Could a Higher Inflation Target Enhance Macroeconomic Stability?[1]

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Abstract

Recent international experience with the effective lower bound on nominal interest rates has rekindled interest in the benefits of inflation targets above 2 per cent. We evaluate whether an increase in the inflation target to 3 or 4 per cent could improve macroeconomic stability in the Canadian economy. We find that these benefits hinge critically on two elements: (i) the availability of effective unconventional monetary policy (UMP) tools at the effective lower bound, and, (ii) the level of the real neutral interest rate. In particular, we show that when the real neutral rate is in line with standard estimates, raising the inflation target yields only modest improvements in macroeconomic outcomes. These gains are close to zero if effective UMP tools are available. In contrast, in a situation of secular stagnation, with a deeply negative real neutral rate, a higher inflation target substantially improves macroeconomic stability regardless of UMP.

[1] The views expressed in this paper are solely those of the authors and may differ from official Bank of Canada views. No responsibility for them should be attributed to the Bank.

1. Introduction

Most advanced-economy central banks now target an inflation rate of 2 per cent, but in recent years this ubiquitous objective has come under increased scrutiny. Prior to the 2007-2009 global financial crisis, most observers viewed a 2 per cent inflation target as sufficiently high to make the constraint arising from the effective lower bound (ELB) on nominal interest rates largely irrelevant. But, in the aftermath of the crisis, the ELB proved to be a more persistent and severe constraint on conventional monetary policy than anticipated. In this context, several academics and policymakers have called for higher inflation targets in order to reduce the likelihood that monetary policy will be constrained by the ELB in the future.[2]

We assess the extent to which raising the inflation target to 3 or 4 per cent could lead to greater macroeconomic stability. We find that the macroeconomic implications of a higher inflation target depend crucially on two factors: (i) the availability of effective unconventional monetary policy (UMP) tools at the ELB, and (ii) the level of the neutral real interest rate. While our quantitative analysis relies on a model of the Canadian economy, our findings regarding the importance of UMP and the neutral rate are likely to be relevant more broadly.

We define the neutral real interest rate as the real interest rate that would prevail in a flexible-price equilibrium after the effects of all cyclical shocks have dissipated. Our neutral rate concept differs from, but is related to, the real natural rate of interest as defined in Woodford (2003). Our neutral rate is effectively the Woodfordian natural rate of interest that would prevail in the long run.

[2] See Williams (2009); Blanchard, Dell'Ariccia and Mauro (2010); Ball (2014); Krugman (2014a).

Recent research suggests that this neutral real interest rate has fallen. For a given inflation target, the decline in the neutral rate implies lower nominal interest rates and less scope for central banks to cut interest rates in response to shocks. But there is disagreement about the magnitude of the fall in the neutral rate. Many studies find that the real neutral rate has declined, but remains substantially above zero. In contrast, advocates of the secular stagnation hypothesis argue that the real neutral rate is deeply negative.

These divergent views of the neutral rate lead to starkly different conclusions about the implications of a higher inflation target. Under the orthodox assumption that the neutral rate remains positive, our results depend on the availability of effective UMP tools. In the absence of UMP tools, we find that raising the target to 3 or 4 per cent would yield materially better outcomes. In particular, a higher inflation target would reduce the expected frequency and duration of ELB episodes, and decrease the magnitude of output and inflation gaps at the ELB. However, when we allow for UMP, raising the target does not lead to improvements in macroeconomic stability. Effectively, UMP provides sufficient scope for stimulus at the ELB that there are no additional gains from raising the target. On the other hand, if we adopt the secular stagnation view of the neutral rate, then the availability of UMP tools becomes irrelevant. Under the assumption of a negative real neutral rate, a higher inflation target substantially improves macroeconomic performance regardless of UMP.

Our analysis is novel in several respects. Unlike much of the literature, we conduct our analysis in a quantitatively realistic large-scale DSGE model. This is important given the inherently quantitative nature of our question. In addition, most analyses of monetary policy assume that the central bank is powerless once its conventional policy rate has reached the ELB. Since this assumption might bias our results in favour of a higher inflation target, we allow for the central bank to use both quantitative easing (QE) and forward guidance at the ELB. This requires us to model market segmentation in order to allow for a role for QE and to develop a procedure for handling state-contingent forward guidance.

