Office for Budget Responsibility

08 February 2024

The economic effects of full expensing

Autumn 2023 Statement: permanent full expensing

1 In our November 2023 *Economic and fiscal outlook* (*EFO*), we analysed the long-run impact of allowing 100 per cent expensing of eligible plant and machinery investment on investment and GDP, using a cost of capital framework, which we have used to analyse the impact of several other recent policy changes.[1] This note explains why firms respond to changes in the corporation tax policy regime and how our 'cost of capital' model captures these changes in incentives, before detailing how we adjusted our forecast for business investment in response to this policy change in our November 2023 forecast.[2]

2 As usual, we would welcome any feedback on our modelling, assumptions, or general approach to feedback@obr.uk.

How tax policy changes affect firms' incentives to invest

3 When choosing whether to undertake an investment, a business considers the impact it expects it to have on future revenues. Investment increases the firm's stock of capital at the point in time that the investment is made. But as capital assets – like factories or buildings – are durable, investment also raises the capital stock in future periods, and therefore also increases the output that firms expect to be able to produce in the future. Typically, firms are assumed to take into account these future benefits when making an investment.

4 Firms' decisions to invest also account for how the costs associated with then owning an additional unit of capital affect their expected stream of future profits. Importantly, in doing so, firms do not consider the entire cost of purchasing the machine or building, as much of this can be recovered, if the assets are sold in future. But they do take into account the cost of financing the investment (i.e., paying interest to lenders that finance the transaction or the foregone interest that could have been obtained by investing cash elsewhere in the economy), so as a result, profits that can be realised today are more valuable than profits that will only be realised in the distant future. They also consider the extent to which the asset is expected to depreciate over time (i.e., due to wear-and-tear or obsolescence), as this lowers the price it can be sold at in the future or the return on that asset if it is not sold. So, economic theory suggests that profit-maximising firms will invest in capital until the expected rate of (post-tax) profit from an investment no longer exceeds the 'cost of capital' (the cost of financing the investment plus the rate of depreciation).

[1] Over the last three years, the UK corporation tax regime has witnessed four major changes, as discussed in Box 2.4 of the November 2023 *EFO*.
[2] We use this framework to capture the effect of tax policy changes on marginal investment decisions, although other responses such as changes in the composition or location of investment decisions are possible. And other factors, such as aggregate demand and uncertainty can also play important roles in determining the level of investment.

5 By affecting the post-tax profitability of a given investment, corporation tax rates and allowances also affect the incentive to invest. Corporation tax is levied on companies' gross profits: so, if the headline corporation tax is 25 per cent, as has been the case in the UK since April 2023, then the post-tax profit that a firm expects to receive from its investment in every future period is reduced by 25 per cent (relative to the tax not existing). Because this does not affect the costs of financing or depreciation, it lowers the benefits, but not the costs, of adding to the capital stock, disincentivising investment.[3]

6 Capital allowances help remove this disincentive, by allowing firms over time to deduct the costs of depreciation from their profits when calculating their corporation tax bill. Capital allowances that can be claimed immediately when the investment is made are more valuable to firms than those that spread the allowance over the life of the asset. This is because up-front allowances reduce the amount of finance the firm needs to raise at the point of investment by the full amount of the allowance. For instance, in the example above, a 100 per cent upfront capital allowance, as has been the case in the UK since April 2023, would allow the firm to deduct 100 per cent of an investment's cost from its taxable profits, in the year in which it makes the initial investment. This would remove the disincentive to invest from corporation tax and incentivise investment (relative to the capital allowance not existing).[4]

Cost of capital model

Our cost of capital model

7 When modelling a tax policy change in our forecast, we assume that the economy-wide aggregate of firms' desired or 'optimal' capital stocks, K^*, responds to changes in the cost of capital, adjusted for the impact of the corporation tax regime, CoC^A, via a user cost elasticity, σ. This means that a 1 per cent increase in the cost of capital is associated with a σ per cent *decrease* in the optimal (net) capital stock (see paragraph 13 for more on our user cost elasticity assumptions). This simple relationship can be estimated empirically and is also generated, under certain assumptions, in some theoretical models of business investment in which firms behave so that the following equation is satisfied:[5]

$$\%\Delta K^* = -\sigma \, \%\Delta CoC^A \qquad (1)$$

8 As discussed further below, we assume that firms cannot adjust their capital stocks instantaneously following a policy change, for instance, because of the time required to construct a new building or structure, so the investment required occurs over time.

