ENNs for Corporate and Sovereign CDS and FX Swaps

by

Lee Baker, Richard Haynes, Madison Lau, John Roberts, Rajiv Sharma, and Bruce Tuckman[1]

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I. Introduction

The sizes of swap markets, and the sizes of market participant footprints in swap markets, are most often measured in terms of notional amount. It is widely recognized, however, that notional amount is a poor metric of both size and footprint. First, when calculating notional amounts, the long and short positions between two counterparties are added together, even though longs and shorts essentially offset each other. Second, notional calculations add together positions with very different amounts of risk, like a relatively low-risk 3-month interest rate swap (IRS) and a relatively high-risk 30-year IRS.

The use of notional amount to measure size distorts understanding of swap markets. A particularly powerful example arose around Lehman Brothers' bankruptcy in September, 2008. At that time, there were $400 billion notional of outstanding credit default swaps (CDS) on Lehman, and Lehman's debt was trading at 8.6 cents on the dollar. Many were frightened by the prospect that sellers of protection would soon have to pay buyers of protection a total of $400 billion x (1 – 8.6%), or about $365 billion. As it turned out, however, a large amount of protection sold had been offset by protection bought: in the end, protection sellers paid protection buyers between $6 and $8 billion.[2]

In January, 2018, the Office of the Chief Economist at the Commodity Futures Trading Commission (CFTC) introduced ENNs (Entity-Netted Notionals) as a metric of size in IRS markets.[3] To compute IRS ENNs, all notional amounts are expressed in terms of the risk of a 5-year IRS, and long and short positions are netted when they are between the same pair of legal counterparties and denominated in the same currency.

The CFTC's IRS ENNs report as of September, 2018, shows that, across U.S. reporting entities, there was $225 trillion notional amount of IRS outstanding. Measured with ENNs, however, this IRS market transfers the same amount of interest rate risk as a market of $15.4 trillion principal amount of 5-year bonds.[4] Furthermore, this order of magnitude makes sense in the context of other financial markets. The U.S. Treasury market, for example, had principal outstanding of $17.4 trillion as of September, 2018.[5]

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[1] Office of the Chief Economist, Commodity Futures Trading Commission. While this paper was produced in the authors' official capacity, the analyses and conclusions expressed here are those of the authors and do not necessarily reflect the view of other Commission staff, the Office of the Chief Economist, or the Commission. The authors would like to thank Jean-Baptiste Home and Guillaume Huteau for helpful discussions.

[2] For a fuller discussion of this event, see Tuckman (2015), p. 17.

[3] Haynes, Roberts, Sharma, and Tuckman (2018).

[4] Baker et al. (2019).

[5] Board of Governors of the Federal Reserve System (2018), Table L.210.

The purpose of this paper is to propose and calculate ENNs metrics for CDS on corporate and sovereign credits and for foreign exchange (FX) swaps. While ENNs are conceptually similar across all swaps markets, their implementation has to be tailored to each market with respect to the choices of a risk benchmark and netting sets.

For CDS, this paper proposes that ENNs be expressed in terms of the risk of a 5-year CDS on a corporate or sovereign that trades at a spread of 100 basis points. Since shorter-term and lower-spread CDS are less risky than this benchmark, the notional amounts of these swaps contribute less than one-to-one toward ENNs. For longer-term and higher-spread CDS, however, which are more risky than the benchmark, notional amounts contribute more than one-to-one toward ENNs.

With respect to netting, the proposal here is that long and short CDS positions net if all swaps are on the same name, i.e., the same underlying corporate or sovereign credit, and are between the same two legal counterparties.

As of September, 2018, the notional amount of global corporate and sovereign CDS markets was $5.5 trillion. In terms of ENNs, calculated as just described, the CDS market transfers credit risk to the same extent as a market of about $2 trillion of 5-year bonds that trade at a spread of 100 basis points. About 80% of notional amounts and ENNs correspond to corporate credits and 20% to sovereign credits.

For comparison purposes note that, according to the Bank for International Settlements, principal outstanding in global debt markets was about $115 trillion in March, 2018, with about $60 trillion of that in corporate credit and about $55 trillion in sovereign credit.[6] Relative to U.S. markets, note that, as of September, 2018, principal outstanding was $17.4 trillion in the Treasury market and $13 trillion the corporate bond market.[7]

For FX swaps, this paper proposes no risk benchmark for ENNs. More specifically, the only risk adjustment to the notional amounts of FX swaps is to express the notional amount of FX options in delta equivalents.

With respect to netting, the proposed rules are as in the case of IRS swaps. Long and short FX swaps net if they are between the same pair of legal counterparties and denominated in the same currency.

As of September, 2018, across U.S. reporting entities, the notional amount of FX swaps was about $57 trillion. The size of the market in terms of ENNs, however, was a significantly lower $17 trillion.

A comparison of ENNs across markets reveals that notional amount overstates size, in terms of risk transfer. The notional amounts of the IRS, FX, and CDS markets considered here are $225 trillion, $57 trillion, and $5.5 trillion, respectively. More illuminating, however, is to say that the amount of interest rate risk transfer in the IRS market is the equivalent of $15.4 trillion 5-year bonds; that risk transfer in the FX swaps market is the equivalent of a delta-adjusted notional of $17 trillion; and that

[6] Bank for International Settlements (2018), p. A11 and Statistical Annex C, which can be found at https://www.bis.org/publ/qtrpdf/r_qt1812.htm .
[7] Board of Governors of the Federal Reserve System (2018), Table L.213. This measure of the U.S. corporate bond market includes bonds of foreign issuers sold in the United States.

credit risk transfer in the CDS market is the equivalent of about $2 trillion 5-year bonds at a spread of 100 basis points.

Section II of this paper describes the computation of ENNs for CDS and presents empirical results as of September, 2018. Section III does the same for FX swaps, and Section IV concludes.

II. ENNs for Corporate and Sovereign CDS

A Brief Introduction to CDS and Risk Metrics for CDS

Through a CDS, a "protection seller" essentially insures a "protection buyer" against losses arising from the default of corporate or sovereign debt. For example, a protection seller might agree to receive $10,000 per year from a protection buyer in exchange for insuring $1,000,000 face amount of bonds of ABC Corp over the next five years. In this case, the notional amount of the CDS is $1,000,000; the premium payments are 100 basis points, that is, 1% of the notional amount;[8] and the ABC bond, which is being insured, is the "underlying bond" of the CDS contract.

