Irish Fiscal Advisory Council

Ireland's next ramp-up in public investment

Analytical Note No. 13

Niall Conroy, Eddie Casey and Elliott Jordan-Doak

November 2021

Abstract

Ireland's public investment has fluctuated over the past two decades with booms and busts in the economy. With its new National Development Plan, the Government now plans to expand public investment significantly in the coming years to high levels, both by historical and international standards. This note examines some of the implications. Using various methods, we estimate that, by 2030, economic activity may be boosted by about 1%. But prices across the economy would also be expected to rise by about 0.6%, while the government debt ratio would also be higher by about 5.7 percentage points of GNI*. There are risks that a tight labour market and low productivity in construction could act as capacity constraints. This could lead to less output from investment and potentially lower value for money. It is therefore important that the Government safeguards the value of its investments while fostering greater productivity in the sector.

Suggested reference:

Conroy, N., E. Casey, and E. Jordan-Doak, (2021). "Ireland's next ramp-up in public investment". Irish Fiscal Advisory Council Analytical Note Series No. 13. Dublin. Available at: www.FiscalCouncil.ie

This report can be downloaded at www.FiscalCouncil.ie

The authors are economists on the Secretariat of the Irish Fiscal Advisory Council. Email: admin@fiscalcouncil.ie. The opinions expressed and arguments employed in this paper do not necessarily reflect the official views of the Fiscal Council. We would like to acknowledge the helpful comments from Thomas Conefrey (Central Bank of Ireland) and the feedback and kind assistance received from members of the Council and from the Secretariat.

Summary

Ireland's public investment has fluctuated over the past two decades with booms and busts in the economy. This has been unhelpful for planning and for the viability of the construction sector, which suffers from weak assurances that investment and training will lead to sustainable workloads. Partly due to this, Ireland's construction sector is much less productive than other countries. Given past investment, the overall level of public capital assets stood at about 75% of national income in 2019. Though information across countries is limited, this appears small relative to other OECD peers.

With its new National Development Plan, the Government now plans to expand public investment significantly in the coming years to high levels, both by historical and international standards. The Government plans to increase public investment to 5.4% of national income in 2024, remaining broadly at that level out to 2030. In the past two-and-a-half decades, there was only two years in which investment was higher. It also represents a rapid pick up compared to the low levels of public investment in the aftermath of the financial crisis when rates fell to about 3% of national income. By comparison, other OECD countries tend to see rates of about 3 to 4%. The increased investment could increase the public capital stock to 80% of national income in 2030. This would be a record level for Ireland, but still lower than in some other countries such as France.

The increase in public investment should help to meet climate change and housing objectives. More generally, investment spending, if it is efficient, should benefit the State either in terms of public services provided or through benefits to the private sector that may flow back to the government through higher taxes. Low interest rates at present reduce the marginal return required for investment projects.

However, there are some risks to the sustainability of the public finances. The additional investment spending is to be funded in part by running higher deficits and comes at a time when Ireland's debt ratio is already high and needs to be reduced to more prudent levels over time.

The additional public investment is also likely to have broader macroeconomic impacts: boosting growth, raising prices and leading to more pressures on an already tight construction sector. As we show using a variety of approaches, the additional public investment would be expected to boost the size of annual economic activity by almost 1% by 2030. This is compared to a situation in which public investment rates stayed at their current level of about 4% of national income. The fact that much of the additional investment is in

housing and green areas, where short-run economic impacts can be higher, raises the likely boost to growth. However, with the economy recovering, higher prices are also likely to accompany the increase in economic activity. Price inflation across the whole economy is estimated to be 0.6% higher than it otherwise would be due to the additional investment.

There are risks that upward pressure on costs driven by price inflation or wage increases, including due to material or labour shortages in construction, could limit the boost to economic activity. It could also result in higher investment costs for the Government or lower output for a given price, poorer value for money and possible spending overruns. The ramp-up in public investment will come at a time when many other countries are also making similar efforts to increase public investment in these areas. It is also unclear to what extent the additional public investment might simply displace activity that the private sector would have undertaken anyway.

Looking at capacity constraints in the construction sector, we estimate that around 180,000 workers would be required in the construction sector to achieve the Government's planned increases in public investment. Getting to this level could be difficult as there are already limited numbers of unemployed construction workers domestically. Estimating a construction sector unemployment rate, we find that this could have been as low as 2 to 3% at the end of 2019 — well below historical rates. It is also unclear whether migration flows can provide the same boost to labour supply as it did in the past. Other countries have narrowed the wage gap with Ireland, but costs remain high such that Ireland's relative attractiveness has fallen by more than one-third relative to the mid-2000s.

Higher productivity growth might help to boost output in the construction sector for the same numbers of workers, but a major leap forward is required. Ireland's construction sector was about one-fifth below productivity levels in the UK in 2019; 29% below the Euro Area; and about 44% below the average for the top 5 most productive countries. Closing a gap of that size over ten years would require Ireland's construction sector to grow its productivity by at least 6% annually on average. By contrast, the last two-and-a-half decades have seen productivity growth average just 0.7% annually in the sector.

Ireland has had a poor track record in preventing substantial public investment cost overruns. This is true of specific high-profile projects like the National Broadband Plan and the National Children's Hospital, but it is also visible for general investment plans, which have tended to be revised up systematically in economic upturns. Ramping up public investment at the same time as there are shortfalls in construction workers could compound these problems.

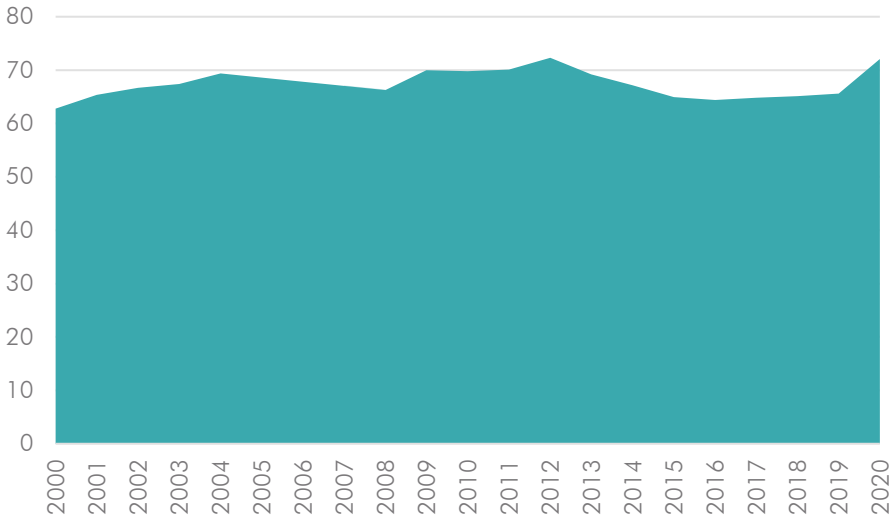
If Ireland is to avoid further overruns and poor value-for-money outcomes in future, it will need to improve how public investment spending is governed. Past reports have highlighted the substantial scope for the Irish authorities to adopt policies that will help improve how public investment is managed. In particular, past recommendations from the IMF suggest that the Department of Public Expenditure and Reform needed to take on more responsibility ensuring value for money is achieved in capital projects. Changes proposed and introduced in recent years include many good initiatives, which may result in better value for money. However, their success will be difficult to assess, and a high degree of diligence will be required, given capacity constraints, the high scale of investment, and the greater need to ensure value for money with high government debt levels. Careful planning and management of public investment spending will be essential.

1. Public capital stock in Ireland

Ireland's public investment has fluctuated over the past two decades. As a result, the overall level of the Irish public capital stock — a measure of all non-financial assets built up — has varied over this time between 60 and 75% of national income (Figure 1). A sharp increase in the ratio for 2020 was driven both by an increase in the public capital stock and a fall in national income. But the level of Ireland's public capital stock was 65.6% of GNI* in 2019. For context, the Irish public capital stock is about a fifth of the capital stock of the domestic economy.[1]

Figure 1: Ireland's public capital stock

% GNI*, non-financial general government assets



Sources: CSO and Authors calculations.

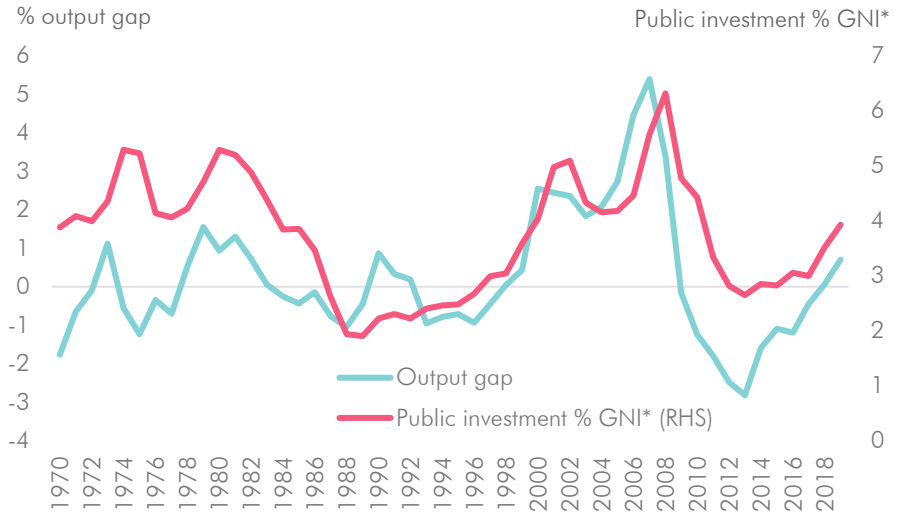
The fluctuations in the capital stock have tended to arise as public investment fluctuates with booms and busts in the economy. We can see this from how the output gap — a measure of the economic cycle — has tended to lead public investment rates (Figure 2). That is, in the past five decades, downturns in the economy have been followed by sharp reductions in public investment rates, whereas upturns have been followed by sharp increases in public investment rates.

The procyclical nature of public investment spending was most spectacularly evident before and after the financial crisis. A large and growing output gap saw public investment rates rise gradually from the early 2000s to a record 6.3% in 2008. The public investment rate was then more than halved to 2.6% by 2013 before gradually picking up to

[1] An alternative measure of the total capital stock is used in this note, one that is consistent with the concept of the CSO's "Domestic GVA" measure where sectors that are dominated by activities of foreign-owned multinational enterprises are removed.

3.9% by 2019 as the economy recovered. In a similar fashion, the recessionary periods in the 1980s led to contractions in public investment rates. An exception was the late-1990s when more moderate increases in public investment rates preceded an upturn in the economy before the Celtic Tiger period.

Figure 2: Public investment has risen with booms and fallen with busts



Sources: CSO; and Fiscal Council output gap estimates.
Notes: The output gap is the difference between actual economic output and its potential with negative output gaps suggesting spare capacity or some slack in the economy. Public investment refers to general government gross fixed capital formation. Nominal modified GNI* is backcast from 1995 using data for gross national income.

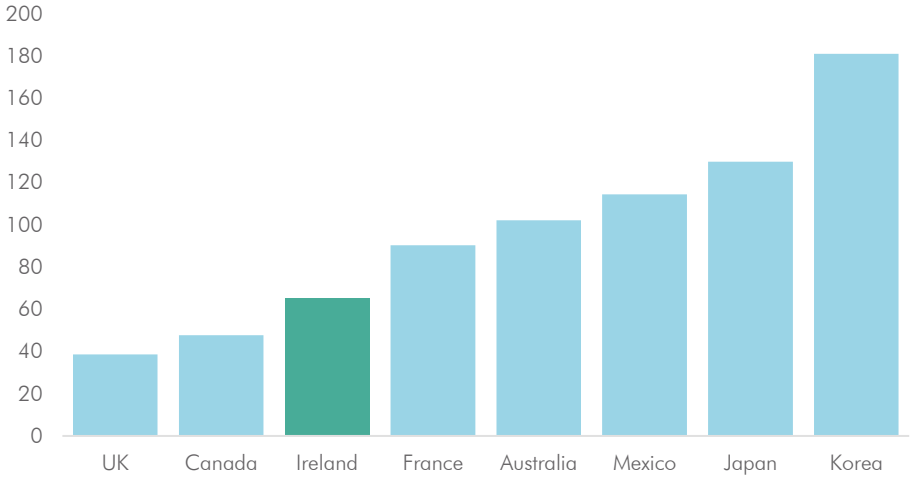
Ireland's public capital stock appears small relative to other OECD peers. We can see that there is a great deal of variety in the level of the public capital stock of various countries (Figure 3). When using GNI* as the measure of Irish national income, the Irish public capital stock is at the smaller end relative to other countries, although there is only a small sample of countries for which similar data are readily available. There are also many issues of comparability. Measuring the capital stock is inherently difficult, given the unobservable nature of depreciation rates and difficulties in valuing the capital stock, particularly in the public sector where assets are generally not traded. Ireland's public investment rate, which has been somewhat below the OECD median, tends to confirm that the public capital stock is relatively low compared to other OECD countries.

Three factors contribute to the evolution of the public capital stock. First, general government gross investment, which adds to the stock. Second, depreciation (or consumption of fixed capital) which subtracts from the capital stock. The difference between these two factors is often referred to as "net investment". Third, there are changes in net worth that are due to other economic flows. These would typically be caused by valuation changes, though catastrophic losses and other changes play a role too.

For example, public land or buildings could change in value due to revaluation by statisticians, without any investment taking place. This final factor could contribute positively or negatively to the value of the public capital stock.

