What Australian Investors Need to Know to Diversify their Portfolios

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Abstract

According to a report by the Australian Securities and Investments Commission in 2008, most (78%) of Australian investors had heard the term diversification. Nevertheless, around half of investors (49%) held only one type of investment (shares only) with the average number of holdings of 2.19 securities. More telling, a third (33%) of share owners acquired their shares passively (as part of a demutualisation or had received shares through an inheritance or gift), while almost two-thirds (63%) of share owners acquired the shares actively. One conclusion is that Australian investors, on average, own poorly diversified portfolios and leave themselves exposed to excessive diversifiable risk. To study this issue, we simulate portfolios using daily observations for all traded and delisted equities in Australia between 1975 and 2011. We calculate two measures of risk, including heavy tailed to account for extreme events. For each risk measure, we recommend the number of portfolio holdings that result in a 90% reduction in diversifiable risk for an average and a more conservative investor. We find that, on average, 24 to 30 stocks are sufficient to attain a well-diversified portfolio.

Keywords: Portfolio diversification, expected shortfall, standard deviation, Australian equities.
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1   Introduction

We study the question of the optimal number of portfolio holdings for Australian equity investors. Surveys show that Australian investors do not diversify their portfolios sufficiently (e.g., ASIC2008), with an average of 2.19 securities held by an average Australian. In the past 20 years, however, more Australians have become   unwitting share owners with the privatisation of such government organisations as Qantas, CBA, Telstra and the demutualisation of companies such as AMP. Many have received shares through an inheritance or gift. These events have taken place in an environment of high returns and growth in many asset classes, which has led to an increase in the number and diversity of investors in the Australian market.

In this paper, we study the issue of portfolio diversification for Australian investors between 1975 and 2011. Investors are faced with a dilemma: how many stocks should be included in a portfolio[2] to reduce diversifiable risk to its minimum. To provide an answer to this question

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[2] Hereafter, referred to as portfolio size.

we calculate two measures of risk using daily data and include one that reflect extreme events. Previous academic research [5, 2, 6, 3] has analyzed the optimal portfolio sizes for an average investor. We build on our predecessors' contributions by estimating confidence bands around the average number of stocks in portfolios that diversify firm-specific risk 90% of the time as opposed to achieving it on average. When we compare the year-by-year dynamic of portfolio sizes, we find that the recommended number of stocks depends upon whether markets are in distress or quiescent as well as on the average level of correlations among stocks in the Australian market.

Investors are often reminded that holding a number of uncorrelated securities in their portfolios is important for diversification. Of course, holding too many stocks is costly both in terms of transaction costs as well as the opportunity cost of monitoring a large diversified portfolio. The fees associated with a large portfolio subtract from overall performance. Holding too few stocks exposes investors to unnecessary firm-specific risk. If it is possible to eliminate most diversifiable risk with a small portfolio, the need for the large portfolios held by equity funds is unjustified. Campbell *et al* (2001), however, have shown that firm specific risk in the U.S. has grown over the past thirty years relative to the overall volatility of the stock market and that correlations between stocks have correspondingly decreased, reinforcing the advisability of larger portfolios. We check whether these results also hold for Australia.

To trace the dynamics of diversification benefits over the past 37 years we simulate random portfolios based on actual daily Australian equity returns over the period 1975 to 2011. [3] Each year we construct equally weighted random portfolios of different sizes ranging from portfolios consisting of only one security to a broad market portfolio including all actively traded securities at the time. For each of these different-sized portfolios and each year we calculate standard deviation (SD) and expected shortfall (ES). We focus on SD as our benchmark to be able to compare our results to the previous literature. The ES provides a downside risk measure that captures the extreme tail in the historical return distribution. We measure diversifiable risk as the difference between the average security risk and market risk – this represents 100% of diversifiable risk. As portfolios grow in size from one stock to n stocks, total risk is reduced but market risk remains. A "well-diversified" portfolio is one where anywhere from 85% to 95% of diversifiable risk has been removed. In what follows, we use 90% reduction in diversifiable risk and refer to is as a "well-diversified portfolio".