[3] This is not the case for investments eligible for capital allowances (as discussed below) or if interest is tax deductible and the investment is debt financed, as is the case for some UK investments.
[4] In practice, the corporation tax system is more complex than discussed here, with different capital allowances for different asset types, various rules around shifting profits, and other tax reliefs.
[5] For instance, in 'neoclassical' models, which assume, amongst other things, that there are a large number of profit-maximising firms and that firms produce output using a constant elasticity of substitution production function.

How we model the tax-adjusted cost of capital

9 We split the tax-adjusted cost of capital (CoC_t^A) into the cost of capital (CoC_t^U) and a tax adjustment factor (TAF_t), as in equation (2) below:

$$CoC_t^A = TAF_t \, CoC_t^U \tag{2}$$

10 A tax adjustment factor (TAF), in equation (3), summarises the majority of the effect of taxes including capital allowances, or the tax base, and the corporation tax rate (denoted by τ_t). As the net present value (NPV) of capital allowances that can be claimed on an investment (D_{it}) depends on the type of asset being purchased, the overall adjustment factor is composed of ones for each asset type (for both main and special rate plant and machinery and vehicles, and for buildings), weighted by their shares in overall investment, w_i:

$$\text{TAF}_t = \sum_i w_i \left(\frac{1-\tau_t D_{it}}{1-\tau_t}\right) \tag{3}$$

11 As described above, the unadjusted cost of capital (CoC_t^U), as expressed in equation (4), is broken down into the depreciation rate (d_t) and the post-tax real cost of finance (r_t), taking account of the tax deductibility of nominal interest payments (i_t), and includes a term to account for the relative price of investment goods, P_t:[6]

$$CoC_t^U = P_t \, (d_t + r_t) \tag{4}$$

12 The post-tax real cost of finance (r_t) captures the costs of financing investment in the economy, whether it is financed through debt (i_{debt}) or equity (i_{equity}), accounting their relative weights (w_{debt} and w_{equity}) and expected inflation ($E(\pi_t)$). The further adjustment to account for the tax deductibility of debt financing is applied to the nominal cost of debt:

$$r_t = (1-\tau_t)\, w_{debt}\, i_{debt} + w_{equity}\, i_{equity} - E(\pi_t) \tag{5}$$

Our assumptions

Key parameters

13 One particularly important assumption is that the long-run user cost elasticity between the increase in the cost of capital and the decrease in the optimal net capital stock is 0.4 (Table 1.2). Studies have found the user cost elasticity to range from 0.25[7] to 1[8]. At 0.4, our assumption lies within this range and is in line with a UK estimate from a Bank of England study.[9] There is considerable uncertainty around these estimates, and they will vary depending on the specific estimation methods that are used, the countries the data are drawn from, and the time frame over which the analysis is conducted.

[6] For more information on this term, see OBR, *Briefing paper No. 5: The macroeconomic model,* 2013.
[7] Chirinko, B., et al., *How responsive is business capital formation to its user cost?: An exploration with micro data*, 1999.
[8] Dwenger, N., *User Cost Elasticity of Capital Revisited*, 2014.
[9] Barnes, S., Price, S., Barriel M.S., *The elasticity of substitution: evidence from a UK firm-level dataset,* Bank of England, 2008.

