many construction projects are very similar and given the paucity of Irish studies it is useful to consider the jobs impact of construction projects identified in other countries. As mentioned previously, caution must be adopted when using such analysis due to possible differences between countries.

5.2. In the USA, there has been particular interest in the employment impact of construction given the stimulus that has been applied to the economy. Economic advisors to President Obama produced a paper that suggested the ex-ante employment impact of the American Recovery and Reinvestment Act (ARRA) would create or sustain 6.8 million job years with the jobs per billion euro invested estimated to be 8,600 (Romer and Bernstein, 2009). However, this impact has been challenged more recently. Cogan et al (2010) estimate the impact to be just one sixth of that claimed by Romer and Bernstein. However, Conley and Dupor (2013) in an ex-post analysis found about half the impact claimed in Romer and Bernstein (2009).

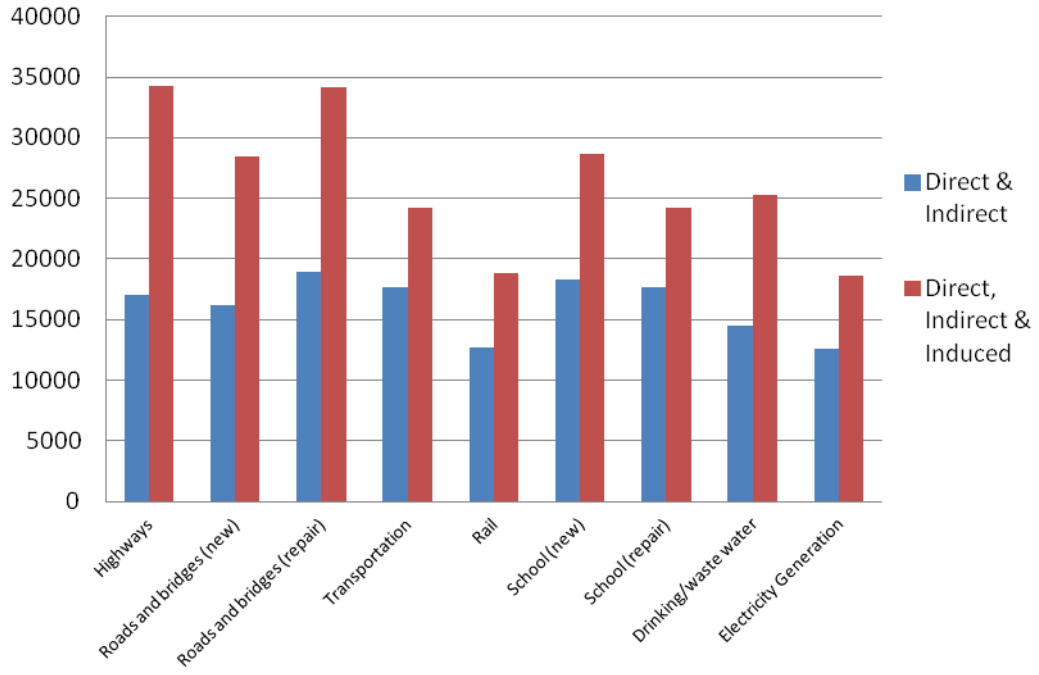
5.3. There have been numerous other studies, the most relevant of which are summarised in Table 4 with the full list given in the Appendix. The average direct job years per billion euro invested across all the studies examined is approximately 10,300. This is almost identical to the impact found in FitzGerald and Kearney (2013) for Ireland. It should be noted that in many studies, the level of the direct effect is not calculated separately to the indirect effect. For this reason, the combined effects are shown in the table below.

Table 4: Direct and Total Employment Effects (for €1bn) – International Studies

Project Type	Direct & Indirect Employment	Total Employment
Highways	17,082	34,288
Roads and bridges (new)	16,172	28,403
Roads and bridges (repair)	18,926	34,182
Transportation	17,696	24,223
Rail	12,709	18,871
School (new)	18,287	28,687
School (repair)	17,618	24,167
Drinking/waste water	14,493	25,316
Electricity Generation	12,565	18,574

5.4. The most striking difference between the economic evaluation carried out as part of this report and the results of the international studies is the much higher level of induced employment. The average level of additional induced employment is 62% for those sectors shown in Table 4. This is seen graphically in Chart 2 with the addition of induced employment substantially raising the employment effects. The economic evaluation for Ireland found a level of additional induced employment to be 15%. This difference is thought to be due to a combination of Ireland's small open economy (with large amounts of expenditure on imports) and a higher marginal propensity to consume in countries on which a number of international studies are based (e.g. USA).

Chart 2: Direct & Indirect and Total Employment Effects (for €1bn) based on International Studies



5.5. The combined direct and indirect employment effects in international studies indicate projects with high traditional type construction lead to higher levels of employment. Projects that have high technology or equipment content, such as those in the rail and water industries, have a lower employment effect (see Table 4). However, the differences between the sectors (e.g. roads v schools) and different types of projects (e.g. new v repair) are not as large. This is broadly consistent with the findings from the economic evaluation carried out as part of this note.

5.6. In several cases, the levels of direct and indirect employment shown in the international studies are substantially higher than those in the economic evaluation. In some cases, the direct and indirect employment effects are over one third higher. This is at least partly explained by the higher cost of labour in Ireland.

6. Conclusions

- There are reasonably significant differences between the levels of direct employment generated by potential investment projects in different sectors. These differences are reduced when indirect and induced employment effects are included.

