OLIVER WYMAN

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Invested in America

The Volcker Rule
restrictions on proprietary trading
Implications for the US corporate bond market

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FINANCIAL SERVICES

MARSH & McLENNAN COMPANIES

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Contents

Executive summary

- Oliver Wyman has estimated the impact of an overly restrictive implementation of the Volcker rule statute on the US corporate credit market – specifically US corporate bonds
- The corporate credit market is a critical source of funding for American businesses (with nearly $1 TN raised each year) and an essential element of a diversified investment strategy for US household investors, who hold approximately $3 TN in corporate debt across direct holdings, pensions, and mutual funds[1]
- An overly restrictive implementation of the Volcker rule (as proposed) would artificially limit banking entities' ability to facilitate trading, hold inventory at levels sufficient to meet investor demand, and actively participate in the market to price assets efficiently – reducing liquidity across a wide spectrum of asset classes
- In the US corporate bond market, any meaningful reduction in liquidity could have significant effects:
  - Cost investors ~ $90 to 315 BN in mark-to-market loss of value on their existing holdings, as these assets become less liquid and therefore less valuable
  - Cost corporate issuers ~ $12 to 43 BN per annum in borrowing costs over time, as investors demand higher interest payments on the less liquid securities they hold
  - Cost investors an additional ~ $1 to 4 BN in annual transaction costs, as the level and depth of liquidity in the asset class is reduced
- Our analysis focuses on the US corporate bond market as an example – the Volcker rule obviously covers other asset classes where liquidity provision by banks also has significant value to the economy as a whole

1. Based on SIFMA and Federal Reserve Flow of Funds data

Summary results of analysis

	One-time costs	Recurring costs
Asset valuations Illiquidity discount	Section 2 **Borne by investors:** Asset holders will be directly affected by the market value depreciation *Potential mark-to-market valuation loss for investors of $90 to 315 BN*	Section 3 **Borne by issuers:** Issuers will have to pay higher yields on new debt raised to compensate investors for holding less liquid assets *Potential annual costs to issuers of $2 to 6 BN in year one, and $12 to 43 BN at steady state* [1]
Transaction costs	N/A	Section 4 **Borne by investors:** Investors will have to pay more to trade bonds that are now systematically less liquid *Potential annual costs to investors of $1 to 4 BN*

1. Steady state implies that all outstanding debt has been refinanced at the higher borrowing cost
Source: Oliver Wyman analysis

Purpose and scope of analysis

- Quantifying potential economic effects of major policy innovations is inherently difficult, especially when the changes concern the full complexity and range of today's capital markets
- Our aim in this analysis is to provide a robust view of the magnitude of potential effects of an overly restrictive implementation of the proposed Volcker rule on a single asset class – US corporate bonds
- Our analysis is limited to clear first-order impacts, including
  - Mark-to-market decrease in value on existing bonds due to loss of liquidity
  - Higher interest rates paid by corporate bond issuers, due to investors demanding greater liquidity premia
  - Increases in transactions costs paid by investors, directly due to trading lower liquidity instruments
- Many of these first-order effects would be realized as transfers from one economic group to another (e.g. higher interest rates paid by issuers would be received by investors), but for brevity we refer to each by the most negatively affected group
- We do not directly analyze a wide range of potential knock-on effects, including
  - Effects due to the Volcker rule that are not directly attributable to loss of liquidity in the US corporate bond market (e.g. changes in transaction costs caused by shifting economics for Volcker-affected dealers)
  - The potential replacement of some proportion of intermediation currently provided by Volcker-affected dealers by dealers not so affected

Section 1

Liquidity in the US markets

A rigid implementation of the Volcker rule (as proposed) will almost certainly reduce market liquidity across several asset classes in the United States

Analytical approach

- The vast majority of asset classes are not agency markets – dealers consistently provide liquidity to these markets as principals
- Even highly liquid asset classes like US Treasuries require significant dealer intermediation and inter-dealer activity
- The main providers of liquidity to these markets are institutions covered by the Volcker that will face at least some restrictions on trading activity
- The Volcker rule therefore risks constraining market liquidity across a number of dimensions (as summarized to the right)
- We frame our analyses of the potential effects of a rigid interpretation of Volcker using three scenarios of overall loss of corporate bond market liquidity

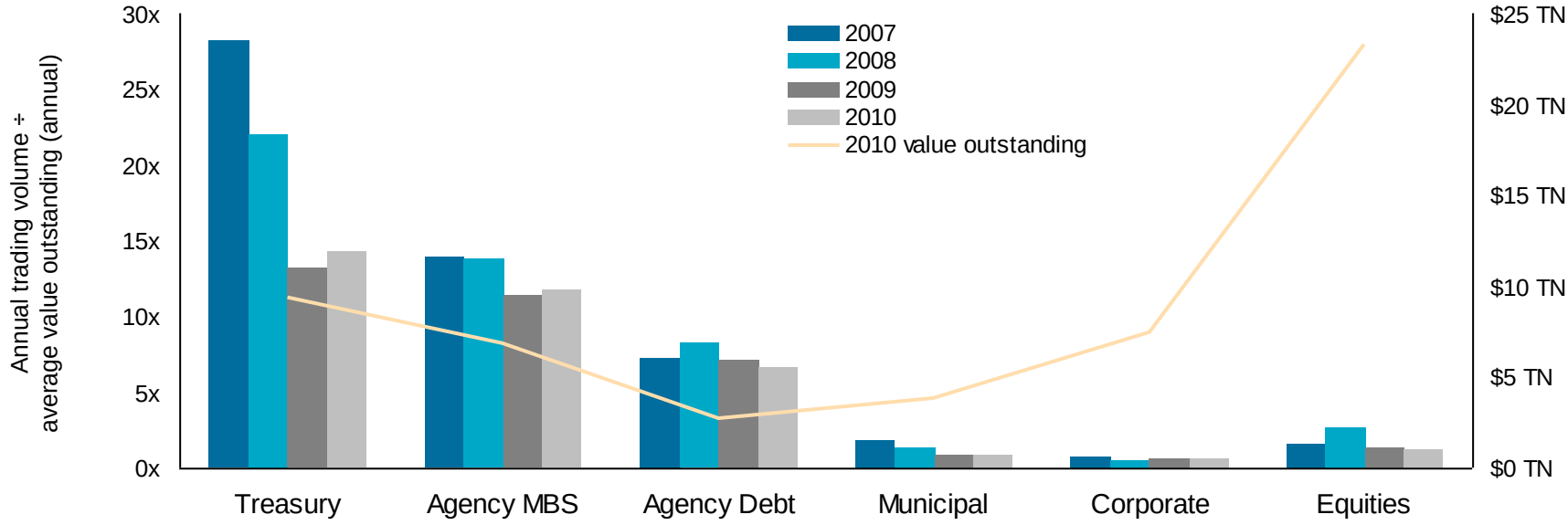
Provisions of the Volcker rule that risk constraining market liquidity

1. Artificial limits on size of inventory and retained risk
2. Artificial limits on duration of inventory and retained risk
3. Restrictions on inter-dealer trading
4. Restrictions on active trading to price assets
5. Requirement to show consistent revenue and risk dynamics
6. Fragmented regulatory oversight and enforcement

