SOLACTIVE
German Index Engineering

IN THE HUNT FOR RETURN? OVERWEIGHT SAFETY!

White Paper

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Research, Solactive AG

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EXECUTIVE SUMMARY

In this white paper, we analyze the historical performance and characteristics of a basket of sovereign bonds weighted according to the inverse of their issuing country's level of indebtedness (hereinafter referred to as the "GDP-to-Debt strategy"). In the GDP-to-Debt strategy, we weight more heavily bonds of countries with a higher level of GDP-to-government debt. In order to control for country size and potential bond liquidity issues, we multiply the GDP-to-debt ratio by country population to obtain our weights. We use the Solactive Broad Global Developed Government Bond Index (hereinafter referred to as the "benchmark") as the GDP-to-Debt strategy's benchmark.

Through our historical analysis – between October 2008 and January 2020 – we observe the following:

- The GDP-to-Debt strategy exhibited a higher degree of both country and currency diversification than the benchmark. This broader degree of diversification came largely in lieu of exposure to Japanese government bonds.
- The historical credit rating and duration of the GDP-to-Debt strategy were better and lower, respectively, throughout the entirety of the studied period.
- The Sharpe Ratio of the GDP-to-Debt strategy was 0.38 (0.93 vs. 0.55) higher than that of its benchmark. This outperformance came from both higher annualized returns (4.97% vs. 3.93%), and a lower annualized volatility (5.35% vs. 7.09%).
- The outperformance of the GDP-to-Debt strategy relative to its benchmark appears not to be linked to foreign exchange fluctuations. This fact follows as the currency portfolio of both strategies appreciated to a similar extent relative to the Euro during the timeframe of our study.

INTRODUCTION

Public debt is issued in order to finance government budget deficits via government bonds and bills. Its importance is underscored by its amount outstanding. As of the end of 2018, government debt outstanding reached USD 66 trillion, or about 80% of global gross domestic product (GDP). [1] Its sheer size and function make public debt play an essential role in the global economy.

However, research shows that a high ratio of public-debt-to-GDP can lead to negative economic consequences for debt issuing countries. Historically, countries with a high government debt-to-GDP ratio have exhibited a relatively low economic growth compared to their less-indebted peers. [2] This fact is accentuated by the fact that highly-leveraged nations tend to stay indebted for an extended amount of time. Additionally, slowing growth's embedded riskiness is not entirely transmitted through high real interest rates. [3]

Thus, investing in relatively low-leveraged nations' bonds should be preferred if investors require an adequate level of compensation in order to be exposed to sovereign default risk (consequential to slower economic growth). Under this setting, Norwegian, Australian, and Israeli government bonds would appear more appealing than those of Japan, Greece, or Italy, for example.

In this white paper, we construct an index of a GDP-to-public-debt weighted basket of sovereign bonds and benchmark its performance to that of a market-value-weighted one.

IS THERE GROWTH IN TIMES OF DEBT?

To fund his efforts against France on the Nine Years' War, William the III granted a Royal Charter for the creation of the Bank of England – the world's first central bank – in 1694. [4] Ever since, the responsibilities of central banks have evolved to encompass regulation of the national currency's value and distribution of banknotes, alongside

acting as a lender of last resort to banks suffering a liquidity crisis, amongst others. [5] Nonetheless, central banks' policies can lead to undesired outcomes at times.

In his classic book, "Manias, Panics, and Crashes", Charles Kindleberger elaborated on Hyman Minsky's model to explain economic cycles and financial market fragility. Following Minsky's theory, events leading up to a crisis start with a displacement in the macroeconomic system (e.g., the beginning or ending of a war, an unanticipated change in the political or financial system, etc.). If the displacement is significant enough, it will tend to shift profit opportunities in the economy. This shift will, in turn, mark the beginning of an economic boom. [6]

In Minsky's model, booms are fed by an expansion in credit, which is accompanied by an enlargement in money supply. If this monetary expansion is translated into a rise in speculative demand for goods and services, price increases become a self-fulfilling prophecy. Given enough momentum, this process leads to an overheating of the economy that may expand internationally. [6]

