



BOSTON COLLEGE
Carroll School of Management

Case Write-up

The Vanderbilt University Endowment (2006)

MFIN 8803 Quantitative Portfolio Management

Presented to Prof. Arié Dahan

BAI, Ling
DINGLEY, Megan
JIN, Xiao
LIU, Zixuan
VARMA, Advait A.

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Executive Summary

Vanderbilt University located in Nashville, Tennessee. Numbers surrounding the university are as follows: 330-acre campus, 10 major schools and a major medical center (operating independently). The school has 11,000 students and it employs more than 20,000 people. 41 Active trustees who met semiannually, overseen by several board committees, including executive, Budget, and Investment committees, which met quarterly. Investment committee has 11 members, including 4 non trustees who were investment professionals.

The case talks about Bill Bain who in 2006 September became the newest member and chair of Vanderbilt University's Investment Committee. He had been a long-time member of Vanderbilt University's Investment committee and remembered that the asset mix during the 1980s had been relatively simple. Now he finds himself in a conundrum. He feels that the portfolio has been more complicated in terms of the type of assets they have invested in. He realized that there were certain incongruencies in terms of the planning surrounding the asset mix and a general sense of unawareness on behalf of the constituencies that the investment committee represented.

Main Concern:

The main concern was the tolerance or ability of the fund to withstand another financial crisis as the ability is highly dependent on the liquidity of the assets in the portfolio. There was considerable illiquidity in the portfolio as the fund had invested in Real Estate, Private Equity, and Hedge Funds.

Adding to that was the problem related to the amount of explicit leverage. That was difficult to evaluate as it was employed by PE firms and Hedge funds. Which also goes for the remaining portion of the fund, that was managed by Managers A through D. They had employed various strategies that took a significant amount of exposure in terms of the long and short positions in equity and investing the alpha earned into S&P 500 Futures. It was difficult to translate them into how much leverage was in the position and if the members of the board and the fund understood the strategies executed by managers C and D.

The Recommended Portfolio:

The benchmark portfolio was created to reference the creation of Vanderbilt's 2021 endowment portfolio. The portfolio would consist of fixed income assets, private equity, real estate, Natural resources, venture capital, hedge funds, US equities and cash. Availability of liquidity has been a prime concern while formulating the portfolio, thus the investments in g-bonds and T-bills have been made accordingly. Real estate has been used as a hedge against the stock market and inflation. Allocation to private equity was reduced. Venture capital and Hedge Funds investments have been made keeping in mind the high returns and liquidity concerns.

Major Concerns

Leverage

Bill believes that the amount of leverage being used by investment managers is the biggest risk to the Vanderbilt endowment. Most of the leverage in the endowment stems from the investment in underlying assets. Specifically, for Vanderbilt it is coming from real estate, private equity, timber, and energy. For the more complex investment strategies, it is more difficult to quantify what the leverage is due to not knowing what is exactly invested in and how. Also, it was difficult for him to value the leverage of an alpha transport strategy. He questioned whether he should add the total exposure together or subtract them from each other with the inclusion of net-zeroing exposure via alpha transport. With what can be seen in the table below, the largest exposure to leverage, non-marketable assets, has a low Sharpe ratio at 0.36. This confirms Bill's doubts that Vanderbilt is taking on more risk than they are being rewarded for.

