This draft: January 11, 2024

Preventing Another SVB: The Case for Mandatory Duration Gap Disclosure

Edward L. Golding[1] and Deborah Lucas[2]

[1] Senior Lecturer and Executive Director MIT Golub Center for Finance and Policy

[2] Sloan Distinguished Professor of Finance and Director of the MIT Golub Center for Finance and Policy, corresponding author, dlucas@mit.edu.

We thank Mickey Levy for encouragement and helpful discussions, and we are grateful to Tanmay Bagree for excellent research assistance. Views expressed are those of the authors and not those of the MIT Golub Center for Finance and Policy.

Abstract

We propose that regulators mandate periodic, public disclosure by banks of their "duration gap" as a means of reducing the incentive for banks to take excessive interest rate risk. We consider alternative rules for calculating the duration gap, with a focus on how deposits and franchise value should be treated. We also suggest how the reported gap might be linked to capital requirements. A rough estimate of the duration gap of SVB suggests that the bank's realized losses were consistent with the predictions of that metric given realized rate changes. We review the history of duration gap disclosures by the GSEs, which suggests that disclosure can discourage risk-taking behavior. Finally, we elaborate on why a reported duration gap would provide information that is currently unavailable using accounting or market price data, and present evidence on the empirical relation between interest rate changes and bank equity value.

1. Introduction

The reasons for the collapse of Silicon Valley Bank (SVB) are all too familiar to students of banking history. SVB's managers were gambling on short-term interest rates remaining lower than current long-term rates, investing heavily in long-term mortgages and government bonds funded with short-term deposits. The steep and rapid increase in interest rates caused those asset values to plummet, eroding the bank's equity capital. Uninsured depositors became fearful when alerted to the possibility of losses and hastily exited. As during the 1980s--when bets on interest rates led to the S&L crisis and to the near bankruptcy of the mortgage giant Fannie Mae--it was a classic case of purposeful "duration mismatch" between assets and liabilities. The strategy would be profitable if rates stayed flat or fell, and if not, the government would share in the losses.

While the mechanics behind SVB's failure are straightforward, it is harder to understand why it was allowed to happen.[3] Commercial banks like SVB are highly regulated. Unlike credit risk, interest rate risk exposure is relatively easy to identify, quantify, and hedge against. It was no secret that the Federal Reserve was committed to a series of rate hikes to combat inflation, or that the yield curve could steepen if investors came to believe that inflation would persist. SVB's larger investors and regulators were reportedly well aware of its elevated risk exposure months before the run materialized. Regulatory stress tests, which take interest rate conditions into account, also could have alerted regulators to the risk exposure.[4]

Were SVB's regulators asleep at the wheel? While perhaps they had the discretion to have done more, there appears to have been no explicit rule that should have been enforced but was ignored. In fact, surprisingly few regulations are directed at formally measuring and controlling interest rate risk. Bank capital requirements are primarily linked to credit risk, and regulatory accounting standards often allow interest rate losses to be deferred. Partially in response to SVB's and other recent failures, tighter liquidity and capital requirements are currently being

[3] See NYU Stern White Paper (2023) for a more detailed analysis of the causes and consequences of SVB's failure.
[4] Some have argued that stress tests could miss this risk because they do not always incorporate scenarios with rapidly rising rates.

proposed. However, there is still no regulatory requirement that addresses interest rate risk head-on.

In this paper, we suggest a new disclosure requirement directed at reducing the incentive for banks to take excessive interest rate risk. Specifically, we propose that regulators mandate periodic, public disclosure by banks of their "duration gap." A duration gap is a well-known measure of the exposure of the equity value of financial institutions to interest rate changes. That disclosure would alert regulators and investors to whether and when a bank is taking significant interest rate risk or relaxing its hedging practices. The reporting mandate would in itself serve as an incentive for bank managers to limit interest rate risk in order to avoid regulatory action and bad publicity. To provide even stronger incentives for interest rate risk management, regulators could consider formulaically tying capital requirements to the disclosed duration gap, and we discuss possible ways to operationalize that linkage.

The idea that mandating duration gap disclosures could improve banks' risk management practices is given credence by the historical effects of such disclosures on the behavior of the Government-Sponsored Enterprises (GSEs), Fannie Mae and Freddie Mac. Although the S&L bailouts and near-bankruptcy of Fannie Mae in the 1980s did not give rise to the direct regulation of interest rate risk, it did cause a significant change in GSE disclosure policies that continues to this day. The GSEs agreed to regularly report their duration gap both monthly and in their quarterly financial statements. Not only did adopting this disclosure policy make it much easier for regulators and investors to gauge the GSEs' risk exposure, it appeared to changed behavior: When interest rate risk-taking became more transparent, the GSEs voluntarily did less of it.

Duration gap disclosures would provide new information that today even the most astute market analysts or regulators would not be able to infer from existing disclosures or from market price reactions to interest rate changes. Technically, calculating the gap requires knowing the detailed maturity structure of a bank's assets and liabilities and incorporating the effects of swaps and other derivatives on that maturity structure. Banks already have all the necessary information to do those calculations and most already do them internally, making the incremental regulatory burden modest.

The idea of using a financial institution's duration gap to quantify its susceptibility to interest rate risk dates back to the 1980s. Bierwag and Kaufman (1986) derive a bank's duration gap in terms of Macaulay duration and discuss the advantages and limitations of that measure. Here we focus on the more modern notion of "effective duration," which generalizes the concept to apply not only to risk-free bonds, but to any claim whose value is sensitive to interest rate changes. Importantly, that generalized definition allows the concept of duration to be operationalized for sticky deposits and franchise value, and clarifies the relation between duration and run risk. A technical contribution of this paper is to suggest how the duration of these quantities should be evaluated. Estimating the duration of most other components of bank assets and liabilities is straightforward, and computation practices could be standardized across banks using directives pointing to standard textbook or industry approaches.

