Deutsche Bank
Markets Research

North America

Quantitative Strategy
Signal Processing

Date
9 February 2016

Accounting for Eighty Million Pensions

Kevin Webster
kevin.webster@db.com

Javed Jussa
javed.jussa@db.com

Gaurav Rohal, CFA
gaurav.rohal@db.com

Yin Luo, CFA
yin.luo@db.com

Miguel-A Alvarez
miguel-a.alvarez@db.com

Sheng Wang
sheng.wang@db.com

George Zhao
zheyin.zhao@db.com

Allen Wang
allen-y.wang@db.com

David Elledge
david.elledge@db.com

North America: +1 212 250 8983
Europe: +44 20 754 71684
Asia: +852 2203 6990

Studying companies from an employee's perspective

Nobody knows a company better than its employees. As a firm grows or loses ground to a competitor, employees will change their savings behavior, gain or lose benefits and potentially react by voting with their feet.

BizQualify, verifiable pension data from the IRS

BizQualify is a data vendor that follows the tax filings of nearly a million companies to keep track of the pension, benefits and other employee-related accounting metrics for about eighty million workers in the Unites States.

A granular description of the labor market

Our data keeps track of employment, pension assets and growth as well as benefits and credit characteristics linking together firms with employees. This gives us an in-depth view of the US labor market and its effect on sectors, privately owned companies and publicly traded companies.

Stock selection and sector comparison

We apply stock-selection techniques to BizQualify's accounting data. Sector-neutralization shows particularly promising alpha, confirming the idea that employees can tell us something about the relative performance of a company with respect to its direct competitors. We then extrapolate these results in order to draw conclusions as to which sectors have the most promising privately owned companies – Real estate and Healthcare.

Source: www.gettyimages.com

Table of contents

A letter to our readers

Looking at companies from an employee's perspective

Using data collected and verified by the IRS, BizQualify provides yearly insights into the pensions and benefits of workers for nearly a million individual companies. Analyzing the data across twenty sectors, we provide a granular analysis of the US labor market, both from publicly traded companies and privately owned companies. Readers with a macro view on the world may find this data set a treasure trove of information.

The data also leads us to stock selection factors for publicly owned companies based on BizQualify's accounting data. The first strategy, which is based on benefits offered to employees, leads to a low turnover and a Socially Responsible Investment (SRI) tilted portfolio with a Sharpe ratio of 0.7 over the past five years. Looking at companies from an employee's perspective falls very much into the Governance pillar of the ESG investment philosophy, delivering alpha over the long term.

We also backtest BizQualify's own growth score and find strong in-sample performance within the past five years. This model can be used to evaluate the performance of private companies for which pricing data is not readily available. The model exhibits a significant positive premium in private capital. Real estate and Healthcare show a particularly strong outperformance of privately owned companies against their public counterparts. We find a negative premium for private Finance and Insurance companies. Counter to commonly held beliefs, private companies in the Information Technology sector do not outperform their publicly traded competitors, at least as measured by employee and employee pension growth.

This report is a part of a series of research papers that we published on the topics of corporate actions, event-driven strategies, corporate governance, forensic accounting, ESG, and tactical premia. Please contact us at DBEQS.Americas@db.com for more information on these topics. We hope you enjoy the remainder of this unique report.

Regards,

Yin, Javed, Kevin, and the quant team
Deutsche Bank Quantitative Strategy

Macro insight from the IRS

A comprehensive dataset on US pension plans

Form 5500 is an annual accounting report of employee benefit plans filed with the IRS and US Department of Labor. Since 2009, the reports have been filed electronically, putting the numbers within the reach of big data. BizQualify (BQ) is such a company, leveraging this source of information to provide its customers with IRS-audited, verifiable data on nearly all the companies with employees in the US.

BizQualify's data includes the number of employees of a company with a pension plan, their pension assets as well as the contribution of both employees and employers to the plan. The filings also allow them to capture a host of data on credit and benefits related items linked to employees (see Figure 1).

BizQualify's data includes the number of employees of a company with a pension plan, their pension assets as well as the contribution of both employees and employers to the plan

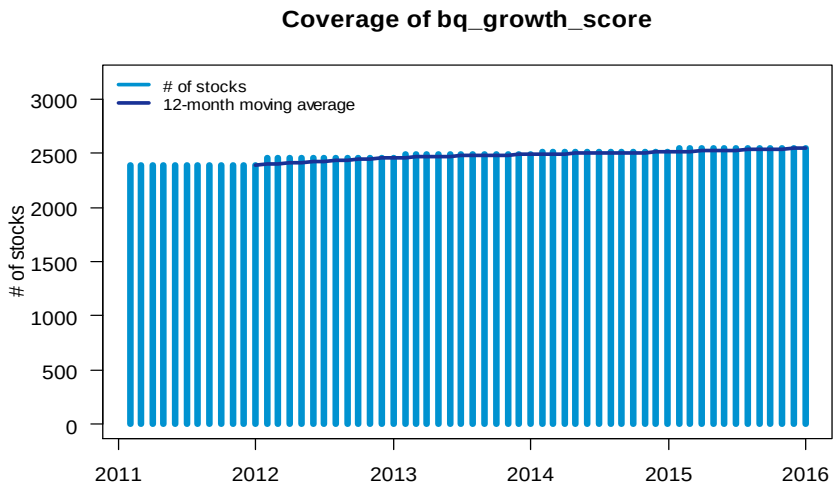
Figure 1: Raw BizQualify data items

Category	Description	Factor code	Type
General	Company EIN	company_ein	integer
	Industry name	bq_industry_name	string
	Company legal name	bq_company_legal_name	string
	Company ticker symbol for public companies	bq_ticker	string
Size	Company is a public company for which BQ has actual financial information	bq_public_indicator	boolean
	Small company (files a simplified EZ form)	bq_small_company_ind	boolean
	Number of current employees in a welfare and/or retirement plan	bq_current_employees_plan	integer
	Retirement plan net assets	bq_net_assets_pens_eoy	integer
Savings	Employee plus company contributions to retirement plans	bq_tot_contrib_pens_amt_a	integer
	Company contributions to retirement plans	bq_co_contrib_pens_amt_a	integer
	Defined contribution plan	bq_defined_contrib_pens_ind	boolean
	Defined benefit plan	bq_defined_benefit_pens_ind	boolean
	Profit-sharing	bq_profit_sharing_ind	boolean
	401(k)	bq_code_section_401k_ind	boolean
	Stock bonus option	bq_stock_bonus_ind	boolean
Benefits	Health plan	bq_health_insurance_ind	boolean
	Dental plan	bq_dental_insurance_ind	boolean
	Vision plan	bq_vision_insurance_ind	boolean
	Life insurance plan	bq_life_insurance_ind	boolean
	Long term disability plan	bq_long_term_dis_insurance_ind	boolean
Credit	Failure to make timely payments in a retirement plan	bq_fail_trans_contrib_pens_ind	boolean
	Failure to make timely payments in a welfare plan	bq_fail_trans_contrib_welf_ind	boolean
	Failure to provide a benefit in a retirement plan	bq_fail_provide_benf_due_pens_ind	boolean
	Failure to provide a benefit in a welfare plan	bq_fail_provide_benf_due_welf_ind	boolean
	Delinquent filer voluntary compliance (DFVC) member	bq_vol_delinquent_filer_pgrm_ind	boolean
	Negative employer contributions to a retirement plan	bq_pens_negative_contrib_ind	boolean
	No company filings in the past 2 years	bq_no_filings_prev_2_yrs_ind	boolean
	Company elected to terminate a plan	bq_terminate_any_ind	boolean
	Company closed all plans	bq_closed_all_plans_ind	boolean
	Company closed a plan	bq_final_filing_any_ind	boolean

Source: BizQualify, Deutsche Ban Quantitative Strategy

The data is divided by company EIN, a company identifier issued by the IRS that BizQualify maps to tickers for publicly traded businesses. It covers about 2,500 companies within the Russell 3000 (see Figure 2), as well as nearly a million private and public companies overall since 2010.

Figure 2: Coverage chart of the BizQualify data set within the Russell 3000 since 2011.



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

The data has a yearly frequency, but the filings are recorded and potentially updated on a quarterly basis. They cover nearly 100 million employees, three quarters of which work in privately owned companies.

In addition to providing the raw data from the form 5500 filings on employees, pensions, contributions and benefits, BizQualify also provides model-based scores estimating a company's revenue, size and growth. These are all built upon the form 5500 filings collected by the IRS, leading to a high degree of verifiability of the data. Figure 3 covers the three derived factors from the BizQualify data set.

Figure 3: Derived BizQualify models

Category description		factor code	type
Derived	BQ growth score	bq_growth_score	integer
	BQ profitability score	bq_profitability_score	integer
	BQ Risk Score	bq_risk_score	integer

Source: BizQualify, Deutsche Bank Quantitative Strategy

Classifying pension data

One of the main features of BizQualify is the sheer breadth of the data set. It covers close to a million companies located in the US covering over 100 million US employees. The large majority of these companies are not publicly traded. This leaves us with factors not traditionally studied by quants. They fall more in line with traditional macroeconomic variables, but with the granularity that greatly appeals to data scientists. In this section, we analyze the different accounting items covered by BizQualify. We do this from a macro perspective, subdividing and aggregating the data across its many dimensions to provide an in-depth view of the US labor market.

It covers close to a million companies located in the US covering over a hundred million US employees

The factors presented by BizQualify fall into four broad categories:

1. Company size: The size of the company, as measured by its number of employees or the total pensions assets of the employees. This is highly correlated to market cap for publicly traded companies.

2. Employee pensions: The state of the employee savings, such as median pension size, company contributions and employee savings. These can measure both the health of the labor force, as well as the growth prospects of the company.

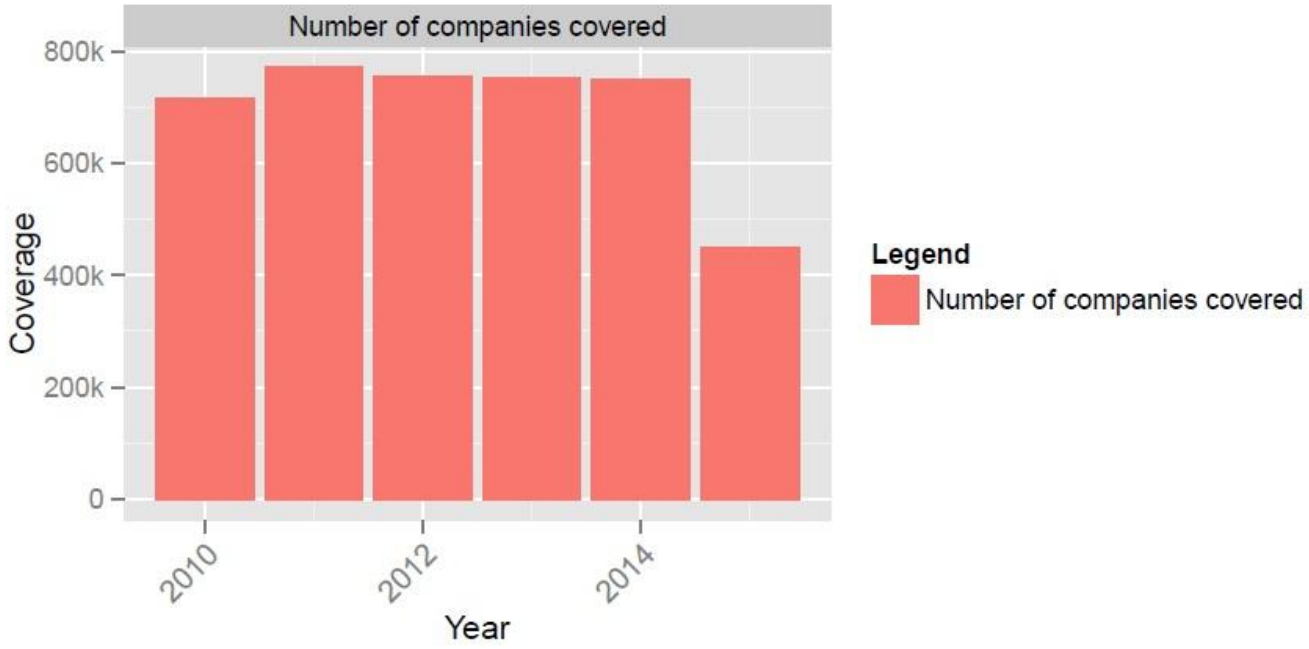
3. Employee benefits: Benefits offered by the company to the employees, e.g., health plans, insurance plans and whether the pension plan is a defined contribution or benefit plan. These factors fall into the social and governance pillars of the ESG investment paradigm.

4. Credit events: A number of negative events relating to the company failing to provide or pay for a pension or welfare benefit for its employees. We loosely call these 'credit' events. Our rational for this is that a company that fails to pay its employees is likely to be under financial stress or have defaulted on other payments as well.

A quick peek at the dataset

We begin by reiterating the breadth of the data. Figure 4 illustrates the number of companies covered by BizQualify as a function of time. As we can see, even our broadest investment universe, the Russell 3000, represents less than one percent of all the companies present in the data set.

Figure 4: Companies covered



Source: BizQualify, Deutsche Bank Quantitative Strategy

One may ask why we care about companies that are not publicly traded. The answer is two-fold.

- First, they are important from a macro perspective, as the large majority of the economic output of the US stems from privately owned companies.
- Second, we can have a better view of the competitive landscape of publicly traded companies by monitoring their privately owned counterparts. Especially in sectors such as Technology, where the biggest threat or opportunities to a company may come from outside the portfolio manager's investment universe.

