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Pershing Square's Pandemic Trade (A)

One of the benefits of being an investor is understanding compounding. Why will this thing not spread to every corner of the world? Why won't everyone get it? The only way to deal with the virus would be to shut down the global economy…

— Bill Ackman, CEO and Founder of Pershing Square Capital

On Sunday, February 23, 2020, Bill Ackman (Harvard College '88, HBS MBA '92), founder and CEO of Pershing Square Capital Management, decided it was time to act without delay. For the past few months he had been closely following the news about a novel, highly infectious, and lethal coronavirus that was spreading across the globe. Ackman had become particularly concerned about the potential for a global pandemic a month earlier, when the media reported that 5 million people had fled the city of Wuhan in China, where the virus had first spread, just before it went into lockdown. This news had prompted him to ask his team to explore alternative ways to protect the firm's investment portfolio from the financial fallout that would likely ensue from a global pandemic.[1]

A month later, he was astonished that large convening events were still being held everywhere despite the global health emergency that had been declared by the World Health Organization. To date, there had been nearly 79,000 detected cases and 2,500 deaths worldwide. The last straw had been Milan Fashion Week, which had just finished and had brought together a global audience of thousands to a city that was experiencing one of Europe's first outbreaks of the virus. He wondered how many of those visitors to Milan had already been infected and carried the virus back to their own communities across the globe.

Ackman was now completely persuaded that it was too late to contain an exponential spread of the virus, and that this spread would quickly lead to a global health and economic crisis. In his view, the latest news from Milan meant that it was time to make a final decision on which portfolio hedging strategy to pursue and to start executing on it as soon as financial markets opened the following day. It would be a busy Sunday.

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The Covid-19 Pandemic

On December 31, 2019, the local government in Wuhan, China reported that health authorities were treating dozens of patients with pneumonia-like symptoms, though the cause of the illness had not yet been identified. Days later, on January 9, 2020, the World Health Organization (WHO) confirmed that a new coronavirus – named COVID-19 and in the same virus family that produced the SARS and MERS outbreaks – was likely behind the growing number of illnesses in Wuhan. Though the number of reported cases in the city was relatively small at the time, health experts around the world warned that the disease could quickly become a bigger threat during the upcoming Lunar Holiday on January 25, when tens of millions of Chinese typically traveled around the country (see **Exhibit 1** for timeline of cases in Wuhan and the rest of China).

On January 21, 2020, the Center for Disease Control (CDC) in the United States announced that a Washington state resident had been recorded as the first known case in the country. On that same day, a Chinese scientist confirmed that the new coronavirus could spread through person-to-person contact, not just through exposure to animals as previously believed. On January 23, the Chinese government took the unprecedented step of putting 15 cities in Hubei province, including its capital Wuhan, under full or partial lockdown. These measures affected a combined population of over 57 million people,[2] though the mayor of Wuhan estimated that nearly 5 million people had left the city before the quarantine went into effect.

On January 31, the WHO issued a global health emergency, as the global case total skyrocketed to just under 10,000 and the death total exceed 200. The United States followed suit on February 3 by declaring a public health emergency. A week later, on February 10, the Covid-19 death toll of 908 in China had already exceeded the country's total from the SARS pandemic. By February 23, the exponential spread of the virus had resulted in nearly 79,000 total detected cases and 2,500 deaths worldwide (see **Exhibit 2** for statistics on Covid-19 cases and deaths).

As the Covid-19 crisis worsened in early 2020, health officials and epidemiologists were especially concerned about the fraction of infected individuals who showed mild or no symptoms, since it had been shown that they were still capable of transmitting the virus to others. In a report released in early March, the WHO estimated that nearly 80% of Covid-19 infections to date had been mild or asymptomatic.[3] The high asymptomatic rate led many in the health community to believe that the spread of Covid-19 would be harder to contain than previous pandemics such as SARS or MERS.[4]

Asymptomatic spread or delayed onset of symptoms not only implied that the total number of cases could be much higher than the recorded number, but also meant that a strategy of testing only symptomatic individuals and tracing their contacts might fail to contain new outbreaks.[5] The potential danger was amplified by the vulnerability of specific groups. Early studies showed a 14.9% case fatality rate among patients over 80 and a 10% fatality rate among those with heart conditions, compared to an overall fatality rate of 2.3%.[6] Outbreaks among these vulnerable populations could prove both deadly and difficult to prevent.