We find that well-diversified portfolios aimed at limiting extreme losses measured by $ES_{1\%}$ are, on average, smaller in size (18 stocks), compared to when SD is used as a risk measure (24 stocks). We hypothesise that this is the consequence of the increased correlations between securities and the market in the lower tail of the return distributions. However, to achieve a well-diversified portfolio with 90% confidence, instead of on average, we find no difference in portfolio sizes between the two risk measures (38 stocks). We conclude that the size of a well-diversified portfolio for Australian investors depends on the measure of risk used, the changing correlations between stock returns across time and market volatility.

In Section 2, we discuss our approach and the data. In Section 3, we present our results. We conclude in Section 4.

2 Data and Methodology

We obtained our data from Datastream. These data consist of daily total returns on

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[3] In Alexeev and Tapon (2012) four additional developed equity markets are discussed at length.

common stocks listed on the Australian Security Exchange (ASX) from 1975 to 2011 (formerly Australian Stock Exchange) [4]. To avoid survivorship bias we acquire the data for both active and delisted securities. For each of these years, we consider only securities which have traded at least 75% of the trading days in a particular year. This is done to avoid unreasonably low correlations of some thinly-traded stocks with the rest of portfolio holdings.

We construct portfolios by randomly drawing n stocks without replacement from all available stocks on the ASX each year. We use equal weights to construct portfolios. Given that our sample includes non-surviving stocks, a stock in the chosen portfolio that does not survive in one period, is replaced in the subsequent period with a new randomly selected stock not already in the portfolio. For each portfolio of size n we use 10,000 random draws. A unique equally-weighted portfolio is constructed when all securities available in the market are included. We define it as the market portfolio.

Because, in the finance literature, measuring risk is more contentious than measuring return, we consider two risk measures. The first is standard deviation (SD), a well accepted measurement of risk of a financial asset or portfolio. Another important risk measure, is downside (or tail) risk. It accounts for deviations below a certain threshold, unlike SD, where positive and negative deviations from the expected level are penalized equally. One advantage of a downside risk measure is that it accounts, to some extent, for the asymmetries in returns during bull and bear markets. For this purpose, we use expected shortfall (ES) due to its well behaved properties as opposed to the commonly used Value-at-Risk (VaR).

3 Results

Knowledgeable investors are aware of the need for a reasonably large number of stocks to minimize diversifiable risk.[5] Figure 1 displays the dynamic of diversifiable risk remaining for portfolios of various sizes between 1975 and 2011. Using SD as a measure of risk, a 5-stock portfolio yields, on average, a 60% to 70% reduction in diversifiable risk and is thus not a well-diversified portfolio. On the other hand, a 40-stock portfolio exposes an investor to 2% to 7% of diversifiable risk. Looking at the year 1987 when a major crash occurred, an investor with a 10-stock portfolio was exposed to 18% of diversifiable risk using SD as a risk measure, but the same 10-stock portfolio exposed this investor to 14% of diversifiable risk using ES.

In Figure 2 we trace the recommended portfolio sizes for two risk measures to achieve a well-diversified portfolio for an average investor (solid lines). The dotted lines show the recommended portfolio sizes for more conservative investors who require a higher level of assurance (90% of the time instead of on average).

In Table 1 and Figure 2, we observe that between 2000 and 2006 the average investor needed to hold a higher number of stocks (SD: 27-30 stocks) compared to the periods 1987 to 1989 (SD: 14-18 stocks) and 2008 to 2010 (SD: 20 stocks). A similar trend is observed for more conservative investors. This is a consequence of higher average correlations among stocks in the earlier period compared to the later period (Figure 3.C).

The periods 1975-1976 (oil crisis), 1987 (Black Monday), the bursting of the Dot-com bubble following 2000, and the Global Financial Crisis in 2008 were marked by a wide gap

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[4] The number of actively traded stocks on the ASX has steadily increased from 1975 (145 stocks) to 2011 (1,562 stocks). It is interesting to note that the peak number of actively traded stocks on the TSX was in 2008 (1,574 stocks).

[5] According to the ASX 2010 Australian Share Ownership Study, in 2010 50% of Australian investors rated themselves as very knowledgeable or somewhat knowledgeable about shares. The average investor held 3-4 shares.

between average security SD and market SD (Figure 3.A and D). We note that correlations among stocks increase during market-wide crises (Figure 3.C and D) resulting in the lowest number of stocks required (Figure 3.D).

