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The Long and Short of It: The Post-Crisis Corporate CDS Market

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OVERVIEW

- Regulatory changes altered the structure of the credit default swap (CDS) market following the 2007-09 financial crisis, with regulatory-imposed reporting requirements increasing visibility into this once opaque market.
- The authors use the resulting granular supervisory data to examine the CDS market and present stylized facts on its post-crisis evolution across types of contracts, counterparties, and risk exposures. They also study institutions' choices on whether to participate in the four most common CDS products.
- The study shows that dealers became net buyers of credit protection in the second half of 2014, both by reducing the amount of protection they sell in the single-name market and by switching to buying protection in the index market.
- The authors argue that considering simultaneous positions in different types of credit derivatives is key to understanding institutions' participation in these markets and how their decisions affect prices.

The credit default swap (CDS) market, which became notorious in the wake of the 2007–09 financial crisis, is the third biggest over-the-counter (OTC) derivatives market in the world, with $8 trillion notional value outstanding as of June 2018 (BIS 2018). Because of the importance of this market to the world financial system, sweeping regulatory changes—meant to address fragilities uncovered during the crisis—were implemented globally in the years following the crisis. These new regulations changed the market's structure and also, through extensive data collection requirements, allowed greater visibility into the previously opaque bilateral OTC market. In this article, we exploit granular supervisory data to study the properties of exposures taken through the CDS market to corporate reference entities in the United States and Europe, including which institutions use these contracts, what kinds of exposures they take, when they take them, and what factors influence the prices of these exposures. To examine the CDS market, we use supervisory position-level data from the CDS trade repository maintained by the Depository Trust and Clearing Corporation (DTCC). DTCC provides different data subsets depending on the relevant supervisory authority's purview.

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As a prudential supervisor, the Federal Reserve is entitled to view positions and transactions for which at least one counterparty is an institution it supervises or for which a supervised institution is the reference entity. Each week, the Federal Reserve receives a weekly snapshot showing all outstanding CDS positions that meet these criteria.

This data allows us to document properties of both existing and new positions, such as the credit risk profile of the underlying entity, the maturity of the swap, locations of the party and counterparty to the trade, and the type of credit derivative used. Thus, we can present stylized facts on the CDS market's post-crisis evolution across different types of contracts, counterparties, and risk exposures. Unlike previous literature, we study jointly institutions' choices on whether to participate in the four most common CDS products. We show that this holistic view of exposures is necessary for understanding market changes made in response to industry- and regulatory-led innovations.

We document four facts about the structure of the CDS market for U.S. and European corporate credit derivatives. First, while dealers historically were protection sellers in the index CDS market, they became net protection buyers in the second half of 2014. At the same time, dealers have continued their historical pattern of selling protection in the single-name market and buying protection in the index tranche and index options markets. Considering different types of CDS products simultaneously is thus crucial to understanding institutions' credit derivative exposures.

Second, index options have replaced index tranches as the more prevalent levered derivative product written on index contracts. Historically, institutions used levered products to get exposure to a particular range—or "tranche"—of losses on a CDS index. The decline of the collateralized debt obligation (CDO) market and the introduction of options on the index have, however, led institutions to lever the entire index position.

Third, the maturity at inception of exposures taken through the CDS market has been declining over time, with index CDS contracts trading almost exclusively in five-year maturities at the end of our sample. Thus, not only has the gross notional of aggregate CDS exposure declined since the financial crisis, but so too has exposure duration.

Fourth, most of the decline in single-name CDS gross notional outstanding since the crisis has been in single-name contracts not eligible for voluntary clearing through a central counterparty. Thus, the market for plain-vanilla CDS in the United States essentially migrated wholly to central clearing even without the introduction of mandatory single-name CDS clearing rules.

The article also serves as a primer on the overall structure of the CDS market in the post-crisis regulatory environment, providing a summary of the characteristics of the most commonly traded CDS contracts and the most salient features of the market's evolution since its inception in the early 1990s.

