J.P. Morgan Index Research Replication Strategies (IRR)

Strategic replication baskets to capture index beta

Introduction

This publication introduces the J.P. Morgan Index Research Replication (IRR) platform which offers durable cash-based beta access solutions for replicating the performance of J.P. Morgan EM sovereign, local currency and corporate debt indices. The IRR platform focuses on constructing tradable bond and NDF baskets to mirror EM fixed income beta.

- **IRR bond baskets are synthesized using permutations of stratified sampling and tracking error minimization by disaggregating various risk dimensions of a bond index.** Security selection emphasizes liquid and tradable securities yielding a longer shelf life of three - six months.
- **Bond based replication enables asset managers to swiftly bootstrap the beta component of their portfolios and focus their efforts on alpha generation.** Specially curated IRR baskets can also enhance the income generating capabilities of the overall portfolio by picking in-demand securities (specials) which can be lent out in the repo markets.
- **On average, IRR baskets have less than one-tenth of the number of securities in their respective reference bond indices resulting in significant transactional efficiency when compounded with less frequent rebalancing.** Consequently, the estimated transaction cost of IRR baskets is typically less than a third of the costs of rebalancing the underlying reference index.
- **Optimized IRR baskets match the total return of the reference index within a few basis points precision while anchoring realized tracking error versus the benchmark.** IRR enhances the traditional sampling techniques by taking into account the correlation and dispersion among index constituents which helps isolate the sub-components that drive return volatility.
- **Similar to customized benchmarks, IRR baskets can be tailored to precisely match investment preferences based on country, sector, issuer and credit rating filters.**

Figure 2: IRR statistics

Metric	EMBIGD	IRR Basket	Diff	GBI-EM GD	IRR Basket	Diff	CEMBI+ IG	IRR Basket	Diff
No. of bonds	587	**40**		209	**37**		702	**49**	
Yield (%)	5.7	**5.7**	-	6.3	**6.3**	-	3.9	**3.8**	-0.1
Spread (bp)	268	**264**	-3		NA		190	**181**	-9
Duration	6.6	**6.6**	-	4.9	**5.0**	0.06	5.3	**5.3**	-
Return (%)	2.54	**2.53**	-0.01	3.8	**3.8**	-0.02	1.85	**1.88**	0.03

Source: J.P. Morgan.

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Figure 1: Beta access options

EM Indices	IRR	ETFs	TRS (JPM Trading)
Local currency Gov't debt			
GBI-EM GD	X		
GBI-EM Core	X	X	
GBI-EM 10/1	X	X	
GBI-EM 15/4.5	X	X	
Sovereign debt			
EMBI+	X		X
EMBIG	X		
EMBIG Div	X		
EMBIG Core	X	X	X
Corporate debt			
CEMBI Div	X		X
CEMBI Core	X	X	
CEMBI BD	X		
CEMBI+ IG	X		
CEMBI+ HY	X		
JACI Core	X	X	

Source: J.P. Morgan.

See page 8 for analyst certification and important disclosures.

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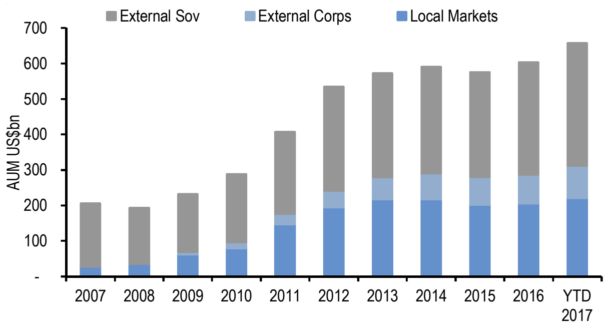
Efficient access to EM Fixed Income through IRR platform

J.P. Morgan Index Research Replication Strategies (IRR) offers durable cash-based passive indexing strategies for investors looking to efficiently replicate the performance of the J.P Morgan EM Bond suite of indices. Investor appetite for EM fixed income remains strong as seen on the robust $77bn of inflows year to date. Assets tracking various JPM EM bond indices have grown three fold since 2007 standing at a total of $658bn as of August 2017 (Figure 3). However, trading EM instruments can involve significant operational and accessibility hurdles even for savvy investors. In addition, there has been a surge in the number of EM issuers coming to market presenting a coverage challenge for investors looking to get involved in the space. For instance, the EMBI Global Diversified (EMBIGD) covers 146 sovereign and quasi-sovereign issuers from 66 countries. The Corporate EM Broad Diversified (CEMBI BD) is even more encompassing with 581 issuers across 12 industry sectors and 51 countries. The IRR platform aims to mitigate both the execution and coverage hurdles in one unified solution.

