Callable vs Bullets: Performance History

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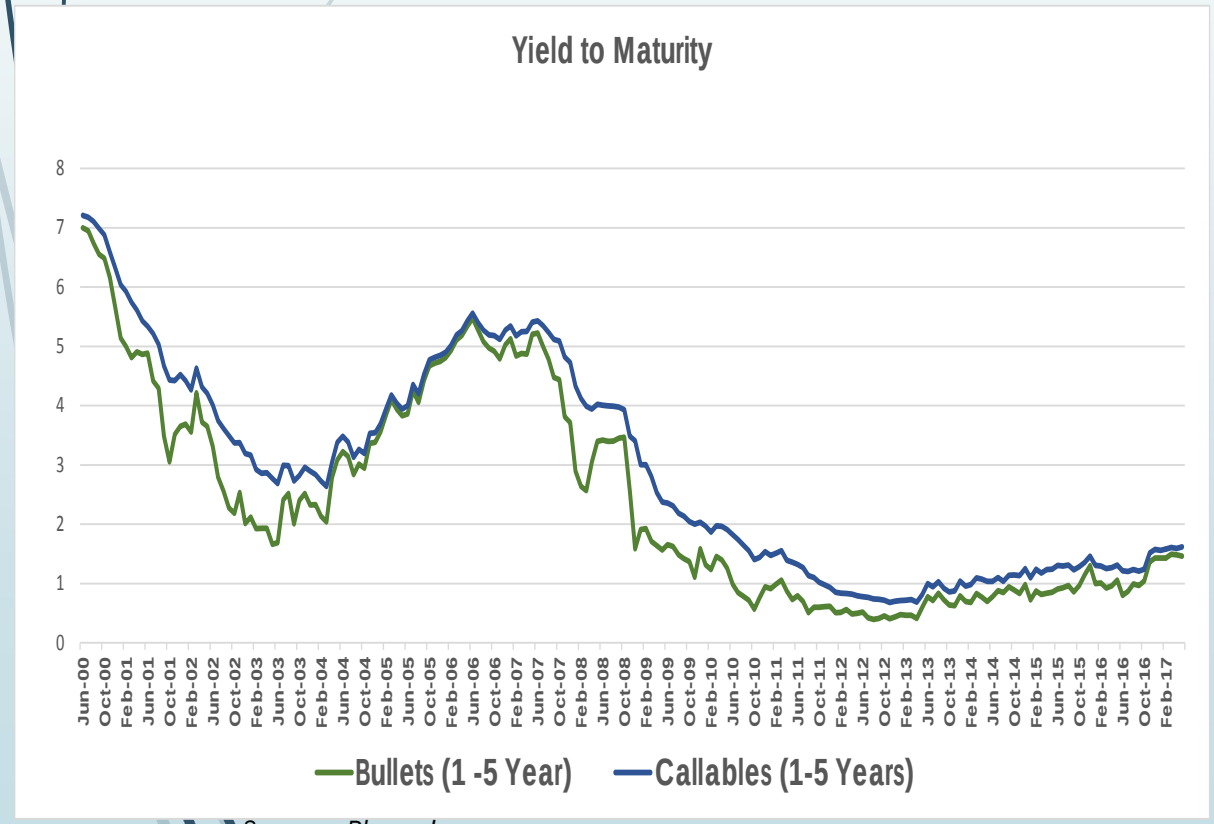
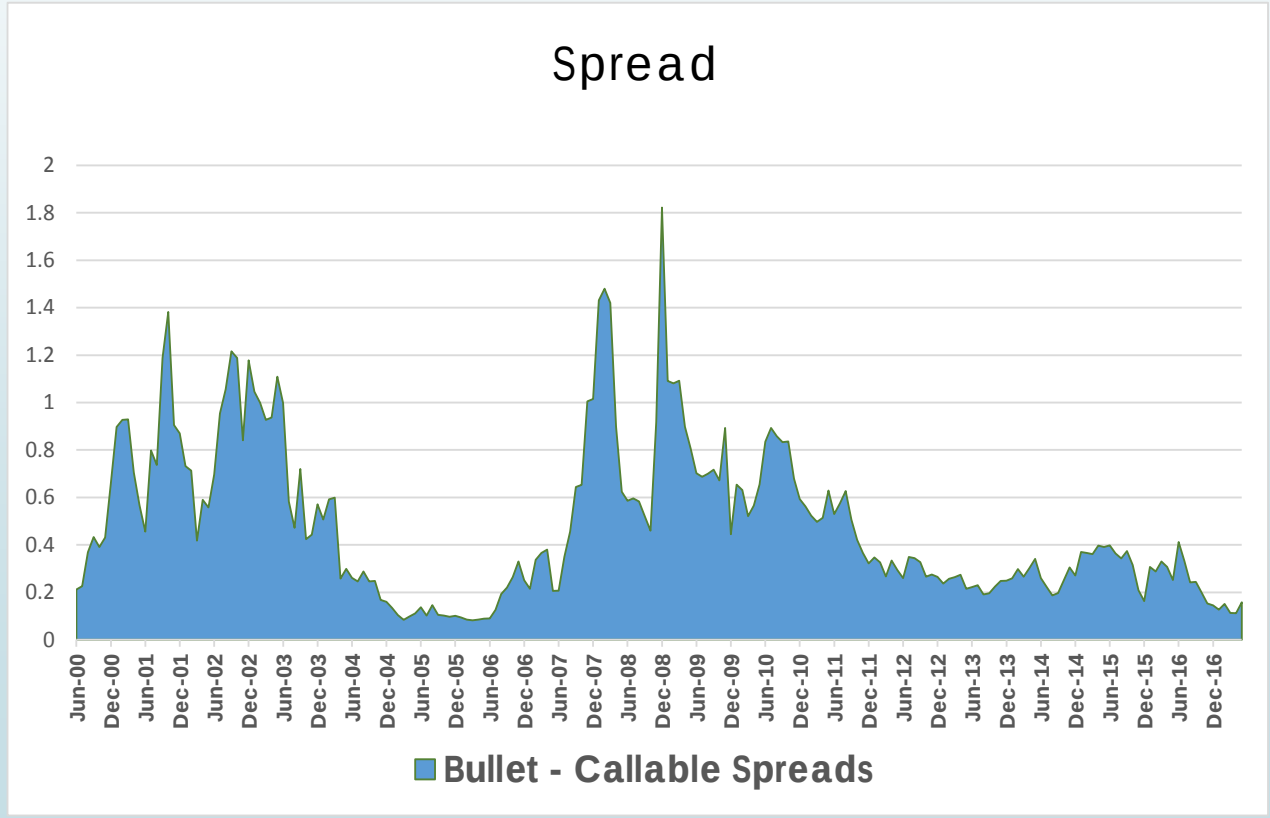
Yield Spread