As we can see, even our broadest investment universe, the Russell 3000, represents less than one percent of all the companies present in the data set

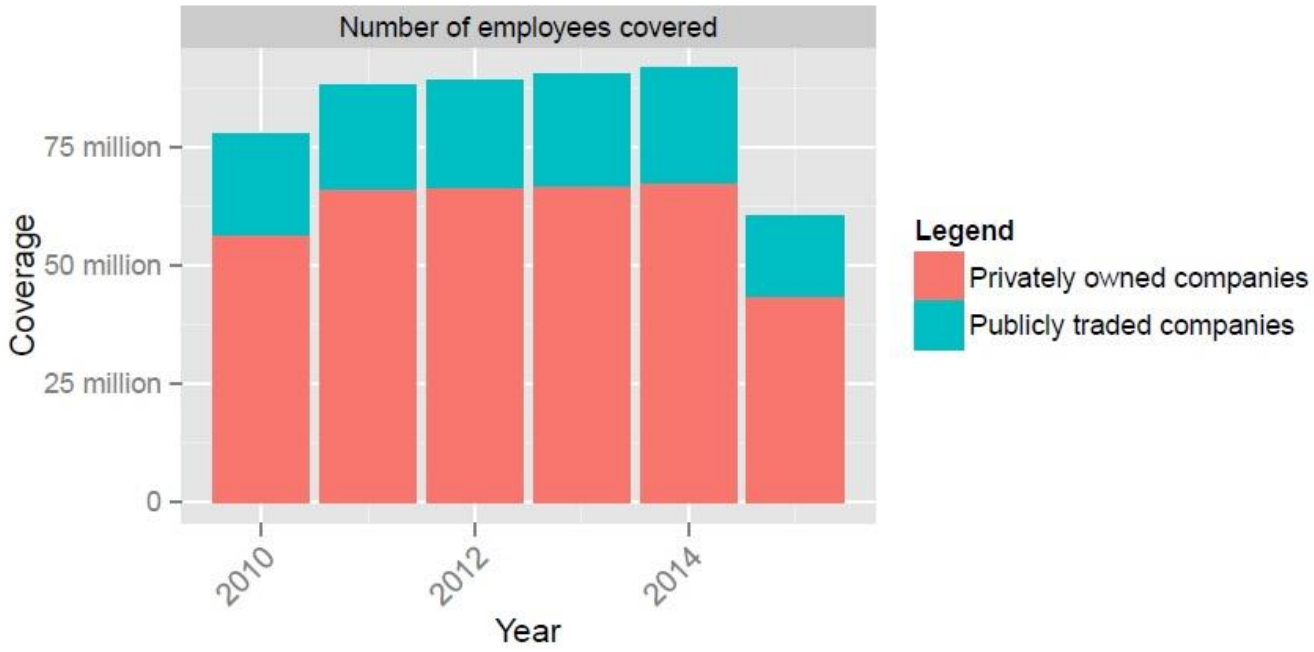
A topic for future research is to combine the data on private company present in this data set with supply chain data (See Jussa et al, 2015). This can greatly increase the leverage of supply chain data by providing information on nodes of the chain for which we have no market information. We can also incorporate job opening data, such as those provided by LinkUp (See Jussa et al, 2015), in order to provide further information of where employees are migrating to within a sector.

BizQualify covers somewhere between 75 and 100 million employees with pension plans. Most own some form of pension through a company, although some also receive their pension benefits through an external organization, such as a union. While this is not exhaustive of the US labor force, it boasts an impressive level of granularity coupled with breadth.

Publicly traded companies represent less than one percent of the companies in our sample, but they cover roughly a quarter of the employees

Figure 5, shows that employment has steadily increased over time. Publicly traded companies represent less than one percent of the companies in our sample, but they cover roughly a quarter of the employees. This large-size tilt is to be expected and will repeat itself multiple times throughout the report. We note that between 2010 and 2011, most of the growth came from privately owned entities, while from 2011 onward, most of the jobs created came from publicly traded companies.

Figure 5: Employees covered



Source: BizQualify, Deutsche Bank Quantitative Strategy

Company size

The first category or dimension is company size, based on number of employees or pension size (see Figure 6). We can slice this data in a number of ways. Figure 7 gives the sector breakdown of the employees covered by BizQualify including private and public. Rows correspond to sectors as defined by the IRS. Columns group companies within a sector by their size, and whether they are publicly traded or not.

Figure 6: Example of a company with 100-1,000 employees in 2012

Company name	Business type	Sector	Number of employees	Total Pension assets ($)
A. W. ZENGELER CLEANERS, INC.	Drycleaning & Laundry	Other Services	128	6,827,188.00

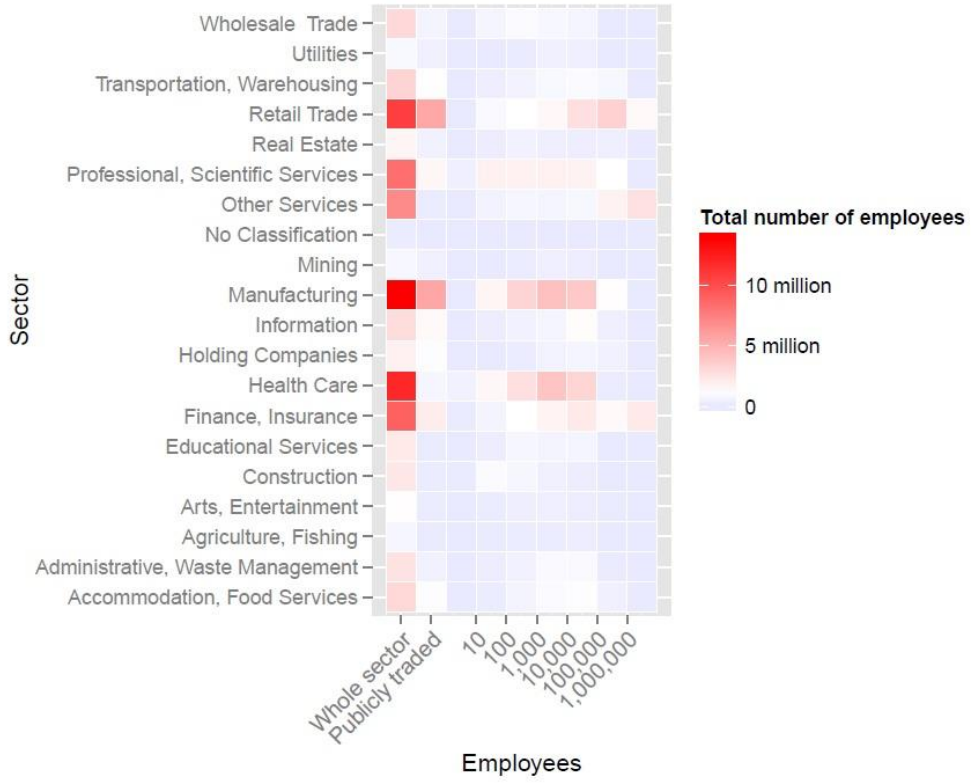
Source: BizQualify, Deutsche Bank Quantitative Strategy

Taken as a whole, the largest sectors are Manufacturing, Healthcare and Retail Trade at around 10 million employees each (see Figure 7). They are followed by Scientific Services, Finance and Insurance, with more than 5 million employees each. The smallest sectors in terms of workers are Utilities, Mining and Agriculture, and Fishing.

Taken as a whole, the largest sectors are Manufacturing, Healthcare and Retail Trade at around 10 million employees each

Within Manufacturing and Healthcare, employees are most represented within companies that have between 1,000 and 10,000 workers. Retail, on the other hand, is tilted toward much larger companies: 100,000 and above. In general, the majority of employees work within medium- to large-sized firms.

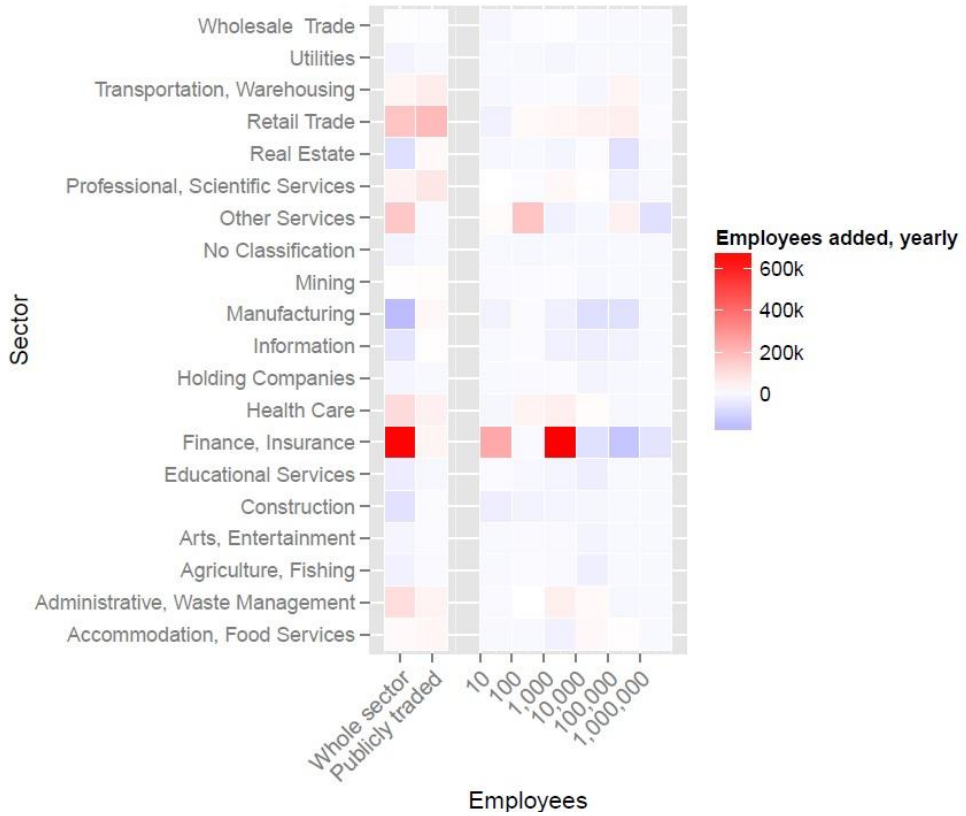
Figure 7: Sector breakdown



Source: BizQualify, Deutsche Bank Quantitative Strategy

When studying changes in number of employees, we find Finance and Insurance, as well as Retail Trade to have the largest gains annualized over the past five years (see Figure 8). Manufacturing, on the other hand, saw significant losses, especially within the privately owned companies. In Finance and Insurance, most of the gains came from small to medium companies (10,000 and below) that are privately owned.

Figure 8: Employees added



Source: BizQualify, Deutsche Bank Quantitative Strategy

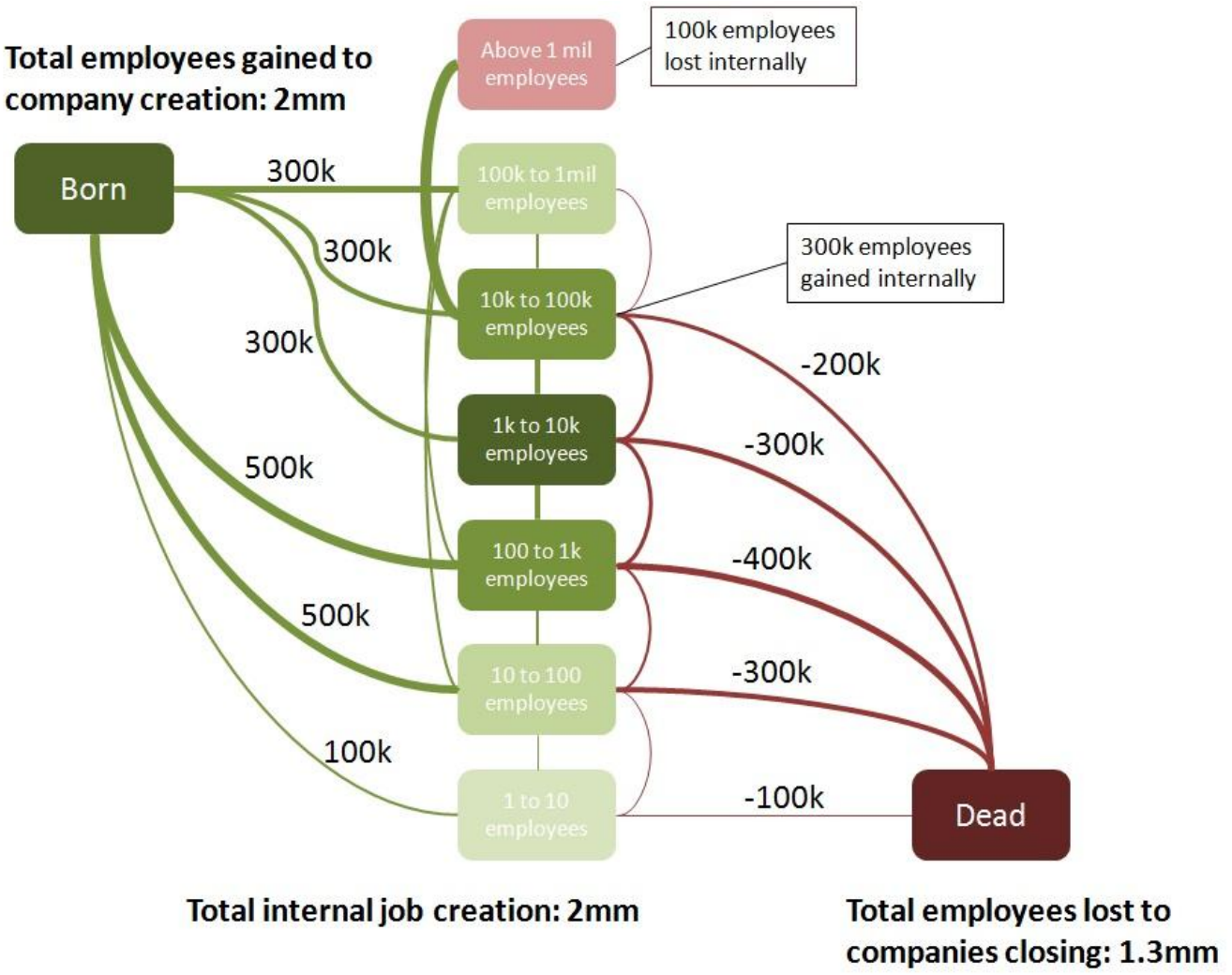
We find Finance and Insurance, as well as Retail Trade to have the largest gains annualized over the past five years

To get a better sense of how a company evolves in size – from creation to its ultimate demise – we plot a birth-and-death flowchart. Figure 9 decomposes where jobs are created from one year to another. For example:

- Almost 500,000 employees were hired by newly created firms with a size of 100 to 1,000 workers.
- About 400,000 employees were lost to companies with size 100 to 1,000 disappearing.
- The total job creation of already existing companies (internal job creation) exceeded two million per year. Compare this to a loss of 1.3 million jobs to businesses closing and 2.0 million jobs created through new companies.