Exhibit 1. Vanderbilt Endowment Fund- Performance Measures

	US Equities	Wilshire 5000	Global Equities	MSCI World	Int'l Equities	MSCI EAFE	Emerg. Mkt. Eq.	MSCI Free	Absolute Return	2.5 XT-bill	Fixed Income	Fixed Benchmark	Non- Marketable	Blended Benchmark	Opportuni stic	Tremont Macro Index	Total Fund	Blended Benchmark
1999	6.80%	19.6%	25.9%	15.7%	16.8%	7.6%	34.3%	28.7%	0.0%	12.2%	0.8%	-0.3%	107.0%	19.9%			19.8%	16.2%
2000	11.40%	9.70%	21.40%	12.20%	14.10%	17.20%	35.70%	9.50%	-4.50%	14.70%	2.90%	4.60%	129.30%	13.80%			31.90%	11.8%
2001	-0.30%	-15.20%	-14.00%	-20.30%	6.50%	-23.60%	-25.40%	-25.80%	14.60%	14.10%	10.30%	10.00%	-21.20%	-4.70%			-4.70%	-7.10%
2002	-8.40%	-16.60%	-13.60%	-15.20%	-9.80%	-9.50%	1.00%	1.30%	8.20%	5.50%	9.20%	9.10%	-18.50%	-17.80%			-5.80%	-8.80%
2003	1.60%	1.30%	1.80%	-2.40%	1.80%	-6.50%	4.10%	7.00%	8.00%	3.40%	17.30%	19.40%	-4.10%	-1.90%			3.80%	2.80%
2004	19.90%	21.20%	26.20%	24.00%	42.40%	32.40%	38.20%	33.50%	10.10%	2.60%	-2.10%	-4.00%	13.30%	12.30%	1.70%	4.40%	16.90%	13.60%
2005	6.50%	8.40%	9.20%	10.10%	12.40%	13.60%	43.10%	34.90%	10.60%	6.00%	10.20%	16.80%	38.80%	19.70%	7.10%	11.10%	17.90%	14.20%
2006	3.80%	10.00%	18.70%	16.90%	18.10%	26.60%	24.10%	35.90%	9.70%	10.20%	-3.20%	-6.30%	27.30%	19.00%	15.60%	11.90%	14.00%	13.80%
Performance Measures																		
Avg Return	5.16%	2.69%	7.10%	3.61%	12.21%	7.17%	17.26%	13.76%	8.10%	8.07%	6.37%	7.09%	23.56%	5.77%	8.13%	9.13%	10.57%	4.75%
SD	8.36%	13.98%	16.38%	16.68%	16.20%	20.69%	25.00%	22.77%	5.97%	4.96%	7.45%	9.72%	51.75%	14.14%	7.01%	4.12%	13.59%	10.75%
Sharpe	0.04	-0.15	0.14	-0.07	0.46	0.11	0.50	0.39	0.55	0.66	0.21	0.23	0.36	0.07	0.48	1.05	0.42	0.00

Sharpe Ratio calculated with risk-free rate 4.08%.

We agree with Bill's concerns about leverage because it could cause large losses. It also can cause unnecessary risk without providing the expected returns. A way to help alleviate his concerns could be to implement a leverage target or constraint.

Lack of Transparency

Another of Bill Bain's main concerns was the lack of transparency on the part of what is being invested in. This was mainly derived from the fact that a lot of the investments were controlled by 95 external investment organizations, and that 22% of the funds invested in hedge funds containing non-marketable holdings had not provided any specific information about what they were invested in. For Vanderbilt University, Bill felt that the managers should be as transparent as possible. Bill needed this to confidently value the risk that the fund managers were taking on. Due to the lack of transparency, it made it difficult for Bill to quantify and measure leverage within the endowment.

These concerns can easily be fixed. To calm his concerns about not knowing what each investor has been investing in, quarterly or semiannual reports could be given to Bill. The reports could include more information about what is specifically invested in, the risk associated with those investments, and any projected changes. This information would provide Bill an avenue to better understand how the managers are investing, and if their strategies are worth the risk. He would also be better able to measure the actual leverage being utilized by the managers. We agree with this concern because what is being invested in should be readily available. Also, the information that is not given makes it more difficult to analyze the endowment portfolio and know how appropriate the amount of leverage and allocation is.

Illiquidity

The other concern of Bill Bain was that 45% of the endowment is invested in illiquid holding. More specifically, 23% of the funds was composed of nonmarketable investments such as real estate and private equity. He was also concerned about the pricing of these investments since it is difficult to correctly price illiquid investment and the use of alternative investment strategies. Since the university's endowment is required to meet operating, strategic, and financial needs of the college, liquidity can be a major concern.