The 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act introduced multiple changes that affected how CDS contracts are traded in the United States, including registration requirements for market participants, central clearing, and reporting of OTC derivative positions[1]. A concern regarding our choice of data set is that the supervisory sample selection might bias empirical findings. However, we compare coverage of positions data collected for supervisory purposes in the United States over time with the full universe of trades maintained by the DTCC.[2] We find that the weekly supervisory snapshot of open positions captures a large fraction of total market activity covered in the DTCC trade

information warehouse (TIW). In particular, for a median week in our sample, supervisory data capture over 70 percent of single-name contracts, over 60 percent of index contracts, and over 85 percent of index tranche contracts[3] in the TIW in terms of the number and the gross notional of contracts outstanding.

The rest of the article is organized as follows. In Section 1, we describe the four credit derivatives considered contracts in this article—single-name CDS, CDS index, index tranche, and index options—and how recent regulatory changes have affected trading. Section 2 gives a short overview of the supervisory version of the DTCC data, discussing the differences and similarities with other proprietary data sets used in previous literature. We describe the properties of existing and new positions in Section 3. Section 4 concludes.

1. Overview of the Credit Default Swap Market

A CDS is a bilateral agreement between a protection buyer and a protection seller in which the buyer agrees to make fixed periodic payments to the seller in exchange for protection against a credit event of an underlying asset or portfolio of assets. The underlying may be a single reference entity (single-name CDS), a portfolio of reference entities (CDS index), or a particular amount of losses in a basket of reference entities (tranche CDS). In this section we review the definition of these contracts, including how they are priced and traded. We also review the industry- and regulatory-led changes to the trading mechanisms for these OTC derivatives.

1.1 Single-Name CDS Contracts

The *single-name* CDS contract insures the buyer of protection against a default of a single issuer, such as a corporation, sovereign, or municipality. A credit event triggers a payment from the protection seller to the protection buyer. To obtain this protection, the buyer makes quarterly coupon payments to the seller until either default or contract expiry. The reference obligations are often senior unsecured bonds. The ISDA Master Agreement, published by the International Swaps and Derivatives Association, specifies contract terms and conditions including the reference entity, the deliverable obligations, the contract tenor, the notional principal, and the credit events covered by the contract. Standard credit events include bankruptcy, failure to pay, obligation default, obligation acceleration, and repudiation or moratorium. The CDS contract may also insure against debt restructuring, a credit event that would not necessarily result in losses for the reference obligation holder.

In September 2014, credit event triggers were amended for new transactions on financial and sovereign reference entities, as well as restructuring and bankruptcy credit events. The changes included a government-initiated bail-in for CDS contracts on financial reference entities; a split between senior and subordinated if a government intervention or restructuring credit event occurs; and an "Asset Package Delivery" provision, under which existing bonds that were deliverable before the bail-in will be deliverable to a post-bail-in auction to determine the final auction price.

Before 2005, when a credit event occurred, CDS contracts were physically settled. The protection buyer delivered the cheapest-to-deliver bond issued by the reference entity and, in turn, received the bond's face value. However, with the rapid growth of the CDS market, in many cases, the volume of CDS outstanding far exceeded the volume of deliverable bonds, and the market transitioned to cash settlement. An auction mechanism was introduced in 2005 to determine the fair price of the defaulted reference entity. Creditex and Markit administer these auctions and publish auction results online.[4]

In the auction, protection buyers and sellers settle on the *net* buy or sell CDS position, reducing the amount of bond trading necessary to settle all contracts.[5] The auction mechanism determines the inside market midpoint for physical CDS contract settlement. The protection seller then pays the difference between the par value and this auction-identified price per unit of the contract notional to the protection buyer. Gupta and Sundaram (2015), Chernov et al. (2013), and Du and Zhu (2017) study theoretically and empirically the auction mechanism for determining settlement price.

Another change that affected single-name CDS contracts during our sample period is the standard roll frequency. As of December 21, 2015, instead of rolling to a new on-the-run single-name contract each quarter on the 20th of March, June, September, and December, single-name contracts now only roll to new contracts in March and September. For example, under the old convention, on June 2015, there was a move to a new five-year single-name contract maturing on September 20, 2020. That five-year contract was considered on-the-run for a three-month period. Under the new roll convention, a five-year single-name contract that started trading on March 20, 2016, and was set to mature on June 20, 2021, was considered on-the-run until September 20, 2016, when a new on-the-run five-year single-name contract started trading. This change aligned single-name contracts with the roll frequency of CDS index contracts, improving liquidity around the new semiannual roll dates.