Overall, most of the 'action' happens within companies having between 1,000 and 10,000 employees. Most companies that are created or lost have below 1,000 employees.

Figure 9: Average annual company creation

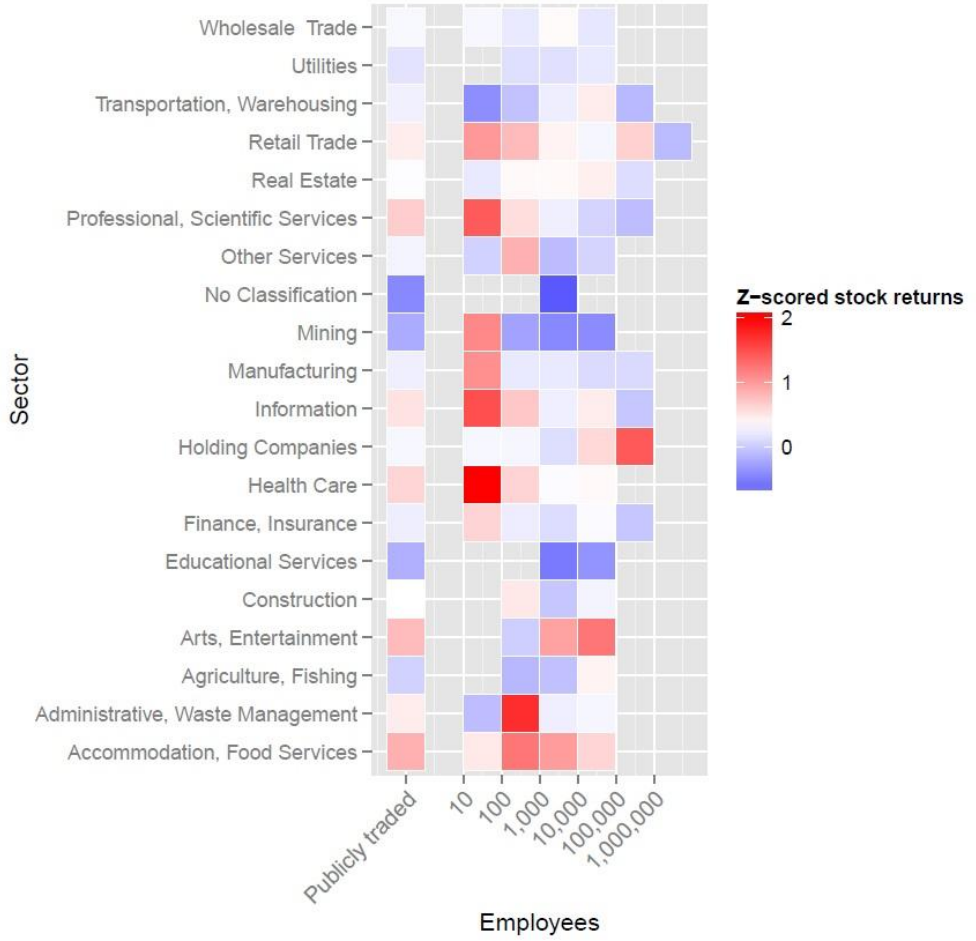


Source: BizQualify, Deutsche Bank Quantitative Strategy

If we focus on the publicly traded companies within our data set, we can see which of the IRS-denominated sectors outperformed and underperformed over our five year sample (see Figure 10). Overall, smaller companies (10 to 1,000 employees) have outperformed, especially within Information and Healthcare. Mining, Educational Services and Agriculture, and Fishing have underperformed. The returns were normalized over the year and are equally weighted within each sector.

Overall, smaller companies (10 to 1,000 employees) have outperformed, especially within Information and Healthcare

Figure 10: Stock returns, Z-scored



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

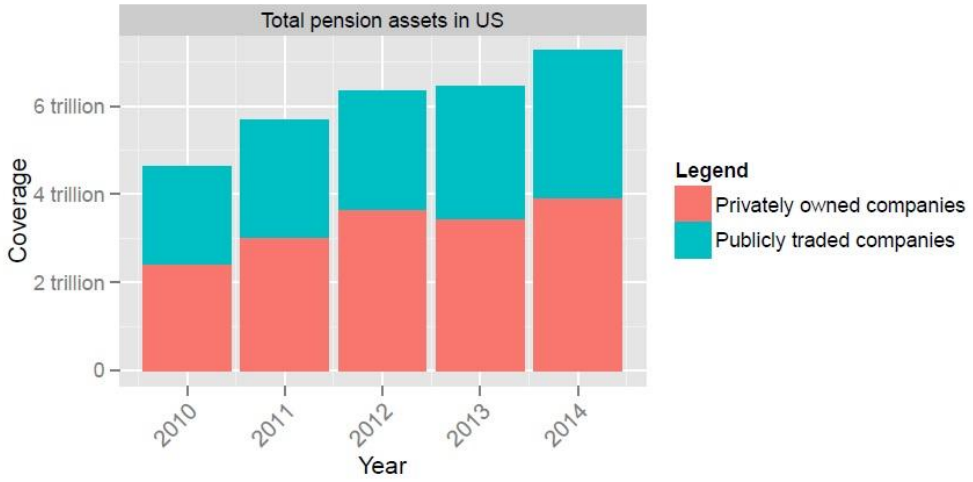
Employee pensions

The second category or dimension is employee pensions. A unique aspect of the BizQualify data set is that it provides a picture of the pensions of nearly all US employees at the company level. This in turn informs us on the overall health of the US economy. Figure 11 shows the growth of the total pension assets present in the US.

Despite only representing a quarter of the employees, workers in publicly traded companies own nearly half of the pension assets

Despite only representing a quarter of the employees, workers in publicly traded companies own nearly half of the pension assets. Both the publicly traded and the privately owned companies have had healthy growth in their pension assets.

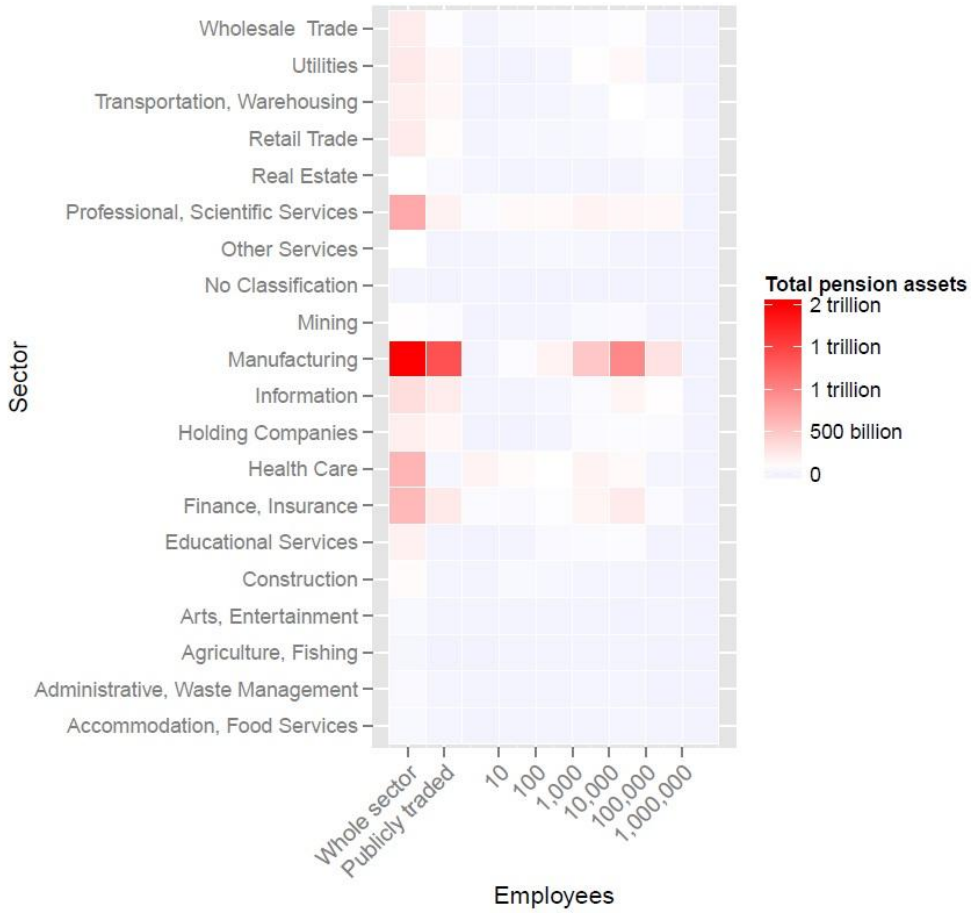
Figure 11: Total pension assets



Source: BizQualify, Deutsche Bank Quantitative Strategy

If we now decompose these assets across sectors, we see that a third of the pension assets are owned by employees in manufacturing, who represent the largest group of workers at 10 million (see Figure 11). The data also presents a large-size tilt: most of the pension assets are owned by employees of large companies, not by the larger population of workers at small businesses (see Figure 12).

Figure 12: Total pension assets, by sectors

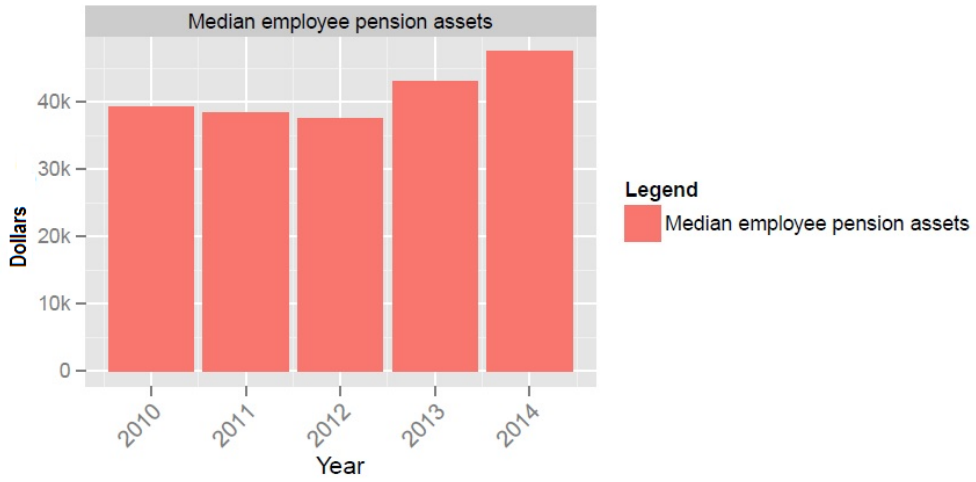


Source: BizQualify, Deutsche Bank Quantitative Strategy

A third of the pension assets are owned by employees in manufacturing, who represent the largest group of workers at ten million

When we look at the median pension assets per employee, the situation becomes even more interesting. Thankfully, pension assets have increased after 2012, as seen in Figure 13. The strength in effect of an aging labor force, which would push pension assets up, is unclear from our data alone.

Figure 13: Median pension assets

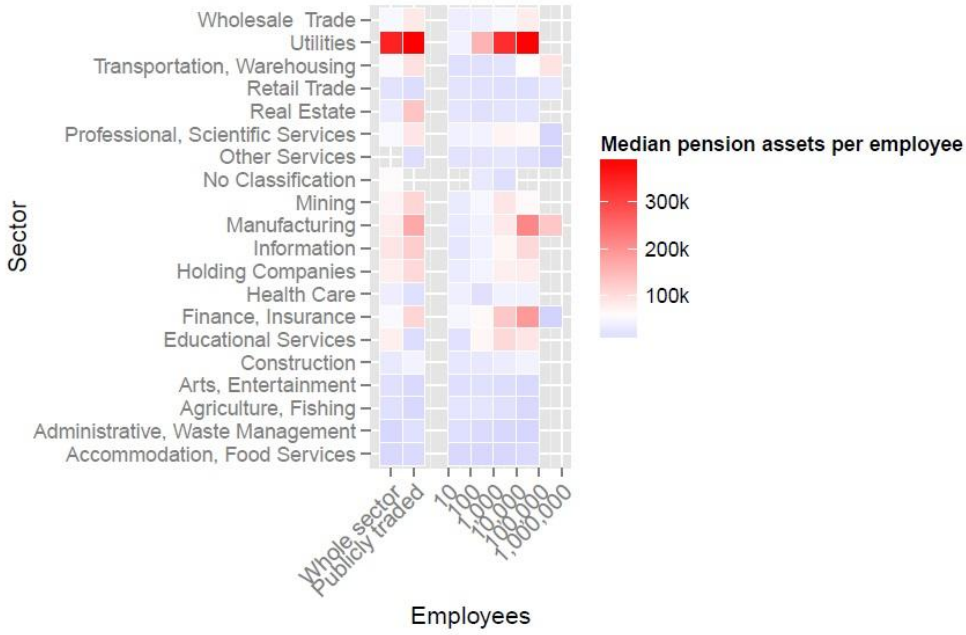


Source: BizQualify, Deutsche Bank Quantitative Strategy

Deep-diving into sectors, we see that Utilities, Manufacturing, Finance, and Insurance command the most generous pension assets (see Figure 14). This tilt may be explained by an older worker population when compared to Retail Trade or Healthcare. In all sectors, large, publicly traded companies exhibit pension assets approximately three times larger than their privately owned peers.