We believe that we should not confuse liquidity with safety, and we should use liquid and illiquid assets as components that when combined can provide different protection or return enhancement. It is important to be prepared for downturns during bull markets and closely monitor the performance of the funds. There are several ways to alleviate Bill Bain's concern on illiquidity. For example, the endowment can be subject to stress tests that simulate different situations and use outcomes to decide the components and the percentage of the components in the endowment. Another way is to refine liquidity requirements. For instance, we can specify the percentage of liquid assets in endowment or in detailed requirements, how much of the long-term asset should be liquid within 1-3 years.

Recommended Portfolio for 2021

Benchmark Portfolio

We construct a benchmark portfolio to provide a reference for the construction of Vanderbilt's 2021 endowment portfolio. The benchmark consists of five largest U.S. University endowments in fiscal year 2020, which includes Harvard, Yale, Princeton, MIT, and Stanford (Exhibit 2). It is constructed using a weighted-average strategy relative to the size of each endowment. Compared to the benchmark portfolio, Vanderbilt's endowment has higher weights on public equities and fixed income and cash, while allocates less to the non-marketable. Specifically, Vanderbilt has a relatively smaller weight on real estate.

Exhibit 2. Benchmark Portfolio

	Vanderbilt	Harvard	Princeton	Yale	MIT	Stanford	Benchmark
U.S. Equities			10.00%	2.30%	11.00%	6.00%	
Int'l Equities			3.00%	11.40%	24.00%	19.00%	
Emg. Equities			9.00%				
Total Public Equities	28.00%	18.90%	22.00%	13.70%	35.00%	25.00%	21.60%
Bonds/TIPS	9.00%	5.10%			6.00%		
Cash	5.00%	5.60%	6.00%		5.00%		
Total Fixed Income and Cash	14.00%	10.70%	6.00%	13.70%	13.70%	10.00%	10.74%
Private Equity	26.00%	23.00%	30.00%		25.00%	30.00%	
Real Estate	2.00%	7.10%		8.60%	12.00%	8.00%	
Natural Resources	4.00%	2.60%		3.90%		6.00%	
Venture Capital				22.60%			
Other Real Asset		1.30%			3.00%		
Total Non-Marketable	32.00%	34.00%	30.00%	35.10%	40.00%	44.00%	36.33%
Hedge Funds	25.00%	36.40%					
Absolute Return			24.00%	21.60%		21.00%	
Total Marketable Alternatives	25.00%	36.40%	24.00%	21.60%	14.00%	21.00%	25.15%
Leveraged Buyouts				15.80%			3.34%
Commodities	1.00%		18.00%				3.16%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Annual Return	-0.10%	7.30%	5.60%	6.80%	8.30%	5.60%	6.67%

Constraints Analysis

To construct the recommended portfolio, we set a few constraints. The constraints are based on the asset allocation of the benchmark portfolio, the real-life scenario and the concerns discussed above.

According to the benchmark portfolio and each endowment within the portfolio, the allocation to fixed income is set to be more than 5% and the allocation to cash is set to be more than 3%. While the return of these two assets is relatively low compared to others, we still include them in the target portfolio based on two reasons. From one perspective, we would like to maintain a minimum level of liquidity and receive a stable but not excess return from investing in government bonds and 3-month T-bill so that the endowment could provide sufficient and continuing financial support to university and its students. From another perspective, the covariances of fixed income and cash relative to other asset classes are all negative, indicating that they could add diversification to the portfolio and provide it against downturn in the macroeconomic environment or even in recession.

The allocation to total global equities is set to be less than 26.60%, 5% higher than its weight in the benchmark portfolio to allow some level of flexibility. Equity is a traditional way of investing and has long acted as an important investment tool to many investors. We include domestic equities, international equities, and emerging market equities in this category for diversification purpose and protect against the downturn in any single country. However, the covariances of the global equities have been increasing especially in recent years and sometimes the stock market crash in one country soon becomes a global crash. Therefore, we anticipate the weight on U.S. equities will be higher than that on the other two equities since its historical return is relatively high and the volatility is low.

