Quant Keys
Costs as a style factor

Equities

Global
Quantitative

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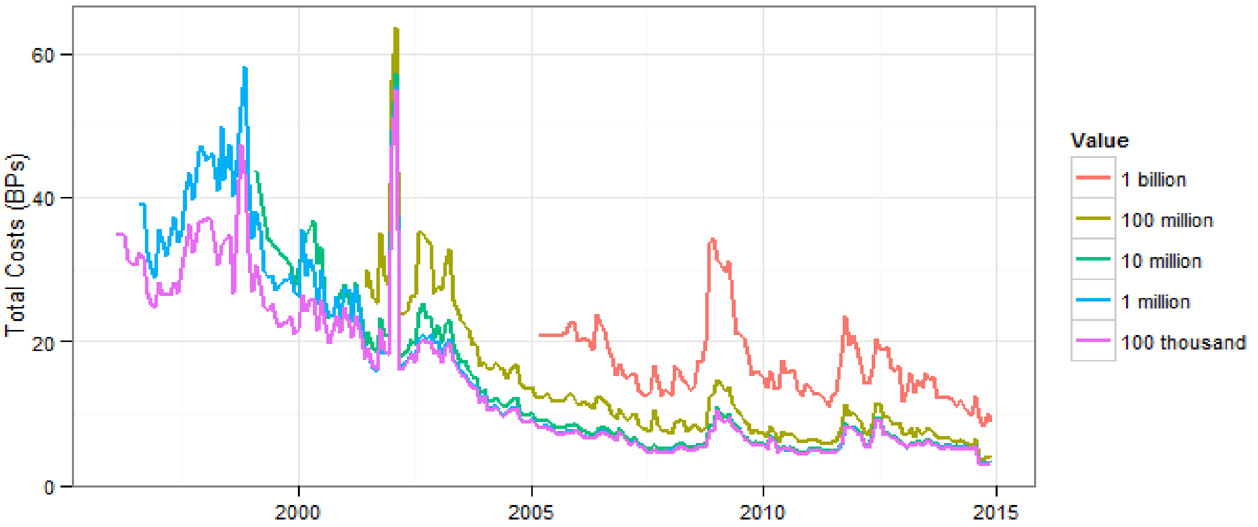
Expensive to trade stocks do not have a premium on a net returns basis

Expensive to trade stocks appear to outperform cheap to trade stocks (under some definitions of expensive to trade) on a gross return basis, but after costs have been introduced, the effect disappears in both Europe and the US. Only investors with unusually low costs or with very small portfolios would be able to take advantage of this effect. For most investors there is no premium, just higher costs.

Costs to trade appear to have declined

Using a well-known academic cost model we have estimated the costs to trade stocks. it appears that costs have fallen considerably over the last 20 years in Europe and the US, and larger trades are now much more feasible.

Figure 1: Costs appear to have fallen significantly over the last twenty years



Source: UBS Quantitative Research, Estimated cost to fully replicate the Dow Jones Europe index at different investment sizes, assuming all trades take place over the course of 1-day

Summary

Trading costs are hugely important to investors. We use a simple costs model (taken from Almgren et al, May 2005) to examine how costs have changed through time and whether there is a premium to expensive to trade stocks which would justify their greater expense.

Trading costs have fallen considerably since the 90s in Europe and in the US. The most marked change has been in bid-ask spreads, which have narrowed a great deal, making the direct costs an investor faces much lower. The proportion of a firm's shares outstanding traded on a typical day has also increased (although this figure has fallen over recent years) which means that price impact of trades has typically been lower.

Stocks which are more expensive to trade do not appear to be associated with higher net returns, not even for fairly small investment sizes, where the price impact of the trade is modest. It seems reasonable for investors to screen out the most expensive to trade names. This still appears to be true over the most recent five years when trading costs have been lower.