- When all effects are included, projects that could be described as 'technology or equipment heavy' such as those in the water and rail sectors have a lower employment effect than projects in the more traditional 'construction heavy' sectors.

- The level of induced employment estimated for Ireland is 15% in addition to direct and indirect employment. This is low by international standards due to the nature of Ireland's economy and therefore the 'jobs boost' due to investment in infrastructure projects is not likely to be as large as international evidence would suggest.

- If employment is to be prioritised in the selection of potential investment projects, traditional low-technology projects (such as power lines, social housing and road improvements) should be preferred to those with higher equipment or technology content (such as water and rail). However, the level of increased employment in one sector over another is unlikely to be the deciding factor when all of the economic benefits of the relevant projects are evaluated.

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8. Appendix

Table 5: Employment Effects (for €1bn invested) – International Research

Asterisk (*) indicates average numbers across the relevant studies

	Direct	Indirect	Induced	Direct + Indirect	Indirect + Induced	Direct + Indirect + Induced	Unspecified	Sources
Energy			6,472	14,978		21,450		Heintz et al. (2009a)
Coal	2,431	3,839	2,559	6,270	6,398	8,829		Heintz et al. (2009b)
Gas			7,565	20,443		28,008		Heintz et al. (2009a)
Nuclear	11,828				21,943	33,770		DeVol & Wong (2010)
Oil and gas exploration and development (including fracking)	5,343				19,232	24,575		DeVol & Wong (2010)
Electricity Generation			6,009	12,565		18,574		Heintz et al. (2009)
Smart metering						51,185		Houser, Mohan, Heilmayr (2009)
Solar	6,910	5,630	5,577*	26,554*	10,621	18,853*		Heintz et al. (2009a,b)
Biofuels	9,238	7,527	6,672	16,765	14,199	23,437	9,749	Heintz et al. (2009b) Appollo Alliance (2004)
Wind	12,350	10,063	7,533*	35,307*	18,983	25,187*		Heintz et al. (2009a,b)
Total renewables (solar, wind, biofuels)	10,189				19,495	29,684		DeVol & Wong (2010)
Hydrogen fuel cells							6,755	Appollo Alliance (2004)
CCS	11,779				20,651	32,430	7,360	DeVol & Wong (2010) Appollo Alliance (2004)
Battery R&D						28,792		Houser et al. (2009)
Transportation			6,527	17,696		24,223		Heintz et al (2009a)
Average roads and bridges	11,500		6,628	17,549		28,084*		Houser et al. (2009) Heintz et al (2009a)

	Direct	Indirect	Induced	Direct + Indirect	Indirect + Induced	Direct + Indirect + Induced	Unspecified	Sources
Roads and bridges new	11,837		6,186	16,172	7,294	20,744*	7,659	Swenson (2009) Heintz et al (2009a) Appollo Alliance (2004)
Roads and bridges repair	15,824		7,073	18,926	9,751	25,787*	8,395	Swenson (2009) Heintz & Pollin (2009a) Appollo Alliance (2004)
Highways	11,753	5,330	17,206	17,082	22,535	34,288	11,196	DDoT (2008) CNT, SGA and USPRIG (2010)
Rail			6,161	12,709		18,871		Heintz et al (2009)
New high speed rail							7,830	Appollo Alliance (2004)
Rail maintenance							8,236	Appollo Alliance (2004)
Mass transit	14,527*	5,826*	10,761*	23,329*	18,726*	29,295*	20,935	Heintz et al (2009) Weisbrod and Reno (2009) Heintz et al (2009a) CNT, SGA and USPRIG (2010) Houser et al. (2009)
Aviation	3,755		6,736	17,917	18,549	23,478*		DeVol & Wong (2010) Heintz et al (2009a)
Inland waterways/levees	11,746		8,149	22,286	21,161	31,671*		DeVol & Wong (2010) Heintz et al (2009a)
New transit starts							7,716	Appollo Alliance (2004)
Intelligent transportation system	9,592			12,124		21,715		Liebenau et al (2009)
Buildings								
School buildings (average of below two)			6,696	17,952		24,648		Heintz et al (2009a)
School: new institutional construction			6,841	18,287		28,687*		Houser et al. (2009) Heintz et al. (2009a)
School: repair of non-residential buildings			6,549	17,618		24,167		Heintz et al. (2009a)
US building retrofits	8,957	6,270	6,142	15,228	12,412	26,872*		Houser, Mohan, Heilmayr (2009) Heintz et al (2009b)
Household weatherization						32,119		Houser, Mohan, Heilmayr (2009)
New Manufacturing	11,798				5,937	17,736		Swenson (2009)
New Residential	15,773				7,938	23,711		Swenson (2009)

	Direct	Indirect	Induced	Direct + Indirect	Indirect + Induced	Direct + Indirect + Induced	Unspecified	Sources
New Commercial	21,087				10,612	31,699		Swenson (2009)
Water			6,945	18,352		25,297	5,951	Heintz et al (2009a) Appollo Alliance (2004)
Dams			8,149	22,286		30,435		Heintz et al (2009a)
Drinking/waste water	11,940		5,943*	14,493*	23,136	25,316*		DeVol & Wong (2010) Gordon et al. (2011) Heintz et al. (2009a)
Telecommunications								
Broadband	8,878*				19,729*	28,608*		Atkinson et al (2009) Liebenau et al (2009) DeVol & Wong (2010)
Health								
Health IT	5,555	4,668	10,133	10,223	14,801	20,356		Atkinson et al.(2009)