The paper is organized as follows. Section 2 provides a brief summary of the model used in our analysis. Section 3 outlines the solution simulation methodology. Section 4 discusses the relationship between the neutral rate and the unconditional probability of being constrained by the ELB. Section 5 presents our main results on the benefits of a higher inflation target under different assumptions about the availability of UMP and the level of the real neutral rate. Section 6 concludes.

2. Brief description of ToTEM

ToTEM (Terms of Trade Economic Model) is a large scale open economy DSGE. Since this model is used for quantitative policy analysis, the model features more disaggregation than in prominent DSGE models used in the academic literature such as Christiano, Eichenbaun and Evans (2005) and Smets and Wouters (2007). In this section we present the features of ToTEM's structure that are of greatest relevance to the analysis in this paper.[3]

ToTEM is a multisector model that includes producers of four distinct types of final products: core consumption goods, business investment goods, government goods, and non-

[3] For details on ToTEM, see Dorich et al (2013).

commodity export goods. The production of the final goods takes place in two stages in each of these four sectors. In the first stage, identical and perfectly competitive firms produce an intermediate good by choosing an optimal mix of capital services, labour, commodities and imported inputs to maximize profits. These firms face costs of adjusting all of their inputs.

In the second stage, monopolistically competitive firms produce both final goods and manufactured inputs by using intermediate goods and a composite of manufactured inputs.[4] Following Gali and Gertler (1999), it is assumed that two types of price setters co-exist in the second stage of production: rule of thumb (RT) firms and forward looking optimizing firms. Both types of firms face nominal price rigidity à la Calvo (1983). With a fixed probability θ, a firm does not reoptimize its price, instead it is simply indexed to the inflation target. With probability $1-\theta$, forward looking firms set their prices optimally as in Calvo's model, whereas RT firms use a simple rule of thumb that index prices to a weighted average of lagged inflation and the inflation target.

Allowing for RT firms helps to prevent the economy from responding excessively to forward guidance (i.e., forward guidance puzzle).[5] To illustrate this, consider a slightly simplified version of ToTEM's Phillips curve for the consumption sector in which RT firms don't index to

[4] The existence of manufactured inputs implies greater strategic complementarity (i.e., a flatter Phillips curve), which is needed in the model to obtain aggregate inflation dynamics that are consistent with micro evidence on pricing behaviour.
[5] Del Negro et al (2012) present a well-documented review of the literature on the forward guidance puzzle.

lagged inflation and expected current and future mark-up shocks are zero.[6] In this case, the Phillips curve is represented by

$$\pi_t = \bar{\pi} + \frac{(1-\omega)(1-\theta)(1-\beta\theta)}{\theta + \omega(1-\theta)} \sum_{i=0}^{\infty} \left(\frac{\beta\theta}{\theta + \omega(1-\theta)} \right)^i \widehat{rmc}_{t+i}^c, \tag{1}$$

where π_t is quarterly inflation, $\widehat{rmc}_t^c$ is the deviation of real marginal cost from steady state, $\bar{\pi}$ is the quarterly inflation target, ω is the share of rule of thumb firms and β is the household's quarterly discount factor.

As is evident from equation (1), when the share of rule of thumb firms is equal to zero, the Phillips curve becomes the standard one, which has been criticized by Carlstrom et al (2012), Chung et al (2014) and Kiley (2014) for generating the forward guidance puzzle.[7] In particular, these authors argue that, under the standard specification of the Phillips curve, forward guidance generates implausibly strong feedback effects from expected real marginal costs to current inflation, and consequently to real interest rates. Given that the weights applied on expected real marginal costs are decreasing in the share of rule of thumb firms, by allowing this share to be higher than zero, the effects of expected real marginal costs on inflation are reduced relative to the standard case. Dorich et al (2013) find that the estimated share of rule of thumb firms for the consumption sector is 48 per cent. They also show that this value, together with $\theta = 0.75$, generate considerably smaller weights on expected real marginal costs than those implied by the standard Phillips curve.

[6] This simplification is also empirically relevant, given the very low degree of estimated indexation to past inflation in the consumption sector.
[7] An alternative explanation for this puzzle is proposed by Del Negro et al (2012) and McKay et al (2016), who suggest that the relevant amplification mechanism is generated by the Euler equation for consumption.

