

Research Insight

# Managing Portfolio Liquidity Costs

**Case Study: Rebalancing a Passive Bond Portfolio in the Presence of Liquidity Costs***Zita Marossy and Christopher Finger*[Zita.Marossy@msci.com](mailto:Zita.Marossy@msci.com)[Christopher.Finger@msci.com](mailto:Christopher.Finger@msci.com)

June 2013

## Considering Liquidity Costs at Rebalancing

When rebalancing a portfolio, the simplest way to minimize liquidity costs is to minimize turnover: the lower the traded volume, the lower the costs incurred in the rebalancing. While this argument is true for an individual security, it is not necessarily valid for the portfolio as a whole, particularly when the portfolio constituents cover a broad range of liquidity.

A more efficient rebalancing strategy can be designed given information about security level bid-ask spreads. The total liquidity cost is reduced by concentrating the trading activity in those securities with lower bid-ask spreads.

In this paper, we develop a hypothetical portfolio following an EMU sovereign bond benchmark. We present a selection of rebalancing strategies, each incorporating a different degree of liquidity information, and illustrate the impact of more granular liquidity data on the actual rebalancing costs that are realized.

# Case Study: Rebalancing an EMU Sovereign Bond Portfolio

## A Hypothetical Mandate and the Need to Rebalance

To develop our case study, we consider a hypothetical investment mandate. We assume that a portfolio manager is mandated to follow the Bank of America Merrill Lynch EMU Direct Government Index within an ex ante annual tracking error limit of 25 basis points.<sup>1</sup> The mandate also stipulates that the active weight on each country should be below two percent, and that the duration bias in each country should be lower than 0.2 years. We assume that rebalancing occurs on the eighth calendar day of each month.

On January 8, 2013, there were 282 bonds in the benchmark portfolio. Our hypothetical tracking portfolio on that date contained 32 bonds, and met all of the requirements of the mandate. Except for Slovenia and Luxembourg, each country was represented with at least two bonds, with more bonds for countries with heavier presence in the benchmark.

Due to the significant market movements in January 2013, the ex ante annual tracking error rose to 25.6 basis points on February 8, 2013, which was 1.6 bps above the limit in the investment mandate. See Figure 1 for the active country exposures of the portfolio, and Figure 2 for the duration bias for each country. In addition to the tracking error limit breach, the active country weight for Germany was outside the range prescribed by the mandate, and the durations for Germany, Ireland and the Netherlands were lower than the minimum value of their target range.

Under these conditions, the portfolio requires a rebalancing to return to compliance with the investment mandate.

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<sup>1</sup> The tracking error is calculated with RiskManager using historical simulations. The tracking error is measured based on 22-day returns with a 21-day overlap and a five-year lookback horizon.

Figure 1: Portfolio Active Country Exposures before the Rebalance (as-of-date: February 8, 2013).

