Stay-out premiums, penalties, and multi-year regulatory rate plans

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Abstract

Multi-year regulatory rate plans are becoming more common. An agreement to "stay out" of the rate revision process takes away an option for the utility company or regulatory commission to request a modification to rates in response to changes in benchmark interest rates. This paper develops an objective approach to adjust the required cost of equity of the utility to account for these lost options. The paper also shows how to account for the ability of the utility to pay a fixed monetary penalty to request a rate review prior to the end of the stay-out period.

Keywords: utilities, rate of return regulation, options

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Stay-out premiums, penalties, and multi-year regulatory rate plans

Multi-year regulatory rate plans are becoming more common. An agreement to "stay out" of the rate revision process takes away an option for the utility company or regulatory commission to request a modification to rates in response to changes in benchmark interest rates. This paper develops an objective approach to adjust the required cost of equity of the utility to account for these lost options. The paper also shows how to account for the ability of the utility to pay a fixed monetary penalty to enter into a new rate agreement prior to the end of the stay-out period.

1. Introduction

Tariff rates for electricity, natural gas, and other essential services provided by regulated utilities are determined by public utility commissions through an adjudicated rate case process. Commissions base their rate decisions on competing perspectives provided by the utility and parties (interveners) representing utility customers (ratepayers).³ This adversarial process is complex and costly. Direct rate-case expenses include professional fees and travel expenses for lawyers and expert witnesses, and indirect costs include the distraction of utility personnel. Direct rate case expenses, if deemed prudently incurred, ultimately are passed through to ratepayers as higher tariff rates. These costs, along with a desire to make tariff rates more predictable for ratepayers, have contributed to growth in rate freeze arrangements, which preclude all parties from initiating a rate case over a multi-year period, sometimes called a stay-out period.

³ We focus on the process in the United States and Canada. Similar processes are used in other jurisdictions.
While commissions consider a number of financial and operating issues in setting tariff rates, one critical mandate is that rates must generate an adequate return on equity (ROE) for shareholders. In the absence of a rate freeze, the utility can file a rate case when ROE increases due to an increase in interest rates. Commissions follow well-established policies for determining a fair ROE in these unconstrained cases. Under a rate freeze, however, the allowed ROE is fixed for the duration of the stay-out period, leaving shareholders vulnerable to rising interest rates and allowing them to over-earn under falling interest rates. An extension of a rate freeze is a multi-year rate plan, which embeds mechanisms to adjust rates for certain contingencies. Under a multi-year rate plan allowing automatic adjustment mechanisms to ROE under changing interest rates, the fate of shareholders is only marginally improved because adjustments often are incomplete.

Some commissions attempt to adjust ROE the additional risk from a rate freeze by authorizing a “stay-out premium,” a return to shareholders different from what would be stipulated in the absence of a rate freeze (see, for example, State of New York Public Service Commission, 2014a). While there is a general belief that such a premium is warranted, the academic literature and rate case precedent provide little guidance on how to determine this premium. Our paper proposes an option-based methodology to do so.

Our approach estimates a market-based stay-out premium to fairly compensate shareholders for lost flexibility and increased risk arising from a rate freeze. Using portfolios of options, one can replicate the future payoff structure to utility shareholders in an unconstrained world and under a rate freeze. The valuations of these portfolios generate an objective estimate of a reasonable stay-out premium. We demonstrate our approach using Bloomberg pricing functions, with the goal of developing a procedure that is easy to implement with technology readily available to many parties to a rate case. These functions use standard market data and pricing methodology, thereby reducing the
likelihood of contentious debate between rate case participants. Because our framework draws from prices of traded instruments reflecting market consensus, it can help commissions establish uncontroversial policies on stay-out premium calculations, and thereby accelerate adoption of rate freeze plans. Reducing the frequency of rate cases likely will, over time, reduce rate case expenses ultimately borne by ratepayers.

Our approach can be used to estimate the stay-out premium for any stay-out duration and rate case triggering assumptions. Illustrative stay-out premium estimates, based on a 3-year stay-out period beginning on April 1, 2014, range from 10.9 basis points to 80.4 basis points. The premium depends on frictions inherent in the rate case process – even without constraints, interest rates must rise by a sufficient amount to make it worthwhile for the utility to file a rate case, and similarly, interest rates must fall by an even larger amount for the utility commission to force a new rate case on the utility. Stay-out premium estimates increase with interest rate volatility and the length of the stay-out period. We also show how our approach can be extended to deal with stay-out plans in which the utility can elect to pay a fixed dollar penalty to file a rate case prior to the end of the stipulated stay-out period.

Section 2 explains how tariff rates are set and Section 3 describes rate freezes. Section 4 outlines how shareholder returns are altered by a rate freeze and details how these effects are analogous to positions in interest rate call and put options. We then demonstrate calculation of the stay-out premium under different assumptions about what would cause a case to be initiated in an unconstrained world. We also consider the special case of a plan allowing the utility to pay a penalty to file a case before the end of the stay-out period. The Appendix describes an approach to value stay-out premiums when the penalty can be paid to initiate a case in any year. Section 5 concludes.

While some prices for over-the-counter trades in interest rate caps and floors may not be available in public data sources, we note that the Bloomberg pricing methodology for interest rate caps and floors uses the observed trade prices for interest rate futures contracts and benchmark interest rates as inputs into a standard pricing function.
2. Rate of Return Regulation in the U.S.

Public utilities are natural monopolies. Competitive forces cannot be relied upon to set fair and reasonable service prices (or tariff rates) for them. A regulatory process serves as a substitute price-setting mechanism. Rates are set to allow a utility to cover its operating costs, including taxes and depreciation, plus a specified return on the utility’s capital investment (rate base). The specified return is computed as an allowed rate of return multiplied by the book value of the utility’s capital investment or rate base (Myers, 1972). This regulatory structure is codified in the standard revenue requirements equation for utilities:

\[
\text{Revenue requirement} = \text{operating expenses} + \text{taxes} + \text{depreciation} + \text{ROR} \times (\text{rate base}),
\]

where the authorized rate of return (ROR) is calculated as:

\[
\text{ROR} = w_E \times \text{ROE} + w_D \times (\text{cost of debt}) + w_P \times (\text{cost of preferred stock})
\]

and \(w_E\), \(w_D\), and \(w_P\) denote the share of common equity, debt, and preferred shares in the capital structure. The ROR is similar to a weighted average cost of capital, except that in the ROR equation (1) the weights of debt and equity are set at book values, not market values, (2) the cost of debt is historical or “embedded,” as opposed to marginal or expected, and (3) all capital costs are on a pre-tax basis.

It is relatively straightforward to estimate the rate base, book value weights of debt and equity, and embedded cost of debt. In contrast, the return required by shareholders is perhaps the most important and arguably the most complex determinant of a utility’s rates because it isn’t observable. For investor-owned utilities, it is critical for shareholders to receive a fair rate of return on their investment; only then can the utility hope to attract sufficient capital to provide reliable service. Two U.S. Supreme Court decisions guide the determination of a public utility’s ROE: *Bluefield Waterworks*
Co. v. Public Utilities Commission, 262 U.S. 679 (1923), and Federal Power Commission v. Hope Natural Gas Co., U.S. 591 (1944). In the Hope decision, the Court stated:

"... the investor interest has a legitimate concern with the financial integrity of the company whose rates are being regulated. From the investor or company point of view it is important that there be enough revenue not only for operating expenses but also for the capital costs of the business. These include service on debt and dividends on the stock. By that standard the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks. That return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise, so as to maintain its credit and to attract capital."