Deep-diving into sectors, we see that Utilities, Manufacturing, Finance and, Insurance command the most generous pension assets

Figure 14: Median pension assets, by sector



Source: BizQualify, Deutsche Bank Quantitative Strategy

Next we ask ourselves the question: who is contributing more to the pension? In Figure 15, we can see the example of a medium-sized company. Employees save 50% more money into their pensions than what the company matches.

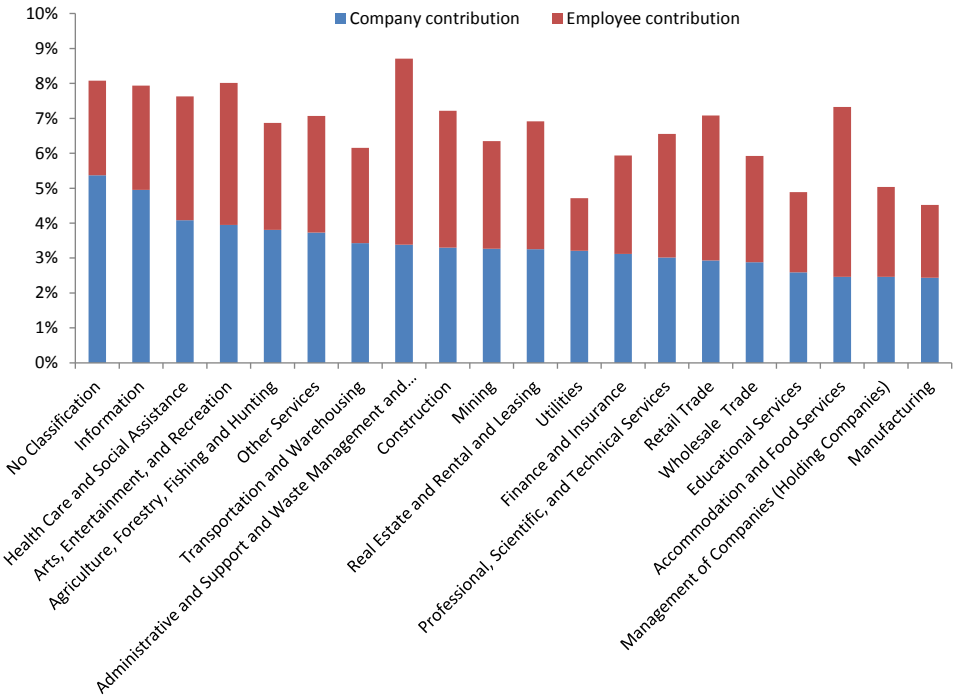
How much do employees save above what their employer matches and which sectors contribute the most? Figure 16 provides some numbers, with sectors matching between 3% and 5% on average. These numbers were employee-weighted, meaning that companies with a larger number of employees contribute a larger weight within the below statistic. Information Technology, Healthcare, and Social Assistance see a large proportion of company contributions to employee pensions. Manufacturing, on the other hand, exhibits a rather low total and company contribution to employee pensions.

Figure 15: Example in 2013

Company name	Business type	Sector	Number of employees	Company contribution($)	Employee contribution($)
IFCO SYSTEMS NORTH AMERICA, INC.	Other Wood Product Manufacturing	Manufacturing	3867	1,394,574.00	2,197,209.00

Source: BizQualify, Deutsche Bank Quantitative Strategy

Figure 16: Company and employee contributions to pensions



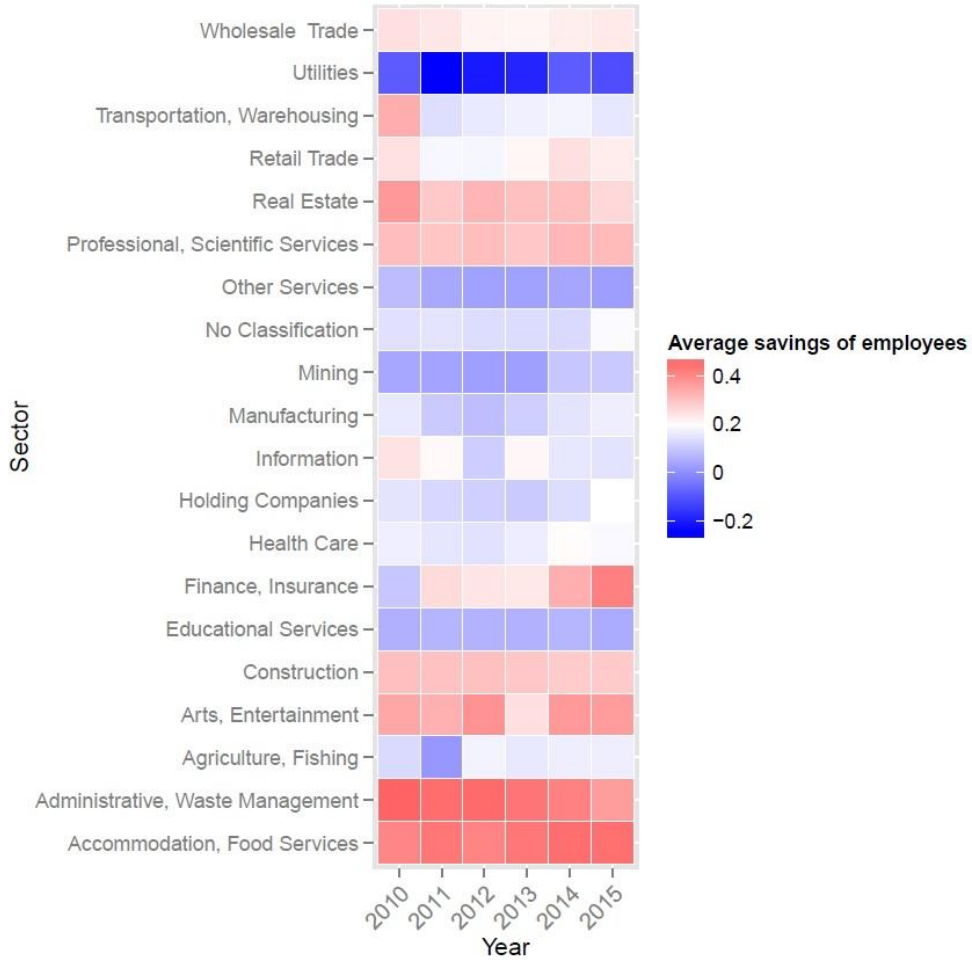
Source: BizQualify, Deutsche Bank Quantitative Strategy

Information Technology, Healthcare, and Social Assistance see a large proportion of company contributions to employee pensions

In Figure 17, we define the savings ratio of an employee. It is a number between minus one and one. One corresponds to a situation where the employee contributes their entire pension, while minus one means the employer is contributing the entire pension. Therefore, the savings ratio measures how much employees over-save or under-save compared to their employer's contributions.

Employees of Utilities companies, with their larger pensions, do not seem to put as much additional personal contributions as other sectors. Administrative, Waste Management and Accommodation, and Food Services exhibit smaller employer contributions, leading to excess savings by their employees. Interestingly, Finance and Insurance have switched from an under-saving to an over-saving mentality. The chart is employee weighted.

Figure 17: Average savings ratio of employees



Source: BizQualify, Deutsche Bank Quantitative Strategy

Interestingly, Finance and Insurance have switched from an under-saving to an over-saving mentality. The chart is employee weighted.

Employee benefits

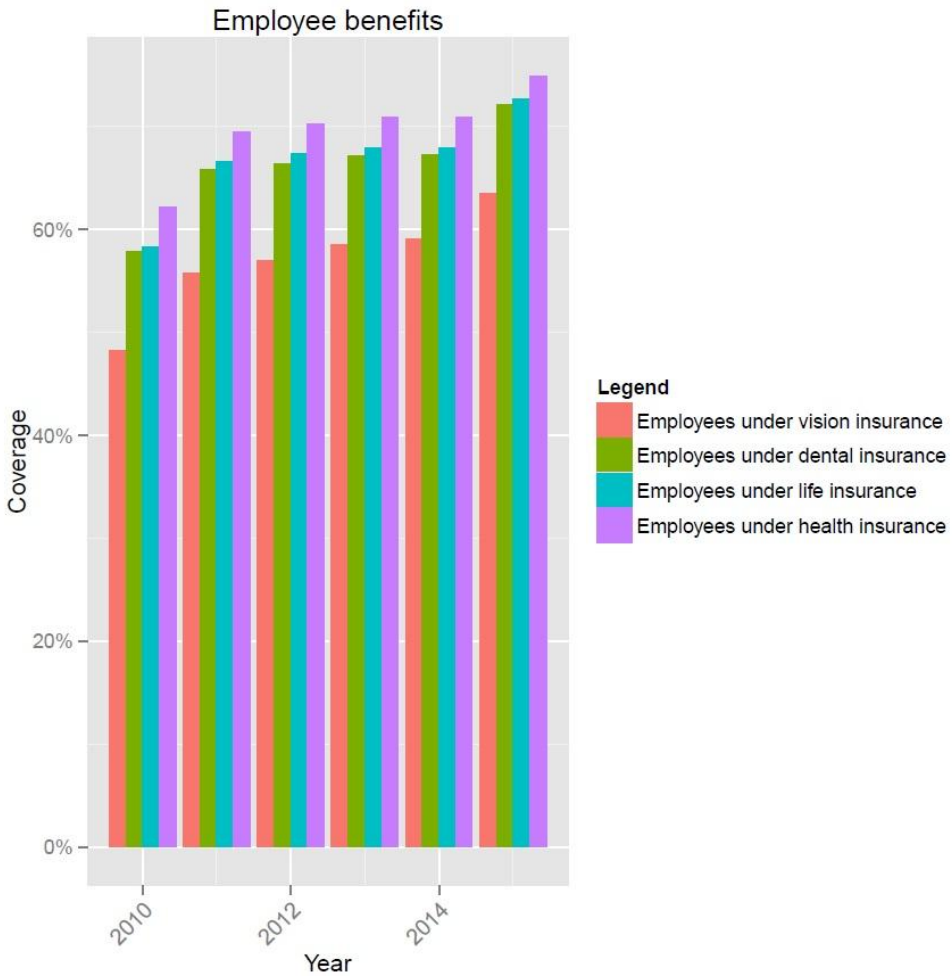
The third category or dimension is employee benefits. BizQualify provides data on insurance plans that companies offer to their employees. One example is shown in Figure 18, where three benefits are provided to employees of a large company. This yields a picture on which sectors provide what kind of benefits to their workers. Such data in turn informs us of good social and governance policies of the respective companies. Figure 19 shows the overall coverage of four different benefits over time. All of the numbers are employee-weighted. For example, in 2013, seventy percent of US employees within the data set had health insurance. This figure includes both publicly traded and privately owned companies.

Figure 18: Example: FEDEX CORPORATION, 2010

Benefit	Coverage
Health plan	TRUE
Dental plan	TRUE
Vision plan	TRUE
Life insurance plan	FALSE
Long term disability plan	FALSE

Source: BizQualify, Deutsche Bank Quantitative Strategy

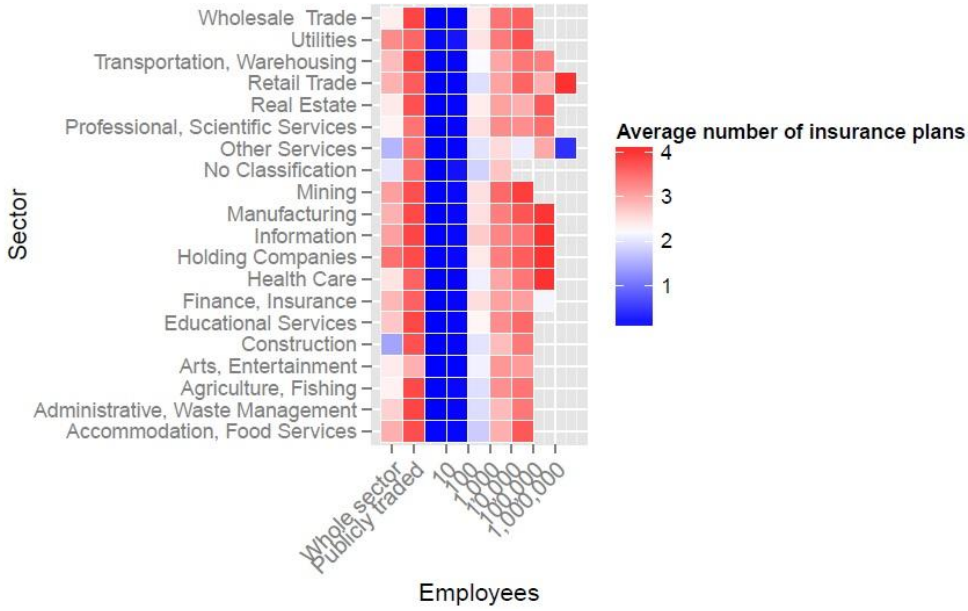
Figure 19: Benefits coverage over time



Source: BizQualify, Deutsche Bank Quantitative Strategy

These same benefits can be analyzed over sectors (see Figure 20). As expected, this leads to a massive large-size bias, as larger companies have enormous economies of scale to implement such benefit programs. Companies that have more employees tend to offer more insurance plans. Privately owned companies tend to offer fewer insurance plans. The major notable exception is Construction, which has on average a single insurance plan for employees.

Figure 20: Benefits across sectors



Source: BizQualify, Deutsche Bank Quantitative Strategy

Credit events

The fourth category or dimension is credit events. BizQualify captures events related to the failure to provide a pension or welfare benefit to their employees. Figure 21 gives an example of a company that failed to provide a benefit in a retirement plan in 2010.