Liquidity varies considerably across markets

Annual turnover and value outstanding

Turnover, 2006-2010; Value outstanding (in $TN), 2010



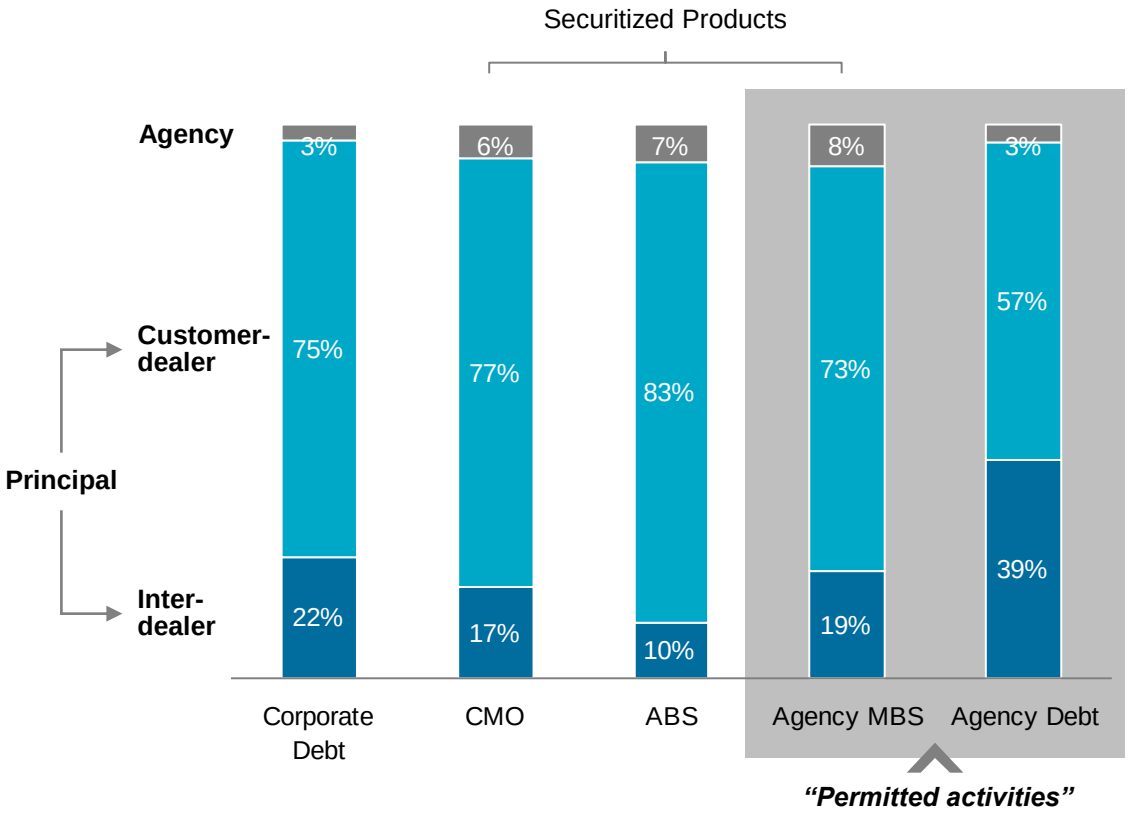
2010						
Number of CUSIPs [2]	~300	>50,000	~12,000	~15,000	~25,000	~5,000
Total outstanding	$9.4 TN	$6.9 TN	$2.7 TN	$3.8 TN	$7.5 TN	$23.3 TN
Average daily volume	$528 BN	$321 BN	$72 BN	$13 BN	$16 BN	$114 BN
Annual turnover ratio	14.2x	11.8x	6.6x	0.9x	0.5x	1.2x

1. Annual trading volume defined = average daily volume * 252
2. Based on publicly traded securities only

Sources: SIFMA, Treasury, Federal Reserve Bank of New York, TRACE, MSRB, NYSE, NASDAQ, Oliver Wyman analysis

Few asset classes are agency markets; even highly liquid products require significant dealer intermediation (as principals) and inter-dealer activity to support liquidity

Principal vs. agency par value traded
Percent share of Average Daily Volume in US markets, Q3 2011



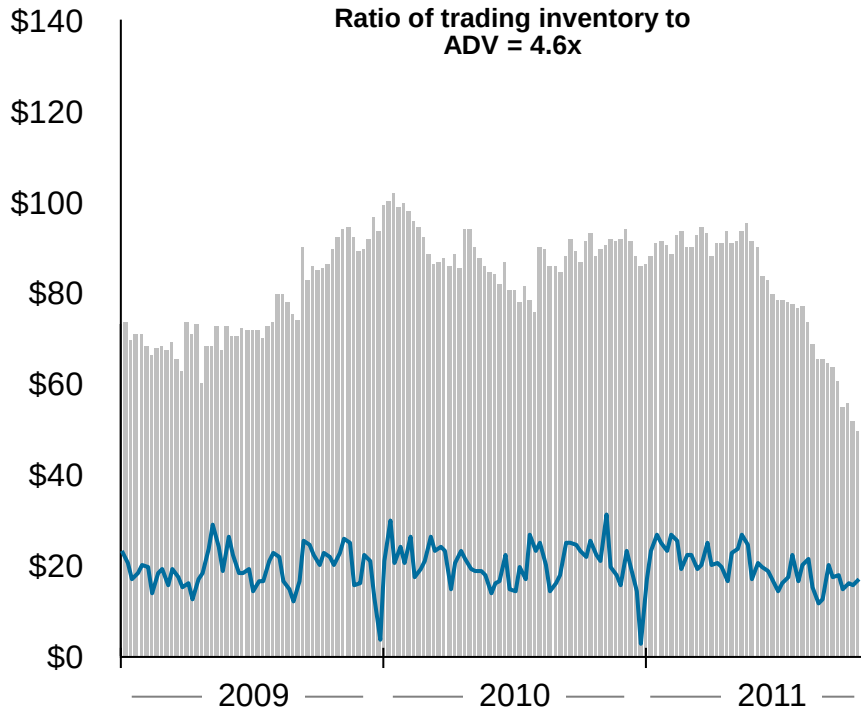
- Debt markets rely heavily on intermediation by dealers on a 'principal basis'
  - Majority of trading volume is directly driven by customer demand
  - However, inter-dealer trading is critical to facilitating these transactions
- Agency trading is naturally limited in scope in these markets
  - Relatively low levels of overall market liquidity
  - Enormous variety of individual bond issues
- Market observers (including the FRB) have noted the "importance of market makers, who are willing to take on a position in a rarely traded asset and hold the risk for some time" when these market features are present[1]
- This concept extends even to liquid markets like Agency Debt and US Treasuries, which were explicitly exempted from the Volcker rule[2]

1. "An Analysis of CDS Transactions: Implications for Public Reporting" (Staff Report 517, Federal Reserve Bank of New York, September 2011)
2. The Federal Reserve Bank of New York reports Primary Dealer transaction volume for US Treasury securities with (1) Inter-Dealer Brokers and (2) All Other counterparties; trades with Inter-Dealer Brokers (which represent a subset of Inter-Dealer activity) have contributed 40% of volume in 2011 year to date
Sources: TRACE, Federal Reserve Bank of New York, Oliver Wyman analysis

And to serve customers in less liquid asset classes, dealers must hold inventory well in excess of trading volume