Figure 3: Growth in assets tracking JPM EM Bond indices



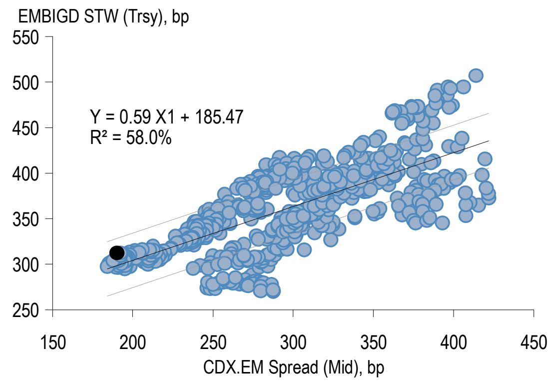
Source: J.P. Morgan.

IRR replication strategies offer efficient access to EM fixed income beta and enables asset managers to swiftly bootstrap the beta component of their portfolios and focus their efforts on alpha generation. IRR bond baskets are synthesized using permutations of stratified sampling and tracking error minimization by disaggregating various risk dimensions of the bond index. Baskets are typically constructed for a three to six month horizon which minimizes turnover costs compared to the monthly rebalance cycle of the benchmarks. The shelf life of the basket is predicated on selecting the most liquid securities and optimizing the minimum lot sizes in the portfolio. Alpha generation strategies such as over/under weighting duration, specific credits, countries or regions can also be incorporated into IRR baskets based on investor preferences. In addition to the aforementioned opportunities, investors can also enhance the income generating capabilities of their overall portfolio by using curated baskets consisting of in-demand instruments, also known as specials, which benefit from securities lending in repo markets.

Bond based replication is particularly appealing to investors who have restrictions in using derivatives or want more flexibility. CDX.EM, a tradable basket of CDS contracts, offers one of the most liquid means to synthetically gain (or hedge) EM exposure. However, investment guidelines for certain mandates may prohibit the use of derivatives altogether. Furthermore, the reliability of CDX.EM to fully hedge has diminished to a certain extent (Figure 4) due to the growing compositional differences of the CDS index versus the EMBIGD (the benchmark bond index). While the EMBIG Div tracks 146 sovereign and quasi sovereign issuers from 66 countries, the CDX.EM coverage is limited to only 14 sovereign CDS contracts. Moreover, CDX.EM only covers the credit spread component of the EMBIGD and investors would have to separately trade UST futures to hedge out the underlying interest rate exposure. On the cash side, there are obvious benefits to using ETFs, but they may not provide portfolio managers with the desired asset mix and flexibility for credit selection. IRR accommodates both these situations since they can be tailored to precisely match investment preferences based on avoiding derivatives and applying country, sector, issuer and credit rating filters.

Figure 4: Reliability of CDX.EM to full hedge EMBIGD spread moves has diminished due to compositional differences

EMBIGD STW vs. CDX.EM Mid-spread (2013-2017 YTD)



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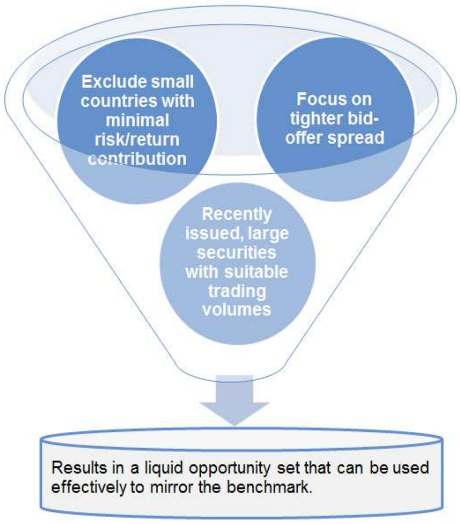
Disaggregating the risk dimensions of an Index

