Goldman Sachs | **Asset Management**

Innovation-Driven Investing

Innovation is critical for successful investing. This view is not new, but its value has never been as strong as it is today. Data has become the world's most valuable commodity and technology is dominating economies, financial markets and politics alike.

IN THIS ISSUE

Speed Read

Innovation-Driven Investing

Investment success is not static. We believe innovation can provide a dynamic investing edge. In a data-driven and technology-oriented world, an innovative investment process requires partnership with fixed income strategists ('strats') and technology professionals.

The goal is simple: make **smarter** investment decisions **faster** and more **cost-effectively** to deliver **better outcomes for our clients**…

Smarter, Faster and Cost-Effective Investing

We engineer every aspect of our investment process to be data-driven and technology-informed.

Investment Signals.
Our digital platform derives investment signals based on disaggregated drivers of returns. These signals can ignite investment discussions, overcome behavioral biases and increase the breadth of investment views being undertaken.

Proprietary Indicators.
We digest various data into a single metric to help us formulate views on a particular market or the global economy in a matter of minutes.

Communication Platforms.
Communication platforms and apps can improve intellectual cross-pollination within and between investment teams across geographical locations.

Digitized Research.
Storing, monitoring and updating research in a centralized "digital warehouse" adds structure and organization to our research process, allowing research analysts to develop more views faster.

Trading Intelligence.
We accumulate around 41 million trading-related data points on any given day. Combining internal and external datasets yields trading intelligence. This intellect allows us to implement investment decisions faster and cost-effectively either through lower transaction costs or by being rewarded for providing market liquidity.

…the route to achieving this is also straightforward: **collaboration between humans and machines**.

Humans and Machines: In Collaboration not Competition

We view technology (or 'machines') as a means to better equip—not replace—investment professionals.

Automation: Start Small, End Big.
Automation of routine tasks allows our investors to spend more time on a refined set of investment activities.

The value of automation is magnified when several tasks coalesce; digitized research views combined with trading intelligence can result in faster investment decision-making and better portfolio construction.

Value is also realized when tools or datasets unite. Data-driven insights can provide a portfolio manager with bond purchase recommendations consistent with a client's investment objectives, but also optimized for the prevailing market environment.

One Ecosystem.
In the past, portfolio managers, research analysts and traders undertook certain activities using a certain toolkit. In the current era of investing, toolkits and data-driven insights are combined into one integrated investment ecosystem (or platform).

This framework provides the investment process with two important capabilities: constant connectivity and real-time updateability. A single integrated platform is able to connect information from each function or team in real-time, and can also be updated for any change in views in a split second.

The World in 1990 vs. The World Today

Our investment philosophy is unchanged since we began actively managing fixed income portfolios in 1990; it is founded on the belief that consistent long-term positive excess returns ('alpha') can be generated by employing diverse investment opportunities with disciplined risk management.

But the world around us has changed considerably over this time period. In 1990, less than half a percent of the world's population had access to the internet. By 2017, almost half of the world's population was online[1]. Digitization and data proliferation have become hallmarks of the modern economy and financial markets. At the same time, seemingly improbable economic and political outcomes have transpired.

The result is a distinctly different investment opportunity set and investing environment. Risk premiums—or the excess return that active managers seek to capture due to market inefficiencies— have been compressed. When they do exist, they often evaporate quickly.

But change gives rise to opportunities. A rising presence of fixed income exchange-traded funds (ETFs) has contributed to greater market liquidity and lower trading cost for large bond transactions. Meanwhile, regulatory changes have led banks to offer bonds to asset managers at more competitive prices in order to manage the size of their balance sheets.

Change commands continuous conversations around how to innovate our investment process; something our fixed income investment team has always been engaged in. In a technology-oriented world, investors alone do not drive the dialogue. This is why we partner with our fixed income strats and technology professionals.

The goal is simple: make smarter investment decisions faster and more cost-effectively to deliver better outcomes for our clients. The route to achieving this is also straightforward: collaboration between humans and machines.

[1] Source: The World Bank.

Against a shifting macro, market and investment backdrop…

Macro Backdrop	Market Microstructure	Investment Environment
Elongated Cycles	Post-Crisis Banking Regulations	Proliferation of Data
Contained Inflation	Presence of non-fundamental investors ('quants', risk parity, high frequency, etc.)	Improved Processing Power
Low Yield World		
Elevated Uncertainty	Rise of Passive Products (ETFs, smart beta)	

…we maintain our fixed income investment philosophy but dynamically evolve our investment process.

Smarter, Faster and Cost-Effective Investing through Human-Machine Collaboration

Investment Signals	Communications Platforms	Trading Intelligence	Holistic Investment Platform
Proprietary Indicators	Digitized Research	Electronic Trading	Environmental, Social and Governance (ESG) Analytics
		Algorithmic Pricing	

The portfolio risk management process includes an effort to monitor and manage risk, but does not imply low risk. There is no guarantee that objectives will be met.

I. SMARTER, FASTER AND COST-EFFECTIVE INVESTING

Overview

Engineering our investment process to be data-driven and technology-informed can drive efficiency to deliver better outcomes for our clients' portfolios. One innovation we have implemented in recent years is to derive **investment signals** based on disaggregated drivers of returns. These signals allow us to pursue a more diverse set of potential investment opportunities. We have also created **proprietary indicators** that digest various data into a single metric to help us formulate views faster.

In addition, we digitize investment views in a centralized "information warehouse" called **Fluent**. This enhances intellectual cross-pollination both across and within teams—an outcome that can also be achieved through our communication platform, **Symphony**. And we obtain **trading intelligence** to invest cost-effectively, either through lower transaction costs or by being rewarded for providing liquidity.