Continuing with the example, if ABC's bonds do not default over the 5-year term, the protection buyer will have paid the $10,000 premium each year and received nothing in exchange. If, however, the bonds do default at any time over the 5-year term, the protection seller will compensate the protection buyer for the loss on the underlying bond relative to its face value.[9]

More specifically, assume that, in this example, the market price of the bonds after default is 40 cents on the dollar, or $400,000 on the $1,000,000 notional amount of the CDS contract. The protection seller would then pay the protection buyer the loss of $1,000,000 – $400,000, or $600,000. Similarly, if the market price of the bonds after default is 8.6 cents on the dollar—as in the case of Lehman Brothers described in the introduction—then the protection seller would pay the protection buyer $1,000,000 x (1 – 8.6%), or $914,000.

Note, in passing, that the protection buyer of CDS does not have to own the underlying bond to "insure" it. More specifically, the protection buyer need not own the underlying bond in order to pay the premiums and collect compensation in the event of default.

With respect to credit risk, the economic position of a protection seller is similar to that of a buyer of the underlying bond. Both positions receive a periodic premium or coupon so long as there is no default and suffer losses in the event of a default. For the protection seller, the loss is the payout of face value minus post-default value to the protection buyer. For the buyer of the underlying bond, the loss takes the form of the bond's post-default price drop.

Because the positions of protection sellers and bond buyers are similar in this way, both positions will be described here as being "long" credit risk.

Along the same lines, the position of a protection buyer is similar to that of a short-seller of the underlying bond. Both positions pay a periodic premium or coupon so long as there is no default, but

[8] The definition of a basis point is 0.01%, which makes 100 basis points equal to 1%.
[9] The actual workings of a CDS are more complex than indicated by the simplified explanation provided in the text. For a more detailed presentation, see, for example, Tuckman and Serrat (2012), pp. 545-561.

receive compensation or register profit in the event of a default. Therefore, both of these positions will be described as being "short" credit risk.[10]

Over its life, the risk of a CDS arises from the event of default and from the post-default value of the underlying bond. On a daily basis, however, the value of a CDS contract fluctuates with changes in the credit quality of the underlying bond.

To elaborate, say that the quoted 5-year CDS spread for ABC bonds is 100 basis points on day one, that is, protection buyers and sellers agree on day one that 100 basis points over the life of the CDS is fair against compensation in the event of a default.[11] On day 2, however, the market-clearing spread can change. If the credit quality of the underlying bond improves, the new market-clearing spread might fall to 95 basis points. On the other hand, if the credit quality of the underlying bond worsens, the spread might rise to 105 basis points.

A common measure of the risk of a CDS is its "credit spread '01" or CS01, which is defined as the change in the value of 100 notional amount of a CDS if the CDS spread falls by one basis point. Under standard industry assumptions,[12] the CS01 of a 5-year CDS at a spread of 100 basis points is 0.044, or, 4.4 cents per $100 notional value. The value of this CDS would rise by 0.044 if the CDS spread fell from 100 to 99 basis points. The value would fall by 0.044 if the CDS spread rose from 100 to 101 basis points.

In general, longer-term CDS have higher CS01. For a given increase in underlying credit quality, the value of protection for 10 years will fall by more than the value of protection for five years, which will fall by more than the value of protection for two years.

Table 1, Panel A, illustrates how CS01 varies with the term of a CDS, under the same assumptions. The CS01 of a 2-, 5-, and 10-year CDS at a spread of 100 basis points is 0.019, 0.044, and 0.079, respectively.

It is also the case that CS01 falls with the level of the spread. As credit quality deteriorates, the CDS price becomes less sensitive to even further credit deterioration. Table 1, Panel B, quantifies this effect, again under the same assumptions. A 5-year CDS at a spread of 25, 100, and 250 basis points has a CS01 of 0.047, 0.044, and 0.039, respectively.

Investors and asset managers use CS01 to measure both the absolute and relative riskiness of CDS. As already mentioned, the CS01 of a 5-year CDS at a spread of 100 basis points is 0.044. Adding the assumption that the daily volatility of credit spreads is about two basis points per day, the price volatility of this 5-year CDS is 0.044 x 2, or 0.088 per day.

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[10] These analogies ignore the fact that sellers and buyers of protection have also secured financing of their positions over the lives of their CDS contracts, while buyers and short-sellers of the bond would need to add repurchase agreements to their positions to secure financing. See, for example, a short discussion in Tuckman and Serrat (2012), pp. 554-556, or a more detailed analysis in Tuckman (2013).

[11] This discussion is also simplified. Protection buyers actually pay the CDS coupon, which is fixed at either 100 or 500 basis points, plus or minus an upfront amount. The upfront amount is calculated to reflect the difference between the market-clearing CDS spread and the CDS coupon. See, for example, Tuckman (2012), pp. 548-552.

[12] The most significant assumptions are that the rate of default is constant over time and that defaulted bonds ultimately recover 40% of face value. The latter assumption is consistent with the historical average of recovery rates on senior unsecured debt. See, for example, Tuckman and Serrat (2012), Table 19.2, p. 531.

In contrast, the CS01 of a 10-year CDS at a spread of 100 basis points is .079. Assume, again, that spread volatility is two basis points per day. The 10-year CDS price volatility, therefore, is 0.079 x 2, or 0.158 per day. Relative to the 5-year CDS, then, the price volatility of the 10-year CDS is 0.158 / 0.088, or 1.8 times larger.

The discussion of CDS risk cannot quite end here, however, because spread volatility is roughly proportional to spread. In other words, if, spread volatility is two basis points per day for corporate bonds or CDS that trade at a spread of 100, then it is four basis points for bonds or CDS that trade at 200, five basis points at 250, six at 300, etc.[13]

How then, for example, does the price volatility of a 10-year CDS at a spread of 100 basis points compare with the price volatility of a 5-year CDS at a spread of 250?

From Table 1, Panel A, the 10-year CDS at a spread of 100 has a CS01 of .044. Maintaining the assumption that spread volatility is 2 basis points per day for this CDS, which has a spread of 100, gives a daily price volatility of 0.088 per day.