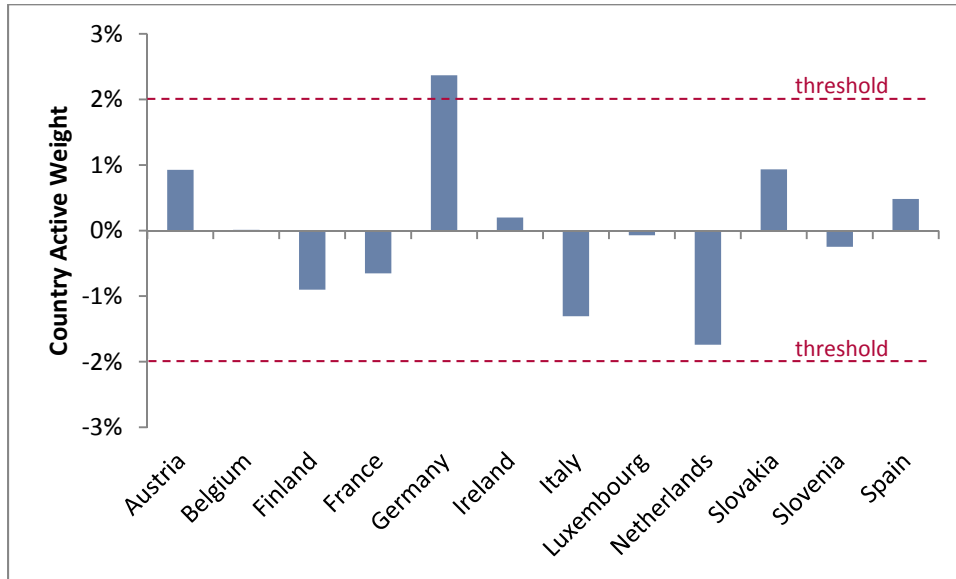
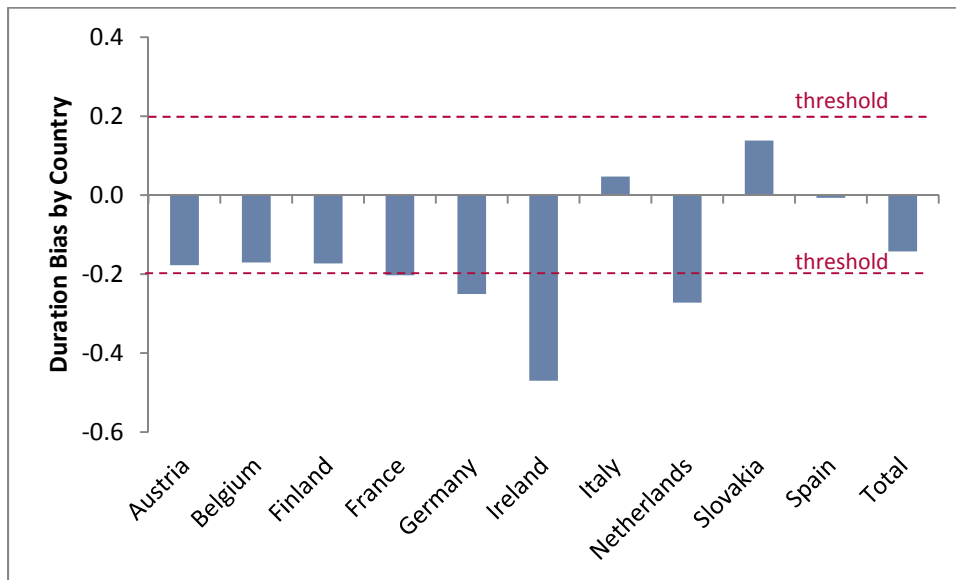


Figure 2: Duration Bias for each Country before the Rebalance (as-of-date: February 8, 2013).



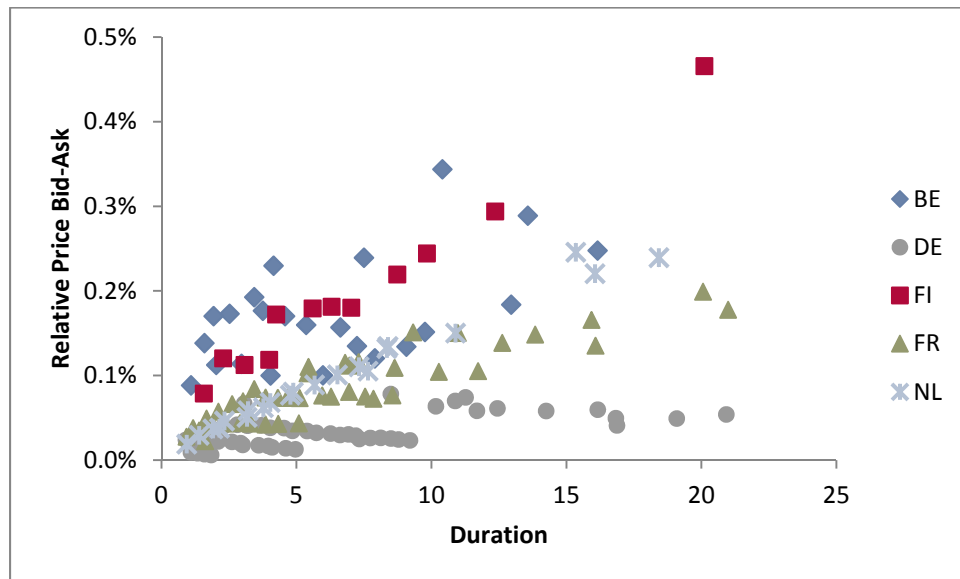
## Liquidity Profiling of the Investment Universe

To characterize the range of liquidity in the investment universe, we examine the liquidity profile of the benchmark.

For this, trading costs are measured with the MSCI Bond Liquidity Measure (BLM) data. The BLM data are indicative bid-ask spreads estimated with cross-sectional regressions based on bid-ask quotes. For further details, see Acerbi, Stefek and Szekeres (2012).