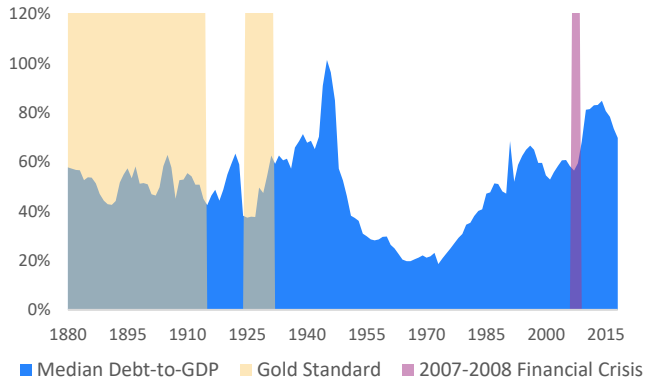
At the peak of the boom, insiders decide to sell the objects of speculation. A leveling off in prices is followed by their decline and culminates in a generalized market panic, as well as in a sharp decline in liquidity. [6]

Even though Minsky's model is better suited to explain economic bubbles, under his framework, debt accumulation – consequential to loose monetary policy – is a key trigger for a speculative rise in asset prices.

Despite the recent hike in demand for gold from central banks, these institutions have not been required to back their nation's currency with physical assets since the end of the Gold Standard.

The Gold Standard monetary system did not necessarily lead to an end of monetary policy, economic crises, currency devaluations, suspensions of convertibility, or sovereign defaults.[7] Nevertheless, it did limit the degrees of freedom governments had to accumulate debt.

Exhibit 1: Selected Developed Economies* Median Gross Government Debt-to-GDP, Gold Standard, and 2007-2008 Financial Crisis Periods**



Source: Solactive, Carmen M. Reinhart, and the IMF.

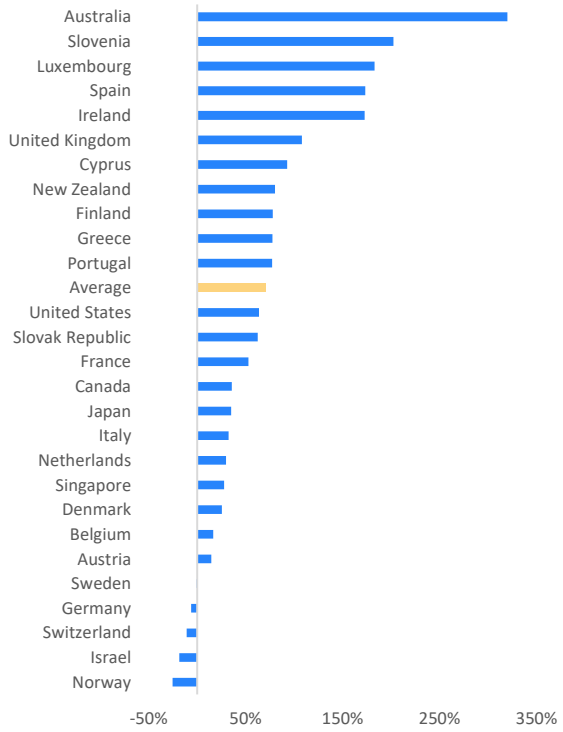
Most recently, the 2007-2008 financial crisis resulted in an increase in public indebtedness across many developed nations. This action may have been a necessary one to take in the wake of the global financial meltdown.

According to Olivier Blanchard, this fact follows as debt is particularly justified in two specific cases (besides tax smoothing). [8] The first is the financing of public infrastructure projects with a positive risk-adjusted social rate of return. The second one – which most closely resembles the onset of the crisis' circumstance – is in an environment in which demand is weak, output is below potential, and monetary policy is sharply limited by a zero-rate lower bound.

* Selected Developed Economies are considered to be the following: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom, and the United States

** Gold Standard Periods are taken as those in which at least half of the Selected Developed Economies were under a Gold Standard monetary system.