Pershing Square

History

Pershing Square Capital Management, L.P., was founded by Bill Ackman in 2004. The firm was built on his experience at another fund, Gotham Partners, that he had founded with HBS classmate David Berkowitz upon graduation. After starting with $54 million in assets under management (AUM),

Pershing Square had $8.8 billion in AUM as of February 21, 2020. The fund employed a value-oriented activist strategy – often described as engaged activism – that focused on large-cap public companies. It held a concentrated portfolio and took significant stakes in target companies. With a focus on longer-term investment horizons, Pershing Square unlocked value by actively improving business operations, enhancing cash-flow generation, and changing management if it deemed it necessary. Pershing Square was also a pioneer in the use of permanent capital for investment management funds and had raised $2.7 billion through a publicly traded vehicle in 2014.[a,7]

Tail Risk Hedging During the 2008 Global Financial Crisis

Pershing Square and Ackman were not new to using financial instruments to hedge (or protect) portfolios from large negative shocks (or "tail events"). The fund had experience in navigating periods of global turmoil, most recently during the 2008 Global Financial Crisis. Housing and mortgage markets were at the heart of that particular crisis, and Pershing Square had used single-name credit default swaps (CDS) to profit from the increase in default probability – and, in some cases the actual default – of bond and mortgage insurers including MBIA, Ambac, FSA, MGIC, Radian, Fannie Mae and Freddie Mac, and PMI Group. A CDS was effectively an insurance contract between two counterparties that protected the buyer of insurance against default. In a CDS, the counterparty purchasing protection made recurring payments to the CDS seller.[b] In return, the buyer received a payout from the seller if the underlying asset on which the contract was written defaulted (typically a debt instrument like a corporate bond, a sovereign bond, a mortgage, etc.).

In addition to the $4 billion of notional CDS protection that they purchased on these firms, Pershing Square purchased approximately $8 billion in CDS protection on the CDX Investment Grade (IG) and European iTraxx indices through the course of the crisis. They also shorted the common equity of MBIA and Ambac, and purchased put options on MBIA's equity as an additional hedge. Pershing Square had entered many of these hedges well before the crisis peaked, which meant that the fund had paid insurance premiums for several years before the positions paid off during the economic downturn. Prior to the crisis, insurance premiums had been near their all-time lows, as low as 10 basis points per dollar of notional exposure, which dampened the cost of carrying these hedges for an extended period of time.

Portfolio in January 2020

At the end of January 2020, Pershing Square held a concentrated portfolio of nine holdings (see **Exhibit 3** for details). The fund's major positions were in Chipotle Mexican Grill (CMG), Hilton Worldwide (HLT), and Lowe's (LOW), representing roughly 21%, 16%, and 14% of the portfolio's value, respectively. The fund had been invested in Chipotle Mexican Grill since the third quarter of 2016 and they began investing in Hilton and Lowe's in 2018. The majority of Pershing Square's investments were in the form of common equity.

Pershing Square was a long-term investor who often held their positions for several years. For example, they had been invested in Howard Hughes (HHC) since 2010, Restaurant Brands International (QSR) since 2012, and Fannie Mae and Freddie Mac since 2013. Consistent with their long-

[a] Pershing Square Holdings, Ltd. started as a private fund and then went public in 2014. At the time of its listing, it had roughly $3.5 billion of private capital and raised an additional $2.7 billion through the public listing.

[b] Depending on the type of CDS contract (e.g., single name or index), the buyer also made an upfront payment to the seller.

run view of portfolio positions, Pershing Square had appointed members to the boards of both Howard Hughes and Chipotle, and had successfully assisted in recruiting a new CEO at Chipotle.

Options for Hedging Tail Risk

Based on the trajectory of the virus in mid-February, Ackman believed his thesis on the virus "would be proven right or wrong in a short amount of time". His confidence that the virus would cause a significant global disruption had only grown with the Chinese response to the virus. As he noted, "China was able to control the virus with widespread mask mandates and lockdowns, which had significant short-run economic costs. This playbook may not be so easy to follow in the U.S. and Europe." In addition, as the virus took hold in February, Ackman had spoken to the CEOs of some of the largest companies and financial institutions in the world and none shared his level of concern about the virus. Stock and bond markets also did not appear to have priced in the potential for a pandemic, and were instead trading at levels that anticipated normal economic conditions.

Based on these data points and given his conviction, Ackman discussed with his team a number of different hedging alternatives.

Cash

One seemingly simple route would be for Pershing Square to partially or fully liquidate its stock holdings. While moving to cash would certainly protect Pershing Square from a large drawdown in financial markets, there were a few reasons why selling was not as easy as it might seem. For one, given the size of its positions, Pershing Square would likely have to accept a substantial discount to find willing buyers on such short notice. Taxes were another consideration when it came to the liquidation option. There was also the concern that a liquidation was not aligned with the firm's general investment approach, since Pershing Square typically held its positions in companies for extended periods of time and had representatives on the boards of these companies. Moreover, Pershing Square's investors might not understand such a drastic portfolio shift and perceive it as too extreme, even if it ultimately proved correct when the tail event was realized. On the other hand, Ackman knew that a global pandemic could significantly alter the long-run business models of many of their portfolio companies, and his team at Pershing Square would need to carefully consider whether their original investment theses would still be applicable in a post-Covid world.

Futures

Another way to hedge against Covid-19 was to sell futures. Futures were a type of derivative contract in which the buyer, at the time of initiation, agreed to purchase an underlying asset from the seller at a later date. The purchase price, known as the futures price, was agreed upon at initiation.