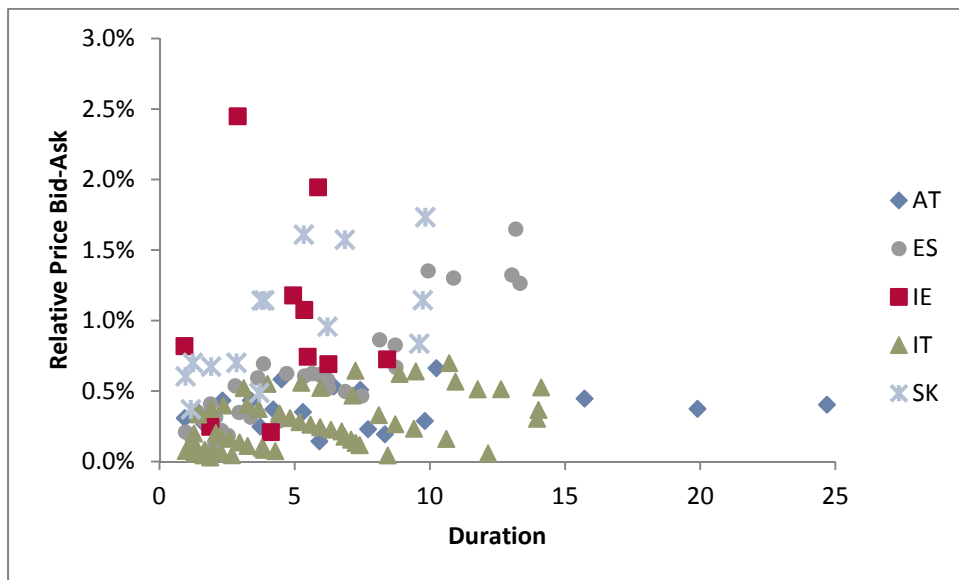
Figures 3 and 4 show the BLM data for the benchmark constituents.<sup>2</sup> For this case, we measure liquidity in terms of the *relative price bid-ask*, which is the bid-ask spread divided by the bond price. The values of the relative price bid-ask represent the trading costs of buying and selling a present value of one euro in the given bond. As the graphs show, trading a present value of one euro can cost up to 2.5 cents if we trade in the most illiquid bond. Trading in the most liquid bonds would cost only a small fraction of one cent. A turnover-based rebalancing strategy would miss this fact.

**Figure 3: Liquidity of Bonds In the Benchmark Portfolio for Belgium, Germany, Finland, France, and the Netherlands (as-of-date: February 8, 2013).**



<sup>2</sup> Bonds issued by the governments of Luxembourg and Slovenia are omitted from the analysis.

**Figure 4: Liquidity of Bonds In the Benchmark Portfolio for Austria, Spain, Ireland, Italy, and Slovakia (as-of-date: February 8, 2013).**



Bonds issued by countries of Figure 3 have higher liquidity with lower relative price bid-ask spreads. It is cheaper to trade sovereign bonds of these countries.

Figures 3 and 4 show that bid-ask spreads differ not only across countries (namely across sovereign bond issuers) but tend to be higher with higher durations. For more details on BLM and on its dependence on duration and other factors, see Acerbi, Stefek and Szekeres (2012).

### Liquidity Profiling of the Portfolio

As a second step to select the most liquid bonds for trading, we plot the liquidity profile of our hypothetical portfolio versus the benchmark in Figures 5 and 6.

Figure 5: Liquidity Profile by Country for Belgium, Germany, Finland, France, and the Netherlands (as-of-date: February 8, 2013).