Establishing efficient replication baskets starts with selecting the appropriate established benchmark such as the EMBIGD or GBI-EM GD since they provide a strong baseline for comparison. Moreover, starting with a frequently utilized benchmark makes the replication basket fungible with other tradable products such as ETFs as a creation/redemption unit. In the following section, we highlight the intrinsic impediments to reliably sample linear beta factors of the index, and outline the algorithm utilized in the IRR platform to systematically decompose such factors for replication. Finally, we elucidate the viable and cost effective solutions utilized to overcome such structural issues, and the optimization techniques used to minimize tracking error.

Enhancing transactional viability through liquidity filters

Within the selected benchmark scope, narrowing the composition to an investable opportunity set is the key to ensuring the success of the IRR basket and minimizing transaction costs. Our proprietary liquidity algorithm achieves this in a multidimensional approach (Figure 5). First, the smallest countries/issuers with minimal contribution to risk/return are excluded from the opportunity set. The threshold for exclusion depends on the target size of the IRR basket and the number of countries and issuers in the given reference index. This approach is valuable in narrowing the scope of broad based benchmarks such as the CEMBI Broad which tracks hundreds of issuers and less applicable for the GBI-EM GD which is homogeneous and tracks only 18 countries. The second step in the liquidity filter involves identifying frequently traded bonds with the tightest bid-offer spreads within each sample strata. Pricing frequency and bid-offer spreads are inherent in the daily transactional data captured in the calculation of a bond index, and therefore lend themselves well to reliably quantify liquidity. The last step in the filtering process screens for market depth for efficient execution. Unlike equities, the market for EM fixed income remains largely OTC. Therefore trading volumes and transactional records are scarce and unreliable. Hence, the liquidity algorithm relies on the face amount outstanding of the issuer and security to gauge implied market depth. Accordingly, the largest securities by amount outstanding with suitable trading volumes when available (e.g. from EMTA) are selected from within the opportunity set that satisfies the previously outlined criteria.

Figure 5: Applying liquidity filters for transactional viability



Source: J.P. Morgan.

Liquidity varies significantly by asset class, sector and issuer, therefore IRR liquidity filters are applied with the principle of proportionality in mind. For instance, a $2 billion size threshold maybe appropriate for selecting sovereign (EMBI) bonds while such a threshold maybe too restrictive if applied on corporate (CEMBI) bonds. Instead, the nuances specific to each asset class and anecdotal market evidence are taken into account when selecting securities. Intuitively, the most recently issued large benchmark bonds tend to trade with a tighter bid-offer spread compared to that of older bonds with similar maturity; therefore new benchmark bonds are favored in IRR baskets (Figure 6).

Figure 6: Most recently issued benchmarks tend to trade with the tightest bid-offer spreads

Bid/Off Price Spread (bp)	10Y		30Y	
	Benchmark bond	Prev. On-the-run	Benchmark bond	Prev. On-the-run
PEMEX	30	50	40	75
PETBRA	55	76	84	113

Source: J.P. Morgan.

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Stratified Sampling

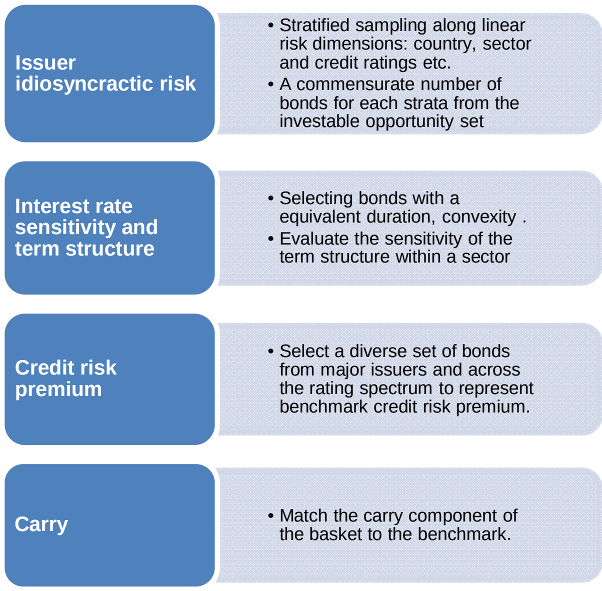
The next phase of the IRR construction involves breaking down the reference index into a linear matrix along country, sector & issuer dimensions, and assigning representative securities for each cell from the liquid opportunity set. The number of instruments and basket weight for each cell is determined pro rata to the weight of the category in the reference index. For instance, in a 50 bond IRR basket designed to replicate the EMBIGD, Mexico sovereigns will be represented by 2 to 3 sovereign bonds making up a weight of close to 2.5% in the basket. Country inclusion and weights in the replication basket will match that of the reference benchmark. This scheme encapsulates idiosyncratic issuer risk by focusing on the major issuers in terms of index weight and high beta.