> " Our investment signals and proprietary indicators are data-informed but grounded in our deep understanding of market structure and fundamental drivers of investment returns.
>
> Simon Dangoor | Head of Macro Rates Investing

Investment Signals

Proprietary Indicators

Smarter Faster Cost-Effective

GSAM Fixed Income Investing

Digitized Research

Trading Intelligence

Communication Platforms

I. SMARTER, FASTER AND COST-EFFECTIVE INVESTING

Investment Signals

Traditionally, fundamental investors form a macro outlook and then implement investment decisions based on this expected backdrop. But economic, market, policy and political conventions—and in turn macro outlooks—are subject to considerable uncertainty. As the 2020s progress, we believe successful investment decisions will be increasingly based on disaggregated drivers of asset prices and returns.

The ability to form a perspective on the global economy, understand market structure, recognize fundamental drivers of investment returns, and digest policy responses and political outcomes will still be vital. But investment decisions will be optimized for any given backdrop rather than for an expected outcome that is subject to considerable uncertainty.

Across our fixed income platform, we already derive **investment signals** that are informed by disaggregated drivers of asset prices and returns (Box 1). These drivers can be macro-oriented, statistical relationships, market dynamics or security-level traits. Consideration of investment signals can ignite investment discussions, overcome behavioral biases and increase the breadth of investment views being undertaken. This helps us to build more resilient and diversified portfolios.

Risk management is central to our decision to act upon an investment signal and there will be occasions where we discount investment signals or implement contrarian views. For example, ahead of the June 2019 G20 meetings, a directional rates investment signal proposed we be underweight global duration. Given unstable US-China relations and potential for a rally in rates, we did not act on this signal. We also omitted the British pound from one of our currency signals due to the binary and highly unpredictable nature of Brexit negotiations. Importantly, we systematize data analysis but not investment decision-making.

> " Investment signals use a scientific approach to challenge behavioral biases.
>
> Fred van der Wyck | Co-Head of GSAM Fixed Income Strats

Box 1: GSAM Investment Signals

Across our fixed income platform, we derive investment signals as follows:

1. **Fundamental analysis.** We identify **drivers** of persistent and consistent returns. These drivers can be macro-oriented (such as a weak inflation process), statistical relationships (including mean reversion), market dynamics (for example new issuance activity, index extension, momentum or seasonals) or security-level traits (primarily curve steepness which can give rise to "carry and roll" opportunities).

2. **Quantitative testing.** We rigorously **back-test** performance characteristics including alpha[1], sharpe ratio[2] and drawdowns associated with an investment strategy informed by the factors identified in step 1. Our objective is to find an investment strategy that can extract value from fixed income markets in a repeatable and objective manner.

3. **Obtain investment signals.** The **tested drivers** obtained from steps 1 and 2 create investment signals, which are provided to our investment teams on our digital platform.

Key Benefits

Mitigate behavioral biases. Investment signals are derived in an objective manner and can therefore be used to cross-examine existing investment views. This can improve the resilience of our investment portfolios**.**

Ignite investment discussions. An investment signal may advocate an investment idea that may otherwise be overlooked. Consideration or implementation of these signals can therefore lead to more diversified and balanced portfolios.

Improved information ratio. Signals can lead to an increased breadth of investment views and potentially improved security selection skill. Taken together, this can result in a higher information ratio[3].

[1] Alpha is the portion of the total return on the portfolio not attributable to the portfolio's exposure to its benchmark or index.
[2] Sharpe Ratio is calculated by taking the excess return of the fund versus the risk-free rate and dividing that result by the standard deviation of the fund over that same period.
[3] Information Ratio is the ratio of the excess returns of an investment relative to a benchmark divided by the standard deviation of those excess returns.

The portfolio risk management process includes an effort to monitor and manage risk, but does not imply low risk. There is no guarantee that objectives will be met.
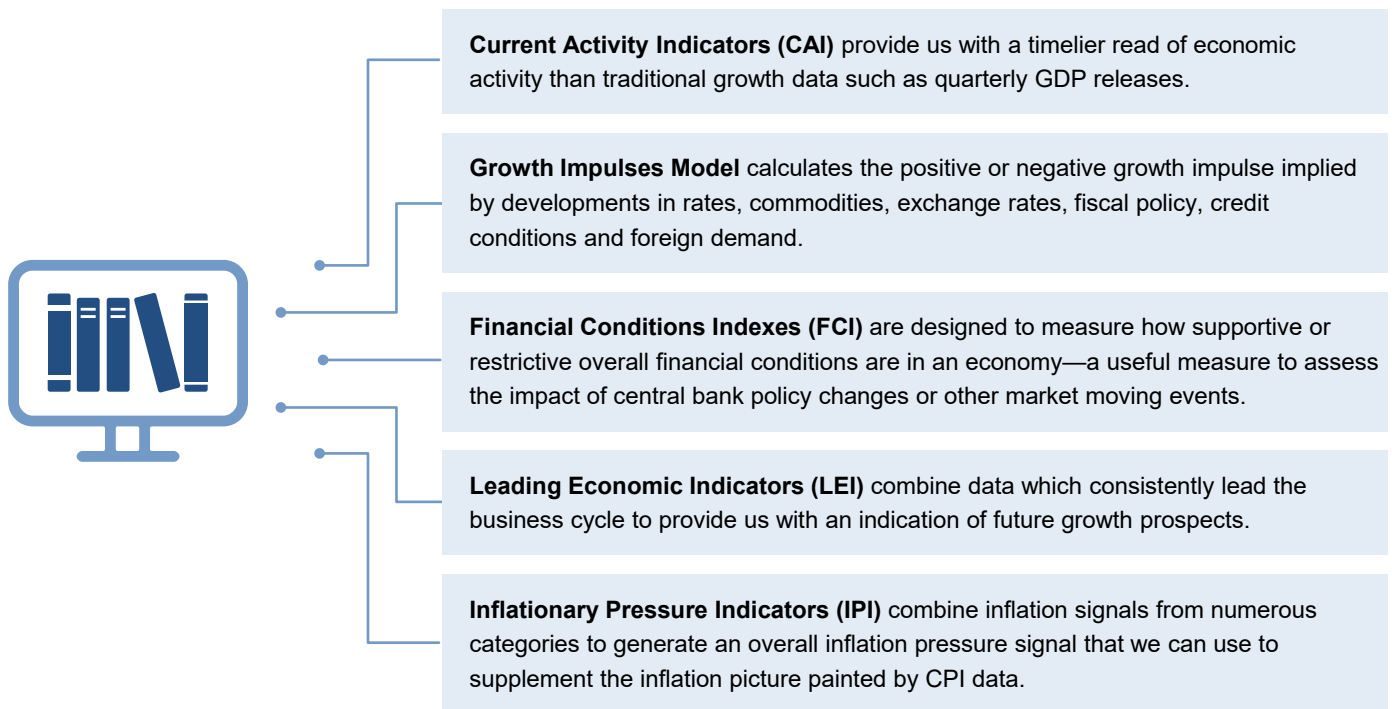
I. SMARTER, FASTER AND COST-EFFECTIVE INVESTING