From Table 1, Panel B, the 5-year CDS at a spread of 250 has a CS01 of .039. Invoking the proportionality of spread volatility, the volatility of a spread of 250 is 2.5 times the volatility of a spread of 100, i.e., 2.5 times 2 basis points, or 5 basis points. Hence, the daily price volatility of this 5-year CDS is 0.039 x 5, or 0.195 per day.

With respect to the relative risk of these two CDS, the price volatility of the 5-year CDS at 250 is 0.195 / 0.088, or 2.2 times that of the price volatility of the 10-year CDS at 100. The conclusion, therefore, is that the 5-year CDS is riskier than the 10-year CDS—despite the lower CS01 of the 5-year—because the spread volatility of the 5-year is so much higher.

This brief introduction to CDS has described a “single-name CDS,” that is, a CDS on the debt of a single corporate or sovereign entity. An “index CDS,” by contrast, is a bundle or portfolio of many single-name CDS.

If a given name in the CDS index defaults, the single-name CDS component of the index settles as described earlier and is, from then on, dropped from the index CDS. The protection seller, therefore, is selling protection simultaneously on all names in the index, while the protection buyer is buying protection on all names.[14]

Options and tranches on CDS are also included in this study. Discussion of these products is beyond the scope of this exposition, but can be found elsewhere.[15] For present purposes, suffice it to say that every option and tranche position has a “delta” to its underlying credit. If, for example, the delta of an option or tranche on a particular CDS index has a delta of 0.3, then the CS01 of that option or tranche is 0.3 times the CS01 of its underlying CDS index.

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[13] See Ben Dor (2007a) for corporate spreads and (2007b) for CDS spreads. Winston (2018) is a more recent example of applying this empirical relationship in the asset management context.

[14] For more detailed discussions of index CDS, see, for example, Hampden-Turner and Goves (2010), Markit Group (2014), O’Kane (2011), Mahadevan et al. (2011), and Tuckman and Serrat (2012), pp. 557-559.

[15] See, for example, Hampden-Turner and Goves (2010), Mahadevan et al. (2011), and Markit Group (2014).

Data

The CFTC receives data on both index and single-name CDS positions from DTCC's Trade Information Warehouse (TIW).[16] According to DTCC, TIW covers nearly all of global credit derivative transactions.[17] Data used in this paper are as of September 14, 2018.

This paper focuses exclusively on CDS on corporate and sovereign credits; CDS on mortgage and loan products are excluded. The latter constitute less than 8% of CDS notional amount in the data.

Calculation of ENNs for CDS

As described in the introduction, ENNs are designed to achieve the following objectives:

1) Express all notional amounts as risk-equivalent amounts of 5-year CDS that trade at a spread of 100 basis points;
2) Net long and shorts that are between the same two counterparties and denominated in the same currency.

Establishing a risk benchmark is highly desirable for the present purpose because some CDS, e.g., longer-term and higher-spread, are much riskier than others, e.g., shorter-term and lower-spread. The benchmark should seem natural and intuitive to market participants, but the choice of a specific benchmark is somewhat arbitrary. In any case, results presented on a risk-equivalent basis can easily be transformed to correspond to a different benchmark of interest.

For CDS markets today, setting the risk benchmark as a 5-year CDS trading at a spread of 100 basis points is quite natural. First, the 5-year term is the most liquid trading point and is regarded as the trading benchmark. Second, since post-crisis market reforms, CDS coupons are set at either 100 or 500, and more than 80% of notional amount currently carries a coupon of 100.

Turning to implementation, the first step is to convert the notional amount of all options and tranches to their delta equivalents. For example, 100 notional amount of a 0.3-delta tranche on a particular CDS index, would be converted to 30 notional amount of that index.

The second step is to break down all index positions into their single-name name components. For example, $125 million notional amount of a CDX.NA.IG index is converted into $1 million notional amount of single-name CDS on each of the 125 names in that index.

The third step is to express all of the single-name notional amounts as risk-equivalent amounts of the benchmark CDS, that is, a 5-year CDS that trades at a spread of 100. Recall from Table 1, Panel A, that this benchmark CDS has a CS01 of 0.044.

Now consider 100 notional amount of a 10-year CDS that trades at a spread of 25 basis points, which has a CS01 of 0.089 (not shown in Table 1). Accounting just for the difference of CS01 between

[16] The CFTC receives data on positions in index CDS from swap dealer repositories (SDRs) under its "Part 45" reporting rules. Single-name CDS, however, are under the jurisdiction of the Securities and Exchange Commission, which, as of this writing, has not implemented a corresponding regime. As a result, analysis across index and single-name CDS has to rely on DTCC's TIW data.

[17] See http://www.dtcc.com/derivatives-services/trade-information-warehouse .

this CDS and the benchmark, this 100 notional amount would be equivalent to 100 x (0.089 / 0.044), or 202 notional amount of the benchmark.

Accounting, on the other hand, just for the fact that the spread volatility of a CDS that trades at 25 basis points is less than that of a CDS that trades at 100 basis points, the 100 notional amount of this 10-year CDS would be equivalent to 100 x (25 / 100), or 25 notional amount of the benchmark.

The correct adjustment, of course, is to account for both the CS01 and spread volatility differences. Doing so means that 100 notional amount of the 10-year CDS at a spread of 25 basis points is equivalent in risk to 100 x (0.089 / 0.044) x (25 / 100), or 51 notional amount of the benchmark, 5-year CDS trading at 100 basis points.

For clarity, consider one additional example, namely 100 notional amount of a 2-year CDS that trades at a spread of 250 basis points, which has a CS01 of 0.018 (also not shown in Table 1). This CDS is equivalent in risk terms to 100 x (0.018 / 0.044) x (250 / 100), or 102 notional amount of the benchmark. Here, 100 notional amount of the 2-year CDS, which has a much lower CS01 but a much higher spread, has just a bit more risk than 100 notional amount of the benchmark.