- Callables out yielded bullets from June 2000 to May 2017 by 48 bps, on average.
- $10 Million invested in a 1-5 year callable only portfolio in June 2000 turned into $16.084 Million by May 2017.
- How much did $10 Million invested in an agency bullets only portfolio turn into?

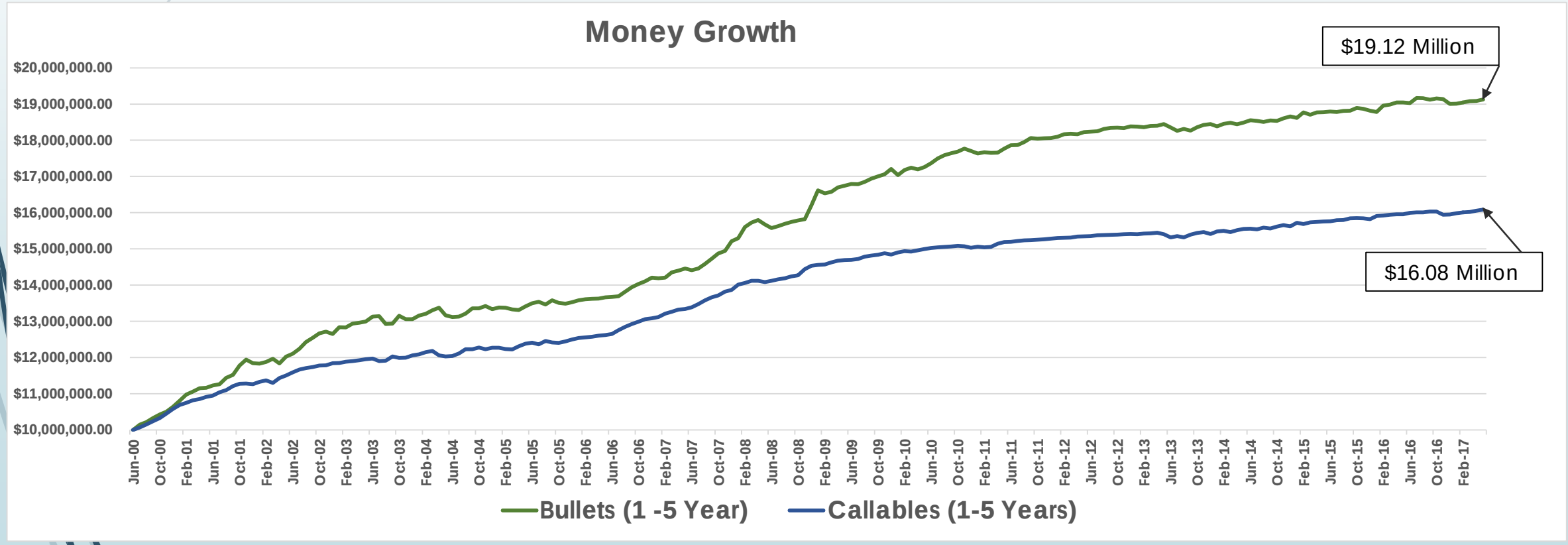




Source: Bloomberg
BAML 1-5 Year US Non-Bullet Agency Index & BAML 1-5 Year US Bullet Agency Index