The allocation of the total non-marketable is limited to 41.33%, also 5% higher than its weight in the benchmark portfolio. While fixed income and cash provide a stable return and add liquidity, university endowments rely on equity type securities to boost long-term growth. The non-marketable and illiquid assets are included in the target portfolio to protect against global inflation and generate future cash flow. The non-marketable assets include private equity, real estate, natural resources, and venture capital. Like mentioned in the Yale Endowment Annual Report 2015, these non-traditional assets tend to be less efficiently priced compared to traditional marketable assets, providing an opportunity to exploit market inefficiencies through active management.

As alternative investments, private equity and venture capital can result in outsize returns for investment portfolios, and in this year, large endowments gain huge benefits from investing in private equity and venture capital, which is said to be the best banner year since 1986. MIT reported that its endowment had gained 56 % in its most recent fiscal year, and Yale has 40 % over the same period, and with the median return coming in at 27% for the period across the board. These large returns encourage endowments to allocate more to private equity and venture capital. Although private equity and venture capital had a bumper year and performed well in past couple years, their values are only superior on paper, and may not be able to withstand public market scrutiny in the future. Also, this bumper year may be because the economy is recovering from the impact of COVID-19 and may not last a long time. Moreover, even though the endowment has a long-time investment horizon and can benefit from illiquidity premium, they also need to meet college's operating, strategic, and financial needs. Therefore, with respect to Bill's illiquidity concern, allocation to private equity and venture capital can't be too high. Based on such concerns about illiquidity, we cautiously decide to increase the total weight of private equity and venture capital to 33.33%, which is 7% higher than the weight in benchmark portfolio. Which is achieved by lowering weight of private equity and increasing the weight of venture capital. We also set limitations for venture capital to increase the diversification.

We also allocate a lower bound of 5% to real estate and 3% to natural resources based on the benchmark portfolio. In the case of real estate, it typically has low correlation relative to equities and bonds since its value fluctuates behind the same speed as the economy. Therefore, we add real estate to the portfolio to hedge against the stock market. Real estate can also be used to hedge against inflation. After the real estate bubble burst during the 2008 financial crisis, the price of most of the real estate properties went back to the pre-crisis level. In the future, the values of the properties tend to generate an upward sloping curve. It is also notable to learn that many Ivy League endowments put a heavy allocation to real estate. For example, in 2020, Harvard allocated 7.10% and Yale allocated 8.60% to real estate. Therefore, while the weight of real estate of Vanderbilt in 2020 is only 2%, we decide to put a heavier weight on it to boost return. The philosophy of investing in natural resources is pretty much the same as real estate, as it acts as a store of value and becomes more attractive when facing inflation. However, we also do not want to put too much weight on natural resources as its volatility is the highest among all the selected asset classes in the recent decade.

In case of hedge fund, it is also an illiquid alternative investment which may be able to achieve excess risk adjusted returns. Based on 4.08% risk-free rate and past ten years quarterly return data, the sharp ratio of hedge fund is 0.71, compared to 2.47 for private equity and 2.32 for venture capital. As the Sharpe ratio of hedge fund is lower than private equity and venture capital, we decide to lower the allocation of hedge fund to 15.67% while allocate more to private equity and venture capital. However, maintaining a certain level of hedge fund investment is still necessary. On the one hand, it is difficult for endowments to develop expertise to directly invest in securities. Thus, the better option is to focus on asset allocation and selection of top managers of hedge fund while pay attention to transparency issue. On the other hand, hedge fund is well diversified with low correlation that helps to reduce risk for the whole portfolio.

In addition, we add a constraint of 20% allocated to any asset class. This is to avoid a heavy weight on a single asset and add diversification benefit to the target portfolio to protect it against the downside risk on that asset.