The risk adjustment just described captures the first order risk of a portfolio of CDS, namely, volatility-adjusted spread risk. Less important risks—though by no means of no importance—are not captured here. Some of the more important omitted risks would be changes in the term structure of credit spreads (i.e., a single credit's long-term spreads moving by more or less than its short-term spreads); changes in volatility of spreads, which would affect option and tranche prices; changes in the correlation of spreads, which would affect tranche prices; and changes in financing conditions of the underlying bonds, which would affect the CDS-bond basis.

In any case, under the stated risk adjustments, all notional amounts are now expressed in benchmark equivalents. The fourth step, then, is to net long and short positions. To illustrate the netting process, consider the sample CDS market in Table 2, panel A. Note that this panel assumes that none of the trades are cleared.

There are four trades in this market. In trade 1, an insurance company is long (sells protection on) 300 million notional amount of CDS on company ABC against a dealer. In trade 2, the insurance company and the dealer unwind 200mm of trade 1. In trade 3, the insurance company is short 200mm of company XYZ against the dealer. Finally, in trade 4, an asset manager is short 300mm of XYX company against the dealer.

Traditional calculation of the size of a market just adds together the notional amount of all trades (without any prior risk adjustments). Adding the notional amounts of the four trades in this example, given in the rightmost column of Panel A, shows a market size of 1 billion.

Intuitively, 1 billion clearly overstates the extent of risk transfer in this market. Trades 1 and 2 contribute 500mm toward that 1 billion, but the exposure of the insurance company and dealer to each other on company ABC nets down to only 100mm.

Instead, the ENNs metric of market size calls for netting trades between counterparties on the same name. Netting trades 1 and 2, which are both between the insurance company and the dealer, and which both are on company ABC, leave the insurance company long 100 and the dealer short 100. This result is listed in the row "ENNs: ABC."

For the CDS on company XYZ, the row "ENNs: XYZ" says that the insurance company is long 200mm, the dealer is long 300mm and short 200mm, and the asset manager is short 300mm. Note that the dealer's long and short positions do not net down: its 300 longs are against the asset manager while its 200 shorts are against the insurance company.

The fifth and final step to compute total market ENNs is to sum the longs or the shorts, which are the same and which equal 600mm. The difference between the 1 billion conventional notional amount and the 600mm ENNs equals the reduction of the size of ABC trades between the insurance company and the dealer from 500mm—which does not represent the amount of risk transfer between those counterparties—to 100mm, which does.

The ENNs of 600mm can be subdivided in a number of ways. Across underlying credits, there are 100mm longs and shorts on company ABC and 500mm longs and shorts on company XYZ. Across market participants, the long and short ENNs have to be subdivided separately. Of the 600mm long ENNs, 300mm are attributed to the insurance company and 300mm to the dealer. Of the 600mm short ENNs, 300mm are attributed to the dealer and 300mm to the asset manager.

The subdivision of ENNs across market participants can also be described in terms of their business models. The insurance company may be long 300mm ENNs (and not short at all) because it takes on credit risk in the form of CDS. The asset manager may be short 300mm ENNs (and not long at all) because it uses CDS to deviate from index exposures, in this case so as to disfavor exposure to company XYZ. Finally, the dealer is long 300mm ENNs and short 300mm ENNs because that's what dealers do: they make markets. The dealer here, in fact, is taking on basis risk because it is net long 100mm XYZ ENNs and short 100mm ABC ENNs.

Table 2, Panel B, shows the same market, but assumes that all of the trades are cleared through a single clearinghouse. In other words, all trades of the insurance company, the dealer, and the asset manager legally face the clearinghouse. And since the clearinghouse is a single legal counterparty, the calculation of ENNs nets long and short positions of any counterparty against the clearinghouse.

In the example of Table 2, the difference between the uncleared market in Panel A and the cleared market in Panel B is highlighted in yellow in Panel B. In the uncleared market, the dealer's long in XYZ with the insurance company does not net against the dealer's short in XYZ with the asset manager. Trades with different counterparties represent distinct instances of risk transfer.

In the cleared market of Panel B, however, where the dealer's longs and shorts in XYZ are all against the clearing house, they do net. Therefore, the dealer's ENNs position in XYZ in Panel B is long 100mm ENNs, where it is long 300mm and short 200mm ENNs in Panel A. As a result, the size of the cleared market in Panel B is 400mm, instead of the 600mm of the uncleared market in Panel A.

Haynes et al. (2018), which introduced ENNs for IRS, showed that the prevalence of clearing in the IRS market greatly reduced IRS ENNs relative to IRS notional amounts. Clearing can be expected to play less of a role in compressing CDS market size because single-name CDS are not mandated to be cleared. In fact, about 45% of CDS notional is cleared, compared with 85% of IRS notional.

Empirical Results

Table 3 shows the effect of the risk adjustments in quantifying the size of the CDS market. In Panel A, the rows divide the market into three sectors: swap dealers, banks, and other. (The plan for future work is to divide the "other" category into the categories used in the CFTC's IRS and FX ENNs reports.) In Panel B, the rows divide the market into investment grade and high yield credits, for both the corporate and sovereign sectors.

Focusing on the row of totals, the first two columns of each panel show that the notional amount of the market is about $5.5 trillion. Recall from earlier that there are two adjustments—a CS01 adjustment and a spread adjustment—to convert notional amounts to benchmark equivalents, where the benchmark is a 5-year CDS at a spread of 100 basis points.

The CS01 adjustment columns show that, adjusting for CS01 alone, the total $5.5 trillion notional amount falls to $3.2 trillion benchmark equivalents. This is not particularly surprising given that the most liquid term for new issuance is 5 years, from which term all issues begin to age.

The spread adjustment columns show that, adjusting for spread alone, the total of $5.5 trillion rises to $6.7 trillion benchmark equivalents. In other words, the market contains many issues at spreads greater than 100 basis points. Panel B gives more detail on this observation, showing that the spread adjustment gives significantly higher equivalents than notionals for both the corporate and sovereign high yield sectors; gives somewhat higher equivalents than notionals for the sovereign investment grade sector; and gives significantly lower equivalents than notionals for investment grade corporates.

The columns with both the CS01 and spread adjustments show that the total of $5.5 trillion notional amount is equivalent to $3.5 trillion of the benchmark. The effects of spreads greater than 100 basis points are largely offset by the lower CS01 of those high-spread CDS.