Costs model

We use a costs model taken from Almgren et al's paper *Direct Estimation of Equity Market Impact,* May 2005. They use five key inputs to estimate the cost of a trade:

i. The **bid-ask spread (BA)**, a direct measure of charges made to the investor to buy or sell

ii. **Volatility (σ)**, if the stock is more volatile, then the price is more likely to move during execution, which leads to higher costs

iii. **Order size ($\frac{X}{V}$)** as a proportion of the average daily trading volume (ADV), larger orders tend to have bigger price impacts

iv. Length of **time (T)** allowed to complete the order, if an investor demands faster execution he will need to pay more for the privilege

v. The **inverse turnover ($\frac{\phi}{V}$)**, which is the inverse of the ADV as a proportion of the shares outstanding. There will typically be less price impact with more liquid companies

They divide the price impact into two categories, permanent and temporary, giving us this model:

Figure 2: Almgren et al's Cost Model

$$Permanent\ price\ impact = 0.314 \cdot \sigma \cdot \frac{X}{V} \cdot \left(\frac{\phi}{V}\right)^{0.25}$$

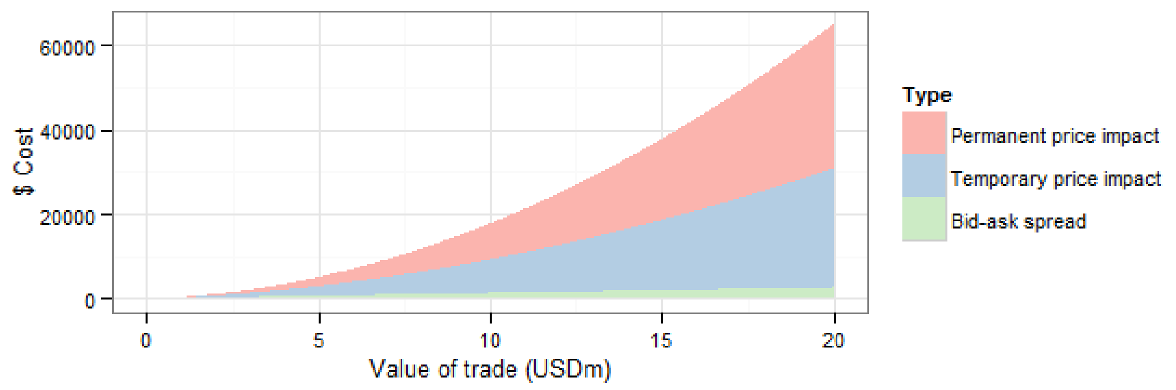
$$Temporary\ price\ impact = \frac{1}{2} \cdot permanent\ price\ impact + sign(X) \cdot 0.142 \cdot \sigma \cdot \left|\frac{X}{V \cdot T}\right|^{0.6}$$

$$Direct\ costs = \frac{1}{2} \cdot BA$$

Source: Almgren et al, *Direct Estimation of Equity Market Impact*, May 2005

If we input the data for a single stock we can see some key effects of this model. Below we have plotted how the cost of buying a stock varies with the size of the order, given an execution time of one day.

Figure 3: Example of how costs vary with order size



Source: UBS Quantitative Research, Data is for Tesco as of November 2014, estimates based on 1-day to execute the trade

Costs are convex and dominated by price impact

Clearly the costs are convex: a larger order is more expensive in percentage terms (although this must eventually reach a maximum when you buy the whole company). Also the majority of costs are due to price impact, not the direct costs from the bid-ask spread.

A word of caution though; Almgren et al's paper was published ten years ago, so their model many now be out of date - please take these costs as indicative only. That said however, we do not anticipate the sign of the relationships to have changed since Almgren et al's note's publication, so the broad direction our conclusions should remain valid.

Also, after presenting this work at our London conference on March 26th several clients commented that the assumption of direct costs of half the bid-ask spread was overly pessimistic for their fund's execution costs. So, we have repeated some of our analysis assuming zero direct costs to examine how relevant our results are for clients who can obtain lower direct costs.

Our Data

Our main universe is the European stocks in the Dow Jones World Index. Our data history is from Mar-1996 to Nov-2014. We use Datastream data for our parameters to estimate the costs of trading for each stock back through time. For the sake of comparison, we have also considered the S&P 500 index from Dec-1992 to Feb-2015. For this US universe, we use CRSP data for our parameter data.

