Understanding Mortgage Dollar Rolls

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- Dollar rolls serve as the primary channel for mortgage securities borrowing and lending in the MBS TBA market, and as such they play a critical role in providing liquidity to the market. The borrowing rate associated with a dollar roll provides significant information on technicals in the MBS market. A background in the conventions and calculations associated with dollar rolls is thus critical to understanding relative value in the MBS market. The primary goal of this primer is to provide this background.
- Functionally speaking, dollar roll transactions are a form of securities lending and are closest in spirit to repurchase agreements (repos). In a typical repo, a lender agrees to sell securities to a buyer in return for cash. At the termination of the transaction, the securities are resold at a predetermined price plus an interest payment. A dollar roll is analogous to a repurchase transaction except that the party borrowing the securities has the flexibility of returning "substantially similar" securities, instead of the same ones.
- In addition to providing financing opportunities for mortgage pass-through positions and enhancing liquidity in the TBA market, dollar rolls also serve other needs. Dollar rolls are used to obtain collateral for CMO deals and TBA transactions, to avoid operational issues associated with taking delivery of mortgage pools, to hedge specified pool positions, and to express a view on prepayment speeds.
- As financing transactions, dollar rolls can offer attractive borrowing rates and a considerable portion of this primer is devoted to explaining how to calculate the implied financing rate associated with a particular dollar roll. The sensitivity of roll pricing to different factors such as prepayment speeds and reinvestment rates is also explored.
- Historical data suggest that dollar rolls can offer financing advantages of as much as 15 bps to 100 bps versus 1-month LIBOR. This advantage should not be construed as a "free lunch", however, since it comes with risks attached. These risks include being redelivered collateral with inferior prepayment characteristics relative to the original securities that were delivered and prepayment risk. Credit risk and liquidity risk play a relatively minor part in dollar rolls.
- Our primer concludes with a "real life" example of how dollar rolls trade in practice. We review the history of roll levels on FNMA 6s and comment on the various factors that led to the roll trading in a 2 to 15 tick range between 2003 and 2004.

I. INTRODUCTION

As one of the most liquid fixed income sectors in the world, mortgage-backed securities (MBS), particularly those backed by agency guarantees, constitute an active subsector of global securities lending markets because of their high credit quality and liquidity. Securities lending transactions in MBS are usually structured in one of two ways: as **repurchase agreements (repos),** or as **dollar rolls**. Repurchase agreements are **securities lending** transactions in which one party (the lender) agrees to sell securities to another party (the borrower) in return for cash (or securities), with a simultaneous agreement to repurchase the same securities at a specific price at a later date.[1] At the termination of the transaction, the securities are resold at the predetermined price plus an interest payment (calculated based on a previously determined interest rate). A dollar roll is analogous to a repurchase transaction, except that it provides the party borrowing the securities with additional flexibility of returning "substantially similar" securities, instead of the same ones.[2] In addition, unlike a repo, the party borrowing the security owns the principal and interest payments generated during the roll period.

The popularity of mortgage repos and dollar rolls can be gauged from the fact that parties to these agreements span the entire range of institutional participants in the mortgage market: broker-dealers, GSEs, banks, pension funds, hedge funds, insurance companies, mutual funds and overseas investors. The needs and motivations of these participants vary from transaction to transaction, depending upon whether they are acting as a borrower or lender of securities (or sometimes even both). For example, a broker-dealer might borrow securities to cover a short position, or simultaneously borrow and lend securities to earn a high rate on the securities loaned versus the securities borrowed. To give a specific example relevant to the mortgage sector, during times of heavy Agency CMO issuance activity the demand for mortgage pools by broker-dealers can lead to very attractive financing rates for MBS holders who choose to "roll" their securities to these dealers. The ability of MBS investors to "roll" the pass-through securities they have in position lowers funding costs and can significantly enhance returns on these positions versus other fixed-income alternatives.

As our discussion and examples suggest, dollar roll transactions play an important role in enhancing liquidity in the MBS market by facilitating market making and the creation of structured securities. Unfortunately, it is not easy to quantify this liquidity because no official statistics exist for the volume of dollar roll transactions since they take place "over-the-counter." In other words, dollar rolls are privately negotiated transactions between two parties that take place through a trading desk or an electronic trading system. However, data from TradeWeb and the Bond Market Association suggest that dollar rolls constitute

[1] Securities lending has been defined as the "temporary exchange of securities, generally for cash or other securities of at least an equivalent value, with an obligation to redeliver a like quantity of the same securities on a future date." An excellent introduction to this subject can be found in *Securities Lending Transactions: Market Developments and Implications*, Technical Committee of the International Organization of Securities Commissions (IOSCO), Bank of International Settlements (BIS) Committee on Payment and Settlement Systems (CPSS), July 1999.