Figure 3: Irish public capital stock compared to OECD countries

% GDP (% GNI* for Ireland), 2018 data

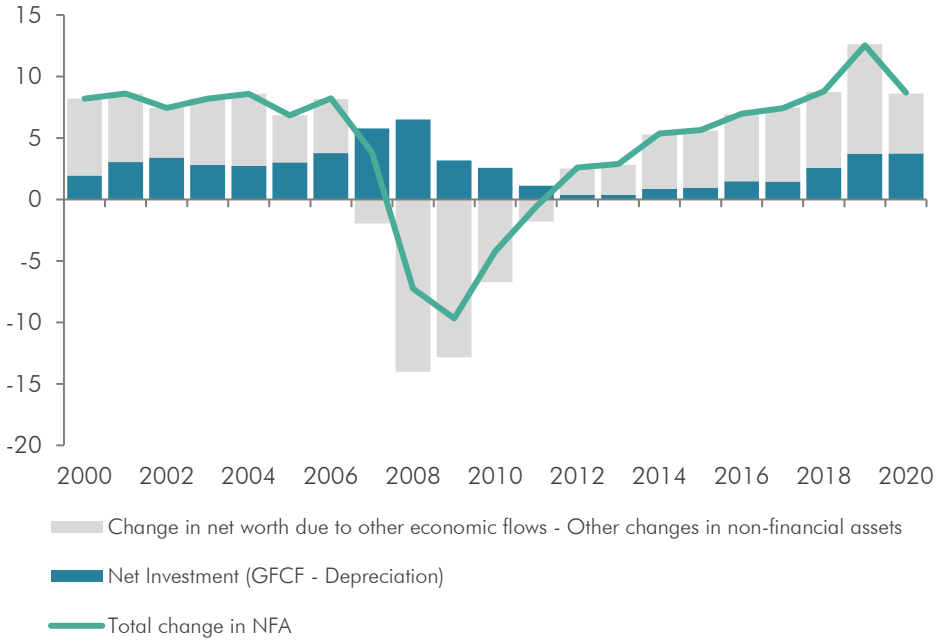


Sources: CSO and OECD.

Figure 4 shows the contribution of these factors to the nominal Irish public capital stock over time. It is clear that other economic flows can have a significant impact on the stock of government non-financial assets. In many instances, this impact was even larger than that from net investment.

Figure 4: Factors contributing to the change in the nominal Irish public capital stock

€ billions



Sources: OECD; CSO; and authors' workings.
Notes: The net investment series shows general government gross fixed capital formation minus depreciation (consumption of fixed capital).

Over the period 2000-2020, other economic flows had a positive impact on the capital stock. On average, this contribution was equivalent to 2.1% of the previous year's public capital stock. Over the same period, the deflator on modified national income (GNI*) rose by an average of 2.4% per year.

Over the period 2000–2020, Ireland's capital stock steadily rose until a severe correction after the financial crisis, which was only gradually unwound. Net public investment was positive in the early 2000s and the capital stock also benefited from other increases such as due to valuation effects. However, when the financial crisis hit, Ireland's net public investment was halved in a single year in 2009. Around the same time, other reductions in the level of non-financial assets were also observed, including due to falling values, and the annual change in non-financial assets turned sharply negative during 2008 to 2011.[2]

Net public investment fell to almost nothing by 2012 and 2013 and was barely sufficient to cover the depreciation of existing assets. As the crisis subsided and as the public finances were returned to a sounder footing, net public investment levels gradually recovered, rising from €0.4 billion in 2013 to €3.8 billion by 2020.

[2] Falling property and land prices led to a significant downward revision in the value of public lands and buildings.

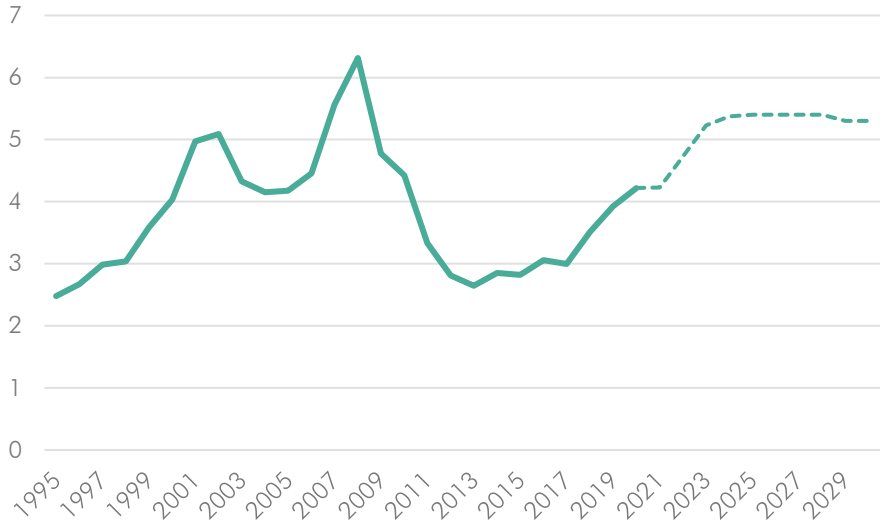
2. Investment plans

The National Development Plan (NDP) sets out the Government's investment plans from 2021-2030.[3] Ireland has had multi-year capital plans for some time. They are designed to help plan the capital spending programme. In recent years, these plans have tended to be revised frequently, often well before plans are due to expire.

The Government plans to increase public investment to 5.4% of GNI* in 2024, remaining broadly at that level out to 2030.[4] This is high by historical standards in Ireland (Figure 5) and represents a rapid pick up compared to the low levels of public investment in the aftermath of the financial crisis when rates were as low as 2.6 to 3% of GNI*.

Figure 5: Capital spending is planned to rise in coming years

% GNI*, general government basis



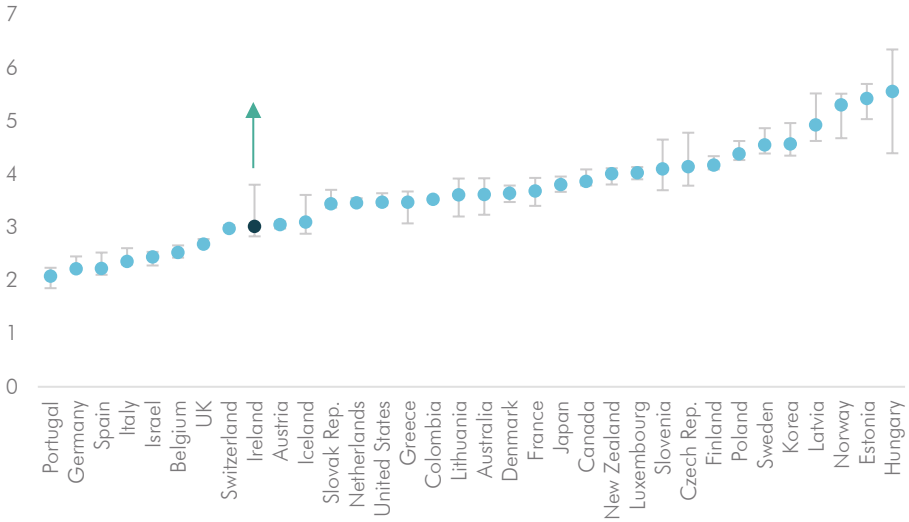
Sources: OECD; CSO; and own workings.
Notes: Data up until 2020 is CSO outturn data on general government gross fixed capital formation and nominal GNI*. Values from 2021- 2025 are general government gross fixed capital formation and nominal GNI* forecasts from *Budget 2022*. Values for 2026-2030 are obtained by applying the year-to-year change in this ratio from using NDP forecasts of GNI* and exchequer funding for capital expenditure.

Looking internationally, government investment of over 5% of national income would be above the rate typically seen in other OECD countries, which have tended to range between 3 and 4% of GDP (Figure 6).

[3] The full document can be found here.
[4] *Budget 2022* sets out forecasts on a general government basis out to 2025. On this basis, government investment rises to 5.4% of GNI* in 2024 and 2025. Using NDP forecasts of exchequer investment and GNI* would see public exchequer investment rise to 5.1% of GNI* in 2024, remaining largely flat thereafter.

Figure 6: Investment will be high by historical and international standards

Public investment as % GDP (% GNI* for Ireland), general government basis



Sources: OECD and own workings.
Notes: The median shows the median public investment ratio for the past ten years (2012–2021) and lines the middle 50% (interquartile) range observed over the same period.

The rise in public investment is likely to lead to a larger public capital stock. The implications of different levels of investment for the public capital stock are given in Figure 7 below. Two key assumptions are made:

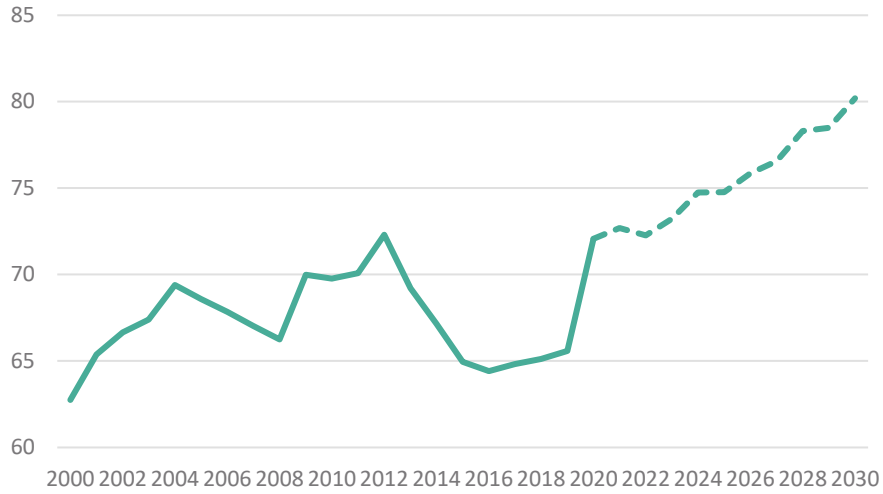
- First, the nominal depreciation rate for 2021 to 2030 is assumed to be 3.3% (the average rate over 2000-2020).
- Second, an assumption is required on the changes in the capital stock due to "other economic flows". As was the case with depreciation, we assume the average rate observed over 2000 to 2020. This implies a positive contribution equivalent to 2.1% of last year's stock is made due to other economic flows (such as valuation changes).[5]

Using these assumptions and the NDP levels of investment, the public capital stock is projected to expand from 72% of GNI* in 2020 to 80% in 2030 (Figure 7).[6] This would be a record level for Ireland of the public capital stock relative to the size of the economy. However, it would still likely be lower than a number of other OECD countries.

[5] This is similar to the deflator growth forecast for GNI* under the NDP. As a result, the assumed valuation changes would not make significant contributions to the public capital stock to nominal GNI* ratio.

[6] The nominal GNI* forecasts used are those implied by the NDP. Nominal GNI* growth averages 4.7% for 2021-2030.

Figure 7: Government Non-financial assets forecast to rise
% GNI*



Sources: CSO; and own workings.
Notes: Data up until 2020 is CSO outturn data. Values from 2021-2030 are based on NDP forecasts of exchequer capital spending and GNI*.

Efficient capital spending should provide benefits to the State in future years, either in the form of a flow of public services or through benefits to the private economy that may flow back to the government in the future through higher revenues. In a low interest rate environment, it is more attractive to borrow as these interest costs are lower and the marginal return required for investment projects is lower.

One strategy for increasing the capital stock may be to frontload this build-up with a temporary period of unusually high public investment spending. Merely raising investment rates to a higher steady-state level implies a very slow transition path to the higher desired capital stock. Following a period of frontloading, investment rates could then be returned to more normal historical levels and in line with norms for advanced economies after a period of time. Gross investment would nevertheless need to remain higher than in the past to maintain the new higher level of the capital stock.

3. Growth impact of public investment

This section examines the impact that the additional public investment might have on growth. We first assess the potential growth impacts through a production function approach, then using estimates from the international literature and, finally, using the Council's Maq model — a macro-fiscal structural model — together with specific fiscal multipliers based on the types of investment set out in Ireland's capital plan.

Production function approach

As in the Council's Long-term Sustainability Report (Council, 2020a), we can assess the impact of the additional public investment planned for the coming years through a production function approach.

Taking the *Budget 2022* forecasts for real GNI*, we decompose the growth of output ΔY_t into inputs from labour (total hours worked) ΔL_t, private and public capital ΔK_t and total factor productivity (TFP, ΔA_t).

$$\Delta Y_t = \Delta A_t + \alpha \Delta K_t + (1-\alpha)\Delta L_t$$

The level of the real net capital stock K_t is assumed to evolve according to the depreciation rate δ_t and real underlying investment I_t.

$$K_t = (1-\delta_t)K_{t-1} + I_t$$

The parameter α determines the output elasticity to capital and is assumed to be equal to 1/3, with the parameter on labour then equal to 2/3.

We start with real net capital stock estimates for 2019 from the CSO based on the concept of Domestic GVA. These overcome distortions caused by substantial inflows of intellectual property assets associated with foreign multinational enterprises in recent years. We then use *Budget 2022* forecasts of underlying investment (excluding aircraft and intangibles) and assume real depreciation rates of 4.8% — its two-decade average.[7] We use the *Budget 2022* labour forecasts to derive total hours worked. From 2026, we assume TFP and employment growth rates gradually moderate towards 0.6% and 1%, respectively. This is consistent with the analysis in the Long-term Sustainability Report which assumes that productivity growth moderates as the economy matures to rates typical for other advanced economy regions at the same level of productivity. The employment growth assumptions are based on the same analysis and draw on the Council's Long-term Model and its demographic projections. Average weekly hours worked are assumed to remain constant as in the

[7] This is different to the exercise in Section 1 based on nominal rates.

Long-term Sustainability Report. Finally, we assume private investment is constant as a share of GNI* and that the GNI* and underlying investment price deflators grow at a constant 2% annually after 2025.