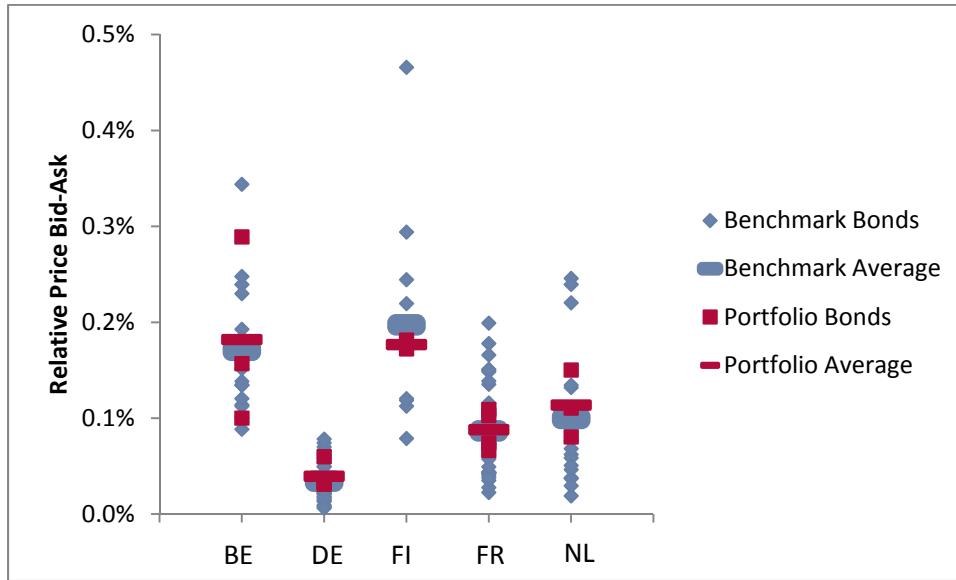
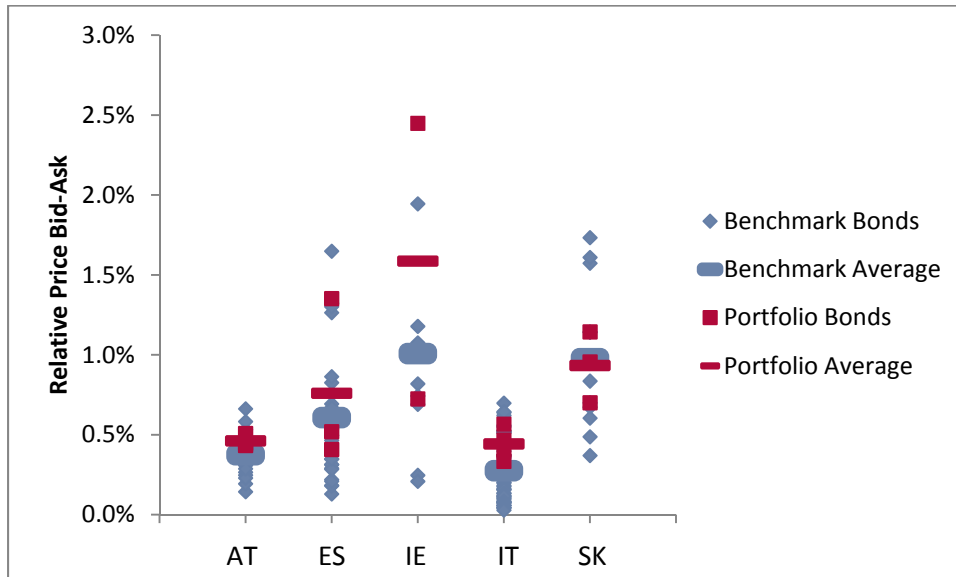


Figure 6: Liquidity Profile by Country for Austria, Spain, Ireland, Italy, and Slovakia (as-of-date: February 8, 2013).



Figures 5 and 6 compare the portfolio assets and benchmark assets with respect to liquidity for each country. For Finland and Slovakia, the portfolio has more liquid bonds relative to the benchmark. The bonds from Belgium, Germany, the Netherlands, Austria, Spain, Ireland, and Italy have lower liquidity in the portfolio than in the benchmark.

Note that Ireland, Slovakia, and Spain have bonds with high relative price bid-ask spreads (above one percent). Ideally, these issues would be used in the rebalancing only if the constraints of the mandate cannot be met otherwise.

# Optimal Trading Scenarios

In absence of liquidity data, the hypothetical portfolio can be rebalanced based on portfolio turnover. With bond-level bid-ask spread information, the manager can choose the more liquid bonds to rebalance the portfolio. To compare the two strategies in terms of estimated trading costs, we conduct an analysis within a formal optimization framework. Our aim is to select the optimal trades for each of the two approaches and to highlight the differences in the optimal trades and their associated costs. For each trading method, we use a standard optimization setup with linear and quadratic constraints and a linear goal function to select the optimal trades.

The constraints of the optimization problem are the same for each trading strategy and are formulated based on the constraints in the investment mandate. Specifically, the optimization constraints are:

- The ex ante tracking error range should be less than 22.5 basis points, so that the portfolio meets the tracking error constraint with some buffer.
- The active country weights of the portfolio should be less than two percent.
- The duration bias should be less than 0.2 years for each country.

Trading is restricted to the securities already held in the portfolio and very small trades are not allowed (that is, trades smaller than 0.001 percent of the total portfolio present value).

We assume that the costs associated with the trading are covered from cash; therefore the incurred costs do not decrease the total value of the invested portfolio.