It's a Trick Question

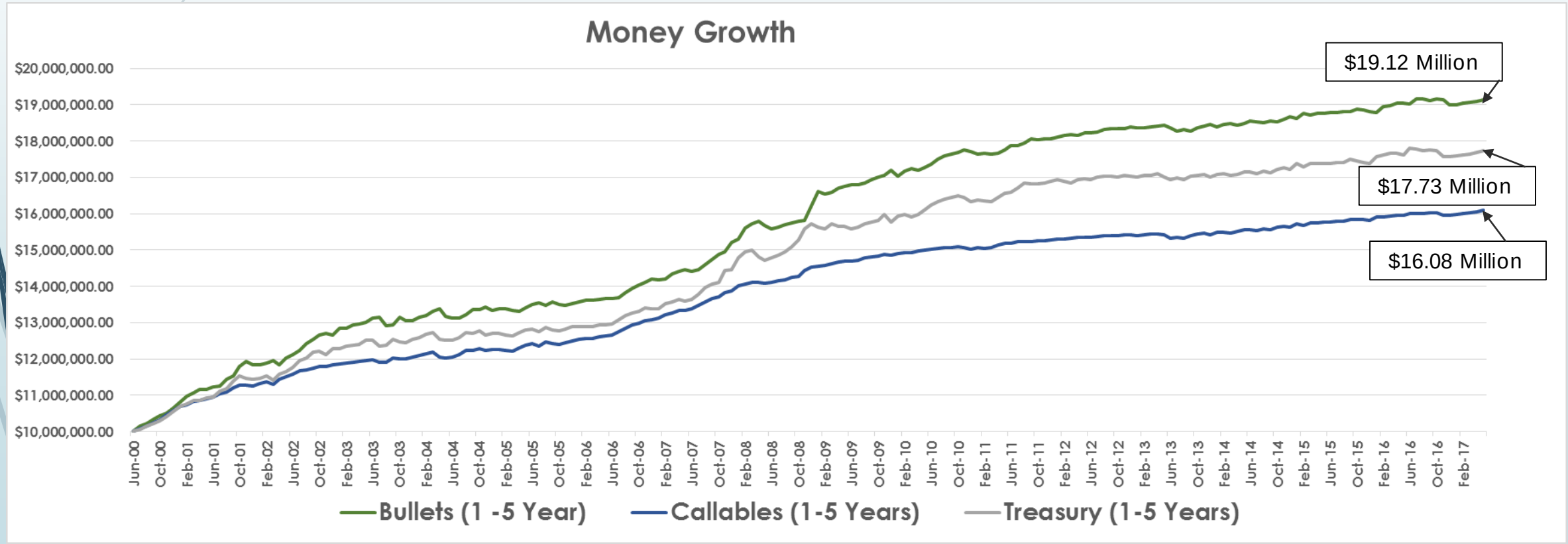
- 1-5 year treasury and agency bullets only portfolio turns into $19.128 Million.
- Bullets out-performed by $3.44 Million.
- How much does a 1-5 year treasury only portfolio turn into?



Source: Bloomberg
BAML 1-5 Year US Non-Bullet Agency Index & BAML 1-5 Year US Bullet Agency Index

Treasuries Only?

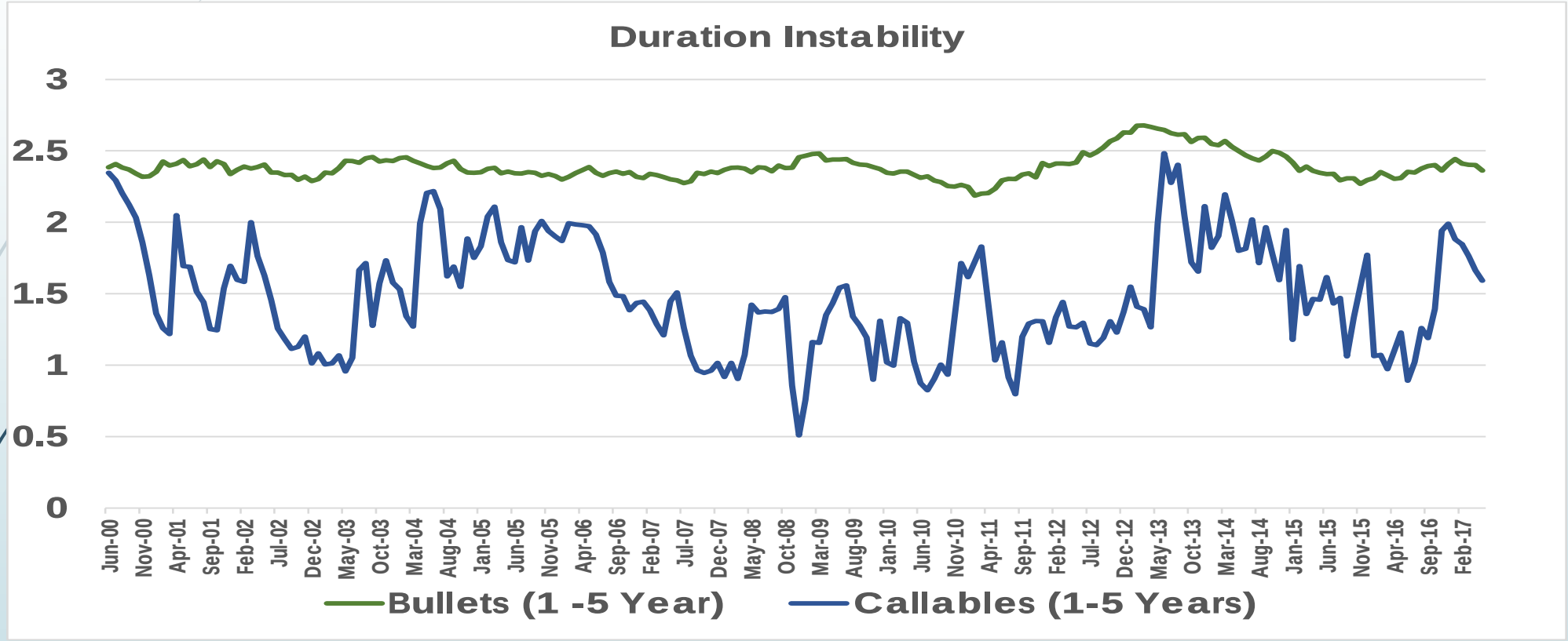
- 1-5 year treasury only portfolio turns into $17.73 Million.
- Treasuries out-perform callable agencies by $1.64 Million.