1.2 CDS Index Contracts

A *CDS index* is a portfolio of single-name CDS. A protection buyer is insured against a default of any constituent in the underlying portfolio. In return, the buyer makes quarterly coupon payments to the protection seller. As with a single-name CDS, in case of default, the protection seller pays par less recovery determined in the auction. Today, CDS indexes are the most common instruments for assuming credit risk exposure. They are more liquid and trade at smaller bid-ask spreads than baskets of cash bonds or single-name CDS contracts.

The most popular CDS index families are Markit CDX indexes, covering North American and emerging markets, and International Index Company (IIC) iTraxx indexes, covering Europe, Australia, Japan, and Asia excluding Japan. The CDX index family includes the North American Investment Grade CDX index (CDX.NA.IG), the North American High-Yield CDX Index (CDX.NA.HY), and the CDX Emerging Markets Index (CDX.EM). The iTraxx index family includes the iTraxx Europe index and the iTraxx Crossover index. In 2018, the combined daily traded volume in the Markit CDX and Markit iTraxx indexes was approximately $38 billion on average, representing 1,003 daily transactions, $5.6 trillion of gross notional, and $906 billion of net notional outstanding.[6]

For the credit exposures calculated in this article, we consider the three most popular indexes and their sub-indexes: CDX.NA.IG, CDX.NA.HY, and iTraxx Europe. The CDX.NA.IG index is a portfolio of 125 North American reference investment-grade corporations, with $13 billion average traded volume and 226 average daily transactions in 2018. In addition to the aggregate investment grade index, there are also sector-specific sub-indexes (consumer cyclical; energy; financial; industrial; and telecom, media, and technology) and the CDX.NA.IG.HVOL sub-index, which includes reference entities with high volatility. (As of 2018, the latter sub-index is no longer actively traded). The CDX.NA.HY index comprises 100 North American corporations with a high-yield rating, with $6.2 billion average traded volume and 276 average daily transactions in 2018. The CDX.NA.HY has been divided into two rating sub-indexes: CDX.NA.HY.B and CDX.NA.HY.BB. The iTraxx Europe index comprises 125 equally weighted investment-grade European reference entities. The iTraxx Europe family includes three sector sub-indexes covering nonfinancial, financial senior, and financial sub, and a HiVol index, comprising the 30 widest-spread nonfinancial names. The iTraxx Crossover index consists of up to 75 sub-investment-grade European entities. Unlike market value–weighted benchmark bond indexes, the CDS index constituents are equal-weighted by notional, and provide the same default exposure as buying/selling CDS on each underlying firm.

Importantly, although sectoral representation is taken into consideration in constructing an index, larger banks and broker-dealers are excluded from CDX indexes. Historically, the indexes were owned by the International Index Company Limited (iTraxx family) and CDS IndexCo LLC (CDX family), which were themselves owned by a consortium of large dealers. Including bank obligors in the indexes would have been a conflict of interest. In the current market structure, a small set of large dealer participants still dominates transaction volume. Therefore, as a seller of protection, a dealer would expose the buyer of protection on an index to "wrong way" risk—that is, the risk that the seller of protection is exposed to the same risk as the underlying —if that index were to include the dealer as a constituent. As a buyer of protection, the dealer would be buying protection against its own default, raising questions about contract legality. Therefore, excluding banks and broker-dealers as constituents and including other financial firms in the index allows market participants to gain credit exposure to a diversified basket of firms without introducing conflicts of interest.

The basket's composition is determined when the index is rolled to the market. That composition remains unchanged throughout its lifetime, unless a credit event is triggered for one of the constituents, in which case that constituent is removed without replacement and settled separately. The protection seller pays the loss on default to the protection buyer based on trade notional and the weighting of the name. A new *version* of the index is published, assigning a zero percent weight on the triggered entity. The contract continues to its full term at a reduced notional amount, with the defaulted name removed from the portfolio.