[2] "Substantially similar" is defined in the American Institute of Certified Public Accountants' *Statement of Position 90-3* as meaning that the original and returned security should be of the same agency/program, original maturity, and coupon and both should satisfy "Good Delivery" requirements. Some of the requirements associated with "Good Delivery" are spelled out in **The TBA Market** section.

anywhere from one-third to two-thirds of all "To Be Announced" (TBA) transactions.[3] These numbers and information on Agency MBS trading volumes released by the Federal Reserve Bank of New York lead us to an estimated daily volume of $20 billion in dollar roll transactions in 2006. However, we should point out that a daily number is somewhat misleading in this context since most roll activity takes place two to five days before TBA settlement dates. Turning to the composition of participants in these transactions, based on trading desk flows, we estimate that money managers and U.S. banks account for nearly 50% of dollar roll activity, with the other half attributable to the GSEs, mortgage servicers, insurance companies and overseas investors.

The primary goal of this primer is to describe and discuss the conventions and calculations associated with dollar roll transactions. Consequently, we begin by sketching some of the key conventions associated with the MBS TBA market, which is the market where these transactions take place. The next section explains some of the basic aspects of dollar roll transactions and provides practical examples of how and why these agreements are executed by market participants. From there, we delve into the nuts and bolts of calculating the all-important financing rate associated with these transactions. This is followed by a sensitivity analysis that demonstrates how this financing rate depends upon prepayment assumptions and the reinvestment rate. The sensitivity analysis provides a natural segue into a more detailed discussion of the risks associated with the dollar roll—with redelivery and prepayment risks being the crucial ones. The paper concludes with a review of recent trading activity in the rolls associated with a specific coupon to provide readers with some "real-life" background for the dollar roll market.

[3] TradeWeb is a multi-dealer electronic auction system that links fixed-income securities dealers with buy-side institutions. Besides TBA-MBS, other products traded on the platform include US Treasuries, agencies and several other types of debt securities. The Bond Market Association is a private trade association that represents security firms and banks that underwrite, distribute, and trade debt securities. The Association's membership includes all major dealers.

II. THE TBA MARKET

As a preface to an explanation of the dollar roll market, it is useful to review some features of the "To Be Announced" (TBA) market for mortgage pass-throughs that play a particularly important role in dollar roll transactions. The TBA nomenclature captures two important features of how this market operates:

- The market is a forward delivery market with participants entering into forward contracts to buy or sell MBS on a monthly settlement schedule set by the Bond Market Association. A settlement date is typically 30 days into the future but can be as much as two to six months in the future. The current settlement month is known as the **front month** and the settlement months following the front month are typically known as **back months**. The actual numbers of pools and pool numbers are not known at the initiation of the forward contract but are "announced" on 48-hour day: two business days before the agreed settlement date, prior to 3pm EST. Other general trade parameters such as the agency type, price, coupon and par amount are known at the time the trade is executed.
- The pools delivered by the seller on the settlement date have to satisfy **Good Delivery Guidelines**. These are also established by the Bond Market Association and detail the specifics associated with confirming and settling MBS. For example, the guidelines govern the maximum number of pools per lot and maximum allowable variance between the face amount of the pools delivered and the agreed-upon face amount. Current standards for Good Delivery include a maximum of three pools per lot and a maximum variance of 0.01% per lot. In other words, for a $1 million lot, the sum of current face amounts of the pools should be within 0.01% of $1 million, or between $999,900 and $1,000,100.

Settlement **fails** on TBA transactions turn out to play an important role in the economics of dollar rolls. In a TBA transaction, the seller does have the option to fail to deliver the securities to the buyer. In this situation, the buyer does not have to pay the seller until the securities are delivered. The price of the security, including the accrued interest that is to be paid, does not change. In essence, then, the buyer is compensated for the fail by reinvestment income on the money that was to be paid for the pools.

III. DOLLAR ROLLS

The close tie between the dollar roll and TBA markets arises from the fact that the process of trading rolls is indistinguishable from that of trading TBAs from the perspective of a pass-through trading desk. To understand why this is the case, recall the definition of a dollar roll again: these are essentially repurchase agreements in which the seller of securities is obligated to repurchase securities that are substantially similar to, but not identical with, the securities originally sold. It is useful to further unpack this definition a little and think of a dollar roll as a combination of two simultaneous transactions: a buy and a sell order for a mortgage pass-through security for two different settlement dates. By convention, the **Seller** of roll is the party who sells mortgage securities for a settlement month (the **front month**) and agrees to buy back "substantially similar" securities for a future settlement month (the **back month**). On the other side of the transaction, the **Buyer** of roll is the party who buys securities for the front month and agrees to sell "substantially similar" securities for the back month. The equivalence of the dollar roll and TBA markets becomes clear when we realize that the roll buyer's commitment to return securities in the second leg of the dollar roll can be hedged by getting long TBAs for the future settlement month.

Pricing on a dollar roll transaction can be requested from a pass-through desk by specifying the size of the MBS position to be rolled (based on original face amount), long/short, agency, maturity, coupon, the month the position is expected to settle, and the future settlement month that the position should be rolled to. The **roll price** (also known as the **drop**) is equal to the difference between the purchase and sale prices of the mortgage security on the two settlement dates and is expressed in ticks. For example, a trading desk might tell a customer: *I can offer you $500 million of the FNMA 6 Sep/Oct roll at 11+*.

As an intuition building exercise, it is useful to review some concrete examples of roll transactions.

