Chapter 7: Quantitative vs. Credit Easing

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In Chapter 6, we studied one kind of unconventional monetary policy: forward guidance, i.e. communication about future policy interest rates.

In Chapter 7, we will study two other kinds of unconventional monetary policy: quantitative easing and credit easing.

Broadly speaking,

- “quantitative easing” (QE) refers to an increase in bank reserves (on the liability side of the central bank’s balance sheet),
- “credit easing” (CE) refers to an increase in private loans and securities (on the asset side of the central bank’s balance sheet).

According to these definitions,

- the Bank of Japan has conducted QE from 2001 to 2006,
- the Federal Reserve has been conducting CE since 2008.
“In Bernanke’s (2009) words I

“The Federal Reserve’s approach to supporting credit markets is conceptually distinct from quantitative easing (QE), the policy approach used by the Bank of Japan from 2001 to 2006. Our approach — which could be described as ‘credit easing’ — resembles quantitative easing in one respect: It involves an expansion of the central bank’s balance sheet. However, in a pure QE regime, the focus of policy is the quantity of bank reserves, which are liabilities of the central bank; the composition of loans and securities on the asset side of the central bank’s balance sheet is incidental. Indeed, although the Bank of Japan’s policy approach during the QE period was quite multifaceted, the overall stance of its policy was gauged primarily in terms of its target for bank reserves.”
In Bernanke’s (2009) words II

In contrast, the Federal Reserve’s credit easing approach focuses on the mix of loans and securities that it holds and on how this composition of assets affects credit conditions for households and businesses. This difference does not reflect any doctrinal disagreement with the Japanese approach, but rather the differences in financial and economic conditions between the two episodes. In particular, credit spreads are much wider and credit markets more dysfunctional in the United States today than was the case during the Japanese experiment with quantitative easing. To stimulate aggregate demand in the current environment, the Federal Reserve must focus its policies on reducing those spreads and improving the functioning of private credit markets more generally.”
The past two years have also seen dramatic developments with regard to the composition of the asset side of the Fed's balance sheet (Fig. 2). Whereas the Fed had largely held Treasury securities on its balance sheet prior to the fall of 2007, other kinds of assets—a variety of new "liquidity facilities", new programs under which the Fed essentially became a direct lender to certain sectors of the economy, and finally targeted purchases of certain kinds of assets, including more than a trillion dollars' worth of mortgage-backed securities—have rapidly grown in importance, and decisions about the management of these programs have occupied much of the attention of policymakers during the recent period. How should one think about the aims of these programs, and the relation of this new component of Fed policy to traditional interest-rate policy? Is Federal Reserve credit policy a substitute for interest-rate policy, or should it be directed to different goals than those toward which interest-rate policy is directed?

These are clearly questions that a theory of monetary policy adequate to our present circumstances must address. Yet not only have they been the focus of relatively little attention until recently, but the very models commonly used to
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Glossary

The basic New Keynesian model is unable to capture any role for these unconventional policies, because it has

- no financial exchanges (as all households are identical),
- no financial frictions (as loans are costless and safe).

To analyze these policies, we will use Cúrdia and Woodford’s (2011) model, which introduces, into the basic New Keynesian model,

- heterogeneity across households (to generate financial exchanges),
- financial intermediaries (to generate financial frictions).
Outline of the chapter

1. Introduction
2. Model
3. Quantitative easing
4. Credit easing
Each household $i$ seeks to maximize

$$\mathbb{E}_0 \sum_{t=0}^{+\infty} \beta^t \left\{ u^{\tau_t(i)} [c_t(i)] - \int_0^1 v^{\tau_t(i)} [h_t(j; i)] \, dj \right\},$$

where $\tau_t(i) \in \{b, s\}$ is household $i$’s type at date $t$,

$$u^\tau (c) \equiv \frac{c^{1-\sigma^\tau}}{1-\sigma^\tau} \quad \text{and} \quad v^\tau (h) \equiv \frac{\psi^\tau}{1+\nu} h^{1+\nu},$$

with $\sigma^\tau > 0$, $\nu > 0$, and $\psi^\tau > 0$ for $\tau \in \{b, s\}$.