Exhibit 2: Relative Growth of Selected Developed Economies' Gross Government Debt-to-GDP from 2007 (Until 2018)

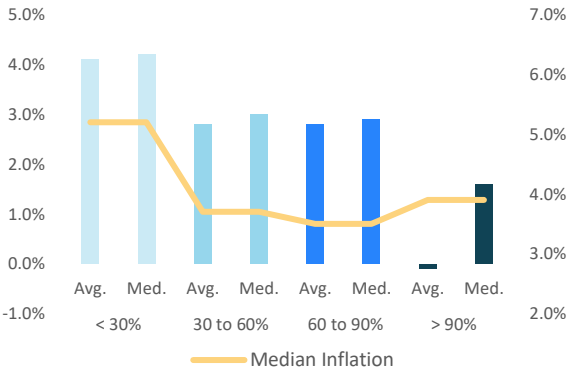


Source: Solactive and the IMF.

Nevertheless, a large degree of indebtedness may be harmful to the economy. Namely – for 44 countries, through a time period spanning about 200 years – a government debt-to-GDP ratio above 90% translated to a median GDP growth one percentage point lower than that of their peers and an average GDP growth even lower than that. [2]

Slowing growth rates can be especially harmful as countries with public-debt-to-GDP levels above 90% have commonly experienced extended debt overhangs. Particularly, in the 26 cases (identified by Reinhart, Reinhart, and Rogoff [3]) in which this threshold was surpassed – between the early 1800s and 2011 – 20 of them lasted over a decade, implying that the output shortfall of over-leveraged nations can potentially be massive. This observation can be particularly relevant to fixed income investors, given that slowing economic growth consequential to high indebtedness is apparently not transmitted entirely through high real interest rates. [3]

Exhibit 3: Advanced Economies' Average and Median Real GDP Growth (left axis) and Median Inflation (right axis) Across Different Levels of Indebtedness (1946 to 2009)

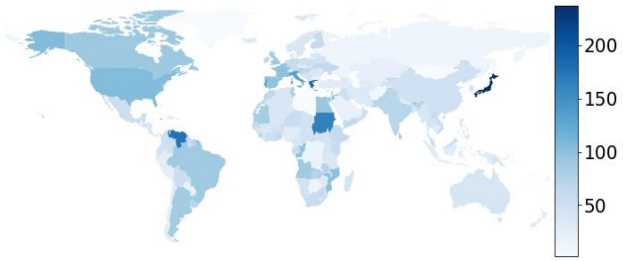


Source: Reinhart and Rogoff (2010) and sources cited therein.

Further research has demonstrated that a nation's ability to exert fiscal action more loosely during a crisis can be linked to its prior level of leverage. This finding can be attributed to the fact that high debt translates to both limited market access, and policymakers' austerity measures during a downturn. [9]

Given this set of facts, it should come as no surprise that investors would prefer exposure to bonds of less-indebted countries instead of those of highly-leveraged ones. This assumption may be accentuated by a possible higher demand for securities emitted by countries with a high level of debt in market-capitalization-weighted sovereign bond investment strategies. Furthermore, an expanding monetary policy by multiple central banks globally (which may translate to higher levels of public indebtedness and sovereign default risk, that may in turn not be entirely reflected via higher real interest rates) could make investments in bonds of countries with low public debt even more attractive.

Exhibit 4: 2018 Global Government Debt-to-GDP (%)



Source: Solactive and the IMF.

DATA AND METHODOLOGY

Each country's sovereign bond basket on the GDP-to-debt strategy is weighted as its relative GDP to general government gross debt. In order to control for size, we multiply this ratio times the country's population.

General government gross debt-to-GDP, as well as country population, is obtained from the International Monetary Fund's (IMF) World Economic Outlook Database April 2019. Since 2000, the IMF has published its World Economic Outlook Database. The database contains a diverse set of historical as well as predicted economic data. Its April 2019 version's time series data spans from 1980 to 2024.

We use the bond universe of the Solactive Broad Global Developed Government Bond Index (the "benchmark") as the baseline for our study. It includes all liquid local currency bonds issued by the central governments of the US, Ireland, Canada, the UK, Germany, Italy, Spain, Belgium, France, Israel, Slovakia, Portugal, New Zealand, Finland, Austria, Luxembourg, the Netherlands, Singapore, Australia, Switzerland, Denmark, Greece, Japan, Norway, Sweden, Slovenia, and Cyprus.