- Investor A is long FNMA 6s for October delivery. At some time prior to October settlement day, investor A decides it does not want to have a forward position on FNMA 6s for October settle and rolls the position forward to November. The decision to roll could be based on an attractive drop between the October and November prices, or operational issues such as not being willing or able to take delivery of the security in October. By selling the roll, Investor A remains invested in mortgages and can potentially also lock in an attractive financing rate on the funds obtained during the roll period.

  Mechanically, Investor A sells FNMA 6s for October settlement and purchases FNMA 6s for November settlement. The only transfer that takes place on the October settlement date is a cash transfer that reflects the difference between the price of FNMA 6s that the investor agreed to pay when they purchased them and the front month price of FNMA 6s when they rolled these bonds (both prices are for October settlement).

- Investor B holds a collection of FNMA 6 pools and decides to lend these pools to the pass-through trading desk of broker-dealer X for October delivery in return for "substantially similar" FNMA 6s pools in November. Investor B is motivated to do this transaction by the fact that it can obtain attractive financing rates over the October-November roll period. Based on recent history, the comparative advantage of

financing rates obtained through dollar rolls can be anywhere from 15 bps to 100 bps over 1-month LIBOR.

Mechanically, investor B sells FNMA 6s from its inventory to pass-through desk X for October settle and buys FNMA 6s for November settle. The FNMA 6s held in Investor B's inventory are transferred from its inventory to the inventory of the pass-through trading desk.

- Investor B delivers FNMA 6s to pass-through desk X for October settle. At the same time, it enters into a forward commitment to purchase FNMA 6s for November settle. Before November settlement, Investor B and desk X agree to roll the transaction to December. Desk X sells the FNMA 6s for October settle to investor C while simultaneously agreeing to buy FNMA 6s for November settle with investor D. On being notified of Investor B's intention to roll their 6s from November to December, Desk X sells the November/December FNMA 6 roll to Desk Y.

This sequence of transactions demonstrates how the dollar roll market adds liquidity to the pass-through market by providing an outlet for market making pass-through trading desks to maintain a neutral position in pass-throughs or go long or short.

- The Agency CMO trading desk of broker-dealer X can use the dollar roll market both for taking delivery of the collateral required for issuing a CMO and for hedging the collateral that they have in inventory for soon-to-be-issued CMOs. Normally, CMO deals are collateralized by current coupon pools, but these pools can be hard to find because of the lag between current interest rates and the time when the corresponding pass-through pools are actually created.[4] A supply crunch in CMO deal collateral impacts the roll market though increased demand for collateral in the front month. This bids up prices for front-month settlement TBAs relative to back-month TBAs and increases the drop in the roll market. In addition, CMO deals are frequently done using "story collateral" i.e., collateral with desirable prepayment characteristics. In this case, the roll may be bid up to induce the owners of the bonds of these desirable characteristics to either deliver them in to TBA or to sell them outright.

This list of transactions does not exhaust all the possible uses dollar rolls can be put to. For example, rolls can be used for hedging a **specified pool** position: when rolls are trading rich, the attractive characteristics of specified pools are worth less since the cost of hedging specified pools with TBAs increases (or the carry advantage of specified pools is reduced).[5] Finally, sophisticated investors can use the roll market to express a view on prepayment rates on different coupons. As discussed later in this paper, it is sometimes beneficial to maintain ownership of pass-throughs rather than roll them and vice versa, depending on the prepayment rate realized in the front month of the roll, and whether the pass-through is a discount or a premium security.

[4] It typically takes four to eight weeks to close a mortgage.

[5] Specified pool trades take place outside the TBA market and are executed by specifically identifying certain pools that an investor wishes to acquire. In general, investors "pay up" for these specified pools—for example, for the prepayment protection offered by a premium pool with a low average loan size or for the extension protection offered by slightly seasoned discount pools relative to TBA discount pools.

Comparing Mortgage Dollar Rolls and Repos

To round up our introductory review of dollar roll transactions, it is instructive to compare a dollar roll to a mortgage repurchase transaction (also known as a **repo**):

- All the cash flows generated during the roll period belong to the buyer of the dollar roll. Thus, for example, if a record date falls during the term of the roll, the principal and interest for the front month are paid to the buyer of the dollar roll.[6] In a repo transaction, principal and interest go to the original owner.
- Securities "substantially similar" to the original ones borrowed can be returned in a dollar roll. In a repo, the ownership of the security is not transferred and the same security needs to be returned.
- There is considerable flexibility in terms of setting the length of repo transaction, with typical maturities ranging from one to 30 days. The settlement dates for dollar rolls typically match TBA settlement dates.
- The collateral backing a repo transaction can consist of small collections of pools, agency CMOs and non-agency CMOs, while dollar rolls trade in the TBA market. The perceived fungibility or interchangeability of mortgage pools plays a crucial role in terms of being able to perform roll transactions.

The flexibility to deliver substantially similar collateral in a dollar roll makes dollar roll transactions far more common than mortgage repos. In general, mortgage repos are collateralized by structured securities or specified pools. From both an operational and a financing advantage perspective, it usually makes more sense to roll pass-throughs than to repo them.