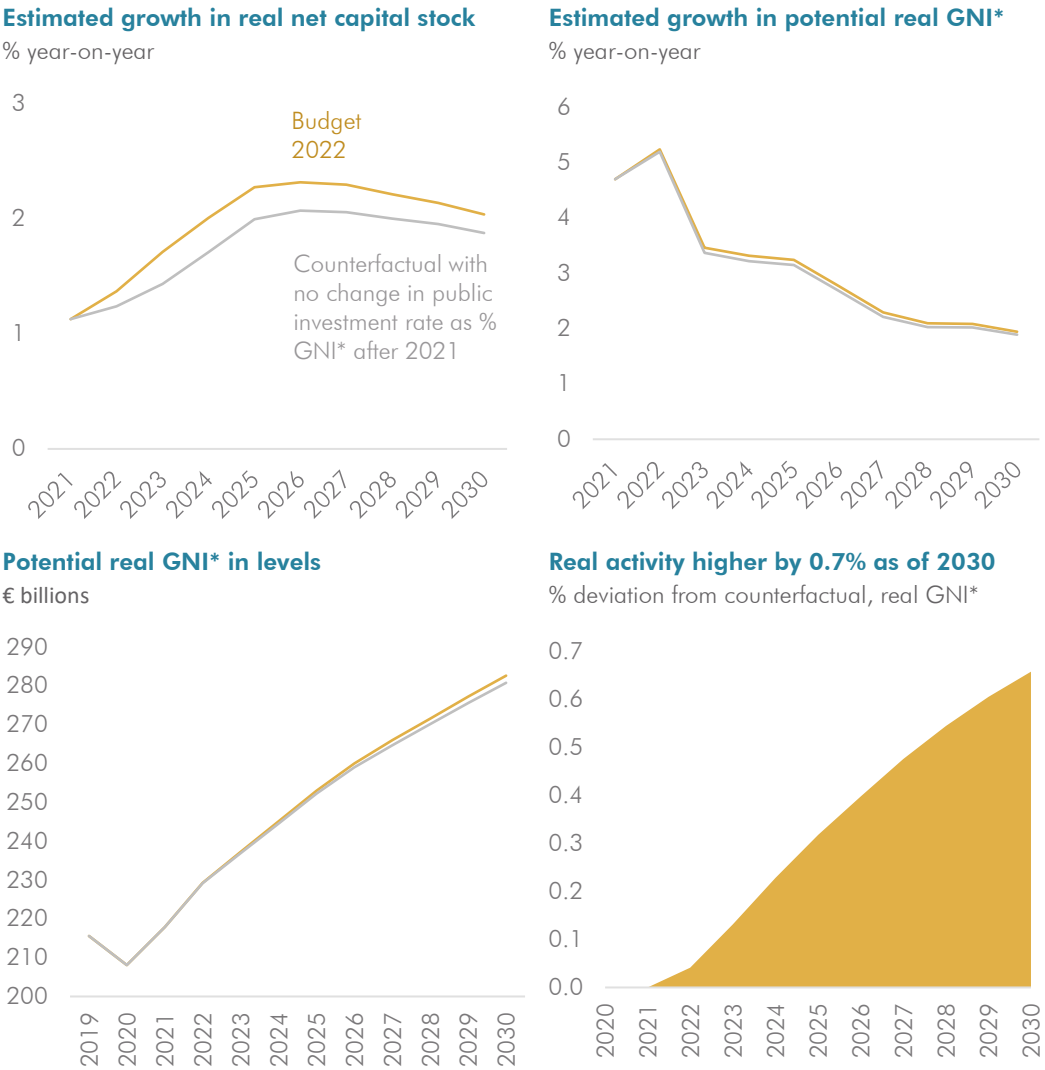
While the longer-term assumptions could be questioned on various grounds, altering them leads to negligible changes in the results. The focus of the exercise is on the differences that would arise for real GNI* resulting *only* from adjustments to public investment rates and so the assumptions are otherwise unchanged across the scenarios we consider.

We compare what happens in a scenario where public investment is held constant at its 2021 rate of 4.1% GNI*, which is around the long-term average, as compared to the *Budget 2022* forecast where it rises to 5.4% GNI* by 2024. Note that this analysis therefore does not look at the estimated growth effects arising from the *totality* of planned public investment, but from the additional investment above constant rates as a share of national income. The official forecasts suggest public investment would average about 5.3% from 2025–2030, consistent with the NDP and our assumptions about growth in nominal GNI*.

Implications for economic activity

With Ireland's overall net capital stock already large—even when accounting for distortions from multinational activities—the boost to real economic activity from the ramp-up in public investment is estimated to be relatively low. We find that the cumulative additional €22 billion investment would raise the capital stock levels by about 20% and real GNI* output levels by 0.7% by 2030. As Figure 8 shows, this reflects the increase in the growth of Ireland's real net capital stock that subsequently boosts the potential real GNI* growth rate and hence the level of real GNI*. This only represents a part of the overall increase in the capital stock that would eventually be achieved by maintaining investment at these levels.

Figure 8: Estimated boost from public investment would be relatively low



Sources: CSO; Department of Finance (Budget 2022 forecasts); Department of Public Expenditure and Reform (National Development Plan 2021); and author's workings.

Sensitivity checks

We explore a number of sensitivity checks in relation to the results found above. Table 1 shows the cumulative real boost to growth would be under varying assumptions. First, we consider what would happen if the responsiveness of output to capital inputs was higher at 0.5 as compared to the standard 0.33 assumption. This would result in a higher boost to the economy of 1%. Second, higher inflation could limit the real impact of the increased nominal investment. For instance, if the investment deflator was 1 percentage point higher on average over the period 2022 to 2030 (averaging 3.3% per annum), this would lower real output to 0.6% compared to the baseline, whereas no inflation would produce an outcome closer to 0.8%. Third, depreciation rates could be lower than assumed, for example if investment was focussed on housing, but this is shown to have marginal impacts to the results.

Table 1: Results relatively insensitive to alternative assumptions

Sensitivity check	Real GNI*, % deviation from counterfactual in 2030
Baseline results	0.7%
Higher elasticity to capital (α = ½)	1.0%
Lower inflation (investment deflator = 0%)	0.8%
Higher inflation (investment deflator = 3.3%)	0.6%
Lower depreciation (halved from 4.8% to 2.4%)	0.7%

Sources: Author's workings.

Something we do not consider in this analysis, but worth noting, is the extent to which a higher public capital stock might also lead to higher total factor productivity growth. This a channel that is more difficult to assess. The basic idea would be that better public infrastructure would also result in better productivity in the wider economy. For instance, better transport with clean energy requirements might improve e-commerce with a boost to productivity being a spinoff of these effects.

Assessing these results in context

To assess whether the impacts on growth are plausible, we consider them in the context of the wider literature and output impacts based specifically on public capital. To this end, the Bom and Ligthart (2009) meta-analysis of the elasticity of output to public capital is a useful study. The meta-analysis finds a positive and significant average output elasticity to the capital stock of 0.146 when assessing 67 international studies for the 1983–2008 period, while controlling for publication bias. This suggests that a 1% increase in the public capital stock would result in a 0.146% increase in output.

This implies larger gains to public investment than the simple production function approach. These estimates may reflect the productivity of public investments at the margin or wider spillovers to the economy that might offset the skew towards more long-lived assets in the public capital stock.

The estimates we produce above suggest that the domestic capital stock would increase by €17.5 billion in real terms (+13%) compared to a counterfactual in which public investment rates stay at their 2021 levels of 4.1% GNI*. This would suggest output being 1.9% higher by 2030 — nearly three times the baseline 0.7% result we find in our production function approach in the previous section.

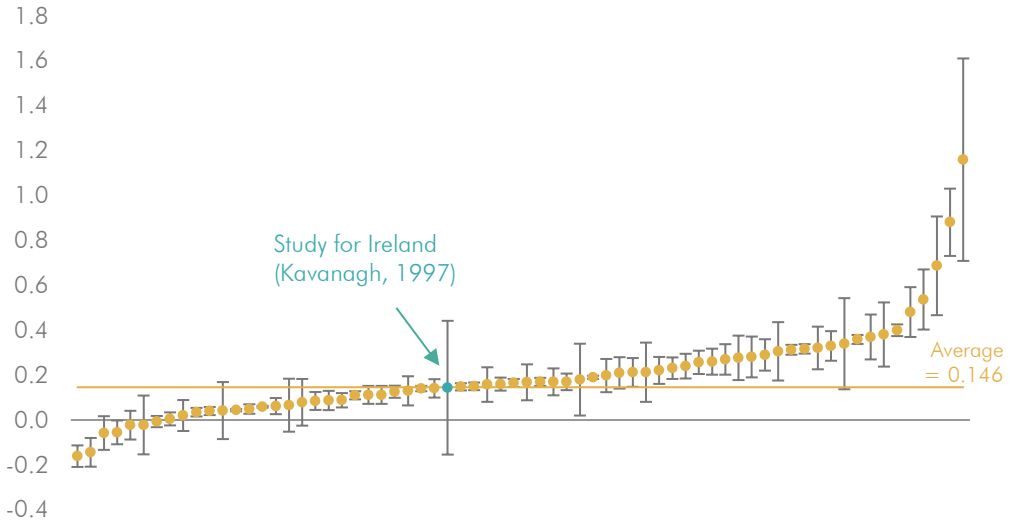
It is important, however, to note that the Bom and Ligthart (2009) meta-analysis points to wide differences in estimates of how economic output responds to public capital. Their meta-regression shows substantial differences across estimates. These differences are found to be due to

differences in models used, estimation techniques, types of public capital involved, and the level of aggregation of public capital data across individual studies.

While substantial variations can be expected across studies, there is one specific Irish study included in the Bom and Ligthart (2009) meta-analysis. The meta-analysis cites Kavanagh (1997) as one of the inputs retained for its core analysis.

Figure 9: Public capital typically benefits output, but less clear-cut for Ireland

Elasticities of output to public capital found across 68 studies



Sources: Bom and Ligthart (2009) meta-analysis.
Notes: Standard errors are shown as grey lines around elasticity estimates. The average is estimated by Bom and Ligthart (2009) controlling for publication bias.

While it is difficult to draw conclusions from a single and old study, the Kavanagh (1997) analysis for Ireland stands out as having the second largest standard errors of on any estimate included in the meta-analysis (Figure 9). This suggests that there is less confidence around estimates produced for Ireland and it is not possible to say whether estimates are different from zero to a degree that is statistically significant. As Kavanagh (1997) notes, "the coefficient of the public capital variable at 0.14 is insignificantly different from zero, indicating that public capital has no statistical significant relationship with private sector output".

The large error bands on estimates for Ireland suggest caution is warranted. Assessing why estimates of the impact of public capital spending on output for Ireland are so weak, Kavanagh (1997) makes a few observations:

- First, she cites poor quality of public capital spending in Ireland historically and notes previous work by Kennedy *et al*. (1988) and Leddin and Walsh (1995) suggesting misuse of public capital in the 1970s and 1980s, with little attention given to expected

returns — a problem exacerbated as the scale of investment expanded.

- Second, she notes that greater accountability for capital projects is required in countries such as the USA and Sweden compared to Ireland.

- Third, she notes that it is possible that sampling or errors in measurement might contribute as public and private capital measures were estimated using the perpetual inventory method and the sample was possibly too short (1958–1990).

While some of these factors may have changed, the Department of Public Expenditure and Reform's (2021) interpretation that the "meta-analysis carried out by Bonn [sic] and Ligthart (2014) found that doubling the stock of infrastructure increases GDP by approximately 10%" should therefore be treated with caution. The wide differences found in the literature, and the findings by Kavanagh specifically for Ireland, highlight that a policy of increasing public infrastructure will not automatically lead to increases in economic growth. The results from the metastudy show a wide range of outcomes, many of them even weaker than the Irish result. It is unlikely that ramping up the scale of investment would generate constant returns to output. As noted in Kennedy *et al.* (1988), this is a particular risk if expanding the scale of investment exacerbates risks of unproductive expenditure being pursued as is argued to have been the case in the past.

Public investment multipliers

While the previous section looked at production function approaches as a way to understand how public capital spending may impact growth, this section looks at another tool: fiscal multipliers.

Spending fiscal multipliers are estimates of the impact that government spending has on overall economic activity. They are expressed as the ratio of total additional economic activity arising from an initial boost to spending. Typically, these are estimated using vector-autoregression style frameworks, though structural models and DSGE models are also often employed. While these exercises typically focus a lot on the short-run demand impact of higher investment, they can also be used to estimate the long-run effects too.

There are a wide variety of estimates of fiscal multipliers found in the literature. In addition, confidence intervals — when shown — can be very large. This highlights the uncertainty around what the eventual impact on the economy might be from public investment. Indeed, the question "what is the impact of public spending on growth?" is often a contentious one in macroeconomics.

As Figure 10 shows, over the medium- to long-run public investment multipliers tend to be larger than estimates for government consumption (recurrent spending on goods and services). This is true for Ireland and other economies. The Ivory, Casey, and Conroy (2019) estimates using COSMO are for a 1.6 fiscal multiplier on public investment. Using a structural vector autoregression specification, they find a larger long-run multiplier of 2.0. However, there is a wide range on other estimates for multipliers associated with public investment for Ireland ranging from -1.9 to 2.2. The wide range therefore covers both potential crowding in and crowding out of additional investment.

However, as shown in several studies, including for Ireland in Ivory, Casey and Conroy (2019), the positive effects become statistically insignificant after a few years. In other words, we cannot reject the conclusion that the impact of public investment on growth over the medium to long run is significantly different from zero. However, the 95% confidence interval on the preferred structural VAR specification suggests a very wide range of estimates from –0.7 to 4.7 that could be consistent with very large positive effects or with negative effects. This uncertainty and lack of significance over the long run chimes with findings elsewhere for Ireland and other countries (Bénétrix and Lane, 2009; Hall, 2010; Giordano et al., 2007).