Futures contracts existed for a wide array of underlying assets, including commodities and financial securities. An obvious hedge to consider was selling (or entering short) futures contracts on the S&P 500 index via the Chicago Mercantile Exchange (CME), since many of Pershing Square's portfolio companies were included in the index. An important characteristic of S&P 500 index futures was that the futures price tracked the index because of arbitrage. Thus, fluctuations in the value of the S&P 500 index translated directly into fluctuations in the futures price, and hence into gains or losses on a futures position. Holders of futures positions could easily exit them before maturity by entering futures contracts of opposite sign. For example, if the index rose, a holder of a long position in the futures market could enter a selling position of equal size and expiration date to lock in a gain. For futures

traded on the CME, the investor could realize the gain from this trade immediately, without having to wait for the contracts' expiration.

On February 21, 2020, the futures price for contracts expiring on March 20 and June 20 were $3,339.25 and $3,339.50, respectively.[8] In theory, if Pershing Square sold one unit of the March 20 futures contract, on that date they could purchase 1 share of the S&P 500 on the open market and sell it to the buyer of the future contract for the agreed upon futures price of $3,339.25. The S&P 500 was currently trading at 3,337.75, so if it fell by 30% by March 20 then Pershing Square would pocket roughly $1,002.83 (3,339.25– 0.7 x 3,337.75) for every unit of futures it sold. Hedging via selling futures also exposed Pershing Square to the risk that the S&P 500 could rise before the contract expired. For example, if the S&P 500 were to rise by 25%, Pershing Square would lose roughly $832.94 (1.25 x 3,337.75 – 3,339.25) for every futures contract they sold. In this way, selling futures offered limited upside but infinite downside, since Pershing Square could make a maximum of $3,339.25 per contract but could lose an unlimited amount.

In practice, S&P 500 futures that were listed on the CME traded in blocks of 250 times the index. In other words, if Pershing Square were to sell 1 standard S&P 500 futures contract on the CME, they would expect to make $250,708 (250 x $1,002.83) if the S&P 500 fell 30% by March 20. Furthermore, to protect both the buyer and seller against the risk that their counterparty would be unable to fulfill the contract at expiration, large exchanges like the CME required margin payments for trading futures. For each S&P 500 futures contract that Pershing Square was considering, the CME would require $60,000 of an initial margin, plus additional margin payments if the underlying asset (e.g., the S&P 500) rose in value past a certain point. Conversely, Pershing Square would receive margin payments from the buyer of the future if the underlying asset fell in value. Based on his experience over the years, Ackman knew that optimally managing fluctuations in margin payments would be critical if Pershing Square were to effectively hedge Covid-19 risk by selling S&P 500 futures.

Put Options

Ackman also wondered whether Pershing Square should hedge by purchasing put options on the S&P 500. In a put option, the owner had the right – but not the obligation – to sell an underlying asset at a future date to the "writer" of the option. The price at which the owner would sell the asset to the option writer was known as the "strike price". In exchange for this option, the owner paid the writer a so-called "option premium". The exchange of the option premium and the determination of the strike price both occurred when the option was first initiated. The Chicago Board Options Exchange (CBOE) was the most popular exchange for trading put options on the S&P 500, which typically had so-called European-style exercise clauses indicating that the owner could only exercise their right at the time of expiration, or "at maturity".

Hedging via put options would require Ackman and his team to decide on a target strike price and maturity, both of which depended on their view of when and how far the S&P 500 could fall in response to the pandemic. These choices mattered because the future payoff of a put depended on the difference between the stock price at option maturity and the strike. For example, suppose Pershing Square purchased a put option with a strike price of 3,200 that expired on March 20, 2020, and by March 20 the market had fallen by 30% from its current level of 3,337.75. At that time, they would then purchase the S&P 500 on the open market for $2,336.43 (0.7 x 3,337.75), exercise their put option to sell at $3,200 (the strike), and earn a payoff of $863.58 (3,200 - 0.7 x 3,337.75). Cost considerations were also a factor: to generate that future payoff, Pershing Square would have to pay the option premium of $30.30 today (see **Exhibit 4** for put option premiums as of February 21, 2020).[9] In general, the premium that Pershing

Square would have to pay to buy puts would increase with the strike price, stock volatility, and time to maturity.

Practically speaking, Pershing Square would not have to hold the option to maturity to profit from a decline in the S&P 500 because they could sell the option on the secondary market at any time before maturity. The resulting profits would depend on how much the underlying index had moved, how its volatility had changed, and how much time had passed since their initial purchase. To this end, the "delta" of the option approximated how much the option premium would change in response to small and near-term movements in the S&P 500.[c] For bigger index movements that occurred over long horizons, the future market price of an option could be better approximated by its so-called intrinsic value. The intrinsic value of put options was zero if their strike was below the spot price and equaled the strike minus the spot price otherwise. For example, if the S&P 500 were to fall 30% over the next month, the market price of the put with strike $3,200 expiring on March 20, 2020 would approach its intrinsic value of $863.58 (3,200 - 0.7 x 3,337.75). Thus, under this scenario, if Pershing Square were to purchase one unit of that put option and sell it in a month, then they would earn a profit of approximately $833.28 = (863.58 – 30.30). In downturns, the volatility of the S&P 500 also tended to rise, so the actual increase in price could be even larger because of a factor known as "vega."[d] Another important factor that determined the potential profits from purchasing puts was liquidity. If liquidity in the options market were to dry up as it did during the 2008 Global Financial Crisis, Pershing Square's ability to sell their put contracts at a fair price down the road could be hampered.