[6] The **record date** is the date for determining the registered owner of the next scheduled payment of principal and interest for the mortgage security. The record date for MBS is typically the last business day of the month.

III. PRICING DOLLAR ROLLS

Dollar Roll Calculations

Let's review the definition of a dollar roll once again: a dollar roll is a combination of two simultaneous transactions: a buy and a sell order for a mortgage pass-through security for two different settlement dates. Thus, a natural entry-point for thinking about the value of dollar rolls is to analyze the economics of holding onto pass-through securities versus "rolling" them. To this end, Figure 1 itemizes the cash flows associated with the two alternatives. It would be more advantageous to roll securities versus holding them if the cash flows in the "Financing" box of the figure added up to more than the cash flows in the "Holding" box.

The forward repurchase price plays a crucial role in determining which of the two alternatives presented in the figure is more advantageous. If this were a repo transaction, the repurchase price would equal the initial sale price, plus an interest payment at a previously determined interest rate (the repo rate). The repo rate is typically lower than prevailing short-term rates since the repo transaction is a form of collateralized borrowing. Thus, the lender of securities (the borrower of money) benefits because even though they are paying more to repurchase their securities, they are (typically) able to invest the funds received from the initial sale of securities at a higher rate than their borrowing rate (the repo rate).

A dollar roll introduces one crucial twist to the above situation. Since the principal and interest earned on the security over the roll period belong to the lender of cash (the roll buyer), in an upwardly sloping yield curve environment, the forward price is usually lower than the initial price to compensate the seller of the roll for losing one month of **positive carry** on the position.[7] Other than that, the situation is exactly analogous to the repo agreement discussed above. After taking the lost carry into account, the forward price is set at a level that defines a financing rate for the transaction. The security owner then compares this financing rate to their other alternatives to determine whether to hold or "roll" their securities.

Figure 1. Cash Flows Associated with Rolling versus Holding Pass-throughs

Cash Flows of the Roll (Financing the Mortgage Securities)
+ Sale of Security at initial price (plus accrued interest)
+ Reinvestment income on sale proceeds
- Repurchase of security at the forward price (plus accrued interest)

Cash Flows From Holding Mortgage Securities
+ Coupon Payment
+ Scheduled payment of principal
+ Prepaid principal
+ Reinvestment income on interest and principal received during roll period
- Discount on interest and principal received after the roll period

Source: Banc of America Securities

[7] The **carry** on a fixed income investment is usually defined as the interest income on the position less the cost of financing it. In case of dollar rolls, an investor needs to also consider the premium/discount received on pay-downs. Note also that the forward price (back-month settlement price) need not be lower than the initial price (front-month settlement price) even when the yield curve is upwardly sloping if prepayment speeds on premium coupons are very fast.

A worked example illuminates several of these issues. Recall that the roll price, which is referred to as the **drop** in market parlance, is equal to the difference between the purchase and sale prices of the mortgage security on the two settlement dates. An investor who owns 30-year FNMA 6s enters into a dollar roll transaction by selling $1 million of the September/October 2004 roll on 30-year FNMA 6s. As of August 27th 2004, FNMA TBA 6s for September settlement were trading at 103-14 and the drop for the September/October roll was 11.8 ticks. Thus, the investor is committing to simultaneously selling $1 million FNMA 6s for September settlement at 103-14 and buying $1 million FNMA 6s for October settlement at a price of 103-2.2.

In addition, we make the following assumptions:[8]

- The 1-month reinvestment rate over the roll period for the investor is equal to 1.77%;
- TBA FNMA 6s have a WAC of 6.50% and a WAM of 356 months;
- The expected prepayment speed for this collateral in September is 28.2% CPR;
- The payment date for September principal and interest payments is October 25, 2004 (following FNMA's stated delay of 54 days).

Based on these assumptions, cash flows from the roll transaction are shown in Figure 2. The seller of the roll delivers $1,000,000 face value of FNMA 6s and receives $1,036,708.33 on the front- month settlement date (September 15). The seller then reinvests these proceeds at 1.77% until October 14th (the back month settlement date) and obtains $1,038,186.51. To facilitate the comparison to the buy-and-hold situation, we assume that what the seller buys back is the amount left after a total principal pay-down of $28,131.44.[9]

Figure 2. Cash Flows from Rolling FNMA 6s

Date	Transaction	Cash Flow
15-Sep	Sell $ 1,000,000 FNCL 6s @ 103-14	$1,034,375.00
	Plus 14 days accrued interest (6% * 14/360 * 1,000,000)	$2,333.33
		$1,036,708.33
	Reinvest proceeds @ 1.77%	
	29 actual days/360 * 1.77% * 1,036,708.33	$1,478.17
		$1,038,186.51
14-Oct	Purchase $ 971,868.55 FNCL 6s @ 103-2.2	-$1,001,692.77
	Plus 13 days accrued interest (6% * 13/360 * 971,868.55)	-$2,105.72
		-$1,003,798.49
	Net Proceeds from the Roll	**$34,388.02**

Source: Banc of America Securities

Now, consider the situation in Figure 3 where the investor holds on to the $1 million FNMA

[8] Readers with access to Bloomberg can verify the results obtained in Figures 2 through 4 by using the assumptions listed below and a roll calculator such as Bloomberg's Roll Analysis function (*FNCL 6 <Mtge> RA <Go>*).