Proprietary Indicators

Our **proprietary indicators** digest various data into a single metric to help us formulate views faster (Box 2). Their value-add is three-fold: digest data efficiently, add a layer of conviction to an existing view and provide prompts to consider opportunities in markets we may not otherwise consider. For example, our current activity indicators (CAI) serve as forward-scanning radars for economic growth in 31 countries, while also allowing us to obtain a snapshot of the global economy in a matter of minutes. Our Inflationary Pressure Indicators (IPI) may flag divergent price trends in two markets, leading us to consider the potential for divergent central bank policies and in turn relative value sovereign bond views.

Box 2: Snapshot of our Library of Proprietary Indicators

Current Activity Indicators (CAI) provide us with a timelier read of economic activity than traditional growth data such as quarterly GDP releases.

Growth Impulses Model calculates the positive or negative growth impulse implied by developments in rates, commodities, exchange rates, fiscal policy, credit conditions and foreign demand.

Financial Conditions Indexes (FCI) are designed to measure how supportive or restrictive overall financial conditions are in an economy—a useful measure to assess the impact of central bank policy changes or other market moving events.

Leading Economic Indicators (LEI) combine data which consistently lead the business cycle to provide us with an indication of future growth prospects.

Inflationary Pressure Indicators (IPI) combine inflation signals from numerous categories to generate an overall inflation pressure signal that we can use to supplement the inflation picture painted by CPI data.

Key Benefits

Efficiency: CAIs and FCIs allow us to digest data and identify macroeconomic changes in a timely and systematic way. This can lead to more efficient investment idea generation.

Strengthened Conviction: Combining insights from our fundamental research with data analytics can result in investment decisions that are better informed, adding a layer of conviction to our existing investment intuition.

New Insights: Innovations in proprietary datasets may identify macro or market shifts. They can also lead us to consider opportunities in markets that we may otherwise not consider, in part due to time and resource constraints.

I. SMARTER, FASTER AND COST-EFFECTIVE INVESTING

Communication Platforms and Digitized Research

Communication platforms and digitized research can improve intellectual cross-pollination both across and within teams. Both technologies allow our research analysts to develop more views faster while also deepening relationships with other investment teams and clients.

Portfolio managers can efficiently examine an investment thesis, while traders unite analyst opinions with market liquidity knowledge to implement investment views in the most cost-effective way. Taken together, this can enhance portfolio construction, particularly for more customized portfolios.

Communication through Symphony

Communication and collaboration are central to our team-oriented investment process. This has long been facilitated through face-to-face meetings, telephone and video conferences and email exchange.

While these communications remain in use, new platforms and apps can strengthen our model of knowledge sharing. One example is **Symphony**, a communication platform that is used across GSAM Fixed Income to share information, solve problems, discuss opportunities and streamline workflows (Box 3).

In keeping with the hashtag world around us, tags in Symphony include '#newissuesEUR' and '#ratings'; the former can enable traders and portfolio managers to efficiently filter for information related to new Euro-denominated corporate bond issuance while the latter can identify corporate spread moves based on rating agency actions.