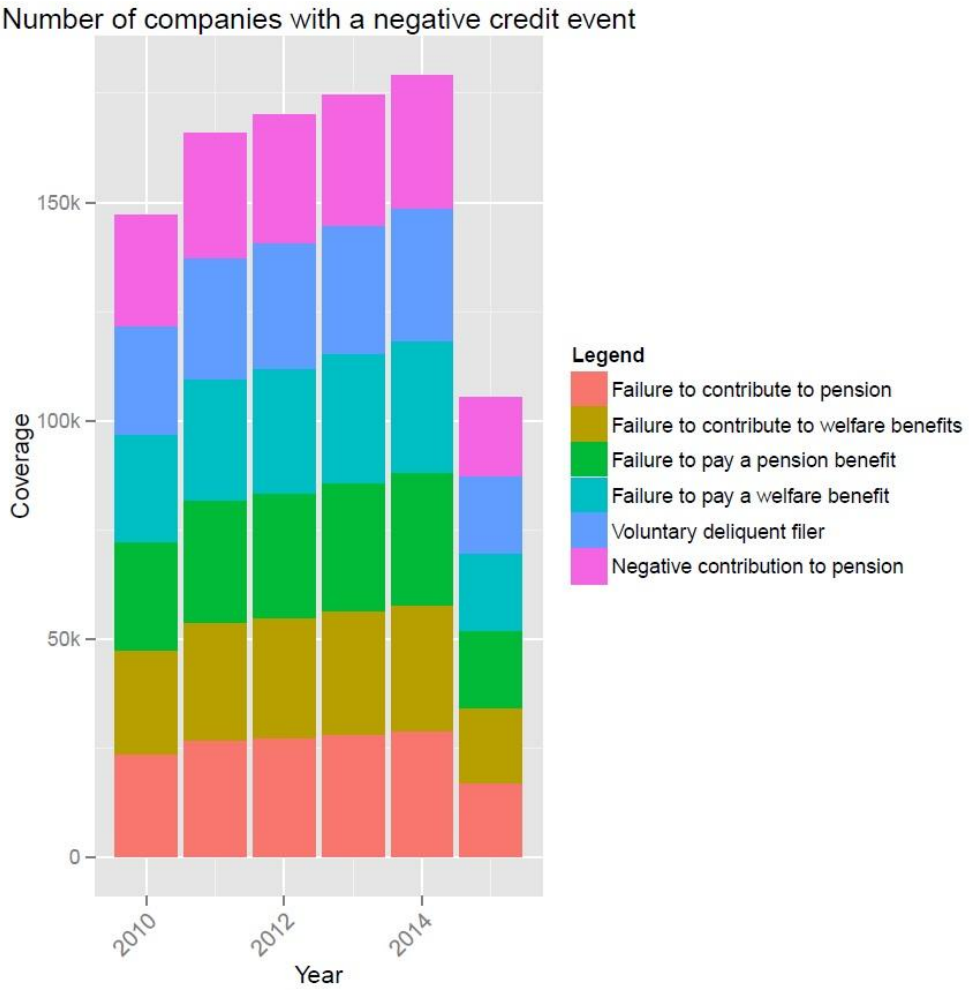
This should have a direct negative impact on their social governance score, as well as instant ramifications on the quality of their credit. In total, we enumerate more than 150,000 such credit events per year (see Figure 22) across all US companies.

Figure 21: Example: FEDEX CORPORATION, 2010

Credit event	outcome
Failure to make timely payments in a retirement plan	FALSE
Failure to make timely payments in a welfare plan	FALSE
Failure to provide a benefit in a retirement plan	TRUE
Failure to provide a benefit in a welfare plan	FALSE
Delinquent filer voluntary compliance (DFVC) member	FALSE
Negative employer contributions to a retirement plan	FALSE
No company filings in the past 2 years	FALSE
Company elected to terminate a plan	FALSE
Company closed all plans	FALSE
Company closed a plan	FALSE

Source: BizQualify, Deutsche Bank Quantitative Strategy

Figure 22: Negative credit events over time



Source: BizQualify, Deutsche Bank Quantitative Strategy

When subdividing these credit events across sectors, we find the data exhibits stark contrasts. Most of the offending companies are large, publicly traded companies. Transportation, Manufacturing, Healthcare, and Education are particularly prone to such failures (see Figure 23). Finance and Insurance, on the other hand, rarely fail to pay their employees. Now that we have a sound overview of the dataset, we dig deeper to explore potential stock selection signals from the dataset.

Figure 23: Negative credit events across sectors

Source: BizQualify, Deutsche Bank Quantitative Strategy

Stock selection based on tax filings

Employee based alpha factors

Based on the analysis above, we build various stock specific factors based on the employee dataset. For each of these, we construct a factor and sector-neutralize it across the full population of companies. We then compute statistics on these factors on the investable part of the universe.

Our three factors are:

1. The Benefits Factor: The benefits factor is computed by counting the number of benefits a company provides to its employees, and dividing this number by the sector average (including private companies).

2. The Growth Factor: The BizQualify growth factor captures a weighted average of the growth in employees, pension contributions, and other size factors of the company.

3. The Sector Neutral Growth Factor: This is a sector neutral version of the Growth factor. Since employees tend to work in the same sector, we expect outperformance or underperformance of a stock to arise when employees join or leave from similar position at competing companies.

The Benefits factor

The benefits factor is an interesting factor from a quality perspective. Intuitively, companies that provide more benefits to their employees – relative to their peers – would be seen as an example of good corporate governance.

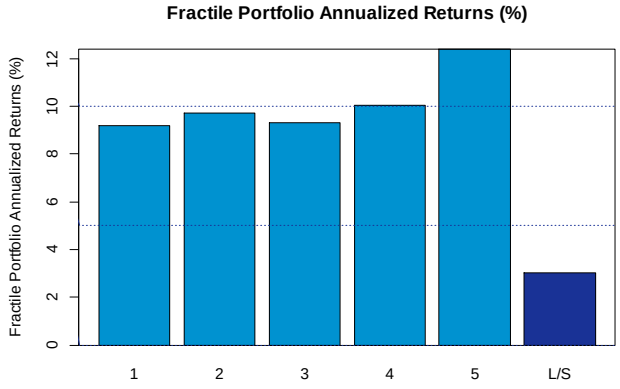
The benefits factor is computed by counting the number of benefits a company provides to its employees, and dividing this number by the sector average (including private companies).

The benefits factor is computed by counting the number of benefits a company provides to its employees, and dividing this number by the sector average (including private companies)

We find that benefits exhibit positive alpha over the six year time period of our data set. This is despite a significant large-cap tilt to the factor and the fact that the data is only collected yearly. We backtest the BizQualify factors assuming we trade on them on December 31 of each year.

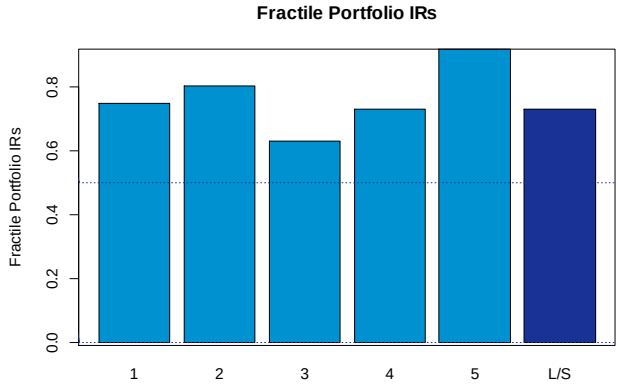
While the annualized spread (see Figure 24) in returns between the different quantiles is only a modest 3%, the ensuing portfolio exhibits a number of positive traits. First, it exhibits low volatility, leading to a Sharpe ratio of 0.72 (see Figure 25).

Figure 24: Annualized quantile returns for the benefits factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

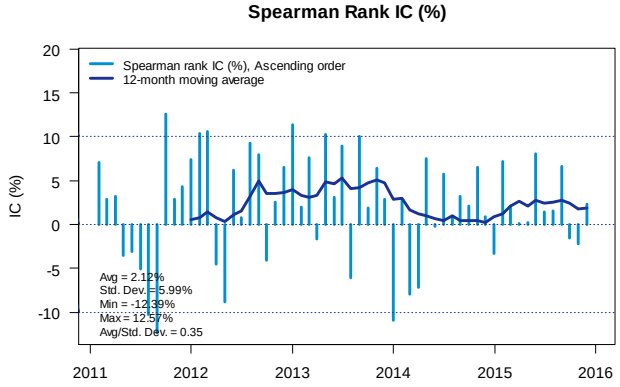
Figure 25: Sharpe ratio for the benefits factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

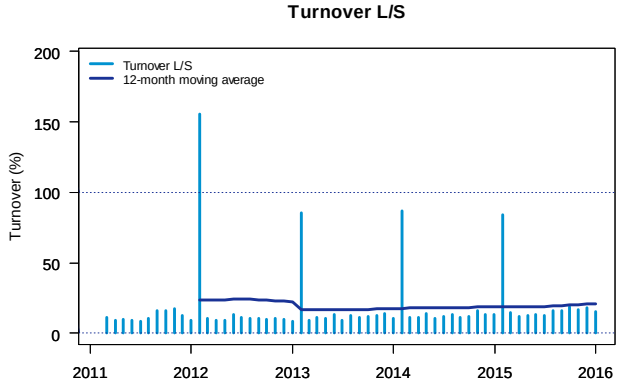
It also has a very consistent, albeit somewhat modest, rank IC of 2% (see Figure 26). The return payoff pattern is also fairly monotonic.

Figure 26: Rank IC for the benefits factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

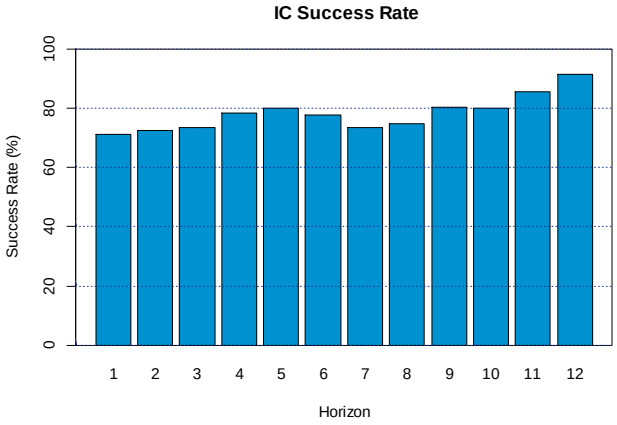
Figure 27: Two way turnover for the benefits factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

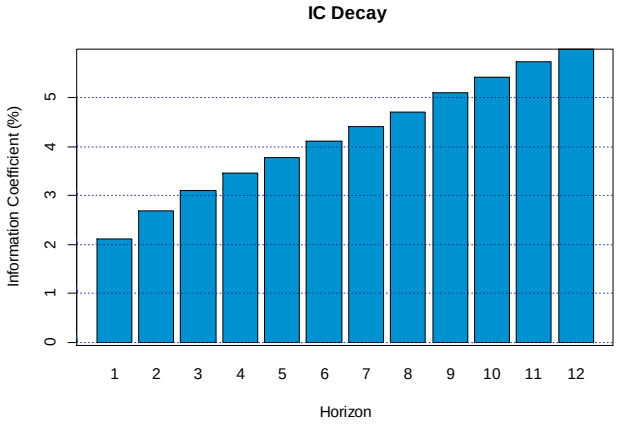
Most importantly, the portfolio is very much adapted to a long-term buy-and-hold strategy. It has low turnover (see Figure 28) and its optimal prediction horizon is above 12 months (see Figure 29). As such, this strategy is particularly suited for low turnover portfolio managers who have an interest in quality names and longer holding periods.

Figure 28: Success rate as a function of investment horizon for the benefits factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

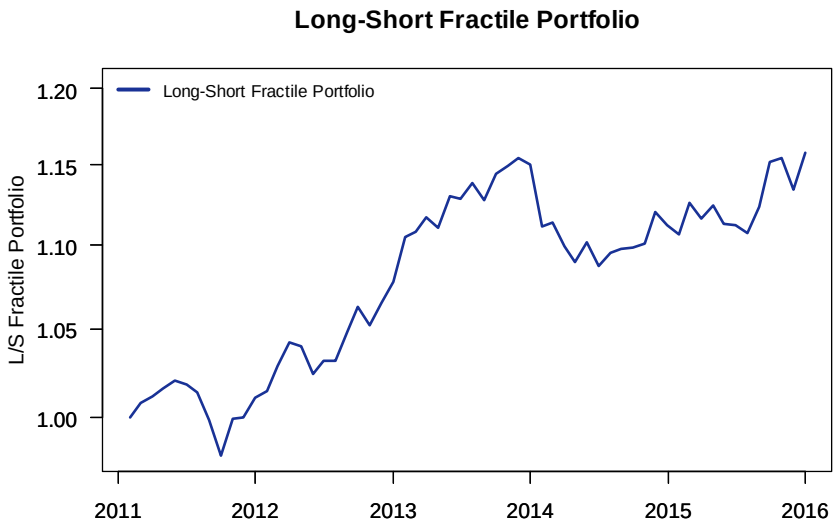
Figure 29: Rank IC as a function of investment horizon for the benefits factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

Figure 30 shows the historical cumulative performance of the benefits factor over time, with the most significant drawdown happening at the beginning of 2014.

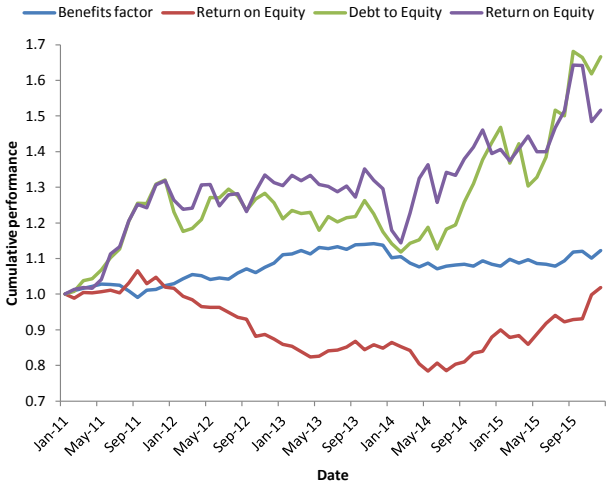
Figure 30: Long-Short quantile portfolio for the benefits factor, rebalanced monthly.