There are a few subtleties to be aware of:

- For our volatility estimates, we compute the volatility from the daily returns over the previous month's total returns.
- For the European bid-ask spreads and daily trading volumes we take the median over the course of the previous month to smooth out some data issues. For the US, we take data on the day.
- Share prices are taken at the close, in USD, for both universes.

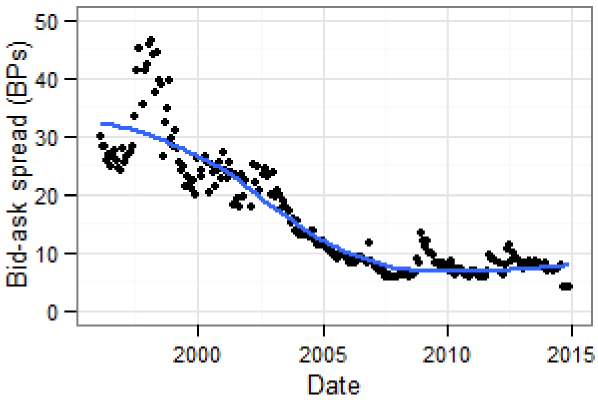
Where we require European style portfolios for our analysis, we have taken the constituents and weights of the portfolios from our Global Style Watch definitions. Please see our latest edition (out on the first business day of the month) for a complete description, but in brief these portfolios are:

- Thirds of the universe e.g. low / mid / high earnings yield
- Region neutral (between UK and Europe ex UK) and broadly size neutral
- Cap weighted

How have costs changed over time?

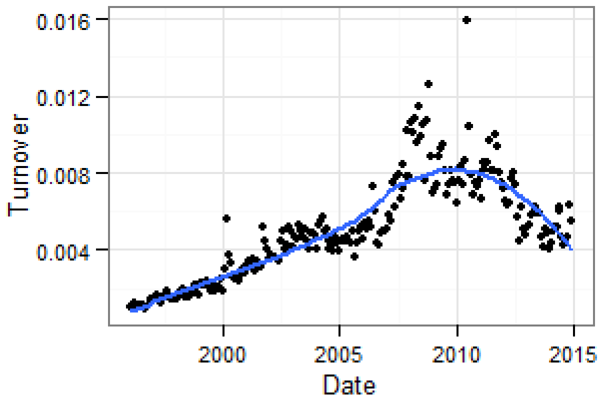
The average bid-ask spread is a lot lower and turnover, a measure of liquidity showing the proportion of a firm's stocks outstanding traded on a typical day, has increased, although it has slipped back again since 2010. These suggest that costs have fallen.

Figure 4: Average bid-ask spread



Source: UBS Quantitative Research, Index weighted average of the largest 100 names in the European index on that date