As the goal function of our optimization problem, trading costs are minimized. The goal functions differ for the two liquidity strategies:

- **Turnover Optimization:** In this case, the aim of the optimization is to minimize the turnover. The value of the goal function equals the sum of the intended trading volumes. No specific information on bond liquidity is required.
- **Trading Cost Optimization:** In this approach, the total trading cost is minimized using BLM data. The value of the goal function is calculated assuming that the unit trading cost for the securities equals half the bid-ask spread measured with the BLM data.

Bid-ask spreads of bonds vary by country and by security. Due to these differences, the optimal trades and the associated costs are different for the two strategies. Based on the optimization results, we can contrast the resulting trading actions and the trading costs.

To have a richer structure to compare the two scenarios, we introduce a hypothetical third strategy:

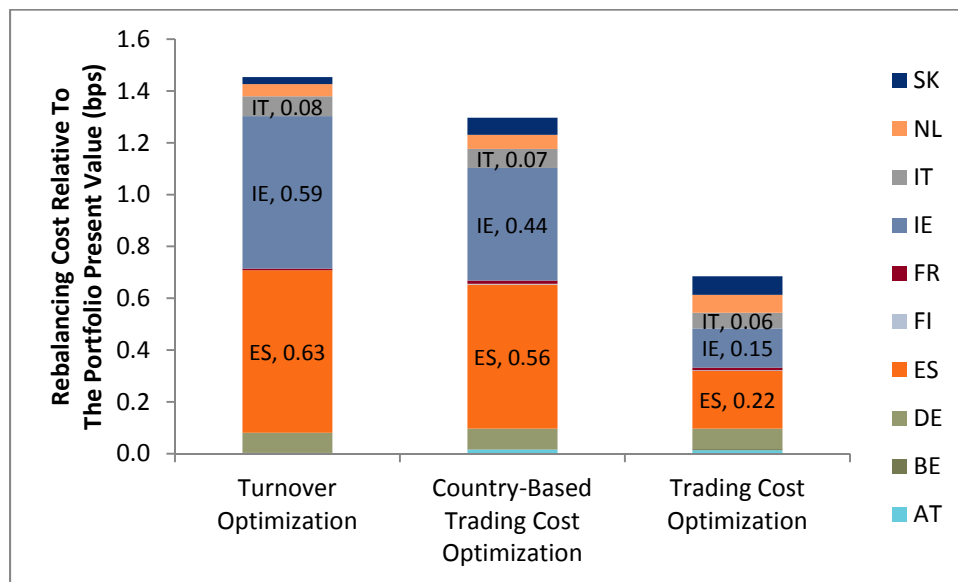
- **Country-Based Trading Cost Optimization:** Similarly to the Trading Cost Optimization, the total trading cost is minimized. In this approach, we assume that the country-level relative price bid-ask averages are known for the benchmark. The total trading cost is calculated based on these country-level averages, assuming no difference in liquidity within countries.

The strategy to use country-level average spreads is not necessarily realistic. We introduce it in order to analyze the effect of country-based liquidity differences on optimal trades. The Turnover and Country-Based Trading Cost approaches will differ according to the liquidity differences across countries. Similarly, the discrepancy in the optimal trading plan of the Country-Based Trading Cost and the Trading Cost methods will give insights about the effect of the asset-based differences within the countries.

## Trading cost decreases significantly with more granular liquidity information

Figure 7 compares the actual trading cost<sup>3</sup> for the three approaches under the optimal trading scenarios. For this specific example, relative to the Turnover Optimization, the rebalancing cost decreases by more than 10 percent when we consider country-level differences, and by more than 50 percent when we consider bond-level liquidity information.

Figure 7: Estimated Rebalancing Cost with Country Contributions.



The total trading cost saving is 0.77 basis points relative to the total portfolio. This is a monthly rebalancing, so a reasonable estimate for the annual gain from the Trading Cost optimization is 8-10 basis points. This is significant compared to typical passive management fees, and relative to the annual tracking error of 25 basis points.

Figure 7 highlights the main contributors to total costs. For the Turnover strategy, 89 percent of the total cost comes from trading in Spain, Ireland, and Italy. The Country-Based Trading Cost and Trading Cost methods could successfully decrease total liquidity costs by lowering trade sizes in these countries. The cost contribution of the three countries to the total cost drops to 66 percent for the Trading Cost approach.