The model also contains a separate commodity-producing sector due to the importance of commodities in the Canadian economy.[8] Commodities are exported at global prices, consumed directly by households or used in the production of finished products. The importance of the commodity sector in our analysis is also reflected in the fact that commodity price shocks are one of the most important causes of ELB episodes in the simulations.

The model contains three types of consumers: (i) unrestricted lifetime-income consumers, (ii) restricted lifetime-income consumers and (iii) rule of thumb consumers. Unrestricted households face a lifetime budget constraint and can redistribute consumption across time by trading both short- and long-term bonds. Following Andres et al (2004) and Chen et al (2012), it is assumed that these securities are imperfect substitutes due to the fact that unrestricted households have to pay a transaction cost for purchasing one unit of a long term bond. The existence of this transaction cost breaks the perfect arbitrage opportunity between the two assets and allows the long-term rate to deviate from the level implied by the expected path of short term rates. This deviation is the term premium.

A transaction cost function is directly assumed such that the term premium in the model is driven by the foreign term premium, the ratio of long term bonds to short term bonds held by households and an exogenous domestic component.[9] We allow the foreign term premium to influence the domestic term premium in order to account for empirical importance of global

[8] Commodity production represented 18 per cent of total GDP in 2014. Moreover, the investment in the commodity sector accounted for 56 per cent of total investment and commodity exports represented 49% per cent of total exports.
[9] Like Chen et al (2012), we directly assume a relationship between the transaction cost and variables of interest.

term premium identified by Bauer and Diez de los Rios (2012).[10] We assume that the central bank can affect the term premium by modifying the ratio of outstanding long-term to short-term bonds through QE.

Restricted households are similar to unrestricted households, except that they can trade only in long-term bonds and do not incur transaction costs when they do so. As a result of this assumption, the spending decisions of this subset of households are exclusively driven by long-term rates. Consequently, ToTEM allows aggregate household spending to depend on both short- and long-term interest rates. To illustrate this, consider a simplified version of ToTEM's aggregate Euler equation.[11] In this case, the linearized expression for the consumption of the lifetime-income consumers is given by:

$$\hat{C}_t^l = \xi\hat{C}_{t-1}^l + E_t\left[\hat{C}_{t+20}^l - \xi\hat{C}_{t+19}^l\right] \\ -\mu(1-\xi)\left[s_u\sum_{j=0}^{19}E_t\,\hat{R}_{t+j} + (1-s_u)20\hat{R}_t^{20}\right] + \mu(1-\xi)\sum_{j=0}^{19}E_t\hat{\pi}_{t+j+1}, \quad (2)$$

where ξ is the habit persistence, μ is the intertemporal elasticity of substitution, s_u is the percentage of unrestricted households, $\hat{C}_t^l$ is the log deviation of the aggregate consumption of lifetime-income consumers from steady state, $\hat{R}_t$is the deviation of the short term risk free rate

[10] The rest of the world block in ToTEM also has an equation that relates foreign long term rates with the expected path of foreign short term rates and the foreign term premium. Therefore, our analysis includes simulated paths for the foreign term premium.

[11] The aggregate Euler equation is the weighted sum of the individual Euler equations for each type of lifetime-income consumer. In the simplified version in the text, we assume that utility is separable between consumption and labour, the spreads between household interest rates and risk-free rates are zero and the discount factor is not affected by household wealth.

from steady state, $\hat{\pi}_t$ is the deviation of inflation from steady state and $\hat{R}_t^{20}$ is the long-term (5-year) interest rate deviation from steady state. The latter is given by

$$\hat{R}_t^{20} = \frac{1}{20}\sum_{j=0}^{19} E_t\hat{R}_{t+j} + tp_t, \tag{3}$$

where tp_t denotes the term premium.

The percentage of unrestricted households is estimated to be only 0.12, implying that the long-term rate and the term premium play an important role in explaining consumption. Moreover, notice that equations (2) and (3) imply that the impact of changes in the expected path of short term rates is independent of the fraction of unrestricted agents. As in standard DSGE models, the sensitivity of consumption to short-term rates in ToTEM is basically determined by the intertemporal elasticity of substitution (estimated to be close to unity) and by the degree of habit formation, which is relatively high in the model (0.94). The high degree of habit formation suggests a delayed peak response of consumption to variations in short-term interest rates.