We also consider the tradeoffs involved in making other choices about how mandatory duration gap disclosures are calculated and interpreted. It is not obvious whether the reported duration gap should be based on current obligations only, or whether it should also incorporate franchise value. Relatedly, whether regulators would choose a duration gap of zero as the preferred operating target for banks will depend on how comprehensive a duration-gap measure is adopted, and which risks are of greatest concern.

The rest of the paper is organized as follows. In Section 2 we introduce the generalized concept of duration, suggest how to best operationalize and interpret it for deposits and franchise value, and illustrate the main considerations for what to include in a duration gap calculation with some simple examples. Alternatives for linking capital requirements to the duration gap to are also considered. Section 3 briefly recounts the factors leading to the insolvency of SVB and relates its losses to a rough estimate of its duration gap. Section 4 reviews the history of duration gap disclosures by the GSEs. Finally, in Section 5 we elaborate on why a reported duration gap would provide information that is currently unavailable using accounting or market price data, and present evidence on the empirical relation between interest rate changes and the market value of bank equity. Section 6 concludes.

2. Measuring bank exposure to interest rate risk with duration metrics

Duration quantifies the sensitivity of the value of an asset or liability to changes in interest rates. When the concept is applied to bank equity, it provides a measure of the solvency risk that arises from exposure to interest rate risk. Because perceptions about solvency affect depositor and other creditors' behavior, duration measures are also informative about potential liquidity problems.

In this section we review the relevant duration concepts. We discuss the most appropriate way to measure duration for different types of claims—most notably, for deposits and franchise value. Some simple examples illustrate how the interpretation of the reported duration gap will change depending on what is included in its measurement, and the implications of targeting a duration gap of zero. Finally, we suggest how the duration gap could also be used to scale the size of an incremental capital requirement for interest rate risk exposure

2.1 Duration as a measure of interest rate risk exposure

Duration measures the sensitivity of the value of a financial claim to small changes in the level of interest rates. The concept is often used by asset managers and traders to evaluate or hedge their exposure to interest rate risk. The generalized concept of duration can be applied to any type of financial claim whose value is affected by interest rate changes, including derivatives such as interest rate swaps and the franchise value of a bank. For a financial institution, the difference between the duration of its assets and its liabilities—its duration gap—approximates the exposure of the value of its equity to interest rate changes.

Duration can be defined as:

$$(1) \qquad D(V) = -\frac{\partial V}{\partial r}/V$$

where, V is the value of a claim, $D(V)$ is the duration of the claim, and r is the relevant interest rate. The negative sign maintains the convention that duration is positive for coupon bonds,

whose value moves inversely with interest rates. Representing duration as a partial derivative recognizes that the value of the claim may also be affected by other factors such as default risk.

There are standard approaches that financial practitioners use to implement eq. (1) for different types of claims. Often the value of a claim is affected by rates at multiple points along the relevant yield curve, such as for a coupon bond. In such cases, ∂r is commonly taken to be the derivative of value with respect to the claim's yield to maturity. Alternatively, duration may be calculated using multiple rates along the yield curve, with ∂r then representing a parallel shift of the curve. In practice, exactly how duration is measured depends on the application at hand.[5]

In this paper, we take the relevant duration concept to be "effective duration," which requires $\partial V(r)/\partial r$ to be the best available linear approximation to the sensitivity of a claim's value to small rate changes. That best approximation could be based on an analytical valuation equation or on a numerical model. Notice that duration is defined in percentage terms. Duration can be converted to a measure of monetary exposure by multiplying it by the value of the claim. That metric, which is called "dollar duration," is the most frequently used form of duration for hedging strategies.

For claims with embedded interest rate options (e.g., prepayable mortgages), the sensitivity of value to rate changes can be highly non-linear. Approximations based on eq. (1) can be refined to more accurately incorporate non-linear effects by adding a second derivative or "convexity" term. Capturing curvature can be important for evaluating institutions like Fannie Mae and Freddie Mac, that are highly exposed to such claims. However, because evaluating and incorporating convexity adds complexity, and because for most commercial banks a linear approximation is likely to be adequate, we abstract from convexity in most of the analysis that follows. Banks could voluntarily choose to report on convexity effects, as the GSEs routinely do.

In general, the duration of a coupon bond or fixed rate loan will depend on its maturity, coupon rate, market interest rates, and any embedded options such as a prepayment or default option. It is straightforward to apply eq. (1) to the standard formula for the present value of a risk-free

[5] For a more complete discussion of the various concepts of duration see for example Tuckman and Serat (2022).

bond to establish that duration and maturity are equal for zero-coupon obligations.[6] A bond with a positive coupon rate or with embedded call or put options will have an effective duration that is shorter than its maturity. Pure floating rate bonds or loans have an effective duration equal to the time until the next rate reset; e.g., a 5-year loan with a rate that resets annually has a duration of approximately one year. Prepayment and default options shorten effective duration. The intuition for why is easily understood by considering a long-maturity bond that is expected with certainty to prepay or default the next day. Its duration is just one day because its value will be unaffected by what happens to interest rates beyond that horizon. Technically, a bond with an embedded option is equivalent to a portfolio consisting of a bond without that option and the option. The effective duration is the sum of the duration of the option-free bond and the duration of the option.