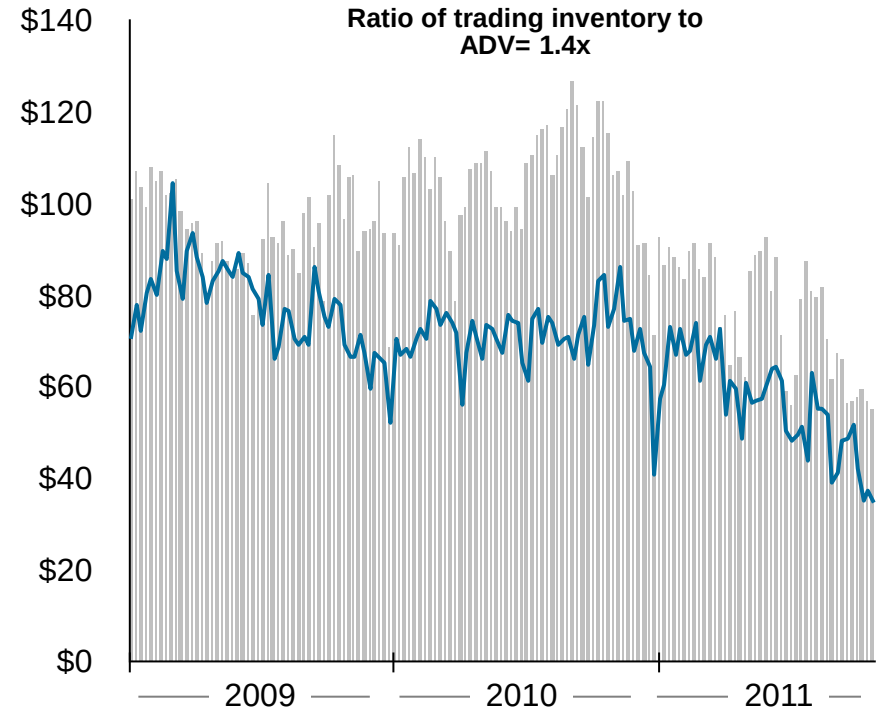
US corporate securities

Dealer inventory and daily trading volume (in $BN), 09-11 YTD[1,2]



Federal agency securities

Dealer inventory and daily trading volume (in $BN), 09-11 YTD[1,2]



1. Inventory net of long and short positions; volume represents average daily transaction value
2. US corporate securities includes corporate bonds, non-agency MBS, etc. with maturities >1 year

Sources: Federal Reserve Bank of New York, Markit

The proposed Volcker rule risks reducing market-making activity by affected institutions, and thereby lowering overall market liquidity

1	**Artificial limits on size of inventory and retained risk**	• Implicit or explicit limits on the size of dealer inventories could lead market makers to ration their support of customer needs not on the basis of economic and risk considerations • Less liquid instruments or markets would likely be disproportionately affected
2	**Artificial limits on duration of inventory and retained risk**	• General restrictions on how long market makers can remain in a position are likely to be an overly blunt tool, given how widely liquidity varies by asset class, instrument, and market conditions • Dealers may be less willing to facilitate large transactions (“block trades”) if they have a limited window of time in which to work down the position without unduly affecting the market price
3	**Restrictions on inter-dealer trading**	• Virtually all markets rely on some degree of inter-dealer trading, which serves to more efficiently match natural investor order flows, spread concentrated risk positions, and hedge individual and portfolio risks that market makers incur • Explicit or implicit limits on inter-dealer trading could have negative knock-on consequences on the willingness of market-makers to facilitate customer trades (e.g. due to inability to efficiently hedge risk)
4	**Restrictions on active trading to price assets**	• In many asset classes, market makers are able and willing to economically offer hedging and trade facilitation services to customers because they are active participants in the markets for related instruments • Active participation allows market makers to understand and maintain current views on market risk and pricing dynamics, which in turn support customer facilitation • Restrictions on the degree and manner in which covered dealers can participate in trading could reduce their capacity to assume risk on behalf of customers
5	**Requirement to show consistent revenue and risk dynamics**	• Many elements of the compliance regime in the proposed rule seem to be based on an assumption that market making functions should show consistent revenue, risk taking, and trading patterns, both over short time periods (day to day) and across different periods of market conditions • In both more and less liquid markets, customer flows are often “lumpy” (e.g. via facilitating block trades), and volatile risk-taking and revenue are natural consequences for market makers • In addition, market conditions – and the way market makers both serve customer needs and manage their own risks – can shift substantially over time
6	**Fragmented regulatory oversight and enforcement**	• The proposed rule leaves supervision and enforcement at one institution as an activity potentially shared by several regulatory agencies • This will needlessly complicate the regulatory oversight process, and could lead to inconsistent or unpredictable application of restrictions among different legal entities within one institution

The main providers of liquidity across asset classes are the institutions that will be most affected by the Volcker rule

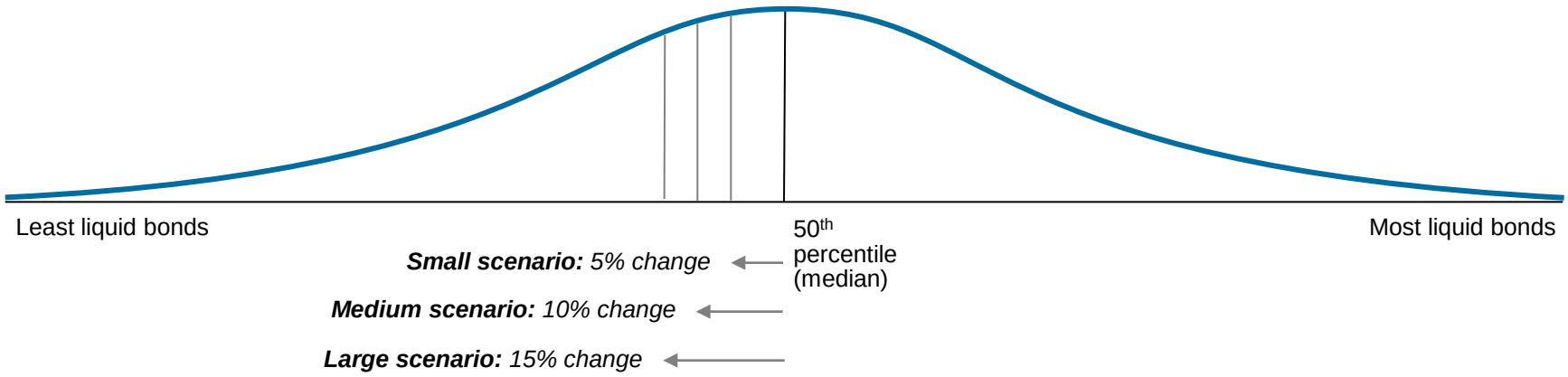
Primary dealer	Covered by Volcker
Bank of Nova Scotia	✓
Barclays Capital	✓
BMO Capital Markets	✓
BNP Paribas Securities	✓
Cantor Fitzgerald & Co.	
Citigroup Global Capital Markets	✓
Credit Suisse Securities (USA)	✓
Daiwa Capital Markets Americas	
Deutsche Bank Securities	✓
Goldman, Sachs & Co.	✓
HSBC Securities (USA)	✓
J.P. Morgan Securities	✓
Jefferies & Company	
Merrill Lynch, Pierce, Fenner & Smith	✓
Mizuho Securities USA	✓
Morgan Stanley & Co.	✓
Nomura Securities International	
RBC Capital Markets	✓
RBS Securities	✓
SG Americas Securities	✓
UBS Securities	✓

Source: Federal Reserve Bank of New York

We frame our analyses of the potential effects of a rigid interpretation of the Volcker rule on US corporate bonds using three scenarios of the decline in market liquidity

- We use robust, empirically tested measures of liquidity to understand the distribution of liquidity among the universe of US corporate bonds
- Liquidity measures are based on
  - Movements of a bond's market price in response to trades of different sizes (price impact)
  - Transaction costs (effectively) paid to market makers for trades in that bond
  - The volatility of price impact and transaction costs over time
- Each liquidity scenario is defined in terms of a market-wide shift equivalent to the differences between the median liquidity bond and a less liquid bond

Distribution of observed liquidity across US corporate bonds
Illustrative - observed liquidity is not normally distributed



Section 2

Impact on investors' asset valuations

A significant reduction in liquidity will have a material adverse impact on investor wealth held in the US corporate bond market