Type $b$ will stand for “borrower”, type $s$ for “saver”.

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Households’ types

- At each date, with probability $\delta$, the type remains the same as in the previous date.

- With probability $1 - \delta$, the type is drawn again:
  - it is $b$ with probability $\pi_b$,
  - it is $s$ with probability $\pi_s = 1 - \pi_b$.

- Therefore, under adequate initial conditions, the population fractions of the two types are constant over time, equal to $\pi_\tau$ for each type $\tau$.

- It is assumed that $u^b_C(c) > u^s_C(c)$ for all values of $c$ that can occur in equilibrium.

- So, for the same consumption level, households of type $b$ value more marginal consumption than households of type $s$. 
Marginal utilities of consumption for the two types

Source: Cúrdia and Woodford (2010). The values $\bar{c}^s$ and $\bar{c}^b$ indicate the steady-state consumption levels of the two types, and $\bar{\lambda}^s$ and $\bar{\lambda}^b$ the corresponding marginal utilities.
Households can

- save only by depositing funds with financial intermediaries, at the one-period nominal interest rate $i^d_t$,
- borrow only from financial intermediaries, at the one-period nominal interest rate $i^b_t$.

Only one-period riskless nominal contracts with the intermediaries are possible for either savers or borrowers.

There is also one-period riskless nominal government debt, which for households is a perfect substitute to deposits with intermediaries.
Without any insurance mechanism, each household’s current consumption decision would depend on his/her whole type history.

Therefore, the distribution of consumption across households would become more and more dispersed over time.

To avoid this complexity, it is assumed that households

- originally start with identical financial wealth,
- are able to sign state-contingent contracts with one another, through which they may insure one another against idiosyncratic risk,
- are able to receive transfers from the insurance agency only when they draw a new type (and before knowing this type).
An insurance mechanism to simplify aggregation II

- These state-contingent contracts will be such that all households drawing their types at the same date will have the same marginal utility of income at that date before learning their new types (if each has behaved optimally until then).

- Given that they have identical continuation problems at that time (before learning their new types), these contracts will be such that they have the same post-transfer financial wealth at that date (if each has behaved optimally until then).

- Contractual transfers are contingent only on the history of aggregate and idiosyncratic exogenous states, not on households’ actual wealths (otherwise this would create perverse incentives).
It can be shown that, under certain conditions, households that have not re-drawn their type have the same marginal utility of income as households that have re-drawn their type and are of the same type.

Therefore, in equilibrium, the marginal consumption utility of any given household $i$ at any given date $t$ depends only on its type at this date: $\lambda_t(i) = \lambda_{\tau t}(i)$.

Therefore, in equilibrium, the consumption of any given household $i$ at any given date $t$ depends only on its type at this date: $c_t(i) = c_{\tau t}(i)[\lambda_{\tau t}(i)]$.

This insurance mechanism facilitates aggregation, as the goods-market clearing condition can then be written $Y_t = \sum_{\tau \in \{b, s\}} \pi_{\tau} c^\tau (\lambda_{\tau t}) + \Xi_t$, where $\Xi_t$ denotes resources consumed by intermediaries.
Euler equations

- It can be shown that, under certain conditions, in equilibrium,
  - households of type $s$ always have positive savings,
  - households of type $b$ always borrow.

- Therefore, the intertemporal first-order conditions of households’ optimization programs are

$$
\lambda_t^\tau = \beta E_t \left\{ \frac{1 + i_{t-1}^b 1_{\tau=b} + d_{t-1}^b 1_{\tau=s}}{\Pi_{t+1}} \left[ [\delta + (1 - \delta) \pi_t] \lambda_{t+1}^\tau + (1 - \delta) \pi_{-\tau} \lambda_{t+1}^{-\tau} \right] \right\}
$$

for each type $\tau \in \{b, s\}$, where for either type $\tau$, $-\tau$ denotes the opposite type, and $\Pi_{t+1} \equiv \frac{P_{t+1}}{P_t}$ denotes the gross inflation rate.