## Smaller trades in less liquid countries

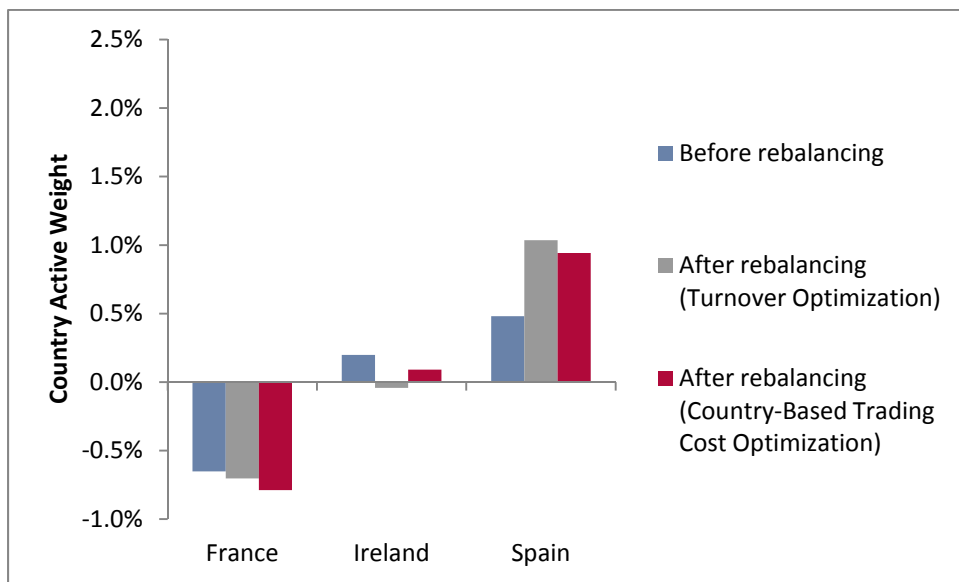
To assess the impact of the country-level differences in liquidity, we examine the active country weights before and after the rebalancing. Figure 8 displays the country weights before the rebalancing, after the rebalancing under the Turnover method, and after the rebalancing under the Country-Based approach. For Ireland and Spain, the Turnover Optimization produces large changes in the country active weights. The Country-Based approach gives the same directional signals (sell Irish bonds and buy Spanish ones),

<sup>3</sup> The actual trading cost is calculated based on bond-level bid-ask spread data and equals the estimated cost that actually occurs when we trade using the optimal strategies.

but the size of the rebalancing trades are noticeably less. This is consistent with our observation in Figure 4 that these two countries' bonds displayed relatively low liquidity.

Compared to the Turnover approach, the Country-Based approach reflects France's relatively high liquidity in a larger active weight.

**Figure 8: Country Differences in Bid-Ask Spreads Induce Lower Trades in Countries with Wider Relative Spreads and Vice Versa.**



In short, this example illustrates that a rebalancing strategy that incorporates country-based liquidity information emphasizes trades in countries with lower liquidity costs.

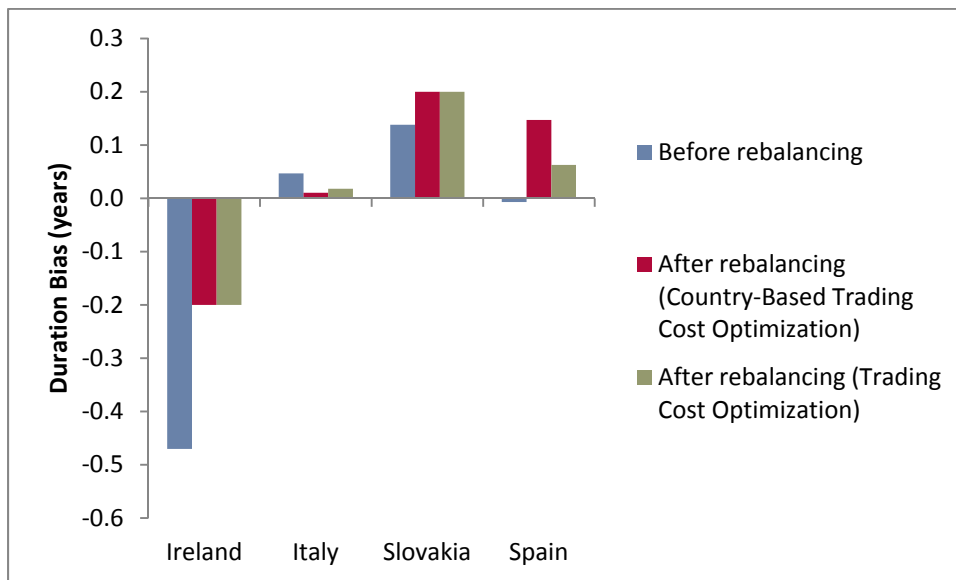
### Fewer trades in less liquid issues

We now examine the impact of bond-level liquidity information on the rebalancing results. Figure 9 displays the duration bias for selected countries before and after the rebalance for the two trading cost-based rebalancing approaches.