Source: Bloomberg
BAML 1-5 Year US Non-Bullet Agency Index, BAML 1-5 Year US Bullet Agency Index & BAML 1-5 Year US Treasury Index

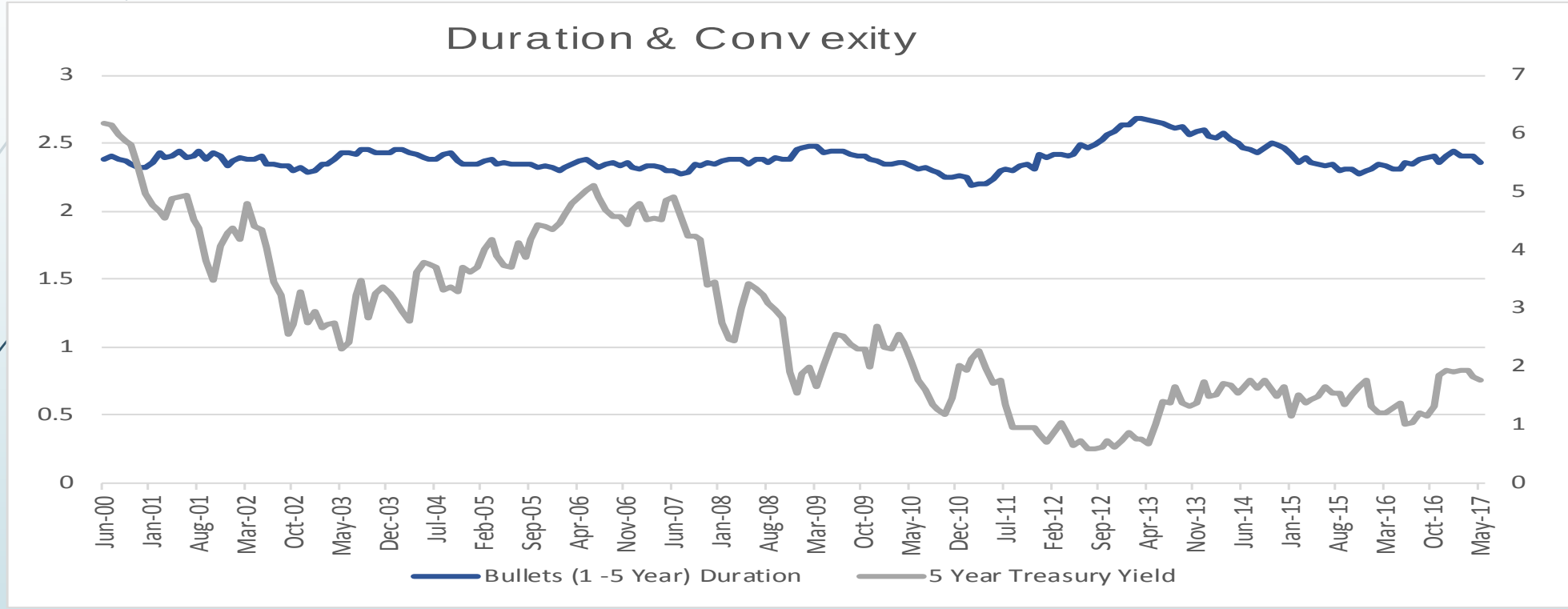
Why do callables that out yield bullets significantly underperform bullets with respect to total return?