- Compared to the basic New Keynesian model, there are two Euler equations, not just one.
Let $\omega_t \equiv \frac{i^b_t - i^d_t}{1 + i_t^q}$ denote the credit spread.

Let $\Omega_t \equiv \frac{\lambda^b_t}{\lambda^s_t}$ be a measure of financial-intermediation inefficiency.

Log-linearizing the two Euler equations and subtracting one from the other gives

$$\hat{\Omega}_t = \hat{\omega}_t + \mu E_t \hat{\Omega}_{t+1},$$

where $\mu < 1$ and variables with hat denote log-linearized variables.

This equation can be solved forward to give $\hat{\Omega}_t = E_t \sum_{j=0}^{+\infty} \mu^j \hat{\omega}_{t+j}$. 
Log-linearizing the goods-market-clearing condition and using it to compute a weighted average of the two log-linearized Euler equations gives the following IS equation:

$$\hat{Y}_t = \mathbb{E}_t \hat{Y}_{t+1} - \frac{1}{\sigma} \left( \hat{i}_{t}^{\text{avg}} - \mathbb{E}_t \hat{\pi}_{t+1} \right) - \mathbb{E}_t \Delta \hat{\Xi}_{t+1} - k_1 \hat{\Omega}_t + k_2 \mathbb{E}_t \hat{\Omega}_{t+1},$$

where $\sigma > 0$, $k_1 > 0$, $k_2 > 0$, and $\hat{i}_{t}^{\text{avg}} \equiv \pi_{b} \hat{i}_t^b + \pi_{s} \hat{i}_t^d = \hat{i}^d_t + \pi_{b} \hat{\omega}_t$.

Compared to the basic New Keynesian model, what matters for aggregate-demand determination is not only the expectation of the future path of the general level of interest rates $\hat{i}_{t}^{\text{avg}}$, but also the expectation of the future path of the credit spread $\hat{\omega}_t$ (via $\hat{\Omega}_t$).
The log-linearized Phillips curve is of the form

\[ \pi_t = \beta E_t \pi_{t+1} + \kappa \hat{\psi}_t + k_3 \hat{\Omega}_t - k_4 \hat{\Xi}_t, \]

where \( \kappa > 0, \ k_3 > 0, \) and \( k_4 > 0. \)

Compared to the basic New Keynesian model, the main change is the presence of the terms \( k_3 \hat{\Omega}_t \) and \( -k_4 \hat{\Xi}_t, \) which capture the effects of credit frictions.
Case where $\hat{\omega}_t$ and $\hat{\Xi}_t$ are exogenous 1

- In the case where both $\hat{\omega}_t$ and $\hat{\Xi}_t$ can be treated as exogenous (and hence so can $\hat{\Omega}_t$), $(\pi_t, \hat{Y}_t, \hat{i}_{t}^{avg}, \hat{i}_{t}^{d})_{t \in \mathbb{Z}}$ is determined by
  - the Phillips curve,
  - the IS equation,
  - the equation $\hat{i}_{t}^{avg} = \hat{i}_{t}^{d} + \pi_b \hat{\omega}_t$,
  - the policy-interest-rate rule for $\hat{i}_{t}^{d}$.

