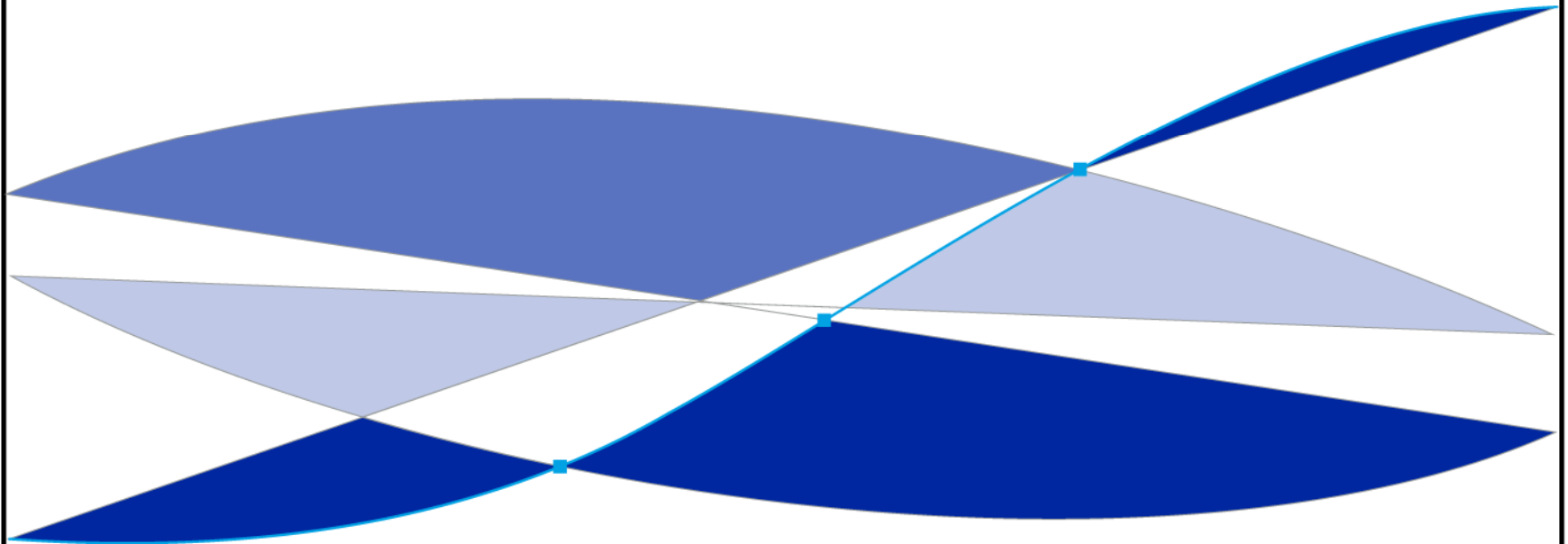


RiskFrontier™ – Next Generation Portfolio Manager: Moving Away from Loan Equivalent Credit Portfolio Analysis



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Agenda

1. A brief history of Portfolio Manager
2. The lattice structure
3. Case study: Puts and calls in a bond portfolio
4. Case study: Dynamic usage for revolvers
5. Modeling CDO tranches in a credit portfolio
6. Case study: Hedging portfolio risk
7. Conclusion



A brief history of Portfolio Manager

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1989 KMV Founded

1993 Portfolio Manager v. 1

- DOS version
- Default-No Default Model
- No Monte Carlo

1997 Portfolio Model v. 1

- Windows version
- Modeled Credit Migration
- Risk Comparable Value

1999 PM v. 1.3

- Monte Carlo

2001 Portfolio Model v. 2

- Empirical Credit Migration

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The lattice structure

Modeling contingencies in single name credit exposures using the lattice structure

- The lattice structure models cash flows associated with each credit state at each point in time
- Lattice model is able to produce more accurate MTM values, value and loss distributions at horizon, which in turn are translated to better estimation of risk metrics

“Loanx validation of RCV and Lattice valuation models”

by Jeffrey Bohn and Bin Zeng

- Taking options and other contingencies into consideration can have large impact on risk and return