Theoretically, the version of the index with the defaulted constituent should not be traded after the default date. In practice, however, the version including the defaulted entity continues to be traded until the recovery value is determined in an auction. This approach is in place because dealers hedge their index derivative positions using the index and only when the auction results are finalized can the characteristics of a derivative product on the new version of the index be determined.[7]

As time passes, the characteristics of the constituents might deviate from the index's desired profile. Therefore, a new index *series* is introduced twice a year, in March and September, with extended maturity and updated constituents. This series is considered the on-the-run series. Although trading continues in previous series, the liquidity of the off-the-run series is lower than that of the on-the-run series. In the roll, entities that no longer qualify for index inclusion are removed and new entities are added to keep the number of reference entities in the index constant. The majority of names remain unchanged.[8] In particular, on average, 4 percent of CDX.NA.IG and 7 percent of CDX.NA.HY constituents are replaced in each roll.[9]

The set of rules governing the constituents' selection has evolved, tracking market developments. The key change took place in March 2011, when DTCC TIW data were utilized for the first time to determine the liquidity of potential constituents.[10] In September 2015, since the liquidity of single-name CDS had become a concern, the rules governing the constituents of the CDX.NA.HY index family were updated to better match the cash market counterpart. A criterion to avoid excess weighting of certain sectors was added and criteria to avoid insufficiently liquid single-name CDS were tightened. Entities that fail to satisfy the rating requirement because of an upgrade or downgrade, or that are not sufficiently liquid, are replaced by the most-liquid entities with the necessary credit rating.[11]

In theory, a CDS index should trade at its intrinsic value, which is approximately equal to the duration-weighted average of the underlying single-name CDS expressed as a price value in basis points. In practice, a CDX index's market value is determined by supply and demand, often resulting in a spread between its intrinsic and market values. Junge and Trolle (2014) use this differential to construct a measure of CDS market illiquidity. They find that CDS contracts with higher liquidity exposures have higher expected excess returns for sellers of credit protection and trade with wider CDS spreads, with liquidity risk accounting for 24 percent of CDS spreads on average.

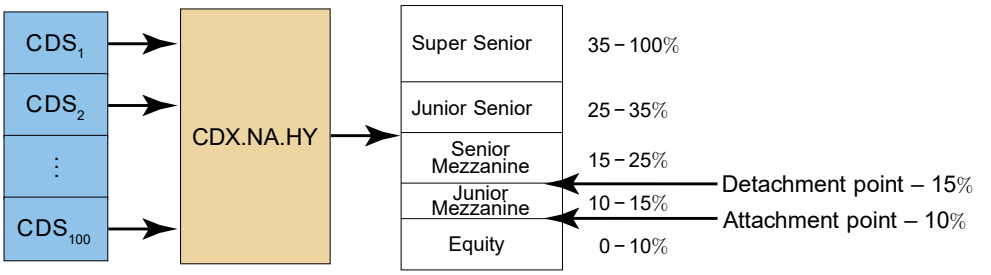
1.3 Index Tranche CDS Contracts

It is also possible to assume a long or short credit exposure to a particular portion of the index loss distribution by trading a *CDS index tranche*. An index tranche is defined by its attachment (minimum level of losses) and detachment (maximum level of losses) points on the loss distribution. For example, an equity tranche with attachment at 0 percent and detachment at 5 percent will absorb the index's first 5 percent of losses. When a credit event is triggered, the appropriate tranche is adjusted for the reduced notional (based on loss-given-default) and a new detachment point is calculated for the remaining index names.

Exhibit 1 summarizes the relationship between the single-name contracts forming an index and the tranche contracts on the index, using the CDX.NA.HY as an example. The CDX.NA.HY includes 100 North American reference entities with high-yield ratings and has the following tranches: equity, absorbing the first 10 percent of losses; junior mezzanine, absorbing the next 5 percent; senior mezzanine, absorbing the next 10 percent; junior senior, absorbing the next 10 percent; and super senior, absorbing the last 65 percent. Consider an investor that buys

Exhibit 1

Relationship between Single-Name CDS Contracts, Index Contracts, and Index Tranches



Notes: The exhibit illustrates the relationship between contract types using the CDX.NA.HY index as an example. The CDX.NA.HY includes 100 North American reference entities with a high-yield rating.

protection on the equity tranche with a notional of $10 million. When a name in the index defaults, with loss-given-default (LGD) set at 35 percent, the payout from the protection seller is

$$\begin{aligned}\text{Payout} &= (\text{Notional} \times \text{LGD} \times \text{Weighting}) \,/\, \text{Tranche Size} \\ &= (\$10{,}000{,}000 \times 0.35 \times 0.01) \,/\, 0.1 = \$350{,}000.\end{aligned}$$

The equity tranche is then adjusted for the reduced notional based on the 35 percent LGD, and 9.65 percent of the notional remains in the tranche. The new detachment point must be adjusted for the remaining names in the index. Using a factor of 0.99, the equity tranche for new trades becomes a 0–9.9 percent tranche. The principal of other tranches is unaffected, but they now have a smaller cushion protecting them against further losses.