Duration – Callables vs Bullets



Source: Bloomberg
BAML 1-5 Year US Non-Bullet Agency Index & BAML 1-5 Year US Bullet Agency Index

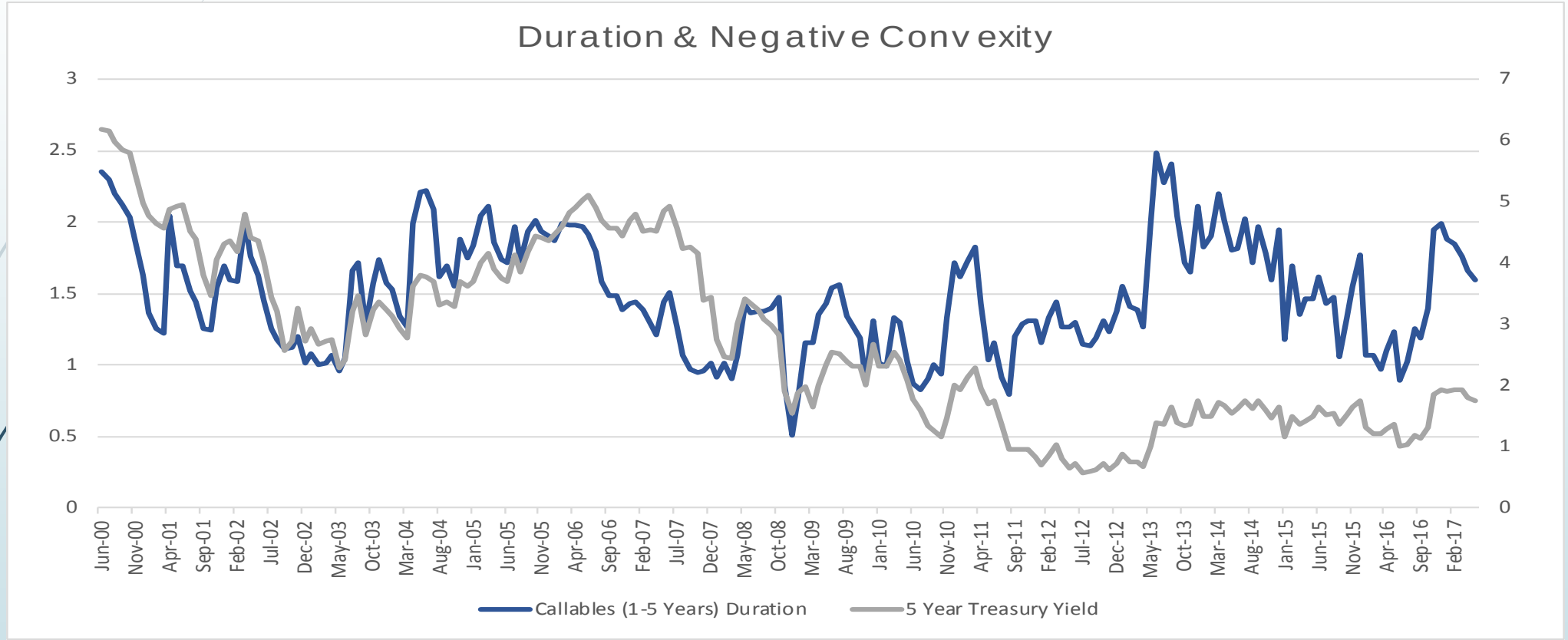
Bullet – Duration vs Yield



- No correlation between yield and duration in the case of bullets.

Source: Bloomberg
BAML 1-5 Year US Non-Bullet Agency Index & BAML 1-5 Year US Bullet Agency Index