Credit Default Swaps

Ackman had also asked his team to consider portfolio hedges beyond stock market derivatives. Specifically, he thought that CDS could be another instrument to use to hedge against Covid-19 risk. In standard CDS contracts, the buyer and seller of default protection would initially exchange an "upfront" amount, after which the buyer made quarterly fixed coupon payments to the seller over the life of the contract. In return, for every notional dollar of protection, the seller of CDS would make a payment to the buyer if the bond experienced a so-called "credit event," such as default or debt restructuring. The coupon of standard CDS contracts depended on the type of underlying bond. Maturity was typically set at five years.[e]

The direction and amount of the upfront exchange depended on the difference between two estimates: the present value of the seller's expected payout and the present value of the buyer's coupon payments. The fair value of the seller's payout was a function of the parties' estimates of the recovery rate of the bond in case of default, the probability of default, and the notional amount in the trade. For example, if the parties anticipated a high probability of default and the expected value of the seller's payout exceeded that of the buyer's coupon payments, the seller would require an upfront payment to offset the difference. If the probability of default were low enough, the seller could be the one required

[c] For example, the delta of the put with strike $3,200 expiring on March 20, 2020 was -0.2018. Thus, if the S&P 500 were to fall by 1% on the next day, the put price would increase by roughly $6.74 (0.2018 x 0.01 x $3,337.75). Delta more accurately measured the sensitivity of option prices to *small* movements in the S&P 500. To fully account for larger movements in the index, changes in volatility or interest rates, and time-to-maturity, Pershing Square would typically choose an option pricing model and use it to compute option prices under different scenarios.

[d] The expected change in an option price resulting from a change in volatility of 1% (e.g., going from 20% to 21%) was called "vega." It is always positive because put and call options become more valuable when the volatility of the underlying increases.

[e] Neither one of the counterparties needed to hold a position on the underlying asset. Thus, CDS could also be used to speculatively bet on defaults.

to compensate the buyer. Finally, if the coupon were such that both parties considered it fair compensation for the expected payout by the seller, there would not be any upfront exchange of cash.

CDS contracts were quoted in two different ways, both of which reflected the market's constantly evolving perception of default and recovery. The first was simply the upfront exchange required per $1 of notional value. The second and most frequent quotation method was the so-called CDS spread or breakeven spread. The CDS spread was the fixed coupon payment per $1 of notional that would require no upfront exchange between the buyer and seller at initiation.[f]

In principle, a CDS position could be unwound by entering another CDS on the same underlying security with the opposite sign. For example, if the probability of a default event increased dramatically, the upfront amount – or equivalently, the breakeven CDS spread – on a newly issued position would increase. The buyer of an existing CDS could simply issue (or sell) a new CDS, realizing the difference between their initial upfront payment and the upfront payment from the sale. All remaining coupon payments would cancel out across the two offsetting positions. The CDS buyer would also be protected if a default actually occurred, since the payoff on the long position would offset the payment due on the short position. In practice, funds like Pershing Square could easily unwind a CDS trade with their broker-dealer, who would then offset the position with other clients or in the interdealer market.

CDS contracts written on individual bonds were known as single-name CDSs, but there were also contracts known as index CDSs that were written on baskets or portfolios of bonds. The two most common index CDS families were the CDX and iTraxx indices. CDX indices tracked bonds of North American companies and iTraxx indices tracked European companies. Within the CDX family, the two most popular contracts were linked to the investment grade (IG) and high yield (HY) indexes. The CDX IG index was an equally weighted basket of 125 bonds that were rated investment grade by the major credit ratings agencies (**Exhibit 5** contains the IG index composition as of February 21, 2020). Because these were bonds with relatively low credit risk, breakeven CDS spreads on the CDX IG index were typically small. In the event that one of the firms in the basket experienced a credit event, the amount the seller would pay was determined by the weight of the firm in the index times the amount that would be paid on a single-name CDS. In the same spirit as the CDX IG, the CDX HY tracked a basket of 100 high-yield rated bonds and the iTraxx Europe tracked a basket of 125 investment grade bonds issued by European firms.

Index CDS contracts were centrally cleared, which meant that a clearing house acted as a counterparty to both sides of the transaction. This arrangement significantly reduced counterparty risk and improved liquidity in the index CDS market.[g] By contrast, single-name CDSs tended to trade at larger breakeven CDS spreads and bid-ask spreads than index CDS contracts. Because of this lack of liquidity, Pershing Square would likely have to build any single-name CDS hedge positions over a longer period of time to avoid materially impacting their execution price.

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[f] The different conventions were analogous to quoting a bond's discount (or premium) relative to par and its yield-to-maturity.

[g] This structure of the CDS market was dramatically different from the prevailing structure before the 2008 Global Financial Crisis. Prior to the crisis, both single name and index CDS were traded over-the-counter, meaning contracts and margin requirements were negotiated bilaterally between the buyer and the seller. This arrangement proved problematic during the crisis, since many sellers – perhaps most famously the large insurer AIG – were unable to make their promised CDS payments to buyers in the face of an unprecedented number of corporate defaults. In addition, the bilateral nature of the CDS market also led to a dry up of liquidity during the peak of the crisis, as evidenced by large bid-ask spreads in both the single name and index CDS markets in the fall of 2008.