Analytical approach

- The effects of liquidity on asset values are well studied in academic finance, both theoretically and empirically
- In the US corporate bond market, the FINRA trade database (known as TRACE) provides a rich sample of historical transaction-level data
- The most recent and robust analysis is "Corporate bond liquidity before and after the onset of the subprime crisis" by Dick-Nielsen, Feldhutter, and Lando (DFL) [1]
- DFL uses the same core method used by all investigations into liquidity effects on corporate bonds: a disaggregation of credit risk and liquidity risk contributions to observed yields
- For our investigations of the potential effects of the removal of dealer liquidity, we rely on the core liquidity impact analysis by DFL – estimates for yield differences among bonds of different liquidities (i.e. bond liquidity premia)
- We have also undertaken complementary analytical work in order to extend the baseline DFL analysis, to be able to better estimate the effects of specific changes in liquidity

Summary findings and takeaways

- DFL finds a significant impact from liquidity effects on bond yields and ultimately asset values
- The impact of a liquidity shift is highly dependent on the credit of the underlying assets
  - A shift from the 50th percentile to the 25th percentile on the liquidity spectrum would drive an increase in yield of just 10 bps for AAA rated bonds
  - By contrast, a shift from the 50th percentile to the 25th percentile would drive an increase in yield of nearly 230 bps for high yield bonds
- The increase in yield due to a decrease in liquidity would result in a decline in bond valuations
- We model three 'liquidity shift' scenarios to reflect the potential impact of the implementation of Volcker rule on 'median liquidity' securities
- Based on 2010 holdings of US corporate bonds ($7.5 TN) our estimate of the range of possible outcomes is ~ $90-315 BN in value reduction across investors

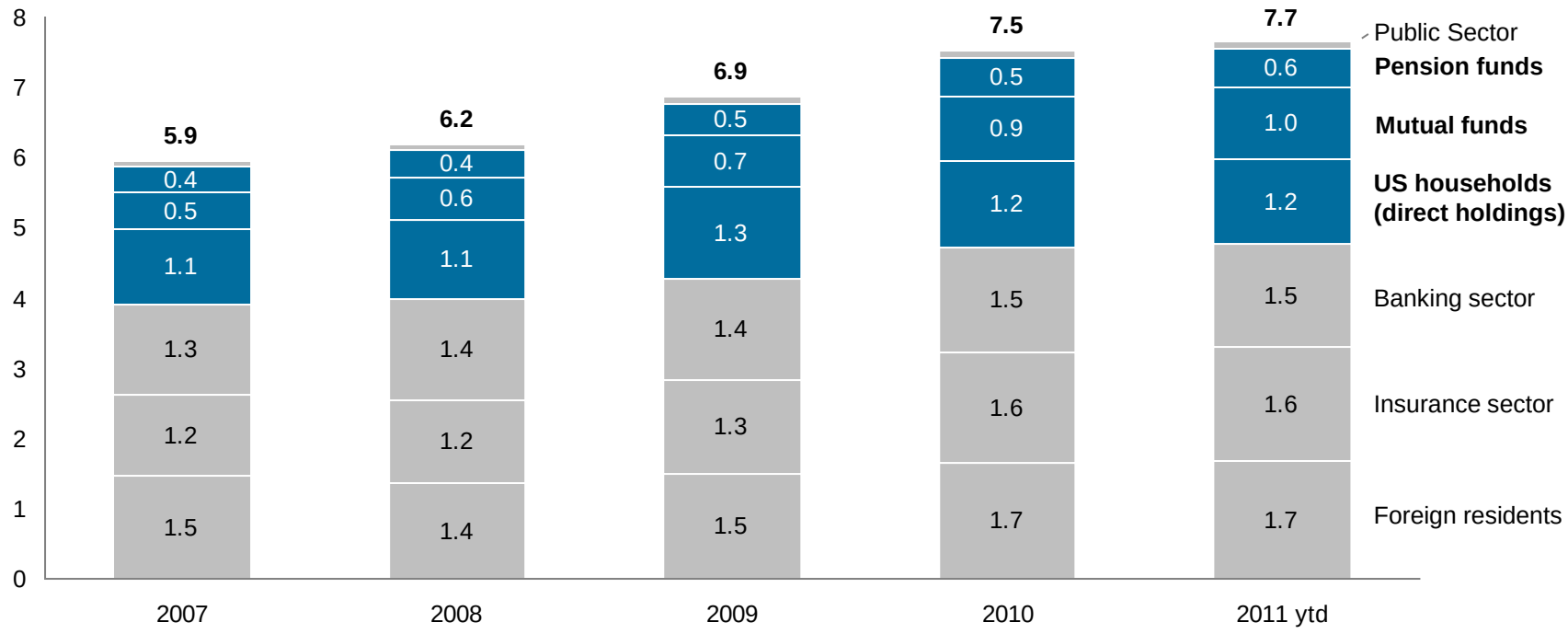
1. DFL construct two independent 'panels' of bond liquidity data – one for the Q3 2005-Q2 2007 period, one for the Q3 2007-Q2 2009 period – using TRACE data. The most recently available panel is used in our analysis; the earlier period shows smaller, but still significant effects.

The US corporate bond market is a critical asset class for investors

Exposure to US corporate credit

Holdings of US corporate bonds by investor, in $TN

Highlighted cells represent direct and indirect holdings of corporate bonds by household investors in the US - $2.8 TN in total



Source: SIFMA, Federal Reserve Flow of Funds (Q2 2011), Oliver Wyman analysis

Liquidity is a significant driver of yield on US corporate bonds – particularly at the lower end of the credit spectrum

Liquidity premium relative to a bond with median liquidity [1]
in bps

Percentile liquidity	Rating bucket				
	AAA	AA	A	BBB	HY
99	-6 bps	-57 bps	-57 bps	-77 bps	-155 bps
95	-6 bps	-55 bps	-55 bps	-74 bps	-149 bps
75	-4 bps	-39 bps	-40 bps	-53 bps	-107 bps
60	-2 bps	-19 bps	-20 bps	-26 bps	-53 bps
50	0 bps	0 bps	0 bps	0 bps	0 bps
40	3 bps	26 bps	27 bps	35 bps	72 bps
25	10 bps	85 bps	85 bps	114 bps	230 bps
5	25 bps	219 bps	220 bps	293 bps	593 bps
1	29 bps	258 bps	258 bps	344 bps	696 bps

More liquid

For example:
The liquidity premium of a HY bond with 40th percentile liquidity is 72 bps higher than that of a bond with median liquidity

1. DFL construct two independent 'panels' of bond liquidity data – one for the Q3 2005-Q2 2007 period, one for the Q3 2007-Q2 2009 period – using TRACE data. The most recently available panel is used in our analysis; the earlier period shows smaller, but still significant effects.

Sources: TRACE, "Corporate bond liquidity before and after the onset of the subprime crisis" (Dick-Nielsen, Feldhutter, Lando 2011), Oliver Wyman analysis

Reduced market liquidity is likely to drive substantial mark-to-market loss of value for investors, ranging from $90-315 BN under a range of modeled scenarios

Level of the potential effect	% liquidity decrease from median	Average effect on yield premium [1]	Estimated mark-to-market loss of value [2]	Share lost on outstanding debt
Small	5%	16bps	$90 BN	1.2%
Medium	10%	34bps	$200 BN	2.5%
Large	15%	55bps	$315 BN	4.1%

"A 15 percentile decrease in liquidity from the median results in an average increase in liquidity premium of 55bps. Given this increase in yield, the market overall would lose an estimated **$315 BN** of mark-to-market value, which corresponds to 4.1% of outstanding debt."