[9] The total principal pay-down includes both the scheduled and unscheduled principal payments. The unscheduled principal payment assumes a prepayment rate of 28.2% CPR in September.

6s instead of rolling these bonds. In this case, they would own $971,868.55 face of FNMA 6s on October 14 because of principal pay-downs. Also, because the investor held the MBS as of the September record date, they are entitled to the September principal and interest payments on the pools. These payments will be received on the payment date of October 25. Specifically, as Figure 3 shows, a total cash flow of $33,131.44 would be received on this date consisting of an interest payment of $5,000 and a principal payment of $28,131.44. To make the situation comparable to Figure 2, we need to discount these cash flows back to October 14. The principal and interest payments received on October 25 are worth $33,113.53 on October 14 when discounted at an annualized reinvestment rate of 1.77%.

Figure 3. Cash Flows from Holding FNMA 6s

Date	Transaction	Cash Flow
25-Oct	Receive Principal and Interest on FNMA 6s	
	Receive Interest (6% * 30/360 * 1,000,000)	$5,000.00
	Receive Principal:	
	Scheduled Principal	$927.14
	Prepaid Principal (@28.2% CPR)	$27,204.30
		$33,131.44
	Net Proceeds from Holding FNMA 6s (as of Oct 14)	**$33,113.53**
	Present value of Principal and Interest Cash Flow Rcvd on Oct 25	
	33,131.44/(1 + (1.77% * 11/360))	
	Cash Value of Rolling vs Holding FNMA 6s	**$1,274.48**

Source: Banc of America Securities

Thus, the owner of the 6s earns an additional $1,274.48 ($34,388.02 - $33,113.53) during the roll period by rolling their securities instead of holding onto them. In this specific example then, it is more advantageous to roll.

Calculating the Implied Financing Rate of a Roll

The drop of a dollar roll along with the principal and interest cash flows received over the roll period together imply a certain financing rate for the seller of the roll. Figure 4 shows how to calculate this rate. The logic of the calculation goes as follows: the situation in Figure 2 is preferable to Figure 3 because the financing rate being offered to the seller of the roll is less than the prevailing reinvestment rate. For a given drop, the advantage in Figure 2 decreases as the reinvestment rate goes down and the "breakeven" point occurs when it is equal to the implied financing rate. At this point, the drop simply reflects the lost carry at prevailing reinvestment rates. Thus, to find the implied financing rate, we need to solve for the reinvestment rate in Figure 2, which equates the cash flows in this situation to Figure 3.

Figure 4. Calculating the Implied Financing Rate for Rolling FNMA 6s

Date	Transaction	Cash Flow
15-Sep	Sell $ 1,000,000 FNCL 6s @ 103-14	$1,034,375.00
	Plus 14 days accrued interest (6% * 14/360 * 1,000,000)	$2,333.33
		$1,036,708.33
	r = implied financing rate	
	Reinvest proceeds @ r%	
	29 actual days/360 * r% * 1,036,708.33	$1,036,708.33 * 29/360 * r%
		$1,036,708.33 * (1 + 29/360 * r%)
14-Oct	Purchase $ 971,868.55 FNCL 6s @ 103-2.2	$1,001,692.77
	Plus 13 days accrued interest (6% * 13/360 * 971,868.55)	$2,105.72
		$1,003,798.49
	Present value of Principal and Interest Cash Flow Rcvd on Oct 25	$33,113.53
		$1,036,912.02
	To calculate the implied financing rate, solve for r in the equation:	
	$1,036,708.33 * (1 + 29/360 * r%) = $1,036,912.02	
		r = 0.24%

Source: Banc of America Securities

Calculating the Breakeven Drop of a Roll

The **breakeven drop** is the difference between the front and back month TBA settlement prices such that the implied financing rate is equal to prevailing short-term reinvestment rates. We typically take the short-term rate to be 1-month LIBOR. Figure 5 lists the computations involved in calculating the breakeven drop for the roll on FNMA 6s. The figure shows that the breakeven drop is equal to 7.6 ticks, which is 4.2 ticks less than the roll price of 11.8 ticks. Thus, the investor earns 4.2 ticks of additional carry by rolling their mortgage pools instead of simply holding onto them. The net advantage of rolling versus holding tends to zero as the difference between the quoted drop and the breakeven drop decreases.