The Hope standard stipulates that the ROE be measured as the risk-adjusted cost of equity consistent with current capital market conditions and investment alternatives, and this approach guides how ROE is estimated in practice. A typical rate case considers ROE estimates from multiple methods, including the Capital Asset Pricing Model (CAPM) (Sharpe, 1963 and 1964; Lintner, 1965; Fama, 1968), the Discounted Cash Flow (DCF) method (Gordon and Shapiro, 1956), and risk premium models (e.g., Treasury bond yield plus a risk premium).\(^5\) Ahern, et al. (2011) also propose a consumption-based asset pricing model of ROE.

The rate case process begins with the utility filing a rate application and ends with an order or stipulation by the commission authorizing tariff rates.\(^6\) The order usually includes detail on the determination of the authorized ROE, rate base, and other elements used to set tariff rates, though some “black box” settlements provide detail only on the final change in tariff rates. While in theory the utility, the commission or interveners can request a rate hearing, evidence suggests that the vast majority of hearings are initiated by the utility. The peak of regulatory activity for electric and gas utilities occurred from 1980 through 1989, a period of heavy capital investment as well as high and

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\(^5\) Myers (1972) summarizes some of the methods used in a regulatory context.
volatile inflation and interest rates. During this decade, more than 1,200 rate cases were decided for
approximately $40 billion in total revenue increases (Regulatory Research Associates, 2014). If
commissions were equally likely to request a rate case on concerns the utility is over-earning, we would
expect the volume of rate cases to be roughly consistent over time.

In some jurisdictions the autonomy of the utility in seeking rate adjustments is more explicit,
such as in Minnesota:

“Utilities in Minnesota are under no obligation to file, and have not filed, rate cases
asking for decreases in rates. The Commission can require a utility to file a rate case if
the Commission believes the utility’s rates may be unreasonable, but it is a lengthy
process. . . After the investigation and hearing process, if the Commission finds it
warranted, it can require the utility to initiate a rate proceeding; but under statute, the
Commission must allow the utility at least 120 days to make the rate filing. It is unlikely
that the utility would request a decrease in rates in its mandated rate filing, and if any
decrease is warranted, it would only happen after the full 10-13 month rate case
process.” (State of Minnesota Public Utilities Commission, 2010)

Seminal papers by Myers (1972), Breen and Lerner (1972) and Higgins (1974) laid the foundation
for the theory and practice of rate of return regulation. These papers, together with follow-up work,
addressed specific issues in estimating and applying ROE. One of these is regulatory lag, or the
divergence between authorized ROE and earned ROE that can occur due to the length and complexity of
the regulatory process. Regulatory lag compromises the ability to adhere to the Hope standard because
tariff rates cannot be instantaneously increased (decreased) whenever the realized return falls below
(rises above) the allowed return. Carleton, Chambers and Lakonishok (1983) find that earned ROEs
significantly lag behind interest rate changes. More recently, Murry, et al. (2011) discuss how the ROE
varies with various financial, market and regulatory risk variables.

To understand the rate case process more fully, we use data from SNL Energy, which reports
information on all electricity, natural gas, and steam rate cases filed in the U.S. from July 1977 to the
present, where the requested revenue change is at least $5 million or the authorized revenue change is
at least $3 million. SNL reports data for 2,976 rate cases filed through March 31, 2014. We also collect data on Treasury yields from Bloomberg and the Federal Reserve Bank of St. Louis. Selected rate case attributes are shown in Table 1.

Panel A presents statistics for rate cases. The average time between the rate case filing and the final rate authorization is about 9 months, but some cases can last a year or more. These time spans indicate the complexity and, by extension, the cost of a rate case. On average, utilities wait 24 months between rate case filings.\(^7\) The average change in ROE requested, computed as the difference between the ROE requested by the utility and its most recent authorized ROE, is 0.70% with a median of 0.60%. Utilities generally request a ROE higher than their current ROE, but utilities rarely get the ROE they seek; the vast majority of ROE levels authorized by commissions are below the most recent authorized ROE, with an average reduction of 0.43% and a median reduction of 0.25%. These reductions are likely caused by the generally falling level of interest rates over the past 30 years. In addition, utilities often file a rate case due to an increase in the rate base, even though they know the ROE on the rate base may be lower. Reductions in authorized ROE could also be driven by deregulation, changes in the non-regulatory component of utility revenues, or by increases in the equity share of the capital structure over time. The inclusion of trackers, such as weather normalization clauses, may have also contributed to trends in requested and authorized ROE.

Panel B presents correlations between rate case attributes and interest rates. The correlation between the requested ROE and the concurrent 30-year Treasury yield is 91.6%, indicating that utilities base their ROE requests quite directly on the general level of long-term interest rates. As well, the

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\(^7\) In unreported results, we find that the median time between rate filings falls to about 16 months when we exclude firms that have constraints on their ability to file a new rate case, such as an identifiable multi-year rate plan or other corporate action.
number of filings is positively correlated with both the general level of interest rates and the increase in rates, indicating that the interest rate environment is a key factor motivating a rate case filing.

Table 1 shows that: (i) utilities tend to file rate cases when the general level of interest rates is rising, and ROE requests are directly related to the current level of long-term interest rates; (ii) the rate case process is lengthy and subject to a significant risk of being granted an ROE less than the current authorized ROE; and (iii) even though utilities rarely are granted their desired ROE, they wait on average two years to file their next rate case. Taken together, these observations are consistent with the interpretation that utilities don't immediately file a rate case when interest rates rise; instead, they appear to balance the desire for a higher ROE against the costs and risks of the rate case process.

3. Alternative Regulation Plans and Rate Freezes

Alternative regulation plans allow the utility to earn returns, under certain pre-determined conditions, over and above returns that would typically be authorized (Regulatory Research Associates, 2013). Such plans streamline the rate-setting process and reduce regulatory costs (Lowry and Kaufmann, 2006). One such plan is a rate freeze, which prohibits the utility from filing rate cases for a specified period of time. Rate freezes were uncommon during the 1980s because many electric utilities were involved in large-scale investments (e.g., nuclear plant construction and expansion of transmission and distribution systems) that required frequent rate adjustments. In the mid to late 1990s, after capital investment activity slowed and inflation subsided, rate freeze activity increased. In recent years, the increase in rate freeze activity is noteworthy. As of May 31, 2012, rate freezes were in force for 57 electric and gas utilities in 26 jurisdictions (Regulatory Research Associates, 2012); as of November 17, 2014, rate freezes were in effect for 75 electric and gas utilities in 30 jurisdictions (Regulatory Research Associates, 2014a). This trend appears likely to continue. As a case in point, Xcel Energy recently announced plans to derive 75% of its revenue from multi-year plans by 2017 (Xcel Energy, 2014).
Rate freezes save costs for the utility, regulatory body, interveners, customers, and shareholders. Case expenses are significant relative to the allowed rate increase. For example, Fitchburg Gas and Electric Company incurred total rate case expenses of $751,339 to achieve an annual rate increase of $5,592,390. These expenses represent over 13% of the rate increase. As long as case expenses are deemed to be “… reasonable, appropriate, and prudently incurred”, these expenses will be recovered through the authorized tariff rate increase, which means rate case expenses are borne by ratepayers. Otherwise, rate case expenses are implicitly borne by shareholders. Rate freezes reduce the frequency of rate cases and thereby reduce expenses over time. Freezes also create incentives for the utility to operate as efficiently as possible during the freeze to preserve and enhance cash flow for shareholders, and provide enhanced stability and certainty for all parties. Rating agencies and equity analysts view favorably the reduction in regulatory uncertainty (Regulatory Research Associates, 2014b).

Rate freezes increase the risk earned ROE will depart from authorized ROE as interest rates change. Regulatory lag is a well-established problem even when a rate case can be initiated without restriction; rate freezes exacerbate gaps between earned and realized ROE because all parties are prohibited from requesting a change in tariff rates during the stipulated stay-out period. This risk is borne by shareholders, who lose when interest rates rise, and consumers, who lose when interest rates fall.