Matching linear beta factors in a barbell

Security selection for each category mirrors the risk factors such as duration, convexity, yield, term structure for the respective sub-component while maintaining the overall sector and credit rating exposure of the reference index. Subsequently, for each cell in the sampling matrix, a diverse set of bonds from major issuers are selected to adequately represent the respective credit risk premium and the carry component. Typically, the top two issuers by index weight within each sub-component are targeted while taking into account dispersion and high beta assets which may have an outsized contribution to return and spread volatility. In order to maintain term-premium and balance duration risk, an equal mix of longer duration and short duration bonds are selected if applicable and where basket sampling permits. As an example, the benchmark 10Y and 30Y bonds in a sovereign issuer such as Indonesia or Turkey would be robust candidates for executing this approach. The added benefit of the barbell strategy is that it captures the slope of the issuer(s) curve and provides a risk-adjusted insurance for convexity moves due to tail risk events and interest rate shocks. Securities from several countries/issuers can be combined for this strategy in cases where the sampling does not allow for multiple bonds to be selected from a single issuer.

Sampling in corporate bond indices (CEMBI) is more involved since it takes into account additional risk dimensions of various industry sectors and credit rating buckets. As an example, the Brazil country sub-index of the CEMBI Broad consists of 86 instruments with a weight of 8.5% in the broader index. IRR sampling, in this instance, would focus on bonds from the Oil & Gas and Financials sectors which collectively account for three-quarters of the country weight. Once the sectors are isolated, bonds from major issuers such as Petrobras and Banco do Brasil SA with a risk profile matching the sample set would be selected to represent the bucket. There are structural limitations to the sampling in the case of a larger index such as the CEMBI Broad given the need to cover the wide array of issuers and industry sectors that they represent. In other words, the large index size imposes a floor on the minimum number of securities required to execute a replication basket with minimal tracking error.

Figure 7: Disaggregating the risk dimensions of the reference index



Source: J.P. Morgan.

Minimizing Turnover

Based on the liquid set of cash securities baskets are typically constructed for a 3 months horizon (i.e. quarterly rebalance). This minimizes turnover costs compared to the monthly rebalance cycle of benchmark indices. When the IRR basket is rebalanced (as needed), the replication algorithm favors the instruments in the current index composition to the extent possible without compromising the integrity of the optimization process. This inherently reduces transaction costs and avoids the substitution problem.

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Appendix: IRR baskets for JPM EM Indices

EMBIGD

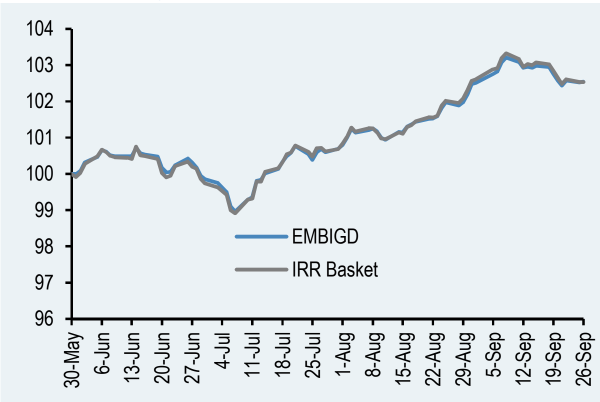
Figure 8: Replication of EMBIGD with IRR basket (May 31st – Sep 26th 2017)

Metric	EMBIGD	IRR. Basket	Diff
No. of countries	65	**37**	
No. of issuers	135	**40**	
No. of bonds	587	**40**	
Current Yld (%)	5.7	**5.7**	-
Spread (bp)*	268	**264**	-4
Duration	6.6	**6.6**	-
Avg. Bid-Offer (bps)	0.65	**0.58**	-0.07
Return (%)	2.54	**2.53**	-0.01

Source: J.P. Morgan.