Figure 5: Average turnover

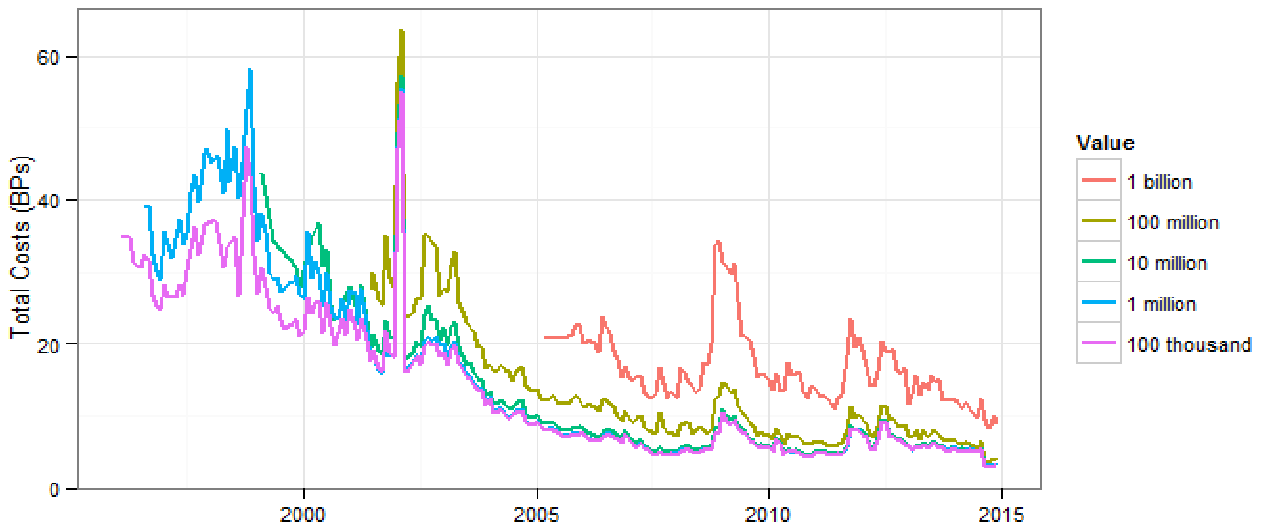


Source: UBS Quantitative Research, Index weighted average of the largest 100 names in the European index on that date

If we input each stock's historical parameters into our simple costs model then we can get a rough estimate of the cost to buy or sell different amounts of each stock. Using all of this historical data, we can estimate the costs of fully replicating the index, in one day, with different investment amounts (e.g. $100,000). This is shown in Figure 6.

We deflate the $-investment back through time by CPI, so that all investment amounts are in 2015 money. We cap the amount we can buy in any one stock at 30% of its average daily volume (ADV) and leave any remnant not invested. If this leads to less than 95% of the investment invested then we don't plot a point for that date and investment size e.g. pre 2005 it was not feasible to buy $1bn of the index in one day without breaching the 30% of ADV bound on a large numbers of stocks.

Figure 6: In Europe, costs have fallen significantly over the last twenty years



Source: UBS Quantitative Research, Estimated cost to fully replicate the index at different investment sizes

It is much cheaper to trade in Europe than it has been historically

Costs appear to have fallen significantly. Also it is now possible to buy larger amounts of the index over short periods than it was historically, so in that sense the market appears to be more liquid.

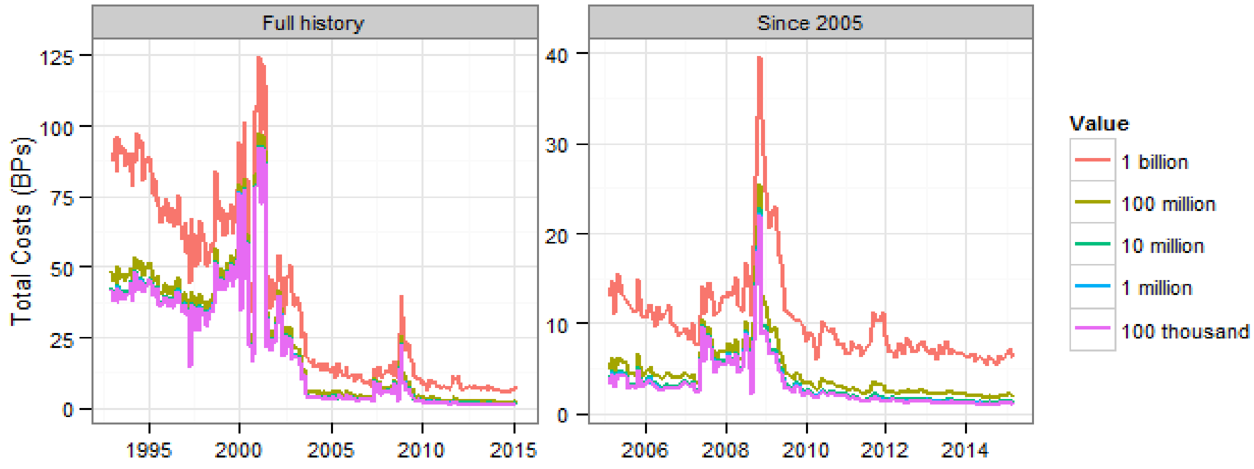
Looking at the estimated cost to buy $100,000 in a day, where the price impact is a fairly minor part of the costs, we can see that most of the changing cost seems to have come from declining bid-ask spreads. However, as you can see from the tightening of the gap between the lines for different investment values, the price impact also appears to have fallen as markets become more liquid.