Each household supplies a continuum of types of labour services. For each type of these services, there is a labour union which sets the wage rate for its members and faces nominal wage rigidities.[12] The unions include only the members of unrestricted and restricted lifetime-income households. The rule of thumb households are paid the aggregate nominal wage.

[12] In the same way as the price setting, nominal wage rigidities are introduced by assuming the existence of two types of union (rule of thumb and forward-looking) that face nominal wage rigidity à la Calvo.

The monetary authority sets the quarterly short term risk free interest rate according to the following augmented Taylor rule that depends on the output gap, deviations of expected (one year-ahead) average inflation from the target and an interest rate smoothing term:

$$R_t = \max\left[ELB,\ \Theta_R R_{t-1} + (1-\Theta_R)\left(\bar{r} + \bar{\pi} + \Theta_\pi\left(\frac{\sum_{j=1}^{4}\pi_{t+j}}{4} - \bar{\pi}\right) + \Theta_x x_t\right)\right], \tag{4}$$

where ELB is the effective lower bound, Θ_R measures the degree of interest rate smoothing, $\bar{r}$ denotes the quarterly real neutral rate, Θ_π measures the long run response to inflation and Θ_x measures the long run response to the output gap x_t. The estimated monetary policy parameters reveal a large degree of interest rate smoothing, with $\Theta_R = 0.85$. The long-run response to core inflation is 4.65, whereas the long-run response to output gap is 0.4. This estimated rule does a good job of capturing the historical evolution of the Bank of Canada's policy rate.

Finally, the output gap is defined as the percentage deviation of actual output from potential output. Potential output is defined by evaluating the aggregate production function with the actual values for total factor productivity and the capital stock, and the steady-state value for labour. The resulting output gap does not correspond to a welfare-relevant metric, but it is a commonly used measure in policy analysis exercises.

3. Methodology

To assess the implications of a higher inflation target for macroeconomic stability, we conduct stochastic simulations of ToTEM to generate artificial time series of key macroeconomic variables. When conducting the stochastic simulations, we draw shocks from a multivariate normal distribution. We exclude all policy shocks and measurement errors from the simulations, leaving 33 structural shocks. The variance-covariance matrix of the shocks was estimated using shocks backed out over 1995-2015. We believe this period provides a useful benchmark because the inflation target has been stable at 2 per cent in Canada since 1995.

Solving the model poses several challenges. Given that we need to impose an occasionally binding ELB on nominal interest rates, we cannot simply linearize the model and apply standard methods for solving linear rational expectations models. Global solution methods are often used to solve smaller models with the ELB.[13] These methods, however, are limited to models with a small number of state variables and are therefore not a feasible approach for solving ToTEM.

Our solution methodology involves two approximations. First, we linearize the structural equations of the model. This is a common practice in the ELB literature, as it simplifies the computational problem by making the ELB the only source of nonlinearity in the model.[14] Second, following Reifschneider and Williams (2000), we assume that agents' beliefs about the future path of the economy are equal to the model's predictions under the assumption that there are no future shocks to the economy. Thus, agents in the model use a modal forecast to form expectations, while the true rational expectation would be a mean forecast. This is an approximation because, despite the fact that all exogenous shocks are assumed to be

[13] In some cases, such as Adam and Billi (2006), the structural equations of the model are first linearized and then the linearized structural equations are solved together with a nonlinear policy rule that respects the ELB using a global method. Others, including Basu and Bundick (2012) and Nakata (2013), apply the global solution methods directly to the fully nonlinear model.

[14] Others who have used linearization techniques when analyzing the ELB include Eggertsson and Woodford (2003), Adam and Billi (2006) and Christiano, Eichenbaum and Rebelo (2011).

symmetrically distributed, the nonlinearity associated with the ELB can lead to differences between the mode and the mean in the distribution of endogenous variables. Nevertheless, the use of modal forecasts facilitates simulation of the model because it allows us to use perfect foresight methods to compute agents' expectations.

In order to obtain reliable estimates of the impact of a higher inflation target on macroeconomic performance, we conduct a large number of simulations for every parameterization that we consider. In particular, for each parameterization, we conduct 300 simulations, each of which is 1,000 periods long (a model period corresponds to one quarter). Thus, we make 300 draws of 1000-period time series of the shock vector. In order to ensure comparability across parameterizations, we use the same 300 draws for all parameterizations. To randomize over the initial conditions, in each simulation we excluded the initial 200 periods.