Sometimes, rate moratoriums permit a rate case filing before rate freeze expiration if the utility’s earned ROE falls below a pre-determined threshold. For example, in 2013 the Florida Public Service Commission issued an order authorizing a ROE for Tampa Electric Company (TECO) of 10.25%

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8 The Commonwealth of Massachusetts Department of Public Utilities, 2014.
9 Ibid.
10 This risk can be substantial, so much so that Brigham, et al. (1985) argued that risk premiums (over Treasury bond rates) were too volatile to be in place for two years.
until 2018. The authorized ROE would rise to 10.50% if the average yield on the 30-year Treasury bond increases by 75 basis points or more for any consecutive six-month period. In addition, if TECO’s earned ROE falls below 9.25% or rises above 11.25%, rates will be reviewed for possible adjustment before 2018 (Florida Public Service Commission, 2013).

Rate freeze arrangements sometimes allow for rate adjustments before the end of the stay-out period if the utility is willing to pay a financial penalty. For example, in 2013 the New York Public Service Commission authorized for Niagara Mohawk Power a ROE of 9.3% to be in effect through March 31, 2016. The approved ROE was calculated in part to allow for an annual dollar stay-out premium – $10.1 million for electric and $2.7 million for gas – intended to compensate shareholders for the risk of rising interest rates and inflation. Niagara Mohawk is permitted to initiate a rate case for rates to take effect prior to the end of the three-year stay-out if Niagara Mohawk reimburses customers for the dollar stay-out premium. This clawback provision was intended to discourage Niagara Mohawk from filing for new rates before the end of the 3-year rate plan unless interest rates and inflation rise dramatically (State of New York Public Service Commission, 2013).11

Despite the noticeable rise in rate freezes in recent years, utilities and commissions appear to struggle with quantifying added risk from a stay-out as a dollar or percentage stay-out premium. The dollar stay-out premium stipulated in the Niagara Mohawk case is one method by which a utility commission compensates a utility’s shareholders for the additional risk they bear under a rate freeze. Another method is an increment to the allowed ROE. For example, for a particular three year rate plan case, the New York Department of Public Service adjusted ROE upward by a stay-out premium calculated as one-half the difference between the historical five-year average yields on 3-year and 1-year Treasury Notes (State of New York Public Service Commission, 2011). This approach has two

11 Public filings do not disclose how the stay-out premiums were determined.
shortcomings. First, it is based on historical interest rates, while the relevant risk stems from future interest rate uncertainty. Second, this approach captures movement along the yield curve at the short end, while the relevant risk is unexpected shifts in the yield curve at the long end.

Interest rates have been abnormally low and stable since the 2008 credit crisis. Most analysts, however, expect rates to rise over the medium term, in accordance with Federal Open Market Committee (FOMC) guidance. It is critical all parties in the rate setting process have an objective method to account for an uncertain rising interest rate environment in their rate case arguments, especially so in the context of a multi-year rate freeze. This paper presents a framework for doing so. Importantly, our framework incorporates both expected future interest rates and interest rate uncertainty. We believe this approach measures the additional premium for entering a multi-year rate plan more accurately than methods currently in use.

4. Estimating the Stay-out Premium

While a rate freeze locks in all elements of the revenue requirements formula given in Equation (1), everything except the ROR is under some degree of managerial control and often known or easily forecasted. Within the ROR, while future interest rate changes also are relevant for the costs of debt and preferred stock, in practice these rates are directly observable and typically are not controversial or contested in rate cases. The utility can manage its debt maturity schedule such that it doesn’t need to issue debt during the stay-out period. As such, we hold the cost of debt and the cost of preferred stock constant under a stay-out plan. We also hold the capital structure weights constant.¹²

¹² In practice, one might argue that the equity weightings in a multi-year rate plan should be adjusted: to the extent that a multi-year rate plan stabilizes cash flow, it may be possible to increase leverage. Capital structure changes can be accommodated within our framework.
The stay-out premium can be expressed as an annual dollar amount (as in the Niagara Mohawk case discussed previously) and as a percentage risk premium to ROE. The Hope standard requires ROE to compensate shareholders for the rate they could earn on a comparable risk investment. We define the percentage stay-out premium as the additional return on equity required by shareholders to compensate them for the additional risk imposed through a stay-out plan, such that:

$$\text{ROE for multi-year rate freeze} = \text{unconstrained ROE} + \text{stay-out premium}$$  \hspace{1cm} (3)

where the unconstrained ROE is the ROE that can be reviewed for adjustment at any time. In all estimation approaches used, ROE is a positive function of the risk-free rate, for which long-term Treasury yields are used as the typical proxy. We estimate the percentage stay-out premium as the difference between the cost of equity if the authorized ROE is permitted to change in the future as the general level of interest rates changes, and the cost of equity if authorized ROE is fixed based on the current interest rates.

Figure 1 illustrates the impact of a three-year rate freeze agreement on the timing of the rate case process. This figure assumes, in the unconstrained world, the option to file a rate case occurs on an annual basis, and the rate case process takes one year to complete. To correspond with our subsequent empirical results, our rate case cycle occurs on an April to April period. The top of the figure illustrates the rate case pattern in the unconstrained world, assuming the firm requests a new rate case at the first possible opportunity. Thus, the rate case process to set rates for April 2015 – April 2016 is initiated in April 2014, and the ROE is determined based on interest rates observed at the initiation of the case, i.e. interest rate observed in April 2014. Similarly, the April 2016 – April 2017 rate case would be initiated in April 2015 and use rates observed at initiation, and the April 2017 – April 2018 rate case would be initiated in April 2016 and use rates observed then.
The bottom of the figure illustrates what happens when a three-year rate freeze is implemented. Now, the interest rates observed in April 2014 are used to set tariff rates for the period April 2015 – April 2018. The next opportunity to enter a rate case process occurs in April 2017. The three-year rate freeze eliminates the option to request a new rate case at two times: April 2015 and April 2016.

The annual timing of rate plans in Figure 1 is a generalization designed to capture the option to begin a new rate case each year. This option isn’t always exercised, and as the statistics in Table 1 suggest, the timing of rate cases is less frequent in practice. Many jurisdictions have regulations that specify when and how often one can file. Virginia, for instance, requires a rate case every two years. In some jurisdictions, utilities are restricted from filing too frequently. The approach outlined below assumes annual rate cases would be filed in an unconstrained world, but it is generalizable to any timing and rate freeze duration.

If rate cases can be filed annually, the utility holds a call option on interest rate increases, while the interveners hold a put option on interest rate reductions. In other words, the utility holds a long call and a short put on future interest rates. Under a rate freeze, such options are removed or altered, changing the risk faced by shareholders and their required return. The change in risk depends on the general level of interest rates, the direction they are expected to take, and their future volatility. The Hope standard implies that potential change in value (gain or loss) to shareholders must be compensated in such a way that the utility’s ability to attract capital isn’t compromised. Shareholders can be kept whole under a stay-out if their return is adjusted to fairly compensate them for the change in risk from the change in optionality. We offer an approach to estimate this change in risk premium, the stay-out premium, based on the options the utility loses and gains. We use existing priced instruments to capture these features, allowing us to draw inferences about the size of the stay-out premium from the prices of these instruments.