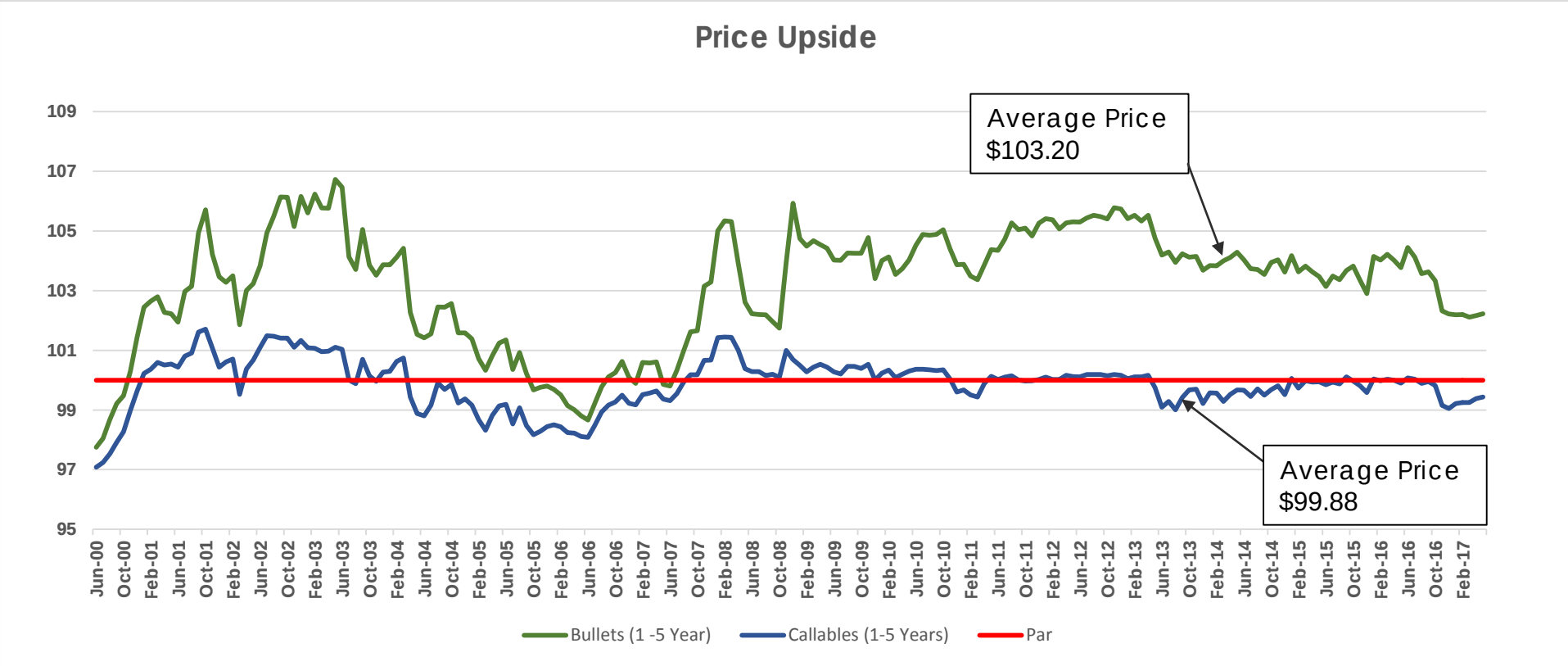
Duration – Negative Convexity



- High positive correlation between yields and duration.
- Callable bonds share exactly the opposite relationship with duration than do bullets.
- As yields rise, bonds become more interest rate sensitive.

Source: Bloomberg
BAML 1-5 Year US Non-Bullet Agency Index & BAML 1-5 Year US Bullet Agency Index

Price Upside?



- On average, callable portfolios were carried at a $0.12 loss vs a $3.20 gain, assuming they were issued at par.

Source: Bloomberg
BAML 1-5 Year US Non-Bullet Agency Index & BAML 1-5 Year US Bullet Agency Index

Total Return Attribution

- Breaks down an assets return into individual components (i.e. factors)
  - Done via regression analysis
  - Currency, country, yield curve, spread, etc.
- Sum up the component return to create total return number
- In this case, we break down the returns of bullets and callables into two different factors
  - CURVE CARRY – Includes (Accrued Interest + Roll Down)
  - CURVE CHANGE – Returns attributed to parallel shift in the yield curve (up or down)

Total Return Attribution

	Curve Carry (Accrued + Roll Down)			Curve Change		
	Bullets	Callable	Delta	Bullets	Callable	Delta
Mar-13	0.09%	0.07%	0.02%	-0.03%	-0.04%	0.01%
Jun-13	0.09%	0.08%	0.01%	-0.86%	-0.75%	-0.11%
Sep-13	0.15%	0.15%	0.00%	0.06%	0.03%	0.03%
Dec-13	0.13%	0.12%	0.01%	-0.41%	-0.40%	-0.01%
Mar-14	0.14%	0.13%	0.01%	-0.15%	-0.12%	-0.03%
Jun-14	0.16%	0.15%	0.01%	0.04%	0.03%	0.01%
Sep-14	0.17%	0.17%	0.00%	-0.31%	-0.37%	0.06%
Dec-14	0.17%	0.16%	0.01%	-0.11%	-0.34%	0.23%
Mar-15	0.17%	0.11%	0.06%	0.43%	-0.06%	0.49%
Jun-15	0.17%	0.11%	0.06%	-0.30%	-0.14%	-0.16%
Sep-15	0.19%	0.13%	0.06%	0.16%	0.16%	0.00%
Dec-15	0.21%	0.16%	0.05%	-0.84%	-0.47%	-0.37%
Mar-16	0.21%	0.17%	0.04%	0.78%	0.37%	0.41%
Jun-16	0.19%	0.14%	0.05%	0.44%	0.07%	0.37%
Sep-16	0.18%	0.14%	0.04%	-0.41%	-0.15%	-0.26%
Dec-16	0.26%	0.22%	0.04%	-1.26%	-0.83%	-0.43%
Sum	**2.68%**	**2.21%**	**0.47%**	**-2.77%**	**-3.01%**	**0.24%**

- Callables offer inferior returns to bullets on both factors.

Source: Bloomberg
BAML 1-5 Year US Non-Bullet Agency Index & BAML 1-5 Year US Bullet Agency Index

Callables – From Issuer's Perspective

Bullet		
Bullet Coupon	Coupon Cashflow	Price
5.00%	$ 500,000.00	$ 100.00
5.00%	$ 500,000.00	$ 102.80
5.00%	$ 500,000.00	$ 103.85
5.00%	$ 500,000.00	$ 102.96
5.00%	$ 500,000.00	$ 100.00
Total	$ 2,500,000.00	

Yield Curve		
Year	Bullet Rate	Callable Rate
Year 1	1.00%	1.50%
Year 2	2.00%	2.50%
Year 3	3.00%	3.50%
Year 4	4.00%	4.50%
Year 5	5.00%	5.50%

Hypothetical Callable		
Term Structure	Coupon	Price
1.50%	$ 550,000.00	$ 100.00
2.50%	$ 450,000.00	$ 100.00
3.50%	$ 350,000.00	$ 100.00
4.50%	$ 250,000.00	$ 100.00
5.50%	$ 150,000.00	$ 100.00
Total	$ 1,750,000.00	