Some commentators loosely equate maturity and duration, perhaps because for risk-free zero-coupon bonds the two are identical. However, for the purpose of evaluating risk exposure, it is important to recognize that a claim's duration and its maturity may differ considerably. For example, the effective duration of a 30-year mortgage may be less than four years in a rapidly falling interest rate environment. As just discussed, floating rate loans and claims with embedded options often have durations that can be considerably shorter than their maturity.

The concept of duration can be applied to either the market or book value of a claim. For most of what follows we implicitly assume that market values are the objects of interest. However, we will also consider how the interpretation of reported duration gap measurements change when certain elements that affect the market value of equity are excluded from its calculation, or when distortions from held-to-maturity accounting are not corrected for.

[6] This also requires that the discount rate be represented on a continuous basis.

2.1.1 Duration of deposits

In keeping with eq. (1), the duration of a deposit measures the sensitivity of its value to an upward shift in interest rates. First, consider a demand deposit that creates no rents for the bank, i.e., the depositor earns interest at a market rate net of the cost to the bank of the liquidity and custodial services provided. The depositor can withdraw the funds at any time (and in principle the bank could refund the deposits at any time). The deposit is a zero-coupon bond with zero maturity; it has a duration of zero. Denote the value of this deposit by Δ.

What about a demand deposit that creates positive franchise value for the bank? Deposits may contribute to franchise value because depositors accept zero or low monetary returns even as market rates rise. Deposits may be sticky because of depositor inattention, transactions costs, or imperfect competition that allows rents from underpriced deposit insurance to be partially captured by shareholders. The value of such deposits can be decomposed into two components: (1) the value of a fairly-priced zero-maturity obligation Δ; and (2) the associated franchise value, F_δ. The total value of the deposit is $V_\delta = \Delta + F_\delta$. The duration of the first component is zero, as established earlier. The contribution to duration of the second component is $-\frac{\partial F_\delta}{\partial r}/V_\delta$. Interestingly, this element of franchise value will be increasing in interest rates as long as the widening of the difference between the fair deposit rate and the deposit rate paid doesn't cause large withdrawals. It follows that the contribution of franchise value to the effective duration of demand deposits is often negative, causing the overall duration of demand deposits to be negative. Furthermore, deposits that are less likely to be withdrawn when rates rise and so likely to remain in the bank for longer actually will have a more negative effective duration than those that are more rate sensitive. An example of such a deposit is one that is held as a compensating balance on a loan.

The conclusion that demand deposits have a zero or even negative duration may seem contrary to the observation that deposits tend to remain with a bank for months or even years. Because of that stickiness, the effective maturity of deposits is often described as being much longer than their contractual maturity. To intuitively reconcile the zero or negative duration of deposits with their tendency to remain in place, note that all short-term liabilities, even when they are used to

fund long-term investments, are understood to have a short duration. For example, overnight commercial paper is routinely rolled over by finance companies funding multi-year auto loans. Duration is unaffected by whether the claim is likely to be rolled over or not.

The same logic applies to time deposits. The duration of a time deposit with no associated rents for the bank is reasonably approximated by its time to maturity, with the caveat that any intermediate interest payments and the possibility of early withdrawal shortens its effective duration. When a time deposit creates franchise value that is sensitive to interest rate changes, the effective duration of the time deposit incorporates that effect.

What is the effect of a possible bank run on the duration of deposits? One would expect the effects to be small except when a run is imminent. The right of depositors to withdraw their money at any time is analogous to an American put option on a bond with a strike price equal to any penalty payment for withdrawing the funds early. For demand deposits, that strike price is zero. In general, an embedded put option shortens the absolute value of the duration of a claim. Intuitively, it decreases the importance of more distant cash flows on present value, and hence the sensitivity of distant cash flows to interest rate changes become less important. For demand deposits that already have a zero duration, there is no effect. One would expect any associated deposit franchise value to decline with an increase in the likelihood of a run, and therefore the duration of demand deposits inclusive of franchise value would become less negative. A similar analysis suggests that the duration of time deposits will decrease in the likelihood of a run.[7] For healthy banks, the effect of the possibility of a run on the value of deposit put options, and its effect on deposit duration, should be minimal.

From a technical perspective it is convenient that the duration of deposits is largely unaffected by the future behavior of depositors, absent consideration of deposit franchise value. As we discuss below, there are a number of reasons to exclude franchise value from the mandated duration gap disclosure. With that exclusion, a simple and fairly accurate rule for calculating deposit duration would be to set it to zero for demand deposits and to the remaining maturity of time deposits.

[7] This assumes that the dominant effect is the shortening of the time the deposits remain at the bank, and not the decrease in franchise value.

Finally, note that on the asset side, the duration of reserves is zero analogously as it is for demand deposits.

2.1.2 Duration of franchise value

The market value of a bank's assets can be divided into two components: (1) the market value of existing investments, and (2) franchise value, which is defined as the present value of the future profits that a firm is expected to earn as a going concern.

Estimates of the duration of franchise value will be very sensitive to how franchise value is modeled. In fact, the magnitude and even the sign of franchise duration are likely to vary over time with macroeconomic and bank-specific conditions. Indirect evidence of the instability of the relation between rate changes and franchise value is presented in Section 3. Scatter plots show that the relation between interest rate changes of at least 50 basis points and changes in the value of market equity relative to asset value for mid-sized and large banks is extremely noisy and averages close to zero.[8]

There are several reasons that franchise value may be increasing in interest rates, in which case its duration is negative. As noted earlier, sticky deposits create franchise value with negative duration when the spread between investment returns and the rate paid on depositors increases in interest rates. Interest rates tend to increase when the economy is strong, which can lead to more growth opportunities for banks and hence greater franchise value.