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13 Virginia Code 56-585.1. See: https://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+56-585.1
All else equal, tariff revenues change in proportion to the change in the allowed ROE:

\[
\Delta \text{Tariff revenues} = w_e \ast (\text{rate base}) \ast \Delta \text{ROE}. \tag{5}
\]

Let ROE\(_t\) denote the required ROE in year \(t\). The utility will only request a rate case when ROE\(_2\) > ROE\(_1\), and the commission will only request a rate case when ROE\(_2\) < ROE\(_1\). In an unconstrained world, the utility’s ability to file a new rate case at \(t=2\) is a call option with the payoff:

\[
\text{Utility option payoff} = w_e \ast (\text{rate base}) \ast \max (\text{ROE}_2 - \text{ROE}_1, 0) \tag{7}
\]

Similarly, in an unconstrained world, the utility commission has a put option with the payoff:

\[
\text{Ratepayer option payoff} = w_e \ast (\text{rate base}) \ast \max (\text{ROE}_1 - \text{ROE}_2, 0) \tag{8}
\]

As shown previously, the correlation between the ROE requested and the general interest rate levels is over 90%. So, while other factors could cause a utility’s risk and ROE to change over time, our methodology focuses solely on underlying interest rates as the determinant of ROE.

Interest rate options differ from equity options because changes in interest rates affect both the option’s payoff and the rate used to discount the option's cash flows (and its corresponding hedged position). In the context of interest rates, a call option is referred to as a caplet and a put option is referred to as a floorlet. The basic intuition still applies. The payoffs for these options (based on a calculation period of a year\(^{15}\)) are:

\[
\text{Caplet payoff} = \text{notional amount} \ast \max (r - K, 0) \tag{9}
\]

\(^{14}\) In practice, the result in Equation (5) would be grossed up for taxes by dividing it by \((1-T)\). This adjustment allows an increase in pre-tax tariff revenues sufficient to generate the desired ROE after taxes.

\(^{15}\) In more general terms, the payoff for a caplet is given by notional amount \(\ast\) (days in period / day count basis) \(\ast\) \(\max (r - K, 0)\), where days in period refers the number of days over which the interest accrues, and the day count basis is the market convention for the number of days in a year (typically 360 days for USD money market).
Floorlet payoff = notional amount * max (K - r, 0)  \hspace{1cm} (10)

where \( K \) denotes the option strike price and \( r \) is the reference interest rate observed at the payoff date.

A series of caplets (e.g., a series of annual options to reset rates) is referred to as an interest rate cap and a series of floorlets is referred to as an interest rate floor. If we set the notional amount as the value of the utility's allowed rate base, we can model the value of the utility's option to file a rate case each year over a multi-year period as the premium (i.e., price) of an interest rate cap, with a strike price of \( K_C \), and the value of the utility commission's option to order a rate case each year as the premium of an interest rate floor, with a strike price of \( K_f \). Thus, the value of the altered optionality from a multi-year stay-out period, from the perspective of the utility, can be expressed as:

\[
\text{Value of altered optionality} = \text{Premium of Cap (} K_C) - \text{Premium of Floor (} K_f). \tag{11}
\]

This combination can be viewed as a collar trade, in which the utility is long a cap and short a floor. If the value of altered optionality is positive, the utility is a less appealing investment under a stay-out plan than it is without one; otherwise, it is more appealing.

The regulatory process aims to enable utilities to attract equity capital by allowing them to earn a fair ROE. As such, we need to determine the effect of altered optionality on the ROE, and determine a stay-out premium that provides the shareholder with an expected return under a stay-out equivalent to the expected return without a stay-out. If the altered optionality is positive, utility investors lose under a stay-out, so the stay-out premium must be positive to neutralize this effect. Otherwise, the stay-out premium is negative. We can convert the value of altered optionality, a dollar figure covering a multi-year period, into an annualized measure expressed as a percentage risk premium by first converting the value of altered optionality into an equivalent annual figure. We then can estimate an annual stay-out premium by dividing the annualized dollar figure by the notional amount as:
Adding this premium to the unconstrained ROE allows utilities to earn a fair ROE under a stay-out plan.

For equity options, put-call parity implies the value of the long call plus a short put is equal to the discounted value of the difference between the strike price and the forward price:

\[
\text{Call (K) – Put (K) = Discount Factor} \times (\text{Forward price} – \text{Strike Price}).
\]

(13)

For swaptions, the analogous expression is:

\[
\text{Value of cap – Value of floor} = \text{Value of swap}
\]

(14)

When \( K_C = K_F \), we have put-call parity and the value of the stay-out premium equals the rate implied by the value of the swap, which can be thought of as the discounted value of the difference between the current spot rate and the expected future rate. In other words, when \( K_C = K_F \), the option approach provides no further insights beyond using the forward rate to calculate a stay-out premium.\(^{16}\) The benefit of our approach comes from frictions inherent in the decision to file a rate case. The statistics in Table 1 suggest utilities unconstrained by a stay-out arrangement don't automatically request a rate hearing when long-term interest rates change by a small amount, and the average (median) rate increase requested is 70 (60) basis points. Utilities appear to wait until the overall interest rate increase is deemed sufficient to overcome the administrative costs of a rate case. An analogy is that individuals do not automatically refinance their home mortgage whenever rates fall since there are fixed costs associated with the refinancing.

We begin by focusing on three possible situations:

\[^{16}\text{The outcome of the option approach and forward rate may differ slightly because of “second-order” convexity and boundary issues related to interest rate options.}\]
Case 1: Cap only, \( K_C = \text{current spot rate} \). This case recognizes utility commissions rarely initiate a rate case simply because interest rates fall, and therefore omits the put option from the stay-out premium calculation.

Case 2: Cap only, \( K_C = \text{current spot rate} + X \), where \( X \) is the amount by which interest rates must rise to trigger a rate case. \( X \) reflects the expected administrative costs and a premium for the risks associated with filing a new rate case.

Case 3: Collar, \( K_C = \text{current spot rate} + X, K_F = \text{current spot rate} - Y \), where \( Y \) reflects the amount by which interest rates must fall before the commission would initiate a rate review.

We use the 30-year Treasury Constant Maturity Swap (CMS) rate as the reference rate for the interest rate caps and floors. These contracts are traded heavily in the OTC market and can be priced using Bloomberg.\(^{17}\) The CMS rate is almost perfectly correlated with the "cash market" 30-year Treasury yield, with small differences between the rates arising to the extent the CMS rate incorporates market predictions about changes in the 30-year rate in the upcoming five years. This feature is realistic, as rate cases will explicitly or implicitly factor in expectations about rate changes when determining the ROE.

Each of the component caplets (and floorlets) is valued using a specific expected volatility reflecting market expectations for the path of interest rates between its valuation and payoff date. We can model the volatility term structure as a \textit{volatility cube}, or we can summarize the volatility over the

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\(^{17}\) The reference rate is the fixed rate to be exchanged for the 30-year Treasury yield observed every three months over a 5-year contract period. To illustrate the mechanics, suppose two parties enter into the CMS. Each year, one party pays a floating rate based on the observed value of the 30-year Treasury yield at the beginning of the year, while other party pays an agreed fixed rate. The fixed rate of a CMS at the contract initiation is equal to the discounted value of the expected future 30-year Treasury yields, such that the CMS has a fair value of zero at initiation. The 5-year contract period is standard convention and is unrelated to the duration of the stay-out (or the selected Treasury yield). Options where the underlying asset is a swap are termed swaptions.
life of the contract using the same constant rate each period, known as a flat volatility. The volatility cube allows market expectations of volatility to differ across strikes (the volatility smile) and swap tenors (the time period being considered).

Table 2 provides estimates of the stay-out premium for a 3-year stay-out assuming that in the absence of a rate freeze rate freeze rate cases would have been initiated at the end of year 1 and year 2. We use a valuation date of April 1, 2014. The timing of the contract corresponds to the timeline of the options in Figure 1. The premium is obtained using Bloomberg’s interest rate swap function (SWPM), based on the Black-Scholes valuation model with a log-normal convexity adjustment. We consider both the current volatility cube (VCUB), and constant ("flat") volatility set equal to 20%, 30%, and 40% (these values are in the range of those implied by the expected volatility surface on the pricing date). These results are illustrative – the model parameters can be calibrated for timing and interest rate conditions. To express the option premium in annual yield terms, we first divide the premium into three equal payments of $P$, such that $(D_1*P) + (D_2*P) + (D_3*P) = \text{premium}$, where $D_1$, $D_2$, $D_3$ are the 1-year, 2-year, and 3-year discount factors implied by Eurodollar futures rates. We then divide these payments by the notional amount to obtain the stay-out premium in annual yield terms as in Equation (12). Figure 2 shows a Bloomberg screenshot for a sample calculation of the cap premium.