- Moreover, in this case, assuming an optimal employment subsidy, the second-order approximation of the weighted average of households' utility functions is

$$L_t = \mathbb{E}_t \sum_{k=0}^{+\infty} \beta^k \left[ \pi_{t+k}^2 + \bar{\lambda} \left( \hat{Y}_{t+k} - \hat{Y}_{t+k}^n \right)^2 \right]$$

with $\bar{\lambda} \equiv \frac{k}{\varepsilon}$, where $\varepsilon$ denotes the elasticity of substitution between differentiated goods and $Y_t^n$ the natural (i.e., flexible-price) level of output.
Case where $\hat{\omega}_t$ and $\hat{\Xi}_t$ are exogenous II

- Therefore,

  - the determination of optimal mon. policy is the same as in Chapter 2,
  - the implementation of monetary policy is the same as in Chapter 3.

- The only differences are that

  - the reduced-form coefficients are different: $(\bar{\kappa}, \bar{\lambda}, \bar{\sigma}) \neq (\kappa, \lambda, \sigma)$,
  - the exogenous shocks now have financial components.
Financial intermediaries

- Financial intermediaries
  - take deposits, on which they pay the nominal interest rate \( i^{d}_t \),
  - make loans, on which they demand the nominal interest rate \( i^{b}_t \),
  - holds \( M_t \) reserves at the central bank, on which they receive the nominal interest rate \( i^{m}_t \).

- Although they are perfectly competitive, we have \( \omega_t > 0 \) because
  - they use resources to originate loans,
  - they cannot distinguish between good borrowers (who will repay their loans) and bad ones (who will not), so that they charge a higher interest rate to all borrowers.
More specifically, we assume that for any $L_t$ good loans originated,

- there are $\chi_t(L_t)$ bad loans originated, with $\chi'_t \geq 0$ and $\chi''_t \geq 0$,
- $\Xi^p_t(L_t; m_t)$ resources must be consumed, with $\Xi^p_{LL,t} \geq 0$, $\Xi^p_{mm,t} \leq 0$, $\Xi^p_{Lm,t} \geq 0$, and $\Xi^p_{Lm,t} \leq 0$, where $m_t \equiv \frac{M_t}{P_t}$,
- there exists a finite satiation level of reserve balances $\overline{m}_t(L_t)$, defined as the lowest value of $m$ for which $\Xi^p_{m,t}(L_t; m) = 0$.

We also assume that deposits are acquired in the maximum quantity $d_t$ that can be repaid from the anticipated returns of the assets:

$$(1 + i^d_t)d_t = (1 + i^b_t)L_t + (1 + i^m_t)m_t.$$
At each date $t$, financial intermediaries choose $L_t$ and $m_t$ so as to maximize their distribution of earnings to their shareholders

$$d_t - m_t - L_t - \chi_t(L_t) - \Xi^p_t(L_t; m_t),$$

taking $i^b_t$, $i^d_t$ and $i^m_t$ as given.

The first-order conditions are

$$\Xi^p_{L,t}(L_t; m_t) + \chi_{L,t}(L_t) = \omega_t \equiv \frac{i^b_t - i^d_t}{1 + i^d_t},$$

$$-\Xi^p_{m,t}(L_t; m_t) = \delta_t = \frac{i^d_t - i^m_t}{1 + i^d_t},$$

and give the two spreads as functions of $L_t$ and $m_t$. 
The central bank uses its liabilities $m_t$ to fund its assets: loans to the private sector $L_t^{cb}$ and holdings of government debt.

Therefore, two (unconventional) policy instruments are $m_t$ and $L_t^{cb}$, subject to $0 \leq L_t^{cb} \leq m_t$.

The resource cost of central-bank extension of credit to the private sector is $\Xi_t^{cb}(L_t^{cb})$, with $\Xi_t^{cb'}(0) > 0$ and $\Xi_t^{cb''} \geq 0$.

A third and last (conventional) policy instrument is the interest rate $i_t^d$.