Final Recommendation

The final recommended portfolio is derived with Solver. We track the quarterly performance of each asset classes from the last 10 years and calculate the annual return and the variance-covariance matrix. After applying all the constraints to solver, we generate the following result.

Exhibit 3. Essential Calculations and Final Recommendation Solver Output

Return and Risk Level

	Fixed Income	Non-Marketable				Marketable Alternatives	US Equities	Int'l Equities	Emg. Equities	Cash	Commodities
	S&P U.S. Aggregate Bond	Private Equity	Real Estate	Natural Resources	Venture Capital	Hedge Fund	Wilshire 5000	Vanguard Developed Markets Index Fund Admiral Shares	MSCI Emg.	3M T-bill	Dow Jones Commodity
Quarterly R.	0.96%	3.63%	2.66%	0.58%	3.82%	0.98%	3.06%	1.81%	0.75%	0.18%	0.39%
Annual R.	3.88%	15.33%	11.08%	2.33%	16.20%	3.98%	12.83%	7.44%	3.02%	0.72%	1.56%
Var.	0.10%	0.39%	0.16%	4.55%	0.49%	0.32%	2.50%	2.75%	3.52%	0.00%	3.31%
StdDev.	3.21%	6.22%	3.99%	21.33%	6.99%	5.62%	15.80%	16.58%	18.75%	0.44%	18.20%

Variance-Covariance Matrix

	Fixed Income	Private Equity	Real Estate	Natural Resources	Venture Capital	Hedge Fund	U.S. Equities	Int'l Equities	Emg. Equities	Cash	Commodity
Fixed Income	0.1032%	-0.0368%	-0.0377%	-0.1063%	-0.0567%	-0.0404%	-0.1079%	-0.1134%	-0.0686%	0.0034%	-0.0514%
Private Equity	-0.0368%	0.3865%	0.0426%	0.8542%	0.2827%	0.2687%	0.7221%	0.7606%	0.7896%	-0.0095%	0.7943%
Real Estate	-0.0377%	0.0426%	0.1589%	0.0347%	0.0069%	0.0452%	0.0540%	0.0603%	0.0156%	-0.0051%	-0.0123%
Natural Resources	-0.1063%	0.8542%	0.0347%	4.5486%	0.6207%	0.9965%	2.9158%	3.1367%	3.5909%	-0.0189%	3.3586%
Venture Capital	-0.0567%	0.2827%	0.0069%	0.6207%	0.4887%	0.2417%	0.6119%	0.6335%	0.6479%	-0.0048%	0.5737%
Hedge Fund	-0.0404%	0.2687%	0.0452%	0.9965%	0.2417%	0.3159%	0.8178%	0.8577%	0.8820%	-0.0080%	0.7576%
U.S. Equities	-0.1079%	0.7221%	0.0540%	2.9158%	0.6119%	0.8178%	2.4958%	2.3620%	2.4208%	-0.0202%	2.1136%
Int'l Equities	-0.1134%	0.7606%	0.0603%	3.1367%	0.6335%	0.8577%	2.3620%	2.7504%	2.8750%	-0.0206%	2.2281%
Emg. Equities	-0.0686%	0.7896%	0.0156%	3.5909%	0.6479%	0.8820%	2.4208%	2.8750%	3.5165%	-0.0173%	2.6072%
Cash	0.1032%	-0.0368%	-0.0377%	-0.1063%	-0.0567%	-0.0404%	-0.1079%	-0.1134%	-0.0686%	0.0034%	-0.0514%
Commodity	-0.0514%	0.7943%	-0.0123%	3.3586%	0.5737%	0.7576%	2.1136%	2.2281%	2.6072%	-0.0155%	3.3111%

