Monetary policy and the zero bound to nominal interest rates

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Some commentators have recently discussed the possibility that certain countries may experience a period of general price deflation. In such a situation, nominal interest rates may reach their lower bound of zero. This article concludes that the evidence available suggests that such a situation is highly unlikely to occur in the United Kingdom. It reviews what the academic literature has to say about the scope for alternatives to cutting interest rates in the improbable event that nominal interest rates do reach zero.

1 Introduction

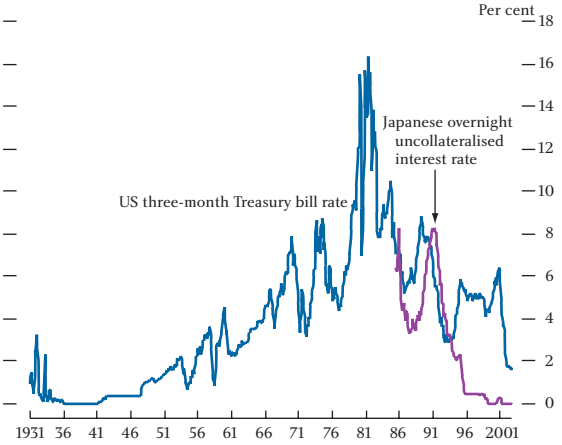
In order to control inflation, modern central banks typically influence private sector interest rates by adjusting the short-term nominal interest rate at which they lend to banks. However, these private sector interest rates cannot fall below zero: no one would make a loan at negative interest rates because they could earn a better return by holding cash. (Cash pays no interest, better than a negative interest rate.) Monetary policy makers face a risk that, if there were a sufficiently large fall in demand, nominal interest rates would have to be pushed to zero. At that point, if the economy required any more stimulus, some other kind of policy would be needed. An additional fall in demand would cause actual and expected future inflation to fall further, and real interest rates—the difference between nominal interest rates and expected inflation—would therefore rise. The rise in real rates would cause an additional fall in spending. That would reduce inflation and expected inflation by yet more and cause real interest rates to rise again, and so on. This extreme scenario was first identified by Wicksell (1898) and is often known as a 'deflationary spiral'. The risk that modern economies could succumb to an episode of this kind has become the focus of more intense scrutiny because nominal interest rates are currently low by historical standards.

This article assesses two strands of recent research: one that has sought to evaluate how material the risk is that interest rates could be pushed to the zero bound, or that the economy could enter a deflationary spiral; and another that has focused on what other policies might be available in the event that interest rates reach zero.(1)

2 What is the risk that interest rates could hit the zero bound?

One approach to estimating the risks of hitting the zero bound, or of entering a 'deflationary spiral', is to look at episodes in economic history or in other countries. Interest rates approached the zero bound in the United States in the 1930s (see Chart 1).

Chart 1
US and Japanese interest rates, 1931-present



But that episode was the product of a set of economic circumstances and a monetary regime—the objectives that the central bank followed—that differed greatly from those of today and in ways we cannot quantify with any certainty. Without being able to replay history with today's monetary policy framework, and in an economy

(1) The article is a condensed version of Yates (2002).

that resembles today's economy, we cannot infer anything very precise from episodes like this in the past. Looking at other countries' experience today (for example, that of Japan)(1) is fraught with the same difficulty. However, we might reasonably say the following: history tells us that episodes of zero interest rates are rare, and those that have occurred were the product of economic circumstances that are unlikely to apply in the case of the United Kingdom today.