Recall from Figure 6 that for Italy and Spain, the portfolio contained more illiquid bonds on average than the benchmark. For both of these countries, the two trading cost optimization approaches agree on the trading direction (decreasing the duration bias in Italy, and increasing it in Spain). But in both cases, the signal is more muted when the specific bond-level information is taken into account, similar to the country weights observation in the previous section.

For Slovakia, and especially Ireland, the portfolio also contains illiquid bonds relative to the benchmark, and yet for these two countries there is no difference in the duration bias under the two trading cost approaches. This is because the duration bias constraint is binding for these countries; it is impossible to meet the investment mandate without trading in those countries' most illiquid issues.

Figure 9: Bond-Level Bid-Ask Information Forces Lower Trades In Less Liquid Issues, and Smaller Changes In The Country Durations.



The liquidity differences within countries thus creates incentives to trade in bonds that are cheap to trade and assigns relatively low or high costs to modify the country duration.

## The Effect of Market Impact

In the previous section, we analyzed the trading costs of the three strategies based on bid-ask spread data. The resulting costs of Figure 7 are valid as long as we can execute the trades at the bid and ask prices. In this section, we show how the trading cost increases for larger portfolios due to the market impact of the trades.

### The Market Impact Function

Figure 10 shows a hypothetical market impact function, which represents the relationship between the order size and the unit trading cost for a given trading period. We utilize the parameterization from LiquidityMetrics,<sup>4</sup> where the shape of the curve is described by the normal market size, the maximum available trading volume, and the shape of the curve between these two points.

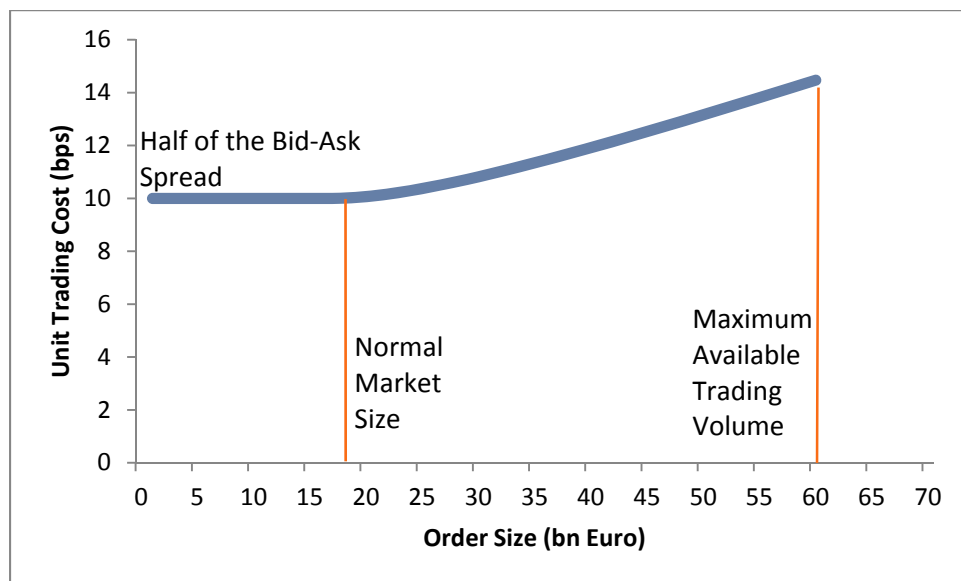
In Figure 10, the *normal market size* incorporates the depth of the market. Trades below the normal market size are executed on the bid and ask prices, as in the example in the previous section. When the intended trades are above the normal market size, the market depth is not enough to absorb the trade at unchanged prices. In this case, the trade has a market impact, moving the available market prices, and the total cost of the trade is higher than the half bid-ask. In Figure 10, the market impact function shows how the unit cost increases after the trade reaches the normal market size.

<sup>4</sup> See Acerbi and Szekeres (2013).

The market impact function can be different for buy and sell trades, depending on the market conditions and asset characteristics.

For our calculations, we use the market impact functions provided by LiquidityMetrics. The parameters of these functions are set based on surveys of bond market participants. See Acerbi and Szekeres (2013) for further details.