Note that the rows in each column of Table 3 do not necessarily sum to the column total. Because of data imperfections, some recorded longs at the clearinghouse do not have corresponding shorts, and *vice versa*. These missing trades are added to obtain the column totals listed in the table.

Table 4 repeats some of the columns from Table 3, but adds columns for ENNs. The tables show that there are significant offsets of CDS longs and shorts between on the same credit and between the same counterparties: ENNs are a bit more than half of benchmark-equivalent notional amount.

The headline result is that risk transfer in the global corporate and sovereign CDS market is the equivalent of $2 trillion notional amount of 5-year CDS at a spread of 100 basis points.

Panel A shows that swap dealers dominate the landscape, even after ENNs netting. The panel also shows that the sectors shown are all relatively balanced with respect to longs and shorts. Future work will break down the "Other" row into more granular sectors to enhance understanding of the activity of those sectors in the CDS market.

Panel B shows that, after netting, in terms of credit risk transfer, the corporate CDS market is very large relative to the CDS sovereign market; the CDS market for lower credit sovereigns is particularly small; and the high-yield corporate CDS market is bigger than the investment grade CDS market. The last of these points is particularly interesting because the notional amount of investment grade CDS is much larger than that of high-yield CDS. But after adjusting for risk, the high-yield market becomes somewhat bigger. And after the greater netting of investment grade CDS exposures, the high-yield market turns out to be significantly larger.

Note that Table 4 also makes an adjustment for missing clearinghouse trades.

III. ENNs for FX Swaps

Products and Risk Considerations

The products included in this analysis of the FX market are forward agreements, swaps, non-deliverable forwards (NDFs), cross-currency swaps, and options. Exotic derivatives are not included.

It is unfortunate that the term "FX swap" is used today in two ways. One use, which is mostly legal, refers to contracts that depend on foreign exchange rates and that are considered "swaps" for the purposes of the Dodd-Frank Act. The heading of this section uses "FX Swaps" in this way. The second use refers to a particular over-the-counter derivatives contract, which will be described below.

In an FX forward agreement, counterparties agree on an exchange rate at which to exchange currencies in the future. For example, counterparty A might agree to buy $100 for €90 from counterparty B in three months. Put another way, the counterparties have agreed today on an exchange rate in three months of €0.9 per $1 on a $100 notional amount.

The risk of the forward agreement, from a foreign exchange perspective, is that the exchange rate rises or falls over the three months. If, three months from now, the exchange rate is €0.95 per $1, then counterparty A has profited from the forward trade: counterparty A will be buying $100 for €90 through the forward contract, while anyone else at that time would have to pay €95 for $100 in the spot market. Similarly, of course, counterparty B would have lost money on the forward trade.

As this example illustrates, the gain or loss on a forward contract as the exchange rate rises or fall is realized at the expiration of the forward contract. Therefore, for a given change in the exchange rate, longer forward contracts are less risky in terms of value today because their change in value is realized further in the future. But the difference is relatively small. At an interest rate of 3%, for example, a $1 gain or loss in three months would be worth 99.3 cents today, while a $1 gain or loss in one year would be worth 97.1 cents today.

An FX swap—referring now to a particular derivatives contract—is like a forward agreement, but there is an up-front exchange of currencies at today's exchange rate. Today, then, counterparty A might sell $100 for €85 to counterparty B, while they simultaneously agree that A will purchase those $100 back from counterparty B for €90 in three months. Note that the forward part of that FX swap is identical to the example of a forward agreement given above. In fact, FX forward and swaps will be categorized together in this study because, once the initial exchange of currencies of an FX swap has happened, the remaining cash flows of an FX swap and forward are the same.

An NDF is a forward agreement in which the currencies are not exchanged at the termination date. Instead, the counterparties exchange the profit or loss on the agreement in a particular currency, often U.S. dollars. NDFs are usually used for currencies that are not easily convertible into more freely-convertible currencies, but, for expositional purposes, continue here with U.S. dollars and Euros.

In the forward contract example, counterparty A agreed to buy $100 for €90 at the end of three months, and the exchange rate in three months turned out to be €0.95. If this contract were an NDF instead of a forward, then counterparty A, instead of making the profitable purchase of $100 for €90 through the forward contract, would receive a U.S. dollar payment equal to the profit on the trade, namely (€95 - €90) / (€0.95 / $1) = $5.26.

A cross-currency swap is like an FX swap, but the initial exchange of currency earns interest and the final exchange of currency is done at the same rate as the initial exchange. For example, counterparty A sells $100 for €85 to counterparty B; counterparty A receives periodic interest from counterparty B on the $100 at a U.S.-dollar interest rate and pays periodic interest to counterparty B on the €85 at a Euro interest rate; and, at the end of two years, counterparty A purchases $100 for €85 from counterparty B.

Finally, FX options give one counterparty the right to purchase or exchange some amount of currency for another currency at an agreed-upon exchange rate. Like any option, FX options have a delta that describes its risk relative to its underlying forward. For example, if an option to buy U.S. dollars in exchange for Euros in three months has a delta of 0.3, then, as exchange rates fluctuate, the value of the option will change by 0.3 times the amount of a three-month forward to buy U.S. dollars for Euros.

Forward agreements, FX swaps, and NDFs tend to have relatively short terms: 90% of their notional amount in the data matures in under one year. Options have somewhat longer maturities, with 85% of notional amount maturing in less than two years. Cross-currency swaps, however, can be much longer: about 55% of notional amount matures in less than five years, and about 80% in less than 10 years.

For the overall FX swaps market, across all of these product types, about 70% of notional amount matures in less than one year, and about 80% in less than two years.

For calculating FX ENNs, this paper proposes to adjust notional amounts only for option deltas, that is, not to make any other risk adjustments. Risk adjustments can often provide more precision, but come at the cost of complexity. In the case of FX products, the gains in precision do not seem worth the complexity, particularly when considered relative to IRS and CDS products.

First, as just discussed, a large portion of FX products are concentrated at shorter terms. Second, as discussed earlier, the exchange rate risk of FX products does not vary as significantly with term differences as rate or credit risk does in IRS or CDS markets. Third, the average historical volatilities of the major exchange rate pairs are roughly comparable, and the top five currencies constitute about 80% of total notional amount.