When purchasing CDS protection on centrally cleared contracts, both parties were required to post initial margin based on the notional value of the contract and the risk of the underlying. This was in addition to any upfront payments made between the parties. Pershing Square estimated that their initial margins on the IG, iTraxx, and HY indices would be 0.8%, 0.9%, and 3.2% of notional, respectively. In addition to the initial margin, Pershing Square would be required to post additional "variation" margin payments if default probabilities – and hence breakeven CDS spreads – were to fall, since this would make any of their existing CDS purchases less valuable. On the other hand, Pershing Square would receive margin payments from the CDS seller in the event that breakeven CDS spreads on the indices rose.

To get a better sense of how CDS markets might react in response to Covid, Ackman and his team looked at the history of index CDS spreads going back before the 2008 Global Financial Crisis (see **Exhibit 6**). At the peak of the 2008 crisis, the CDX IG, CDX HY, and iTraxx Europe reached almost 280, 1900, and 220 basis points (bps), respectively. Ackman did not necessarily think CDS markets would reach those levels in response to Covid, in part because governments would be better equipped to prop up financial markets given their experience during the 2008 crisis. Even if this proved correct, there had still been several meaningful spikes in breakeven index CDS spreads over the last decade. For example, in late 2011 amidst a worsening Eurozone debt crisis, the CDX IG, CDX HY, and iTraxx Europe reached almost 150, 870, and 210 bps, respectively.

Despite the growing threat of Covid-19, breakeven CDS spreads for protection on the CDX IG, HY, and iTraxx Europe indices were at or near all-time lows. For example, the breakeven CDS spread for protection on the CDX IG index was currently at 46 bps per annum. Given the fixed coupon on the CDX IG was standardized at 100 bps per year, this meant that if Pershing Square were to purchase protection, it would receive an upfront payment from the CDS seller. This amount was estimated at $2.55 for every $100 of notional protection that they bought.[h]

If, for instance, breakeven CDS spreads were to rise to 160 bps in 60 days due to Covid, then Pershing Square could effectively unwind their CDS protection purchase with an offsetting CDS sale. At a breakeven spread of 160 bps, sellers of protection would have to be compensated by buyers given the standardized 100 bp fixed coupon. Pershing Square estimated that, as a seller, they would receive an upfront payment of $2.78 per $100 of notional. Thus, under this scenario, Pershing Square would receive a total payoff of $5.33 ($2.55 + $2.78) for every $100 of initial protection bought. Because they would hold the position for 60 days, Pershing Square would pay $0.167 ($100 x 100 basis points x 60 / 360) in fixed coupons. In other words, they would earn roughly $32 per $1 in fixed coupons paid ($5.33/$0.167). (**Exhibit 7** contains the details of this sample computation). On the other hand, if Ackman was wrong about his assessment of the virus and CDS spreads did not move, Pershing Square would essentially pay the fixed coupons of $0.167 and receive no other payoffs.