1. DFL construct two independent 'panels' of bond liquidity data – one for the Q3 2005-Q2 2007 period, one for the Q3 2007-Q2 2009 period – using TRACE data. The most recently available panel is used in our analysis; the earlier period shows smaller, but still significant effects.
2. Mark-to-market loss calculated as the percent reduction in price of outstanding bonds from face value as a result of yield premium increase (where price is calculated for each rating classification using average coupon and average maturity from Dealogic data) multiplied by the total debt outstanding

Sources: Dealogic, TRACE, "Corporate bond liquidity before and after the onset of the subprime crisis" (Dick-Nielsen, Feldhutter, Lando 2011), Oliver Wyman analysis

The impact of reduced liquidity will have a disproportionate impact on the value of bonds backed by (generally smaller) firms at the lower end of the credit spectrum

Estimated increase in liquidity premium as a result of liquidity change [1]
in bps

Change in premium

Rating bucket	Liquidity change: small (50th to 45th)	medium (50th to 40th)	large (50th to 35th)
AAA	1 bps	3 bps	5 bps
AA	12 bps	26 bps	43 bps
A	12 bps	27 bps	43 bps
BBB	16 bps	35 bps	58 bps
HY	33 bps	72 bps	116 bps
Total	16 bps	34 bps	55 bps

Estimated mark-to-market loss of value from reduction in bond prices [2]
in $BN

Mark-to-market loss of value

Rating bucket	Liquidity change: small (50th to 45th)	medium (50th to 40th)	large (50th to 35th)
AAA	$1 BN	$1 BN	$2 BN
AA	$14 BN	$31 BN	$50 BN
A	$24 BN	$51 BN	$82 BN
BBB	$27 BN	$58 BN	$93 BN
HY	$25 BN	$54 BN	$86 BN
Total	$91 BN	$195 BN	$313 BN

1. DFL construct two independent 'panels' of bond liquidity data – one for the Q3 2005-Q2 2007 period, one for the Q3 2007-Q2 2009 period – using TRACE data. The most recently available panel is used in our analysis; the earlier period shows smaller, but still significant effects.
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Sources: Dealogic, TRACE, "Corporate bond liquidity before and after the onset of the subprime crisis" (Dick-Nielsen, Feldhutter, Lando 2011), Oliver Wyman analysis

Section 3

Impact on issuers’ borrowing costs

Increased liquidity premia on corporate bonds will also get passed on to issuers over time in the form of higher coupon rates

Analytical approach

- We apply the same methodology for estimating overall changes in liquidity premia for corporate bonds as a baseline for assessing additional costs to issuers
  - Use DFL analysis of liquidity premia differences across bonds
  - Refine DFL results to assess effects of specific liquidity differences
- We assume that new issuance would pay coupons incorporating any increased liquidity premia, gradually increasing the annual net new cost to corporate debt issuers over time

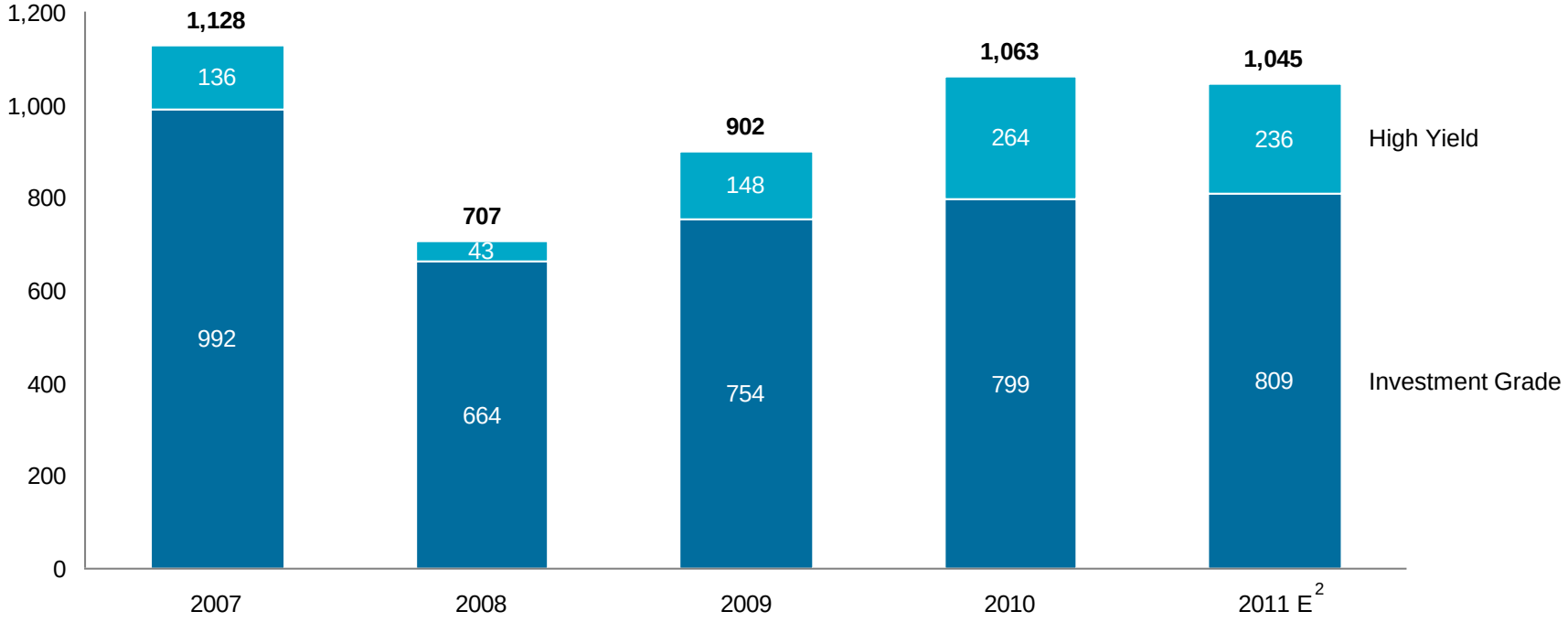
Summary findings and takeaways

- Again, DFL finds a significant impact from liquidity effects on bond yields and asset values
- Investors will demand higher interest payments to compensate for the increased liquidity risk associated with holding corporate bonds
- Taking the DFL estimate of changes in liquidity premia, we can estimate total incremental borrowing costs for corporate bond issuers
- Based on total issuance in 2010 (approximately $1 TN across investment grade and high yield bonds)
  - The outer bound for the first year impact on newly issued bonds is approximately $6 BN, assuming full effect
  - Over time, the steady state level will rise closer to $43 BN as a greater proportion of outstanding bonds absorb the liquidity premium

US corporate bond issuance averages approximately $1 TN across the investment grade and high yield markets

US corporate issuance

Investment grade and high yield issuance, in $BN



1. Investment grade includes all non-convertible corporate debt, medium-term notes, and Yankee bonds, but excludes all issues with maturities of one year or less and CDs
2. 2011 estimated based on 10 months of data

Sources: SIFMA, Oliver Wyman analysis

Investors will demand higher interest payments on newly issued bonds to compensate for the increased liquidity risk

Estimated increase in liquidity premium as a result of liquidity change [1]
in bps

Change in premium

Rating bucket	Liquidity change: small (50th to 45th)	medium (50th to 40th)	large (50th to 35th)
AAA	1 bps	3 bps	5 bps
AA	12 bps	26 bps	43 bps
A	12 bps	27 bps	43 bps
BBB	16 bps	35 bps	58 bps
HY	33 bps	72 bps	116 bps
Total	16 bps	34 bps	55 bps

Estimated annual incremental issuance cost due to reduction in bond prices
In $MM

Change in issuer cost

Rating bucket	Liquidity change: small (50th to 45th)	medium (50th to 40th)	large (50th to 35th)
AAA	$15 MM	$30 MM	$50 MM
AA	$235 MM	$510 MM	$830 MM
A	$350 MM	$760 MM	$1,240 MM
BBB	$400 MM	$870 MM	$1,410 MM
HY	$570 MM	$1,235 MM	$2,010 MM
Total	$1,570 MM	$3,405 MM	$5,540 MM