An alternative way to gauge the risk of hitting the zero bound to interest rates is to build a model of the economy. We can then buffet this economy with the kinds of shocks that resemble those that affect actual economies, and observe what happens to interest rates as the central bank in the model economy sets about controlling output and inflation. This is an approach that has been followed by, among others: Cozier and Lavoie (1994), Fuhrer and Madigan (1997), Black *et al* (1998), Orphanides and Wieland (1998), Wolman (2000), Reifschneider and Williams (2000) and Hunt and Laxton (2001).(2) The results from these studies are summarised in Chart 2.(3)

Chart 2
The time spent at the zero bound under different average inflation rates

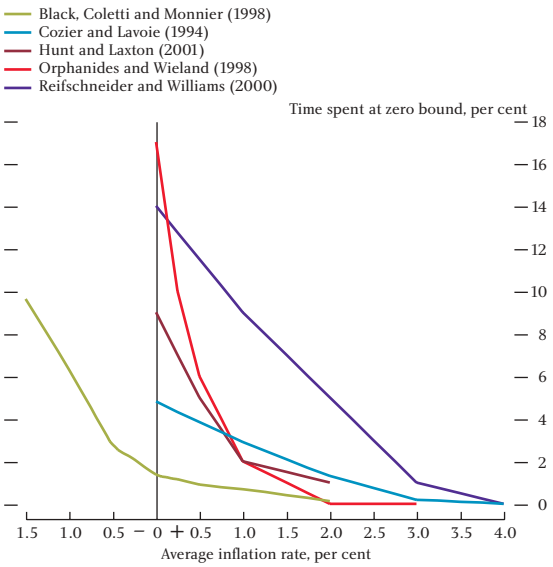


Chart 2 plots estimates of the time an economy spends at zero interest rates as a percentage of the total time the model economy is simulated on the vertical axis, against the average inflation rate that the central banks in these model economies are assumed to target (on the horizontal axis).

Despite the different results in the studies in Chart 2 a consensus of sorts emerges:(4) that the proportion of time an economy will spend at zero interest rates when pursuing inflation objectives of 2%–3% is likely to be small. With a 2% inflation target, Chart 2 suggests that the economy would be at the zero bound in the region of 0%–5% of the time; as this rises to 3%, estimates of the time spent at the zero bound fall to something between 0% and 1%. We might therefore infer from this that the risks of hitting the zero bound to interest rates are small.

Note that experiencing zero nominal interest rates is not in itself costly. But the time spent at zero interest rates indicates time during which central banks will be deprived of the usual tool for stimulating the economy. Whether this turns out to involve costs depends on how much interest rate stimulus central banks would have liked to inject. Time spent at the zero bound could prove to be entirely costless. At the other extreme, if the economy suffered a sufficiently large fall in demand, it could succumb to a deflationary spiral. The studies summarised in Chart 2 suggest that the risks of entering a deflationary spiral—where interest rates never escape the zero bound, and output and inflation fall continuously—are very small indeed. For example, Hunt and Laxton (2001), report that at an average inflation rate of 2% there is virtually no chance of the economy entering a deflationary spiral.(5)

These statistics provide a useful starting point for an analysis of how policy should address the zero-bound problem. But how reliable are estimates of this kind, and what can we infer from them? The estimates will of course be as uncertain as the assumptions on which they

(1) For commentaries on the recent Japanese situation, see Ahearne *et al* (2002), Posen (2002 a, b).
(2) Some of the results in Hunt and Laxton (2001) are also presented in a box authored by Hunt in Chapter 2 of the *IMF World Economic Outlook*, May 2002, page 93, entitled 'Can inflation be too low?', within the essay 'Monetary policy in a low inflation era', by Terrones and Sgherri.
(3) Note that some of the numbers in this chart are approximate, based on estimating numbers presented graphically in the original studies.
(4) Note that these studies attempted to describe different economies. Hunt and Laxton (2001) simulate the Japan block of the IMF MULTIMOD model; Reifschneider and Williams (2000) present simulations of the Federal Reserve Board model of the US economy; Orphanides and Wieland (1998) is a model of the United States; Black *et al* (1998) and Cozier and Lavoie (1994) use models of the Canadian economy.
(5) The risk of entering a deflationary spiral is proxied by recording the proportion of simulations that included zero-bound episodes where the economy was not stabilised. The statistics recorded in Chart 2 itself, on the other hand, are based on calculating time spent at the zero bound as a proportion of total simulation time, but only for those simulations in which the economy was stabilised, and therefore did not enter a deflationary spiral.

are based, so this article turns next to examine some of these assumptions more closely.