Average correlations among stocks in Australia have remained remarkably stable and low except in 1987, 1997-1998 and rising post 2007, with the average correlation between 1975 and 2011 of 0.07 (Table 2 Panel B). As we mentioned previously, Campbell *et al* (2001) find a different trend in average correlations for US equities. Average correlations among the US stocks prior to 1999 were declining, however, this trend reversed after 1999. We note that the higher the correlation among stocks, the lower the number of stocks in a well-diversified portfolio (Table 2 Panels A and B). When large portfolios are recommended (based on SD) we notice that the associated market volatility and correlations are lower than when recommended portfolios are smaller (Table 2 Panel C). For example, portfolios of fewer than 21 stocks are recommended in periods with an average correlation of 0.34 and an increased market volatility of 16.7%. In contrast, larger portfolios of 25 stocks or more are recommended in periods with an average correlation of 0.21 and a market volatility of 8.1%.

In Table 2 Panel D we show the spread between the number of stocks required in a well-diversified portfolio for conservative investors and for the average investor (defined as Δn).[6] Large spreads ($\Delta n > 19$) are associated with increased market volatility (16.9%) and increased correlations (0.33). Spreads of fewer than 11 stocks ($\Delta n < 11$) are associated with market volatility of 7.5% and an average correlation of 0.21. We conclude that in periods of high market volatility characterized by large correlations among stocks, conservative investors will need to add a relatively larger number of securities to their portfolios compared to periods when markets are quiescent and average correlations are low.

4   Conclusion

The period 1975 to 2011 witnessed some significant events in Australian financial market history. We show that portfolio size is determined by the particular risk measure and by market conditions influencing correlations among stocks. We identify two types of significant financial market events, general drops in the market (such as in 1987, 1997 and 2008-2011) and industry specific meltdowns (the Dot-com bubble in 2000-2002). Such crises are characterized by a few common features. In the case of market crashes, we note increased market risk measured by standard deviation (SD) and especially expected shortfall at 1 percent ($ES_{1\%}$) coupled with greatly increased average correlations among securities as well as the correlation of the average security with the market portfolio. During market crashes, the number of stocks required for an average investor to attain a well-diversified portfolio decreases (18-22 stocks when risk is measured by SD and 13-17 stocks when risk is measured by $ES_{1\%}$). Increased correlations among stocks during market crashes make portfolio diversification easier to achieve with a small number of stocks.

In the case of industry specific meltdowns, the market experiences high volatility. The average correlation among securities and with the market portfolio, however, are among the lowest and thus, more stocks are needed to get the desired level of diversification. One interpretation of our findings is that the recommended number of stocks in a buy-and-hold portfolio to attain on average (or with 90% certainty) a reduction in diversifiable risk should not be based on results in

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[6] Refer to the difference between the dashed and solid lines in Figure 2.

periods when markets are in distress. Rather, Australian long term investors should instead conservatively rely on historical results obtained during normal financial market periods opting for larger portfolios.

We recommend, for an average investor, concerned with SD (ES) as a measure of risk to hold 24 to 30 (15 to 21) stocks based on the historical results of 1995-2006 but skipping 1997-2002. These size recommendations are among the largest portfolio sizes over the 1975-2011 period, providing investors with a more conservative diversification strategy over longer investment horizons. We realize that these recommendations greatly exceed the average actual share holdings of ordinary Australians (2-3 stocks). However, as evident from Figure 1, holding as few as 5 securities in a portfolio over 1997 to 2011 would have exposed investors to a considerable amount of diversifiable risk. This problems could be partly alleviated by holding market-wide ETFs which are only now becoming popular with Australian investors.

References

[1]   Alexeev, Vitali and Tapon, Francis. Equity portfolio diversification: how many stocks are enough? Evidence from five developed markets. *FIRN Research paper series*, 2012.

[2]   Bird, Ron and Tippett, Mark. Naive Diversification and Portfolio Risk-A Note. *Management Science*, 32(2):pp. 244-251, 1986.

[3]   Brands, Simone and Gallagher, David R. Portfolio selection, diversification and fund-of-funds: a note. *Accounting & Finance*, 45(2):185–197, 2005.

[4]   Campbell, John Y. and Lettau, Martin and Malkiel, Burton G. and Xu, Yexiao. Have Individual Stocks Become More Volatile? An Empirical Exploration of Idiosyncratic Risk. *The Journal of Finance*, 56(1):1–43, 2001.