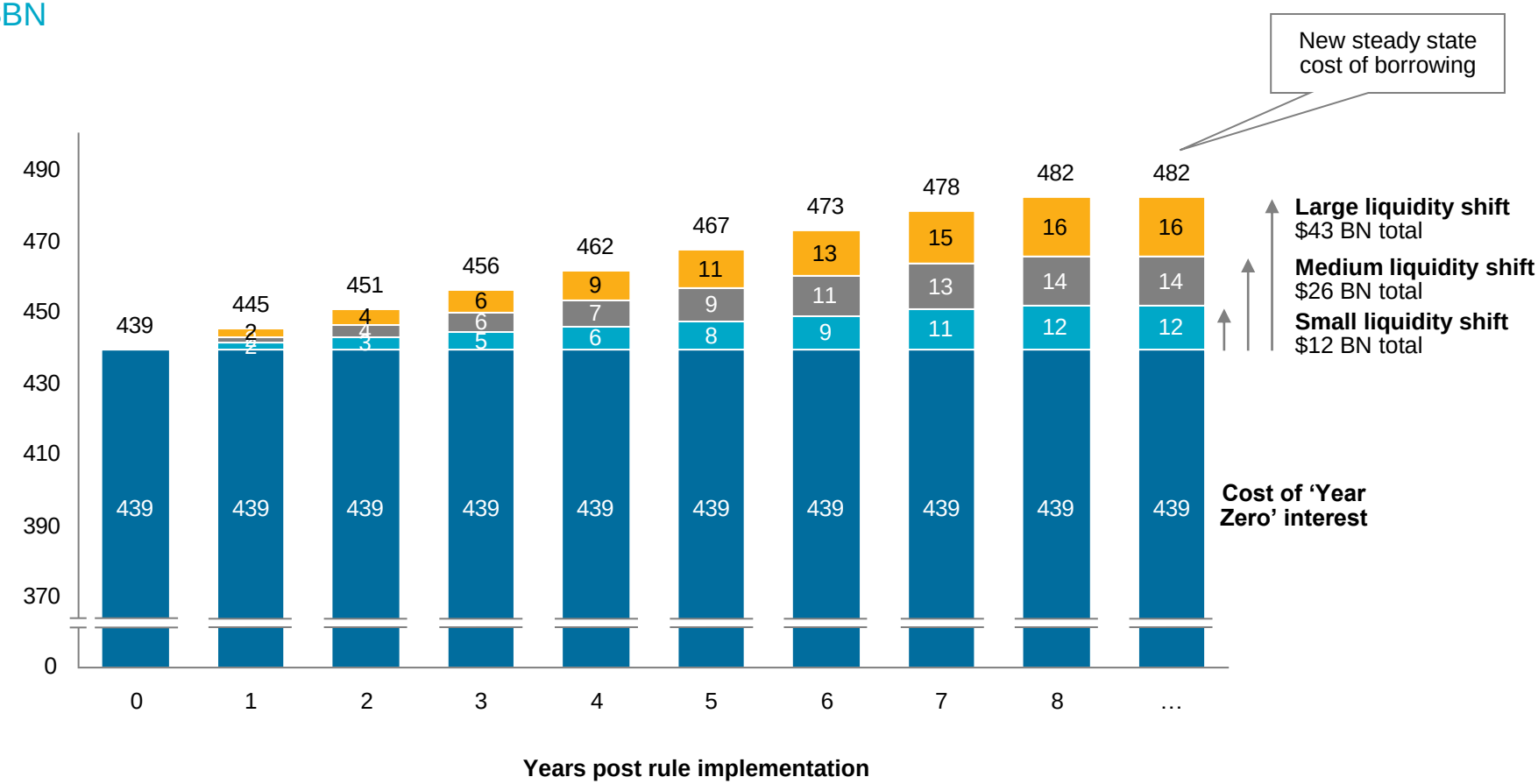
1. DFL construct two independent 'panels' of bond liquidity data – one for the Q3 2005-Q2 2007 period, one for the Q3 2007-Q2 2009 period – using TRACE data. The most recently available panel is used in our analysis; the earlier period shows smaller, but still significant effects.

Sources: Dealogic, TRACE, "Corporate bond liquidity before and after the onset of the subprime crisis" (Dick-Nielsen, Feldhutter, Lando 2011), Oliver Wyman analysis

The impact on issuers will grow as outstanding debt is retired and new issues are priced at higher yields

Simulated cumulative increase in corporate issuance cost [1]

In $BN



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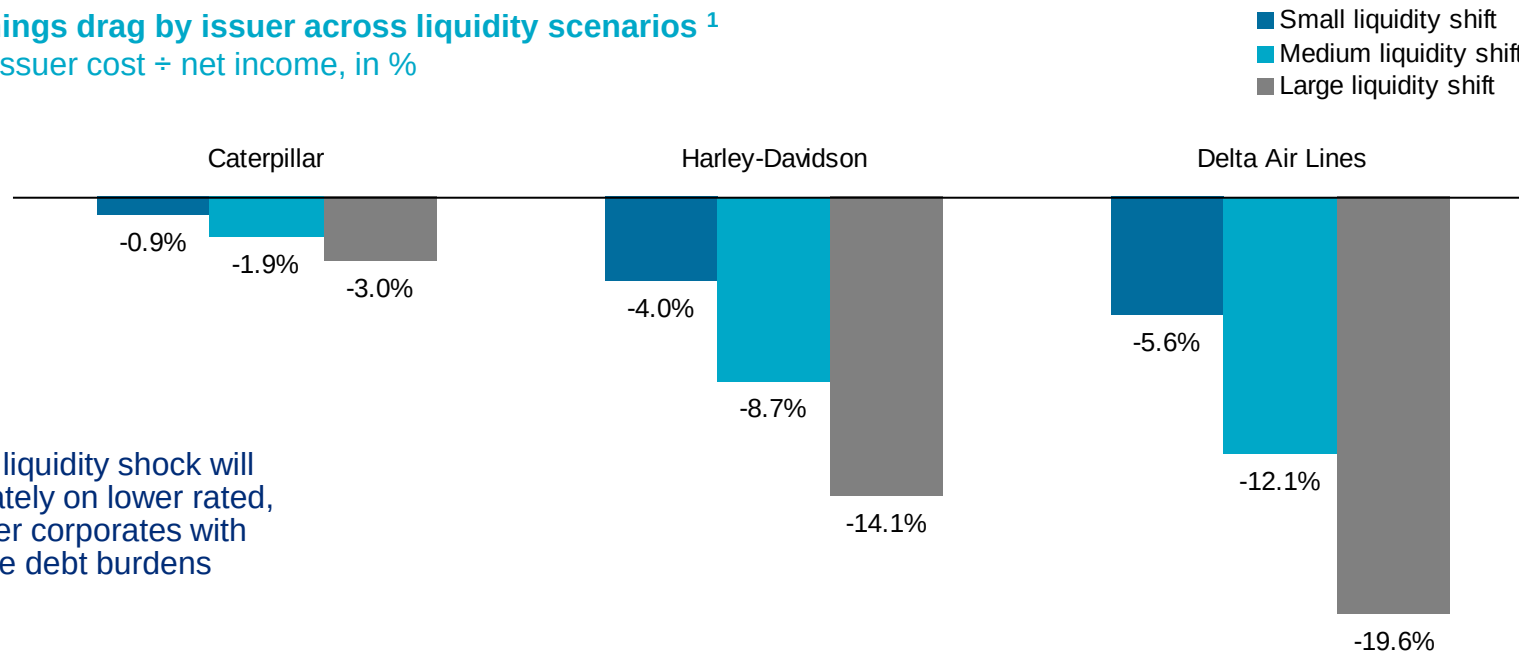
Sources: Dealogic, TRACE, "Corporate bond liquidity before and after the onset of the subprime crisis" (Dick-Nielsen, Feldhutter, Lando 2011), Oliver Wyman analysis