Estimates of the risk of experiencing a zero interest rate episode will depend crucially on what is assumed about how often the economy experiences falls in demand, and how large these shocks tend to be. The larger the recessionary shocks a central bank must offset, the greater the risk of hitting the zero bound. Getting an estimate of the average size of shocks from historical data involves distinguishing between the effects of previous policy regimes on variables like inflation and output, which will no longer be relevant, and genuine disturbances, which will. We might observe that in the past output and inflation have fallen, but we do not know if that happened in spite of policy, or because of it. We can attempt to separate out the influences of policy and genuine recessionary shocks on output and inflation in the past, but our techniques for doing this will give us estimates that we must treat as uncertain. In most cases, the shocks used in the simulations reflect the differences observed in the past between the predictions of model and actual outturns for data. But the models are not perfect descriptions of the economy. And so the 'shocks' estimated in this way will not match the news that prompted central banks to act, but will mix in problems that the model has in fitting the data. Finally, even if we can get a good estimate of the size of recessionary shocks in the past, there is no guarantee that this will be a good estimate of what will happen in the future.

To estimate the risk of hitting the zero bound we also need an estimate of the equilibrium real interest rate. The higher the equilibrium real interest rate, the higher the equilibrium nominal interest rate associated with a given inflation target.(1) The higher the equilibrium nominal interest rate, for a given inflation rate, the lower the risk, therefore, of hitting the zero nominal bound, since higher nominal interest rates make more 'room' for interest rate cuts to respond to shocks as they hit the economy. The equilibrium real interest rate is not directly observable. And estimates of it vary greatly. For example, estimates of the equilibrium real rate that inform the studies in Chart 2 vary by at least 3 percentage points.(2)

This amount of uncertainty about the equilibrium real rate translates into a great deal of uncertainty about the risks of hitting the zero bound. We can get an idea of this simply by using Chart 2. Raising the equilibrium real interest rate by 1 percentage point has the same effect on equilibrium nominal rates (and therefore the risk of hitting the zero bound) as raising the inflation objective by the same amount. Using the Reifschneider-Williams simulations, adding plus or minus 1 percentage point to the real rate (equivalent to adding plus or minus 1 percentage point to the target inflation rate) would change the estimate of the time spent at the zero bound when targeting 2.5% inflation from about 3% to around zero, or to about 7%, respectively.(3)

The risk that a fall in demand pushes interest rates to the zero bound will also depend on how the economy translates that fall in demand into changes in inflation and output. Therefore, our estimates of the risk of hitting the zero bound are also going to be uncertain to the extent that we are uncertain how well the model economies (like those on which Chart 2 is based) describe the real ones.

Preventative policies and the risk of hitting the zero bound to interest rates

The risks of hitting the zero bound are likely to be overstated for at least one reason. Experiments of the kind reported in Chart 2 illustrate the consequences of central banks sticking rigidly to particular interest rate reaction functions, and of the private sector expecting the central bank to do just that. This is a necessary abstraction but it may be misleading. These 'reaction functions' are a mechanical way of describing how the central bank in the model economy reacts to news; they typically assume that interest rates are increased by some fixed amount in response to some given increase of current inflation above the target, or of output above potential, and *vice versa*.(4) There are many ways in which the simple, mechanical reaction functions used

(1) Crudely, lenders want first to be compensated for the amount by which a nominal loan is eroded by inflation, and second, they require some real compensation for postponing consumption. The greater the real reward they demand, the greater the total nominal compensation they will demand.
(2) Orphanides and Wieland (1998) assume a value of 1% for the United States; Black *et al* (1998) assume a value of 4% for Canada.
(3) These are very crude guesses indeed. It is possible that equilibrium real rates themselves may be related to inflation, so a calculation like this is not as simple as suggested. And because the amount by which an increase in inflation reduces time spent at the zero bound itself depends on the starting inflation rate, so will the amount by which an increase in equilibrium real rates reduces the time spent at the zero bound.
(4) These are known as 'Taylor rules', after Taylor (1993), who first pointed out that reaction functions of this kind captured some of the features of the movement of actual central bank interest rates.