For straight bonds without options, PM and lattice produce similar results

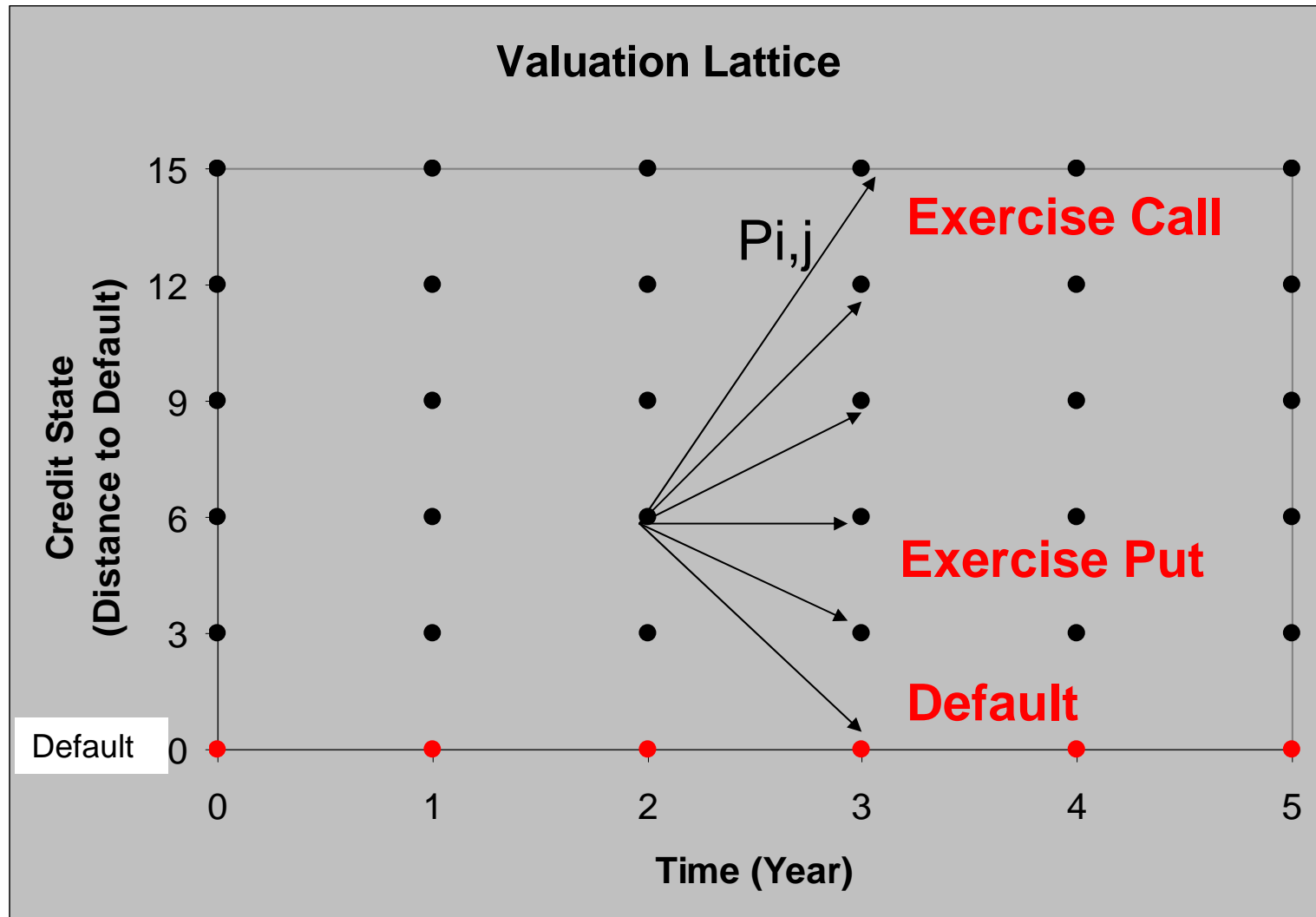
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Case study: Puts and calls in a bond portfolio

Modeling embedded put and call options

- Cash flows vary with credit state and across time
- Call / Put option exercises are economically rational, i.e. the option holder exercises if it is profitable
 - A call option gives the bond issuer the ability to call in, or buy, the principal of the bond before maturity
 - A put option gives the bond holder the ability to receive the principal of the bond before maturity
- Introduce “option exercise cost” which reflects any other cost consideration, such as refinancing costs when deciding to exercise an option
- In each state at each point in time the value of exercising is compared to the value of continuation

Valuation of embedded put and call options using the lattice structure



Sample bond portfolio: Characteristics

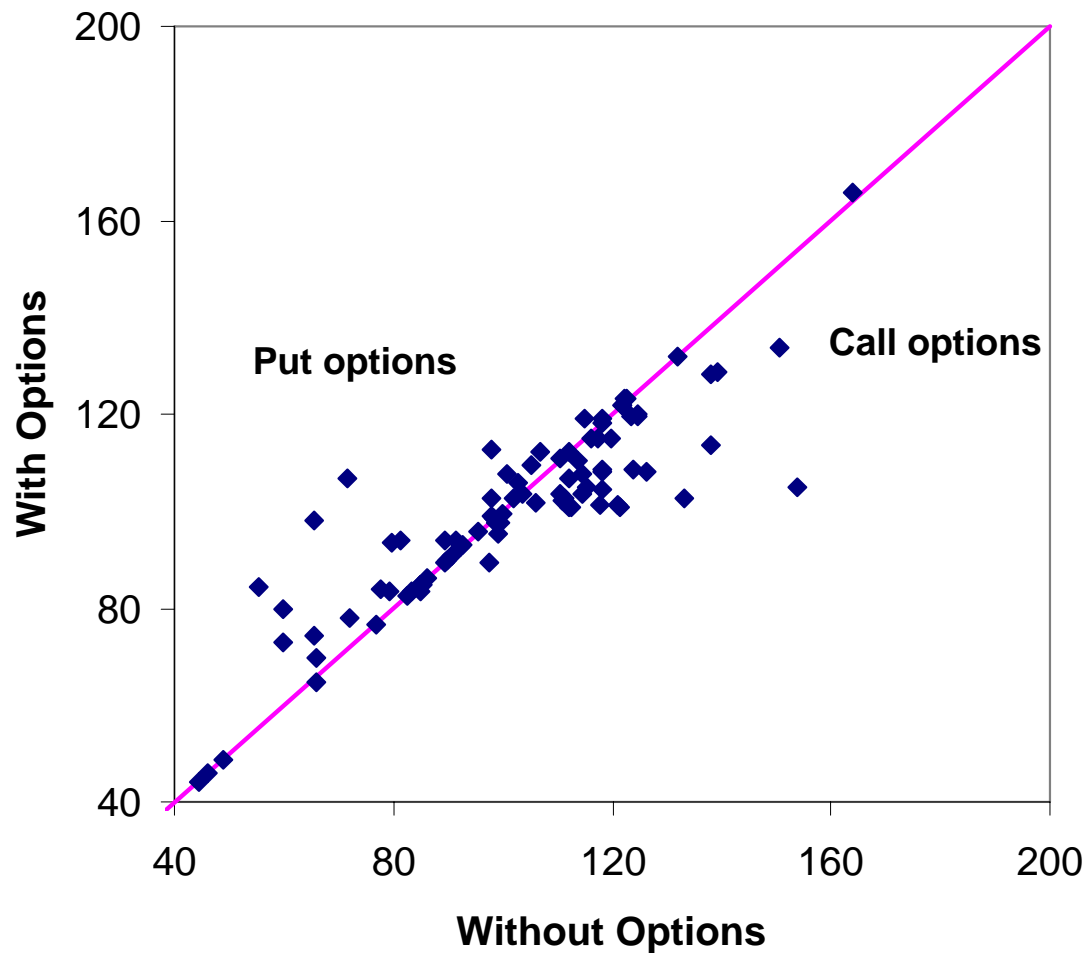
- 90 bonds, terms & conditions taken from Reuters EJV
- Coupon rates, coupon frequency, maturity, EDFs vary across the sample
 - EDFs range from 2 bps to 20 percent (average is 157 bps)
 - Maturity ranges from 5 to 36 years (average is 13.8 years)
- Varying option types and schedules
 - American puts/calls
 - Bermuda puts/calls