There are other situations where franchise value would be expected to decline with rising rates. For instance, an increase in rates could lead to a large decline in the value of existing investments, resulting in deposit withdrawals, questions of whether the firm is a going-concern, and the risk of potential insolvency. An elevated probability of bankruptcy erodes franchise value, as happened with SVB.

[8] The change in equity value in response to a rate change will be dominated by the effect on franchise value for a bank that has hedged the interest rate exposure of its existing investments.

The difficulty of imputing the duration of franchise value and its likely instability over time suggest that a duration gap measure that excludes franchise value would be less noisy and easier to verify. More fundamentally, when the main purpose of the reported duration gap is to assess the exposure of existing bank obligations to interest rate risk, it is natural to exclude franchise value from the measurement. Furthermore, allowing banks to choose to include some measures of franchise value, such as "deposit stickiness" will create an incentive to cherry-pick and include only those factors that make the duration gap appear smaller.

2.2 Duration gap

A bank's duration gap measures the exposure of its equity value to interest rate changes. That idea could be operationalized in a variety of ways, and for the purpose of a mandatory disclosure we discuss several alternatives.

A bank's market value of equity, E, can be expressed as the market value of its currently held assets, A, minus the market value of existing liabilities, L, plus the net value of any derivative positions, S, plus franchise value, F.

(2) $$E = A - L + S + F$$

As discussed earlier, franchise value is the component of equity value arising from future value creation. The source could be the value of customer relationships (network value), growth of existing operations, expansion into new ventures, and any future rents such as those arising from underpriced deposit insurance or regulatory barriers to competition. Derivatives positions include swaps, lines of credit, forwards and futures, CDS, and other contingent claims.

All of the terms on the righthand side of (2) are potentially sensitive to interest rate changes. Differentiating with respect to the interest rate, r, provides a linearized expression for the change in the market value of equity for a parallel shift of the yield curve:

(3) $$\frac{dE}{dr} \cong \frac{\partial A}{\partial r} - \frac{\partial L}{\partial r} + \frac{\partial S}{\partial r} + \frac{\partial F}{\partial r}$$

Eq. (3) can be rewritten in terms of the duration of each component:

(4) $\frac{dE}{dr} \cong -[D(A) \times A - D(L) \times L + D(S) \times S + D(F) \times F]$

The term in square brackets in eq. (4) defines a bank's dollar duration gap in terms of the value and dollar duration of the individual elements that affect equity value. (The expression is also referred to as the dollar value of a basis point, or DV01). A bank manager seeking to minimize the volatility of the market value arising from interest rate changes would manage its assets, liabilities and derivative holdings to keep the duration gap close to zero.

To approximate the change in the value of equity for a given change in rates, the negative of the duration gap is multiplied by the rate change. For example, consider a bank with $E = 8$, $A = 100$, $L = 92$, $S = -2$, and $F = 2$. Liabilities are a mix of deposits and medium-term debt, with combined duration $D(L) = .9$. Its asset holdings consist of reserves, securities and loans, with $D(A) = 3$. All sources of franchise value including from deposits are rolled into F, and $D(F) = -.5$. Its net derivative positions have $D(S) = -12$. Then the duration gap is $[3 \times 100 - .9 \times 92 - 12 \times 2 - .5 \times 2] = 192.2$. An increase in rates of 2 percentage points will cause the bank's equity to fall by approximately 3.84 or about half of its current value. Managers could reduce that exposure by more closely matching the duration of assets and liabilities or by using additional derivatives to hedge.

A common practice, and one we endorse for a mandated duration gap, is to leave out the term reflecting franchise value. As discussed earlier, the difficulty of modeling and verifying the duration of franchise value, and its likely volatility during periods of bank stress, are reasons to exclude it. In the example just considered, that omission would create the appearance of greater exposure to interest rate risk than is in fact the case. Of course, had the franchise value had a positive duration, the distortion would have been in the other direction. When franchise value is excluded from the reported duration gap, it makes sense for regulators to give banks some leeway to target values that are different than zero. That leeway can also be justified by the observation that it is acceptable for banks to take a moderate amount of interest rate risk, for

instance because it is expensive to fully hedge or there may be value creation in maturity transformation by banks between long-term investments and short-term liabilities.

The duration gap is often loosely described as the difference between the duration of assets and liabilities. One might wonder whether the derivative term could also be omitted from the reported duration gap. We believe that would be a serious mistake. Derivatives such as interest rate swaps can reliably hedge interest rate risk while giving banks the flexibility to structure the duration of assets and liabilities so as to maximize value creation, and larger banks in particular depend on derivatives to manage risk. As discussed in the next section, a major benefit of duration gap disclosure is that it provides information that is currently unavailable to policymakers and investors about how derivative usage is affecting risk exposure.

The discussion thus far has presumed that the relevant sensitivity is of the market value of equity, or a fair value approximation to it. However, book values play a prominent role in bank regulation and accounting practices. This raises the question of whether book or market values should be used in computing the reported duration gap? It seems clear that for a duration gap measurement to be meaningful, it has to be based on market or fair value approximations to market values. Most book value entries on both the asset and liability sides of the balance sheet are insensitive to interest rate changes, and hence mechanically have a duration of zero on a book value basis. Where the divergence between book and market value duration is likely to be largest is for long-term securities that are classified as held-to-maturity. Consideration of book versus market values underscores that the purpose of reporting a duration gap is to provide information about solvency risk. A bank that appears comfortably well-capitalized on paper but whose assets precipitously decline in value because of interest rate increases cannot count on continuing as a going concern or being able to hold assets to maturity, and banks that operate with a large duration gap are at risk.