A few papers have examined CDX tranche contract pricing. Coval et al. (2009) find that, from the third quarter of 2004 to the third quarter of 2007, senior CDX tranches offered too little compensation for their market risk exposure *i* compared with the compensation investors were able to earn in the bond and option markets for bearing similar risks. Collin-Dufresne et al. (2012) argue that senior index tranches provide the risk-neutral probabilities of catastrophic risks in the economy. Seo and Wachter (2018) incorporate investor preferences, consumption, and firm cash flows into a rare economic disaster model to explain spreads of senior CDX tranches before and during the financial crisis.

1.4 Index Options

Credit default options (or credit default swaptions) give the buyer the option of entering into a CDS contract at a future date. These options, similar in structure to more commonly referenced interest-rate options, give investors a platform to take positions on volatility in credit markets or tailor their directional spread views and credit exposure. Two types of *CDS index options* trade: a "payer option" gives the holder the right, but not the obligation,

to buy protection (pay coupons) on the underlying index at the specified strike spread level on expiry ("European put"); a "receiver option" gives the holder the right, but not the obligation, to sell protection (receive coupons) at the strike spread level ("European call").

If a default happens among the index constituents before option expiry, the buyer of a payer option (seller of a receiver option) can trigger a credit event by exercising the option. Since the buyer of the payer option receives any losses resulting from default, payer options may be exercised even if the index spread is below the option strike. The total payoff in a CDS index option thus has two components: (1) payoff owing to the difference between the spread level at expiry and the option strike, and (2) payoff stemming from any default losses. Although the credit default options market has existed since 2003, these derivatives (CDS index options) only gained widespread traction in 2011. Today, more than 60 percent of the options on the CDX.NA.IG and the CDX.NA.HY are puts.

Since April 2009, single-name CDS, index CDS, and CDS index options have been traded with fixed coupons and upfront payments that make the expected present value of the protection bought equal to the expected present value of protection sold, conditional on the fixed spread chosen and common assumptions about the recovery rate in a credit event.[12] For both single-name and index CDS, the fixed coupon payments from the protection buyer to the seller are made quarterly using a 360-day year convention. [13]

1.5 The Evolution of the U.S. CDS Market

Although the CDS market has existed since the early 1990s, the contract structure and trading mechanisms were largely unchanged before the 2007–09 financial crisis. Exhibit 2 provides a timeline of industry- and regulatory-initiated changes in the U.S. CDS market.

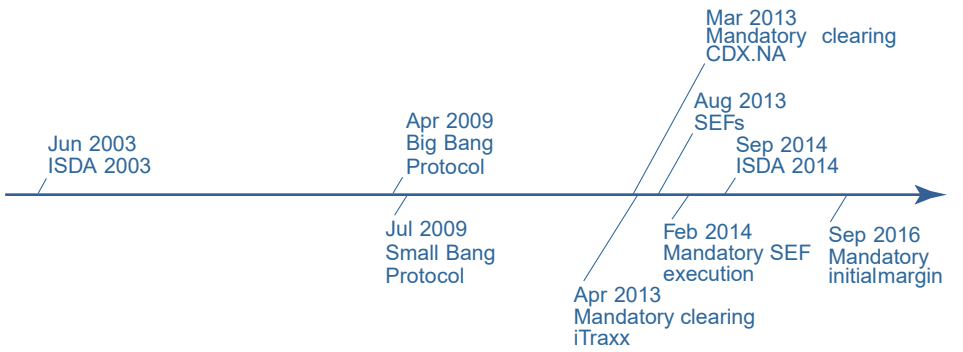
During and after the crisis, industry-led changes focused on revisions to the ISDA Master Agreement—the document specifying CDS contract terms—aimed at creating greater standardization and substitutability. Responding to operational inefficiencies and backlogs, the Big-Bang and the Small-Bang Protocols were introduced in April and July 2009, respectively, to eliminate redundant offsetting trades and facilitate centralized clearing.