Figure 10: Spending multipliers vary widely though investment typically larger

Ratio of change in output to change in government spending across the literature

Sources: Various studies as cited.
Notes: The 95% confidence intervals are shown for Ireland's fiscal multiplier estimates set out in Ivory, Casey and Conroy (2019). Multipliers for Ireland are shown in green; pink for other countries.

The effects of public investment on growth are subject to a lot of uncertainty. Wider economic conditions can have an important bearing on how successful public investment programmes are in terms of boosting growth.

Timing matters, with fiscal multipliers typically higher in recessions. For example, Auerbach and Gorodnichenko (2012) estimate spending multipliers to be close to zero in US expansions and as high as 2 or 3 in recessions. This suggests that the benefits to investment may be higher in the early recovery phase but substantially smaller once the economy has recovered. Delong and Summers (2012) note that, when liquidity conditions are tight, multipliers may be larger than usual. This is due to

heightened liquidity constraints related to problems in the banking sector and a weak economy.

The **nature of the investment** is also important. More labour-intensive investment, such as in housing, would be expected to be more domestically oriented, with stronger positive growth impacts. However, it could also mean that capacity constraints may be greater. By contrast, more capital-intensive investment, such as infrastructure and equipment, would be less likely to hit these constraints, though as many countries are now likely to increase investment in these areas at the same time, similar constraints could emerge.

The **size and openness** of the economy has a bearing. Larger, more closed economies are found to have bigger multipliers than smaller more open economies for instance (Barrell, Holland and Hurst (2012); Ilzetzki, Mendoza and Végh (2013)).

How policy responds elsewhere will inform how much government spending boosts growth. For instance, monetary policy may respond so as to dampen fiscal measures. This might happen if interest rates are increased in response to inflation induced by tax cuts for example, although these kinds of direct feedbacks are less likely for a small country in a monetary union.

Expectations matter. If individuals are more forward-looking, this is found to lead to smaller multipliers (Barrell, Holland and Hurst, 2012). This is relevant where individuals assume that government spending increases today might lead to tax increases tomorrow, hence limiting the extent to which today's increase in spending prompts a crowding in of additional spending.[8] Similarly, countries that have high public debt ratios already are often found to have weaker multipliers (Ilzetzki, Mendoza, and Végh, 2013).

Every public investment programme will be unique. While the impact of public investment in general is difficult to ascertain, specific investment programmes will also inevitably vary in terms of their own unique impacts. Some projects will have more merit than others and will avoid duplication or the crowding out of private investment that might have happened in the absence of public spending.

Green investments

[8] This follows the Barro (1974) argument that, as deficit spending in a recession could be offset by higher taxes in a boom, forward-looking individuals might save a substantial amount of a tax cut in anticipation of higher taxes later. However, taking this assumption to its extreme would be unrealistic. As the Council of Economic Advisers (2014) report notes, it requires consumers who are unrealistically liquid and prescient.

There is relatively limited literature on the fiscal multipliers associated with green investments. Batini *et al*., (2021) use a new international dataset on both public and private investments in green areas to show that carbon-neutral or carbon-sink activities generate more than a dollar's worth of economic activity for every dollar spent over the medium to long run — a multiplier greater than one.

The investments included in their analysis include investments on energy production with zero-emissions (solar, wind, etc.) and investments in biodiversity (nature reserves funding). Using factor-augmented panel vector-autoregressive models on panel data for at least 11 countries or groups, they estimate the impact on economic activity from these types of investments.

Their results show that green renewable energy spending attract impact multipliers of 1.19 that are statistically significant up to four years, falling only marginally and plateauing at a five-year value of 1.11 (with impacts turning insignificant in year five). In other words, an additional dollar of public or private investment on green renewable energy infrastructure is found to crowd in an additional 19 cents of investment initially and 11 cents over the medium term. Table 2 summarises the multipliers found in Batini *et al.*, (2021).

Table 2: Green multipliers found to be larger than one

Cumulated multipliers associated with investment types

	Impact	4-year	5-year
Green (renewable) energy investments multiplier	1.19*	1.14*	1.11
Green land use multiplier	-5.36	5.45*	6.67*

Source: Batini et al., (2021).
Notes: The * denotes multipliers with "credible intervals", delimited by the 16th and the 84th percentiles, that exclude zero.

By contrast, the authors find that non-eco-friendly energy investments, such as fossil fuel energy generation, have weak impact multipliers of 0.65, falling to 0.52 after five years. This suggests that these kinds of expenditures tend to crowd out private investment or consumer spending that would have otherwise taken place to a greater extent. Moreover, the difference between the two multipliers is positive with a high probability.

The multipliers on green land use are strongly positive. The authors show that, while not significantly different from zero on impact, multipliers at horizons greater than one year are large and grow over time. As they note, "this suggests that spending to sustain natural ecosystems exerts powerful positive ripple effects on the economies that practice it: for every dollar spent in conservation, almost seven more are generated in the larger economy in the medium term". The estimates are found to be robust to several different econometric specifications.

Typically, there are arguments for and against public investment based on whether they are likely to "crowd out" or "crowd in" investment. Crowding out describes a situation where public investment replaces/displaces investment that may have occurred from the private sector had public investment not occurred. Crowding in, by contrast, is a situation whereby public investment may encourage private investors to increase their own investment levels. For example, public infrastructure investment might increase returns on private capital, such as building a new manufacturing facility due to improved transport connections. While the literature on the impact of green investment is limited, there are some studies suggesting crowding in effects may be more prevalent (Deleidi et al, 2020 and Geddes et al, 2018).

A further consideration for public investment in green projects is the potential fiscal implications. If successful, public green investment could help governments to achieve targeted reductions in emissions. This could reduce spending in later years, for example, by not having to pay climate fines or purchase carbon credits.

Housing investments

There is limited information on the specific multipliers attached to housing investments.

One source of fiscal multipliers by specific investment area is the Canadian Parliamentary Budget Officer (2021), which provides estimates of potential impacts of government spending and tax measures on the Canadian economy. These are broadly consistent with estimates used by the Canadian Department of Finance (2010), which are noted as being similar to, or lower, than those used by the U.S. Council of Economic Advisers in assessing the impact of the American Recovery and Reinvestment Act and those found in models of leading Canadian private sector forecasters. For housing, the Parliamentary Budget Officer assumes a permanent one-dollar increase in government spending on housing investment leads to a one-dollar increase in real GDP in year one. This rises gradually to a multiplier of 1.6 by year five (meaning an additional 60 cents crowded in for each marginal one-dollar increase). It is not clear whether the estimates are statistically significant and the estimates assume no monetary policy response.

Durand and Espinoza (2021) study EU structural investment funds and public investment at the EU level. However, their analysis only covers one-year impacts. They show fiscal multipliers greater than one for housing investment both contemporaneously and after one year. In the case of GDP the contemporaneous multiplier is 1.1 and the one-year multiplier is 3.1. For employment, these are 1.1 and 0.9 respectively. While the GDP impact is significant at the one-year mark, employment impacts are only significant contemporaneously.

Table 3: Housing multipliers found to be larger than one
Cumulated multipliers associated with investment types

	Impact (1-year)	4-year	5-year
Canadian Parliamentary Budget Officer (2021)	1.0	1.5	1.6
Durand and Espinoza (2021)	3.1**	n.a.	n.a.

Source: Canadian Parliamentary Budget Officer (2021); and Durand and Espinoza (2021).
Notes: The two asterisks ** denote statistical significance at the 5% level.

The evidence on public spending on housing, specifically, and its link to growth is limited. Yet the use of multipliers greater than one would seem intuitive, at least for the short run, if such investments are typically more labour-intensive investment, more domestically oriented, and with flows towards lower-income households that are more likely to spend than save proceeds. However, housing could also have a lower long-run multiplier relative to other forms of public investment that boost productivity more directly, such as in terms of

Ireland's National Development Plan 2021–2030

The recent National Development Plan set out public capital spending out to 2030. Spending by voted area was only allocated for the period 2021 to 2025. Allocations for subsequent years are to be added on a rolling basis. These plans imply an increase in public investment from 4.1% of GNI* in 2021 to around 5½ % in the medium term.

There is €59.2 billion of voted capital spending allocated over the years 2021 to 2025 (averaging €11.8 billion annually). Housing represents almost 30% (€17.6 billion), Transport 22% (€13 billion), Health 10% (€5.7 billion), Education 7% (€4.4 billion), and Environment, Climate and Communications makes up7% (€4.2 billion). The remaining 22% is spread across 16 other areas. Table 4 shows the split of the National Development Plan in detail.

Table 4: National Development Plan allocations for 2021 to 2025

€ millions unless otherwise stated

	2021	2022	2023	2024	2025	2021-25	Share of total 2021-25
Housing, Local Government & Heritage	2,766	3,400	3,516	3,866	4,016	17,564	29.7%
Transport	2,511	2,547	2,614	2,664	2,665	13,001	22.0%
Health	905	1,010	1,127	1,255	1,360	5,657	9.6%
Education	740	792	860	940	1,040	4,372	7.4%
Environment, Climate and Comm's	579	700	850	950	1,100	4,179	7.1%
Further and Higher Education, Research, Innovation and Science	500	538	579	620	652	2,889	4.9%
Enterprise, Trade and Employment	432	523	558	584	611	2,708	4.6%
Agriculture, Food and the Marine	271	281	284	287	290	1,413	2.4%
Justice	258	270	272	274	278	1,352	2.3%
Office of Public Works	206	270	270	288	310	1,344	2.3%
Tourism, Culture, Arts, Gaeltacht, Sport and Media	172	202	206	210	214	1,004	1.7%
Rural & Community Development	169	192	196	200	205	962	1.6%
Defence	131	141	141	142	142	697	1.2%
Children, Equality, Disability, Integration and Youth	32	33	40	50	100	255	0.4%
Public Expenditure and Reform (less OPW)	15	33	30	20	20	118	0.2%
Foreign Affairs	13	25	25	25	25	113	0.2%
Finance	18	22	22	22	23	107	0.2%
Social Protection	16	16	16	16	17	81	0.1%
Shared Island Fund	50	50	100	150	150	500	0.8%
Annual Priority Reserve	-	-	51	148	269	468	0.8%
European Regional Development Fund	-	70	100	115	115	400	0.7%
Total	9,784	11,115	11,857	12,826	13,600	59,182	100.0%

Sources: Department of Public Expenditure and Reform (2021) National Development Plan 2021 – 2030.

Using information on long-run specific fiscal multipliers for specific investment types from elsewhere, we can derive an overall multiplier of 1.34 for public investment in the coming years. This is constructed based on the weights of various programmes within the 2021–2025 allocations. Table 5 sets out the multipliers used to obtain a weighted average multiplier of 1.34 for the NDP plans.

We can use the 1.34 multiplier together with the Maq model to assess the impact on growth over the coming decade over both the short term and the longer term.[9] The Maq model is a macro-fiscal structural econometric

[9] Implicitly, we assume that 2026–2030 has the same weighted allocation of resources by sector as for 2021–2025 (as in, we assume that 30% of the gross voted allocation for the period 2026–2030 also goes towards housing, for example).

model of the Irish economy (Casey and Purdue, 2021). It is designed to be used for medium-term scenario and policy analysis.

Table 5: Multipliers for specific investment areas

Investment area	Weight in NDP gross voted capital spending for 2021–2025	Long-run multiplier assumed	Source
Housing	29.7%	1.6	Canada PBO
Transport	22.0%	1.5	Canada PBO
Environment	7.1%	1.1	Batini *et al.*, (2021)
Other	41.3%	1.097	Various sources*
Weighted average multiplier	100.0%	1.34	

Sources: Batini *et al.*, (2021); Parliamentary Budget Officer (2021); Casey and Purdue (2021); and various sources shown in Figure 10.
Notes: The multiplier used for other categories of investment is the same as used for public investment in Council's Maq model (Casey and Purdue, 2021) and as the average of various estimates shown in Figure 10 excluding the two negative figures from Bénétrix and Lane (2009) and Ilzetzki, Mendoza, and Végh (2013) for high debt countries. The estimate for the environment used is the same as in Batini et al., (2021) for renewable energy infrastructure.

The Maq simulation suggests that real GNI* would be 0.9% higher than it otherwise would be by 2030, given the rise in public investment (Table 6). Given a higher path for inflation, nominal GNI* is estimated to be 1.4% higher. The increase in the public investment from 2021 levels is also estimated to worsen the annual budget balance by 1 percentage point by 2030 compared to a scenario where investment was kept at a constant share of national income. Taking the higher nominal incomes and deficit together, the debt ratio ends up being cumulatively 1.7 percentage points higher than it otherwise would be by 2025 and 5.7 percentage points higher by 2030, despite the positive effects on GNI*.