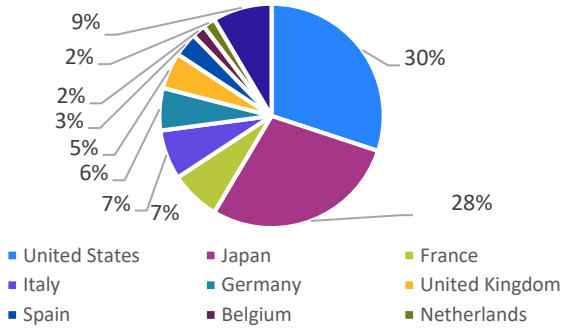
The benchmark follows a standard market-value-weighted approach and holds a historically-simulated history going back to October 2008. It is calculated in Euro and contains no hedging of currency risks in its plain vanilla version. Currently, the benchmark index includes over 1000 bonds issued by 27 different countries.

We rebalance the GDP-to-debt strategy's portfolio on the first trading day of May each year, based on the estimated GDP, general government gross debt, as well as population data from the previous year. We use daily bond returns from October 31, 2008, to January 14, 2020, for our back-test.

INDEX COMPOSITION AND HISTORICAL PERFORMANCE

In Exhibit 5, we can observe the average historical country weights of the benchmark. Given the weighting scheme of the index, as well as its constituents, it is not surprising to see that the US and Japan represent on aggregate almost 60% of the benchmark's historical weight. On the other hand, European countries hold 37.95% of the portfolio's weight.

Exhibit 5: Average Historical Country Weights of the Solactive Broad Global Developed Government Bond Index



Source: Solactive.

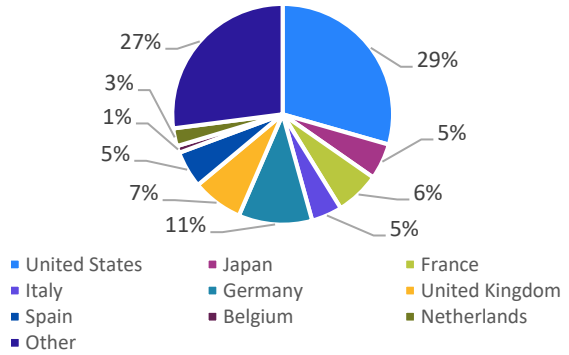
Overall, the GDP-to-Debt strategy heavily underweights Japan relative to the benchmark. During the analyzed period, Japan's average weight is 5.26%, whereas its benchmark historical average weight is around 28.46% – representing an over 23 percentage point difference. This observation

should come as no surprise given the fact that the Japanese government is the most heavily indebted one in the World, according to the IMF. Its public-debt-to-GDP stood at over 237% in 2018, far outpacing that of Greece (183%), and Venezuela (176%) – which came in at the second and third place, respectively.

In lieu of Japanese bonds, the GDP-to-Debt strategy has a relatively large European exposure. The average weight of its European constituents is close to 13 percentage points higher than that of the benchmark. Non-surprisingly, Germany is the most heavily overweight European country relative to the benchmark. Its overweight may, partially, be due to the country's government conservative fiscal policy. As can be seen in Exhibit 2, out of the Eurozone's largest economies, Germany is the only one that deleveraged in relative terms from the onset of the global financial crisis until 2018.

Germany is not the most overweighted country relative to the benchmark on the GDP-to-Debt strategy, however. This distinction goes to Australia. Even though its government debt-to-GDP has risen sharply between 2007 and 2018 (by almost 320%), as of 2018, it stood at just over 40%. Therefore, historically, Australian government bonds have been overweighted by 6.51 percentage points – on average – relative to the benchmark.

Exhibit 6: Average Historical Country Weights of the GDP-to-Debt Strategy



Source: Solactive and the IMF.

Given the weighting scheme of the GDP-to-Debt strategy (and particularly due to Japan's large underweight), its country allocation is more diversified geographically.

This broader level of diversification is reflected by the strategy and benchmark weights' Herfindahl-Hirschman Index (HHI) (i.e., the square root of its weight's sum of squares). A lower HHI indicates a greater degree of weight diversification. [10] The historical average weights of the GDP-to-Debt strategy's HHI is 3548, whereas that of the benchmark is 4369.

The GDP-to-Debt strategy's historical currency exposure is also more diversified than that of the benchmark. The strategy's currency HHI stands at 4872, compared to the benchmark's 5210. Besides the Japanese Yen, the only currency underweight of the GDP-to-Debt strategy is the USD – by barely 0.64 percentage points – as reflected in Exhibit 7.