Figure 5. Calculating the Breakeven Drop for Rolling FNMA 6s

Date	Transaction	Cash Flow
15-Sep	Sell $ 1,000,000 FNCL 6s @ 103-14	$1,034,375.00
	Plus 14 days accrued interest (6% * 14/360 * 1,000,000)	$2,333.33
		$1,036,708.33
	Reinvest proceeds @ 1.77%	
	29 actual days/360 * 1.77% * 1,036,708.33	$1,478.17
		$1,038,186.51
14-Oct	**X = breakeven drop**	
	Purchase $ 971,868.55 FNCL 6s @ 103-14 - X	$971,868.55 * (103-14 - X)%
	Plus 13 days accrued interest (6% * 13/360 * 971,868.55)	$2,105.72
		$2,105.72 + $971,868.55 * (103-14 - X)%
	Present value of Principal and Interest Cash Flow Rcvd on Oct 25	$33,113.53
		$35,219.25 + $971,868.55 * (103-14 - X)%
	To calculate the breakeven drop, solve for X in the equation:	
	$1,038,186.51 = $35,219.25 + $971,868.55 * (103-14 - X)%	
		X = 7.6 ticks

Source: Banc of America Securities

Roll "Specialness"

We say a roll is **special**, when the roll price (drop) is higher than the breakeven drop. This is same as saying that the implied financing rate is less than alternative money market rates. As mentioned before, "special" rolls are created in times of heavy refinancing and CMO production activity, and can contribute significantly to the carry on a mortgage position.

Dollar rolls trading special can have a significant impact on pay-ups for specified pools and on the attractiveness of the coupon with the special roll versus other coupons in the coupon stack. The attractiveness of "specified" characteristics decreases as the "specialness" of the roll increases because the carry advantage of TBAs from special rolls reduces the value of specified pool characteristics. The same logic applies to the relative attractiveness of different coupons across the coupon stack – in general, TBA pass-through coupons with rich rolls tend to trade at rich price levels relative to other coupons because of their carry advantage in the roll market.

Roll "Trading-at-Fail"

When the implied financing rate is zero, the roll is said to be trading at fail. Why would someone offer to lend money at a 0% interest rate? This can occur when a mortgage trading desk or some investors are short a coupon and cannot find the collateral necessary for satisfying TBA delivery requirements or if the CMO desk urgently needs mortgage collateral to complete a planned issuance.

If a trading desk fails to meet TBA delivery requirements, the TBA buyer effectively finances their purchase at a 0% financing rate. As we pointed out in the TBA section of the paper, this is because the TBA buyer does not have to pay for the purchase until the mortgage pools are delivered. Theoretically, the maximum value for a dollar roll drop should not exceed the cost of failing to deliver the underlying security for the roll period. However, strong demand for collateral from CMO desks or stringent requirements for failing to meet TBA delivery requirements occasionally lead to rolls trading through fail levels close to TBA settlement dates.

An interesting point about dollar rolls trading through the fail levels should be noted here. There will be some scenarios in which the collateral that is likely to be delivered for back-month TBAs will be substantially worse than the collateral delivered for the front-month. This usually occurs when new production in a coupon changes the characteristics of TBA delivered collateral by so much that an investor is better off by not rolling their bonds even when the roll is trading through fail levels. It is worth pointing out that standard roll calculations assume that the collateral delivered for back-month is same as the collateral delivered for front month plus one month of additional aging.

IV. SENSITIVITY ANALYSIS OF DOLLAR ROLLS

Our analysis in the previous section can be distilled into a few simple observations. First, the value of a dollar roll is the difference between the actual drop and the breakeven drop on the underlying security. Whenever the actual roll price is greater than the breakeven drop, or conversely, whenever the available reinvestment rate exceeds the implied financing rate, rolling a security *may* be preferable to holding it.[10] The calculations presented in Figures 2 through 5 should also make it clear that in addition to the actual drop, the value of the roll also depends upon the prevailing reinvestment rate and the prepayment speed over the front month of the roll. In what follows, we explore how the implied financing rate for a roll transaction changes as a function of the roll price and prepayment speeds. We also explore the relationship between the breakeven drop, prepayment speeds and the reinvestment rate.

Sensitivity Analysis of the Implied Financing Rate and the Breakeven Drop

Figure 6 shows the implied financing rate for the roll transaction we have been discussing above as a function of the roll price and prepayment speeds. Moving along a row of the figure gives us a feeling for how the breakeven financing rate changes as a function of the drop assuming a fixed prepayment speed. Similarly, moving along a column tells us how the breakeven rate changes as a function of prepayment speeds assuming a fixed drop.

Not surprisingly in light of our analysis, for a given prepayment rate, the breakeven financing rate increases as the drop decreases and vice-versa. For a fixed drop, the figure also shows that the implied financing rate decreases as prepayment speeds increase. The crucial point here is that the 6s are a premium security and as such faster prepayment speeds decrease the value of the captured carry for the buyer of the roll. By keeping the drop fixed, they are lending money to the seller of the roll at more attractive rates.

Figure 6. Breakeven Finance Rate Sensitivity on FNMA 6s

	Drop (32nds)							
CPR (%)	**-14.8**	**-13.8**	**-12.8**	**-11.8**	**-10.8**	**-9.8**	**-8.8**	**Range**
13.2	-0.23	0.14	0.51	0.88	1.25	1.62	1.99	2.22
18.2	-0.42	-0.05	0.32	0.69	1.05	1.42	1.79	2.21
23.2	-0.62	-0.25	0.12	0.48	0.85	1.21	1.58	2.20
28.2	-0.83	-0.47	-0.10	0.26	0.63	0.99	1.35	2.18
33.2	-1.06	-0.69	-0.33	0.03	0.39	0.75	1.11	2.17
38.2	-1.30	-0.94	-0.58	-0.22	0.14	0.50	0.86	2.16
43.2	-1.56	-1.20	-0.85	-0.49	-0.13	0.22	0.58	2.14
Range	1.33	1.34	1.36	1.37	1.38	1.40	1.41	

Source: Banc of America Securities

Conversely, as shown in Figure 7, the breakeven drop decreases as prepayment speeds and reinvestment rates increase. As before, faster prepayment speeds on premium securities render them more unattractive for holding. This increases the value of a roll at a given reinvestment rate by lowering the breakeven drop.