Results with and without options: MTM

The impact on price can be significant and greatly depends on moneyness of options:

- Callable bonds can be valued much lower
- Puttable bonds can be valued much higher
- Relative difference can be as much as 52 percentage points, depending on maturity and credit worthiness among other factors

Normalized MTM can be very different when taking optionality into consideration

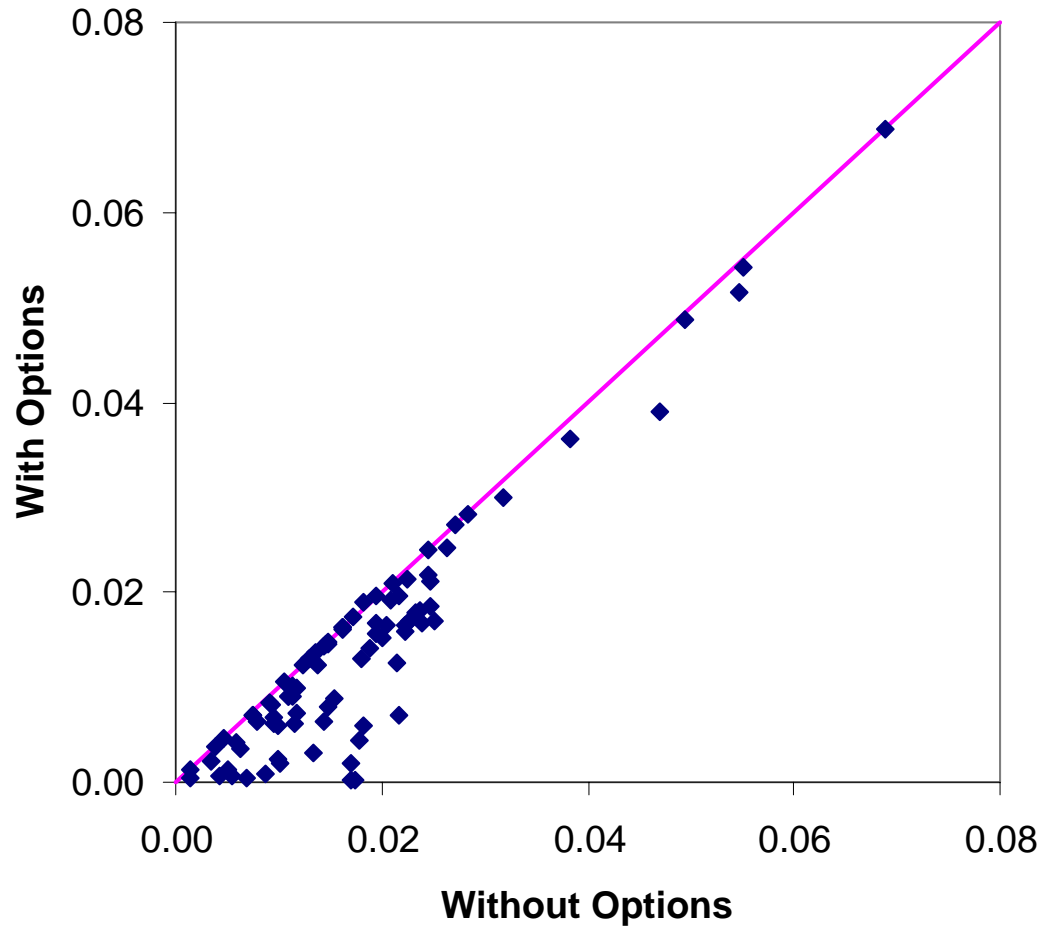


Results with and without options: Risk and return

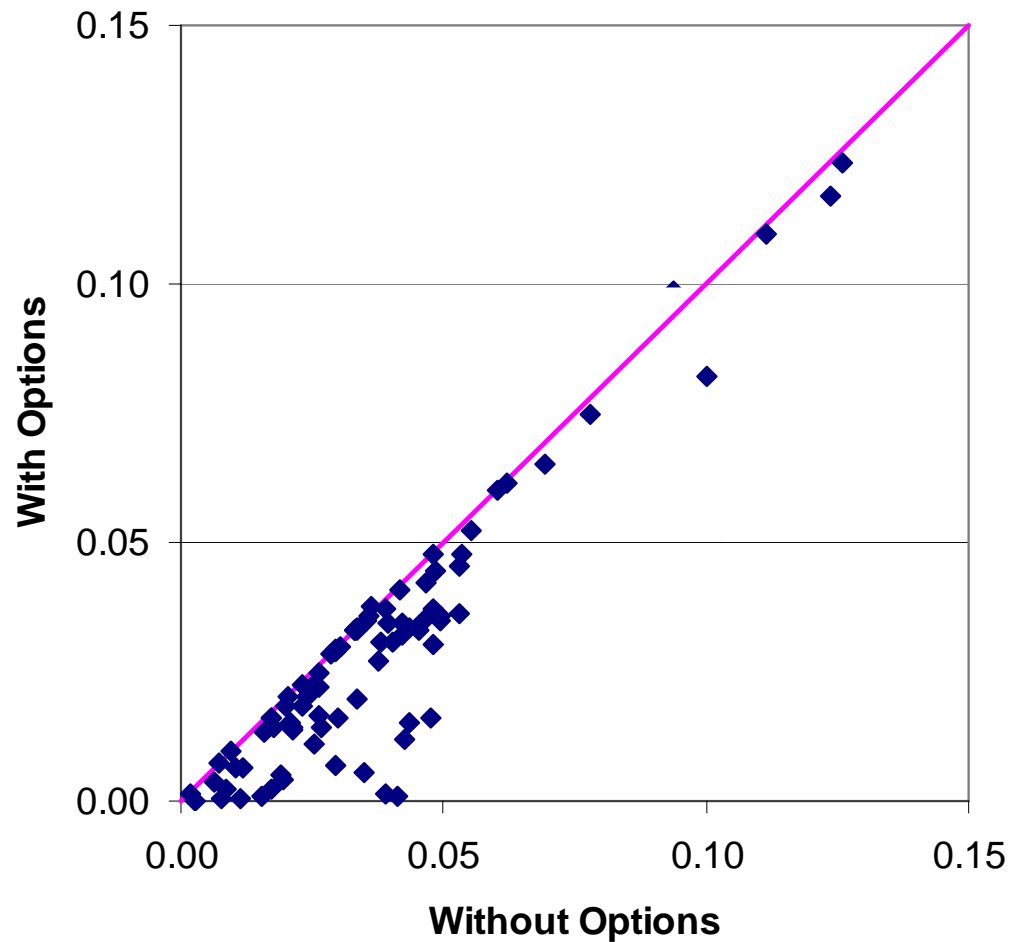
Expected spread and risk contribution are lower when options are taken into account:

- Availability of options reduce variance of value distributions
 - options are exercised when values hit a certain thresholds
- Options shorten bond durations

Expected spread is lower when taking optionality into account



Risk contribution is lower when taking optionality into account



Portfolio impact: Portfolio of 90 bonds

All weighted risk and return metrics are lower when considering options

- All risk and return metrics are lower when considering options
- Sharpe ratio (a measure of return per unit risk) actually deteriorates
 - This effect will be portfolio specific

	Without Options	With Options
Expected Spread	2.03%	1.70%
Total Spread	3.04%	2.85%
Unexpected Loss	8.49%	7.68%
Capitalization Rate with respect to EL	25.48%	22.00%
Sharpe Ratio	49.14%	48.87%

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Case study: Dynamic usage for revolvers

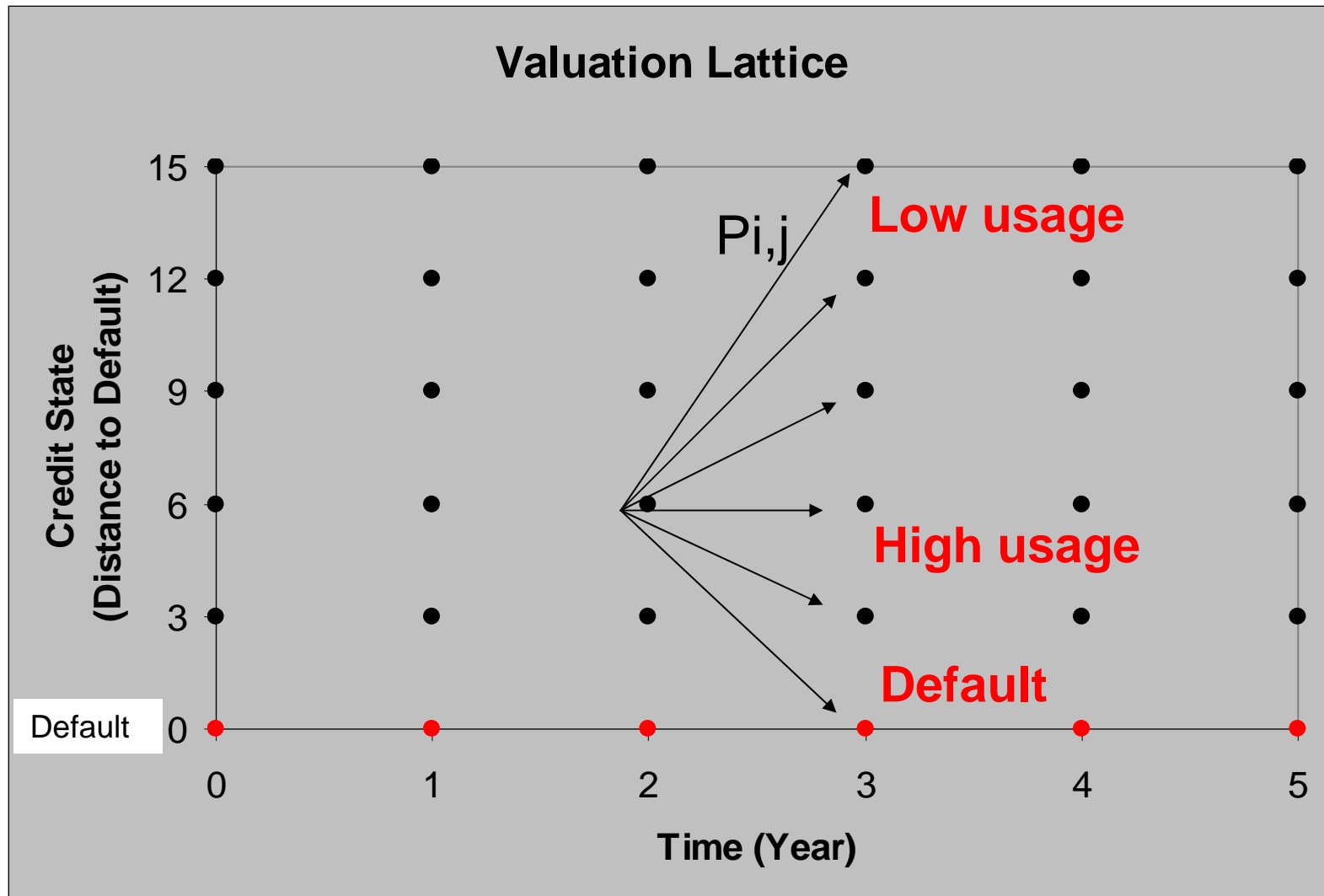
Modeling revolvers with dynamic usage

- Lattice structure allows specification of fees
 - Usage fee
 - Non usage fee
 - Recurring fee