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

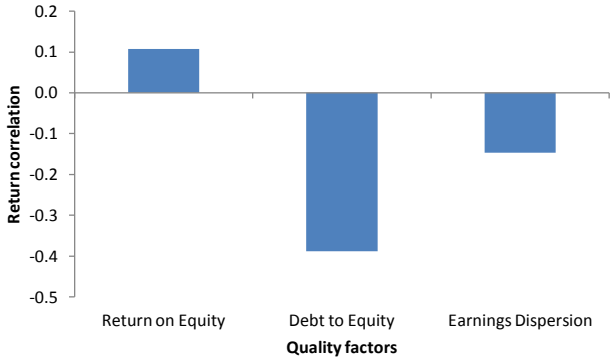
We compare the performance of this factor with three standard quality strategies: Return on Equity, Debt to Equity, and Earnings Dispersion.

Figure 31: Cumulative performance of selected quality factors



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

Figure 32: Return correlation between quality factors and the benefits factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

We find that the benefits factor provides on average smaller returns, albeit with less risk and turnover (see Figure 31). Because of its low correlation, it can be seen as a diversifier to a traditional quality or ESG strategy (see Figure 32 and Figure 33).

Figure 33: Correlation matrix between the returns of different quality factors

	Return on Equity	Debt to Equity	Earnings Dispersion	Benefits factor
Return on Equity	1			
Debt to Equity	-0.352120089	1		
Earnings Dispersion	0.636138486	0.240026839	1	
Benefits factor	0.107206749	-0.388058359	-0.146374651	1

Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

The BizQualify growth factor

BizQualify provides its own factors based on the data they collect across their population of companies. All of the factors are calibrated with the current six years of data. The results therefore might contain some form of look-ahead bias. Nevertheless, it is interesting to note that certain factors collected by the IRS have historically explained the performance of publicly traded companies. In particular, this analysis allows us to extrapolate as to the performance of their privately owned counterparts.

The most relevant factor from a stock selection perspective is the BizQualify growth factor, which captures a weighted average of the growth in employees, pension contributions and other size factors of the company. The growth factor presents weak performance on a short-term (i.e., monthly), but reasonable rank IC over a longer term (i.e., one year) horizon, as would be expected from a yearly factor. This translates into another low turnover portfolio with low risk and a good Sharpe ratio.Figure 34. All of the factors relate to the growth in employees or pension contributions, which are used as proxies for growth in earnings.

The most relevant factor from a stock selection perspective is the BizQualify growth factor, which captures a weighted average of the growth in employees, pension contributions and other size factors of the company.

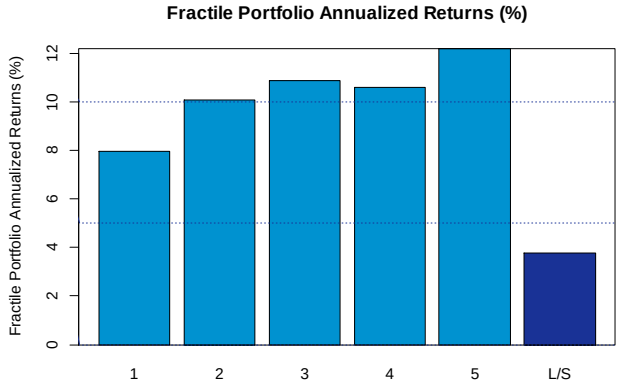
Figure 34: Input factors for the BizQualify growth score

Variable Description	Variable Name
Growth rate of employee contributions to pension plans, 1 year	bq_growth_emp_contrib_pens_amt_a_1yr
Growth rate of employee contributions to pension plans	bq_growth_emp_contrib_pens_amt_a
Growth rate of total contributions to pension plans, 1 year	bq_growth_tot_contrib_pens_amt_a_1yr
Growth rate of total contributions to pension plans	bq_growth_tot_contrib_pens_amt_a
Growth rate of company contributions to pension plans	bq_growth_co_contrib_pens_amt_a
Growth rate of company contributions to pension plans, 1 year	bq_growth_co_contrib_pens_amt_a_1yr
Growth rate of employee contributions per current employee eligible for a pension plan	bq_growth_emp_contrib_per_emp_curr_a
Growth rate of employee contributions per current employee eligible for a pension plan, 1 year	bq_growth_emp_contrib_per_emp_curr_a_1yr
Growth rate of total contributions to pension plans per current employee	bq_growth_tot_contrib_per_emp_curr_a
Growth rate of total contributions to pension plans per current employee, 1 year	bq_growth_tot_contrib_per_emp_curr_a_1yr
Growth rate of company contributions per current employee eligible for a pension plan	bq_growth_co_contrib_per_emp_curr_a
Growth rate of company contributions per current employee eligible for a pension plan, 1 year	bq_growth_co_contrib_per_emp_curr_a_1yr
Growth rate of employees, 1 year	bq_emp_growth_rate_1yr
Growth rate of employees	bq_emp_growth_rate

Source: Deutsche Bank

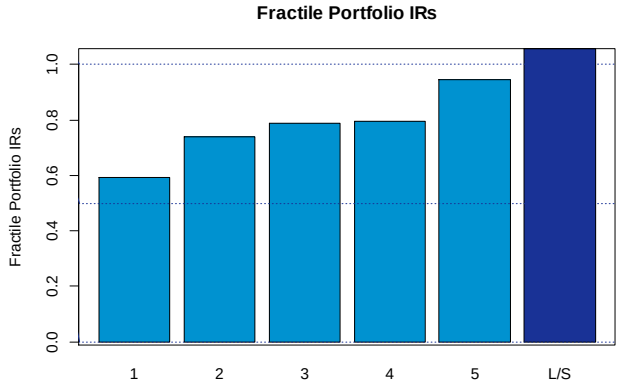
We can see in Figure 35 that BizQualify's growth factor successfully measures outperformance. The pay-off is linear and leads to a strong Sharpe ratio (see Figure 36).

Figure 35: Annualized quantile returns for the BizQualify growth factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

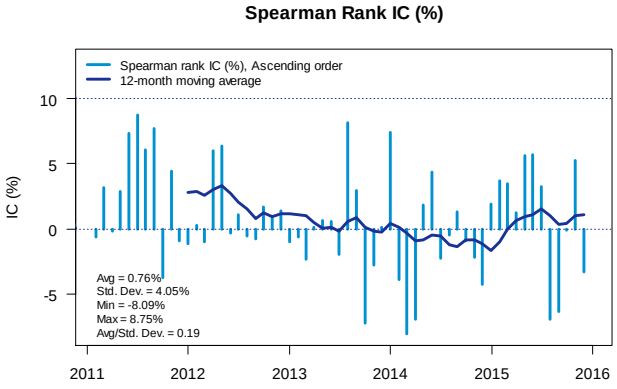
Figure 36: Sharpe ratio for the BizQualify growth factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

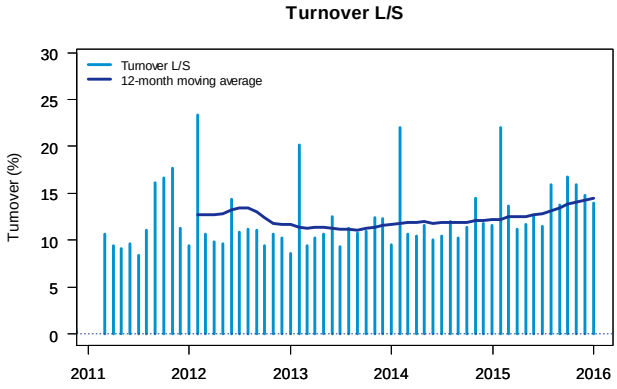
The monthly rank IC is weak (see Figure 37) but the turnover is also low (Figure 38). Again, this indicates that the signal is more adapted for a long-term strategy.

Figure 37: Rank IC for the BizQualify growth factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

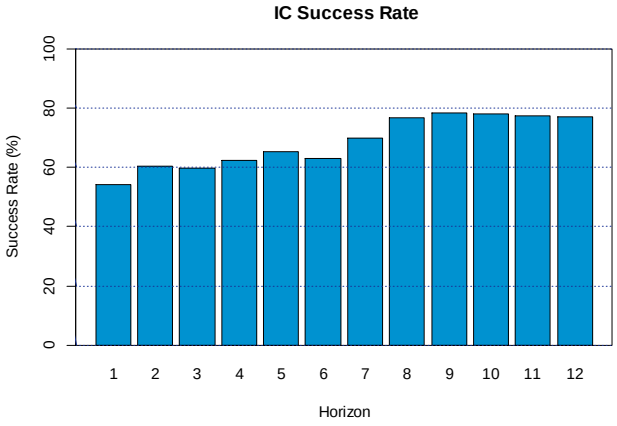
Figure 38: Two way turnover for the BizQualify growth factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

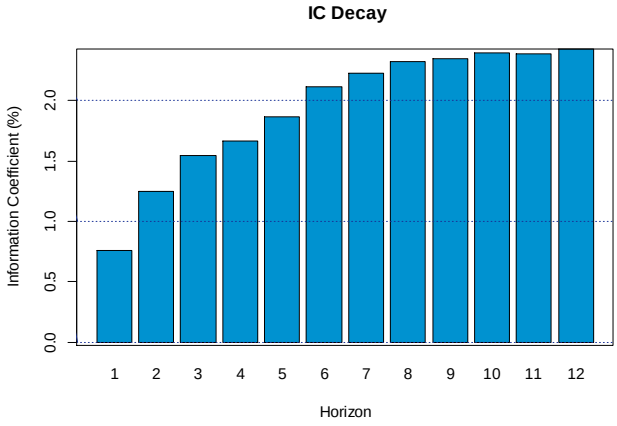
To confirm this, Figure 39 and Figure 40 show the significant increase in performance as we increase the prediction horizon of the strategy.

Figure 39: Success rate as a function of investment horizon for the BizQualify growth factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

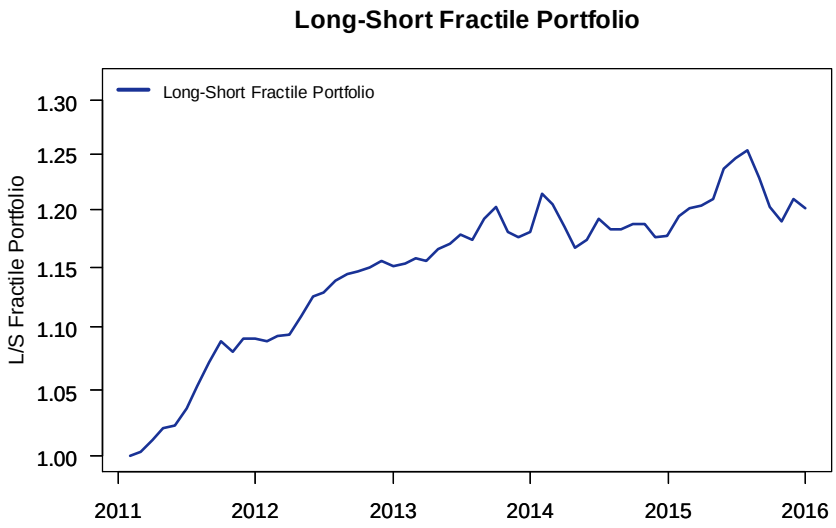
Figure 40: Rank IC as a function of investment horizon for the BizQualify growth factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

Finally, Figure 41 shows the cumulative performance of the BizQualify growth.

Figure 41: Long-Short quantile portfolio for the BizQualify growth factor, rebalanced monthly



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

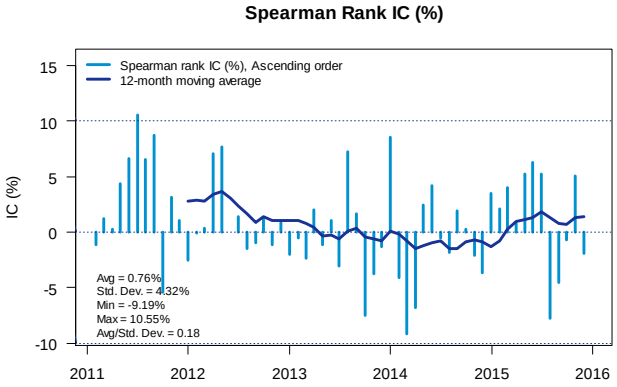
The Sector-Neutral Growth Factor

This is a Sector-Neutral version of the Growth Factor. Since employees tend to work in the same sector, we expect outperformance or underperformance of a stock to arise when employees join or leave from similar position at competing companies

The reasoning behind sector-neutralization is that BizQualify captures employee-level trends of companies. An employee tends to work in a same sector. Therefore, we expect outperformance or underperformance of a stock to arise when employees join or leave from similar position at competing companies.

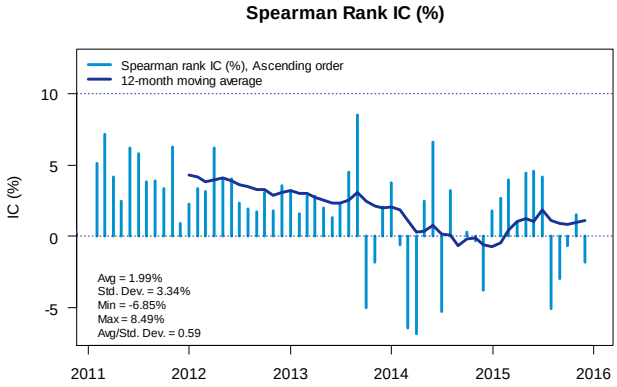
We propose two ways of neutralizing the growth score with respect to sectors: using IRS and using GICs sectors. While both improve the performance of the signal, we can see in Figure 42 and Figure 43 that the GICs sector renormalization significantly outperforms the IRS delineated sectors. This is despite the IRS sector data being much broader due to the presence of privately owned companies. This is consistent with the research done by Scott and Hrazdil [2013].