fall short of a description of policy in reality.(1) Most germane to the discussion here is that if the central bank is faced with a particularly large shock to demand that threatens to push interest rates to zero, central banks will have the option of cutting rates more aggressively in response to the initial shock, relative to the interest rate suggested by a typical reaction function. Central banks are therefore likely to be able to stabilise the economy more effectively than the simple rules used to compute the statistics in Chart 2 allow. Moreover, if it is open for central banks to cut rates more aggressively, arguably the private sector will expect them to do that and expected inflation will fall by less in response to the initial shock, which will mean that demand will turn out higher than otherwise.

So one form of preventative action open to policy is to be prepared to make aggressive interest rate cuts when a zero-bound incident threatens. But, it is argued, the chance of hitting the zero bound (for a given distribution of shocks, and for a given inflation rate) can also be reduced by a central bank resolving in normal times—when a zero-bound episode is not threatening—to make less marked changes in interest rates in response to news.

This sounds like a contradiction, but it is not. The argument was first made by Goodfriend (1991).(2) It runs as follows: the likelihood of hitting the zero bound depends on how much central banks have to move short interest rates to affect aggregate demand and counter the effects of a recessionary shock. The degree to which a change in short interest rates affects aggregate demand depends in part on how much a change in short rates is passed on to other, longer-maturity interest rates, which are relevant for a good deal of consumption and investment spending. Longer-maturity interest rates depend on expectations of short rates over the future. The more a change in short rates is expected to persist into the future, the greater the impact it will have on long rates and aggregate demand. A smaller change in short rates would therefore be needed initially to offset any decline in demand.

So, to recap, the more gradually a central bank moved interest rates in general, the smaller the amount of interest rate stimulus needed to counter any particular fall in demand, and, therefore, the less likely it would be that a central bank pursuing some given inflation target would be pushed to cut rates to the zero floor.

This kind of policy would therefore involve making a sacrifice in normal times (moving rates by less in response to most shocks, which would lead to inflation and output being more variable) in order to make it more likely that interest rate policy would still be available when the economy suffered a large fall in demand (by increasing the responsiveness of the economy to interest rates).

Reifschneider and Williams (2000) suggest an ingenious, but somehow unlikely, procedure for setting rates that would reap the benefits of the Goodfriend-Woodford interest rate policy in the face of a severe shock without paying the costs in normal times. The idea is that interest rates would not be set unduly gradually in normal times, so the benefits of normal interest rate policy would accrue. But when a zero-bound episode threatened, the central bank would first cut rates aggressively, and then announce that the rate cut would endure for longer than would normally have been the case had the economy not faced a zero-bound episode. Making a policy like this work in practice would be a challenge. There are two reasons why the benefits claimed for it might not be reaped. First, there is no simple, benchmark policy reaction function of the kind used to build models of the economy like those in Chart 2. Policy-setting typically involves weighing up information from many different sources and in ways that could vary over time. For this reason it is quite possible that the private sector would not fully appreciate the significance of the announced change in policy: if there is no simple rule to describe past policy, the contrast between some new policy and what went before is likely to be less apparent. Second, making an aggressive cut in rates and committing to keep rates lower than would otherwise be the case may be a commitment that is too complex to be readily communicable and therefore not easily verifiable, and, for that reason also not believed.

This discussion of the impact of expectations on policy underscores the benefits—in terms of the likelihood of hitting the zero bound—of the central bank's policy intentions being believed. We can observe, broadly, that the more faith the private sector has in the central bank's ability and inclination to pursue its announced targets, the less interest rates have to be cut to counter the effect of a fall in demand. If the private sector expects rates to be cut, expected inflation will be higher than otherwise, and real rates therefore lower, and that

(1) For a description of how policy decisions are arrived at in the United Kingdom, see Bean and Jenkinson (2001).
(2) It was later formalised by Woodford (1999).

itself will boost spending and inflation. In turn this means that more credible central banks would be better able to weather large shocks without hitting the zero bound to interest rates.