- Lattice structure allows association between credit state and usage
 - Estimates based on empirical study on revolvers that were issued by a large financial institution
 - Notice the strong relation between usage and DP
When times are rough, firms borrow more

Year 1 Default Probability (%)	Usage(%)
<0.02	0.04
0.03	0.04
0.05	1.1
0.07	1.6
0.08	3
0.1	3.4
0.13	10.5
0.18	16.8
0.37	33.2
1.37	45.1
14	90
>17	100

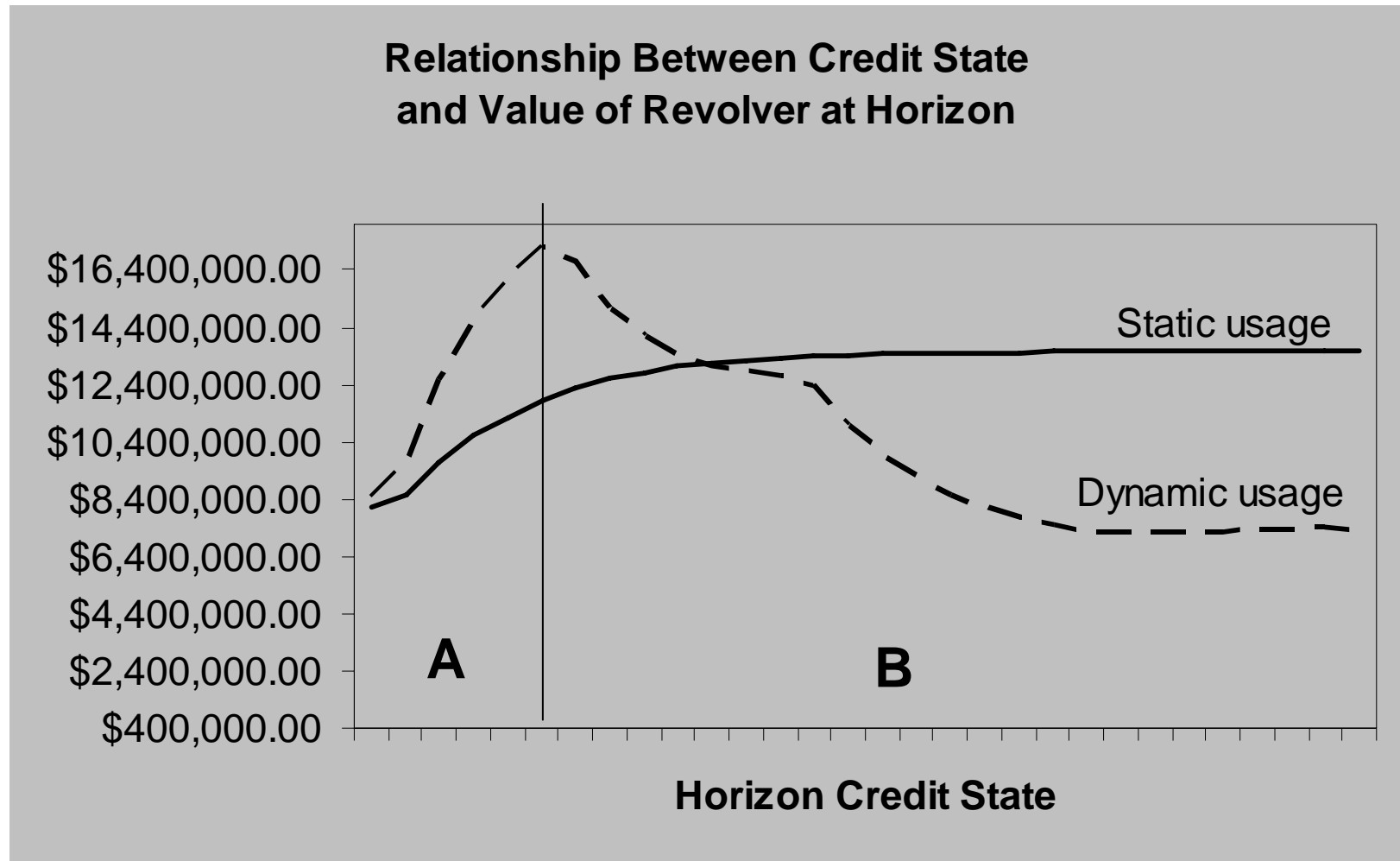
Valuing dynamic usage using the lattice structure



