When in doubt…

How does uncertainty affect business investment? **Murtaza Syed***, of the Institute for Fiscal Studies and Nuffield College, Oxford, reviews the economic theory underlying the presence (or absence) of this relationship.*

Recognising that investment is a key determinant of long run economic growth, the current Labour government regards stimulating business investment as one of its central objectives. It has identified the provision of "macroeconomic stability" as an important means of encouraging higher levels of private sector investment. In this article, we will examine whether economic theory supports the view that uncertainty discourages investment.

Standard Economic Theory

Business investment is spending by businesses on capital goods that will be valuable in generating future output. According to standard economic theory, the demand for capital is driven by the *level* of expected future profits and demand. To the extent that increased uncertainty about the future decreases the *level* of profits and demand expected in the future, increased uncertainty will reduce desired investment. On its own, however, uncertainty should not have any effect on investment decisions.

Let us illustrate this with a simple example. Consider a firm that needs to decide whether to invest in a project that costs £25. Suppose the firm believes that there is a 50% chance that by investing in the project, it will realize a revenue of £70. However, if conditions turn out to be less favourable than expected, there is a 50% chance that its revenue will be equal to £-10. The expected value of its revenue will thus be £30[1]. According to standard economic theory, it is this expected level of revenue minus the cost of the project —the expected level of future profits or net present value (NPV)—that will determine whether the project is undertaken. In this case, since the NPV is positive, the firm should choose to undertake the project.

Now, suppose the firm is more uncertain about the future, perhaps as a result of instability in the macroeconomic environment associated with conflict or volatile stock markets.[2] As a result, it now believes that there is a 50% chance that the project's revenue will be £80 and a 50% chance that it will be £-60. Its expected revenue will now be £10, which is lower than the project's cost and thus the optimal decision will now be *not* to undertake the project. It appears therefore that increased uncertainty about future returns has decreased the incentive of the firm to invest. However, it is the decreased expected return to the project, rather than the uncertainty itself, that has affected the incentive. To see this, consider another example in which revenues are again more uncertain than in our first scenario, but expected future profits are not affected by this uncertainty. In particular, suppose that the firm believes that there is a 50-50 chance associated with receiving revenues of £80 or £-20. Its expected

[1] Calculated as 0.5 (70) + 0.5 (-10).

[2] Greater uncertainty in our example would be associated with an increase in the standard deviation or spread of possible outcomes.

revenue will remain at £30, and thus its decision to invest will remain unaffected.

Real Options and the value of waiting

According to standard economic theory, therefore, uncertainty will only affect investment indirectly, in so far as it affects the expected *level* of future profits. However, this standard theory subtly assumes that investment decisions cannot be delayed. Arguing that this is sometimes unrealistic, a more recent branch of literature has considered modelling investment behaviour when firms have the ability to delay. The recent work also makes a second crucial assumption that investments are irreversible in the sense that an investor cannot recover the initial costs of projects that are abandoned. Under these twin assumptions of irreversibility and the ability to delay, it turns out that there is a more direct role for uncertainty in determining investment decisions.

The starting point of this 'real options' literature is that we all face choices about whether we should spend our resources today or wait and thereby "keep our options open". The possibility of delay gives rise to what is known in finance as a 'call option': the firm has a right (though not an obligation) to undertake the investment project at some future time at its discretion. This option is valuable only if (i) future returns are uncertain and (ii) once undertaken, projects cannot be costlessly reversed.

In deciding to invest today, the firm loses the option to delay until it receives more information about future market conditions. Therefore, when a firm considers whether to invest in a project, it is argued that the value of the lost option should be added to the cost of the project. In other words, the existence of the option creates a wedge between the conventional NPV calculation of the current worth of an investment project and the "true" worth of the project.