4. The Probability of Being Constrained by the ELB

The unconditional probability that monetary policy will be constrained by the ELB depends on both the level of the neutral rate and the level of the ELB itself. Figure 1 shows the relationship between the level of the ELB and the probability of being constrained by the ELB for different values of the neutral rate, under the assumption of a 2 per cent inflation target.

Views of both the ELB and the neutral rate have evolved in recent years. Between 2006 and 2014, the Bank of Canada's estimates of the real neutral rate in Canada declined from about 3 per cent to about 1.5 per cent (Mendes, 2014). Estimates of the ELB have also declined. Until recently, most observers believed that the ELB was zero or slightly positive. For example, while the Bank of Canada set an ELB of 25 basis points in 2009, it now estimates the ELB to be around -50 basis points (Poloz, 2015; Witmer and Yang, 2015). This evolution is part of a broader trend, driven in part by the fact that several central banks in Europe have actually implemented negative nominal interest rates (Jackson, 2015).

According to Figure 1, with the values of the neutral rate (3 per cent) and the ELB (25 basis points) that would have prevailed in the mid-2000s, the ELB would have been binding only about 3 per cent of the time. Thus, this estimated probability is consistent with the then-widespread pre-crisis view that a 2 per cent target was sufficient to render the ELB irrelevant. With a slightly lower neutral rate of 2.5 per cent, the probability of being constrained by a 25 basis point ELB would have been about 5 per cent. This is consistent with results for U.S. economy under the assumption of a 2.5 per cent neutral rate in Reifschneider and Williams (2000) and Fernández-Villaverde et al. (2012).

Assuming that the neutral rate is now closer to 1.5 per cent raises the unconditional probability of being constrained by a 25 basis point ELB to about 10 per cent. This substantial increase results from the fact that, with a lower neutral rate, nominal interest rates will, on average, be lower, meaning that there will be less room for conventional monetary policy to ease before hitting the ELB. The estimated increase in the likelihood of ELB episodes motivates our interest in the role a higher inflation target could play in mitigating the ELB constraint.

The extent to which the decline in the ELB itself can offset the impact of the lower neutral rate will depend on how effective negative nominal interest rates are at stimulating demand. Surveying the international experience, Jackson (2015) finds that "transmission of negative policy rates works, although pass-through to bank deposit and lending rates has generally been partial." We therefore assume that only half of any rate cuts in negative territory are passed on to households and firms in our simulations. With an ELB of -50 bps, which is in line with the Bank of Canada's current estimates, more than half of the increase in the unconditional probability would be eliminated, leaving it at about 6 per cent. Hence, a lower ELB could provide a partial, but significant, offset to the lower neutral rate. Nevertheless, our estimates suggest that the unconditional probability of being constrained by the ELB has roughly doubled, rising from 3 per cent to 6 per cent, since the mid-2000s.