Data

The CFTC receives FX swap positions from all U.S. reporting entities from swap data repositories (SDRs). U.S. reporting entities do include U.S. subsidiaries of foreign parents. But, unlike the CDS data described earlier, the FX data used here does not include the activity of purely foreign entities. The results to follow, therefore, are not fully global in scope. The data used for this paper is as of September 14, 2018.

Exotic FX derivatives are not included in the current analysis because the computation of their deltas is particularly challenging. These exotic products comprise less than 1% of the notional amount of FX swaps included in the study.

Calculation of ENNs for FX Swaps

As mentioned above, once the notional amount of options has been adjusted for delta, there are no further risk-based adjustments before the computation of FX ENNs. The next step, therefore, is to net long and short positions that are between the same two counterparties and that are denominated in the same currency.

To illustrate netting in the FX swap context, consider the sample market depicted in Table 5. Panel A lists the three trades in this market, where all quantities are in millions of U.S. dollars, including foreign currency quantities, which are given as U.S. dollar exchange-rate equivalents.

In trade 1, counterparty A agrees to buy 100 dollars from and sell 100 worth of Euros to counterparty B. In trade 2, counterparty A agrees to sell 50 dollars to and buy 50 worth of Japanese Yen to counterparty B. Finally, in trade 3, counterparty B agrees to buy 50 dollars from and sell 50 worth of Euros to counterparty C.

The notional amount of this market is 200, derived as the sum of the notional amount of the three trades, 100, 50, and 50. The notional amounts for counterparties A, B, and C, respectively, are 150, 200, and 50. The sum of the notionals across counterparties is 400, which is twice the notional of the market: because the notional of every trade appears in the notional of each counterparty, the sum across counterparties double-counts each and every trade.

Notional amount overstates the size of risk transfer in this market because some of the risk of trades 1 and 2, which are both between counterparties A and B, offset each other. It is not immediately obvious how to compute this offset, however. While the counterparties are long and short dollars with each other, trade 1 is dollars vs. Euros and trade 2 is dollars vs. Yen.

A methodology for implementing netting in this setting is to depict each trade by its two legs and then to organize the legs by currency. The result of this procedure is shown in Panel B of Table 5. With respect to U.S. dollars, A is long 100 and short 50, while B is long 50 and short 100. With respect to Euros, A is short 100 and B is long 100. And with respect to Yen, A is long 50 and B is short 50. The same procedure applied to trade 3, between counterparties B and C, is shown in the next two rows of the table.

The bottom row of Panel B gives the sums of the notional amounts in each currency, that is, the sums of either the longs or the shorts in each currency, which must be equal. These totals are 200 in dollars, 150 in Euros, and 50 in Yen, for a grand total of 400. Note that this grand total is twice the 200 notional amount of the market: splitting each trade into its two currency legs and summing notional amounts across those legs doubles the notional size of the market.

The depiction of the market in Panel B, however, makes netting straightforward. Since A and B are both long and short dollars, these legs can be netted. Counterparty A is left long 100 dollars and counterparty B short 50 dollars. No other positions in the table may be netted. Counterparty B is long

Euros and short Yen against A, but netting is not allowed across currencies. Counterparty B is long Euros against A and short Euros against C, but netting is not allowed across counterparty pairs.

Panel C shows the market after all allowable netting, that is, after netting the dollar legs of the trades between counterparties A and B. ENNs can now be computed by summing notional amounts across rows or columns. Summing across rows gives "Doubled ENNs" in each currency, namely, 100 dollars, 150 Euros, and 50 Yen, for a grand sum of 300. These are doubled-ENNs because, as highlighted above, splitting each trade into its two legs makes the total across currencies twice the size of the market. Therefore, the ENNs of this market is one half of 300, or 150.

(For some additional intuition as to why this is the right answer, consider repackaging trades 1 and 2 into two different trades, trades 1' and 2'. In trade 1', A buys 50 dollars and sells 50 Euros. In trade 2', A buys 50 Yen and sells 50 Euros. The net obligations of trades 1 and 2 and of trades 1' and 2' are the same, but the total notional amount of trades 1 and 2 is 150, while the total of trades 1' and 2' is only 100. Hence, after netting, trades 1 and 2 have a notional amount of 100, and trade 3 has a notional amount of 50, for a total market size of 150.)

Returning to Panel C, computing ENNs by summing across columns gives Doubled ENNs by counterparty: 100 for A, 150 for B, and 50 for C, for a total of 300. Once again, this total is twice the size of the market because, as noted earlier, the notional amount of each trade is counted toward the total of each of its two counterparties.

Even though market ENNs are the grand row or column totals of Panel C divided by 2, it is appropriate to keep the row and column totals as Doubled ENNs rather than dividing these by two. Consider, for example, Counterparty C. This counterparty has done one trade with a notional of 50. Dividing its row total by 2 would say that its notional amount was 25, which is in no way correct.

Similarly, consider the column total for Yen. There is exactly one trade involving Yen, i.e., trade 2 between counterparties A and B, which has a notional amount of 50. Dividing the Yen column total by 2 would give a result of 25, which, again, is in no way correct. The best representation of the market, therefore, is to leave the column and row totals as they are and to divide the grand total by 2.

It would be reasonable, however, to express column and row totals as a percent of the grand total. In that case, counterparties A, B, and C, comprise, 33.3%, 50%, and 16.7% of the market, respectively. And, by currency, dollars, Euros, and Yen comprise 33.3%, 50%, and 16.7% of the market.

Empirical Results

The results of the data analysis are in Table 6. Panel A shows notional amounts, delta-adjusted notional amounts, and doubled-ENNs, by sector.[18] The very bottom of the panel shows that size of the FX swaps market measured in notional amount is $56.9 trillion. Adjusting notional amounts for option

[18] When an FX trade is first executed, the value of each currency leg is the same, and each counterparty is both long and short the same value in U.S. dollar equivalents. Over time, however, the relative value of the two legs can change, so that long and short values are no longer the same. In Table 6, therefore, long and short notional amounts for each sector need not be the same. For this table, however, the differences were small enough to be ignored, and each column is presented as an average of longs and shorts instead of as one column for longs and another for shorts.

deltas reduces the size to $52.2 trillion. Finally, in terms of ENNs, which nets delta-adjusted longs and shorts for each pair of counterparties in each currency, market size is $17 trillion. In other words, with delta adjustments and the netting rules proposed here, ENNs for the FX swaps market are about 30% of notional amount.