Table 6: Maq simulation on impact of additional public investment
% deviation from counterfactual where public investment remains constant as % GNI*

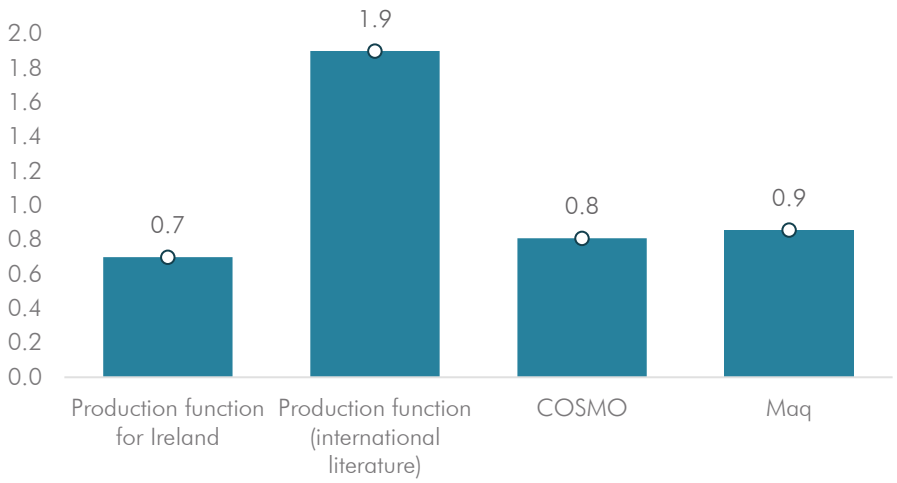
	2021	2025	2030
Real GNI*	0.0	0.6	0.9
Nominal GNI*	0.0	0.8	1.4
GNI* Deflator	0.0	0.2	0.6
Budget balance (pp GNI*)	0.0	-1.1	-1.0
Debt ratio (pp GNI*)	0.0	1.7	5.7

Sources: Authors' workings.

In terms of the estimated impact on overall economic activity, the Maq results are not dramatically different from those produced by other approaches. As Figure 11 shows, three of the four methods we consider in this note lead to estimates ranging from 0.7% to 0.9%, with the 1.9% figure based on international estimates a clear outlier.

Figure 11: Impact on output based on various methods

Estimated boost to real economic output by 2030 due to public investment plans



Sources: NDP 2021–2030; *Budget 2022*; Batini *et al.*, (2021); author's own workings.
Notes: All estimates are derived based on a comparison of a counterfactual where public investment remains constant at 4.2% of GNI* as is projected for 2021 in *Budget 2022*. Estimates for the production function approach are based on authors' workings using data on Ireland's capital stock and the public investment plans. The "international literature" refers to the elasticity of output to public capital estimated in Batini *et al.*, (2021). The COSMO estimates are based on the results shown in the NDP of 1.6% for 2025–2030, however, these are re-scaled to allow for the fact that we assume investment does not remain constant at 2021euro levels but in % GNI* levels. The Maq model estimates draw on the 1.34 multiplier assumed for investments included in the NDP.

The NDP does show some estimates of the impact increased public investment is expected to have on the economy. Using COSMO, estimates are provided of the impact of public investment on GDP, employment and total wages. We re-scale the COSMO estimates shown in the NDP documents to be consistent with a comparison to maintaining public investment at 2021 rates. It suggests that the impact is broadly in line with what we estimate using alternative approaches. While the results using COSMO are useful, what is shown in the NDP documents is highly aggregated and not very detailed. For example, no estimates are provided on the impact this investment is expected to have on the public finances, the labour market, and on specific sectors such as construction and housing. Such work could be produced using the COSMO model and would be important to assess.

In summary, the increase in public investment planned of the coming decade is likely to boost economic activity, raise prices and should help to meet climate change and housing objectives, but there are risks. As we show, the impact on economic activity would be almost 1%. Higher prices are likely to accompany the increase in economic activity, with price inflation across the whole economy estimated to be 0.6% higher than it otherwise would be. However, upward pressure on costs driven by price inflation or wage increases, including due to material or labour shortages in construction, could limit the boost to activity further. It could also result in higher investment costs for the Government or lower output for a given price, poorer value for money and possible spending overruns. It is also

unclear to what extent the additional public investment might simply displace activity that the private sector would have undertaken anyway.

Key to ensuring good outcomes for the State's investment will be (1) the degree to which capacity constraints bind, and (2) the Government's ability to ensure value for money.

4. Capacity constraints

The Government's plans to ramp up public investment in the coming years should help with efforts to address climate change objectives, the shortfall of housing supply, and the transition towards a more digitised economy. While there is a case to be made for this magnitude of investment, it will come at a time when the economy is forecast to grow strongly and as many other countries are also making similar efforts to increase public investment in these areas.

Capacity constraints could become more apparent in the construction sector in the coming years. This would potentially lead to higher prices, lower real output, and poorer value for money in terms of the Government's planned investments.

This section takes a close look at the potential for capacity constraints in the coming decade having an impact on the Government's investment plans.

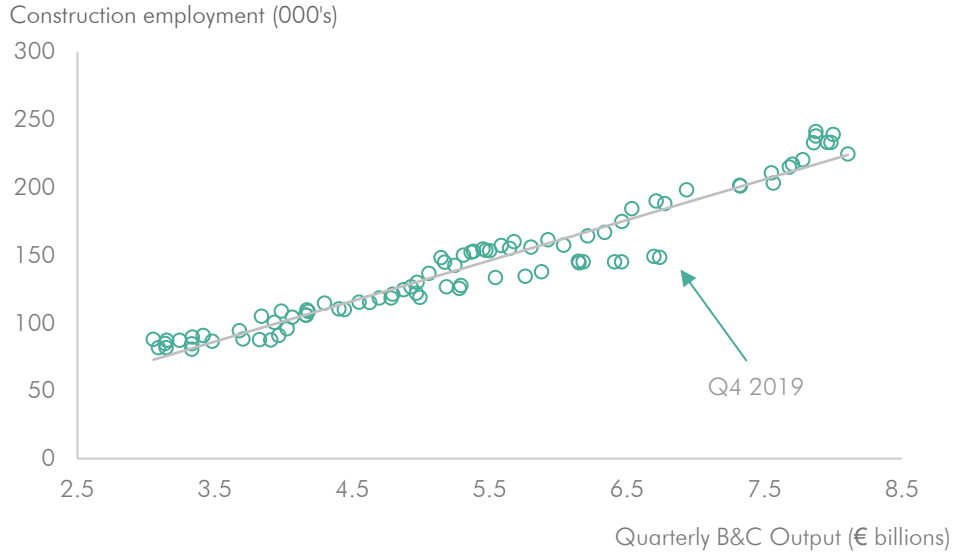
Labour supply in construction

The numbers employed in construction in Ireland fell amid the financial crisis and have not really recovered since then. Construction employment in Ireland soared to record levels prior to the financial crisis, reaching a peak of 241,000 in the second quarter of 2007. It collapsed in the years after the crash before increasing steadily to reach around 148,000 prior to the onset of Covid-19. Close to half of the workers that lost their jobs between 2007 and 2012 had previously worked in construction. Their migration away from Ireland appears to be a factor holding back the recovery in numbers working in the sector since the financial crisis (Conefrey and McIndoe-Calder, 2018).

A key question regarding the delivery of increased investment output has been the extent to which additional labour is required to meet the demand for capital projects. Output per worker in construction has been relatively predictable (Figure 12). Based on past levels of output per worker, we estimate that around 180,000 workers would be required in the construction sector over the years 2022 to 2025 on average to achieve the Government's planned increases in public investment set out in the NDP, still below the 2007 peak.[10] Similarly, the Department of Finance estimates that 178,000 workers will be employed in the sector by 2025, while the Rebuilding Ireland report also indicated a workforce of around 170,000 would be required to meet targets for the supply of new housing.

[10] This is based on a regression of construction sector employment on levels of output in dwellings and other building and construction areas, with the average NDP public investment level taken over the forecast period 2022-2025.

Figure 12: Increasing output will require greater employment in construction



Sources: CSO; and authors' workings.

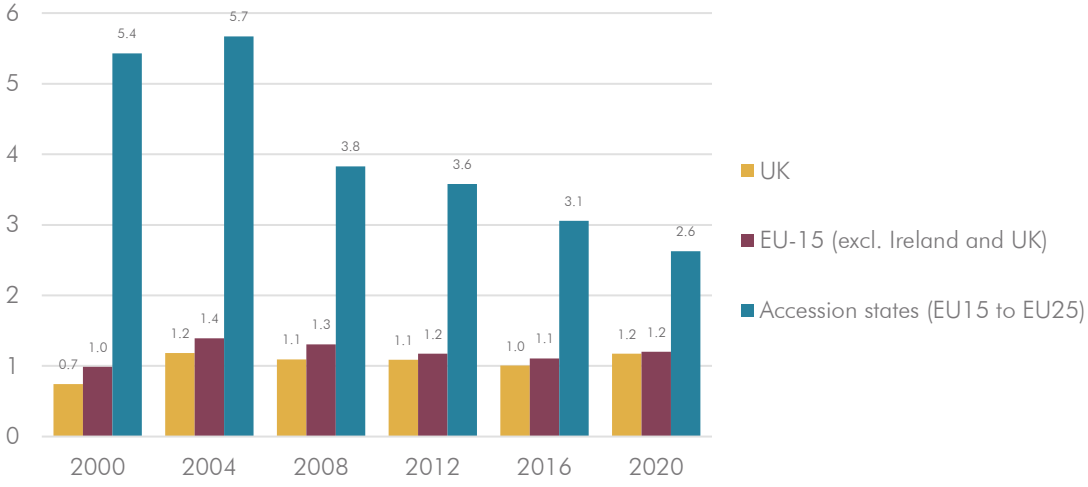
Historically, Ireland has relied on strong inward migration to boost its supply of labour for the construction industry, either from returning Irish citizens or foreign nationals. It is unclear whether this channel can provide the same numbers of workers as it did prior to the crisis.

The relative attractiveness of Ireland's wages in construction has fallen over time. Average hourly wages in construction in Ireland in 2020 were 2.6 times that in the accession states whereas they were 5.7 times higher in 2004 (Figure 13). Nationals from these Member States accounted for 8.7% of Ireland's construction workers in 2006. UK nationals accounted for 2.8% of construction workers at the time and nationals of the rest of the EU-15 accounted for 0.6%. Yet the wage differential with those countries has remained relatively more modest at about 20% in 2020.

Ireland's cost of living is typically higher than in other countries and has not fallen by as much as wage differences have closed in recent decades. In 2020, Ireland's comparative price level for consumer goods and services was 24% above the EU-15 in 2020 and 14% above the UK (Figure 14). However, compared to the average for the Accession States, Ireland's prices were 75% higher.

Figure 13: Wage attractiveness in Ireland has narrowed sharply

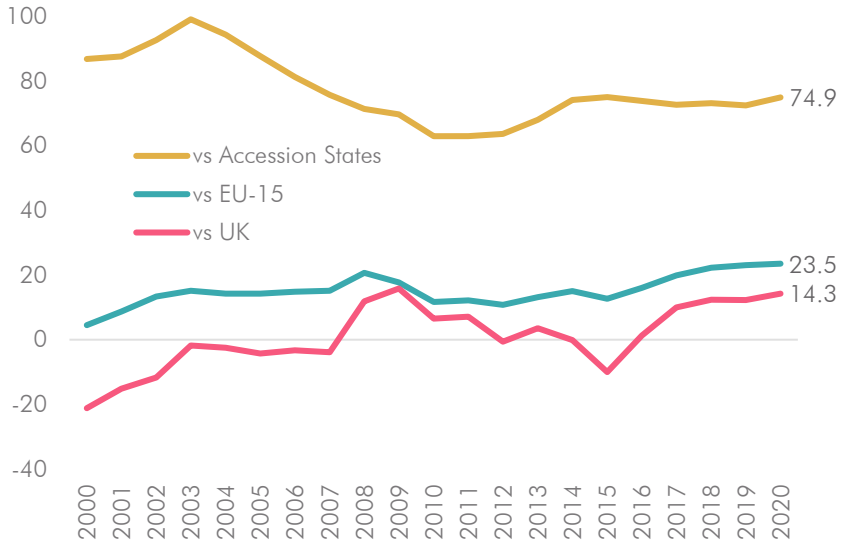
Multiple of average hourly wages in construction compared to Ireland



Source: Eurostat; authors' workings.
Notes: A simple unweighted average of wage levels is used for Accession states.

Figure 14: Cost of living differences have not fallen as much

% difference for Ireland's price index on final household consumption expenditure relative to other regions



Sources: Chart shows % difference in terms of the price level index for final household consumption expenditure.
Notes: A simple unweighted average of wage levels is used for Accession states.

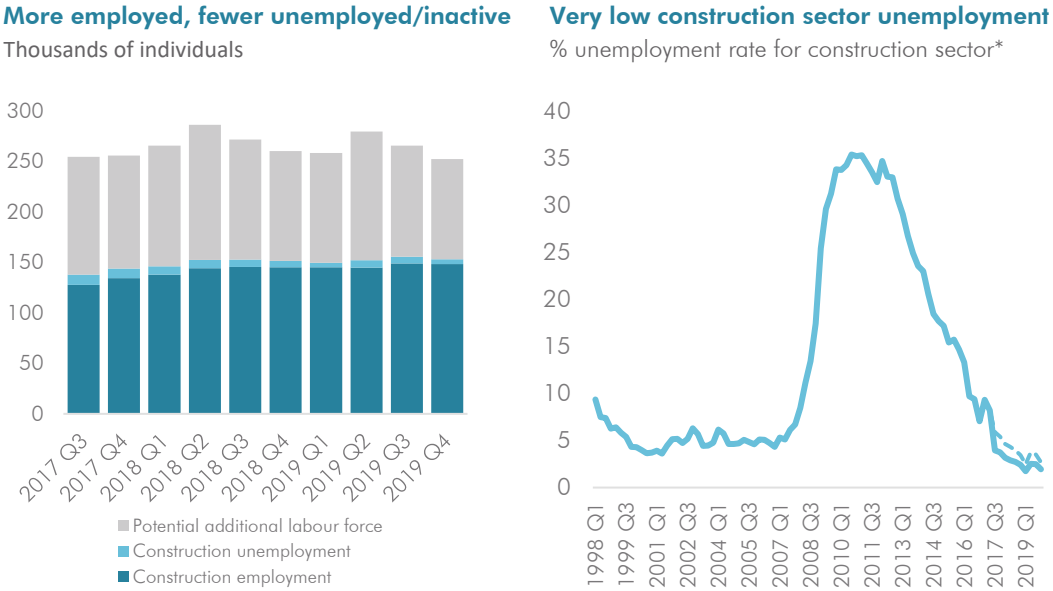
The wage and cost differences suggest that Ireland's relative attractiveness for construction workers from countries that moved here in the past has fallen by more than one-third relative to the mid-2000s in real terms (adjusting for final household consumption expenditure price differences). Rent and housing costs could be a deterrent to attracting potential migrants currently.