Solver Output

	Return	Weight
Fixed Income	3.88%	5.00%
Private Equity	15.33%	13.33%
Real Estate	11.08%	5.00%
Natural Resources	2.33%	3.00%
Venture Capital	16.20%	20.00%
Hedge Fund	3.98%	15.67%
U.S. Equities	12.83%	20.00%
Int'l Equities	7.44%	15.00%
Emg. Equities	3.02%	0.00%
Cash	0.72%	3.00%
Commodity	1.56%	0.00%

Total Weight	100.00%
Total Public Equities	35.00%
Total Fixed income & Cash	8.00%
Total Non-Marketable	41.33%

Return	10.43%
Variance	0.71%
Standard Deviation	8.44%
Sharpe Ratio	0.8771

The projected annual return for the recommended portfolio is 10.13%, with a Sharpe ratio of 0.8771. The standard deviation is 7.33%, which does not exceed the average volatility of 9.3% of similar endowments. It is also noticeable that emerging market equities and commodities are excluded from the portfolio, due to low return and high volatility they present in the past 10 years.

Appendix – Quarterly Performance of Selected Asset Classes

	Fixed Income	Non-Marketable				Marketable Alternatives	US Equities	Int'l Equities	Emg. Equities	Cash	Commodities
	S&P U.S. Aggregate Bond	Private Equity	Real Estate	Natural Resources	Venture Capital	Hedge Fund	Wilshire 5000	Vanguard Developed Markets Index Fund Admiral Shares	MSCI Emg.	3M T-bill	Dow Jones Commodity
Q1 2011	0.56%	5.58%	7.25%	6.33%	4.71%	2.20%	5.55%	3.14%	1.69%	0.05%	9.66%
Q2 2011	2.35%	4.77%	3.91%	-4.95%	4.92%	-0.55%	-0.55%	2.01%	-2.10%	0.06%	-2.51%
Q3 2011	4.11%	-2.06%	0.69%	-23.07%	-0.20%	-4.77%	-15.55%	-20.03%	-23.18%	0.03%	-11.16%
Q4 2011	0.80%	1.16%	-0.18%	7.59%	1.78%	0.70%	11.38%	3.99%	4.08%	0.02%	3.49%
Q1 2012	0.44%	6.07%	5.45%	8.48%	4.53%	4.04%	12.25%	11.48%	13.65%	0.01%	5.72%
Q2 2012	2.01%	1.30%	0.10%	-9.66%	0.90%	-1.76%	-3.70%	-7.06%	-9.99%	0.04%	-8.37%
Q3 2012	1.65%	3.74%	6.13%	7.88%	-0.19%	3.34%	5.51%	6.36%	6.97%	0.05%	11.41%
Q4 2012	-0.63%	2.80%	2.22%	1.56%	2.26%	1.95%	-0.33%	7.58%	5.23%	0.05%	-3.66%
Q1 2013	0.68%	4.08%	4.01%	-1.61%	2.25%	3.55%	10.69%	4.46%	-1.93%	0.03%	-1.94%
Q2 2013	-2.59%	3.75%	5.39%	-10.50%	4.92%	0.13%	2.37%	-0.89%	-9.13%	0.04%	-9.15%
Q3 2013	0.55%	5.09%	0.88%	9.56%	5.61%	1.61%	5.83%	11.66%	5.01%	0.04%	3.12%
Q4 2013	-0.18%	5.48%	7.02%	3.69%	7.81%	4.15%	9.58%	5.59%	1.55%	0.01%	-0.81%