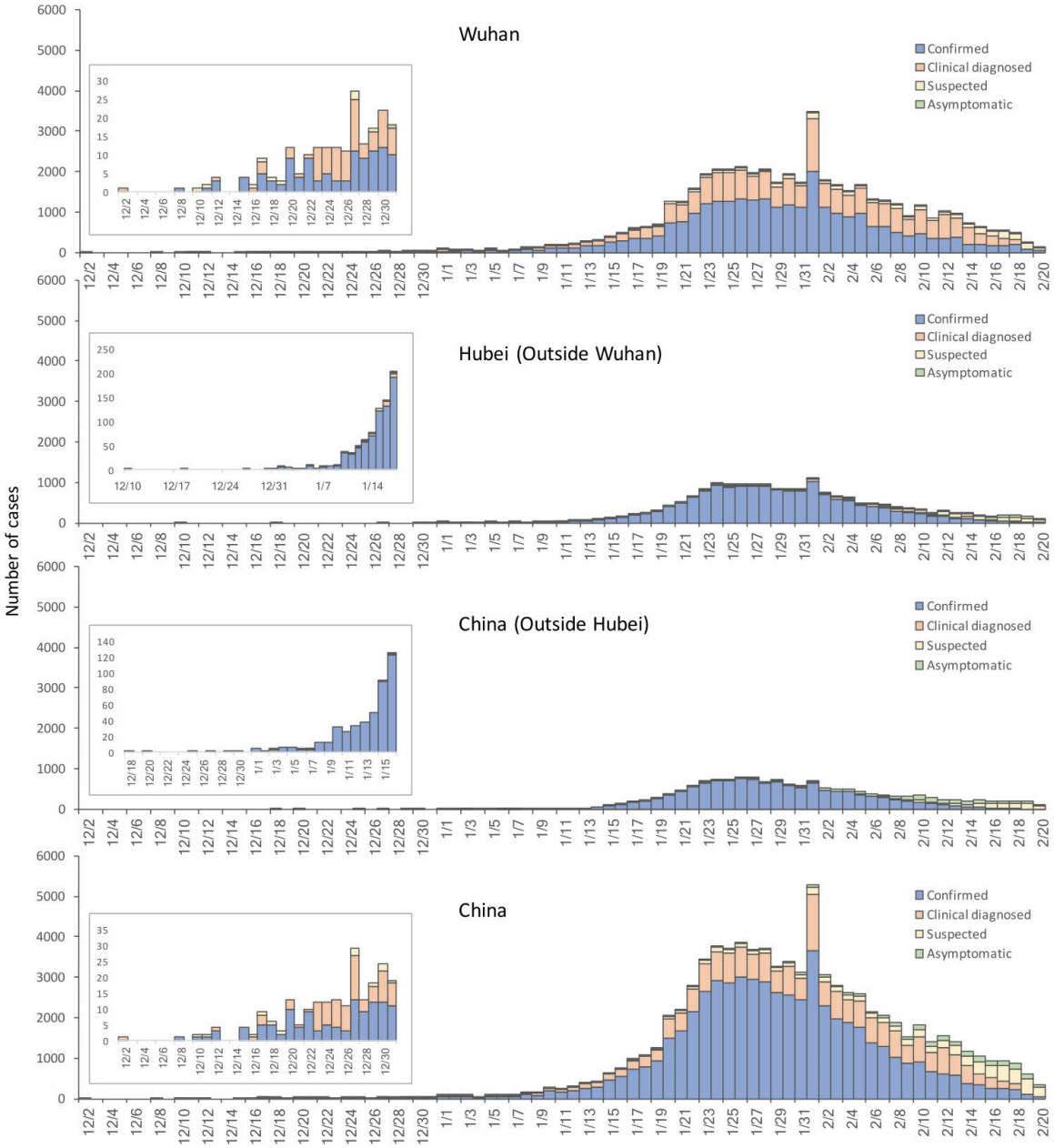
Decision

Ackman had some big decisions to make regarding Pershing Square's portfolio, with little time to waste. First and foremost, he and his team had to determine how Covid-19 might impact Pershing Square's positions and markets more broadly. Was their baseline estimate reasonable? If so, how should Pershing Square structure the size of their hedge positions? Was two months a reasonable

[h] Pershing Square would receive money in the upfront exchange because the fixed coupon they would subsequently pay (1%) exceeded the breakeven CDS spread (0.46%). In other words, based on market perceptions of default risk and recovery for the IG index, Pershing Square would be paying too much in fixed coupon payments for default insurance. The upfront exchange compensated them for this difference.

length to consider for the hedge? How would the cost be impacted if they had to lengthen the maturity? Relatedly, how quickly would markets react to the spread of the pandemic, and how would this impact the performance and costs of the different hedging alternatives? Based on all of these considerations, what was the optimal way to hedge against the impending pandemic?

Exhibit 1 Timeline of cases in Wuhan and China



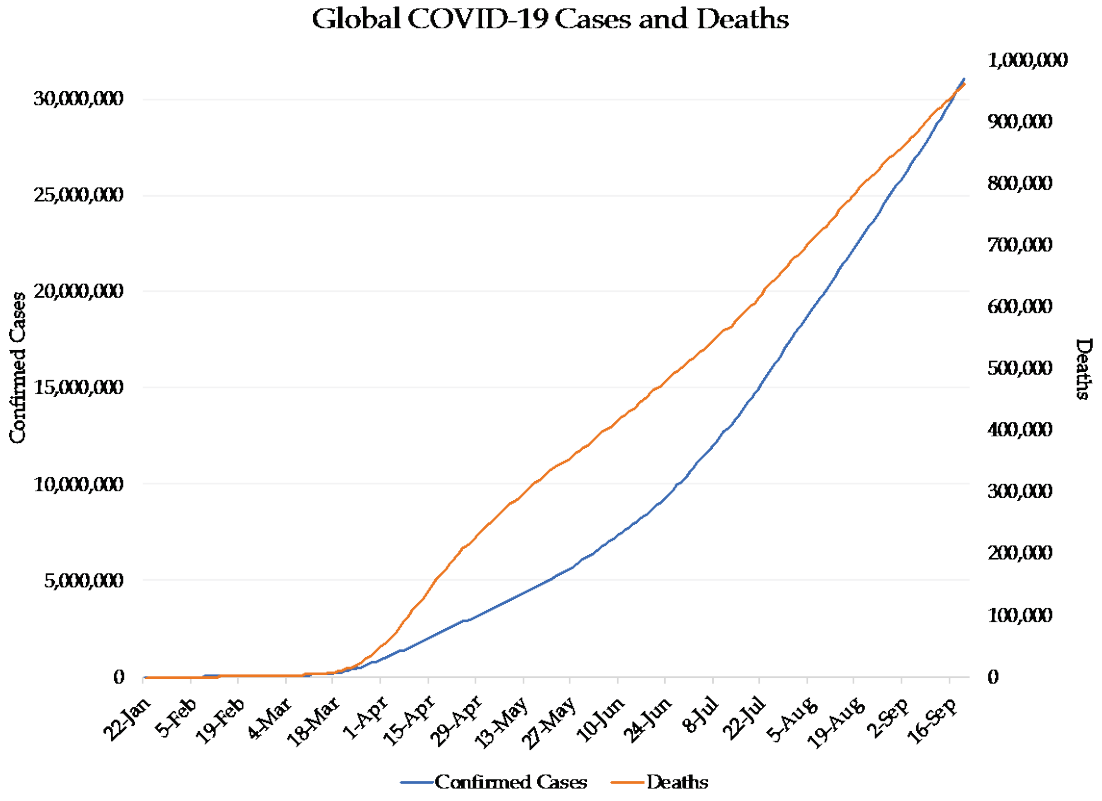
Source: Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19), World Health Organization (WHO), 16-24 February, 2020. https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf, Accessed 1 October, 2020.