Similar pattern in the US

If we repeat this analysis in the US, looking at the cost to fully replicate the S&P 500, we see a similar pattern (although with much noisier data). Figure 7 illustrates this. Costs have fallen dramatically since 1992, when our data begins, and has continued to gradually decline since 2005, although with higher costs through the recent financial crisis.

The US appears to have been a more liquid market than Europe historically. It seems that, even in the early 90s it would have been possible to buy $100 million worth of the S&P 500 in a single day, albeit with high trading costs. The current cost to fully replicate the S&P 500 is somewhat lower than the current cost to replicate the European index.

Figure 7: Cost to trade the S&P 500



Source: UBS Quantitative Research, Estimated cost to fully replicate the S&P 500 index at different investment sizes

How effective is cost-to-trade as a style?

You might anticipate that, as an undesirable trait, investors would be compensated for holding stocks which are more expensive to trade in to and out of. We do not see strong evidence of this.

Two definitions of cost-to-trade

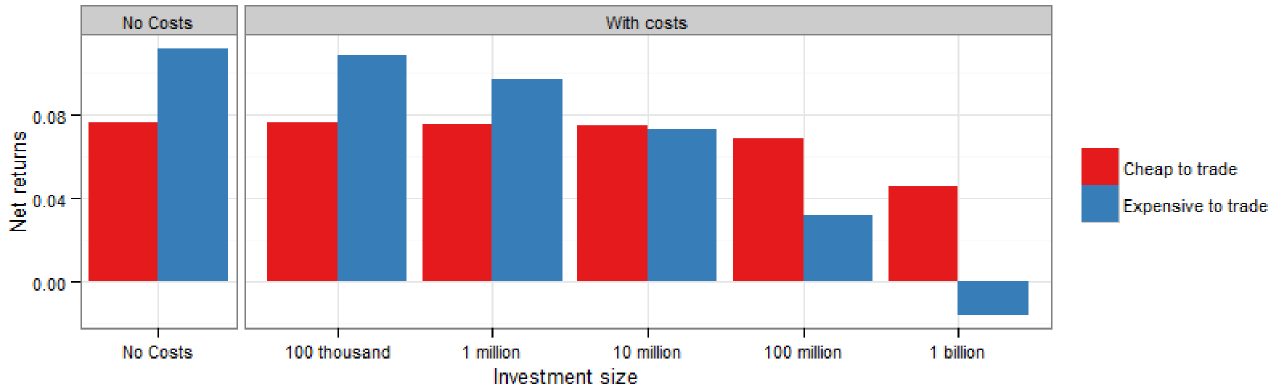
We consider two definitions of cost-to-trade:

a) **$-based definition**, we rank our universe based on how much would it cost to buy $500,000 worth of the stock in one day.

b) **Volume-based definition**, we rank our stocks based on how much it would cost to buy 10% of the average daily volume.

For each definition, we start by dividing the universe into two sub-portfolios: cheap-to-trade and expensive-to-trade. We weight the stocks in each sub-portfolio in proportion to its weight in the overall index, and rebalance the portfolio at the end of each month. We simulate the historical returns to these two portfolios over the period from Mar-1996 to Nov-2014. We find the return either without costs, or net of estimated costs assuming our investment of a particular size on our starting date.

Figure 8: $-based Definition - Is there are premium on expensive to trade stocks?