The results in Table 2 appear reasonable given the interest rate environment prevailing on April 1, 2014. Row [A] Column [1] shows the stay-out premiums that would be required under Case 1, compensating the utility for the lost call option on rising rates without adjustment for the inability of the

---

18 Flat volatility is a quoting convention such that a single number characterizes the price of a given cap or floor. Market participants do not actually believe that the same volatility should apply to every period in the future for that contract but rather solve backwards to obtain the volatility that sets the market price of the contract equal to the price obtained using a pricing model.

19 The convexity adjustment reflects the feature that the path of interest rates matters, in addition to the final value, since the intermediate interest rates impact the discount rates of the purchases / sales required by the market maker to hedge the position. This feature does not hold with traditional equity options.
commission to request a rate review if interest rates fall. The stay-out premiums rises as volatility increases, as we would expect since the lost call option value is higher as volatility is higher, and therefore the premiums must be higher to make investors whole. Row [A] across columns [2], [3], and [4] show results for Case 2. As X increases, the utility is, all else equal, less likely to initiate a rate case and the imposition of a stay-out period requires less compensation. Finally, the effect on stay-out premiums from the avoided obligation under the put option held by commissions (Case 3) can be observed by reading down each column. In comparison to the stay-out premiums in Row [A] assuming no possible rate case initiation by commissions, stay-out premiums are lower (controlling for volatility) when possible commission intervention is introduced. As Y increases and commission intervention becomes less likely, however, stay-out premiums values approach those computed for Case 1 in Row [A]. These results highlight how interest rate volatility expectations can significantly impact the stay-out premium and therefore should be considered in rate case decisions.

In the Niagara Mohawk Power Corp. case discussed previously, the rate decision incorporated the ability of the utility to pay a penalty to file a rate case before the end of the stay-out period. Such “off ramps” are not uncommon in rate moratorium plans. To investigate situations like this one, we consider a fourth case:

**Case 4:** Utility has ability to file a rate case early by paying a fixed penalty.

We begin by considering a regulatory regime in which tariff rates are fixed for two years, but the utility can elect to pay a penalty of P dollars to initiate a rate case after one year. This agreement is one-sided: only the utility can file a rate case early.
The option to file early is valuable to the utility, and hence lowers the required stay-out premium. Incorporating the penalty as an additional administrative cost, over and above X, the utility’s ability to file early is worth:

\[
\text{Premium of caplet } (K_C + \rho) = \text{Premium of caplet (current spot rate + X + } \rho),
\]

where \(K_C + \rho\) is the threshold nominal risk-free long-term interest rate (real interest rate + inflation) at which it becomes optimal for the firm to pay the penalty (and incur other costs of the rate case filing) and apply for a tariff rate increase. Thus, \(\rho\) can be thought of as the fixed dollar penalty \(P\) in interest rate terms. We proceed by first solving for \(\rho\).

We can re-write the standard revenue requirements equation in Equation (1) as:

\[
\text{ROR} \times (\text{rate base}) = \text{revenue requirement} - \text{operating expenses} - \text{taxes} - \text{depreciation}. \tag{16}
\]

Substituting for ROR and incorporating the penalty, we want to solve for the value of \(\rho\) such that

\[
[w_E \times (\text{ROE} - \rho) + (1 - w_E) \times (\text{Return on other capital sources})] \times (\text{rate base}) = \text{revenue requirement} - \text{operating expenses} - \text{taxes} - \text{depreciation} - P. \tag{18}
\]

Combining (16) and (18), we have:

\[
w_E \times \rho \times (\text{rate base}) = P.
\]

In the Niagara Mohawk case, the penalty for requesting a tariff rate increase for electric prior to the end of the period is $10.1 million. The corresponding rate base is $4.107 billion. The equity share of the capital structure is 48%. Thus, holding all else constant we can solve for \(\rho\) as:

\[
0.48 \times \rho \times $4,107 = $10.1 \quad \Rightarrow \rho = 0.51%.
\]
Thus, an increase in the required ROE of approximately 0.51% would be sufficient to offset the utility’s cost of paying the penalty.

For a given $\rho$, the change in optionality from a stay-out plan with a penalty is valued as:

\[
\text{Dollar value of altered optionality} = [\text{Premium of Caplet (K}_C\) – \text{Premium of Floorlet (K}_P\]) – \text{Premium of Caplet (K}_C + \rho\).  \tag{19}
\]

The last term is an additional option that reduces the value of the stay-out premium by the value of the utility’s option to pay a penalty and enter into a new rate case. This caplet’s strike price, $K_C + \rho$, reflects that the option is only worthwhile if underlying interest rates increase enough to offset both $X$ and the costs of paying the penalty $\rho$. We can solve this case using the same methodology as previously, by adjusting the premium by the value of the additional caplet with a strike price of $K_C + \rho$. As the size of the penalty increases, the value of Caplet $(K_C + \rho)$ approaches zero, and Case 4 simply becomes equivalent to Case 3. In contrast, when the penalty is small, it is possible to have a negative stay-out premium: in this case, the utility has lost little, since it can simply pay the small penalty to begin a rate case; whereas the commission has lost the opportunity to force a rate case when interest rates fall.

For long duration rate freezes, we want to account for the feature that the utility can elect to pay the penalty to file in any year of the stay-out period. This option to pay a penalty to file early can be only used once, such that if the utility pays the penalty at the end of year 1, then there is no longer any option value at the end of year 2. In the appendix, we describe how to capture this path dependence by modeling the penalty adjustment as a Bermudan Swaption. A Bermudan Swaption gives the holder the right, but not the obligation, to enter into an interest rate swap on any one of a number of predefined dates. The holder may only exercise the option on one of these dates.

4.1 Incentive Compatible Penalties
The penalty $P$ is likely to differ from the stay-out premium computed using our framework. This difference results because $P$ is typically designed to be incentive compatible with deterring filing a rate case before the end of the stay-out period. As such, penalties tend to be set high and the states of the world in which early filing would happen are rare. In such cases, we can view our framework as one that effectively doesn't allow early filing and the dollar stay-out premium case simplifies to Case 3.

Regulatory commissions can determine the interest rate at which it would be desirable to permit early filing, and our approach allows us to solve backwards for the penalty amount that is economic incentive compatible. Given moral hazard, consumers benefit from a contract structure that explicitly accounts for scenarios in which an early rate case is likely to be allowed.

4.2 Impact of Yield Curve and Interest Rate Expectations

Our previous empirical results were based on the yield curve on April 1, 2014, which reflects unusually low rates, particularly at the short-end, and a steep slope. To explore how our results differ in a different interest rate environment, in Table 3 we report the required compensation for a multi-year rate freeze, based on the yield curve and expected future rates at the beginning of 2006. Across all maturities, rates were much higher in 2006, and the curve was much flatter. In this environment, the compensation required for a stay-out agreement is much higher. These results highlight the importance of interest rate volatility expectations in determining the fair stay-out premium. In 2006, the direction of future interest rates was much more uncertain than in April 2014. In contrast, in the aftermath of the 2008 financial crisis, in April 2014 the Federal Reserve (via the FOMC) had provided transparent forward guidance about interest rates, essentially guaranteeing stable and low rates for an extended time period. While rates in 2014 were low and stable, there was almost universal agreement

\footnote{Linhart and Radner (1992) discuss optimal constraints in the context of utility regulation (with a focus on price caps).}
among market participants that interest rates would be higher in the future. The forward rate approach alone would suggest a higher stay-out premium in 2014, whereas our option-based approach suggests that the required stay-out premium should be higher in 2006, due to the relative higher interest rate uncertainty.