It might appear that we could conclude from estimates like those in Chart 2 that there exists another form of costless, preventative policy: that economies could realise a benefit by targeting a higher rate of inflation and reducing the risk of hitting the zero bound. In fact, we cannot conclude this. Targeting higher inflation, as Leigh-Pemberton (1992), King (2002) and others have pointed out, incurs significant costs. It is precisely to avoid these costs that the Government has mandated the Bank of England to target a relatively low rate of inflation.

Having discussed how policy can prevent a zero-bound episode occurring, the next section evaluates alternative ways of stimulating the economy when interest rate cuts are not possible.

3 Alternatives to stimulating the economy by cutting interest rates

Several alternative means of stimulating the economy have been suggested.

Stimulating the economy using fiscal policy

Although interest rates cannot be cut further at the zero bound, the authorities could boost demand by loosening fiscal policy (cutting taxes, raising expenditure). Indeed, in most developed economies, the United Kingdom included, policy is such that there are 'automatic' fiscal boosts at work when private demand falls. As economic activity contracts, expenditure on benefits tends to increase and tax revenues from wages and profits tend to fall, providing a boost to aggregate demand. No additional change in taxes or spending would necessarily be needed.

Using discretionary changes in fiscal policy—for example, cutting announced tax rates, rather than simply allowing a recession to cause tax revenues to fall—is also an option. But the benefits of varying spending plans and tax rates (lower inflation and output variability) have to be weighed against the costs. It is the desire to avoid these costs that motivates the UK Government's fiscal rules. Such rules make spending and taxes more predictable, and therefore make it easier for firms and consumers to plan for the future. Raising spending and lowering taxes to stimulate the economy could interfere with the provision of public services. Moreover, unlike monetary policy, fiscal policy is not administered through one single 'rate'—there are many taxes and many different types of spending. The administrative and legislative difficulties of varying these in an appropriate way make fiscal policy a sluggish instrument with which to stimulate the economy. Nevertheless, having access to a sluggish instrument would clearly be preferable to having no instrument at all.

Increasing liquidity through central bank purchases of illiquid private sector assets

Conventional money market operations aimed at stimulating the economy are thought not to work at zero nominal interest rates.(1) Such operations involve the central bank entering into a trade with the private sector: buying short-term bonds or bills and offering cash in exchange. At zero interest rates, this involves exchanging assets that are very similar. Neither cash nor bonds bear interest and neither is subject to any default risk. The trade leaves the private sector no better or worse off than before and so open market operations like this at zero interest rates do not stimulate spending in the economy.

Goodfriend (2000)(2) has suggested that the central bank could stimulate the economy by buying assets less similar to cash than normal: illiquid assets like infrequently traded bonds, or even claims on the private sector like shares or corporate bonds. An exchange like this would involve the private sector giving up an illiquid asset and taking a more liquid one, cash, in return. When we say that cash is more liquid than other assets we mean that it can, for example, be more readily transformed into something else that the owner wants. Money can be swapped for goods directly: other assets generally cannot. Having something that is more readily (more cheaply) turned into a good that can be consumed is valuable. Following an exchange of cash for illiquid bonds or shares the private sector would have more 'liquidity' and would therefore be better off. This would stimulate spending. By announcing that the central bank is prepared to engage in operations in formerly illiquid assets, these assets would themselves

(1) And, as Auberach and Obstfeld (2003) point out, when interest rates are not expected to rise in the future.
(2) Kiyotaki and Moore (2001) set out the economic theory behind this policy proposal. This kind of policy has some similarities with current monetary policy in Japan, which has seen the Bank of Japan buy long-dated government bonds. It is signalled as a possibility in remarks by Bernanke (2002).

become more liquid. That would cause their prices to rise, make private sector holders of those assets better off, and increase demand. Higher levels of spending would raise expected inflation and lower real rates, stimulating demand further, and so on, until a point was reached when normal interest rate policy could be effective again.