Issuing a callable saves a $750,000 in coupon payments over the life of the bond

Hypothetical Case (Fixed vs Step-up Callable)

Fixed Coupon Callable				
Fixed Coupon Rate	Callable Price With Cap	Bullet Equivalent Price	Price Delta	Coupon Cashflow
5.50%	$ 100.00	$ 101.79	$ 1.79	$ 550,000.00
5.50%	$ 100.00	$ 104.20	$ 4.20	$ 550,000.00
5.50%	$ 100.00	$ 104.82	$ 4.82	$ 550,000.00
5.50%	$ 100.00	$ 103.45	$ 3.45	$ 550,000.00
5.50%	$ 100.00	$ 100.00	$ -	$ 550,000.00
Total				$ 2,750,000.00

Fixed Coupon Callable provides higher cash flow vs Step-Ups

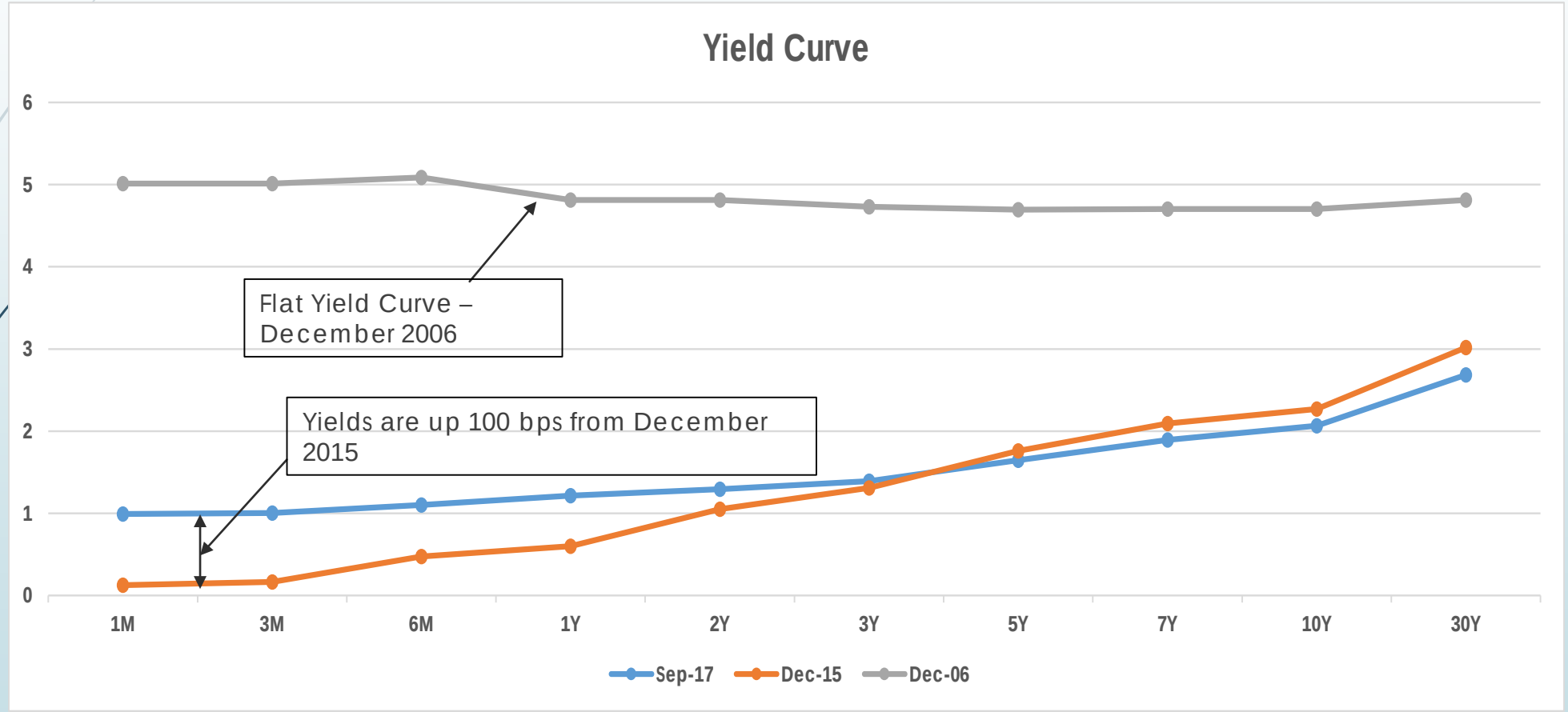
Step-up cash flow catches up with Fixed Callable in the final year. If called before – Steps-up will always underperform Fixed Callable

Step-up Coupon Callable							
Step-up Callable Coupon	Coupon Cashflow	Cash Flow IRR	Bullet Equivalent Price	Price Delta	Cumulative Coupon (Fixed Callable)	Cumulative Coupon (Step-Up callable)	Fixed Coupon Outperformance
4.50%	$ 450,000.00	4.50%	$ 98.21	$ (1.79)	$ 550,000.00	$ 450,000.00	$ 100,000.00
5.00%	$ 500,000.00	4.74%	$ 102.08	$ 2.08	$ 1,100,000.00	$ 950,000.00	$ 150,000.00
5.50%	$ 550,000.00	4.98%	$ 103.82	$ 3.82	$ 1,650,000.00	$ 1,500,000.00	$ 150,000.00
6.00%	$ 600,000.00	5.22%	$ 103.17	$ 3.17	$ 2,200,000.00	$ 2,100,000.00	$ 100,000.00
6.50%	$ 650,000.00	5.45%	$ 100.00	$ -	$ 2,750,000.00	$ 2,750,000.00	$ -
Total	$ 2,750,000.00						

When do callables outperform bullets?