2.3 Linking duration gap to capital requirements

In this paper we emphasize the value of duration gap disclosure as an incentive for reducing risk-taking behavior, and do not take a stand on whether regulators should link it to capital

requirements. However, it would be straightforward for regulators to connect banks' disclosed duration gap with required capital, and doing so would provide a stronger incentive than disclosure alone for controlling interest rate risk.

As shown in the previous section, a bank's dollar duration gap, *G*, multiplied by a given change in rates, *dr*, approximates the drop in the market value of its equity for that rate change: $dE \cong -G \times dr$.

A natural way to incorporate the reported duration gap into capital requirements would be to require banks to hold enough additional equity to cover the drop in value of a rate shock at some threshold, for example up to a two percentage-point rate increase. A bank that wanted to avoid an additional capital levy could manage to a duration gap close to zero. To provide banks with some flexibility, there could also be a ceiling duration gap such that the additional capital requirement is zero as long as the duration gap remains below that ceiling. The safe harbor ceiling could be calibrated to allow modest losses of equity value in percentage terms for interest rate changes that fall within some confidence interval of the distribution of historical rate changes. To the extent that current capital requirements already cover interest rate risk, they might be adjusted downward to account for their replacement with this duration gap-based component.

3. SVB's interest rate risk exposure

That SVB was half giant 1980's savings & loan (S&L) with $117B of long-term securities out of $212B in assets, and half lender to Silicon Valley innovators, was hiding in plain sight. SEC disclosures (10-Qs and 10-Ks) and FDIC call reports show the SBV has $82.7 billion in residential mortgage-backed securities with a disclosed duration of 5.7 years. Under regulatory and generally-accepted account principles (GAAP), these positions were either held to maturity and thus carried at book value or available for sale where the value is the lower of book or mark-to-market, but where losses do not go through earnings and hence do not affect shareholder's book equity. The disclosed overall losses for SVB on a fair value basis were $15.2 billion or 95% of book value shareholder equity ($16.0 billion).

Were these positions hedged with long-term liabilities and derivatives? Piecing together the various disclosures, the answer is no. Most liabilities ($173.1B*)* were short-term deposits that depositors were able to withdraw in a matter of days. Other liabilities included $13.6 billion in short-term borrowings, largely advances from the Federal Home Loan Banks. Long-term debt with maturity over one year comprised only $5.4 billion of liabilities.

As for derivative positions, as of December 31, 2022 the total notional value of derivatives (excluding those held for customers) was just $550 million, a tiny fraction of SVB's asset value. The notional value of derivatives had dropped from $10.7 billion a year earlier, and the CEO discussed taking off the derivative hedges on an earnings call. All this was disclosed.

Using this information, we can estimate that the duration gap between assets and liabilities was in the range of 3 to 4 years. SVB disclosed that 55% of its assets (117/212) were long term, with duration (on most) of 5.7 yrs. Assuming those assets were financed by very short-term deposits, that alone implies a duration gap 3.14 years when everything else is matched, i.e., its commercial loans had same dollar duration as the liabilities funding those loans. Alternatively, assuming commercial loans have a 1-year duration and that the liabilities backing them have a duration close to zero, the estimated duration gap increases to 3.6 years. A one-percentage point increase in interest rates would lead to fair value losses of approximately $6 to $8 billion or approximately half of GAAP shareholder equity. A two-percentage point increase would put SVB on the edge of insolvency.[9]

While this calculation suggests that analysts and regulators may be able to roughly estimate duration gaps from existing bank disclosures, such informal estimates are unlikely to garner enough attention to influence banks' risk management practices. Furthermore, for institutions that make heavy use of derivatives, such estimates are likely to be unreliable.

4. Interest rate risk in historical context, and duration gap disclosure by the GSEs

[9] See Jiang et. al. (2023) for an alternative approach to estimating SVB's losses.

The estimated duration gap for SVB indicates it was taking an unacceptable amount of interest rate risk. Its behavior was similar to what occurred in the 1970s and 80s with the S&L industry funding 30-year fixed rate mortgages with short term deposits. When interest rates rose starting in 1979, the industry was insolvent on a mark-to-market basis. While many gambled for resurrection with risky credit bets that failed, the seed of their downfall and subsequent bailout was mismatch between the duration of their assets and liabilities. The cost of that rescue was reported to be $160 billion, the equivalent of $358 billion today. By way of comparison, the cost of the Troubled Asset Relief Program, the largest source of relief funds for banks beset with credit losses from the financial crisis of 2008, was only about a third as much (Lucas, 2019).[10]

With the demise of the S&L industry, by the 1990s the largest mortgage portfolios were those of the GSEs, Freddie Mac and Fannie Mae. In 2000, their mortgage assets totaled $1 trillion or approximately one-sixth of mortgage debt outstanding. Concern began to grow that these two institutions would suffer the same fate as the S&Ls because of their large mortgage portfolios. While the GSEs issued some long-term debt and partially hedged with derivatives, GAAP at the time had even less information about mark-to-market values and derivative positions than today. Thus, the level of interest rate risk in the GSEs was unknown to the public and policymakers.

4.1 Voluntary disclosure of interest rate risk by GSEs

In October 2000, facing mounting criticism about the risk to taxpayers from their mortgage portfolios, the GSEs announced a package of "voluntary" reforms that included disclosure of duration gaps. An episode in September 2002, where Fannie Mae's duration gap widened sharply to 14 months, caused a negative market reaction—Fannie Mae's debt spreads widened and its stock price dropped. Fannie Mae quickly announced that it was reducing its duration gap.[11] The initial report also triggered a sharp increase in the volatility of Fannie Mae's stock price and no corresponding increase for Freddie Mac, whose duration gap remained stable. Fannie Mae's stock price volatility returned to normal once the gap was closed (Lucas and

[10] Lucas (2019) estimates a fair value cost of TARP of $90 billion in 2008, which translates to $122 billion in 2022 dollars using the CPI index for adjustment.