A policy of this kind would present three challenges. First, since the effectiveness of open market operations of this kind is uncertain, it would be difficult to judge how large purchases would have to be to achieve the desired amount of stimulus to aggregate demand. Second, the central bank would have to be careful to make purchases that increased the liquidity of all assets, and not just some: that would risk affecting how investors allocated their portfolios between assets. Third, buying assets of this kind would expose the central bank (and therefore the public sector as a whole) to greater financial risk than normal open market operations. To see this, suppose that the central bank decided to buy portfolios of long-dated bonds that were not formerly traded in large volumes in financial markets. These purchases would be made at a time when, because the nominal interest rate component of the bond was zero, the price was high. If the policy were successful, nominal interest rates would rise, and, for this reason, the price of the bond would fall. On this count, a successful intervention would reduce the net worth of the central bank. On the other hand, a successful intervention would also increase the amount of liquidity in the economy as a whole, and increase the price of all assets, including those the central bank had purchased. This would lead to a rise in the net worth of the central bank. Which effect would dominate, and therefore whether the central bank would be better or worse off, is not clear. That may depend on what happened when and if the central bank reversed the purchases in the future. But it is clear that the value of the central bank balance sheet would be more uncertain if it engaged in open market operations of this kind, and that in turn could imply a drain on fiscal policy.

Exchange rate devaluation by intervening in foreign exchange markets

Some[1] have suggested that the central bank could stimulate the economy by intervening in foreign exchange markets and depreciating the exchange rate. A central bank could announce an exchange rate target that implied a depreciation and promise to buy assets denominated in foreign currency at the lower exchange rate. A lower exchange rate would give a temporary stimulus to the economy as foreign demand for home-produced exports would increase as their price in terms of foreign currency would fall.[2]

A central bank trapped at the zero bound and trying to devalue its exchange rate would be promising to sell its own currency in exchange for foreign currency assets. If the authorities were so minded, the only limit on reserves of its own currency would be how fast it could run the printing presses. It would therefore be in a more powerful position than central banks trying to promise not to devalue the exchange rate. In those circumstances, the central bank promises to buy its own currency in exchange for foreign currency reserves.

A central bank trying to defend an exchange rate that was 'too high' (relative to fundamentals) would find that it could not credibly promise to buy unlimited quantities of its own currency using foreign assets because its reserves of foreign currency were limited. Market participants would be aware of this and would therefore expect the exchange rate to depreciate despite attempts to defend it by the central bank, and that expectation would make it more likely still that the depreciation happened. The effects of expectations would work the opposite way for a central bank trying to bring about and defend (rather than avoid) a devaluation. There, the expectation that a central bank could print money to buy foreign exchange may mean that it would never have to do so.

However, an exchange rate devaluation of this kind may involve some drawbacks. In order to 'defend' the lower exchange rate, the central bank would have to make a credible promise to print unlimited quantities of its own currency to buy foreign assets. A promise of this kind would run counter to the original aims of monetary policy (monetary stability): a risk is that it would, for this reason, not be believed. However, if a promise like this were believed, another risk is that it would undermine the credibility of promises not to engage in these policies in normal times. When a central bank is mandated to follow an inflation target, that commitment rules out conducting unlimited quantities of market operations by running the printing presses. The

(1) See, for example, Meltzer (1999), Svensson (2001) and McCallum (2000).
(2) Real interest rates would also fall temporarily, as consumers would expect temporarily higher inflation while the depreciation passed through into import prices, and this in turn would stimulate aggregate demand.

challenge would be to make a credible promise to stand ready to use potentially unlimited monetary financing during a zero-bound episode, while making a credible promise not to use tools like this in normal times.

An exchange rate depreciation would obviously affect the trading partners of an economy trapped at zero interest rates. Other things being equal, trading partners would experience lower aggregate demand for a short while. The success of this policy would therefore rely on the authorities in those countries not acting to try to undo the depreciation. If the fall in demand that hit the economy trapped at the zero bound had also affected its trading partners, it is likely that the foreign country would (other things being equal) not want to bring about an appreciation of its own currency, which would reduce demand in that economy (as the demand for its exports would fall). However, it may be that those countries would prefer to tolerate the tighter monetary conditions that an appreciation of their currencies would imply rather than see the 'problem' economy trapped at the zero bound, which could depress demand for their exports indefinitely.