The impact of higher issuer costs is most visible in the potential earnings drag for individual firms

Steady state earnings drag by issuer across liquidity scenarios [1]
Dollar increase in issuer cost ÷ net income, in %



The impact of a liquidity shock will fall disproportionately on lower rated, generally smaller corporates with higher relative debt burdens

Rating bucket	A	BBB	High Yield
Average annual issuance [2]	$6.4 BN	$0.4 BN	$1.4 BN
Debt outstanding	$19.4 BN	$4.5 BN	$14.4 BN
2010 earnings	$2,782 MM	$147 MM	$593 MM
Similarly rated corporates [3] (large liquidity shift % drag)	Walt Disney (-1.4%) Coca-Cola (-0.5%)	Kraft Foods (-3.8%) Clorox (-2.4%)	Sears (-20.0%) Del Monte Foods (-6.2%)

1. Steady state implies that all outstanding debt has been refinanced at the higher (post liquidity premium) borrowing cost
2. Average annual issuance based on 2005 - H1 2011
3. Similarly rated corporates are those with ratings in the same rating bucket: A+/A/A-, BBB+/BBB/BBB-, High Yield

Sources: Dealogic, TRACE, Oliver Wyman analysis

Section 4

Impact on transaction costs

Liquidity is a significant driver of transaction costs in the corporate bond market, and a reduction in liquidity would lead to a material increase in costs paid by investors

Analytical approach

- Our analysis of realized purchase and sales prices was designed to understand the impact of changes in liquidity on transaction costs for investors
- Transaction costs could also be significantly affected in other ways by the Volcker rule that our analysis does not address directly
- Bid-offer spreads are not directly observable in the corporate bond market, and no central repository of bid-offer data exists in the US market today – so transaction costs must be estimated
- We use the FINRA database of corporate bond transactions (known as TRACE) to impute transaction costs from realized purchase and sale prices reported
- Investors' realized transaction costs are imputed by matching buy and sell transactions for the same security on the same day and averaging dealers' realized purchase and sale price
- For 2009, this yields a rich database of > 250 k observations covering ~ $2.5 TN in transaction value

Summary findings and takeaways

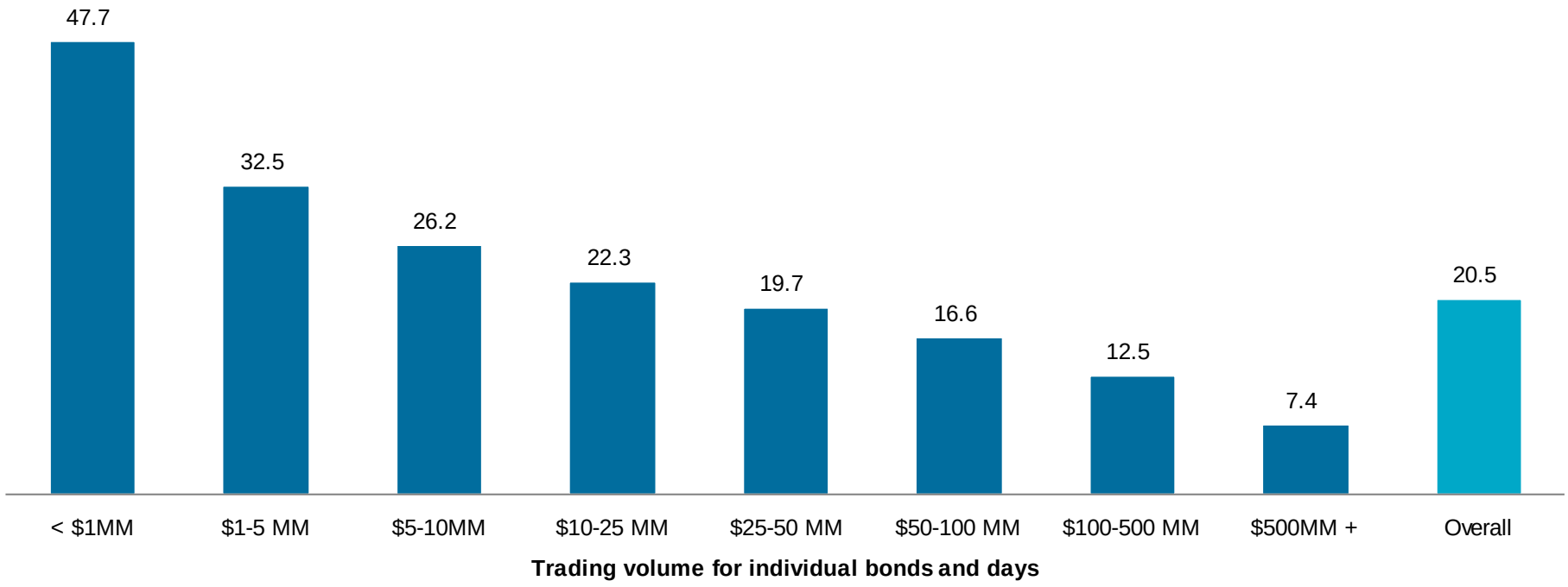
- There is a clear relationship between liquidity and transaction costs in the corporate bond market
- Using historical data on corporate bond trading from TRACE, we observe
  - Significant dispersion (40 bps) in average imputed transaction costs[1] driven by liquidity
  - Average imputed transaction costs for the most liquid securities ($500 MM+ in daily volume) of 7 bps
  - Average imputed transaction costs for the least liquid securities (less than $1 MM in daily volume) of 48 bps
- The average imputed transaction costs for all securities is approximately 20.5 bps, which translates into approximately $6.7 BN in imputed annual transaction costs paid by investors
- A 10% change in liquidity (equivalent to the change in transaction costs between the median bond and the 40th percentile bond) would mean an average increase of 8bps, adding $2.4 BN in costs for investors

1 Transaction costs proxied using 50% of average purchase and sale price range

There is a clear relationship between decreasing liquidity and increasing transaction costs

Imputed transaction costs by liquidity bucket [1]

Transaction costs in bps, liquidity buckets in $ MM of trading volume for each security and day