Table 4 shows how our stay-out premium estimates vary across years and compares them to the ad hoc approach used in some cases of estimating the stay-our premium as half the difference between the historical five-year monthly average of 3-year and 1-year Treasury yields. These results, which focus on just the lost opportunity to the utility with $X = 50$bp, show that over the 2006-2014 period, the highest stay-out premium from our options-based approach would be in 2008. This year corresponds to the peak of the financial crisis when there was a great deal of uncertainty in financial markets. In contrast, the 3 minus 1 approach produces the highest value in 2006 and the lowest value in 2010. Our approach produces more stable estimates, that we believe better capture the lost opportunities from a stay-out plan.

5. Conclusion

Multi-year rate plans can enhance performance incentives and reduce regulatory cost. A better understanding of how to set ROE under these plans may help them become more common. While these rate plans often incorporate automatic mechanisms to adjust for changing rate bases, weather, and commodity prices, most rate plans don’t include automatic adjustments for changes to the required return on equity, and those plans that do often have incomplete adjustments. Since a goal of multi-year rate plans is stable and predictable tariff rates, automatic adjustments to the return on equity are not a solution. Neither is using forward rates, since they don’t fairly compensate for the lost optionality. Our framework recognizes that a rate freeze causes utility shareholders to lose a call option on interest rate increases and utility ratepayers to lose a put option on interest rate decreases that may happen during
the stay-out period. We present an approach that can be used to quantify this altered optionality using priced instruments and thereby calculate the stay-out premium, which is the amount by which shareholders should be compensated to bear the additional risk inherent in a stay-out plan.

Our method can be easily adapted for different circumstances and contact structures, including partial adjustment mechanisms and dead-band provisions that limit new rate cases to interest rate changes outside of a certain range. At a minimum, it requires only two assumptions beyond those already required in a traditional rate case process: the stay-out period duration and the expected timing of rate case filings without a stay-out. Additional analytical steps and assumptions, such as the amount by which interest rates would need to rise to trigger a rate case filing, can be used to estimate a reasonable stay-out premium under more complex arrangements.

Harris and Marston (2013) show that the market risk premium moves inversely with interest rates, suggesting that the positive relationship between interest rates and ROE may be dampened by a partial reduction in the market risk premium. They show that this effect is less pronounced for utility stocks, and attribute the greater interest rate sensitivity of utility stocks to their high dividends and similarity to bonds. While our methodology assumes no link between interest rates and market risk premium, it could be adjusted easily to accommodate a changing premium.

Factors beyond the risk-free rate influence ROE and could be affected by a stay-out. Fixed tariff rates make a firm’s revenues less variable, driving down risk and ROE, all else equal. Since a rate freeze fixes price per unit but not quantity (kilowatt hours billed) and operating costs, free cash flows may become more variable under a stay-out. Whether a stay-out increases or decreases firm risk is an empirical question and an area for future research.
Our approach is relevant to utilities, commissions, and interveners directly involved in a rate case to establish policies for determining a stay-out premium, present arguments for a reasonable stay-out premium, and to consider arguments presented by opposing parties. Indeed, given the ad hoc approaches currently in use to estimate stay-out premiums, concrete guidance on this issue is needed. Our approach also gives equity analysts a path to interpreting the sufficiency of authorized ROE under a stay-out as they make buy, sell and hold recommendations, to portfolio managers wishing to optimize holdings of utilities in their portfolios, and to individual and institutional investors.

We extend our approach to situations in which the utility can pay a dollar penalty to file a rate case before the stay-out period ends. Under a rate freeze, there is the risk that an unexpected, substantial increase in interest rates or inflation, or both, will be sufficient to threaten the economic viability of the utility. Faced with such a scenario, the regulator must decide whether to allow the utility to go into bankruptcy or allow them to file early. We believe that most regulators would decide to allow an early filing, since the potential large-scale failure of multiple utilities is untenable. Given this moral hazard problem, it may be optimal to incorporate explicitly this optionality into the contract in the form of a penalty. Our approach can be used to set a reasonable dollar penalty and to allow shareholders to interpret dollar penalties stipulated by others.

A fair stay-out premium should reflect not just expectations about future levels of interest rates, but also their expected volatility. This insight motivates our options-based methodology, rendering it superior to methods based solely on forward interest rates. To compensate shareholders fairly for the risk they bear under a stay-out, ROE must be adjusted to reflect that all parties to a rate case lose the ability to initiate a rate review as new information is revealed over the course of the stay-out period. Our options-based approach captures this lost discretion.
Acknowledgements

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References


Figure 1
Timeline of annual rate plans and 3-year rate plan
Figure 2

Example of Bloomberg SWPM function for a CMS Interest Rate Cap

This figure shows the results for a cap with a strike of spot + X, where the spot rate = 3.6059% and X = 75bp, under the same parameters and timing as in Table 2. The volatility structure is assumed to be 40% flat. Bloomberg calculates a premium of 1.68241%, or a dollar amount of $168,241.07 for a rate base of $10 million. We then divide this premium by 2.947374, which is the sum of the 1-year discount factor (0.99636), 2-year discount factor (0.986184), and 3-year discount factor (0.96483), obtained from Eurodollar futures rates. The result of this division is 0.571, which is the value of the annual rate adjustment reported in Table 2.
Table 1
Descriptive Statistics on U.S. Rate Cases from 1977 to 2014

This table reports descriptive statistics for all major U.S. electric, natural gas, and steam rate cases filed from July 1977 and completed by March 31, 2014. Full sample includes 2976 rate cases. Rate case data collected from SNL Energy, which reports information for all cases with a requested rate change of at least $5 million or an authorized rate change of at least $3 million. Interest rate data collected from Bloomberg and Federal Reserve Bank of St. Louis.

**Panel A:** Sample Statistics. Duration of rate case, also known as regulatory lag, is the number of months elapsed from rate case filing to the rate authorization for that rate case. Change in ROE requested is the difference between the ROE requested and the most recent authorized ROE for that utility and service type. Change in ROE authorized is the difference between the authorized ROE and the most recent authorized ROE for that utility and service type. Time between filings is the number of months from each filing to the prior filing for the same utility and service type.

<table>
<thead>
<tr>
<th>Valid observations</th>
<th>Mean</th>
<th>10%</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of rate case (months)</td>
<td>2976</td>
<td>8.97</td>
<td>5.0</td>
<td>6.0</td>
<td>8.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Time between filings (months)</td>
<td>2419</td>
<td>37.90</td>
<td>11.0</td>
<td>13.0</td>
<td>24.0</td>
<td>42.0</td>
</tr>
<tr>
<td>Change in ROE requested (%)</td>
<td>1917</td>
<td>0.70</td>
<td>-0.80</td>
<td>0.00</td>
<td>0.60</td>
<td>1.35</td>
</tr>
<tr>
<td>Change in ROE authorized (%)</td>
<td>1726</td>
<td>-0.43</td>
<td>-2.00</td>
<td>-0.95</td>
<td>-0.25</td>
<td>0.09</td>
</tr>
</tbody>
</table>

**Panel B:** Correlations between rate case attributes and interest rates. Change in yield is the difference between the 30-year Treasury yield observed at the beginning of the month a rate case is filed. Significance levels in parentheses; number of observations in brackets.