14 Our tax system parameters are based on current government policy, so the corporation tax rate is set at 25 per cent. We assume NPVs for capital allowances range from 40 for buildings to 100 per cent for main rate plant and machinery (Table 1.1),[10] where the NPV captures how fast firms can deduct the total cost of these assets from their taxable incomes. The NPV of plant and machinery is at 100 per cent, as full expensing means firms can now deduct the cost of all of their main rate plant and machinery investments in the first year.

Table 1.1: Tax system parameters

		Per cent
Corporation tax rate		25
	NPV of capital allowances	
	Main rate	Special rate
Buildings	40	40
Vehicles	75	50
Plant and machinery	100	80

15 The other key assumptions we have used are set out in Table 1.2. Many of these are based on the assumptions in our macroeconomic model, including for the shares of investment in plant and machinery, buildings and vehicles.

Table 1.2: Other key assumptions

Key metric (per cent)	Debt	Equity
Asset weights of financing	34	66
Nominal cost of financing[1]	6	8
Depreciation rate		8
	Main rate	Special rate
Share of investment expenditure[2]	67	33
		Share of investment
Buildings		14
Vehicles		31
Plant and machinery		54

[1] The cost of debt is based on a 2023 average rate on corporate debt reported by the Bank of England. The cost of equity applies an additional spread based on historical differences between the cost of debt and equity implied by our macroeconomic model.
[2] We use these shares to determine how to split plant and machinery investments.

How we assume changes in investment are profiled over time

16 As discussed, we assume gradual, rather than immediate, changes in investment occur to move the economy to the new net capital stock. We assume this transition takes 8 years.[11] For

[10] This has been the case for plant and machinery since April 2023, when full expensing was announced. To focus on the impact of full expensing of plant and machinery, our November 2023 forecast applied the simplifying assumption that the net present value of capital allowances of only plant and machinery investments would increase from making full expensing permanent. This simple approach abstracts from some tax system features which we hope to reflect in due course, like the small shares of some other assets which also qualify for plant and machinery expensing, like vans and software, and the modest allowances available on some buildings investments.
[11] There is a general lack of consensus on how long it takes the long-run capital stock to respond to changes in the cost of capital. In line with the assumption in Chapter 3: Tax incentives and investment in the UK of Wallis, G., *Essays in understanding investment*, 2012, we assume that two-thirds of the adjustment to the new level of the capital stock takes place by the forecast horizon.

simplicity, we typically also assume that the economy is initially at its optimal level, K^*, so that the change in the desired stock is exactly equal to the changes in investment flows, I_t.

$$\Delta K^* = \sum_t^T \Delta I_t \quad (6)$$

17 Typically, we would assume that two-thirds of any change in K^* following a permanent immediate change in the cost of capital occurs within our five-year forecast. So, if the cost of capital changed sufficiently to generate an eventual £80 billion change in the optimal stock, around £50 billion would occur during our five-year forecast period, with £10 billion occurring per year and £2.5 billion per quarter.[12]

How this affects our potential output forecast

18 We then calculate the implications of these changes for the *gross* capital stock, the metric we judge relevant for determining the flow of capital services available in the economy and therefore the level of potential output.[13] (We focus on this metric because the net stock – the market value of the capital stock – falls as it approaches retirement, even though much of the capital stock will continue producing capital services up until it is retired.) We then feed this change in cumulative investment into the capital deepening framework that we use to calculate our forecast for the gross capital stock (this framework assumes that retirements at a rate of around 5 per cent per year erode some of the impact of any addition to the stock of capital). It assumes that changes in the gross capital stock boost potential output via a one-third Cobb-Douglas output elasticity.[14]

Permanent full expensing

How we calculated the impact of permanent full expensing

19 Since April 2023, businesses have been able to fully expense eligible investments in plant and machinery. We estimated that the introduction of permanent full expensing would add £15 billion to cumulative business investment over the forecast period, relative to the policy not existing.[15] As shown in Table 1.3 below:[16]

- Before full expensing, the **net present value of capital allowances** on plant and machinery was 78 per cent. This is because the entire value of most investments could be written off, but only over time, so their net present value was less valuable than if everything could be expensed upfront. Making this change increased the net present