Q1 2014	1.98%	5.10%	3.50%	1.14%	6.25%	0.94%	1.47%	0.47%	-0.81%	0.03%	4.55%
Q2 2014	1.95%	4.73%	3.57%	4.99%	2.98%	1.89%	4.33%	4.25%	5.65%	0.02%	-1.55%
Q3 2014	0.29%	1.59%	3.56%	-6.64%	3.07%	0.56%	-0.49%	-6.09%	-4.33%	0.03%	-11.53%
Q4 2014	1.46%	4.06%	4.39%	-9.67%	6.42%	0.70%	4.38%	-4.10%	-4.88%	0.02%	-11.05%
Q1 2015	1.95%	4.57%	3.17%	-1.42%	5.11%	2.49%	1.28%	5.56%	1.90%	0.03%	-4.21%
Q2 2015	-1.85%	5.93%	4.16%	-2.05%	6.39%	-0.47%	-0.48%	1.02%	-0.24%	0.05%	6.46%
Q3 2015	1.32%	0.27%	2.55%	-21.28%	-0.22%	-2.53%	-7.89%	-9.94%	-18.54%	0.07%	-13.31%
Q4 2015	-0.85%	1.60%	1.86%	-1.14%	2.24%	-0.13%	5.21%	3.94%	0.25%	0.01%	-8.42%
Q1 2016	3.39%	1.52%	2.34%	11.14%	-3.48%	-2.19%	0.27%	-2.02%	5.38%	0.15%	4.08%
Q2 2016	2.21%	5.34%	2.43%	6.12%	-0.06%	0.60%	2.29%	-0.30%	-0.32%	0.14%	16.07%
Q3 2016	0.39%	4.41%	3.11%	6.76%	3.04%	1.75%	3.99%	6.40%	8.31%	0.11%	-2.90%
Q4 2016	-3.34%	1.39%	1.91%	5.04%	0.97%	1.14%	3.76%	-1.44%	-4.56%	0.08%	6.58%
Q1 2017	1.02%	4.32%	3.93%	4.45%	2.70%	2.07%	5.12%	7.82%	11.14%	0.12%	-0.28%
Q2 2017	1.57%	5.51%	1.69%	-2.33%	1.95%	0.76%	2.46%	6.39%	5.46%	0.20%	-1.91%
Q3 2017	0.70%	3.42%	3.45%	12.15%	3.55%	1.82%	3.98%	5.49%	7.01%	0.28%	5.56%
Q4 2017	0.39%	4.84%	2.19%	6.74%	2.34%	2.30%	5.95%	4.45%	7.09%	0.26%	6.77%
Q1 2018	-1.44%	4.72%	2.82%	-0.06%	6.74%	0.47%	-1.38%	-1.09%	1.08%	0.34%	0.91%
Q2 2018	-0.20%	3.69%	2.65%	3.51%	5.59%	0.10%	3.59%	-1.59%	-8.65%	0.47%	1.56%
Q3 2018	-0.07%	3.57%	1.69%	2.16%	4.31%	0.58%	6.57%	1.09%	-2.02%	0.50%	-2.44%
Q4 2018	1.88%	-1.20%	-1.24%	-18.43%	1.90%	-4.30%	-14.90%	-13.06%	-7.85%	0.60%	-8.40%
Q1 2019	3.13%	5.30%	1.59%	14.42%	6.73%	3.99%	13.66%	10.16%	9.58%	0.62%	8.40%
Q2 2019	2.84%	2.61%	1.50%	-0.78%	2.87%	2.35%	3.42%	3.27%	-0.30%	0.69%	-0.26%
Q3 2019	2.34%	3.57%	3.60%	-4.27%	1.48%	0.26%	0.28%	-0.99%	-5.11%	0.58%	-2.31%
Q4 2019	-0.03%	3.76%	1.04%	7.15%	5.44%	2.43%	8.35%	8.36%	11.34%	0.50%	6.14%
Q1 2020	3.29%	-7.34%	1.51%	-31.55%	-1.40%	-8.98%	-21.25%	-24.07%	-23.87%	0.76%	-27.15%
Q2 2020	3.10%	10.03%	-2.62%	19.36%	8.92%	6.20%	22.13%	17.52%	17.26%	0.03%	19.95%
Q3 2020	0.42%	12.97%	1.47%	3.03%	13.66%	3.43%	9.01%	5.67%	8.73%	0.05%	11.64%
Q4 2020	0.61%	3.13%	1.82%	19.25%	14.21%	6.38%	14.43%	16.93%	19.34%	0.03%	16.74%

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