Box 3: Symphony

Investment professionals can create signals to customize their daily newsfeed

Users can track various topics in a single dashboard

Content is tagged according to thematic descriptors (e.g., #earnings) and categories (e.g., #macro) to create well-organized 'information warehouses'

Cross-team communication facilitates intellectual cross-pollination
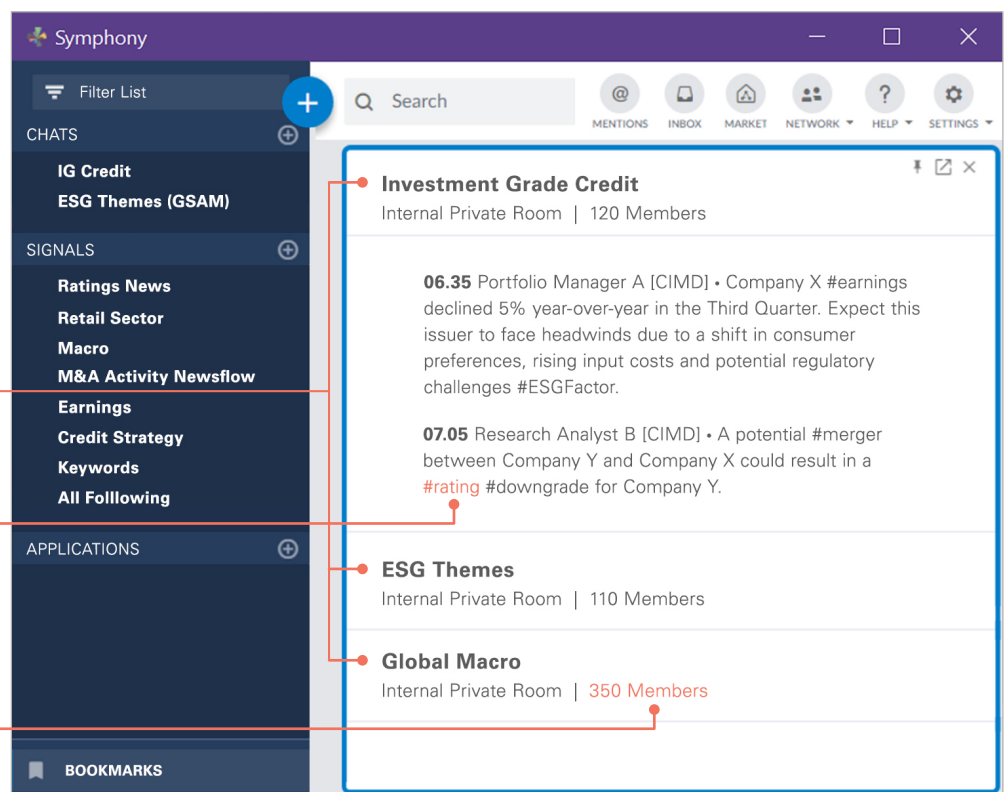
Source: GSAM. For illustrative purposes only.

I. SMARTER, FASTER AND COST-EFFECTIVE INVESTING

Communication Platforms and Digitized Research

Digitized Research in Fluent

Fluent is an organized and centralized "information warehouse" that stores client research requests, digitized investment views and trade instructions (Box 4). Through the 'Activities' tab, we can swiftly respond to client queries, leveraging the knowledge of our 45 credit research analysts[1]. This feature also provides access to country views, trade instructions and corporate engagements. The 'Investment Views' dashboard displays key investment information including research analyst views, financial metrics, a calendar of key market events and an environmental, social and governance (ESG) scorecard.

This dashboard facilitates relative value analysis, enhances analyst accountability and enables portfolio managers to examine an investment thesis more efficiently. The ESG scorecard, comprised of external data and internal views, allows us to seamlessly integrate

ESG-analysis into our investment process and improves our ability to manage ESG-enhanced mandates. ESG integration is inherent to our fundamental investment process across our Fixed Income platform. ESG-enhanced investment mandates go one step further with investment guidelines being governed by ESG considerations.

> " Fluent adds structure and organization to our views, uniting objective metrics (data) with subjective metrics (analyst views).
>
> Stephen Waxman | Head of Global Investment Grade Research

[1] Source: GSAM. As of December 2019. Includes investment grade, high yield, emerging market corporate and ESG research.

Box 4: Digitized Investment Views Dashboard in Fluent

Fluent offers various capabilities including tracking client research activity requests, an investment view dashboard and a learning zone

The 'Investment Views' dashboard displays key investment metrics and streamlines the research process

Research analysts can access and analyze key ESG analytics and also upload financially material ESG factors that form part of their investment thesis
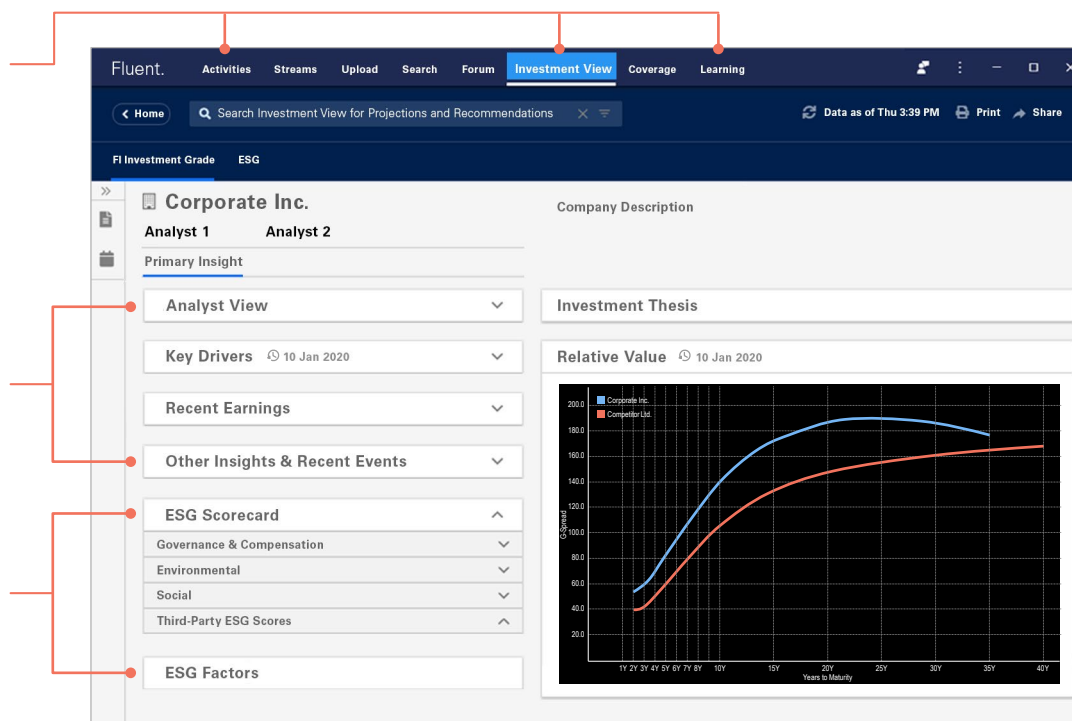
Source: GSAM. For illustrative purposes only.