So there are three independent dimensions of central-bank policy:

- interest-rate policy ($i_t^d$),
- reserve-supply policy ($m_t$),
- credit policy ($L_t^{cb}$).
Optimal reserve-supply policy

- Optimal policy requires that financial intermediaries be satiated in reserves: 
  \( m_t \geq \overline{m}_t(L_t) \), since

  - for \( m_t < \overline{m}_t(L_t) \), raising \( m_t \) increases welfare by reducing both \( \Xi_t^p \) and \( \omega_t \) (for a given \( L_t \)),
  - for \( m_t \geq \overline{m}_t(L_t) \), raising \( m_t \) affects neither \( \Xi_t^p \) nor \( \omega_t \) (for a given \( L_t \)), and hence does not affect welfare.

- This is a Friedman-rule-type result, but one that has no consequences for interest-rate policy.

- Indeed, it implies only that the interest-rate differential \( \delta^m_t \) should be equal to zero at all times, so that the central bank is still free to set its policy interest rate \( i_t^d \) as it wants.
Is a reserve-supply target needed?

- Should the monetary-policy committee take a decision on $m_t$, in addition to a decision on $i_t^d$, at each of its meetings?

  - No need: it is equivalent and simpler to
    - use $i_t^m$, rather than $m_t$, as the instrument,
    - mechanically set $i_t^m$ equal to $i_t^d$,
    - let the central-bank staff adjust $m_t$ accordingly.

- In practice,
  - the Bank of Canada sets $i_t^m$ only 25 basis points lower than $i_t^d$,
  - the Reserve Bank of New Zealand set $i_t^m$ equal to $i_t^d$. 
Is there a role for quantitative easing? I

- Quantitative easing refers to an increase in the supply of reserves $m_t$ beyond the satiation level $\bar{m}_t(L_t)$ for a given quantity of central-bank loans to the private sector $L_t^{cb}$.

- The model implies that there is no benefit from quantitative easing.

- It can be desirable to set $m_t > \bar{m}_t(L_t)$ only if this is necessary to set the optimal $L_t^{cb}$ (as $L_t^{cb} \leq m_t$).

- As can be seen on Slide 6, the Federal Reserve financed its newly created liquidity and credit facilities
  - first by reducing its holding of Treasury securities,
  - then by increasing reserves, but only when it decided to expand these facilities beyond the scale that could be entirely financed by reducing its holding of Treasury securities.
Is there a role for quantitative easing? II

The Bank of Japan’s policy from March 2001 to March 2006 was a quantitative-easing policy because

- its aim was to increase the supply of reserves (or, equivalently, the monetary base), rather than to acquire any particular type of assets,
- the assets purchased consisted primarily in Japanese government securities and bills issued by commercial banks.

In accordance with the model’s predictions, this policy seems to have had little effect on aggregate demand, as apparent on the next slide.
Monetary base and nominal GDP in Japan, 1990-2009

Source: Cúrdia and Woodford (2011). The shaded region shows the quantitative-easing period.
Optimal credit policy I

- Let us now (numerically) determine optimal credit policy
  - under the assumption that reserve-supply policy is optimal, so that
    \[ \Xi_t^P(L_t; m_t) = \Xi_t^P(L_t; \overline{m}_t(L_t)) \equiv \Xi_t^P(L_t), \]
    \[ \omega_t(L_t; m_t) = \omega_t(L_t; \overline{m}_t(L_t)) \equiv \overline{\omega}_t(L_t), \]
  - under various alternative assumptions about interest-rate policy.

- A rise in \( L_{t}^{cb} \) can increase welfare on two grounds: for a given volume of private borrowing \( L_t + L_{t}^{cb} \), it decreases the volume of private lending \( L_t \), which reduces
  - the resources \( \Xi_t^P \) consumed by the intermediary sector,
  - the equilibrium credit spread \( \omega_t \) (and hence \( \hat{\Omega}_t \)).
Optimal credit policy II

- If central-bank policy were costless, then the optimal credit policy would be such that $L_t = 0$.

- If $\Xi_{cb}^c(0)$ is large enough, then the optimal credit policy is $L_{ct}^{cb} = 0$.