[11] https://www.marketwatch.com/story/fannie-mae-says-duration-gap-is-narrowing-shares-rise

McDonald, 2006). This episode suggests that the disclosures provided new and actionable information to market participants, and an incentive for the GSEs to more tightly manage interest rate risk.

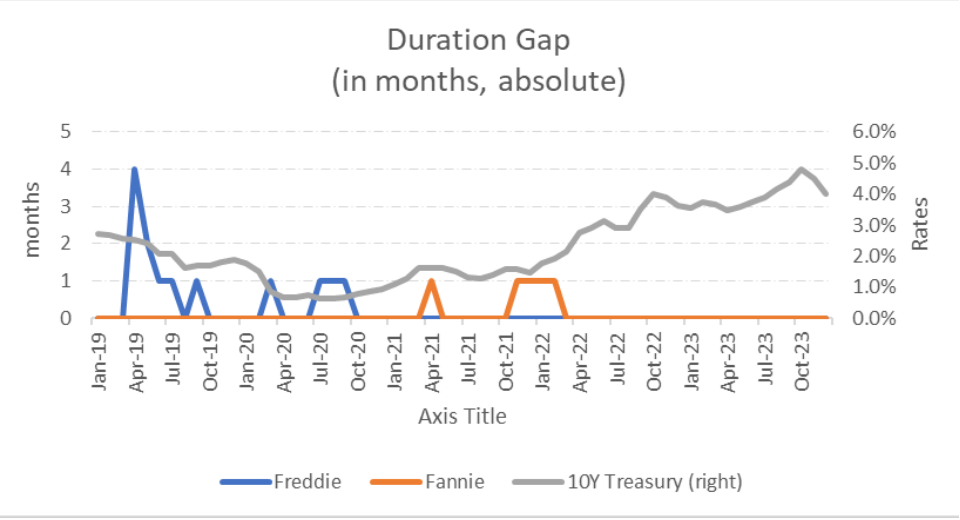
These disclosures are still done today and go beyond those of most other financial institutions. The GSEs disclose the duration gap between their assets and liabilities monthly on their website. For example, Fannie Mae's January 2023 disclosure reveals the exposure of its equity value to both a level shift in the yield curve and to its slope, and also its duration gap.

Table 8. INTEREST RATE RISK DISCLOSURES

	Market Value Sensitivity ($ in Millions)		
	Rate Level Shock (50 bp)	Rate Slope Shock (25 bp)	Duration Gap (in years)
January 2022	(60)	9	(0.05)
February 2022	(71)	(6)	(0.05)
March 2022	(56)	(10)	(0.03)
April 2022	(39)	(4)	(0.03)
May 2022	(43)	(5)	(0.03)
June 2022	(27)	(5)	(0.02)
July 2022	(41)	(8)	(0.04)
August 2022	(31)	(7)	(0.03)
September 2022	(23)	(6)	(0.02)
October 2022	(18)	(4)	(0.01)
November 2022	(13)	(5)	0.01
December 2022	(15)	(7)	0.01
Full Year 2022	**(36)**	**(6)**	
January 2023	(27)	(12)	0.02
YTD 2023	**(27)**	**(12)**	

The GSEs now and for many years have maintained duration gaps close to zero. Figure 1 shows the reported absolute value of the duration gap for the GSEs since 2019 on a quarterly basis, and the contemporaneous 10-year Treasury rate which is commonly used as a reference rate for the value of mortgages. The near-zero duration gaps of the GSEs protected them from losses over the period of volatility and rapidly rising interest rates in 2022 and 2023.

Figure 1: Recent history of the GSE's reported duration gap



The duration gap disclosures from the GSEs use models to estimate change in values of assets, liabilities and derivatives from a parallel change in the yield curve. Unlike depositories, they do not have demand deposits to incorporate into the duration gap measure, but they do have to make decisions regarding the interest rate sensitivity of their guarantee business. Similar to present value of growth opportunities, the value of this business depends on future economic conditions of which future interest rates are just one component.

Fannie Mae excludes the guarantee business from its measures of duration. Freddie Mac includes the guarantee business in its measures but made a change in April 2019 to disclosures on how it modeled this business. Due to this change Freddie Mac's disclosed duration increased to four months before returning to zero several months later.

5. Shortcomings of existing disclosures and market data

Accurately estimating a bank's duration gap requires detailed information about the maturity structure of its assets and liabilities, the associated rates paid and received, and the parameters of prepayment options, swaps and other derivatives. Bank financial statements (e.g., 10K and 10Q

reports) typically only provide coarse information about these characteristics, for instance, dividing loans into broad maturity buckets. Information about derivatives, which often have a major effect on interest rate risk exposure, is particularly limited in financial reports.