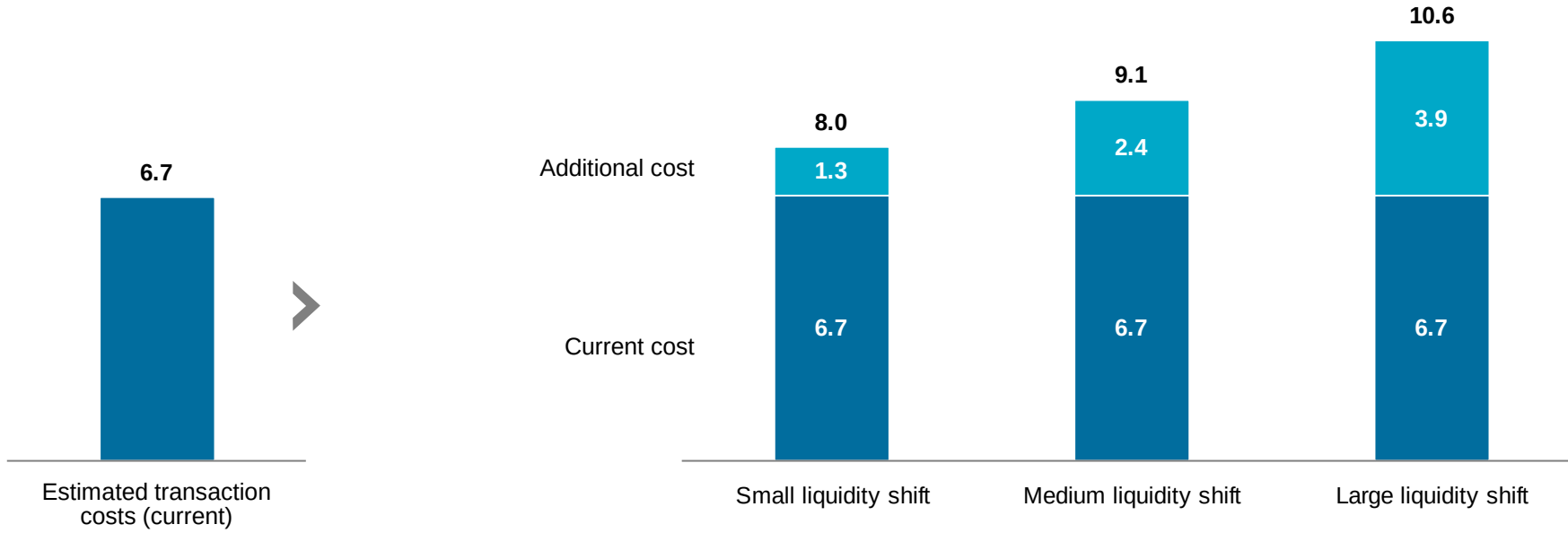


1 Transaction costs proxied using 50% of average purchase and sale price range

Sources: TRACE, Oliver Wyman analysis

Reduced liquidity in the corporate bond market could increase transaction costs to investors from $7 BN to $11 BN

Imputed transaction costs for investors [1]
Current and simulated, in $BN



$3.3 TN in annual volume for customer-to-dealer trades

X

20.5 bps on average transaction across corporate bonds

Estimated impact			
Percentile increase in transaction costs	5%	10%	15%
Additional Transaction costs	4 bps	8 bps	12 bps

1 Transaction costs proxied using 50% of average purchase and sale price range
Sources: TRACE, Oliver Wyman analysis

Appendix

Liquidity impact calculation methodology

Dick-Nielsen, Feldhutter and Lando conducted the most recent and robust analysis of the effect of reduced liquidity on bond prices, which we use as our starting point

- Dick-Nielsen, Feldhutter and Lando (DFL) clean available data, test different liquidity factors, and analyze liquidity effects across two periods: pre-subprime (Q1 2005 – Q1 2007) and post-subprime (Q2 2007 – Q2 2009)

Clean data

- Dataset of 5,376 bonds with 8.2 MM trades obtained after cross-referencing data from TRACE, Bloomberg, Datastream, and IBES and removing retail-sized and erroneous trades
- Treasury yields and LIBOR rates obtained from the British Bankers' Association

Test factors

- Using yield spread to swap rate as the dependent variable, eight liquidity measures are regressed to determine which correlated more highly with yield spread
- Credit risk contribution to the yield spread is controlled with 12 additional factors
  - Bond age
  - Amount issued
  - Coupon size
  - Time-to-Maturity
  - Equity volatility
  - Ratio of operating income to sales
  - Leverage ratio
  - Ratio of long term debt to assets
  - Interest rate coverage
  - 10y swap rate
  - 10y - 1y swap rate
  - Earnings forecast dispersion

Analyze effects

- DFL create a composite liquidity measure using a normalized average of 4 liquidity measures: Amihud, Imputed Roundtrip Cost, and their standard deviations
- Running the regression using the liquidity measure reveals that the liquidity component of bond yields strongly increased from higher credit rating to lower
- Liquidity component increases at the onset of subprime crisis for all but AAA-rated bonds, which is explained by the flight-to-quality phenomenon

DFL develop a composite measure of liquidity and find its yield spread regression coefficient for each rating bucket

Sources: "Corporate bond liquidity before and after the onset of the subprime crisis" (Dick-Nielsen, Feldhutter, Lando 2011)

The DFL composite liquidity measure and its regression coefficients are used to assess the impact of liquidity on our dataset

- After running regressions with eight measures of liquidity, Dick-Nielsen, Feldhutter, and Lando develop a composite liquidity measure, λ, calculated as an equally weighted sum of Amihud's measure of price impact, a measure of roundtrip cost of trading, and the standard deviations of both, all normalized
- DFL provides certain percentile values of λ and coefficients of λ in regressions on the yield spread for each rating
- We perform an exponential regression on the percentile values of λ to interpolate values at other percentiles
- We use the coefficients from the most recently available period (Q3 2007-Q2 2009) for our analysis of the present

Sources: "Corporate bond liquidity before and after the onset of the subprime crisis" (Dick-Nielsen, Feldhutter, Lando 2011)

We use Dealogic data to supplement the results of the DFL paper and calculate estimates of the effect of a decrease in liquidity on asset values in various scenarios

1 Determine current yield

- Use Dealogic data to calculate current yield of outstanding debt using average maturity and average coupon for each rating bucket

2 Estimate outstanding debt

- Estimate corporate debt outstanding for each rating bucket by assuming same proportions as across 2005 through H1 2011 issuance, for which we have data

3 Find liquidity component

- Find the difference in liquidity premia between a median liquidity bond and a bond with lower liquidity as per each scenario by multiplying the difference in the liquidity measure by the corresponding regression coefficient for each rating bucket

4 Estimate percentile shift costs

- Calculate the percent mark-to-market loss of value as a result of increasing the bond yield by the liquidity component change
- Estimate the mark-to-market loss of value in absolute terms by multiplying by outstanding corporate debt in each rating bucket
- Find the share of total outstanding debt lost by dividing absolute mark-to-market loss of value by the total outstanding debt

Sources: Dealogic, "Corporate bond liquidity before and after the onset of the subprime crisis" (Dick-Nielsen, Feldhutter, Lando 2011)

A similar process is used to obtain estimates of costs of credit for future issuance

1 Approximate annual issuance

- Approximate annual issuance for each rating bucket as that across 2005 through H1 2011

2 Find liquidity component

- Find the difference in liquidity premia between a median liquidity bond and a bond with lower liquidity as per each scenario by multiplying the difference in the liquidity measure by the corresponding regression coefficient for each rating bucket

3 Estimate percentile shift costs

- Calculate the estimated additional annual cost in absolute terms by multiplying annual issuance by the increase in liquidity premium
- Project annual issuance cost by assuming that each year bonds mature and are replaced with more costly bonds as dictated by the maturity rate, so that annual cost increases at the rate of the additional annual cost each year for the amount of time of average maturity, at which point it plateaus to steady state

Sources: Dealogic, "Corporate bond liquidity before and after the onset of the subprime crisis" (Dick-Nielsen, Feldhutter, Lando 2011)

We use TRACE data to impute transaction costs from realized buy and sell prices reported and calculate the effect of different shift scenarios

1 Clean TRACE data

- Clean data to remove
  - Corrected, cancelled, or removed trades
  - Equity linked and agency trades
  - Trades with trading volume <$100,000

2 Impute transaction costs

- Aggregate data by security and day
- Calculate average buy and sell prices weighted by trading volume for each security and day
- Compute transaction costs in absolute terms as half of the difference between the average sell and buy prices, multiplied by the total trading volume for each security and day
- Translate into transaction costs per traded dollar for each security and day by dividing absolute transaction cost by the total price

3 Estimate percentile shift costs

- Calculate the increase in transaction costs under different scenarios of shift in transaction cost percentiles
- Translate into dollar costs by applying premium to outstanding debt for each rating bucket for each scenario

Sources: TRACE

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