- The model is calibrated such that the optimal credit policy
  - is $L_{ct}^{cb} = 0$ at the steady state,
  - may be such that $L_{ct}^{cb} > 0$ for large enough financial shocks.

- These financial shocks are exogenous shifts in the functions $\Xi_t^p(L)$ or $\chi_t(L)$ of a type that increase the equilibrium credit spread $\overline{\omega}_t(L)$ for a given volume of private credit.

- Credit-spread increases have been an important feature of the recent crisis, as apparent on the next slide.
Model
Quantitative easing
Credit easing

Introduction

Taylor (2008) has suggested that movements in this spread should be taken into account in an extension of his famous rule.

In addition to such new questions about traditional interest rate policy, the very focus on interest rate policy as the central question about monetary policy has been called into question. The explosive growth of base money in the United States since September 2008 (shown in Figure 2) has led many commentators to suggest that the main instrument of U.S. monetary policy has changed from an interest rate policy to one often described as "quantitative easing." Does it make sense to regard the supply of bank reserves (or perhaps the monetary base) as an alternative or superior operating target for monetary policy?

Does this (as some would argue) become the only important monetary policy decision once the overnight rate (the federal funds rate) has reached the zero lower bound, as it effectively has in the United States since December 2008 (Figure 3)?

And now that the Federal Reserve has legal authorization to pay interest on reserves (under the Emergency Economic Stabilization Act of 2008), how should this additional potential dimension of policy be used?

The past two years have also seen dramatic developments in the composition of the asset side of the Fed's balance sheet (Figure 4). Whereas the Fed had largely held Treasury securities on its balance sheet before the fall of 2007, other kinds of assets—including both a variety of new "liquidity facilities" and new program under which the Fed has essentially become a direct lender to certain sectors of the economy—have rapidly grown in importance. How to manage these program has

Source: Cúrdia and Woodford (2010).
Four kinds of financial shocks I

- Let \( \Xi^{cb',crit} \) denote the minimal marginal cost of central-bank lending \( \Xi^{cb'}(0) \) required for \( L_{t}^{cb} = 0 \) (“Treasuries only”) to be optimal.

- The model’s calibration is such that
  - \( \Xi^{P'} \) is 2.0 percent per annum at the steady state,
  - \( \Xi^{cb',crit} \) is nearly 3.5 percent per annum at the steady state.

- We distinguish between
  - “additive shocks”, which translate the schedule \( \overline{\omega}_{t}(L) \) vertically by the same amount,
  - “multiplicative shocks”, which multiply the entire schedule \( \overline{\omega}_{t}(L) \) by some constant factor greater than 1.
We also distinguish between

- “Ξ shocks”, which change the function $\Xi^P_t(L)$,
- “χ shocks”, which change the function $\chi_t(L)$.

The next slide plots the dynamic response of $\Xi^{cbl,crit}$ to each of the four kinds of financial shocks

- under optimal reserve-supply and interest-rate policies,
- for an initial increase in $\bar{\omega}_t(L)$ of 4 percentage points per annum, from $\bar{\omega} = 2.0\%$ to $\bar{\omega}_0(L) = 6.0\%$,
- for a subsequent decrease in $\omega_t(L)$ according to $\bar{\omega}_t(L) = \bar{\omega} + [\bar{\omega}_0(L) - \bar{\omega)]\rho^t$, where $\rho = 0.9$.

These shocks are small enough for the Zero-Lower-Bound constraint not to be binding under optimal interest-rate policy.
Response of $\Xi_{cb', crit}$ under optimal interest-rate policy

Source: Cúrdia and Woodford (2011).
The optimal credit-policy response to the credit-spread increase depends on the nature of the financial shock.

When the credit-spread increase is due to a multiplicative $\Xi$ shock,
- the resource cost $\Xi^p$ increases,
- the credit spread $\overline{\omega}$ increases as $\Xi^p'$ increases,
so that $\Xi^{cb',crit}$ increases substantially.