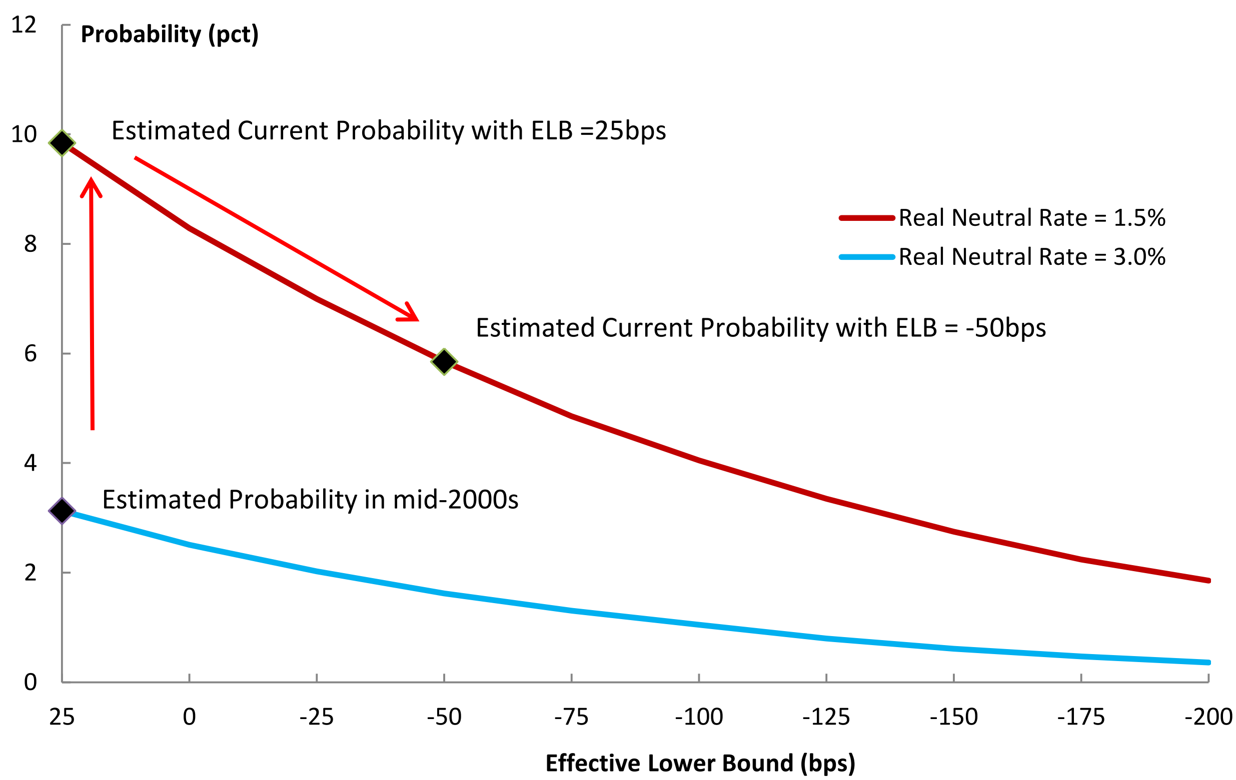

Figure 1. Unconditional Probability of Binding ELB Constraint

5. The Impact of a Higher Inflation Target

Through the Fisher relation, a higher inflation target would lead to higher nominal interest rates on average (for a given real neutral rate). This would create more space for conventional policy to ease before hitting the ELB. In this section, we analyze the impact of raising the inflation target to 3 or 4 per cent under different assumptions about the availability of effective UMP tools and the level of the neutral rate. We maintain the assumption of a -0.5 per cent ELB. As explained in the previous section, we assume partial pass-through from the central bank's policy rate to the interest rates faced by households and firms when the policy rate is negative.

5.1. Results without Unconventional Monetary Policy Tools

We begin by examining the impact of raising the target in the absence of effective UMP tools. For the time being, we adopt a fairly standard view of the real neutral rate, assuming it to be 1.5 per cent (we revisit the case of secular stagnation later). In this context, we find that raising the target could materially reduce the frequency with which the ELB is a binding constraint on the policy rate. Recall that the decline in the real neutral rate from 3 per cent to 1.5 per cent caused the unconditional probability of being constrained by the ELB to rise from about 3 per cent to about 6 per cent. According to Table 1, raising the inflation target to 3 per cent would be sufficient to undo the increase in this probability. The impact on the duration of ELB episodes is also important, as it is in the longest episodes when the policy rate warranted by economic conditions is most significantly below the ELB. Table 1 shows that a higher inflation target could considerably reduce the duration of the most severe episodes.

Table 1: Frequency and Duration of ELB

Real Neutral Rate (%)	ELB (%)	Inflation Target (%)	Proportion of time ELB is binding (%)	Average Duration (qrts)	ELB Duration at 90th Percentile (qrts)
		2.0	5.8	6.1	13
1.5	-0.5	3.0	2.6	2.5	8
		4.0	1.0	1.0	4

Ultimately, the goal of a higher target would be to enhance economic stability by reducing the impact of the ELB on inflation and the output gap. It might seem natural to assess this by examining the performance of the economy in periods in which the ELB is binding under different inflation targets. This, however, would not yield informative results. To see this, consider, for example, the comparison of economic outcomes during ELB periods under a 2 per cent target and a 4 per cent target. The periods in which the ELB binds under a 4 per cent target will be a subset of the periods in which it binds under a 2 per cent target. This is because pushing the policy interest rate to the ELB requires much larger shocks under a 4 per cent target than under a 2 per cent target. Thus, there is a selection bias: the periods in which the ELB binds under a 4 per cent target will, on average, involve relatively larger shocks. Naively comparing performance in periods in which the ELB binds could lead to the spurious conclusion that raising the target leads to a deterioration of macroeconomic performance at the ELB.