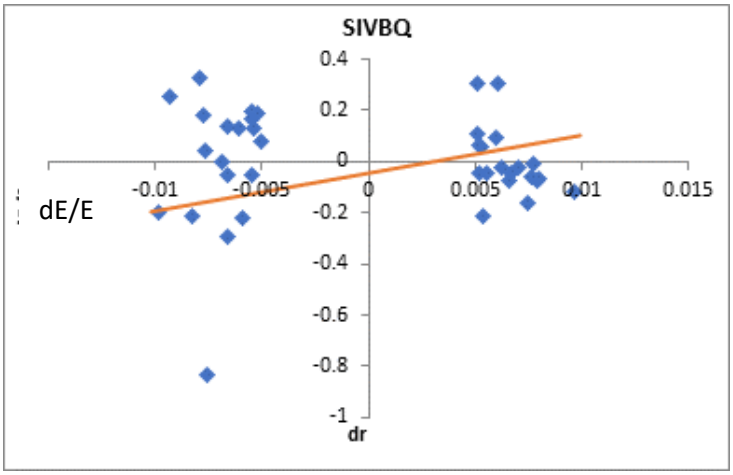
For publicly traded banks, another potential source of information about a bank's duration gap comes from the equity market. The sensitivity of the market value of a bank's equity to rate changes could offer a clue as to how investors perceive the bank's exposure to interest rate risk. To explore this possibility, we collected historical data on interest rate changes and the subsequent change in the market value of equity (normalized by equity value) for 23 large and mid-size U.S. banks. Specifically, using data from 1984-2023, we computed the return on equity over a month that follows a one-month period over which interest rates rose or fell by more than 50 basis points, for non-overlapping time periods. We considered changes in 3-month LIBOR and also in the 5-year US Treasury rate. We repeated the exercise using contemporaneous equity value changes and rate changes.

Figure 2 shows the results for SVB. The findings are typical of what is also observed for the other banks individually and when the data is pooled (see Appendix): The relation between equity changes and interest rate changes is very noisy. In regressions of dE/A on dr, the slope coefficients are not significantly different than zero. These findings are not surprising. Unlike duration calculations that isolate the effect on value of interest rate changes using the structure of a valuation model, observed changes in equity value reflect changes in myriad other factors that affect firm value. *(We expect the same would be true over a week or a day, but have not tabulated those results for this draft.)*

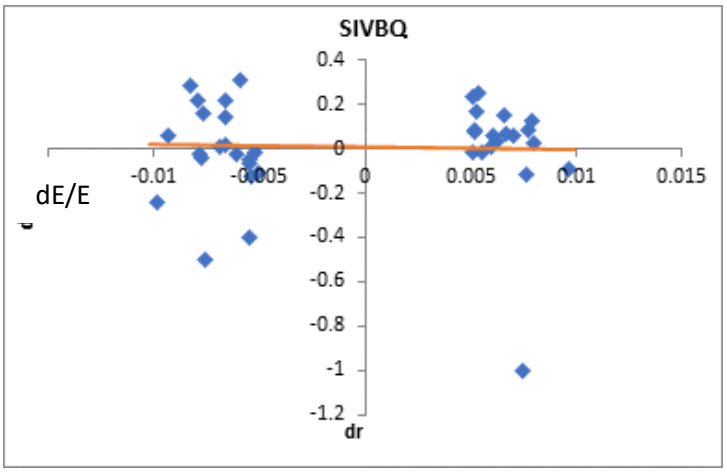
The finding of a weak relation between equity value changes and rate changes would also be expected for a bank that hedges against interest rate risk for existing assets and liabilities. In that case, dE can be interpreted as measuring changes in franchise value in eq. (4). Under that interpretation, the noisy relation between dE and dr supports the conjecture that the duration of franchise value could be either positive or negative and that it varies over time, although the caveat that dE is the result of changes in factors other than dr also applies here.

Figure 2: SVB Equity value versus change in rates

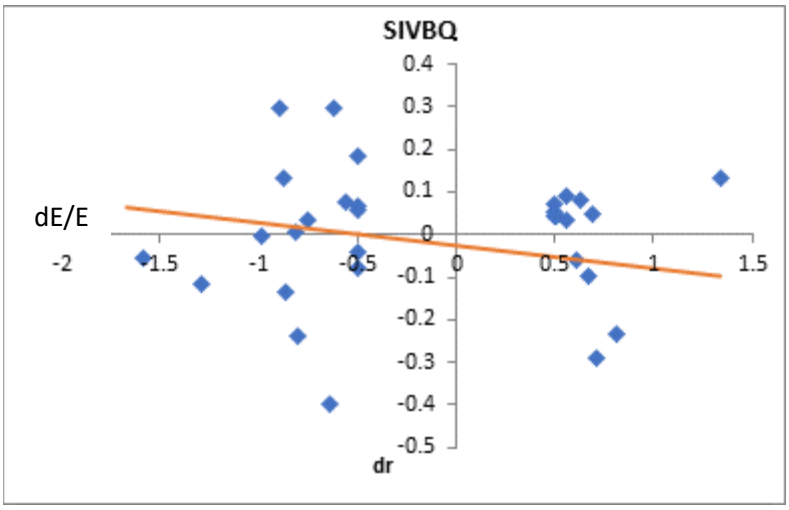
Panel A: UST 5Y, Contemporaneous dr



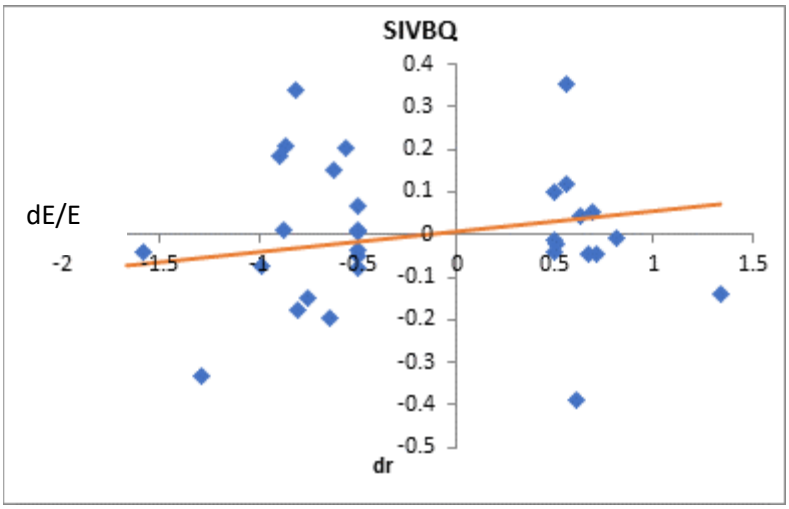
Panel B: UST 5Y, Lagged dr



Panel C: LIBOR 3-mo, Contemporaneous *dr*



Panel D: LIBOR 3-mo, Lagged *dr*



6. Concluding remarks

In this paper we have made the case that banks should be required to periodically disclose their duration gap, and provided suggestions for guidelines for how the measure is constructed. The statistic would provide new information to regulators and investors about interest rate risk exposure that can't be accurately inferred from current financial reports or market data.