<table>
<thead>
<tr>
<th></th>
<th>ROE Requested</th>
<th>Yield on 30-year Treasuries</th>
<th>Number of filings</th>
<th>Change in yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROE Requested</td>
<td>1.000</td>
<td>0.91568 (&lt;.0001) [1930]</td>
<td>0.47260 (&lt;.0001) [2303]</td>
<td>0.25860 (&lt;.0001) [2303]</td>
</tr>
<tr>
<td>Yield on 30-year Treasuries</td>
<td></td>
<td>1.000 (&lt;.0001) [2419]</td>
<td>0.44841 (&lt;.0001) [2419]</td>
<td>0.34118 (&lt;.0001) [2419]</td>
</tr>
<tr>
<td>Number of filings</td>
<td></td>
<td></td>
<td>1.000 (&lt;.0001) [2419]</td>
<td>0.21338 (&lt;.0001) [2419]</td>
</tr>
<tr>
<td>Change in yield</td>
<td></td>
<td></td>
<td></td>
<td>1.000 [2419]</td>
</tr>
</tbody>
</table>
Table 2
Estimates of the annual stay-out premium required as compensation for a 3-year stay-out plan with two lost opportunities to enter into a rate case.

This table reports the option premium in annual yield terms (as a percent of notional) of an interest rate cap or collar (combined cap and floor). The cap strike is set equal to (spot rate + X), where X captures the interest rate increase at which it would be advantageous for the utility to incur the costs of filing a rate case. The floor strike is set equal to (spot rate – Y), where Y captures the rate decrease at which it would be sufficient to justify the regulator requiring the utility to file a rate case. The estimates are obtained using the SWPM function on Bloomberg. The reference rate is the generic U.S. 30-year Treasury Yield Index (USGG30YR) constant maturity swap rate, reset annually in advance, with an annual payment. The pricing is based on the interest rate curve as of 4/1/2014, with a valuation date of 4/1/2014. The cap/collar has an effective date of 4/1/2015 and a maturity date of 4/1/2017. On the valuation date, the spot yield equals 3.6059%. The premiums are calculated using either a constant (“flat”) interest rate volatility or using the Bloomberg interest rate volatility cube (VCUB), both measured on the valuation date. The volatility cube allows volatility to vary across strikes, option terms, and swap tenors.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No floor option [A]</td>
<td>VCUB</td>
<td></td>
<td>0.421</td>
<td>0.324</td>
<td>0.244</td>
<td>0.180</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.388</td>
<td>0.296</td>
<td>0.222</td>
<td>0.165</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.573</td>
<td>0.485</td>
<td>0.408</td>
<td>0.343</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.804</td>
<td>0.717</td>
<td>0.640</td>
<td>0.571</td>
</tr>
<tr>
<td>Y = 50bp [B]</td>
<td>VCUB</td>
<td></td>
<td>0.350</td>
<td>0.253</td>
<td>0.172</td>
<td>0.109</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.340</td>
<td>0.248</td>
<td>0.175</td>
<td>0.117</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.459</td>
<td>0.370</td>
<td>0.294</td>
<td>0.229</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.619</td>
<td>0.532</td>
<td>0.455</td>
<td>0.389</td>
</tr>
<tr>
<td>Y = 100bp [C]</td>
<td>VCUB</td>
<td></td>
<td>0.394</td>
<td>0.297</td>
<td>0.216</td>
<td>0.153</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.378</td>
<td>0.286</td>
<td>0.213</td>
<td>0.155</td>
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<td></td>
<td></td>
<td></td>
<td>0.530</td>
<td>0.442</td>
<td>0.365</td>
<td>0.300</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>0.713</td>
<td>0.627</td>
<td>0.549</td>
<td>0.480</td>
</tr>
<tr>
<td>Y = 150bp [D]</td>
<td>VCUB</td>
<td></td>
<td>0.411</td>
<td>0.315</td>
<td>0.234</td>
<td>0.170</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.387</td>
<td>0.295</td>
<td>0.221</td>
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<td></td>
<td></td>
<td></td>
<td>0.562</td>
<td>0.474</td>
<td>0.397</td>
<td>0.332</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>0.769</td>
<td>0.683</td>
<td>0.605</td>
<td>0.536</td>
</tr>
</tbody>
</table>
Table 3
Historical estimates of the annual rate adjustment required to compensate for the lost option value from a 3-year regulatory stay-out.

This table reports the option premium in annual yield terms (as a percent of notional) of an interest rate cap or collar (combined cap and floor). The cap strike is set equal to (spot rate + X), where X is designed to capture the rate increase at which it would be advantageous for the utility to incur the costs (e.g., administrative, legal, uncertainty) of submitting a rate application. The floor strike is set equal to (spot rate – Y), where Y is designed to capture the rate decrease at which it would be sufficient to justify the regulator requiring the utility to enter into a new rate contract.

These estimates are obtained using the Swap Manager (SWPM) function on Bloomberg. The reference rate is the Generic U.S. 30-year Treasury Yield Index (USGG30YR) constant maturity swap rate, reset annually in advance, with an annual payment. The pricing is based on the interest rate curve as of 4/1/2006, with a valuation date of 4/1/2006. The cap/collar has an effective date of 4/1/2007 and a maturity date of 4/1/2009. On the valuation date, the spot yield equals 4.8898%. The premiums are calculated using either a constant ("flat") interest rate volatility or using the Bloomberg interest rate volatility cube (VCUB), both measured on the valuation date. The volatility cube allows volatility to vary across strikes, option terms, and swap tenors.

<table>
<thead>
<tr>
<th>Floor Strike = Spot - Y</th>
<th>Volatility Structure</th>
<th>Cap Strike = Spot + X</th>
<th>X = 0bp</th>
<th>X = 25bp</th>
<th>X = 50bp</th>
<th>X = 75bp</th>
</tr>
</thead>
<tbody>
<tr>
<td>No floor option</td>
<td>VCUB</td>
<td></td>
<td>0.550</td>
<td>0.429</td>
<td>0.325</td>
<td>0.242</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td></td>
<td>0.666</td>
<td>0.557</td>
<td>0.461</td>
<td>0.378</td>
</tr>
<tr>
<td></td>
<td>30%</td>
<td></td>
<td>0.941</td>
<td>0.840</td>
<td>0.747</td>
<td>0.664</td>
</tr>
<tr>
<td></td>
<td>40%</td>
<td></td>
<td>1.250</td>
<td>1.154</td>
<td>1.065</td>
<td>0.983</td>
</tr>
<tr>
<td>Y = 50bp</td>
<td>VCUB</td>
<td></td>
<td>0.521</td>
<td>0.399</td>
<td>0.296</td>
<td>0.213</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td></td>
<td>0.607</td>
<td>0.498</td>
<td>0.402</td>
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<tr>
<td></td>
<td>30%</td>
<td></td>
<td>0.799</td>
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<td>0.522</td>
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<td></td>
<td>40%</td>
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<td>0.916</td>
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<tr>
<td>Y = 100bp</td>
<td>VCUB</td>
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<td>0.541</td>
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</tr>
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<td>20%</td>
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<td>0.646</td>
<td>0.537</td>
<td>0.441</td>
<td>0.358</td>
</tr>
<tr>
<td></td>
<td>30%</td>
<td></td>
<td>0.868</td>
<td>0.767</td>
<td>0.674</td>
<td>0.591</td>
</tr>
<tr>
<td></td>
<td>40%</td>
<td></td>
<td>1.104</td>
<td>1.008</td>
<td>0.919</td>
<td>0.837</td>
</tr>
<tr>
<td>Y = 150bp</td>
<td>VCUB</td>
<td></td>
<td>0.547</td>
<td>0.426</td>
<td>0.322</td>
<td>0.239</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td></td>
<td>0.661</td>
<td>0.552</td>
<td>0.456</td>
<td>0.373</td>
</tr>
<tr>
<td></td>
<td>30%</td>
<td></td>
<td>0.909</td>
<td>0.808</td>
<td>0.715</td>
<td>0.632</td>
</tr>
<tr>
<td></td>
<td>40%</td>
<td></td>
<td>1.169</td>
<td>1.074</td>
<td>0.985</td>
<td>0.902</td>
</tr>
</tbody>
</table>
Table 4
Year-by-year estimates of the annual rate adjustment required to compensate for the lost option value from a 3-year regulatory stay-out in comparison with estimates based on the slope of the short-end of the Treasury yield curve.