Instead, our approach is to compare the performance of different inflation targets during (i) all simulated periods ("All" in Table 2) and (ii) periods with large negative shocks ("LNS" in Table 2). We define the LNS periods as those in which the policy rule calls for a policy rate that is more than 3.25 percentage points (pp) below neutral. We focus on periods with large movements in the desired policy rate because it allows us to focus on essentially the same periods and shocks across parameterizations.

The simulation results show that raising the inflation target to 3 or 4 per cent decreases the magnitude of the average output and inflation gaps during LNS periods. For instance, raising the target from 2 to 4 per cent would improve the output gap by 0.3pp and the inflation gap by 0.2pp, on average, during LNS periods. Raising the target also leads to a small reduction in the overall volatility of the output and inflation gaps. So, assuming no UMP tools, a higher inflation target yields modest, but material, gains in macroeconomic performance.

Table 2: Macroeconomic Outcomes under Different Inflation Targets (1.5% Neutral Rate)

		Average				Standard Deviation			
		Inflation Gap (%)		Output Gap (%)		Inflation Gap (%)		Output Gap (%)	
UMP	Inflation Target (%)	All	LNS	All	LNS	All	LNS	All	LNS
Without UMP	2.0	-0.04	-0.94	0.01	-1.87	0.72	0.64	1.69	1.52
	3.0	-0.02	-0.82	0.01	-1.64	0.70	0.60	1.65	1.43
	4.0	-0.01	-0.78	0.01	-1.54	0.69	0.58	1.64	1.39
With UMP	2.0	0.00	-0.69	0.01	-1.48	0.68	0.61	1.63	1.44
	3.0	0.00	-0.69	0.01	-1.42	0.68	0.57	1.63	1.42
	4.0	0.00	-0.71	0.01	-1.44	0.68	0.56	1.63	1.41

5.2. The Role of Unconventional Monetary Policy Tools

International experience and evidence suggests that unconventional monetary policy tools can be effective.[15] Maintaining the assumption of a 1.5 per cent real neutral rate, we introduce forward guidance and quantitative easing (QE) into the analysis. We find that these

[15] For surveys of the international experience and evidence with quantitative easing and forward guidance, see, e.g., Reza, Santor and Suchanek (2015) and Charbonneau and Rennison (2015).

unconventional monetary policies largely eliminate the scope for a higher inflation target to improve macroeconomic stability.

Forward guidance provides monetary stimulus by extending the expected length of time for which the policy rate remains at the ELB and thereby reducing long-term interest rates. Forward guidance can take a variety of forms ranging from qualitative to time-contingent or state-contingent (Charbonneau and Rennison, 2015). In order to operationalize guidance in the model, we need to make it systematic. We do this by assuming that (i) guidance is implemented whenever the ELB is reached, and (ii) the guidance takes the form of an unemployment threshold along the lines of those implemented by the Federal Reserve and the Bank of England. These central banks gave guidance by publicly committing to refrain from raising their policy interest rates at least until the unemployment rate fell to the announced threshold level. This was paired with an inflation “knockout” provision that allowed for the threshold to be abandoned should inflation rise above a pre-announced level.

Our approach to modelling this type of guidance follows Mendes and Murchison (2014). At the start of each ELB episode the central bank is assumed to choose the unemployment threshold according to the following procedure:

1. The central bank determines its desired “lift-off” date – the date at which it would like to begin to raise interest rates in the absence of any additional shocks. It makes this determination by minimizing an *ad hoc* loss function defined as the sum of the squared deviations of inflation from target and output from potential.

2. The unemployment threshold is then chosen to implement the “lift-off” date in the absence of any additional shocks.

The central bank promises to keep the policy rate at the ELB until the unemployment rate reaches the threshold as long as the inflation rate does not rise more than one percentage point above target. In our simulations, the value of the unemployment threshold is on average slightly below the natural rate of unemployment. As a result of this type of forward guidance, the simulated duration of ELB episodes increases by an average of 1 to 2 quarters.

QE also aims to provide stimulus by reducing long-term interest rates, but its direct effect operates through the term premium rather than the expected path of future short-term rates. We model QE by assuming that, when the conventional policy rate reaches the ELB, the central bank buys long-term assets in sufficient quantities to decrease the annualized term premium to -0.4pp. We assume that the purchased assets are held for 5 years before the central bank’s balance sheet is allowed to gradually normalize.