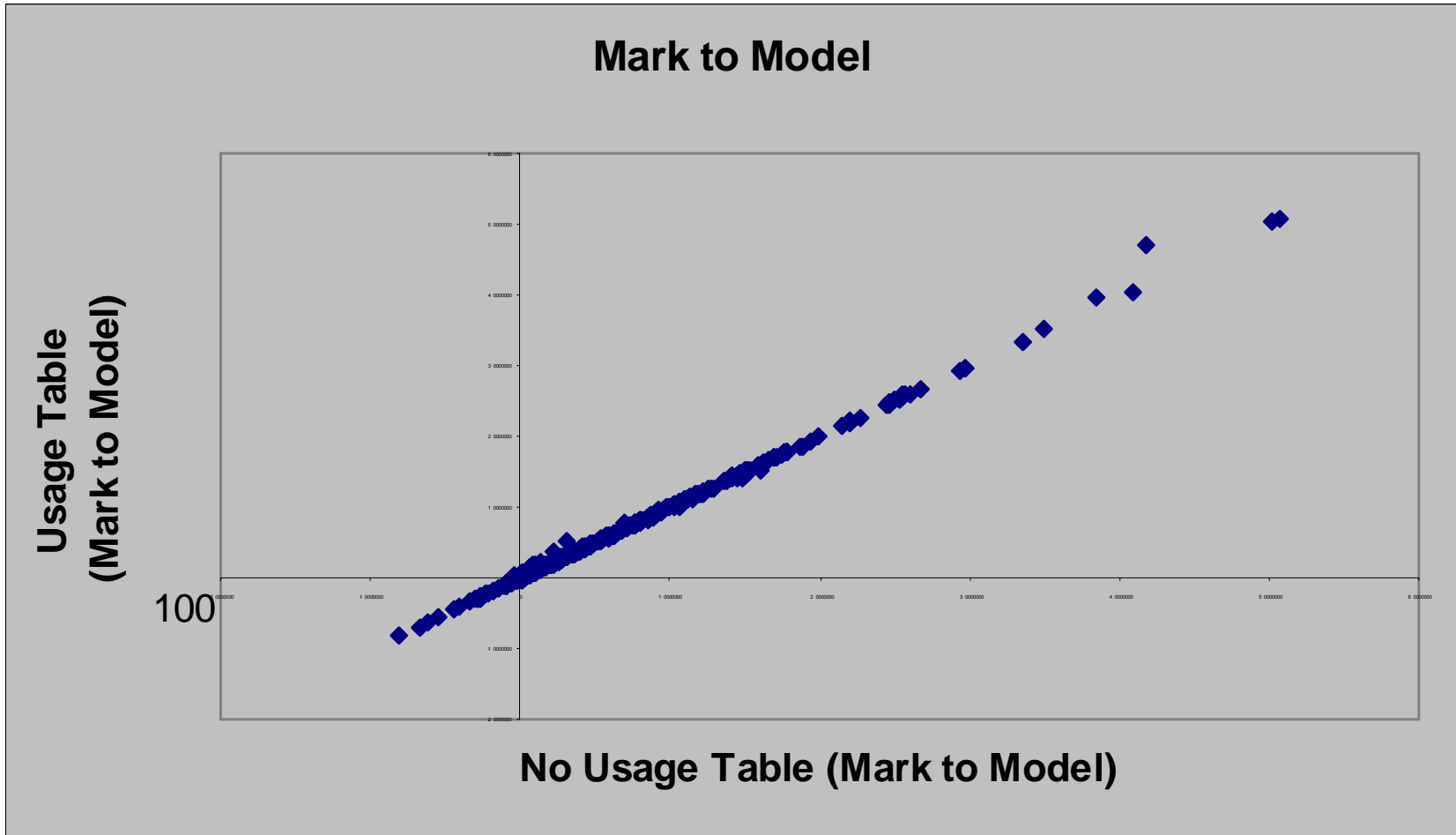
How important is contingent usage when modeling revolvers?

- Typically non-usage fees are low compared with usage fees
- Conventional wisdom:
 - Issuer prefers some usage since fees are higher
Associated with deterioration in credit quality
 - Issuer does not prefer too much usage
- Conventional wisdom suggests banks prefer some deterioration in credit quality but not too much

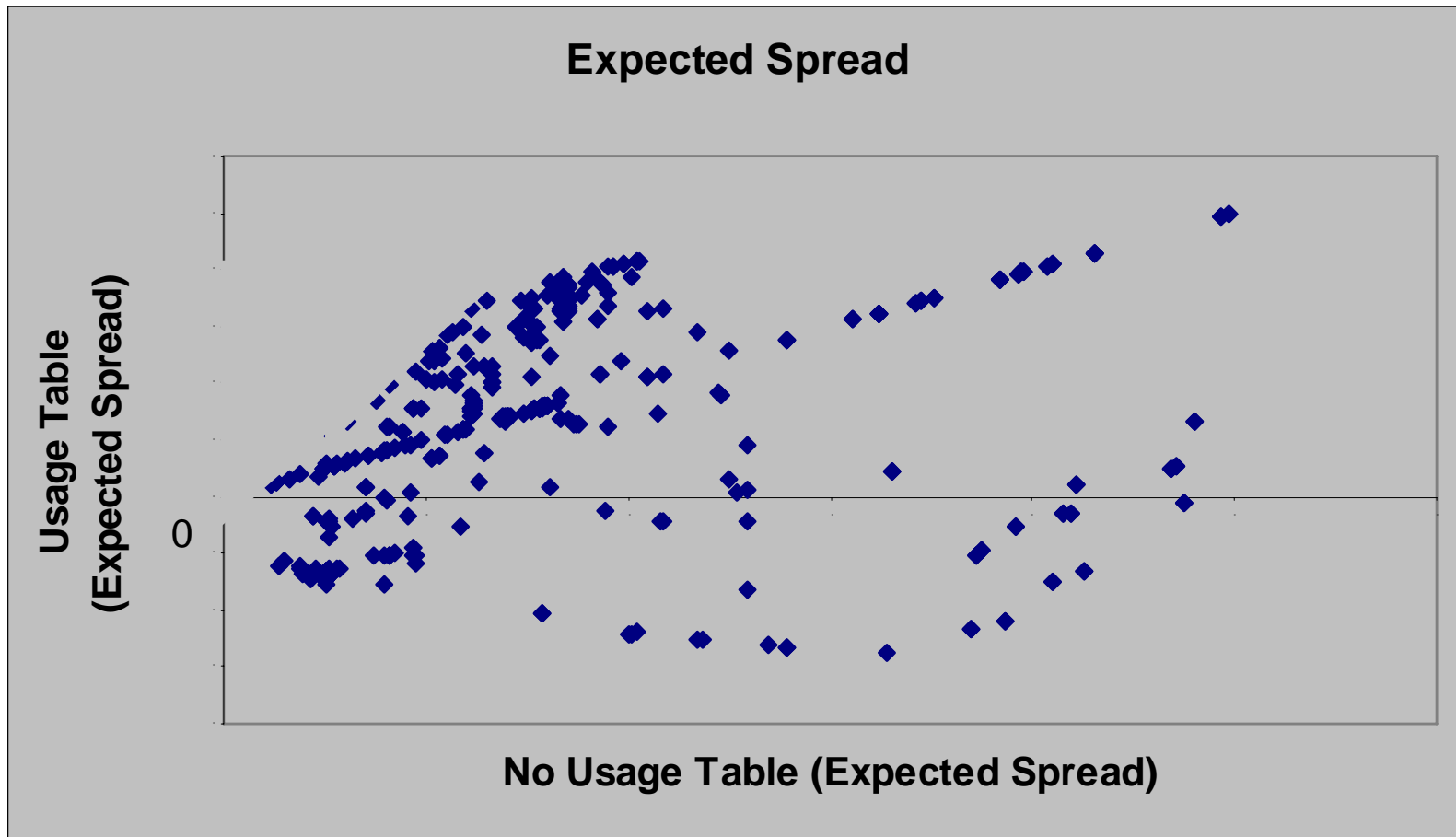
Relationship between credit state and value can be negative if dynamic usage is taken into consideration