The last column of Panel A, “ENNs (%),” shows that the largest concentration of ENNs, by far, 65%, are held by swap dealers. In the next rung of concentration, at about 7-8% each, are banks, asset managers, and hedge funds. The final group, with shares of between about 1% and 4% each, are corporates, pension funds, insurance, and government.

The importance of netting, reflected in the extent to which notionals are compressed into ENNs, is much greater for some sectors than for others. Notional amounts for hedge funds and swap dealers are 4.6 and 3.8 times ENNs, respectively. Bank notional amounts are 2.5 times notionals, and, for the rest of the sectors, the multiples are less than 2.0.

Table 6, Panel B, shows notional amount and ENNs by region and currency. The largest currencies in the FX swap market are U.S. dollars, Euros, and Japanese Yen, which comprise about two-thirds of the total. The extent of netting is similar across currencies, with most notional amounts two to four times as large as ENNs. The Chinese Yuan is a bit of an outlier in this regard; its notional amount is nearly six times its ENNs.

Panel C of Table 6 breaks down notional amounts into product type. By far the largest product type in terms of notional amount are FX Forwards and Swaps, at about 55% of the total. The smaller products are cross-currency swaps, at 25%, options at 12%, and NDFs at 7%. These product percentages are driven, however, by swap dealers and banks. For the other sectors, FX Forwards and Swaps are even more dominant, constituting between 63% and 81% of total notional amount.

The last row of Panel C shows that the clearing percentage of FX swaps is essentially nil, except for NDFs. The explanation is simple. Newly-executed, cash-settled FX swaps, like NDFs, are subject to uncleared margin rules, while newly-executed, physically-settled FX swaps, like the other products in the table, are not. Furthermore, uncleared margin requirements—as intended by many regulators—often exceed cleared margin requirements. Therefore, market participants have chosen to clear a significant portion of their newly-executed NDFs.

IV. Conclusion

CFTC Chairman Giancarlo has commented both on the public’s misunderstanding of the sizes of swaps markets and on the consequences of that misunderstanding: “Swaps have a problem of large numbers. We have known it for a long time. Sizing the global swap markets in hundreds of trillions of dollars has done nothing to bring clarity to newspaper accounts, policy discussions in Congress, or regulatory policy setting in the decade since the financial crisis. Rather, it more often confuses the issue and hinders dispassionate consideration and sound policy setting.”[19]

The goal of this paper can be understood in light of that comment, namely, to increase public understanding of CDS and FX swaps markets, both with respect to their overall sizes and to the footprints of various market sectors.

[19] Giancarlo (2018).

The ENNs metrics proposed here extends the ENNs methodology for IRS to CDS and to FX swaps. ENNs normalizes risk in a manner appropriate to each market, and nets long and short positions that are between the same two counterparties and that are denominated in the same currency.

Measured by ENNs, the size the CDS market is the risk equivalent of about $2 trillion of 5-year CDS that trade at a spread of 100 basis points. The size the FX swaps market is about $17 trillion of delta-adjusted notional amount.

Metrics of swap market size and of the footprint of market participants have the potential to be useful in the regulatory context, particularly for setting thresholds below which entities are considered "small" and deemed exempt from various rules. Much more work, however, needs to be done on the desirability and practicality of doing so. For now, however, the Office of the Chief Economist invites comment on the ENNs metrics proposed in this paper.

Table 1. Credit Spread ’01 (CS01) at Varying Terms and Spreads

The CS01 of a CDS is the change in value of 100 notional amount of CDS for a 1 basis point decline in the CDS spread. The formulas used for CDS valuation are from Tuckman and Serrat (2012), pp. 548-552, which assume a constant rate of default. Both panels assume that the recovery rate is 40% and that the CDS coupon is 100 basis points.

Panel A: CDS Spread is 100 basis points

Term of CDS	**CS01**
2	.019
5	.044
10	.079

Panel B: Term of CDS is 5 Years

CDS Spread	**CS01**
25	.047
100	.044
250	.039

Table 2. Example of a CDS Market ($ Millions)

Notional amounts should be interpreted as risk-equivalents of the benchmark CDS.

Panel A: All trades uncleared

		Insurance Company		Dealer		Asset Manager		
Trade	**Name**	**Long**	**Short**	**Long**	**Short**	**Long**	**Short**	**Notional**
1	ABC	300	0	0	300			300
2	ABC	0	200	200	0			200
3	XYZ	200	0	0	200			200
4	XYZ			300	0	0	300	300
Notional		500	200	500	500	0	300	1,000
ENNs: ABC		100	0	0	100			
ENNs: XYZ		200	0	300	200	0	300	
ENNs		300	0	300	300	0	300	

Panel B: All trades cleared

		Insurance Company		Dealer		Asset Manager		
Trade	**Name**	**Long**	**Short**	**Long**	**Short**	**Long**	**Short**	**Notional**
1	ABC	300	0	0	300			300
2	ABC	0	200	200	0			200
3	XYZ	200	0	0	200			200
4	XYZ			300	0	0	300	300
Notional		500	200	500	500	0	300	1,000
ENNs: ABC		100	0	0	100			
ENNs: XYZ		200	0	100	0	0	300	
ENNs		300	0	100	100	0	300	

Table 3. CDS Notional Amounts and Benchmark Equivalents as of September 14, 2018

The benchmark is a 5-year CDS that trades at a spread of 100 basis points. “Long” means selling CDS protection; “short” means buying protection. In Panel B, investment grade credits are defined as those with CDS coupons of 100 basis points, and high-yield credits are defined as those with CDS coupons of 500 basis points. Column totals are adjusted for trades known to be missing from clearinghouse matched books.