Given that many EU members are embarking on similar investment programmes at the same time as the Irish Government plans to, the prospects of obtaining employment abroad are strong. This could further

dampen the capacity of Ireland to attract migrants to work in construction. On the other hand, Brexit may divert migrants from the EU to Ireland who would otherwise have gone to the UK.

Domestically, there appeared to be limited slack in the construction sector immediately prior to Covid-19 (Figure 15). The CSO estimates that in the final quarter of 2019 there was around 5,000 individuals unemployed that had most recently worked in the construction sector. This suggests a lack of workers that could be quickly recruited into the sector should it need more. Estimating a construction sector unemployment rate, we find that this could have been as low as 2 to 3% at the end of 2019 — well below historical rates and the national average rate. At the same time, however, there was a sizeable 99,000 individuals classified as potential additions to the labour force. These individuals could potentially enter work in the construction sector. Yet a recent change in the nature of the Labour Force Survey question being asked led to higher numbers self-identifying in this category and it is unclear to what extent these individuals may ultimately register as active in the labour force.

Figure 15: The construction labour market tightened in recent years



Source: CSO and Fiscal Council workings.
Notes: The construction sector unemployment rate is estimated as: unemployed construction workers/(unemployed construction workers + employed construction workers + total potential additional labour force). The CSO's methodlogies to calculate potential additional labour changed in 2017, making the time series non-comparable. To account for this, the second panel also shows (as dashed lines) imputed potential additional labour force figures from Q3 2017 onwards based on changes in the new series.

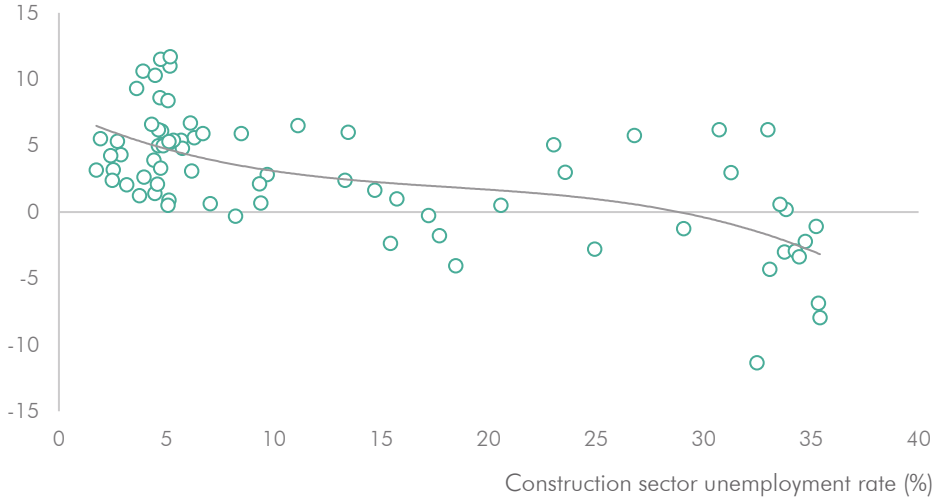
There is likely to be a shortfall of workers required to achieve the Government's construction targets. Even if all unemployed individuals previously employed in construction were to return to employment in the sector, there would still be a sizeable shortfall of about 28,000 relative to the 180,000 estimate. This means that the construction sector will likely have to attract workers either out of inactivity, from overseas or from other sectors. Covid-19 may have changed the dynamics and could result in

workers transitioning from other sectors into construction. However, construction was also a vulnerable sector during the pandemic: non-essential construction sites were closed during lockdowns with few exceptions. These factors would suggest some constraint on the capacity of the sector to respond to increased demands by increasing numbers of workers.

The tightness of labour conditions in construction would likely lead to higher wage pressures in the sector. We can see that the annual changes in average hourly earnings in the sector tended to rise at lower unemployment rates, broadly consistent with the Phillips curve, and that this relationship has tended to be somewhat non-linear (Figure 16). This non-linearity in the relationship is a phenomenon that has been observed for Ireland's labour market more generally (Linehan *et al.*, 2017). If unemployment rates within the sector were to return to end-2019 levels, annual rates of wage inflation close to 6% would be predicted by this relationship.

Figure 16: Wage pressures likely to remain strong

Construction sector annual hourly wage growth (%)



Sources: CSO; authors' workings.
Notes: Data on annual hourly wage growth for construction are taken from the CSO's Earnings Hours and Employment Costs Survey. The construction sector unemployment rate is calculated as unemployed construction workers/(unemployed construction workers + employed construction workers + total potential additional labour force). Note that we remove outlier observations Q4 2008 to Q2 2009.

Within construction, skills shortages are also likely to be an issue. Research suggests that even without additional capital investment, there existed a structural shortage of skilled workers in specific areas of construction prior to the crisis. For example, the number of apprenticeships being undertaken in certain trades had dropped to around 40% of the pre-crisis peak in 2019, while many others were also running well below the required level to keep pace with overall

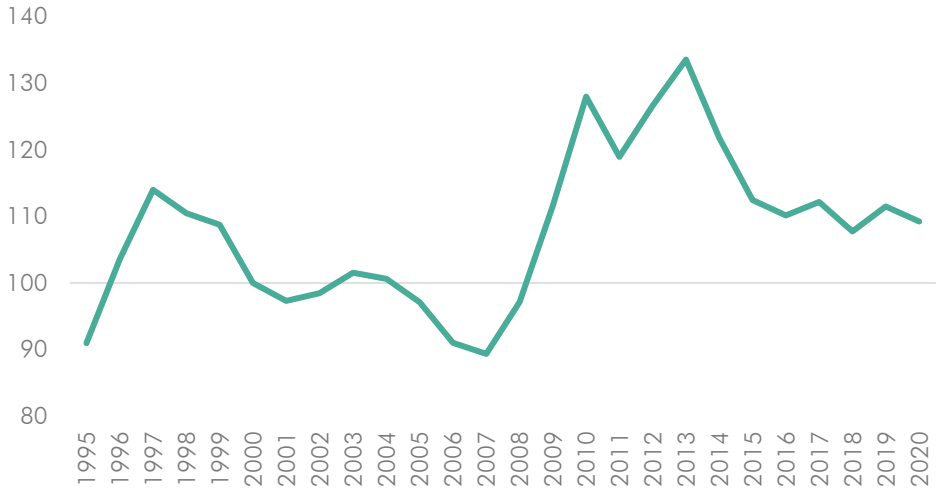
construction output.[11] This deficit was highlighted in recent work by the National Skills Council (2020) that indicated an annual inflow of around 7,000 workers in core and niche skills was required even prior to the New NDP.

Productivity challenges in construction

Naturally, increased productivity (output per hour worked) could offset the requirement for additional labour to increase output. However, as Figure 17 suggests, there has been relatively little growth in productivity in the construction sector since the financial crisis, with progress largely stagnant in recent years. Productivity in the five years before the pandemic was only 5% higher than it was in the mid- to late-1990s.

Figure 17: Productivity has been relatively stagnant in construction

Labour productivity index in construction, 2000 = 100



Sources: Eurostat; own workings.
Notes: The measure shown is real gross valued added in construction divided by hours worked in construction.

Compared to other European countries, Ireland's construction sector has tended to have low productivity. Using data on output per hour worked in construction and adjusting for price differences across countries, Ireland's construction sector was about one-fifth below productivity levels in the UK in 2019 (Figure 18). It was 29% below the Euro Area, and about 44% below the average for the top 5 most productive countries (Belgium, Norway, Denmark, Austria and France).

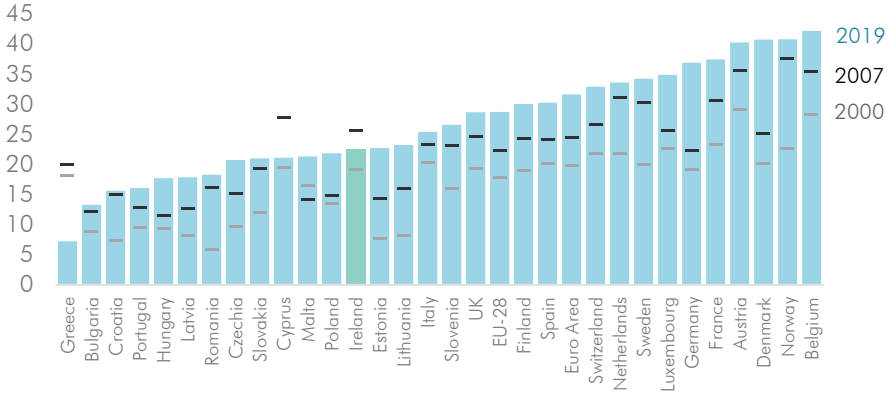
These productivity differences could be misleading and prone to error. Issues could arise, for example, if the types of construction being undertaken vary substantially at a given point in time. For instance, more multi-unit housing developments in a given year would likely mean greater productivity measured compared to greater one-off housing but this difference might be temporary. Similarly, large infrastructural projects might entail higher output per worker. However, the differences are stark.

11 In 2019 for example, new apprenticeship registrations in bricklaying and plastering were estimated to be 90% below its 2004 peak (DPER, 2020).

Closing a gap of that size over ten years would require Ireland's construction sector to grow its productivity by at least 6% annually on average. By contrast, the last two-and-a-half decades have seen productivity growth average just 0.7% annually in the sector.

Figure 18: Irish construction sector has relatively low productivity

Labour productivity index in construction, 2000 = 100

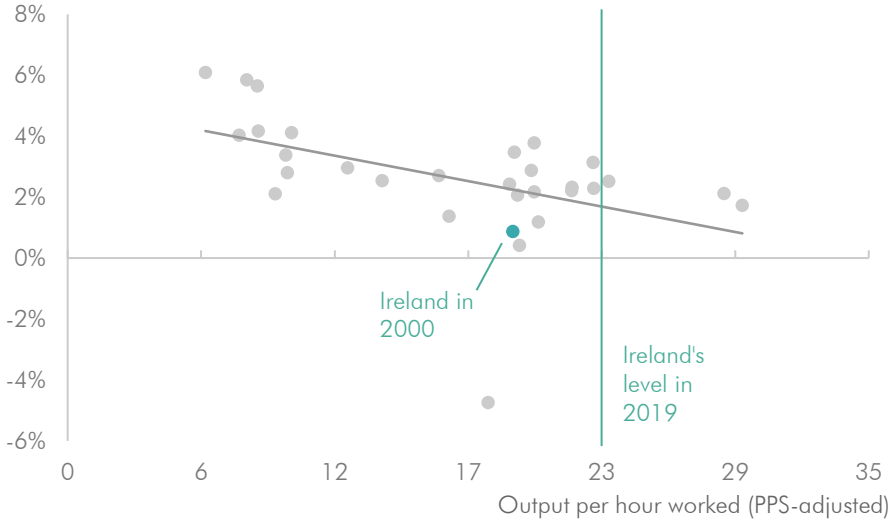


Source: Eurostat; and own workings.
Notes: Data show gross value added in the construction sector (current prices, million purchasing power standards) divided by total annual hours worked by all employed in the sector.

The few countries that have achieved very fast growth rates in construction sector productivity in recent years were those where initial productivity levels were far below EU norms. Many of these economies have since caught up to Ireland's levels of productivity or surpassed it, with Ireland's growth rates being the second lowest next to Cyprus in the past two decades. For an economy with levels of productivity growth equivalent to Ireland's in 2019, growth rates closer to 2% might be feasible based on international experience (Figure 19).

Figure 19: Achieving fast productivity growth will be difficult

Annual average productivity growth (2000–2019)



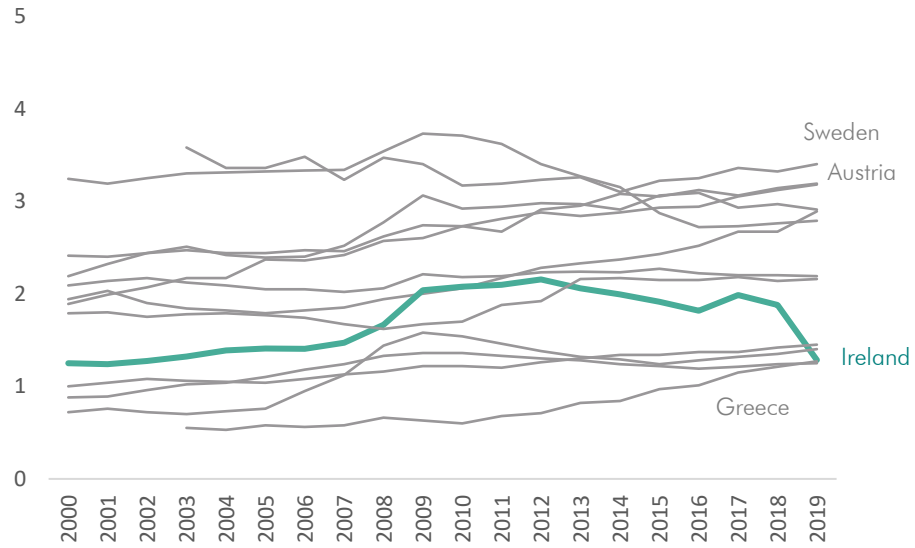
Sources: Eurostat.
Notes: Data shown on horizontal axis are gross value added in the construction sector (current prices, million purchasing power standards) divided by total annual hours worked by all employed in the sector. On the vertical axis is the annual average growth rate in the same series.