Impact of dynamic usage on valuation is typically not substantial

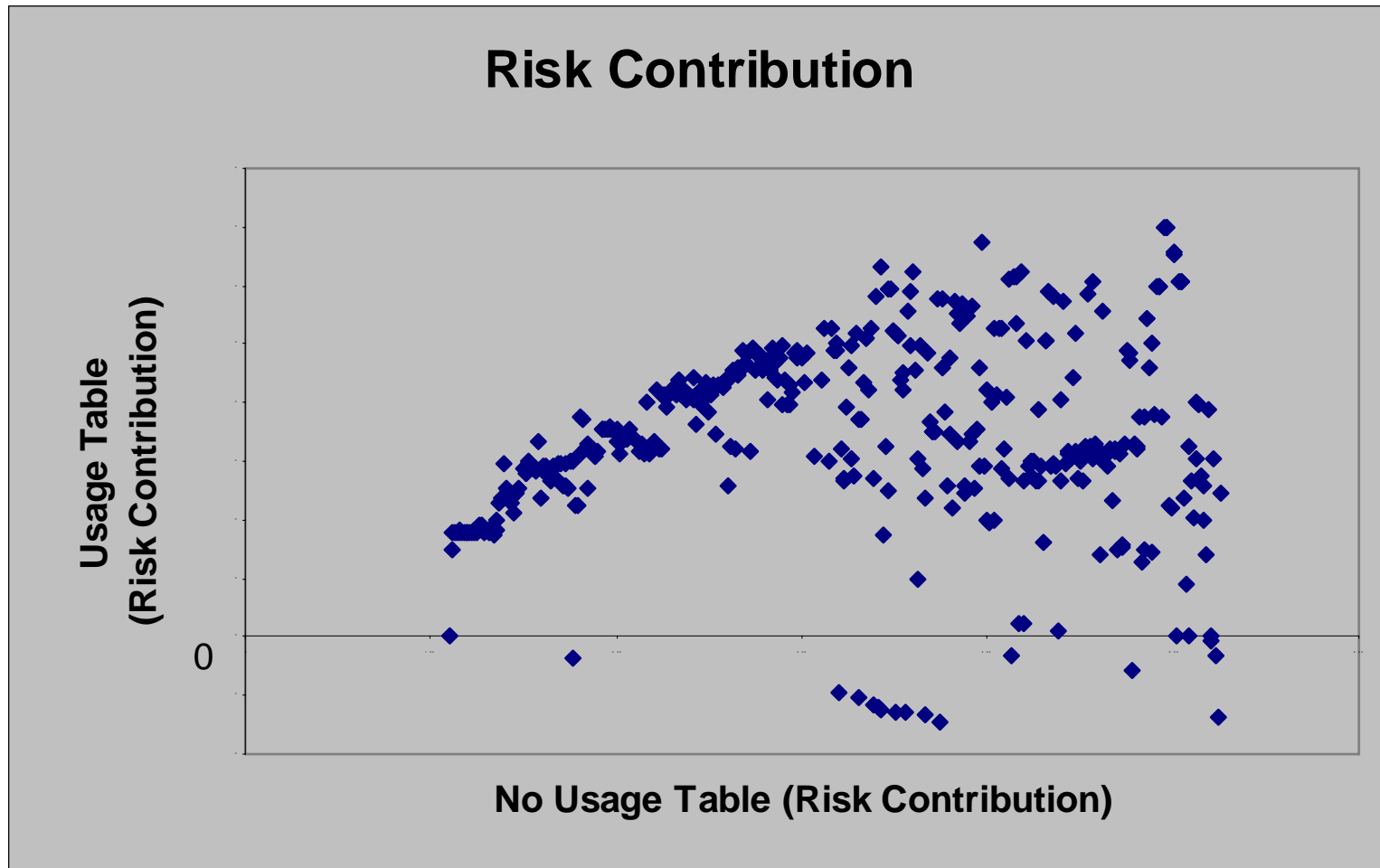


Impact of dynamic usage on return can be substantial



Although MTM does not change much, expected spread changes dramatically as small changes in value can lead to large changes in returns

Impact of dynamic usage on portfolio referent risk can be substantial



Similar to the impact on expected spreads, risk contribution also decreases and can be negative

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Modeling CDO tranches in a credit portfolio

Modeling a CDO tranche within a credit portfolio

- Modeling approach designed around pass through waterfall structures
 - Captures index tranches, bespoke deals and other synthetic structures
 - Accounts for subordination credit enhancement of tranches
- Modeling approach can be parameterized to handle more complex cash deals
- Accurately captures collateral concentration effects – the approach accounts for overlap/correlation of collateral pool with rest of portfolio
- Applications include analysis of impact on economic capital of securitization of loan portfolios

CDO modeling overview: Valuation

- Semi-analytic single factor methodology used for valuation
- Risk evolution of collateral pool capture with full detail of the portfolio model
- Aggregate properties of collateral pool are used for tranche valuation to facilitate fast computation time
- Calibration is used to offset distortions resulting from modeling approximations