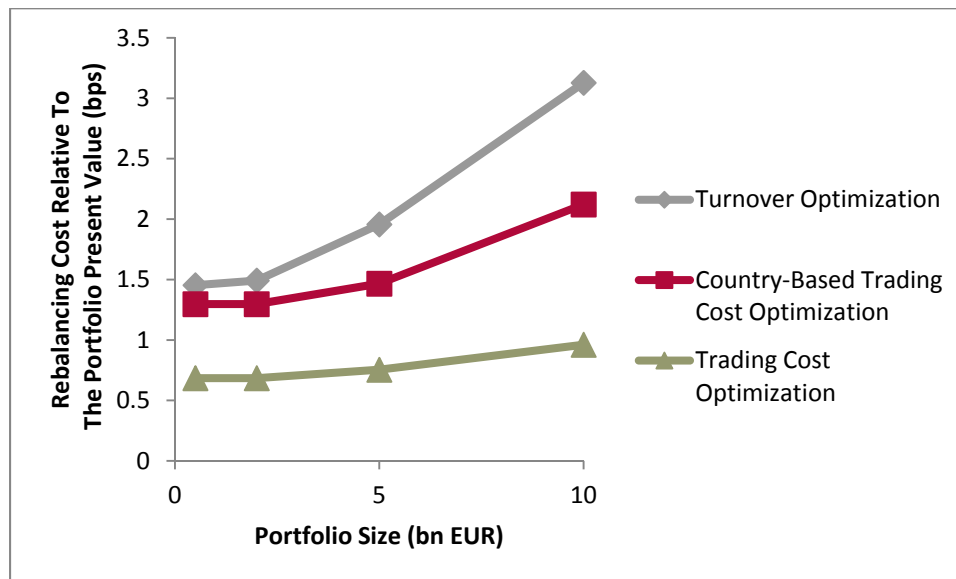
**Figure 10: Hypothetical Market Impact Function.**



### Trading Cost with Market Impact

To examine the effect of market impact, we re-estimate the total cost of the trades generated by the optimization in the previous section (without re-computing the optimization itself), while incorporating the market impact information. For a range of possible portfolio sizes, we scale up the portfolio sizes and trade volumes pro rata, and calculate the trading cost based on LiquidityMetrics. The results are in Figure 11.

Figure 11: Increase In Liquidity Costs Due To Market Impact.



For portfolio sizes up to about two billion euros, the rebalancing trades are all smaller than the normal market size, and the market impact has no effect on our estimated rebalancing cost. As the portfolio value exceeds two billion euros, some of the trades become larger than the normal market size, and the total trading cost increases. As the portfolio size increases further, the trading cost continues to grow as more trades exceed the normal market size and larger trades are further penalized.

In this example, market impact has the strongest effect on turnover-based trades. This suggests a relationship between bid-ask spreads and market depth, as the turnover-based optimizations seem to select bonds with both higher bid-ask spreads and higher market impact. Although this connection seems to be valid for this market on the date of the analysis, it may not prevail for other market conditions. See Acerbi and Szekeres (2013) for further discussion.

## Conclusion

Rebalancing a passive bond portfolio can be costly. Reduced costs can be achieved by trading in more liquid bonds. With available information on asset liquidity, liquid and illiquid assets can be identified. Based on bid-ask spread market data and impact data, the actual trading cost can be quantified and fed into quantitative analyses to reduce the liquidity cost of trading.

In this case study, we demonstrated the effect of liquidity information on trading, showing that trading based on liquidity information can reduce rebalancing costs. For the hypothetical mandate we analyzed, bid-ask spread information helped to cut estimated trading costs by more than half. Of course, this result was specific to the portfolio and the market conditions. The actual cost reduction depends on the mandate, namely whether it is flexible enough to meet its constraints under various trade scenarios.

We also highlighted the effect of the market impact on trading cost for proportionally larger trade scenarios. In case of complex bid-ask spread and market depth structures, considering the market impact explicitly during the optimization process can decrease the total cost of the rebalance.

## References

Carlo Acerbi, Dan Stefek, Zsolt Szekeres: The MSCI Bond Liquidity Measure (BLM). MSCI Model Insight, September 2012.

Carlo Acerbi, Zsolt Szekeres: Introduction to LiquidityMetrics. MSCI Research Insight, June 2013.

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<sup>1</sup> As of September 30, 2012, as published by eVestment, Lipper and Bloomberg on January 31, 2013

Apr 2013