Low investment in technology is likely to be a problem in the construction sector. This may stem from the fact that a large swath of developers in the industry have spent the years since the collapse in 2008 deleveraging and repairing their balance sheets. There are considerable shortfalls in investment levels within the construction sector in Ireland, with the capital stock of machinery and equipment in particular falling markedly since the 1990s.

Ireland also fares poorly when compared with international peers for spending on research and development in the construction sector (Figure 20). Ireland ranks second lowest before Greece on research and development spending when assessed as a share of GNI* (GDP for other countries). There has also been effectively no material increase in research and development spending as a share of GNI* since 2000.

Figure 20: Construction research spending low by international standards

% GDP (% GNI* for Ireland)



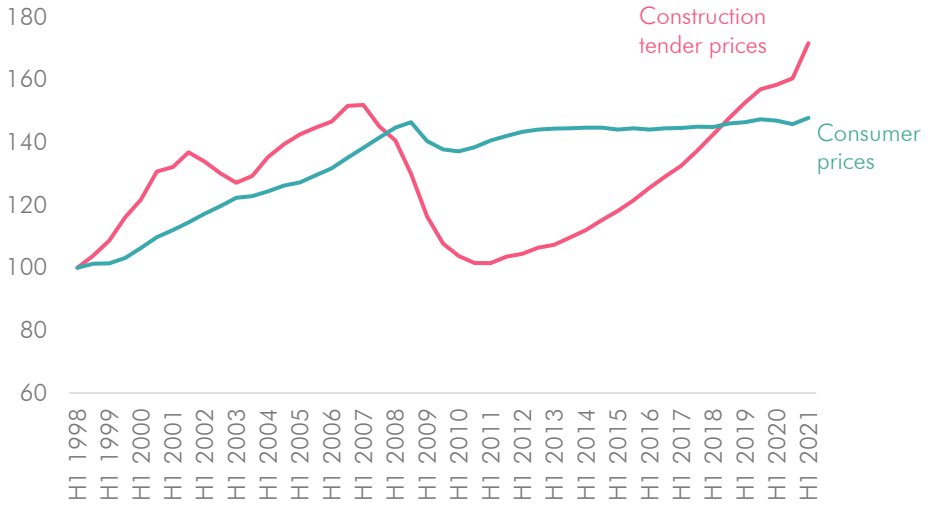
Source: Eurostat

Cost increases as a further indicator of capacity constraints

There have been noticeable price increases in the construction sector in recent years as pressures on the sector have risen. Tender prices have increased sharply having collapsed after the financial crisis (Figure 21). This volatility compares to relatively stable prices elsewhere in the economy. More recently, tender price increases accelerated to 8.4% year-on-year in the first half of 2021. This very recent surge is likely to reflect the impact of the pandemic on supply chains, with the supply struggling to respond to surging demand as restrictions eased, and hence could be temporary. However, the pre-pandemic trend also pointed to sharp increases in tender prices.

Figure 21: Price inflation has been highly volatile in construction

Index: H1 1998 = 100



Sources: CSO (Consumer Price Index); and SCSI Tender Price Index.

Some of the price increases in construction may be temporary impacts linked to supply-chain disruptions, however, greater global demand for raw materials could drive prices higher in the coming years. Numerous countries are embarking on investment programmes in the coming years. This could prompt prices for construction materials rising faster than general inflation.

These factors demonstrate an important role for investment in the construction sector in the coming years to help ensure productivity over the medium term.

The Construction Sector Group was set up in 2018 tasked with maintaining a sustainable and innovative construction sector that would be able deliver on long-term commitments.[12] In particular, the Group aims to deliver on actions outlined in a KPMG/Future Analytics Report on the productivity of the Irish Construction industry. These include 1) establishing research needs; 2) identifying research funding sources; 3) guiding SME uptake of modern methods of construction; 4) establishing a Construction Technology Centre promoting new technology, innovation, digital adoption and modern methods of construction; 5) establish a digital network for sharing best practice and responding to specific skill needs; 6) digitising the planning permission process by end-2022; and 7) establish and fund a Build Digital Centre of Excellence for building information modelling and digital adoption.

[12] The Construction Sector Group is chaired by the Secretary General of the Department for Public Expenditure and Reform. An "Innovation and Digital Adoption" SubGroup was set up in September 2020 to deliver on 7 actions outlined in the KPMG/Future Analytics Report on the productivity of the Irish Construction industry.

The Group faces a significant challenge in boosting productivity levels in Irish construction. The KPMG/Future Analytics Report cited multiple hurdles to overcome. These included the highly cyclical nature of construction work in Ireland; the fragmented nature of the sector (lots of small firms); the complex planning system; onerous public procurement processes; under-investment in technology and innovation; low uptake of modern methods of construction; limited training certification, upskilling, and recruitment; and precarious working conditions.

It is not unheard of for countries to produce reasonably fast productivity growth rates when in Ireland's position, but it will need some support. Ensuring that capital spending is predictable and that public investment will not have to be cut dramatically again in the future would help to incubate productivity growth in the sector. Prudent economic and budgetary management would help to safeguard this. This can, in turn, help to make decisions to invest and to undertake training more viable uses of resources. Increased research spending and upskilling in the sector will also be important.

5. Achieving Value for Money

Ireland has a number of processes in place to ensure that value for money is achieved when it comes to public investment.

However, substantial upward revisions to public investment spending plans and sizeable overruns on large public investment projects have been a common feature in the recent past. Moreover, ramping up public investment at the same time that there may be shortfalls in construction workers would be expected to compound these problems.

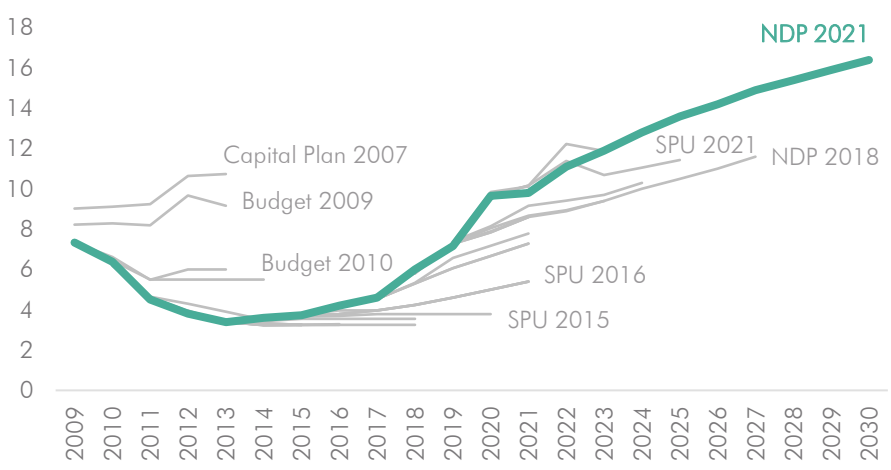
Exceeding initial budgets can have important consequences for the public finances. In worst cases, it can require governments to resort to in-year cuts in other spending areas, the use of temporary revenue gains, or even the sudden delay or abandonment of certain investment projects. Such decisions can, in turn, harm the viability of the construction sector. This can reduce incentives to invest time and resources investing in new technology or in training and upskilling.

If Ireland is to avoid these problems in future, and stick to realistic budgets for public investment spending, it will need to improve its systems of governance.

General capital spending

The pattern of revisions to public investment spending has been highly procyclical in recent decades — revised down in busts and up in booms (Figure 22). This pattern is likely to reflect several factors. In the boom, an underestimation of costs is possible as is a desire by policymakers to simply do more in terms of the size and number of investment projects undertaken. In the bust, it is likely to reflect a procyclical retrenchment in spending, with capital spending often being seen as "easier" to cut than other forms of spending such as welfare and pay, for example.

Figure 22: Revisions to capital spending have been procyclical



Sources: Various budget plans.

In its 2017 technical assistance report on public investment, the IMF (2017) assessed that Ireland had shortcomings in the effectiveness of past investment spending. Comparing the quality and quantity of infrastructure to the size of past investment spending (the size of the capital stock per capita), it estimated an efficiency gap of 58% compared to the best performing advanced countries. The relatively poor "bang for buck" from public investment in Ireland was assessed to be due to a variety of factors. A proliferation of sector strategies, weak results frameworks, limited information on cost estimates, inadequate links between plans and funding decisions, and a need to prioritise maintenance spending contributed to the assessment. It noted substantial scope for the Irish authorities to adopt policies that will help improve the efficiency of public investment management. The IMF has not updated its 2017 assistance report on public investment so it is difficult to say to what extent the challenges and shortcomings highlighted have been addressed.

Planning for large capital projects

A common feature of major capital projects in Ireland is that initial budgets tend to escalate over time (Figure 22). This leads to overruns that can put pressure on the public finances.

Recent evidence (Flyvberg and Bester, 2021) suggests that conventional cost-benefit analyses for public investment projects are systematically biased. That is costs are underestimated and benefits are overestimated in a way that is systematic and predictable. This is found for a range of project types and the bias, which is statistically significant, is not found to have faded over time. In four-out-of-five cases, cost overruns are not compensated by larger-than-expected benefits. Typically, the benefit-cost ratio is overestimated by roughly between 50 and 200%, depending on the nature of the project.

Over-optimism is a key factor cited as driving the bias seen in cost-benefit analyses. Such over-optimism can lead to unrealistically fast timelines being set, few logistical challenges being envisaged, and overly benign assessments of how prices will evolve. That planners and managers can misconceive and underestimate these issues in a systematic way may be explained by a range of behavioural biases: overconfidence, the so-called "planning fallacy", strategic misrepresentation, and so on. The solution proposed by Flyvberg and Bester (2021) is to "de-bias" forecasts, policies, and decisions made at earlier stages. This includes using tools like (1) "reference class forecasting" (using large datasets to assess similar situations in the past and their outcomes), (2) stronger incentives for accuracy in cost-benefit forecasts, and (3) independent audits.

Large capital projects are a special case where cost overruns are a common feature internationally. Nine out of ten so-called "megaprojects" — projects worth over $1 billion — incur cost overruns (Flyvberg, 2014).

Overruns on megaprojects are specifically found to be largely caused by: (1) weak leadership from planners who lack experience in large projects, which can lead to major changes throughout the project; (2) conflicts of interest in decision making by different stakeholders; and (3) the long-term nature of the project, which increases the extent of potential risks.

In line with the international experience, Ireland has faced substantial overruns on its large public capital projects. While lessons should have been learnt from past experience, some ongoing capital projects are still incurring substantial overruns.

Key examples of major capital projects with substantial overruns include:

The Dublin Port Tunnel involved an overrun of 160% of its initial budget.

The Luas line's first construction phase saw a 289% overrun in budgeted costs.[13]

The National Broadband Plan has seen costs rise from an initial €500 million to almost six times that in unofficial estimates — at a reported cost of €3 billion. However, the official estimates note that the "maximum cost" to the State under the contract is €2.7 billion over 25 years, which includes €480 million for contingency costs.

The National Children's Hospital is the largest capital investment programme ever undertaken in Ireland's healthcare system. Since the project was established six years ago, the estimated cost of the investment has doubled. In 2013, the estimated budget for the construction of the hospital was €790 million. By April 2017, the estimated cost had increased to €983 million, which includes costs related to the construction and equipment of the hospital and the two satellite centres. In December 2018, the associated cost increased to €1.43 billion. After this, a further €446 million may be needed to cover additional items (e.g., IT systems) and contractor claims, increasing the latest estimate to €1.88 billion.

A review by PwC (2019) helps to explain the cost-escalation up to end-2018 in the case of the National Children's Hospital. Three key deficiencies were identified: 1) poor planning and the lack of a solid cost-benefit analysis being undertaken prior to the construction process, including underestimating potential risks, and the absence of robust planning to identify a guaranteed maximum price (i.e., a ceiling to the investment cost); 2) execution failures where once the investment had been committed, poor coordination and control of costs was evident; and 3) governance failures wherein the body overseeing the project (the National Paediatric Hospital Development Board) did not adequately

[13] This refers to the first construction phase of the Luas line. The extension that followed (Luas cross-city), however, performed well in sticking to initially budgeted costs.

question project deficiencies, allowing these to progress "too quickly" and without regular challenge.

Table 7: Examples of large capital overruns in Ireland

Approximate increases from initial budget to final cost/latest estimate

	Overrun € billions	Overrun %
National Broadband Plan	2.2	440%
National Children's Hospital	1.1	135%
Luas Line	0.6	289%
Dublin Port Tunnel	0.5	160%

Sources: Authors' workings.

Note: The "Luas Line" refers to the first construction phase of the Luas line. The extension that followed, however, performed well in sticking to initially-budgeted costs. The estimate for the National Broadband Plan overrun is based on the stated "maximum cost" to the State under the contract, which is €2.7 billion over 25 years, including €480m for contingency costs — unofficially reported costs are higher at €3 billion.

There are clear parallels between the failures identified in Ireland and those identified by Flyvberg (2014). In particular, there is evidence of a classic "soft budget constraint" problem. This includes 1) unrealistic forecasts; and 2) weak spending controls; and it means that budgeted costs are very likely to be surpassed repeatedly. Future problems are created by reinforcing the belief that upward revisions to the budget are very likely to be facilitated, hence weakening spending controls further. The interaction between unrealistic forecasts and a subsequent relaxation of ceilings is a known factor to put the public finances at risk.