Gesell money—a tax on money balances

Another proposal is attributed to Gesell.(1) He suggested taxing balances of cash. Recall that the reason interest rates cannot fall below zero is that the costs of holding cash are negligible. If there are no costs to holding cash, an investor will always prefer holding cash to a bond yielding a negative interest rate, even if the benefits that cash confers in terms of making transactions easier have been exhausted, since cash will generate a better return: zero. However, if cash balances are taxed, an investor may be prepared to hold bonds even at a negative interest rate to avoid paying the tax.

Policies of this kind would themselves impose considerable costs on the economy, because they would greatly erode the convenience value of cash. The problem for the cash tax collector would be to persuade anonymous holders of cash to register their balances to be taxed. Goodfriend (2000) proposed that the tax be collected at the point a note re-enters the banking system. Some technology that recorded how long a note had been outside the banking system would be inserted into notes. Notes that had been circulating for longer outside banks would be subject to more tax. This would mean that 'old' cash that had been circulating for a while would be worth less than 'new' cash. (Old cash would be taxed at a higher rate when it re-entered the banking system.) Individuals would have to keep a careful note of the ages of currency they were offered, to make sure they had made a fair exchange: the cost of this policy is the burden that this extra monitoring would impose. Note too that unless the tax moved in synchronicity with the interest rate, this policy, even if introduced temporarily, would impose the same costs that inflation itself brings about. Both erode the real value of cash and encourage the private sector to waste resources economising on cash balances. Money taxes would therefore work against the original purpose of monetary policy and these costs would have to be set against the benefits of any stimulus.

Increasing private sector wealth through money transfers

Another policy that has been proposed is to print more money and to transfer it to the private sector. To recap, normal open market operations involve the central bank and the private sector exchanging cash for bonds, making mirror-image changes in the public and private sector portfolio of assets. However, a money transfer would involve printing money and giving it to the private sector, taking nothing in exchange. If this money were valued by those that received it, they would feel wealthier, and their spending would rise.(2)

There are many difficulties that a money transfer of this kind would entail. Literally distributing money among the population in a way that does not impose costs on the economy by affecting the current distribution of income and wealth is likely to be administratively infeasible. One possibility is that money is printed to finance a tax cut, given some level of government expenditure.(3)

A policy of this kind would affect the credibility of monetary and fiscal policy. On the one hand, a successful money transfer could enhance the credibility

(1) The intellectual pedigree of this idea is traced by Goodfriend (2000) in a helpful footnote on page 1,008 of his paper. Both Buiter and Panigirtzoglou (1999) and Goodfriend point out that Keynes credits Gesell with the original idea. Buiter and Panigirtzoglou (1999) point out that Gesell-like schemes have been tried, for reasons not connected with the zero bound, in Alberta in Canada, and in Austria in the 1930s.
(2) If private individuals expected that the increase in their nominal money balances would lead to an immediate price level increase that left their consumption possibilities unchanged, or if agents anticipated that debt transfers to them would be financed by future taxation, they would not feel any better off after the money transfer.
(3) This is, however, contrary to the provisions of Article 101 of the EC Treaty.

of policy if it were to mean that deviations of inflation from its target were smaller than otherwise. On the other hand, monetary financing of this sort is typically a feature of very high inflation regimes, regimes that often have very unsound public finances. A risk is that the authorities would be suspected of engaging in monetary financing in normal times, not just when interest rates were held at the zero bound.

At some point, if deflation set in, the fall in the price level would increase the real value of money holdings without the authorities printing any money.(1) Existing nominal money holdings would be worth more in terms of goods. So some kind of stimulus would come from that source, though how much and how soon is not clear. Waiting for deflation would also bring with it contractionary effects, as Bean (2002) and King (1994) explain.