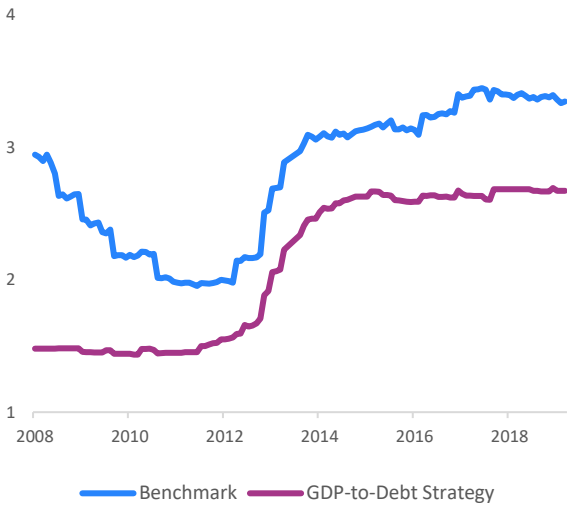
Exhibit 7: Average Historical Currency Weights of the GDP-to-Debt Strategy and the Benchmark

Currency	GDP-to-Debt Strategy	Benchmark	Difference
EUR	36.55%	31.11%	5.44 pp
AUD	7.63%	1.12%	6.51 pp
CAD	3.84%	1.73%	2.11 pp
CHF	1.79%	0.44%	1.35 pp
DKK	1.33%	0.54%	0.79 pp
GBP	7.44%	5.25%	2.19 pp
ILS	1.18%	0.17%	1.01 pp
JPY	5.26%	28.46%	-23.20 pp
NOK	1.40%	0.21%	1.19 pp
NZD	1.38%	0.19%	1.19 pp
SEK	2.26%	0.39%	1.87 pp
SGD	0.49%	0.31%	0.18 pp
USD	29.43%	30.07%	-0.64 pp

Source: Solactive and the IMF.

As can be observed in Exhibit 8, the numerical credit rating – estimated as the average of the countries' S&P and Moody's numerical credit ratings (i.e., AAA = Aaa = 1, AA+ = Aa1 = 2, ..., etc.) – of the GDP-to-Debt strategy is consistently better than that of the benchmark. The credit rating spread between these two strategies is at its widest during the 2008 financial crisis – at 1.46 notches – and at its lowest during the midst of the European debt crisis in December 2012 – at 0.41 notches. On average, the numerical credit rating of the GDP-to-Debt strategy is 0.69 notches lower than that of the benchmark.

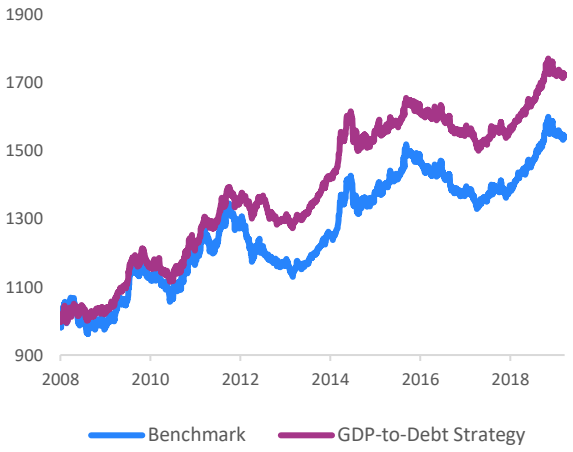
Exhibit 8: Weighted Average Historical Numerical Credit Ratings of the GDP-to-Debt Strategy and the Benchmark



Source: Solactive and the IMF.

Regarding performance, the GDP-to-Debt strategy outperforms the benchmark. This relative outperformance is translated by a diverse set of metrics. The strategy's total return is 18.25 percentage points higher than that of the benchmark (72.34% vs. 54.09%), or 1.04 percentage points on an annualized basis (4.97% vs. 3.93%). It also exhibits a lower maximum drawdown (-9.33% vs. -16.05%), and a 1.74 percentage points lower annualized volatility (5.35% vs. 7.09%) than the benchmark. Consequently, the GDP-to-Debt strategy's Sharpe Ratio is 0.38 higher than the benchmark's one (0.93 vs. 0. 55).