Recent governance changes

The current process governing public investment involves funding Departments giving assurances, with the Department of Public Expenditure and Reform (DPER) scrutinising and challenging these through reviews of business cases. While DPER describes this process as having proven useful, it notes that the ability to robustly challenge on substantive delivery issues such as scrutiny of costings, feasibility of delivery plans, and appropriateness of procurement strategies, needs to be strengthened.[14]

The Government has set out a number of measures to improve governance of public investment spending in future:

- External Assurance Process: This process is to involve a panel of external experts that review public capital projects at two stages (before approval and before tender). The experts would scrutinise costs, risks, feasibility of delivery and governance issues in the business case. It will cover major public capital projects greater than €100 million in cost and will supplement DPER's current formal reviews of business cases. A circular will set out the new requirements in late 2021. The reform partly addresses two

[14] See the press release for the tender for the External Assurance Process on Major Infrastructure Projects available at: https://www.gov.ie/en/press-release/322c8-minister-mcgrath-publishes-tender-for-the-external-assurance-process-on-major-infrastructure-projects/

"medium" findings in the IMF (2017) assessment relating to shortcomings in how public capital projects are selected. Specifically, the IMF noted that external input was limited at selection stage. It also noted that reviews during budgeting were cursory and not attentive to changes in scope and cost; and that the application of selection criteria was not transparent.

- InfraNet: A network of infrastructure professionals in the public service. It provides a forum for experts to examine how public investment is governed and potential reforms and innovations, as well as to examine best practice and solutions to various issues. The November 2020 InfraNet was attended by over 150 participants from 67 organisations. The network should help to develop expertise across departments related to infrastructure spending but is unlikely, on its own, to address shortcomings in how public investments are managed.

- Commercial Skills Academy: This academy was established in 2019 to provide training for public servants involved in the delivery of public capital works projects. The idea was to develop an understanding of key issues, commercial skills, and best practice approaches for delivering projects. The training programmes focus primarily on skills for delivering approved capital projects. It draws on input from construction policy and staff across the public service.

- Supporting Excellence report: This EU-funded report reviews the public service's ability to deliver capital programmes. It highlights how sectors with less established asset management/ delivery functions may benefit from specialist assistance in these areas.

The reforms recently introduced focus on ensuring greater external assurances at key early stages in capital projects and upskilling public sector staff managing capital projects.

Past recommendations suggested that the Department of Public Expenditure and Reform needed to take on more of the responsibility for ensuring value for money is achieved in capital projects. The recommendations of the IMF (2017) report emphasised the Department's role in relation to how capital spending is overseen.

Looking at DPER's role, three broad areas can be highlighted in the IMF's recommendations: 1) building up DPER's in-house expertise; 2) improving transparency; and 3) learning from past experiences.

While some of the IMF's (2017) recommendations have been implemented, others do not appear to have been implemented in full or at all (Table 8). Greater analysis of existing assets, strengthening the use

of analytical techniques, such as cost-benefit-analysis and Reference Class Forecasting, and boosting reviews of past projects would help to improve future outcomes.

Table 8: Selected Past Recommendations (IMF, 2017) and assessment of progress made

IMF recommendation	Progress assessment
1) Building up the Department's in-house expertise	
Establish an "Infrastructure Projects Unit" in DPER to enhance its role as coordinator and gatekeeper of appraisal and selection process, provide advisory services to Minister, studies of infrastructure bottlenecks, financing, and lessons learnt from previous projects	The Investment Projects and Programmes Office (now National Investment Office) was set up in 2018 and advises on appraisal and selection issues
Establish common analytical framework for estimating demand pressures and infrastructure gaps	Some efforts have been made to introduce common frameworks for looking at infrastructure demand and capacity within the NDP process
Strengthen use and application of cost-benefit analysis + other appraisal techniques	The updated Public Spending Code provides some new guidance and requirements for investment planning, appraisal and management but use of these techniques is not necessarily required
Provide greater analysis on cost of maintaining & rehabilitating existing capital stock to prevent its degradation	In place for certain sectors, but not comprehensively
2) Improving transparency	
Develop a central register of infrastructure assets to improve management of assets and maintenance funding	No provision for this appears to be in place
Further develop the "Investment Projects and Programmes Tracker" to show annual cost profiles; implementation of projects; clear capital and recurrent costs; data on adjustments to project design and costs; implementation delays; and results	The tracker was updated, with implementation status updates included. Other aspects are available internally, but not made public: annual cost profiles, the split of capital and recurrent costs, data on adjustments to project design and costs, and information on implementation delays. It gives limited information on results
Publish project assessments with key economic performance indicators and underlying assumptions	Updated Public Spending Code now requires publication of business cases + post-project reviews
Promote transparency around public-private partnerships	Updated Public Spending Code now requires publication of business cases + post-project reviews
3) Learning from the past	
Strengthen ex-post assessments of major projects to improve design of future projects; publish reviews of projects	Updated Public Spending Code now requires publication of business cases + post-project reviews
Encourage C&AG to carry out performance audits of major investment projects	No provision for this appears to be in place
Prepare a summary every two years of government-wide lessons from reviews of the 10 largest projects completed	No provision for this appears to be in place

Sources: IMF (2017); and authors workings.
Notes: The progress assessment is made by the authors of this Analytical Note. Deeper red shaded assessments indicate that weaker progress is assessed to have been made.

The changes proposed and introduced in recent years include many good initiatives, which may result in better value for money in Ireland's public investment spending.

However, their success will be difficult to assess, and a high degree of diligence will be required, given the various challenges posed. These challenges include potential capacity constraints, the high scale of investment, and the greater need to ensure value for money with high government debt levels.

With the Government's plans to ramp up public investment to levels with little historical and international precedent, it is urgent that areas for improvement like those outlined above be reconsidered and implemented as appropriate.

References

Auerbach, A. and Y. Gorodnichenko, (2012). Measuring the Output Responses to Fiscal Policy. American Economic Journal: Economic Policy 4 (2): 1-27. Available at: https://www.aeaweb.org/articles?id=10.1257/pol.4.2.1

Barrell, R., D. Holland and I. Hurst (2012). "Fiscal multipliers and prospects for consolidation", OECD Journal: Economic Studies, Vol. 2012/1. Available at: http://dx.doi.org/10.1787/eco_studies-2012-5k8x6k5wc58x

Barro, R.J., (1974). Are Government Bonds Net Wealth? Journal of Political Economy 82(6): 1095-1117.

Batini, N., di Serio, M., Fragetta, M., Melina, G., & Waldron, A. (2021). Building back better: How big are green spending multipliers? IMF Working Paper 2021/087. Available at: https://www.imf.org/en/Publications/WP/Issues/2021/03/19/Building-Back-Better-How-Big-Are-Green-Spending-Multipliers-50264

Bénétrix, A. S. and P. R. Lane. (2009). The Impact of Fiscal Shocks on the Irish Economy. The Economic and Social Review, Vol. 40,, No. 4, pp. 407-434. Available at: http://www.tara.tcd.ie/handle/2262/58757

Bom, P. and J. E. Ligthart, (2009). What Have We Learned From Three Decades of Research on the Productivity of Public Capital? Journal of Economic Surveys 28, 5. Available at: http://dx.doi.org/10.1111/joes.12037

Canadian Parliamentary Budget Officer (2021). Fiscal multipliers and fiscal sensitivities. Blog post. Available at: https://www.pbo-dpb.gc.ca/en/blog/news/BLOG-2021-013--fiscal-multipliers-fiscal-sensitivities--multiplicateurs-budgetaires-sensibilites-perspectives-financieres

Canada Department of Finance (2010). Job impact of the economic action plan to date. Annex 1 to Budget 2010. Available at: https://www.budget.gc.ca/2010/plan/anx1-eng.html

Casey, E. and D. Purdue, (2021). "Maq: A Fiscal Stress Testing Model for Ireland". Irish Fiscal Advisory Council Working Paper Series No. 13. Dublin. Available at: https://www.fiscalcouncil.ie/maq-a-macro-fiscal-model-for-ireland/

Conefrey, T. and T. McIndoe-Calder, (2018). Where are Ireland's Construction Workers? Central Bank of Ireland, Signed Article, Quarterly Bulletin 02 / April 18. Available at:

https://www.centralbank.ie/docs/default-source/publications/quarterly-bulletins/quarterly-bulletin-signed-articles/where-are-ireland-s-construction-workers-(conefrey-and-mcindoe-calder).pdf

Council of Economic Advisers (2014). The Economic Impact of the American Recovery and Reinvestment Act Five Years Later. Final Report to Congress, February 2014. Available at: https://obamawhitehouse.archives.gov/sites/default/files/docs/cea_arra_report.pdf

Deleidi, M., M. Mazzucato, and G. Semieniuk, (2020). Neither Crowding In nor Out: Public Direct Investment Mobilising Private Investment into Renewable Electricity Projects. Energy Policy 111195. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0301421519307803

DeLong, J. B. and L. H. Summers, (2012). Fiscal Policy in a Depressed Economy. Brookings Papers on Economic Activity 44(1): 233–297. Available at: https://www.jstor.org/stable/23287218

Department of Public Expenditure and Reform, (2021). Project Ireland 2040 | Phase 1 Report Review of the National Development Plan. Available at: https://www.gov.ie/en/publication/77fe2-national-development-plan-phase-1-report-2021/

Department of Public Expenditure and Reform, (2020). "Build 2020: Construction Sector Performance and Capacity." Government of Ireland: Department of Public Expenditure and Reform. Dublin. Available at: https://www.gov.ie/en/publication/c19a5-build-2020-construction-sector-performance-and-capacity/

Durand, L. and R. Espinoza, (2021). The Fiscal Multiplier of European Structural Investment Funds: Aggregate and Sectoral Effects with an Application to Slovenia. IMF working paper no.118. Available at: https://www.sipotra.it/wp-content/uploads/2021/05/The-Fiscal-Multiplier-of-European-Structural-Investment-Funds-Aggregate-and-Sectoral-Effects-with-an-Application-to-Slovenia.pdf

Fiscal Council, (2020). Long-term Sustainability Report: Fiscal challenges and risks 2025-2050. Dublin: Irish Fiscal Advisory Council. Available at: https://www.fiscalcouncil.ie/long-term-sustainability-reports/

Flyvbjerg, B. and D.W. Bester, (2021). The Cost-Benefit Fallacy: Why Cost-Benefit Analysis Is Broken and How to Fix It. J. Benefit Cost Anal. 2021; 1–25.

Flyvbjerg, B., (2014). What You Should Know About Megaprojects and Why: An Overview. Project Management Journal. 45 (2). April-May pp.6-19. DOI: 10.1002/pmj.21409.

Geddes, A., Schmidt, T. S., & Steffen, B, (2018). The multiple roles of state investment banks in low-carbon energy finance: An analysis of Australia, the UK and Germany. Energy Policy, 115. Available at: https://www.sciencedirect.com/science/article/pii/S0301421518300090?via%3Dihub

Giordano, R., Momigliano, S., Neri, S. and Perotti, R. (2007). The effects of fiscal policy in Italy: evidence from a VAR model, European Journal of Political Economy, 23, 707–33. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0176268006001236

Hall, R.E. (2010). Fiscal Stimulus, Daedalus, Vol. 139, Iss. 4, pp. 83 – 94.

Ilzetzki, E., E. Mendoza, and C. Vegh (2013). How Big (Small?) are Fiscal Multipliers? Journal of Monetary Economics, 60(2), 239–254. Available at: https://www.sciencedirect.com/science/article/abs/pii/S030439321200116X

International Monetary Fund. (2017). Technical assistance report – Public investment management assessment. Country Report No. 17/333. Available at: https://www.imf.org/en/Publications/CR/Issues/2017/11/10/Ireland-Technical-Assistance-Report-Public-Investment-Management-Assessment-45383

Ivory, K., E. Casey and N. Conroy, (2020). Ireland's Spending Multipliers. Irish Fiscal Advisory Council Working Paper. Economic and Social Review, Vol. 51 No. 1, Spring (2020). Available at: https://www.esr.ie/article/view/1389

Kavanagh, C. (1997). Public capital and private sector productivity in Ireland, 1958-1990. Journal of Economic Studies 24,1/2.

Kennedy, K.A., T. Giblin, and D. McHugh, (1988), The Economic Development of Ireland in the Twentieth Century, Routledge, London.

KPMG/Future Analytics Consulting Ltd. (2020). Economic analysis of productivity in the Irish construction sector. Report commissioned by the Department of Public Expenditure and Reform. Dublin. Available at: https://www.gov.ie/en/publication/94929-pre-covid-19-productivity-research-in-construction-sector/

Leddin, A. and B.M. Walsh, (1995). The Macroeconomy of Ireland, 3rd ed., Gill and Macmillan, Dublin.

Linehan, S., R. Lydon, T. McIndoe-Calder, P. Reddan, and D. Smyth (2017). "The Labour Market and Wage Growth after a Crisis." Quarterly

Bulletin Signed Article, Central Bank of Ireland October 2017. Available at: https://www.centralbank.ie/docs/default-source/publications/quarterly-bulletins/quarterly-bulletin-signed-articles/the-labour-market-and-wage-growth-after-a-crisis-(linehan-lydon-mcindoe-calder-reddan-and-smyth).pdf?sfvrsn=4

National Skills Council (2020). "Building Future Skills: The Demand for Skills in Ireland's Built Environment Sector to 2030." Available at: https://www.regionalskills.ie/imagelibary/regional%20skills%20-%20national/publications-/publications-pdf/final-building-future-skills-report.pdf

Parliamentary Budget Officer (2021). "Fiscal Multipliers and Fiscal Sensitivities". Blog post. 11 February 2021. Available at: https://www.pbo-dpb.gc.ca/en/blog/news/BLOG-2021-013--fiscal-multipliers-fiscal-sensitivities--multiplicateurs-budgetaires-sensibilites-perspectives-financieres

PwC (2019). New Children's Hospital Independent review of escalation in costs. Available at: https://merrionstreet.ie/merrionstreet/en/news-room/releases/20190409_nch_report.pdf