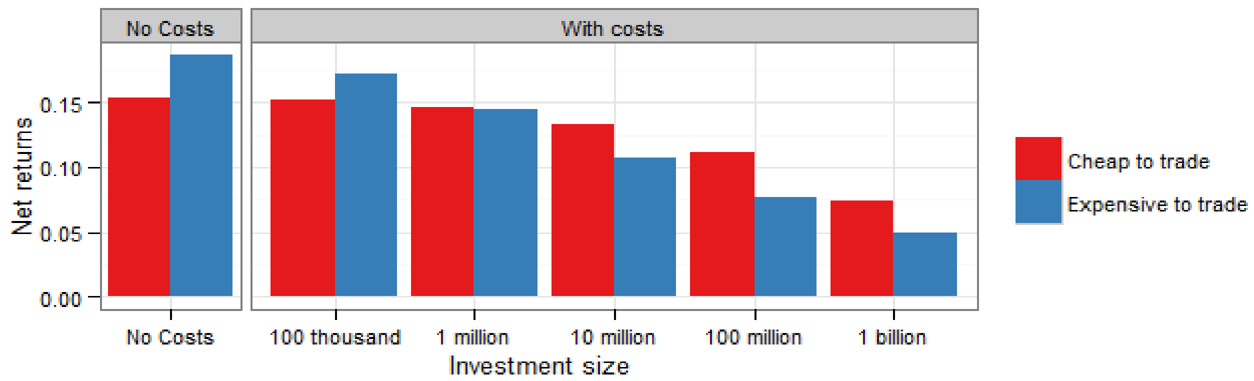
Source: UBS Quantitative Research, European universe

$-based definition – premium to expensive-to-trade stocks rapidly eaten away by costs

The $-based definition has an obvious bias towards small-caps. For small-cap firms $0.5m may represent a substantial share of their total market cap, so it is likely to be an expensive trade. We know there is a probably small-cap premium, so it is perhaps not surprising that, with small investments, there is a premium to expensive to trade stocks under the $-based definition. At an initial investment of $100,000 the expensive to trade portfolio outperforms, with an annualised net return of 10.9% compared to 7.6% for the cheap to trade portfolio. However, with larger investments costs soon take their toll. By $10m, cheap to trade is outperforming expensive to trade.

In the US universe we see a similar pattern. Figure 9 shows the net return to the cheap to trade and expensive to trade S&P 500 portfolios over the last 5 years. Without costs we can see a premium of around 3.3% per annum, but the higher costs in the expensive to trade basket rapidly erode that difference.

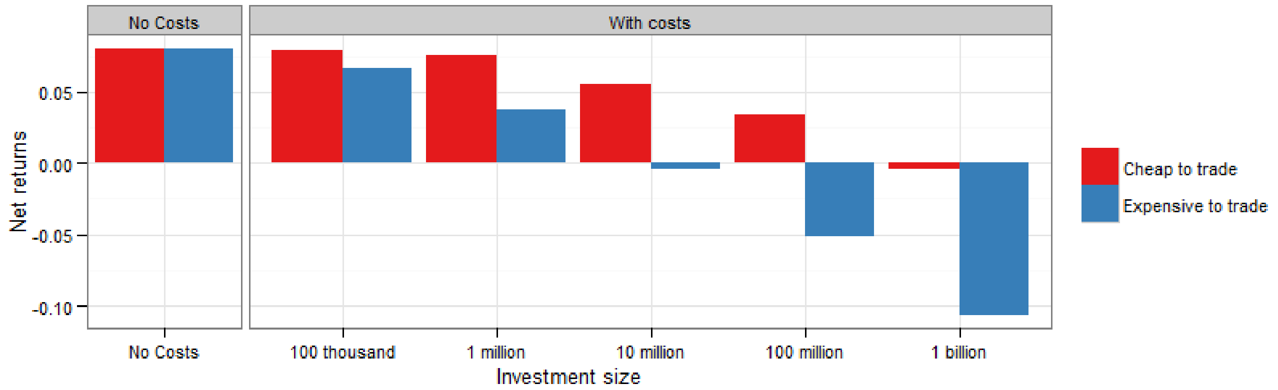
Figure 9: $-based Definition – What happens in the US?