I. SMARTER, FASTER AND COST-EFFECTIVE INVESTING

Trading Intelligence

So far we have focused on how we seek to make smarter investment decisions faster. **Trading intelligence** (Box 5) allows us to implement these investment decisions faster and cost-effectively either through lower transaction costs or by being rewarded for providing market liquidity. Our scale as a global fixed income manager alongside access to technology is central to achieving this.

We accumulate around 41 million trading-related data points on any given day; this data can be internal trading analytics or externally obtained information around dealer inventories or bond transactions.

Our trading professionals collaborate with strats and technology professionals to connect datasets and derive trading intelligence.

This intellect can lower transaction costs by improving price discovery. As discussed earlier, combining trading intelligence with digitized research views can also enhance portfolio construction,

ensuring we implement investment views with the most suitable bonds from a cost and potential "carry and roll" perspective. In addition, our insight into bond dealer inventory levels can also allow us to transact at times or with counterparts that may reward us for providing liquidity.

> " We derive trading intelligence by combining internal trading analytics with external pricing data; this enables us to augment price discovery, trade execution and portfolio construction across teams, products and regions.

Mitesh Popat | Head of Macro Rates Trading

Box 5: Obtaining Trading Intelligence

Internal Data

GSAM trading analytics

+

External Data

Bond transaction information
Bond dealer inventories

=

Trading Intelligence

Cost-effective Trading

Improved price discovery

Enhanced trade planning and execution

Better portfolio construction

Best execution and transaction cost analysis
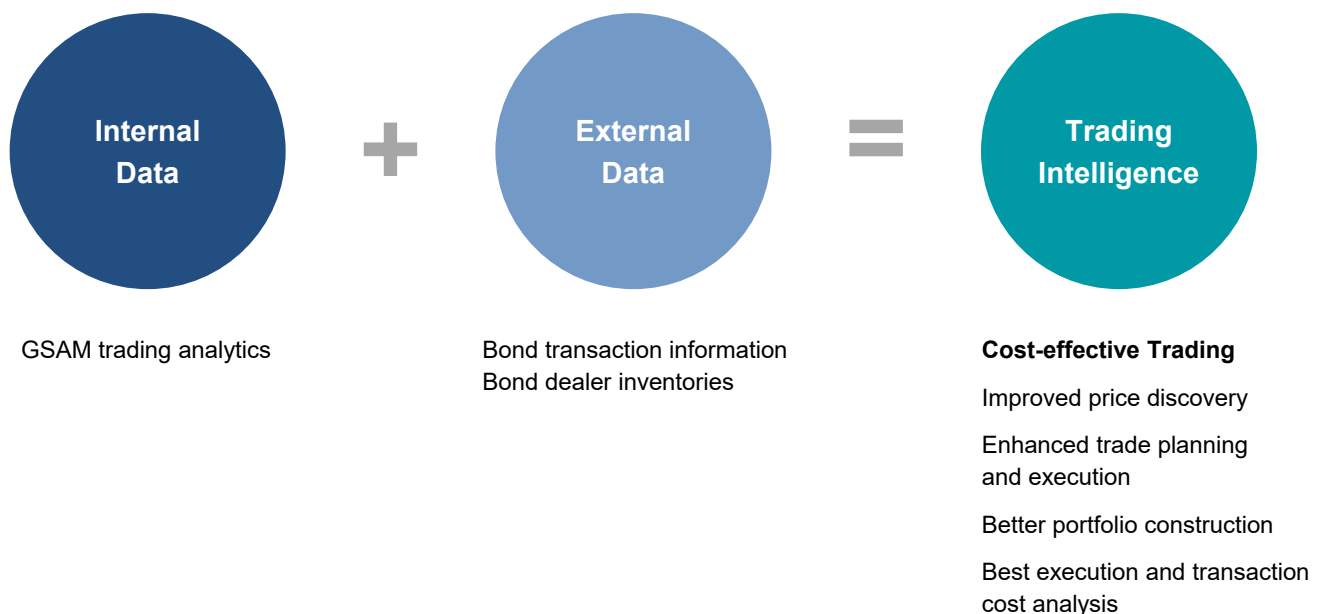
II. HUMANS AND MACHINES: IN COLLABORATION NOT COMPETITION

Overview

We view technology (or 'machines') as a means to better equip—not replace—investment professionals. Admittedly, fixed income investing has lagged other asset classes in its use of new technologies and automation.

Part of the explanation is industry-specific; bond pricing data has existed for less than 20 years and the bond market is larger and more heterogeneous than the stock market (Box 6).

But data availability and advances in automation are narrowing the gap. We believe we are entering a new fixed income era characterized by growing collaboration between human knowledge and machine power. At GSAM, this collaboration is well underway.