Overall, we find that forward guidance and quantitative easing provide sufficient scope for policy easing at the ELB. As a consequence, there are virtually no additional gains from raising the inflation target when the neutral rate is 1.5 per cent. As shown in Table 2, even in the face of large negative shocks, raising the inflation target has almost no beneficial impact on macroeconomic performance.

5.3. Secular Stagnation and the Case for a Higher Inflation Target

Summers (2014), Krugman (2014b), Eggertsson and Mehrotra (2014) and other advocates of secular stagnation contend that the neutral rate may be much lower than standard analyses suggest. These authors point to a number of factors including: (i) increased savings due to changes in the distribution of income and the savings behaviour of some emerging market economies; (ii) decreased investment demand due to lower productivity and/or labour force growth, changes in industrial structure and the decline in the price of capital goods; and (iii) other factors such as the interaction of inflation and the tax system and increased demand for safe assets. We explore the implications of the secular stagnation hypothesis by repeating our simulations with a deeply negative real neutral rate of -1.5 per cent.

The results in Table 3 are striking. Assuming a neutral rate of -1.5 per cent makes macroeconomic performance significantly worse than it is with a positive neutral rate. When the inflation target is set at two per cent and there is no UMP, the average output gap during periods with large negative shocks ("LNS" in the table) is more than 4.5 per cent. Moreover, inflation is close to 3 percentage points below target on average during these periods. Raising the inflation target leads to substantial improvements. Without UMP, going from a 2 per cent to a 4 per cent target reduces the average output gap during LNS periods by more than 2 percentage points. Similarly, it reduces the average inflation gap during these periods by 1.6 percentage points. More generally, raising the inflation target leads to significant declines in the volatility of both the output and inflation gaps.

In contrast to our results with a positive neutral rate, in the secular stagnation case allowing for UMP does not eliminate the gains associated with a higher target. Even with UMP, raising the inflation target leads to substantial improvements in macroeconomic stability. This is consistent with Krugman's (2014b) conjecture that unconventional monetary policies are likely to be of limited value when the need to very low interest rates is a permanent state of affairs.

Table 3: Macroeconomic Outcomes under Different Inflation Targets (-1.5% Neutral Rate)

		Average				Standard Deviation			
	Inflation	Inflation Gap (%)		Output Gap (%)		Inflation Gap (%)		Output Gap (%)	
UMP	Target (%)	All	LNS	All	LNS	All	LNS	All	LNS
Without UMP	2.0	-0.68	-2.82	-0.03	-4.53	1.15	1.02	2.48	2.07
	3.0	-0.26	-1.76	0.00	-3.23	0.88	0.85	2.00	1.88
	4.0	-0.11	-1.21	0.01	-2.36	0.76	0.72	1.78	1.67
With UMP	2.0	-0.48	-2.34	-0.02	-3.94	1.02	0.99	2.24	2.03
	3.0	-0.14	-1.30	0.00	-2.56	0.79	0.82	1.82	1.77
	4.0	-0.03	-0.83	0.01	-1.78	0.71	0.69	1.67	1.54

6. Concluding Remarks

In this paper we have assessed the impact of a higher inflation target on macroeconomic stability. Our simulations reveal that if the real neutral rate is in line with standard estimates, then the gains associated with raising the inflation target are modest. Moreover, if UMP is effective then there are virtually no additional gains from raising the target. This result diminishes, but does not extinguish, the case for a higher inflation target. While there is empirical evidence that supports the effectiveness of UMP, there does remain uncertainty about its limits. In these circumstances, a higher target could help to insure against this uncertainty.

In contrast, if the secular stagnation view of the neutral rate is correct, our analysis shows that the availability of UMP tools becomes irrelevant and a higher inflation target substantially improves macroeconomic performance. Of course, a higher target would only yield the benefits we identify if it were perceived as credible. In a situation of chronically deficient demand, it may not be possible for the central bank to credibly commit to achieve a higher inflation target in a timely manner.

In sum, our research shows that the degree of effectiveness of UMP and the level of the real neutral rate are critical to assess the benefits of higher inflation targets. In this sense, our work reinforces the importance of conducting future research on both issues.

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