Panel A: By Counterparty Sector

$ Billions	**Notional Amount**		**Notional Amount w/ CS01 Adjustment Only**		**Notional Amount w/ Spread Adjustment Only**		**Benchmark-Equivalent Notional Amounts**	
Sector	**Long**	**Short**	**Long**	**Short**	**Long**	**Short**	**Long**	**Short**
Swap Dealer	4,097	4,314	2,209	2,430	4,766	4,992	2,334	2,538
Bank	364	297	222	177	361	319	202	169
Other	890	873	652	618	1,331	1,355	776	760
Total	5,517	5,517	3,252	3,252	6,732	6,732	3,518	3,518

Panel B: By Issuer Sector and Rating Class

$ Billions

Sector	**Notional Amount**	**Notional Amount w/ CS01 Adjustment Only**	**Notional Amount w/ Spread Adjustment Only**	**Benchmark-Equivalent Notional Amounts**
Corporate Investment Grade	3,297	2,047	1,578	1,202
Corporate High Yield	1,036	559	3,516	1,344
Sovereign Investment Grade	1,155	629	1,473	871
Sovereign High Yield	29	17	166	101
Total	5,517	3,252	6,732	3,518

Table 4. CDS Notional Amounts and ENNs as of September 14, 2018

The benchmark is a 5-year CDS that trades at a spread of 100 basis points. “Long” means selling CDS protection; “short” means buying protection. In Panel B, investment grade credits are defined as those with CDS coupons of 100 basis points, and high-yield credits are defined as those with CDS coupons of 500 basis points. Column totals are adjusted for trades known to be missing from clearinghouse matched books.

Panel A: By Sector

$ Billions	Notional Amount		Benchmark-Equivalent Notional Amounts		ENNs	
Sector	**Long**	**Short**	**Long**	**Short**	**Long**	**Short**
Swap Dealer	4,097	4,314	2,344	2,538	969	1,164
Bank	364	297	202	169	128	95
Other	890	873	776	760	667	651
Total	5,517	5,517	3,518	3,518	1,961	1,961

Panel B: By Rating Class

$ Billions

Sector	**Notional Amount**	**Benchmark-Equivalent Notional Amounts**	**ENNs**
Corporate Investment Grade	3,297	1,202	644
Corporate High Yield	1,036	1,344	883
Sovereign Investment Grade	1,155	871	367
Sovereign High Yield	29	101	67
Total	5,517	3,518	1,961

Table 5: Example of an FX Swaps Market ($ Millions)

Note that foreign currencies are given in U.S. dollars exchange-rate equivalents.

Panel A: Notional Amounts By Trade

	A			B			C			
Trade	**USD**	**EUR**	**JPY**	**USD**	**EUR**	**JPY**	**USD**	**EUR**	**JPY**	**Notional**
1	100	-100		-100	100					100
2	-50		50	50		-50				50
3				50	-50		-50	50		50
Total	150			200			50			200

Panel B: Notional Amounts, with Trades Split into Currency Legs and Counterparty Pairs

	USD		EUR		JPY	
Counterparty Pair	**Long**	**Short**	**Long**	**Short**	**Long**	**Short**
A	100	50		100	50	
B	50	100	100			50
B	50			50		
C		50	50			
Total	200		150		50	

Panel C: ENNs

	USD		EUR		JPY		
Counterparty Pair	**Long**	**Short**	**Long**	**Short**	**Long**	**Short**	**Doubled ENNs**
A	50			100	50		100
B		50	100			50	150
B	50			50			
C		50	50				50
Doubled ENNs	100		150		50		300

Table 6. FX Swaps Notional Amounts and ENNs as of September 14, 2018

At the end of each calculation, quantities in foreign currencies are converted to U.S. dollars at current exchange rates and added together. Columns in Panels A and B can be thought of as either the long or short quantities, which are nearly the same. Column totals are adjusted for trades known to be missing from clearinghouse matched books.

Panel A. Notional Amounts and ENNs, by Sector

$ Trillions

Sector	Notional	Delta-Adjusted Notional	Doubled-ENNs	ENNs (%)
Swap Dealer	85.1	77.7	22.3	65.7
Bank	6.6	6.2	2.6	7.7
Asset Manager	5.0	4.7	2.6	7.8
Hedge Fund	10.4	9.2	2.3	6.8
Corporate	2.4	2.3	1.5	4.3
Pension Fund	1.4	1.4	0.8	2.3
Insurance	0.8	0.8	0.5	1.6
Government	0.6	0.6	0.3	1.0
Unclassified	1.5	1.5	1.0	2.9
Total	113.8	104.3	33.9	
½ Notionals ; ENNs	56.9	52.2	17.0	

Panel B. Notional Amounts and ENNs, by Currency

$ Trillions

Region	Currency	Notional	Doubled-ENNs	ENNs (%)
American / Caribbean	USD	52.7	13.4	39.6
	CAD	2.9	1.0	3.1
	BRL	0.9	0.2	0.7
	Other	3.4	1.8	5.3
Europe	EUR	16.9	5.4	16.1
	GBP	6.9	2.5	7.4
	CHF	2.0	0.7	2.2
	Other	2.6	1.0	2.9
Asia / Pacific	JPY	10.8	3.8	11.1
	AUD	3.9	1.2	3.5
	CNY	2.4	0.4	1.2
	KRW	1.3	0.4	1.2
	HKD	1.1	0.3	0.8
	Other	4.2	1.2	3.6
Other		1.8	0.5	1.5
Total		113.8	33.9	
½ Notionals ; ENNs		56.9	17.0	

Table 6, continued. FX Swaps Notional Amounts and ENNs as of September 14, 2018

Panel C. Notional Amounts by Sector and Product and Percentages Cleared

$Trillions

Sector	Swaps and Forwards	NDFs	Cross-Currency	Options	Total
Swap Dealer	44.2	6.2	23.9	10.6	84.9
Bank	3.3	0.5	2.3	0.5	6.6
Asset Manager	3.8	0.5	0.3	0.4	5.0
Hedge Fund	7.0	0.8	0.8	1.8	10.4
Corporate	1.6	0.1	0.4	0.3	2.4
Pension Fund	1.2	0.1	0.1	0.1	1.4
Insurance	0.5	0.1	0.2	0.1	0.8
Government	0.4	0.0	0.1	0.0	0.6
Unclassified	0.9	0.1	0.6	0.1	1.7
Total	63.0	8.4	28.5	13.9	113.8
½ Notionals					56.9
% Cleared	0.1%	25.3%	0.2%	0.0%	1.9%

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