This is what we discussed in Part I. Our research analysts, traders and portfolio managers utilize tools that are data-driven with elements of automation.

The next stage of the human-machine collaboration is the creation of one ecosystem or platform. This is also in motion. Digitized research and trading intelligence is integrated with risk models to optimize portfolio construction. An integrated platform provides two powerful capabilities: constant connectivity and real-time updateability. We are also enthused by growing application of data-analysis techniques such as artificial intelligence, machine learning and natural language processing across fixed income investing[1].

> " Investment success is not static. Combining human intuition with data can provide a dynamic investment edge.

Ersen Bilgin | Co-Head of GSAM Fixed Income Strats

> " When computing power does the heavy lifting, human intellect can be realized with better precision and efficiency.

Ashish Shah | Co-CIO Global Fixed Income

> " Our risk management framework monitors over one thousand risk factors on a daily basis and is continually developed to reflect rapidly changing macro, market and political conditions.

Whitney Watson | Global Head of Fixed Income Risk Management and Portfolio Construction

---

Box 6: Pricing data paired with processing power is facilitating fixed income automation

Unlike Equities, industry-wide bond pricing data has existed for less than **20 years**…

…but since **2001** regulatory changes have led to enhanced bond pricing and transaction data…

…however there are **~8 million** bond CUSIPS versus **~150,000** equity CUSIPS…

…which is why fixed income trading automation is dependent on processing power.

Source: Citi Advisory Services, GSAM.

[1] For additional information, see GSAM Perspectives: Big Data Edition (July 2016).

II. HUMANS AND MACHINES: IN COLLABORATION NOT COMPETITION

Automation: Start Small, End Big

Innovation does not occur with just one or two new technologies; it draws on many. A fully autonomous car will entail automation of several tasks such as steering, speed adjustments and lane changes. Cars on the road today already involve elements of automation. The same applies for investing. A range of routine tasks are already automated and more will be automated. This allows investors to allocate greater time to specialist tasks that require investing expertise and simultaneous application of a wide range of skills.

Activities initially in scope for automation tend to be mundane. A computer can digest millions of data points and package them to highlight potential investment opportunities (i.e., our investment signals discussed earlier). Computing power can achieve this exponentially faster than a human using spreadsheets and models.

Assigning these sorts of tasks to computers enables investors to spend more time on activities that—at least for the foreseeable future—cannot be automated. This includes abstract thinking such as consideration of novel macro or market conditions that may pose upside or downside risks to a current investment view, or discussions with policymakers and corporate executives.

Similarly, algorithmic pricing for liquid fixed income securities and electronic trading for smaller size bond transactions allows our traders to allocate more time to higher value-add tasks. These include acquiring deeper market expertise, management of larger or more complex trades and development of proprietary toolkits. In 2018, 90% of our developed market government bond trading and 85% of our investment grade corporate bond trading was executed via electronic avenues.

The value of automation is magnified when several tasks coalesce; digitized research views combined with trading intelligence can result in faster investment decision-making and better portfolio construction.

Value is also realized when tools or datasets unite. In the retail sector, data analysis can provide a consumer with grocery shopping recommendations based on prior purchases, available budget and shopping frequency. In investing, similar data-driven insights can provide a portfolio manager with a recommended list of bonds to purchase consistent with a client's investment objectives, but also optimized for the prevailing market environment.

Returning to the earlier analogy with autonomous cars, we believe technology can drive better, faster and cost-effective investment decisions but a key distinction for active investment management is that humans will remain at the wheel (Box 7).

> " An artistic mind-set helped in analyzing Financials during the Global Financial Crisis, when 'norms' became abnormal and thinking the unthinkable was the key to navigating new norms. This sort of creative thinking speaks to the role humans will increasingly play in investing alongside machines.

Fiona Macnab | Head of European High Yield Portfolio Management

---

Box 7: Technology will gain responsibility and drive efficiency but humans will remain at the wheel

Portfolio Manager   Machine   Portfolio Manager   Machine
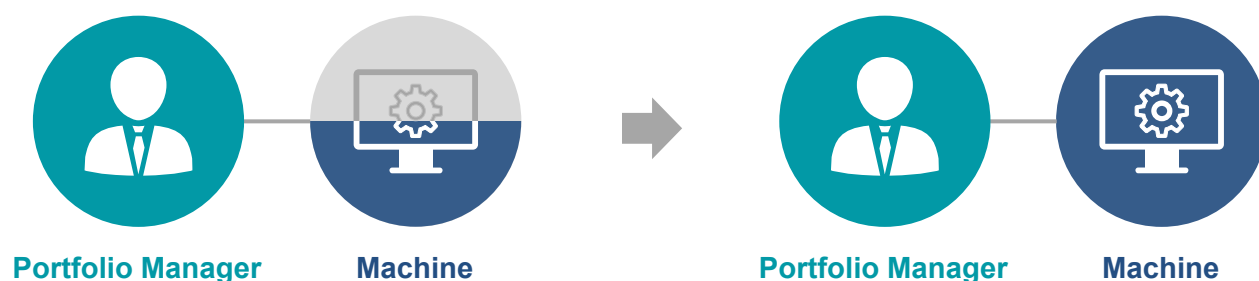
II. HUMANS AND MACHINES: IN COLLABORATION NOT COMPETITION

One Ecosystem

Technology has typically been applied to certain tasks in isolation. Segregation can exist even within technological innovations. A smartphone has separate apps for personal banking, e-commerce and investing. The creation of "super-apps" that combine information from each of these apps into one ecosystem can provide an individual with a holistic view of their current financial situation, while also making investing, saving and spending suggestions. Some apps go one step further and implement investing or saving decisions.