Figure 42: Rank IC for the BizQualify growth factor, IRS-sector neutralized



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

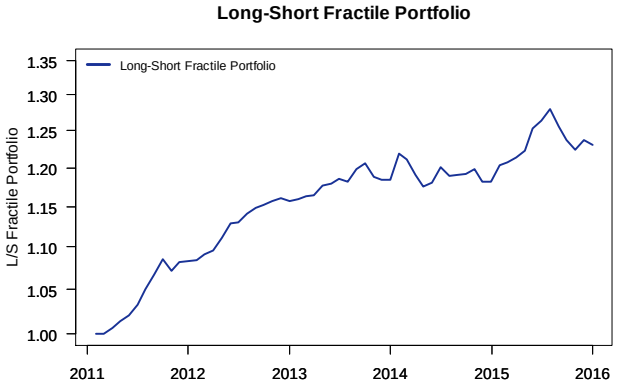
Figure 43: Rank IC for the BizQualify growth factor, GICS-sector neutralized



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

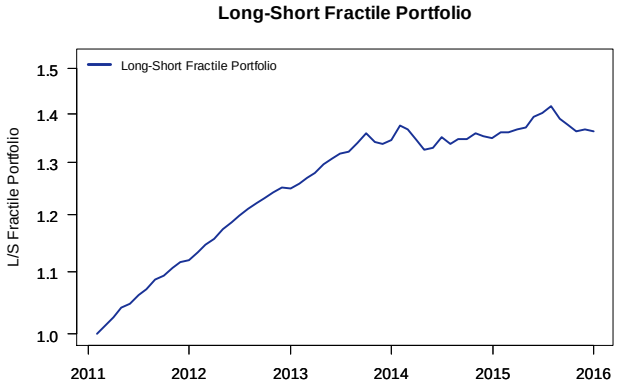
Again, keep in mind that the growth score has been calibrated over the current data sample, with a special emphasis on the first three years. This partly explains the decrease in performance over time that we can see both in Figure 44 and Figure 45.

Figure 44: Cumulative performance for the BizQualify growth factor, IRS-sector neutralized



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

Figure 45: Cumulative performance for the BizQualify growth factor, GICs-sector neutralized

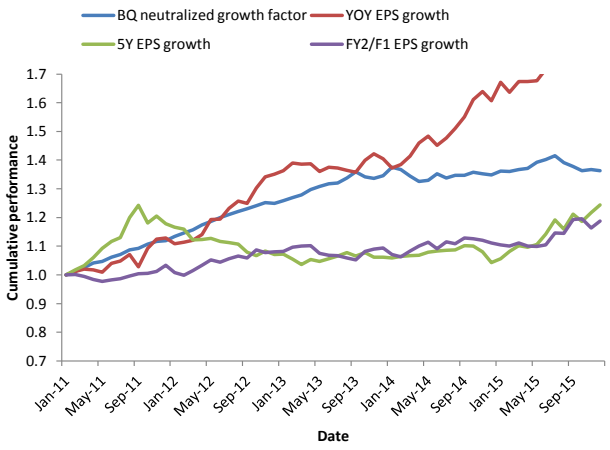


Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

While the cumulative performance is to be taken with a grain of salt because of the in-sample nature of the signal, it provides us some color on how peers and competitors may affect a stock's performance. Growth (or loss) of employees to private competitors can therefore be seen as a negative signal.

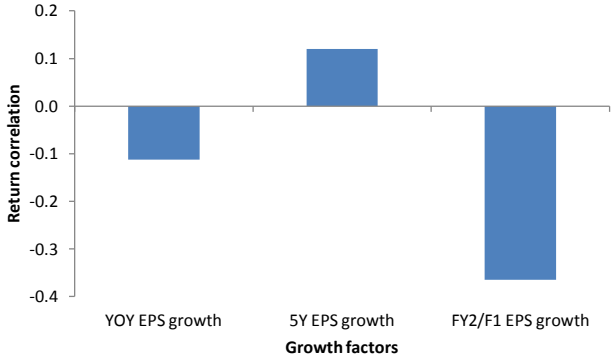
Just as for the benefits factor, we provide a comparison of the final BizQualify growth factor (GICs sector neutralized) with traditional growth factors in Figure 31. The performance is on par with other growth factors, with significantly less risk.

Figure 46: Cumulative performance of selected growth factors



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

Figure 47: Return correlation between growth factors and the Bizqualify sector-neutral growth factor



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

We find that the Bizqualify growth factor is uncorrelated to traditional growth factors, as seen in Figure 47 and Figure 48.

Figure 48: Correlation matrix between the returns of different quality factors

	YOY EPS growth	5Y EPS growth	FY2/F1 EPS growth	BQ neutralized growth factor
YOY EPS growth	1			
5Y EPS growth	0.202701326	1		
FY2/F1 EPS growth	0.683318146	0.190726459	1	
BQ neutralized growth factor	-0.112151712	0.119816735	-0.364426267	1

Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

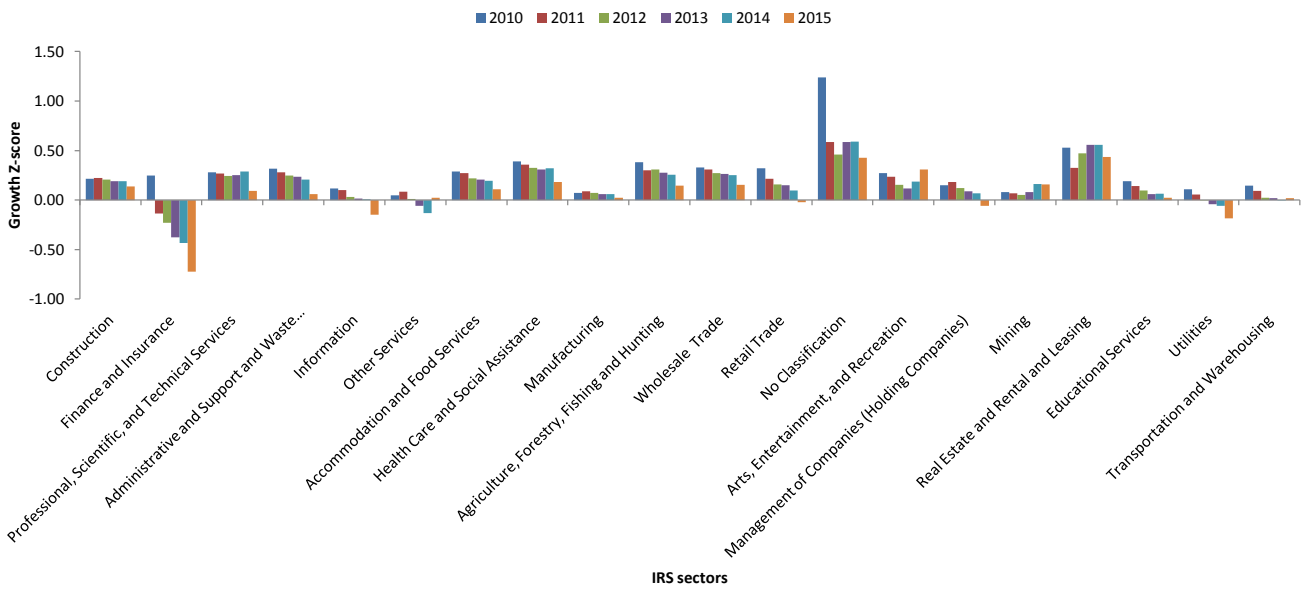
Implications for private capital

Companies that are privately owned, by definition, rarely exhibit public prices. Exceptions relate to corporate events, such as an IPO or merger attempts. This makes it difficult for investors to compare them to publicly traded companies. But such comparisons are useful. Private capital can be invested should a company exhibit particularly promising characteristics. A comparison can also be useful to understand how competitors fare, something BizQualify can provide.

The above two factors, backtested on the few thousand stocks within our investment universe, can be expanded onto the full breadth of the BizQualify data set to provide some color on the performance of hundreds of thousands more companies.

Figure 49 shows the average alpha score of the privately owned companies of each sector. Assuming the alpha model of Figure 44 for publicly traded companies carries over privately owned companies, this allows us to assess the historical growth performance of private companies across sectors.

Figure 49: Growth alpha score for private companies in each of the twenty IRS sectors, employee weighted



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P

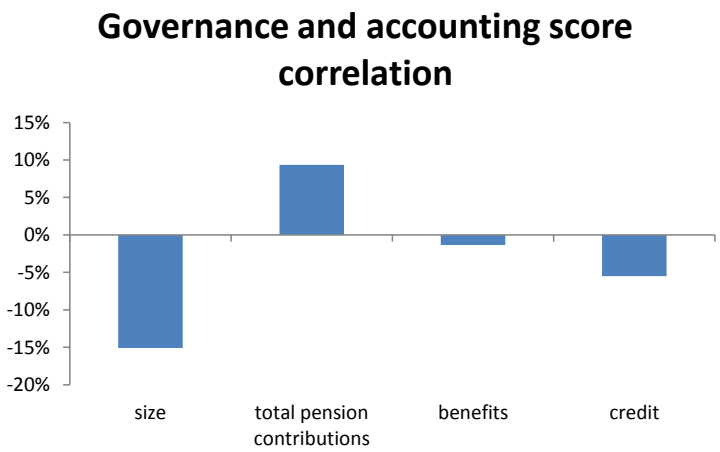
Private Finance companies underperform and Real Estate companies outperform. In general, there is a positive risk premium attached to private equity, which the above alpha score quantifies. For instance, based on its growth factor alpha score, we would estimate that private Real Estate and Rental companies likely outperformed the broader market by about three percent yearly. Privately owned Information companies, on the other hand, did not outperform their public counterparts.

Lastly, the link to quality and ESG

In Figure 50, we plot the correlation between our four factors and the governance and accounting scores from AGR (See Jussa et al, 2013, Jussa et al, 2015, Elledge et al, 2015). Unsurprisingly, larger companies tend to fare less well, mostly because of increased scrutiny. The correlations to savings and credit also make sense, but are quite weak. We would expect companies that fail to provide a benefit to their employees to exhibit a more negative ESG exposure than just -5%.

Surprisingly, we find that companies that provide more benefits to their employees do not score higher in ESG scores. We believe therefore that incorporating the benefits metric into an ESG portfolio could add some additional diversification benefit while promoting the governance of the companies it invests in. We will furthermore show that the benefits factor exhibits positive out-of-sample alpha at a very low turnover, further boosting its value to an ESG portfolio.

Figure 50: Correlation between ESG and BizQualify scores



Source: Bizqualify, Deutsche Bank Quantitative Strategy, Thompson Reuters, Compustat, IBES, Russell, S&P, AGR

References

Jussa, J., Alvarez, M., Wang, S., Luo, Y. and Chen Z. [2014]. "SRI Integration using Smart Beta", Deutsche Bank Quantitative Strategy, August 20, 2013

Jussa, J., Rohal, G., Luo, Y., Alvarez, M., Wang, S., Wang, A., Elledge, D. [2015]. "A Darwinian Approach to Detecting Accounting Irregularities", Deutsche Bank Quantitative Strategy, March 4, 2015

Elledge, D., Luo, Y., Alvarez, M., Javed, J., Wang, S., Rohal, G., Wang, A. [2015]. "Forensic Accounting in Global Stock Selection", Deutsche Bank Quantitative Strategy, May 14, 2015

Jussa, J., Alvarez, M., Wang, S. and Luo, Y. [2014]. "The Spinoff Premia Wave", Deutsche Bank Quantitative Strategy, November 4, 2014

Jussa, J., Alvarez, M., Wang, S. and Luo, Y. [2014]. "Event Driven Merger Premia", Deutsche Bank Quantitative Strategy, September 2, 2014

Wang, S., Webster, K. and Luo, Y. [2015]. "Systematic M&A Arbitrage", Deutsche Bank Quantitative Strategy, September 28, 2015

Luo, Y., Cahan, R., Jussa, J. and Alvarez, M. [2010]. "Signal Processing: Style rotation", Deutsche Bank Quantitative Strategy, September 7, 2010

Luo, Y., Rohal, G., Alvarez, M., Jussa, J., Wang, S., Wang, A., and Elledge, D. [2015]. "Current Affairs", Deutsche Bank Quantitative Strategy, February 18, 2015

Wang, S., Webster, K., Luo, Y., Alvarez, M., Jussa, J., Rohal, G., Wang, A., Elledge, D., and Zhao, G. [2015]. "Systematic M&A Arbitrage", Deutsche Bank Quantitative Strategy, September 28, 2015

Jussa, J., Alvarez, M., Wang, S., Wang, A., Luo, Y., and Chen, Z. [2014]. "Smart Holdings", Deutsche Bank Quantitative Strategy, February 14, 2014

Luo, Y., Wang, S., Cahan, R., Jussa, J., Chen, Z., and Alvarez, M. [2013]. "DB Handbook of Portfolio Construction: Part I", Deutsche Bank Quantitative Strategy, May 30, 2013.

Scott, T.W., Hrazdil, K. [2013] "The Role of Industry Classification in Estimating Discretionary Accruals", Review of Quantitative Finance and Accounting, Vol 40, No 1, pp 13-39.