This table reports the option premium in annual yield terms (as a percent of notional) of an interest rate cap with a strike set equal to the 30-year yield plus 50bp. These estimates are obtained using the Swap Manager (SWPM) function on Bloomberg. The reference rate is the generic U.S. 30-year Treasury Yield Index (USGG30YR) constant maturity swap rate, reset annually in advance, with an annual payment. The pricing and valuation is based on the interest rate curve on April 1st of the valuation year. The cap has an effective date of April 1st on the subsequent year and a maturity date of April 1st for three years following the valuation date. The premiums are calculated using the Bloomberg interest rate volatility cube (VCUB). The last column reports estimates based on taking half the difference between the historical five-year monthly average of 3-year Treasury yields and 1-year Treasury yields on the valuation date.

<table>
<thead>
<tr>
<th>Valuation Year</th>
<th>1-year Yield</th>
<th>3-year Yield</th>
<th>30-year Yield</th>
<th>Cap Strike (X = 50bp)</th>
<th>Stay-out Premium Estimate</th>
<th>Treasury Yield Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>0.1116</td>
<td>0.883</td>
<td>3.6059</td>
<td>4.1059</td>
<td>0.230</td>
<td>0.291</td>
</tr>
<tr>
<td>2013</td>
<td>0.1268</td>
<td>0.347</td>
<td>3.0743</td>
<td>3.5743</td>
<td>0.267</td>
<td>0.297</td>
</tr>
<tr>
<td>2012</td>
<td>0.1675</td>
<td>0.502</td>
<td>3.3358</td>
<td>3.8358</td>
<td>0.284</td>
<td>0.269</td>
</tr>
<tr>
<td>2011</td>
<td>0.2271</td>
<td>1.280</td>
<td>4.4853</td>
<td>4.9853</td>
<td>0.244</td>
<td>0.204</td>
</tr>
<tr>
<td>2010</td>
<td>0.3873</td>
<td>1.607</td>
<td>4.7278</td>
<td>5.2278</td>
<td>0.254</td>
<td>0.147</td>
</tr>
<tr>
<td>2009</td>
<td>0.5404</td>
<td>1.135</td>
<td>3.5015</td>
<td>4.0015</td>
<td>0.249</td>
<td>0.120</td>
</tr>
<tr>
<td>2008</td>
<td>1.62</td>
<td>1.94</td>
<td>4.3993</td>
<td>4.8993</td>
<td>0.401</td>
<td>0.154</td>
</tr>
<tr>
<td>2007</td>
<td>4.90</td>
<td>4.54</td>
<td>4.8432</td>
<td>5.3432</td>
<td>0.258</td>
<td>0.256</td>
</tr>
<tr>
<td>2006</td>
<td>4.82</td>
<td>4.83</td>
<td>4.8898</td>
<td>5.3898</td>
<td>0.327</td>
<td>0.374</td>
</tr>
</tbody>
</table>
Appendix

In this appendix, we consider a stay-out plan that incorporates a rate freeze for longer than two years, but in which the utility can elect to pay a penalty to file in any year of the stay-out period. We assume that this option to pay a penalty to file early can be only used once, such that if the utility pays the penalty at the end of year 1, then there is no longer any option value at the end of year 2.

The path dependence of the option to pay a penalty can be modelled as a Bermudan Swaption. A Bermudan Swaption gives the holder the right, but not the obligation, to enter into an interest rate swap on any one of a number of predefined dates. The holder may only exercise the option on one of these dates.

Standard pricing models for Bermudan Swaption are based on when the underlying interest rate is the London Interbank Offer Rate (LIBOR), which has a maximum maturity of one year. Despite this limitation, useful insights can still be obtained using the LIBOR pricing model. To the extent that 12-month LIBOR and the 30-year Treasury yield differ, our results may over-estimate or under-estimate the actual required compensation for the penalty. In most market conditions, short-term interest rates are more volatile than long-term rates, and as such, we believe that this swaption approach provides an upper bound on the adjustment to the stay-out premium required for the option to pay a penalty.

Table 5 provides estimates of the adjustment to the stay-out premium required with a penalty (expressed as a percent of the notional amount) using the Bermudan Swaption approach. For example, under a 3-year stay-out agreement with a one-time option given to the utility to pay a penalty of 1% of free cash flows and file a rate case before the stay-out period ends, our previous estimates of the stay-
out premium (from Table 2) should be adjusted downward by 17.2 basis points (based on using the volatility cube).^{21}

As volatility increases, the value of the option to pay a penalty to exit the stay-out plan increases. As the penalty increases, the option to file early is less valuable. Policy makers face a trade-off: smaller penalties with lower rates, or larger penalties with higher rates. This decision should reflect the costs of a rate case and interest rate uncertainty.

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^{21} In unreported results, we check whether this estimate is reasonable by comparing it with the results of a caplet approach using a version of equation (20) and Treasury rates, in which the option to pay the penalty only occurs once at the midpoint of the 3-year period. Similar results are obtained.
Table 5
Estimates of the fair value adjustment to the stay-out premium in return for the utility having an option to opt out of the agreement by paying a fixed penalty.

By entering into the stay-out agreement, the utility can be viewed as having entered into a swap in which they receive a fixed rate of return (i.e., fixed ROE) in exchange for ‘paying’ the (floating) cost of capital for the length of the stay-out period. The option to pay a one-time penalty to exit this swap can be modelled as a Bermudan Swaption. In this swaption, the regulator writes (is short) the option. These results are based on a swaption for a swap with an effective date of 4/1/2015 and a maturity date of 4/1/2017, where the floating leg is the 12-month LIBOR rate and the fixed leg is set to be 1.71% (equal to the expected discounted value of the floating leg). Both have annual payments. The option to exit the swap can be exercised on 4/1/2015 or 4/1/2016 for an exercise price expressed as a percent of the notional amount. The Bermudan option can be called at the beginning of each payment period. Once the option is exercised, the agreement is terminated. Cash flows are paid at the end of the period, based on floating rates (USD 12-month LIBOR) observed at the beginning of the period. The reported number is the annualized fair value of the option premium, such that the total discounted present value of three annual payments equals the total option premium. The premiums are calculated using either a constant (“flat”) interest rate volatility or using the Bloomberg interest rate volatility cube (VCUB), both measured on the valuation date. The volatility cube allows volatility to vary across strikes, option terms, and swap tenors. The valuation date and the curve date are 4/1/2014.

<table>
<thead>
<tr>
<th>Penalty (%)</th>
<th>Volatility Cube</th>
<th>Constant (Flat) Volatility Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>0</td>
<td>0.306</td>
<td>0.183</td>
</tr>
<tr>
<td>0.5</td>
<td>0.229</td>
<td>0.075</td>
</tr>
<tr>
<td>1</td>
<td>0.172</td>
<td>0.025</td>
</tr>
<tr>
<td>2</td>
<td>0.103</td>
<td>0.002</td>
</tr>
<tr>
<td>3</td>
<td>0.066</td>
<td>0.000</td>
</tr>
<tr>
<td>4</td>
<td>0.045</td>
<td>0.000</td>
</tr>
<tr>
<td>5</td>
<td>0.032</td>
<td>0.000</td>
</tr>
</tbody>
</table>