The situation in fixed income investing is comparable. In the past, portfolio managers, research analysts and traders have undertaken certain activities using a certain toolkit. In the current era of investing, toolkits and data-driven insights are combined into one integrated investment ecosystem (Box 8).

This ecosystem or 'platform' combines digitized research views with risk models to create customized client portfolios. These portfolios are largely implemented through automated trading that is informed by algorithmic pricing and trading intelligence.

Within this integrated framework, investment professionals can focus on a refined set of activities. For research analysts this includes responding to client queries, developing new insights and expanding their research coverage. Portfolio managers can focus on client engagement and differentiated insights, while traders can develop deeper market expertise and advance our trade execution algorithms.

This framework also provides the investment process with two important capabilities: constant connectivity and real-time updateability. Portfolio managers, research analysts and traders are autonomous agents and it can take time to connect them and to update them on any change in view or process. In contrast, a single integrated platform is able to connect information from each function or team in real-time. It can also be updated for any change in views in a split second.

Box 8: One Investment Ecosystem

- ☑ Scalable
- ☑ Data centric
- ☑ Digitize and automate
- ☑ Platform, not tools
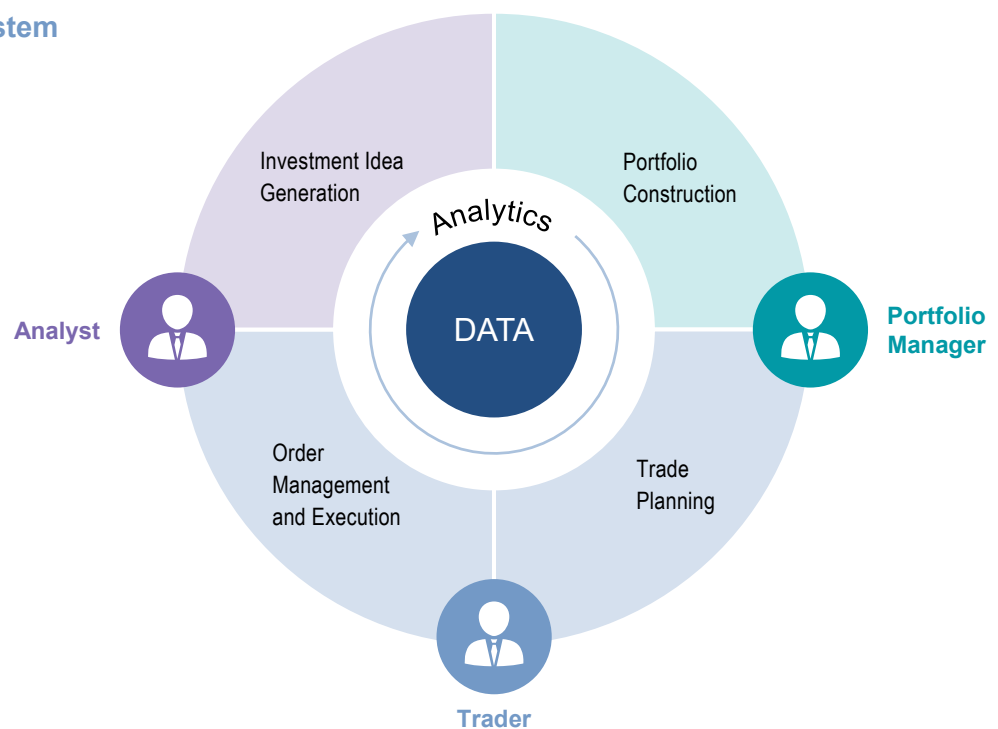
GSAM Fixed Income in Figures

$774 billion+ Fixed income assets under supervision	**319** Fixed Income investment professionals	**1000+** Daily risk factors monitored
11 Offices with fixed income professionals	**30** Years experience actively managing fixed income portfolios	**6x** Annual growth in ESG- enhanced assets under management in 2019
100+ Dedicated fixed income strats and technology professionals	**41 million** Daily trade-related data-points monitored	**1.7 million+** Fixed income trades conduced in 2019

Source: GSAM. Assets, investment professionals, trading activity, risks monitored and office locations as of December 2019. GSAM fixed income management experience as of January 2020. Assets Under Supervision (AUS) includes assets under management and other client assets for which Goldman Sachs does not have full discretion.

The portfolio risk management process includes an effort to monitor and manage risk, but does not imply low risk. There is no guarantee that objectives will be met.

DISCLOSURES

Views and opinions expressed are for informational purposes only and do not constitute a recommendation by GSAM to buy, sell, or hold any security, they should not be construed as investment advice.

All investments involve risk including possible loss of principal. Individual asset classes involve unique risks. Bonds and fixed income investing are subject to interest rate risk. When interest rates rise, bond prices fall. Equity securities are more volatile than bonds and greater risks. International securities entail special risks such as currency, political, economic, and market risks. These risks are heightened in emerging markets securities which may be less liquid and more volatile. These risks should be fully evaluated before making an investment decision.

The currency market affords investors a substantial degree of leverage. This leverage presents the potential for substantial profits but also entails a high degree of risk including the risk that losses may be similarly substantial. Such transactions are considered suitable only for investors who are experienced in transactions of that kind. Currency fluctuations will also affect the value of an investment.

High-yield, lower-rated securities involve greater price volatility and present greater credit risks than higher-rated fixed income securities.