Exhibit 2a Global Cases and Deaths from Covid-19 as of February 23, 2020

Country / Region	Confirmed Cases	Deaths
China	77,042	2,445
Western Pacific	887	7
Southeast Asia	40	0
Europe	121	3
Eastern Mediterranean	43	5
United States	35	0
Canada	9	0
International conveyance (cruise ships)	634	2
Global	78,811	2,462

Source: World Health Organization, https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200223-sitrep-34-covid-19.pdf. Accessed October 31, 2020.

Exhibit 2b Time Series of Global Cases and Deaths from Covid-19



Source: Casewriter, with data from Johns Hopkins University Coronavirus Resource Center, https://coronavirus.jhu.edu/map.html. Accessed September 21, 2020.

Exhibit 3 Pershing Square Portfolio as of January 31, 2020

Firm Name	Number of Shares	Value (in $ million)	% Ownership	% of Fund Value	Board Seat	Inception Date
Chipotle Mexican Grill	1,724,310	$1,494.56	6.20%	21.3%	Yes	Aug-16
Hilton Worldwide	10,556,805	$1,138.02	3.74%	16.2%	No	Oct-18
Lowe's Companies	8,613,212	$1,001.20	1.12%	14.3%	No	Apr-18
Restaurant Brands International	15,468,181	$943.71	3.34%	13.4%	No	Jun-12
Berkshire Hathaway (B)	4,015,594	$901.22	0.29%	12.8%	No	May-19
Howard Hughes	6,386,835	$777.15	14.78%	11.1%	Yes	Nov-10
Agilent Technologies	8,807,760	$727.17	2.84%	10.4%	No	Sep-19
Fannie Mae	131,004,511	$417.90	11.31%	6.0%	No	Oct-13
Freddie Mac	72,010,523	$220.35	11.08%	3.1%	No	Oct-13

Source: Based on the most current public filings, company-provided documents, and author's calculations.

Exhibit 4 Put Option Prices as of February 21, 2020

Current Price (S&P 500 Index): 3,337.75

Expiration Date	Exercise Price	Bid Price	Ask Price	Moneyness	Delta
3/20/20	3000	10.1	10.4	0.9021	(0.0558)
3/20/20	3025	11.6	11.9	0.9096	(0.0647)
3/20/20	3050	13.2	13.5	0.9171	(0.0759)
3/20/20	3075	15.1	15.5	0.9247	(0.0890)
3/20/20	3100	17.3	17.7	0.9322	(0.1043)
3/20/20	3125	19.8	20.2	0.9397	(0.1239)
3/20/20	3150	22.7	23.1	0.9472	(0.1462)
3/20/20	3175	26	26.4	0.9547	(0.1717)
3/20/20	3200	29.8	30.3	0.9622	(0.2018)
3/20/20	3225	34.1	34.6	0.9698	(0.2379)
3/20/20	3250	39.3	39.8	0.9773	(0.2794)
3/20/20	3275	45.2	45.7	0.9848	(0.3279)
3/20/20	3300	52.1	52.8	0.9923	(0.3837)
4/17/20	3000	18.2	18.7	0.9021	(0.1033)
4/17/20	3025	20.2	20.7	0.9096	(0.1158)
4/17/20	3050	22.5	23	0.9171	(0.1298)
4/17/20	3075	25.1	25.6	0.9247	(0.1452)
4/17/20	3100	27.9	28.5	0.9322	(0.1638)
4/17/20	3125	31	31.6	0.9397	(0.1828)
4/17/20	3150	34.6	35.2	0.9472	(0.2049)
4/17/20	3175	38.5	39.1	0.9547	(0.2295)
4/17/20	3200	42.9	43.6	0.9622	(0.2575)
4/17/20	3225	48	48.6	0.9698	(0.2885)
4/17/20	3250	53.6	54.2	0.9773	(0.3235)
4/17/20	3275	59.9	60.6	0.9848	(0.3627)
4/17/20	3300	67.1	67.9	0.9923	(0.4070)

Source: Refinitiv Datastream, accessed October 31, 2020.