Source: UBS Quantitative Research, US universe

Returning to the European analysis, but this time assuming zero direct costs by setting the bid-ask spread to zero, the premium to expensive to trade stocks persists for higher investment sizes. The performance of the cheap to trade portfolio and expensive to trade portfolios equalise when the investment size is $100m per day, not $10m, although for an investment size of $1bn the cheap-to-trade portfolio outperforms strongly.

Figure 10: Volume-based Definition - Is there are premium on expensive to trade stocks?



Source: UBS Quantitative Research, European universe

Volume-based definition – no premium to expensive-to-trade

With the volume-based definition we don't see any premium to the expensive to trade portfolio – just higher costs. Even for the portfolio return assuming no costs we see very little difference between the cheap to trade and expensive to trade portfolios. Once we introduce costs the return to the expensive to trade portfolio falls off very rapidly, while the impact on the cheap to trade portfolio is more gradual. It appears that screening out these expensive to trade names would be advantageous for investors.

If we tweak our costs model and assume that investors have no direct costs to trade (i.e. set the bid-ask spread is zero) this result does not change. It appears that all investors, even those who face lower execution costs than the average, could gain from screening out these expensive to trade names.

If we repeat this analysis just over the last five years, in the new, lower cost environment our results are similar.

What about at the style level?

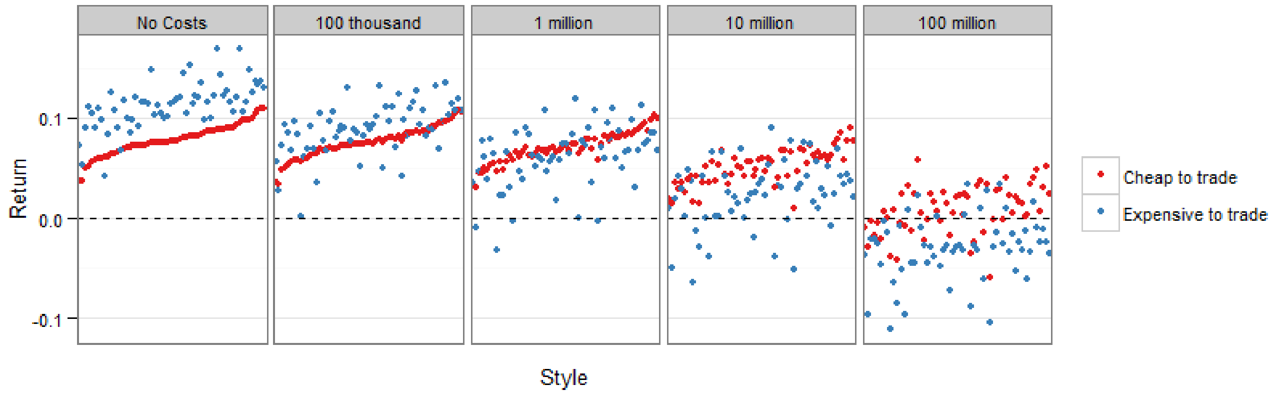
The analysis above is all at the benchmark level, but if we look at the style level we see a very similar picture.

For each style portfolio e.g. high ROIC or low earnings momentum, we divided the portfolio into two sub-portfolios based on the cost to trade. We then simulated the performance of these sub-portfolios from Mar-96 to Nov-14 and computed the returns either without costs or with costs based on various investment sizes.

Even at the style level, expensive-to-trade stocks tends to underperform on a net return basis with larger portfolios

We have plotted our results for the $-based definition in Figure 11. The x-axis is qualitative and represents the style portfolios (e.g. high ROIC). It has been ordered by return to the cheap-to-trade sub-portfolio without costs. The red dots represent the return to a cheap-to-trade sub-portfolio and the blue dots the return to an expensive-to-trade sub-portfolio.

Figure 11: $-based Definition – is there an expensive to trade premium in some style portfolios?



Source: UBS Quantitative Research, European universe

Without costs the expensive-to-trade sub-portfolios almost all outperform their cheap-to-trade counterparts. However, once we include even quite modest costs increasing numbers of the expensive-to-trade sub-portfolios underperform. By the time we are dealing with costs associated with a portfolio of around $10m, the majority of the cheap-to-trade sub-portfolios outperform.