* Weighted avg. spread using market cap and duration

Figure 9: EMBIGD vs. IRR tracking portfolio, Total Rtn% in US$



Source: J.P. Morgan

Figure 10: IRR basket covers 89% of the EMBIGD countries

Country	EMBIGD Wgt%	IRR Wgt%	Diff
Mexico	5.3	6.0	0.7
Indonesia	4.3	4.9	0.6
Russia	4.0	4.6	0.5
China	4.0	4.5	0.5
Turkey	3.9	4.4	0.5
Philippines	3.6	4.1	0.5
Brazil	3.6	4.0	0.5
Argentina	3.4	3.8	0.4
Colombia	3.1	3.5	0.4
Hungary	3.0	3.4	0.4
Peru	2.9	3.3	0.4
South Africa	2.8	3.2	0.4
Chile	2.8	3.2	0.4
Kazakhstan	2.8	3.2	0.4
Malaysia	2.8	3.1	0.4
Poland	2.7	3.1	0.4
Lebanon	2.7	3.1	0.4
Panama	2.7	3.1	0.4
Ukraine	2.6	3.0	0.3
Uruguay	2.4	2.7	0.3
Dom. Republic	2.4	2.7	0.3
Oman	2.1	2.4	0.3
Venezuela	2.0	2.2	0.3
Sri Lanka	1.9	2.2	0.3
Ecuador	1.6	1.9	0.2
Egypt	1.5	1.7	0.2
Costa Rica	1.4	1.6	0.2
Romania	1.3	1.5	0.2
El Salvador	1.2	1.3	0.2
Lithuania	1.1	1.3	0.1
Azerbaijan	1.1	1.2	0.1
Serbia	1.0	1.1	0.1
Pakistan	1.0	1.1	0.1
Jamaica	1.0	1.1	0.1
India	0.9	1.0	0.1
Cote D'Ivoire	0.8	1.0	0.1
Nigeria	0.7	0.7	0.1
Total	88.5	**100.0**	11.5

Source: J.P. Morgan

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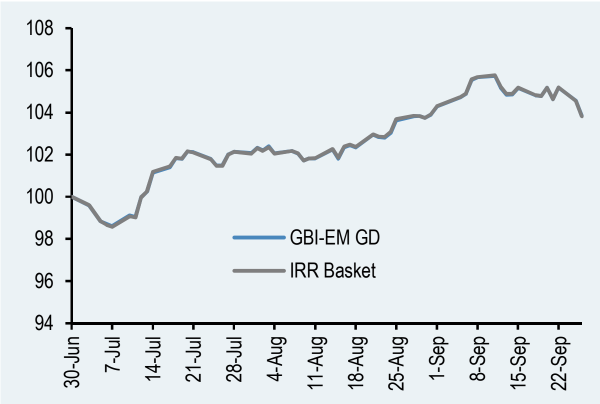
GBI-EM Global Div

Figure 11: Replication of GBI-EM Global Div with IRR basket (June 30th – September 26th 2017)

Metric	GBI-EM GD	IRR Basket	Diff
No. of countries	17	**17**	
No. of issuers	17	**17**	
No. of bonds	209	**37**	
Current Yld (%)	6.3	**6.3**	-
Duration	4.9	**5.0**	0.06
Convexity	43	**44**	1
Avg. Bid-Offer(bps)	0.40	**0.35**	-0.05
Return (%)	3.80	**3.80**	-0.02

Source: J.P. Morgan.

Figure 12: GBI-EM GD vs. IRR tracking portfolio, Total Rtn% in US$



Source: J.P. Morgan.