Exhibit 5 CDX IG – Index Components as of February 21, 2020

CDX Investment Grade - Company Level (Issuers)

Altria Group, Inc	E. I. du Pont de Nemours and Company	Newmont Goldcorp Corporation
American Electric Power Company, Inc.	Eastman Chemical Company	Nordstrom, Inc.
American Express Company	Enbridge Inc.	Norfolk Southern Corporation
American International Group, Inc.	Encana Corporation	Northrop Grumman Corporation
Amgen Inc.	Energy Transfer Operating, L.P.	Omnicom Group Inc.
Anadarko Petroleum Corporation	ERP Operating Limited Partnership	Packaging Corporation of America
Apache Corporation	Exelon Corporation	Pfizer Inc.
Arrow Electronics, Inc.	Expedia Group, Inc.	Prudential Financial, Inc.
Assured Guaranty Municipal Corp.	FirstEnergy Corp.	Quest Diagnostics Incorporated
AT&T Inc.	Ford Motor Company	Raytheon Company
AutoZone, Inc.	General Electric Company	Reynolds American Inc.
Avnet, Inc.	General Mills, Inc.	Royal Caribbean Cruises Ltd.
Barrick Gold Corporation	General Motors Company	Ryder System, Inc.
Baxter International Inc.	Halliburton Company	Sempra Energy
Berkshire Hathaway Inc.	Hess Corporation	Simon Property Group, L.P.
Best Buy Co., Inc.	Honeywell International Inc.	Southwest Airlines Co.
Block Financial LLC	Host Hotels & Resorts, L.P	Target Corporation
Boston Scientific Corporation	HP Inc.	Teck Resources Limited
Bristol-Myers Squibb Company	Ingersoll-Rand Company	The Allstate Corporation
Campbell Soup Company	International Business Machines Corporation	The Boeing Company
Canadian Natural Resources	International Lease Finance Corporation	The Dow Chemical Company
Capital One Bank (USA), National Association	International Paper Company	The Hartford Financial Services Group, Inc.
Cardinal Health, Inc.	Johnson & Johnson	The Home Depot, Inc.
Carnival Corporation	Johnson Controls International Public Ltd.	The Kroger Co.
Caterpillar Inc.	Kinder Morgan, Inc.	The Procter & Gamble Company
CBS Corporation	Kohl's Corporation	The Sherwin-Williams Company
Chubb Limited	Kraft Heinz Foods Company	The Southern Company
Cisco Systems, Inc.	Lincoln National Corporation	The Walt Disney Company
Comcast Corporation	Lockheed Martin Corporation	The Williams Companies, Inc.
Conagra Brands, Inc.	Loews Corporation	Tyson Foods, Inc.
ConocoPhillips	Lowe's Companies, Inc.	Union Pacific Corporation
Cox Communications, Inc.	Macy's, Inc.	United Parcel Service, Inc.
CSX Corporation	Marathon Petroleum Corporation	UnitedHealth Group Incorporated
CVS Health Corporation	Marriott International, Inc.	Valero Energy Corporation
D.R. Horton, Inc.	Marsh & McLennan Companies, Inc.	Verizon Communications Inc.
Darden Restaurants, Inc.	McDonald's Corporation	Viacom Inc.
Deere & Company	McKesson Corporation	Walmart Inc.
Devon Energy Corporation	MetLife, Inc.	WestRock MWV, LLC
Dominion Energy, Inc.	Mondelez International, Inc.	Weyerhaeuser Company
Domtar Corporation	Motorola Solutions, Inc.	Whirlpool Corporation
Duke Energy Carolinas	National Rural Utilities Cooperative Finance Corp.	XLIT Ltd.
DXC Technology Company	Newell Brands Inc.	

Source: IHS Markit, https://www.markit.com/NewsInformation/ViewArchive/CDX, accessed November 2, 2020.

Exhibit 6a Historical Breakeven CDS Spread for iTraxx Europe

Source: Bloomberg, accessed June 16, 2020; Capital IQ, accessed September 14, 2020; author's calculations.

Exhibit 6b Historical Breakeven CDS Spread for CDX IG

Source: Bloomberg, accessed June 16, 2020; Capital IQ, accessed September 14, 2020; author's calculations.

Exhibit 6c Historical Breakeven CDS Spread for CDX HY

Source: Bloomberg, accessed June 16, 2020; Capital IQ, accessed September 14, 2020; author's calculations.

Exhibit 7 Expected CDS Payoffs

CDS Contract Parameters	CDX HY	CDX IG
Notional ($)	100	100
Years to maturity	5	5
Fixed CDS Premium	5%	1%
Recovery rate	30%	40%
Current Data		
Date	2/21/2020	2/21/2020
Riskless Rate	1.30%	1.30%
Breakeven CDS Spread	2.95%	0.46%
Upfront Exchange (Buyer to Seller)	(8.97)	(2.55)
Expected Liquidation Parameters		
Holding period (days)	60	60
Liquidation Date	4/21/2020	4/21/2020
Riskless rate	0.34%	0.34%
Breakeven CDS Spread	6.00%	1.60%
Upfront Exchange (Buyer to Seller)	4.03	2.79
Expected Costs and Payoffs		
Fixed Coupons Paid ($)	0.83	0.17
Payoff from Change in Upfront ($)	13.00	5.33
Multiple-on-premiums	**15.6**	**32.0**

Source: Bloomberg accessed September 20, 2020, and authors calculations.

Endnotes

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