Selling options to underpin a promise to keep interest rates at zero

Tinsley (1999) proposed that a central bank sell options to underpin a promise to keep interest rates at zero in the future. Suppose that interest rates were at the zero bound, but expected to be there only temporarily. Suppose too that a central bank would achieve a better outcome for inflation and output if it could convince the private sector that interest rates would be held at zero for longer. This would lower longer-term nominal rates and stimulate aggregate demand, perhaps sufficiently so that the zero constraint on interest rates no longer binds, or binds for a shorter length of time. Tinsley (1999) pointed out that if a central bank had difficulty in convincing the private sector that rates would indeed be held lower for longer, it could enter into (options) contracts with it that would penalise the central bank were interest rates to rise above the promised level. It is possible that long rates may have a premium built into them because of the uncertainty about the path of nominal rates in the future. Tinsley argued that committing to contracts of this sort could reduce that uncertainty and lower long rates for this reason too.

It is worth making three remarks about Tinsley's proposal. First, if holding interest rates at zero for a long time were consistent with meeting the central bank's mandate, then only a central bank with a credibility problem—one that was not expected to follow its mandate, or one whose mandate was unclear—would benefit from entering into contracts of this sort.

Second, a policy of this kind would be no help if the fall in demand was so severe as to mean that short-term interest rates were not only at zero but expected to be there indefinitely. Third, it is likely that only very large penalties would dissuade a central bank from raising interest rates if better inflation and output control would result from it (since the social return from doing so is likely to be large). Holding such large potential liabilities (large potential penalties if interest rates are raised) on its balance sheet may be undesirable in itself.

4 Summary and conclusions

Recent low levels of interest rates have led some to speculate about the risks of interest rates being driven down to the zero-bound constraint, and of the economy entering a deflationary spiral. The risk is underscored by the current experience of Japan, and by that of the United States in the 1930s. Although we cannot infer anything very precise from these episodes about how significant the risks of hitting the zero bound are elsewhere (since we cannot easily abstract from the many specific aspects of the regimes or the economies of 1930s' United States or present-day Japan), we might conclude nonetheless that the circumstances that brought about these events are not likely to repeat themselves in the United Kingdom.

Studies that simulate models of economies and central banks pursuing inflation targets suggest that the risks of hitting the zero bound are small, and the risk of entering a deflationary spiral is very small indeed. These studies are forced to simplify the behaviour of central banks that pursue inflation objectives by positing simple policy reaction functions that do not accurately describe actual central bank behaviour. They therefore overstate the risks of hitting the zero bound, since they cannot allow for the possibility that the central bank could make significant pre-emptive cuts in interest rates to avoid hitting it.

Many alternatives to conventional interest rate policy have been suggested, were the zero bound to be reached. Automatic fiscal stabilisers are typically always at work (an increase in expenditure on benefits, and a fall in tax revenues) and will still work when interest rates are held at zero. The central bank could inject liquidity into the private sector by buying illiquid bonds or private sector assets, or intervene in foreign exchange markets to devalue the exchange rate and stimulate the export sector of the economy. It could in principle

(1) A point first made by Pigou (1943).

attempt to tax cash holdings, engage in money transfers, or enter into financial contracts with the private sector to underpin a promise to keep short nominal rates at zero for a period of time, and thereby reduce long rates.

These policies are largely untried in modern times, may expose the central bank to risks, or impose other costs on the economy. Against this, simply the expectation that these policies are workable parts of the central bank armoury could be beneficial. For example, the expectation of a successful open market operation to buy private sector assets could increase expected inflation and reduce real interest rates directly, boosting aggregate spending in the way needed, even if nominal interest rates looked likely to head towards the zero bound.

The largely untried and uncertain nature of alternatives to cutting interest rates prompted Fuhrer and Sniderman (2000) to observe that 'prevention is likely easier than cure' (page 845). Since the risks of hitting the zero bound in pursuit of an inflation target like that in place in the United Kingdom are likely to be very small, we might nevertheless conclude that there is enough 'prevention' built into the UK monetary framework.

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