Figure 13: IRR country weights match the GBI-EM GD since there are only 17 markets in the benchmark

Country	GBI-EM GD Wgt%	IRR Wgt%	Diff
Argentina	1.3	**1.3**	-
Brazil	10.3	**10.3**	-
Chile	1.2	**1.2**	-
Colombia	7.9	**7.9**	-
Czech Rep.	1.1	**1.1**	-
Hungary	4.7	**4.7**	-
Indonesia	9.9	**9.9**	-
Mexico	10.0	**10.0**	-
Malaysia	7.3	**7.3**	-
Peru	2.3	**2.3**	-
Philippines	0.4	**0.4**	-
Poland	9.9	**9.9**	-
Romania	2.9	**2.9**	-
Russia	6.5	**6.5**	-
Thailand	7.2	**7.2**	-
Turkey	8.2	**8.2**	-
South Africa	8.9	**8.9**	-
Total	**100.0**	**100.0**	

Source: J.P. Morgan.

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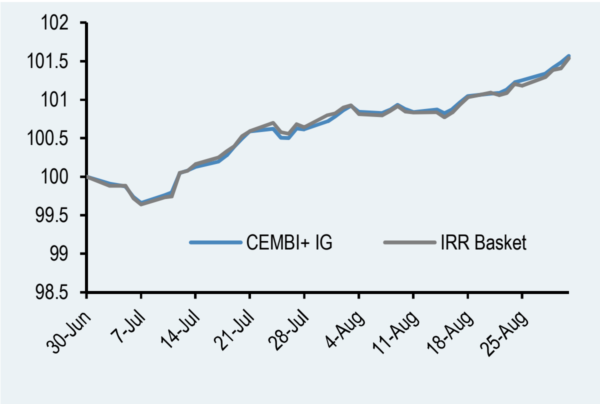
CEMBI+ IG

Figure 14: Replication of CEMBI+ IG with IRR basket (May 31st – August 30th 2017)

Metric	CEMBI+ IG	IRR Basket	Diff
No. of countries	33	**17**	
No. of issuers	281	**49**	
No. of bonds	702	**49**	
Current Yield (%)	3.9	**3.8**	-0.1
Spread (bp)	190	**181**	-9
Duration	5.3	**5.3**	-
Avg. Bid-Offer(bps)	0.60	**0.58**	-0.02
Return (%)	1.85	**1.88**	0.03

Source: J.P. Morgan.

Figure 15: CEMBI+ IG vs. IRR tracking portfolio, Total Rtn% in US$



Source: J.P. Morgan.

Figure 16: IRR basket covers nearly 90% of the CEMBI+ IG countries by weight

Country	CEMBI+ IG Wgt%	IRR Wgt%	Diff
Brazil	6.1	**6.6**	0.6
Chile	5.6	**6.2**	0.5
China	10.0	**11.1**	1.1
Colombia	5.1	**5.5**	0.4
Hong Kong	6.6	**7.5**	0.9
India	6.1	**6.9**	0.8
Israel	4.7	**5.4**	0.7
Korea Republic Of	5.8	**6.6**	0.8
Malaysia	2.6	**2.3**	-0.4
Mexico	6.8	**7.5**	0.7
Peru	3.2	**3.7**	0.5
Qatar	5.5	**5.8**	0.3
Russia	3.9	**5.0**	1.1
Saudi Arabia	2.4	**2.3**	-0.1
Singapore	5.2	**5.8**	0.7
Thailand	4.3	**5.0**	0.8
United Arab Emirates	6.1	**6.8**	**0.7**
Total	89.9	**100.0**	

Source: J.P. Morgan.

Figure 17: IRR basket covers 90% of the CEMBI+ IG sectors by weight

Country	CEMBI+ IG Wgt%	IRR Wgt%	Diff
Consumer	7.5	**7.5**	0.0
Diversified	3.0	**2.1**	-0.9
Financial	29.2	**33.6**	4.4
Industrial	5.9	**5.6**	-0.3
Infrastructure	1.7	**2.8**	1.1
Metals & Mining	7.1	**5.8**	-1.4
Oil & Gas	16.5	**17.0**	0.5
Pulp & Paper	1.6	**2.1**	0.5
Real Estate	3.9	**3.1**	-0.8
TMT	11.1	**10.8**	-0.3
Utilities	12.0	**9.6**	-2.4
Total	89.9	**100.0**	

Source: J.P. Morgan.

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