[5]   Solnik, Bruno H. Why Not Diversify Internationally Rather than Domestically? *Financial Analysts Journal*, 30(4):pp. 48-54, 1974.

[6]   Statman, Meir. How many stocks make a diversified portfolio? *The Journal of Financial and Quantitative Analysis*, 22:pp. 353-363, 1987.
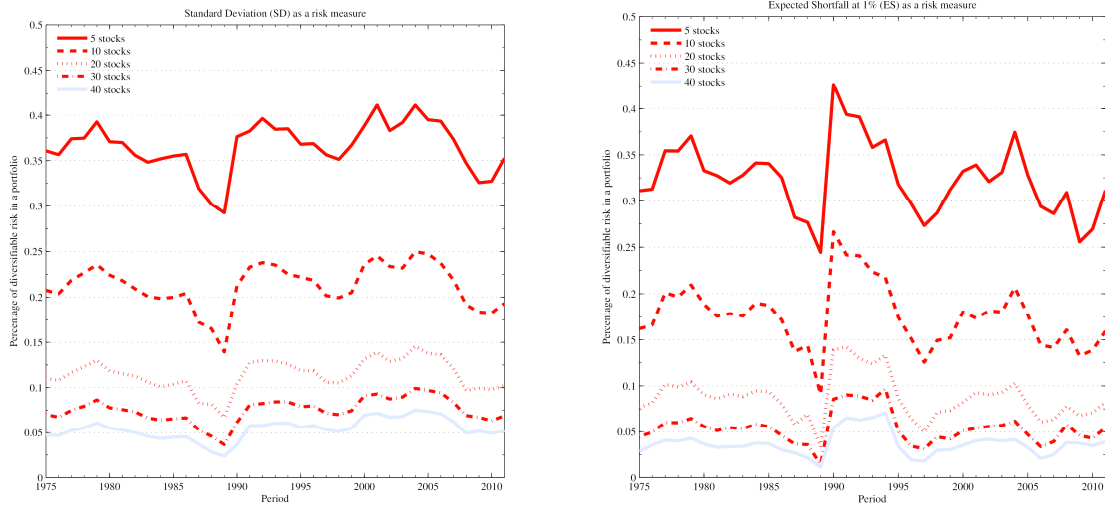
FIGURE 1: DIVERSIFIABLE RISK REMAINING FOR PORTFOLIOS OF VARIOUS SIZES. The panels above show the dynamic of diversifiable risk remaining for portfolios of various sizes.
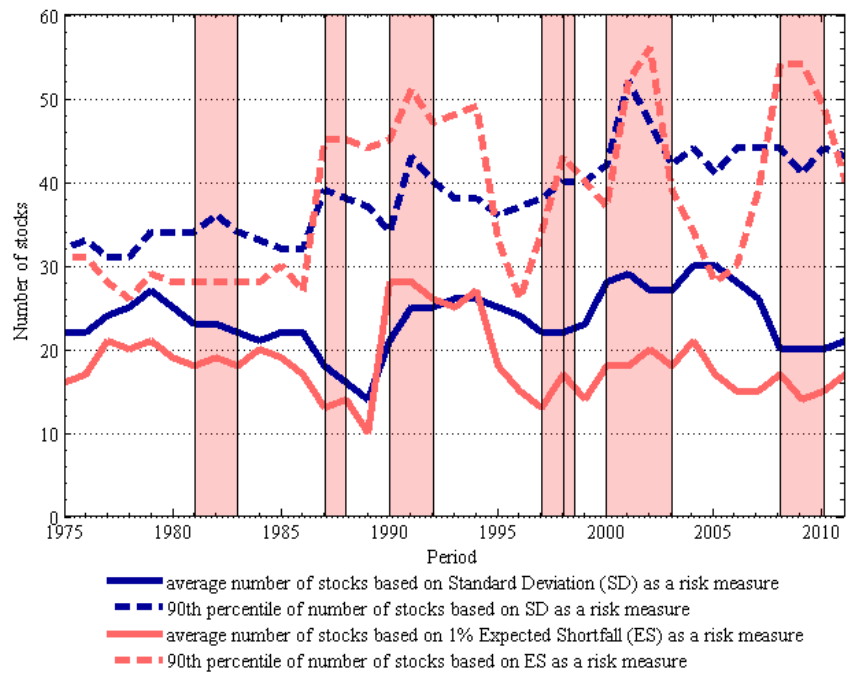
FIGURE 2: RECOMMENDED PORTFOLIO SIZE TO ACHIEVE A WELL DIVERSIFIED PORTFOLIO. The solid dark line represents the number of stocks recommended for an average investor to achieve 90% reduction in diversifiable risk when SD is used as a risk measure. For conservative investors portfolio size is depicted by the dashed dark line. Similarly, light solid and dashed lines depict recommendations for investors concerned with $ES_{1\%}$ as the risk measure. Shaded regions represent periods of crises and correspond