How does this relate to our earlier example? Consider the following variation. The project still costs £25. The firm still believes that there is a 50-50 chance that its revenue if it invests today will be £70 or £-10. However the firm now has the option to wait for a year and observe whether demand conditions fall in the optimistic or pessimistic category. Thus, if the firm delays investing, then it will undertake the project only if it makes a profit of £45. Since this good outcome occurs half of the time, the expected value of having the option to invest next period is £22.5. This is the "real option value" of the call option of delaying, and (in this stylised example) it arises because the firm can wait until all of the uncertainty in the project is resolved. The value of this option to delay investment for a year should clearly be incorporated in the decision about whether to invest now or later. Ignoring the 'real option', the NPV of the project is £5 and favours investment. On the other hand, if the firm chooses to wait and only invests in the favourable case, the NPV is higher at £22.5. This suggests that the firm should only choose to invest today if expected returns are greater than the cost of the project *and* the value of the option to delay, i.e. only if NPV is greater than £22.5. Otherwise, it is optimal to wait until the firm has more information. The investment rule that emerges out of this analysis is no longer

Invest now if NPV > 0 as in standard economic theory

but

Invest now if NPV > (0 + value of the call option of delay); otherwise delay

Clearly, the existence of the call option makes investment less likely. In turn, anything that increases the value of the call option further decreases the likelihood of investment. The call option becomes more valuable (i) the more irreversible projects are (i.e. the less easily existing projects can be scrapped and investments recouped, thereby increasing the incentive to wait in case conditions turn out to be unfavourable), and (ii) the greater the level of uncertainty faced by the firm. The latter effect is easily illustrated. Consider the third variation we discussed earlier, i.e. an increase in uncertainty that leaves the expected level of future profits unchanged and thus does not affect investment behaviour under standard economic theory. Recall that under this scenario, there was a 50-50 chance that by investing today, revenue associated with the project will be £80 or £-20. Add to this the possibility of delay, and the value of the option is now £27.5. Since this is higher than £22.5, the firm now has an increased incentive to delay investment. In contrast to standard economic theory, under the 'real options approach', an increase in uncertainty will tend to make the firm more 'cautious' and less likely to invest today even when it is not accompanied by a decrease in the expected return on a project.

Does uncertainty reduce investment?

From our simple example, we seem to be left with the following prediction: *ceteris paribus, higher uncertainty should be associated with fewer investment projects being undertaken*. Unfortunately, the real world is never quite as simple and this negative relationship remains controversial for a number of reasons.

First, the prediction depends on the degree to which investments are irreversible and the extent to which delaying investment projects is possible. While both features seem reasonable, their significance needs to be evaluated empirically. *Second,* under some conditions, greater uncertainty can increase the level of expected future profits and thus lead to a positive relationship between uncertainty and investment through the standard route.[3] *Third*, most models do not examine the possibility that the option of delay involves not just benefits in the form of more information but also costs in the form of lost returns or investment by competitors. Incorporating these additional elements may complicate the relationship. *Fourth*, there is a dearth of empirical work that evaluates the relationship between uncertainty and investment, owing in no small part to the difficulty of identifying and measuring the many sources of uncertainty.[4] Existing work does not allow us to conclude that such a relationship even exists, much less attach a sign to it.

Moreover, a negative relationship between uncertainty and new investment may not be the object of interest in a policy context since it does not translate automatically into a negative relationship between uncertainty and the *level* of the capital stock employed by firms. By increasing the incentive to delay before committing to any action, increased uncertainty makes both investment and disinvestment (in the form of scrapping existing projects) less likely. Since it is the combination of the two that determines the level of capital that

[3] A more subtle point has been recognised in recent literature. The existence of the 'real option' requires departures from competitive markets, which may not be satisfied in particular industries.

[4] Among other things, firms may be uncertain about future costs, demand, productivity, prices, interest rates and taxes.

firms employ, there is an ambiguous relationship between uncertainty and the capital stock.

The events of September 11th 2001 have heightened interest among policy makers regarding the effects of uncertainty on investment. Although most economists would probably subscribe to the intuition that uncertainty reduces investment, existing economic theory does not provide such a clear conclusion. Similarly, the limited empirical evidence does not yet allow us to sign the investment-uncertainty relationship with any great confidence. Thus, it is by no means clear that increased macroeconomic stability *per se* (without any corresponding increase in the *level* of expected future profits) will enable the government to achieve its objective of higher private sector investment.

So when asked about the relationship between uncertainty and business investment, remember to keep your options open…