[10] The point is that there are some risks associated with dollar rolls. These risks are detailed in the next section.

Figure 7. Breakeven Drop Sensitivity on FNMA 6s

	Reinvestment Rate							
CPR (%)	0.27%	0.77%	1.27%	1.77%	2.27%	2.77%	3.27%	**Range**
13.2	13.3	12.0	10.6	9.2	7.9	6.5	5.2	-8.2
18.2	12.8	11.5	10.1	8.7	7.4	6.0	4.6	-8.2
23.2	12.3	10.9	9.6	8.2	6.8	5.4	4.0	-8.3
28.2	11.8	10.4	9.0	7.6	6.2	4.8	3.4	-8.3
33.2	11.2	9.8	8.4	7.0	5.6	4.2	2.8	-8.4
38.2	10.5	9.1	7.7	6.3	4.9	3.5	2.0	-8.5
43.2	9.8	8.4	7.0	5.6	4.1	2.7	1.3	-8.6
Range	3.5	3.6	3.6	3.7	3.8	3.8	3.9	

Source: Banc of America Securities

How do these results change when we look at discount securities? In this situation, an increase in the prepayment rate at a given roll price *increases* the implied financing rate. In addition, the breakeven drop *increases* with an increase in prepayment speeds. The point is that faster prepayment speeds on discounts render them more attractive for holding and this decreases the value of a roll at a given drop. This is in contrast with the roll example on premium 6s discussed above – there a rise in prepayment speeds at a given drop decreased implied financing rates. However, the relationship between the drop and the implied financing rate remains unchanged – the implied financing rate decreases with an increase in the drop for both premium and discount pass-throughs.

V. RISKS ASSOCIATED WITH DOLLAR ROLLS

The dollar roll market has historically offered as much as 15 bps to 100 bps of a financing advantage versus the 1-month LIBOR rate. However, as Chicago economists have taught us over the past several decades, there is no such thing as a "free lunch" in financial markets, or at least the cafeteria that offers one is not open for any length of time. We can categorize some of the risks assumed by the seller of a dollar roll transaction as follows.

Redelivery Risk. While the mortgage pass-through pools returned in a dollar roll transaction will have to meet good delivery requirements, these requirements do not say anything about the risk characteristics of these pools. In particular, these pools can and frequently do have less desirable prepayment characteristics than the originally delivered pools – the seller receives faster prepaying pools for rolls on premium passthroughs and slower prepaying pools on discounts. This type of **adverse selection,** therefore, makes dollar rolls an unattractive financing option for the holders of vintage and specified pools unless the characteristics of the pools to be returned are agreed on beforehand or the roll is rich enough to compensate for the value of the collateral characteristics lost in the transaction.

Prepayment Risk. At the time of entering into the roll transaction, neither party to the transaction knows what the actual prepayment speed during the front month of the roll is going to be. The value of rolling versus holding a premium security is increased by a faster prepayment speeds and reduced by a slower prepayment speeds in the front month of the roll (see the discussion accompanying Figures 6 and 7). For a discount security, the relationship between the roll's value and realized prepayment speeds is opposite.

Credit Risk. The risk of one of the parties to a dollar roll defaulting during the roll period is called credit risk. The risk is mitigated to a large extent by the fact that either party could sell or buy the security in the market in case of a default. However, the risk of adverse market movements during this period could make this transaction a little painful. The lack of a haircut in a dollar roll further aggravates the credit risk problem.

Liquidity Risk. The inability of a one party to deliver securities to the other on the settlement date is defined as liquidity risk. This may arise in case of a market disruption such as a squeeze. This is different from credit risk since the delinquent party will typically be able to settle the transaction at a later date.

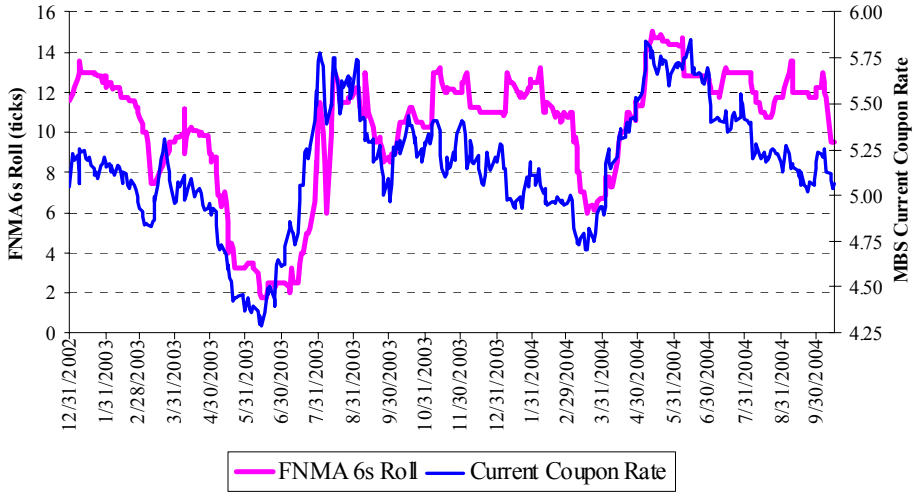
Our catalog of risks thus suggests that some due diligence is required before we can conclude a particular dollar roll will "enhance" the carry on an MBS position. In particular, the redelivery risk by itself suggests that roll prices should trade somewhat above carry. The expected prepayment characteristics of the redelivered pool need to be considered in conducting the analysis of whether it is better to hold or roll.