to events of the 1973 oil crisis (1973-1974), the 1979 oil crisis (1979-1982), Black Monday (1987), the collapse of Long Term Capital Management (LTCM) in 1998, the Dot-com bubble (2000-2002) and the Global Financial Crisis (2008).
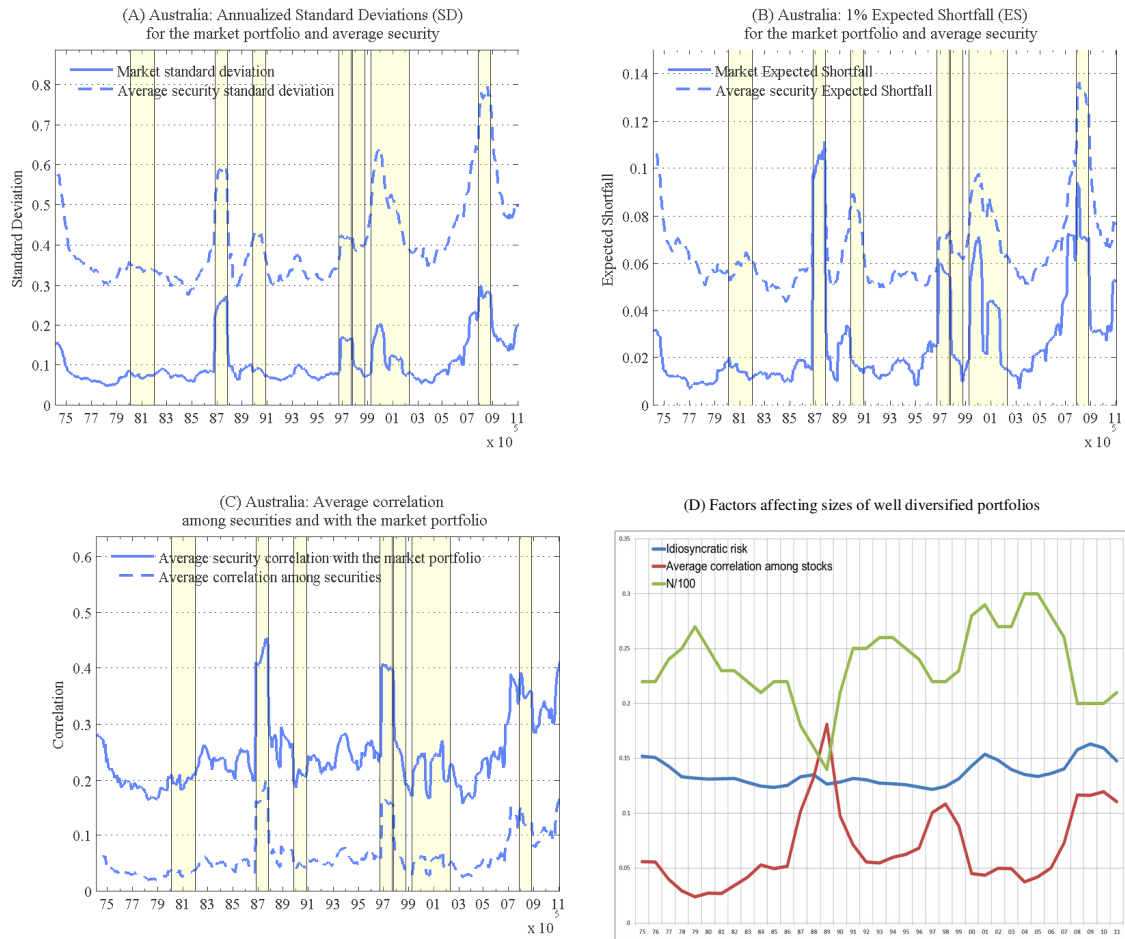
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FIGURE 3: AUSTRALIAN EQUITY MARKET STATISTICS. In panel (A) the solid line shows the annualized standard deviation of daily market returns based on the past 12 months' returns. The dashed line represents the average security standard deviation. Similarly, statistics in Panel (B) are based on $ES_{1\%}$. Panel (C) shows the average security correlation with the market portfolio (solid line) and the average correlation among securities (dashed line). Shaded regions are defined in Figure 1. Panel (D) compares the average idiosyncratic risk with the average correlation among stocks. We also include the rescaled recommended portfolio size for an average investor concerned with SD as a measure of risk.