Can we just exclude the expensive to trade stocks?

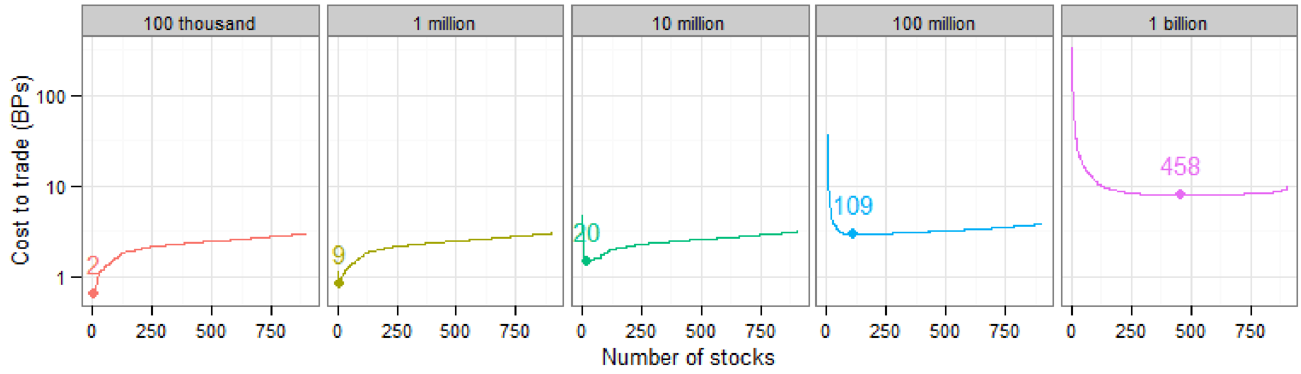
Yes - excluding the expensive to trades stocks reduces costs, and this effect is not offset by increasingly concentrated portfolios

Excluding stocks from your portfolio will naturally lead to more concentrated portfolios, which leads to larger positions and thus more expensive trades (as costs are convex). We need to ensure that excluding the expensive-to-trade stocks doesn't increase costs by leading to more concentrated portfolios. Fortunately this doesn't seem to be a serious problem, as Figure 12 illustrates.

We take our data for the stocks in the index as of Nov-14 and sort it from least to most expensive to trade (based on estimated costs of buying $0.5m in a day). We then estimate the costs of buying an investment amount (e.g. $100,000) in the cheapest N-many stocks in one day. Once we have multiple stocks in the portfolio we weight each stock proportional to their weights in the index overall.

We have plotted the number of stocks vs the estimated cost to trade for various investment sizes in the figure, and labelled the minimum point. For example, if you wish to buy $100m in one day it is cheapest to do this with a portfolio of the 109 cheapest to trade stocks, although anywhere from 68 to 299 stocks gets an overall cost to trade of less than 3 basis points.

Figure 12: Can we exclude expensive to trade stocks without increasing costs? Yes



Source: UBS Quantitative Research

There is a balance to be struck between holding exclusively very cheap to trade stocks (and hence holding a more concentrated portfolio), and holding some more expensive to trade stocks. From this empirical work though, screening out the most expensive to trade stocks (even as much as half the universe) does appear to reduce costs.

Conclusions

Based on the Almgren et al costs model it appears that the cost to trade has fallen dramatically over the last twenty years. It is now feasible to make larger trades, faster without moving the market excessively.

After we have accounted for costs, there does not appear to be any premium to holding expensive-to-trade stocks, except for small investments. So, in the absence of any compelling case for a stock, it would seem to be advantageous to exclude these expensive-to-trade stocks from our portfolios, even though this will lead to more concentrated portfolios.

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Neutral	FSR is between -6% and 6% of the MRA.	43%	33%
Sell	FSR is > 6% below the MRA.	12%	20%
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Source: UBS. Rating allocations are as of 31 March 2015.
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