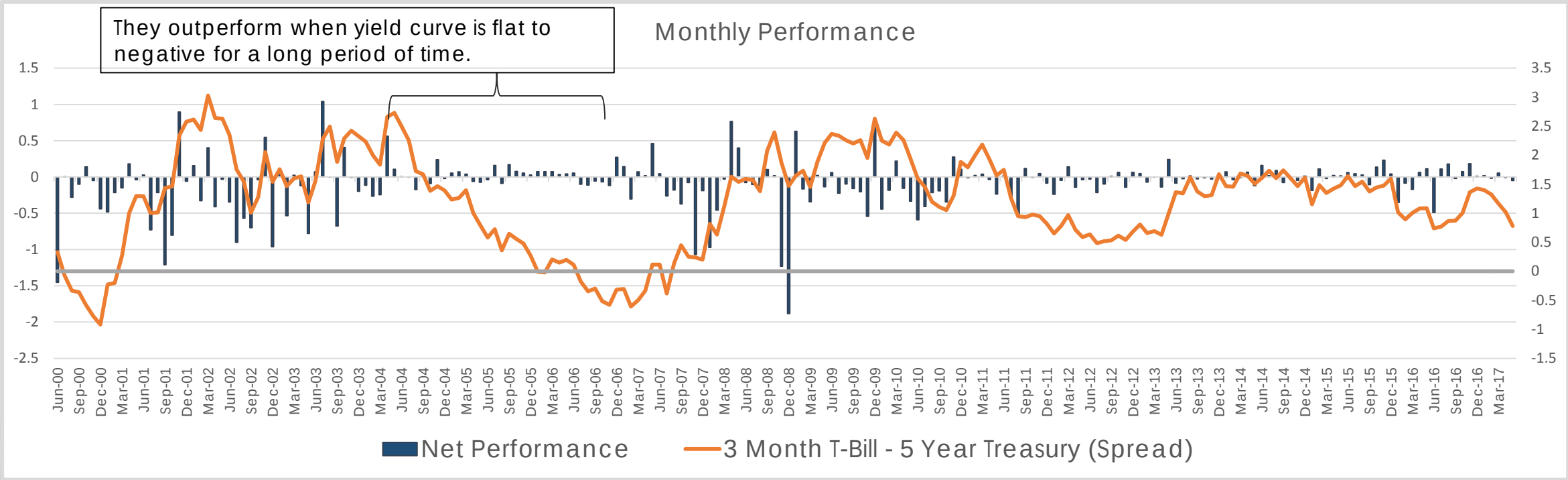
- Callables outperform bullets when the buyer gets to earn the coupon spread (48 bps – from the first slide) all the way to maturity.
- When does this happen?
  - **When the yield curve is flat** -> no roll-down return -> no price appreciation for bullets or callables-> callables unlikely to get called.
  - **When yields rise significantly** -> prices of both callables and bullets fall below par -> no point calling a bond for par if price is below par -> no point calling a bond to reissue it at higher interest rates -> bonds unlikely to get called.

Yield Curve – Flat and Rising



Source: Bloomberg

Yes: They Do Outperform Occasionally



Year	2004	2005	2006	2014	2015
Callable	**1.74%**	**1.86%**	**4.68%**	**1.37%**	**1.27%**
Bullets	**1.71%**	**1.46%**	**4.48%**	**1.28%**	**0.89%**
Delta	**0.03%**	**0.40%**	**0.18%**	**0.09%**	**0.39%**

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Issues with Callables

- Duration & cashflow targeting becomes hard
  - Duration volatility gets more extreme as optionality increases (onetime calls -> anytime calls).
  - Cash flow targeting becomes inherently difficult due to extension/contraction risk.
  - As Interest rates rise, duration of the callable increases.
    - It increases at an increasing rate (i.e. higher interest rates go faster, the duration will rise)
- Pricing callables is difficult (this deserves its own presentation)
  - Rely on model pricing because YTM and YTC don't capture important factors.
    - Input assumptions dictate everything (model selection, input curve, VOL assumption)
  - Relative value comparisons can't be done – each callable bond is different from another (bullet-to-bullet is easily comparable)
  - Callable bonds are not usually issued in index size, limiting their liquidity.
  - Bid/ask spreads on callables are much wider than bullets, making the bid side liquidity worse.

How can these issues be mitigated?

- Lower optionality in the bond (onetime calls are better than anytime calls)
- Lower coupon volatility in the bond (fixed coupon better than step-up coupon)

Questions ?