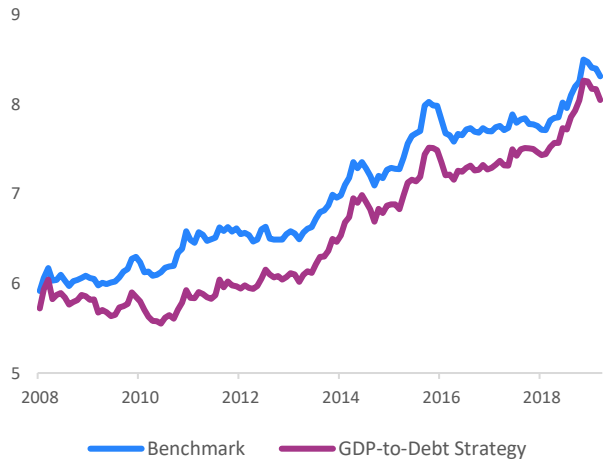
Exhibit 9: Historical Total Return of the GDP-to-Debt Strategy and the Benchmark



Source: Solactive and the IMF

Exhibit 10 reflects that the GDP-to-Debt strategy also exhibits a lower degree of duration (commonly associated with interest rate sensitivity) than the benchmark during the timeframe of the study. Thus, it may also be less susceptible to interest rate risk in a global environment of low interest rates.

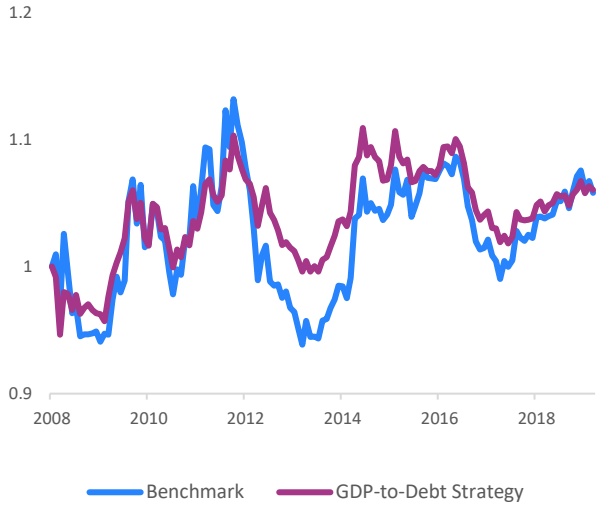
Exhibit 10: Historical Modified Duration of the GDP-to-Debt Strategy and the Benchmark



Source: Solactive and the IMF

Given the local currency nature of the strategies' underlyings, it could be implied that the GDP-to-Debt strategy's outperformance across different risk dimensions can be – partially – attributed to foreign exchange fluctuations. However, Exhibit 11 shows that this is not necessarily the case. This assumption follows as a currency portfolio of the strategy performs in a similar manner than that of the benchmark during the studied timeframe (not taking into account hedging costs). Overall, the GDP-to-Debt strategy's currency portfolio appreciated by 6.02% against the Euro, whereas that of the benchmark appreciated by 5.81%.

Exhibit 11: GDP-to-Debt Strategy and Benchmark Currency Portfolio's Fluctuation with Respect to the Euro



Source: Solactive and the IMF

CONCLUSIONS

In this white paper, we observe that an unhedged, periodically rebalanced GDP-to-public-debt sovereign bond strategy outperformed a market-value-weighted one both risk- and return-wise. The GDP-to-Debt strategy had a Sharpe Ratio 0.38 higher than that of the Solactive Broad Global Developed Government Bond benchmark on the period we analyze. Additionally, it consistently exhibited both a better credit rating and a lower duration than the benchmark.

Over our analyzed timeframe – encompassing October 2008 until January 2020 – European and Australian Sovereign Bonds were historically more heavily weighted in the GDP-to-Debt strategy relative to the benchmark. Their overweight largely comes in lieu of Japanese debt, reflecting Japan's high amount of public debt relative to its population.

Lastly, we observe that currency fluctuations may not have largely driven the GDP-to-public-debt sovereign bond strategy's outperformance. This fact follows from its currency portfolio having appreciated to a similar extent to the benchmark's one relative to the Euro.

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