THIS MATERIAL DOES NOT CONSTITUTE AN OFFER OR SOLICITATION IN ANY JURISDICTION WHERE OR TO ANY PERSON TO WHOM IT WOULD BE UNAUTHORIZED OR UNLAWFUL TO DO SO.

This information discusses general market activity, industry or sector trends, or other broad-based economic, market or political conditions and should not be construed as research or investment advice. This material has been prepared by GSAM and is not financial research nor a product of Goldman Sachs Global Investment Research (GIR). It was not prepared in compliance with applicable provisions of law designed to promote the independence of financial analysis and is not subject to a prohibition on trading following the distribution of financial research. The views and opinions expressed may differ from those of Goldman Sachs Global Investment Research or other departments or divisions of Goldman Sachs and its affiliates. Investors are urged to consult with their financial advisors before buying or selling any securities. This information may not be current and GSAM has no obligation to provide any updates or changes.

Although certain information has been obtained from sources believed to be reliable, we do not guarantee its accuracy, completeness or fairness. We have relied upon and assumed without independent verification, the accuracy and completeness of all information available from public sources.

Past performance does not guarantee future results, which may vary. The value of investments and the income derived from investments will fluctuate and can go down as well as up. A loss of principal may occur.

Economic and market forecasts presented herein reflect a series of assumptions and judgments as of the date of this presentation and are subject to change without notice. These forecasts do not take into account the specific investment objectives, restrictions, tax and financial situation or other needs of any specific client. Actual data will vary and may not be reflected here. These forecasts are subject to high levels of uncertainty that may affect actual performance. Accordingly, these forecasts should be viewed as merely representative of a broad range of possible outcomes. These forecasts are estimated, based on assumptions, and are subject to significant revision and may change materially as economic and market conditions change. Goldman Sachs has no obligation to provide updates or changes to these forecasts. Case studies and examples are for illustrative purposes only.

An investment in real estate securities is subject to greater price volatility and the special risks associated with direct ownership of real estate.

United Kingdom and European Economic Area (EEA): In the United Kingdom, this material is a financial promotion and has been approved by Goldman Sachs Asset Management International, which is authorized and regulated in the United Kingdom by the Financial Conduct Authority.

Switzerland: For Qualified Investor use only – Not for distribution to general public. This document is provided to you by Goldman Sachs Bank AG, Zürich. Any future contractual relationships will be entered into with affiliates of Goldman Sachs Bank AG, which are domiciled outside of Switzerland. We would like to remind you that foreign (Non-Swiss) legal and regulatory systems may not provide the same level of protection in relation to client confidentiality and data protection as offered to you by Swiss law.

Asia Pacific: Please note that neither Goldman Sachs Asset Management International nor any other entities involved in the Goldman Sachs Asset Management (GSAM) business maintain any licenses, authorizations or registrations in Asia (other than Japan), except that it conducts businesses (subject to applicable local regulations) in and from the following jurisdictions: Hong Kong, Singapore and Malaysia.

This material has been issued for use in or from Hong Kong by Goldman Sachs Asset Management (Hong Kong) Limited, in or from Singapore by Goldman Sachs Asset Management (Singapore) Pte. Ltd. (Company Number: 201329851H) and in or from Malaysia by Goldman Sachs (Malaysia) Sdn Berhad (880767W).

Australia: This material is distributed in Australia and New Zealand by Goldman Sachs Asset Management Australia Pty Ltd ABN 41 006 099 681, AFSL 228948 ('GSAMA') and is intended for viewing only by wholesale clients in Australia for the purposes of section 761G of the Corporations Act 2001 (Cth) and to clients who either fall within any or all of the categories of investors set out in section 3(2) or sub-section 5(2CC) of the Securities Act 1978, fall within the definition of a wholesale client for the purposes of the Financial Service Providers (Registration and Dispute Resolution) Act 2008 (FSPA) and the Financial Advisers Act 2008 (FAA),and fall within the definition of a wholesale investor under one of clause 37, clause 39 or clause 40 of Schedule 1 of the Financial Markets Conduct Act 2013 (FMCA) of New Zealand (collectively, a "NZ Wholesale Investor"). GSAMA is not a registered financial service provider under the FSPA. GSAMA does not have a place of business in New Zealand. In New Zealand, this document, and any access to it, is intended only for a person who has first satisfied GSAMA that the person is a NZ Wholesale Investor. This document is intended for viewing only by the intended recipient. This document may not be reproduced or distributed to any person in whole or in part without the prior written consent of GSAMA. This information discusses general market activity, industry or sector trends, or other broad based economic, market or political conditions and should not be construed as research or investment advice. The material provided herein is for informational purposes only. This presentation does not constitute an offer or solicitation to any person in any jurisdiction in which such offer or solicitation is not authorized or to any person to whom it would be unlawful to make such offer or solicitation.

Canada: This material has been communicated in Canada by Goldman Sachs Asset Management, L.P. (GSAM LP). GSAM LP is registered as a portfolio manager under securities legislation in certain provinces of Canada, as a non-resident commodity trading manager under the commodity futures legislation of Ontario and as a portfolio manager under the derivatives legislation of Quebec. In other provinces, GSAM LP conducts its activities under exemptions from the adviser registration requirements. In certain provinces, GSAM LP is not registered to provide investment advisory or portfolio management services in respect of exchange-traded futures or options contracts and is not offering to provide such investment advisory or portfolio management services in such provinces by delivery of this material.

Japan: This material has been issued or approved in Japan for the use of professional investors defined in Article 2 paragraph (31) of the Financial Instruments and Exchange Law by Goldman Sachs Asset Management Co., Ltd.

DISCLOSURES