Appendix 1

Important Disclosures

Additional information available upon request

*Prices are current as of the end of the previous trading session unless otherwise indicated and are sourced from local exchanges via Reuters, Bloomberg and other vendors . Other information is sourced from Deutsche Bank, subject companies, and other sources. For disclosures pertaining to recommendations or estimates made on securities other than the primary subject of this research, please see the most recently published company report or visit our global disclosure look-up page on our website at http://gm.db.com/ger/disclosure/DisclosureDirectory.eqsr

Analyst Certification

The views expressed in this report accurately reflect the personal views of the undersigned lead analyst(s). In addition, the undersigned lead analyst(s) has not and will not receive any compensation for providing a specific recommendation or view in this report. Kevin Webster/Javed Jussa/Gaurav Rohal/Yin Luo/Miguel-A Alvarez/Sheng Wang/George Zhao/Allen Wang/David Elledge

Hypothetical Disclaimer

Backtested, hypothetical or simulated performance results have inherent limitations. Unlike an actual performance record based on trading actual client portfolios, simulated results are achieved by means of the retroactive application of a backtested model itself designed with the benefit of hindsight. Taking into account historical events the backtesting of performance also differs from actual account performance because an actual investment strategy may be adjusted any time, for any reason, including a response to material, economic or market factors. The backtested performance includes hypothetical results that do not reflect the reinvestment of dividends and other earnings or the deduction of advisory fees, brokerage or other commissions, and any other expenses that a client would have paid or actually paid. No representation is made that any trading strategy or account will or is likely to achieve profits or losses similar to those shown. Alternative modeling techniques or assumptions might produce significantly different results and prove to be more appropriate. Past hypothetical backtest results are neither an indicator nor guarantee of future returns. Actual results will vary, perhaps materially, from the analysis.

Regulatory Disclosures

1.Important Additional Conflict Disclosures

Aside from within this report, important conflict disclosures can also be found at https://gm.db.com/equities under the "Disclosures Lookup" and "Legal" tabs. Investors are strongly encouraged to review this information before investing.

2.Short-Term Trade Ideas

Deutsche Bank equity research analysts sometimes have shorter-term trade ideas (known as SOLAR ideas) that are consistent or inconsistent with Deutsche Bank's existing longer term ratings. These trade ideas can be found at the SOLAR link at http://gm.db.com.

Additional Information

The information and opinions in this report were prepared by Deutsche Bank AG or one of its affiliates (collectively "Deutsche Bank"). Though the information herein is believed to be reliable and has been obtained from public sources believed to be reliable, Deutsche Bank makes no representation as to its accuracy or completeness.

If you use the services of Deutsche Bank in connection with a purchase or sale of a security that is discussed in this report, or is included or discussed in another communication (oral or written) from a Deutsche Bank analyst, Deutsche Bank may act as principal for its own account or as agent for another person.

Deutsche Bank may consider this report in deciding to trade as principal. It may also engage in transactions, for its own account or with customers, in a manner inconsistent with the views taken in this research report. Others within Deutsche Bank, including strategists, sales staff and other analysts, may take views that are inconsistent with those taken in this research report. Deutsche Bank issues a variety of research products, including fundamental analysis, equity-linked analysis, quantitative analysis and trade ideas. Recommendations contained in one type of communication may differ from recommendations contained in others, whether as a result of differing time horizons, methodologies or otherwise. Deutsche Bank and/or its affiliates may also be holding debt securities of the issuers it writes on.

Analysts are paid in part based on the profitability of Deutsche Bank AG and its affiliates, which includes investment banking revenues.

Opinions, estimates and projections constitute the current judgment of the author as of the date of this report. They do not necessarily reflect the opinions of Deutsche Bank and are subject to change without notice. Deutsche Bank has no obligation to update, modify or amend this report or to otherwise notify a recipient thereof if any opinion, forecast or estimate contained herein changes or subsequently becomes inaccurate. This report is provided for informational purposes only. It is not an offer or a solicitation of an offer to buy or sell any financial instruments or to participate in any particular trading strategy. Target prices are inherently imprecise and a product of the analyst's judgment. The financial instruments discussed in this report may not be suitable for all investors and investors must make their own informed investment decisions. Prices and availability of financial instruments are subject to change without notice and investment transactions can lead to losses as a result of price fluctuations and other factors. If a financial instrument is denominated in a currency other than an investor's currency, a change in exchange rates may adversely affect the investment. Past performance is not necessarily indicative of future results. Unless otherwise indicated, prices are current as of the end of the previous trading session, and are sourced from local exchanges via Reuters, Bloomberg and other vendors. Data is sourced from Deutsche Bank, subject companies, and in some cases, other parties.

Macroeconomic fluctuations often account for most of the risks associated with exposures to instruments that promise to pay fixed or variable interest rates. For an investor who is long fixed rate instruments (thus receiving these cash flows), increases in interest rates naturally lift the discount factors applied to the expected cash flows and thus cause a loss. The longer the maturity of a certain cash flow and the higher the move in the discount factor, the higher will be the loss. Upside surprises in inflation, fiscal funding needs, and FX depreciation rates are among the most common adverse macroeconomic shocks to receivers. But counterparty exposure, issuer creditworthiness, client segmentation, regulation (including changes in assets holding limits for different types of investors), changes in tax policies, currency convertibility (which may constrain currency conversion, repatriation of profits and/or the liquidation of positions), and settlement issues related to local clearing houses are also important risk factors to be considered. The sensitivity of fixed income instruments to macroeconomic shocks may be mitigated by indexing the contracted cash flows to inflation, to FX depreciation, or to specified interest rates – these are common in emerging markets. It is important to note that the index fixings may -- by construction -- lag or mis-measure the actual move in the underlying variables they are intended to track. The choice of the proper fixing (or metric) is particularly important in swaps markets, where floating coupon rates (i.e., coupons indexed to a typically short-dated interest rate reference index) are exchanged for fixed coupons. It is also important to acknowledge that funding in a currency that differs from the currency in which coupons are denominated carries FX risk. Naturally, options on swaps (swaptions) also bear the risks typical to options in addition to the risks related to rates movements.

Derivative transactions involve numerous risks including, among others, market, counterparty default and illiquidity risk. The

appropriateness or otherwise of these products for use by investors is dependent on the investors' own circumstances including their tax position, their regulatory environment and the nature of their other assets and liabilities, and as such, investors should take expert legal and financial advice before entering into any transaction similar to or inspired by the contents of this publication. The risk of loss in futures trading and options, foreign or domestic, can be substantial. As a result of the high degree of leverage obtainable in futures and options trading, losses may be incurred that are greater than the amount of funds initially deposited. Trading in options involves risk and is not suitable for all investors. Prior to buying or selling an option investors must review the "Characteristics and Risks of Standardized Options", at http://www.optionsclearing.com/about/publications/character-risks.jsp. If you are unable to access the website please contact your Deutsche Bank representative for a copy of this important document.

Participants in foreign exchange transactions may incur risks arising from several factors, including the following: (i) exchange rates can be volatile and are subject to large fluctuations; (ii) the value of currencies may be affected by numerous market factors, including world and national economic, political and regulatory events, events in equity and debt markets and changes in interest rates; and (iii) currencies may be subject to devaluation or government imposed exchange controls which could affect the value of the currency. Investors in securities such as ADRs, whose values are affected by the currency of an underlying security, effectively assume currency risk.
Unless governing law provides otherwise, all transactions should be executed through the Deutsche Bank entity in the investor's home jurisdiction.

United States: Approved and/or distributed by Deutsche Bank Securities Incorporated, a member of FINRA, NFA and SIPC. Analysts employed by non-US affiliates may not be associated persons of Deutsche Bank Securities Incorporated and therefore not subject to FINRA regulations concerning communications with subject companies, public appearances and securities held by analysts.

Germany: Approved and/or distributed by Deutsche Bank AG, a joint stock corporation with limited liability incorporated in the Federal Republic of Germany with its principal office in Frankfurt am Main. Deutsche Bank AG is authorized under German Banking Law (competent authority: European Central Bank) and is subject to supervision by the European Central Bank and by BaFin, Germany's Federal Financial Supervisory Authority.

United Kingdom: Approved and/or distributed by Deutsche Bank AG acting through its London Branch at Winchester House, 1 Great Winchester Street, London EC2N 2DB. Deutsche Bank AG in the United Kingdom is authorised by the Prudential Regulation Authority and is subject to limited regulation by the Prudential Regulation Authority and Financial Conduct Authority. Details about the extent of our authorisation and regulation are available on request.

Hong Kong: Distributed by Deutsche Bank AG, Hong Kong Branch.

India: Prepared by Deutsche Equities Private Ltd, which is registered by the Securities and Exchange Board of India (SEBI) as a stock broker. Research Analyst SEBI Registration Number is INH000001741. DEIPL may have received administrative warnings from the SEBI for breaches of Indian regulations.

Japan: Approved and/or distributed by Deutsche Securities Inc.(DSI). Registration number - Registered as a financial instruments dealer by the Head of the Kanto Local Finance Bureau (Kinsho) No. 117. Member of associations: JSDA, Type II Financial Instruments Firms Association and The Financial Futures Association of Japan. Commissions and risks involved in stock transactions - for stock transactions, we charge stock commissions and consumption tax by multiplying the transaction amount by the commission rate agreed with each customer. Stock transactions can lead to losses as a result of share price fluctuations and other factors. Transactions in foreign stocks can lead to additional losses stemming from foreign exchange fluctuations. We may also charge commissions and fees for certain categories of investment advice, products and services. Recommended investment strategies, products and services carry the risk of losses to principal and other losses as a result of changes in market and/or economic trends, and/or fluctuations in market value. Before deciding on the purchase of financial products and/or services, customers should carefully read the relevant disclosures, prospectuses and other documentation. "Moody's", "Standard & Poor's", and "Fitch" mentioned in this report are not registered credit rating agencies in Japan unless Japan or "Nippon" is specifically designated in the name of the entity. Reports on Japanese listed companies not written by analysts of DSI are written by Deutsche Bank Group's analysts with the coverage companies specified by DSI. Some of the foreign securities stated on this report are not disclosed according to the Financial Instruments and Exchange Law of Japan.

Korea: Distributed by Deutsche Securities Korea Co.

South Africa: Deutsche Bank AG Johannesburg is incorporated in the Federal Republic of Germany (Branch Register Number in South Africa: 1998/003298/10).

Singapore: by Deutsche Bank AG, Singapore Branch or Deutsche Securities Asia Limited, Singapore Branch (One Raffles Quay #18-00 South Tower Singapore 048583, +65 6423 8001), which may be contacted in respect of any matters arising from, or in connection with, this report. Where this report is issued or promulgated in Singapore to a person who is not an accredited investor, expert investor or institutional investor (as defined in the applicable Singapore laws and regulations), they accept legal responsibility to such person for its contents.

Qatar: Deutsche Bank AG in the Qatar Financial Centre (registered no. 00032) is regulated by the Qatar Financial Centre Regulatory Authority. Deutsche Bank AG - QFC Branch may only undertake the financial services activities that fall within the scope of its existing QFCRA license. Principal place of business in the QFC: Qatar Financial Centre, Tower, West Bay, Level 5, PO Box 14928, Doha, Qatar. This information has been distributed by Deutsche Bank AG. Related financial products or services are only available to Business Customers, as defined by the Qatar Financial Centre Regulatory Authority.

Russia: This information, interpretation and opinions submitted herein are not in the context of, and do not constitute, any appraisal or evaluation activity requiring a license in the Russian Federation.

Kingdom of Saudi Arabia: Deutsche Securities Saudi Arabia LLC Company, (registered no. 07073-37) is regulated by the Capital Market Authority. Deutsche Securities Saudi Arabia may only undertake the financial services activities that fall within the scope of its existing CMA license. Principal place of business in Saudi Arabia: King Fahad Road, Al Olaya District, P.O. Box 301809, Faisaliah Tower - 17th Floor, 11372 Riyadh, Saudi Arabia.

United Arab Emirates: Deutsche Bank AG in the Dubai International Financial Centre (registered no. 00045) is regulated by the Dubai Financial Services Authority. Deutsche Bank AG - DIFC Branch may only undertake the financial services activities that fall within the scope of its existing DFSA license. Principal place of business in the DIFC: Dubai International Financial Centre, The Gate Village, Building 5, PO Box 504902, Dubai, U.A.E. This information has been distributed by Deutsche Bank AG. Related financial products or services are only available to Professional Clients, as defined by the Dubai Financial Services Authority.

Australia: Retail clients should obtain a copy of a Product Disclosure Statement (PDS) relating to any financial product referred to in this report and consider the PDS before making any decision about whether to acquire the product. Please refer to Australian specific research disclosures and related information at https://australia.db.com/australia/content/research-information.html

Australia and New Zealand: This research, and any access to it, is intended only for "wholesale clients" within the meaning of the Australian Corporations Act and New Zealand Financial Advisors Act respectively.
Additional information relative to securities, other financial products or issuers discussed in this report is available upon request. This report may not be reproduced, distributed or published by any person for any purpose without Deutsche Bank's prior written consent. Please cite source when quoting.

David Folkerts-Landau
Chief Economist and Global Head of Research

Raj Hindocha
Global Chief Operating Officer
Research

Marcel Cassard
Global Head
FICC Research & Global Macro Economics

Steve Pollard
Global Head
Equity Research

Michael Spencer
Regional Head
Asia Pacific Research

Ralf Hoffmann
Regional Head
Deutsche Bank Research, Germany

Andreas Neubauer
Regional Head
Equity Research, Germany

International Locations

Deutsche Bank AG
Deutsche Bank Place
Level 16
Corner of Hunter & Phillip Streets
Sydney, NSW 2000
Australia
Tel: (61) 2 8258 1234

Deutsche Bank AG
Große Gallusstraße 10-14
60272 Frankfurt am Main
Germany
Tel: (49) 69 910 00

Deutsche Bank AG
Filiale Hongkong
International Commerce Centre,
1 Austin Road West,Kowloon,
Hong Kong
Tel: (852) 2203 8888

Deutsche Securities Inc.
2-11-1 Nagatacho
Sanno Park Tower
Chiyoda-ku, Tokyo 100-6171
Japan
Tel: (81) 3 5156 6770

Deutsche Bank AG London
1 Great Winchester Street
London EC2N 2EQ
United Kingdom
Tel: (44) 20 7545 8000

Deutsche Bank Securities Inc.
60 Wall Street
New York, NY 10005
United States of America
Tel: (1) 212 250 2500