TABLE 1: **Recommended portfolio size to attain a well diversified portfolio on average (and 90% of the time).**

Year	SD	ES	Year	SD	ES
1975	22 (32)	16 (31)	1994	26 (38)	27 (49)
1976	22 (33)	17 (31)	1995	25 (36)	18 (33)
1977	24 (31)	21 (28)	1996	24 (37)	15 (26)
1978	25 (31)	20 (26)	1997	22 (38)	13 (34)
1979	27 (34)	21 (29)	1998	22 (40)	17 (43)
1980	25 (34)	19 (28)	1999	23 (40)	14 (40)
1981	23 (34)	18 (28)	2000	28 (42)	18 (37)
1982	23 (36)	19 (28)	2001	29 (52)	18 (52)
1983	22 (34)	18 (28)	2002	27 (47)	20 (56)
1984	21 (33)	20 (28)	2003	27 (42)	18 (39)
1985	22 (32)	19 (30)	2004	30 (44)	21 (34)
1986	22 (32)	17 (27)	2005	30 (41)	17 (28)
1987	18 (39)	13 (45)	2006	28 (44)	15 (30)
1988	16 (38)	14 (45)	2007	26 (44)	15 (39)
1989	14 (37)	10 (44)	2008	20 (44)	17 (54)
1990	21 (34)	28 (45)	2009	20 (41)	14 (54)
1991	25 (43)	28 (51)	2010	20 (44)	15 (49)
1992	25 (40)	26 (47)	2011	21 (43)	17 (40)
1993	26 (38)	25 (48)	**Average**	**24 (38)**	**18 (38)**

TABLE 2: **Portfolio size results. Panel A** provides the number of stocks required for a well-diversified portfolio for an average and a conservative investor. **Panel B** details average correlations among individual stocks ($\bar{\rho}_{ij}$), average correlations of stocks with the market ($\bar{\rho}_{im}$), average security SD ($\bar{\sigma}_i$) and market volatility (σ_m). **Panel C** relates recommended number of stocks with market characteristics. We identify years with the largest and lowest recommended portfolio sizes (top and bottom 3rd of the sample) and estimate $\bar{\rho}_{im}$ and σ_m for these years only. **Panel D** is constructed similarly to Panel C but relies on the difference between the number of stocks required to assure conservative investors of the desired level of diversification 90% of the time and the portfolio sizes of average investors. This is the difference between the dashed and solid lines in Figure 2.

PANEL A: NUMBER OF STOCKS IN A WELL-DIVERSIFIED PORTFOLIO, 1975-2011

	on average	90% of the time
Based on SD	24	38
Based on $ES_{1\%}$	18	38

PANEL B: STOCK MARKET STATISTICS

$\bar{\rho}_{ij}$	0.07
$\bar{\rho}_{im}$	0.26
$\bar{\sigma}_i$	39.9%
σ_m	10.4%

PANEL C: SMALL VS. LARGE PORTFOLIOS AND ASSOCIATED MARKET CHARACTERISTICS

Recommended n based on SD	Small (n<21)	Large (n>25)
$\bar{\rho}_{im}$	0.34	0.21
σ_m	16.7%	8.1%

PANEL D: DIFFERENCE (Δn) B/W AVERAGE AND 90TH PERCENTILE RECOMMENDED NUMBER OF HOLDINGS

Δn based on SD	Small($\Delta n < 11$)	Large($\Delta n > 19$)
$\bar{\rho}_{im}$	0.21	0.33
σ_m	7.5%	16.9%

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