CDO modeling overview: Linking the CDO tranche with rest of portfolio

- Evolution of credit quality for names in collateral pool is modeled exactly the same as for names in rest of the portfolio through correlated credit migration
- A horizon credit event will be realized in both the collateral pool as well as the credit portfolio
- Take GM as an example
 - Simulate GM's credit quality state for a particular Monte Carlo trial
 - If GM is in default, all facilities related to GM will be in default
 - If not in default GM's simulated credit quality will determine horizon forward default probabilities according to the credit migration model
 - Affects the valuation of stand-alone facilities and CDO tranches

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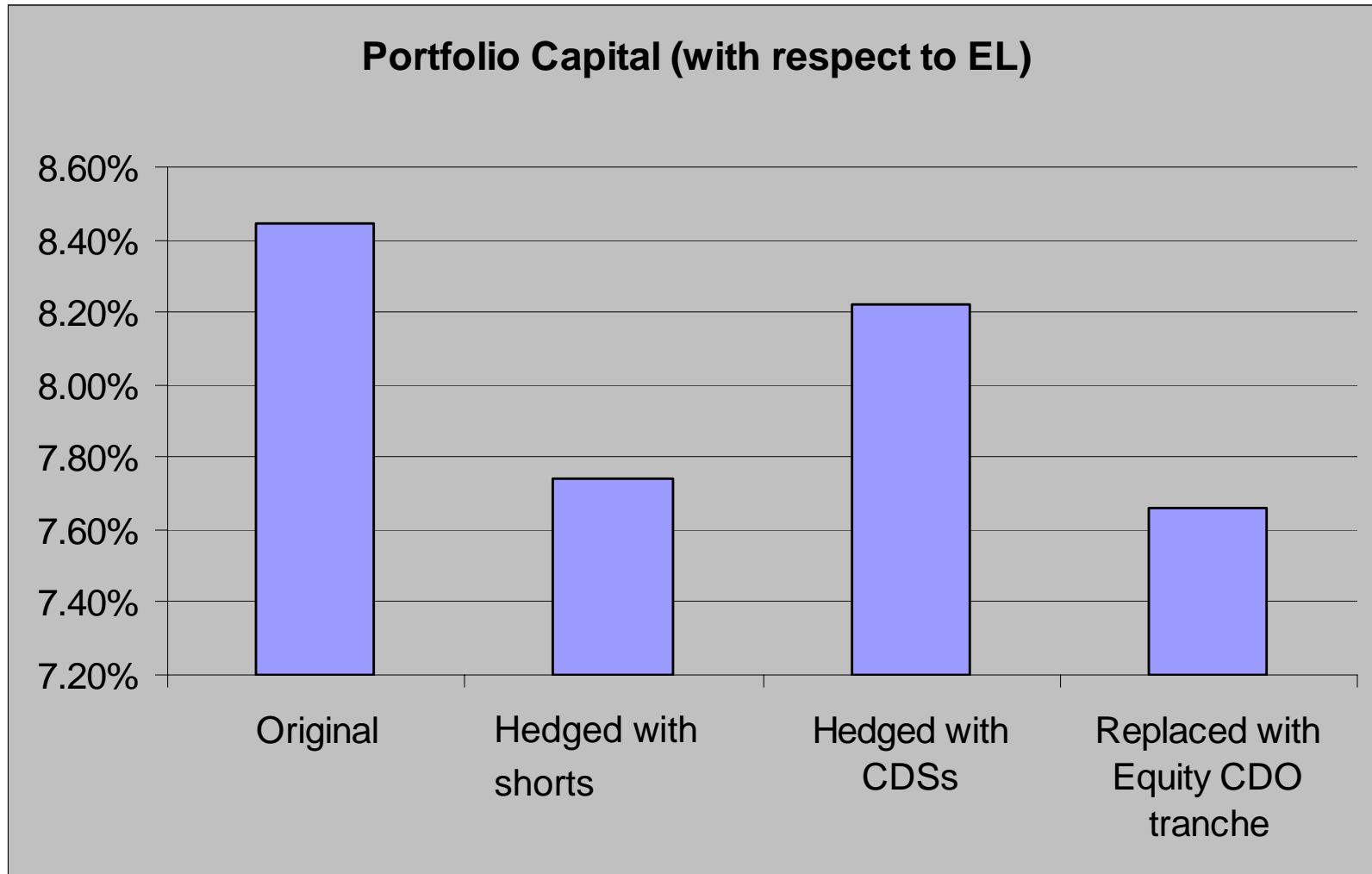
Case study: Hedging portfolio risk

Three approaches to hedging credit portfolio risk

Four portfolios:

- Original
 - A portfolio with 525 facilities
- Shorting Facilities
 - Enter into short contracts for 50 facilities with the worst Sharpe ratios (i.e., perfect hedge) from the “Original” portfolio
- Hedged with CDSs
 - Hedges are purchased using single name 5-year CDSs on 50 facilities with the worst Sharpe Ratios
- Replaced with Equity CDO tranche
 - The 50 facilities with the worst Sharpe Ratios are collateralized as CDO deal, the pool is tranching
 - All tranches are sold except for the 0%-3% equity tranche

Impact of alternative hedging approaches on portfolio capital



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Conclusion

Conclusion

The lattice structure allows for a rich framework to model a wide range of single name credit exposures with an assortment of contingencies

Case study of bonds with embedded options, as well as dynamic usage for revolvers demonstrated the importance of accurately modeling contingencies

Modeling overview of CDOs tranches

- A semi-analytic approach has been introduced to model tranche value distribution
- The collateral pool and credit portfolio are linked so that a common default event impacts both so concentration can be modeled accurately

By modeling a CDOs tranche within a credit portfolio we are able to analyze the impact of tranching and selling parts of a sub portfolio

Other instrument classes and contingencies

CDS with counterparty risk

Equity

Sinking fund

Loans with prepayment options

Pricing grid for revolvers

Pricing grid for loans

LGD term structure