[12] Of course, in the long run, retirements or depreciation will act to weigh down on the capital stock and extra business investment would be required to offset its effects in the long run so as to reach the optimal capital stock. But, for the purposes of our forecast we make a simplifying assumption that the change in business investment is solely a function of the change in the cost of capital.
[13] For more information, see OBR, *Briefing paper No. 8: Forecasting potential output – the supply side of the economy*, 2022.
[14] See OBR, *Briefing paper No. 8: Forecasting potential output – the supply side of the economy*, 2022, for more information.
[15] In practice, this policy was initially announced as a three-year *temporary* measure alongside our March 2023 forecast, before its indefinite extension was announced in November 2023. We had assumed a temporary measure would provide a significant incentive for firms to accelerate their capital plans to take place in the period with more generous capital allowances. When the policy was made permanent, alongside our November 2023, this time-shifting incentive was removed. We have focused on the long-run effect of the policy, relative to it not existing, in order to demonstrate the workings of our cost of capital model. For more information on the November policy change, see Box 2.4 of our November 2023 *Economic and fiscal outlook*.
[16] Our assumptions have been updated slightly since November, so the calculations shown in Table 1.3 were done using slightly different assumptions to those reported in Tables 1.1 and 1.2. These changes would not have had a material impact on the overall result.

value of plant and machinery to 94 per cent under (lower than 100 per cent because not all plant and machinery is eligible for full upfront expensing).

- As other tax system parameters were unchanged, this lowered the **tax-adjustment factor** for plant and machinery by 4.8 per cent, resulting in a 2.4 per cent decrease in both the overall TAF (and therefore also in the tax-adjusted cost of capital).

- Multiplied by a user cost elasticity of -0.4, this increased **the optimal level of the net capital stock** by 1.0 per cent (£22 billion in the long run).

- We assumed that only two thirds of the adjustment in **the actual capital stock** would take place within the forecast, which increased **business investment** by around £3 billion per year (1.2 per cent) and resulted in a £15 billion increase in cumulative investment by the first quarter of 2029.

Table 1.3: Impact of permanent full expensing on capital stock

Key metrics		Baseline	Policy	Per cent difference
NPV of capital allowances (plant and machinery, per cent)		78.1	93.7	20.1
Tax adjustment factor (TAF)	a	1.1	1.1	-2.4
Unadjusted cost of capital (CoC^U)	b	5.1	5.1	0.0
Tax-adjusted cost of capital (CoC^A)	a*b	5.8	5.7	-2.4
Calculating changes				Difference
Change in CoC^A (per cent)	c			-2.4
Optimal capital stock (K*, per cent)	d=-0.4*c			1.0
Optimal capital stock (£ billion)	f=(1+d/100)*e			22
Change in cumulative investment in forecast (£ billion)[2]	g=2/3*f			15
Memo: baseline capital stock in Q1 2029 (£ billion)	e	2,321		

20 This £15 billion increase in cumulative investment, raised the optimal net capital stock by 1 per cent in the long run, equivalent to a 0.5 per cent increase in the larger optimal gross capital stock.[17] As discussed in paragraph 18, we fed this through our capital deepening framework to estimate its impact on potential output. The resulting effect was estimated to boost GDP by 0.1 per cent in 2028-29 (and 0.2 per cent in the long run).

Conclusions and next steps

21 We will continue to use this framework to analyse future measures, so will keep the assumptions about elasticities, weights of various types of investment under review, taking account analysis of the latest data and evidence. We also plan to consider the interaction of outputs of our cost of capital model with our capital deepening framework, including the ways both frameworks account for the depreciation and scrapping of capital assets. We also hope to further refine the framework's tax system parameters to help it capture some of the additional nuances in the capital allowances regime. Any feedback on our approach to these or other aspects of our cost of capital framework would be welcome.

[17] Again, see OBR, *Briefing paper No. 8* for more information.