The additional regulatory burden of this disclosure requirement would be modest. Banks already calculate their duration gap for internal purposes (or should). It is a reform that could be

accomplished in matter of months, and that would presumably encounter much less resistance than calls for higher capital requirements.

In the case of SVB and the other banks that were highly exposed to the Federal Reserve's recent rate hikes, this simple disclosure would have alerted the market and regulators to emerging problems as it did with the GSEs over 20 years ago. Once the disclosures become standardized and widely accepted, bank regulators could provide a stronger and more uniform incentive for interest risk avoidance by tying capital requirements directly to a bank's duration gap.

References

Barta, Patrick and Jerry Guidera, "Two Mortgage Buyers Strike Deal to Permit Debt and Risk Reviews" The Wall Street Journal, Oct. 23, 2000 3:47 am ET
https://www.wsj.com/articles/SB972247715321604744?mod=Searchresults_pos3&page=1

Bierwag, G. O., & Kaufman, G. G. (1985). Duration Gap for Financial Institutions. *Financial Analysts Journal*, *41*(2), 68–71.

Jaffe, Dwight, "The Interest Rate Risk of Fannie Mae and Freddie Mac," *Journal of Financial Services* 2003
https://link.springer.com/content/pdf/10.1023/A:1025968716887.pdf

Jiang, Erica, Gregor Matvos, Tomasz Piskorski, and Amit Seru, "Monetary Tightening and U.S. Bank Fragility in 2023: Mark-to-Market Losses and Uninsured Depositor Runs?" working paper, 2023

Frame, Scott and Larry D. Wall, "Fannie Mae's and Freddie Mac's Voluntary Initiatives: Lessons from Banking," 2002
www.atlantafed.org/-/media/documents/research/publications/economic-review/2002/vol87no1_frame-wall-2.pdf

Lucas, Deborah, "Measuring the Cost of Bailouts," *Annual Review of Financial Economics,* Vol. 11:85-108, November 2019

Lucas, Deborah and Robert L. McDonald, "An Options-Based Approach to Evaluating the Risk of Fannie Mae and Freddie Mac", *Journal of Monetary Economics*, 2006.

NYU Stern White Paper, *SVB and Beyond: The Banking Stress of 2023,* editors V.V. Acharya, M.P. Richardson, K.L. Schoenholtz, and B. Tuckman, 2023

Tuckman, Bruce and Angel Serrat, Fixed Income Securities: Tools for Today's Markets, 4th edition, Wiley, 2022

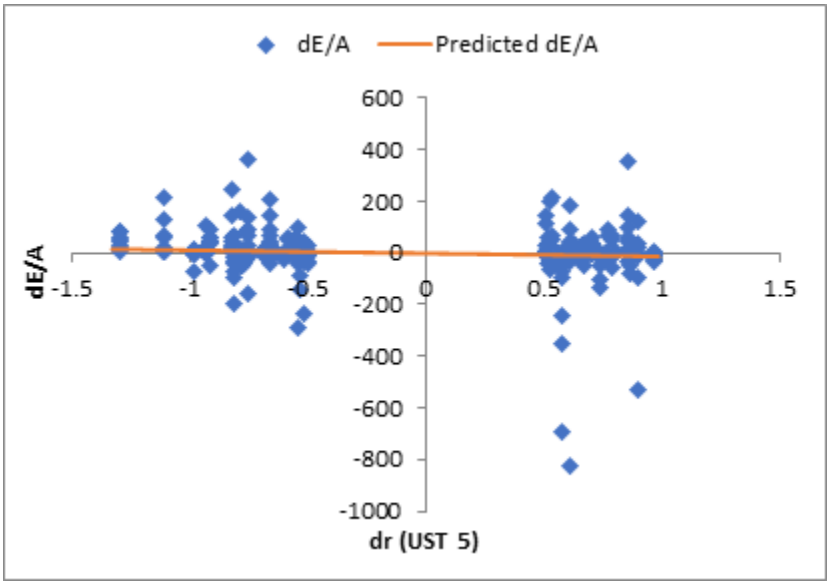
Appendix: dE/A versus dr for pooled sample of mid-sized banks

Ticker symbols of included banks:
ALLY, CFG, FITB, FRCB, HBAN, KEY, MTB, NTRS, PNC, RF, SBNY, SIVBQ, TFC, USB

UST 5Y:

Regression Statistics	
Multiple R	0.107914
R Square	0.011645
Adjusted R Square	0.009688
Standard Error	75.70137
Observations	507

	Coefficients	*Standard Error*	*t Stat*
Intercept	1.756075	3.365652	0.521764
UST 5	-11.3994	4.67322	-2.43931



LIBOR 3M:

Regression Statistics	
Multiple R	0.014697
R Square	0.000216
Adjusted R Square	-0.00247
Standard Error	109.7578
Observations	374

	Coefficients	*Standard Error*	*t Stat*
Intercept	-12.9262	5.757291	-2.24519
dr (Libor 3m)	-2.08626	7.359193	-0.28349