When the credit-spread increase is due to an additive $\Xi$ shock or a multiplicative $\chi$ shock, only one of these two effects is present, so that $\Xi^{cb',crit}$ increases more modestly.

When the credit-spread increase is due to an additive $\chi$ shock, none of these two effects is present, so that $\Xi^{cb',crit}$ actually decreases (due to the decrease in $L_t$).
Response of $\Xi^{cb',crit}$ under alternative IR policies

- Now consider the same financial shocks, but three times as large as previously, i.e. such that $\bar{\omega}_t(\bar{L})$ increases by 12% per annum.

- These shocks are large enough for the Zero-Lower-Bound (ZLB) constraint to be binding under optimal interest-rate policy.

- The next slide plots the dynamic response of $\Xi^{cb',crit}$ to these shocks under four alternative interest-rate (IR) policies:
  
  - the optimal IR policy without ZLB constraint (i.e. allowing for $i_t^d < 0$),
  - the optimal IR policy with ZLB constraint (i.e. Chapter 6’s optimal monetary policy under commitment),
  - the IR policy $i_t^d = \bar{r}^d + \phi_\pi \pi_t + \phi_y \hat{Y}_t$ without ZLB constraint,
  - the IR policy $i_t^d = \max[\bar{r}^d + \phi_\pi \pi_t + \phi_y \hat{Y}_t, 0]$ (close to Chapter 6’s optimal monetary policy under discretion),

where $\phi_\pi = 2$, $\phi_y = 0.25$, and $\bar{r}^d$ is the steady-state real policy interest rate.
The distortions created by a binding zero lower bound are even greater under the hypothesis that policy is conducted in a forward-looking way after the period in which the zero lower bound constrains the policy rate, so that there is no commitment to subsequent reflation of a kind that would mitigate the extent to which the zero bound results in an undesirably high level of the real policy rate. (An optimal interest-rate policy commitment, that takes account of the occasionally binding zero lower bound, will include a commitment to history-dependent policy of this sort, as discussed in Eggertsson and Woodford, 2003, and Cuúrdia and Woodford, 2010a. However, such policy requires a type of commitment that actual central bankers seem quite reluctant to contemplate, as discussed for example by Walsh, 2009.) If a binding zero lower bound coincides with this kind of expectations about future monetary policy, the marginal social benefit of credit policy may be much greater than would be suggested by Fig. 4.

This is illustrated by Fig. 5, where the responses of $\Xi^{cb', crit}$ under alternative IR policies are considered. The figure shows the responses of $\Xi^{cb, crit}_t$ under two different assumptions about interest-rate policy: in the top panels, interest-rate policy is assumed to be optimal, while in the bottom row it is assumed to follow a Taylor rule of the form

$$i_t = \max\{r + f_{pp} + f_y \cdot \frac{\bar{Y}_t}{\bar{Y}}, 0\}$$

Here written so as to respect the zero lower bound on short-term nominal interest rates. In this equation, $p_t$ is the inflation rate, $\bar{Y}_t/\bar{Y}$ is the real output gap, and $r$ is the steady-state real policy rate, so that the policy rule is consistent with the zero-inflation steady state (discussed above) in the absence of disturbances. The Taylor-rule coefficients are assigned the values $f_{pp} = 2$, $f_y = 1/4$, in rough accordance with estimates of US monetary policy in recent decades.

The figure also illustrates the consequences of the zero lower bound on interest rates; the panels in the left column show the response of $\Xi^{cb, crit}_t$ under the assumption that the ZLB is not binding. The panels in the right column show the response of $\Xi^{cb, crit}_t$ under the assumption that the ZLB is binding.
Compared to the Taylor rule, optimal IR policy reduces at least slightly the welfare gain from active credit policy.

The case for active credit policy is clearer when the ZLB constraint is binding, as credit policy can then complement IR policy.

In the latter case, to a first approximation, only the size and persistence of the credit spread matter, not the nature of the underlying financial shock.