VI. A BRIEF HISTORY OF THE FNMA 6s ROLL

We conclude the primer by taking a look at how rolls actually trade in practice. Figure 8 illustrates roll prices on 30-year FNMA 6s from the beginning of 2003 to October, 2004. The convention we use for the rolls associated with these prices is most easily understood by looking at a specific month. In particular, suppose we look at roll values in the month of August. Starting from the first day of the month, these values denote levels for the August/September roll up until the pool notification day for August settlement, and refer to levels for the September/October roll from the next day onward.

Turning our attention back to Figure 8, notice the dramatic changes in roll levels over the observation period: the roll traded between a range of 2 to 15 ticks over the period in question, reaching its lowest point in mid-June 2003 and its highest point in mid-May 2004. What is behind these changes in roll prices? The figure clearly shows that there is a strong correlation between interest rates as represented by the MBS current coupon rates and the FNMA 6s roll. On average, roll prices were higher when interest rates were high and lower when interest rates were low.[11] Over the first half of 2003, the 6s roll gradually declined and reached its lowest point of two ticks in mid-June (this reflects roll prices for the July/August roll). This decrease on the premium 6s was largely due to the increase in refinancing activity that resulted from rates decreasing, culminating in multi-year lows in mortgage rates in June 2003. At this juncture, 30-year 6s were prepaying at 60%–80% CPR. With the expectation of suffering substantial losses from prepayment of principal on a premium security at par, roll buyers were willing to pay very little to own 6s collateral from one settlement date to the next settlement date. Notice how the 6s roll reached another local minimum in early March of 2004 as interest rates rallied and renewed concerns of heightened prepayment rates.

Figure 8. The FNMA 6s Roll: January 2003 to October 2004



Source: Banc of America Securities

[11] Note that the strong relationship between current coupon mortgage rates and roll levels noticed here is partly due to the relatively stable short-term rates during this period. In times of rapid short-term interest rates, this relationship will not be so pronounced and could even reverse.

While the resolution of the figure makes it difficult to see this, another interesting aspect of the data is the occasional jumps in roll levels around TBA settlement dates. For example, the roll price on 6s was 6 ticks on August 8, 2003 while it was 10 ticks on August 11, 2003 (the next business day). This is because as the TBA settlement date moved to September 15 from August 13, the roll price changed from reflecting the August/September roll to the September/October roll. The crucial point is that when the roll price is for the August/September roll, the relevant prepayment speed to consider is the August prepayment speed, whereas when the roll price is for the September/October roll, the relevant prepayment speed is the September speed. Since the market expected prepayment speeds in August and September to be substantially different, the August/September and the September/October roll prices were also substantially different.

The FNMA 6s roll started the year 2004 at 11 ticks and the February/March roll traded as high as 13.5 ticks on the February pool notification day. The 6s roll actually "failed" in February and most market participants believe that this was because delivery was taken on a large number of TBA 6s, which substantially reduced float in this coupon. As the shorts in the market scrambled to cover their positions, the roll traded very rich close to February settlement. However, the 6s roll dropped down to 6–7 ticks in March and April as a rally in rates renewed prepayment concerns. As interest rates backed up over summer and premium prepayment speeds slowed down, the roll improved and traded in a range of 11–13 ticks. The 6s roll dropped below 10 ticks on October 12 after trading at around 12 ticks for about five months. Investors who had earlier taken delivery of FNMA 6s pools sold their holdings, increasing the supply of 6s in the front month and consequently suppressing roll prices.

Tracking these dollar roll values and understanding the reasons for their behavior play an essential role in understanding whether to short or go long 6s over the relevant period. The rich rolls on FNMA 6s helped this coupon trade very rich relative to the coupon stack for most of the year (2004). Some market participants enthusiastically shorted FNMA 6s in early part of 2004 to take advantage of the perceived richness of this coupon but most of them burnt their fingers as the 6s roll continued to trade rich. By the time the 6s roll finally softened in October, very few traders/strategists were actually recommending trades that involved shorting 6s. Similarly, for the greater part of 2004, FNMA 6s traded 4–5 ticks above Gold 6s while other coupon FNMA/Gold swaps traded within +/- 1 tick. Clearly, arbitragers would have jumped on selling this swap except for the rich rolls on FNMA 6s.

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