The Big Bang encompassed four main changes: (1) an auction mechanism to determine the recovery rate following a credit event; (2) Determinations Committees to decide whether a credit or succession event has occurred; (3) a "looking back" period to determine the effective protection period; and (4) a fixed coupon (either 100 or 500 basis points) for single-name North American CDS and an upfront payment at the time of trade. The Small Bang applied similar changes to European corporate and Western European sovereign CDS, introducing fixed coupons (25, 100, 500, and 1000 basis points). The Big Bang Protocol also eliminated restructuring as a credit event in new North American corporate single-name contracts, while European corporate CDS continue to trade with "Modified Modified Restructuring" as the standard convention. These steps toward standardization better aligned single-name CDS contracts with the standard corporate CDS indexes.

Additional contractual change, noted in Section 1.1, came into effect in September 2014 after credit events during the financial crisis exposed flaws in the ISDA's 2003 Definition. The key changes ISDA 2014 introduced were (1) a new credit event that covers possible

Exhibit 2

Timeline of CDS Market Evolution



Notes: The exhibit presents a timeline of major changes affecting the CDS market in the United States. ISDA is International Swaps and Derivatives Association. SEF is swap execution facilities.

government intervention, (2) deliverables in case of bank bail-ins, and (3) further clarification on an obligation's deliverability in a credit event ("Standard Reference Obligation").

Dodd-Frank regulatory reforms also revamped the U.S. CDS market with the goal of ameliorating the vulnerability of institutions linked by a complex web of OTC credit derivatives. Title VII of the Dodd-Frank Act provided a comprehensive framework for regulating the OTC swap markets, including CDS, to mitigate counterparty risk and to improve pricing transparency. The bill introduced registration requirements for market participants, central clearing of certain types of contracts, and reporting of OTC derivatives transactions to swap data repositories (SDR).

Dodd-Frank divides regulatory authority over swap agreements between the Commodity Futures Trading Commission (CFTC) and the Securities and Exchange Commission (SEC). The CFTC has primary authority over swaps, except for "security-based swaps," defined as swaps on a single security, which the SEC regulates. The CFTC and the SEC share authority over "mixed swaps," which are security-based swaps that also have a commodity component.[14] The CFTC has required reporting of swap transactions and pricing for index CDS contracts since December 31, 2012.

The Dodd-Frank Act also requires mandatory clearing through a regulated central counterparty (CCP) of all swap trades that the CFTC and the SEC determine should be cleared. Each party in a CDS contract faces counterparty risk, that is, the possibility the other party will not fulfill contractual obligations. In a counterparty default, the protection seller risks the stream of coupon payments for the duration of the contract. The protection buyer could potentially lose the full notional of the contract, assuming double default and a zero recovery rate. A CCP reduces this risk by becoming the buyer to every protection seller and the seller to every protection buyer. The only counterparty risk market participants face in a cleared transaction is that of the CCP itself.

The clearinghouse is capitalized by its members, which are required to be regulated, well-capitalized institutions. Each member contributes capital in proportion to its trading activity. If clearinghouse capital falls below the required minimum level, remaining members must put up additional capital to compensate for the shortfall. This protects market participants from a default of an individual counterparty and spreads risk among all members. CCPs also permit clearing of offsetting trades, since coupon payments, credit event settlement, and collateral management are carried out through the CCP. These features make cleared transactions—that is, those transactions that have a CCP as counterparty to the trade—more attractive to market participants than uncleared transactions.

However, central clearing comes with a requirement to post margin. In the uncleared world, a bilaterally negotiated ISDA Master Agreement governed collateral posting, which could vary substantially according to counterparty size and credit rating. Anecdotally, in bilateral contracts, dealers were rarely required to post initial margin. In contrast, in cleared transactions, the CCP determines margin and collateral requirements, providing a more standardized approach.

Two forms of margin are required: initial and variation margin. The initial margin is set to compensate for a scenario in which the counterparty defaults and fails to post the daily variation margin. Initial margin is calculated at the portfolio level, with netting allowed for offsetting cleared positions. The variation margin compensates for the trade's daily mark-to-market. Duffie et al. (2015) estimate the impact on collateral demand of these clearing and margin requirements under various scenarios, such as increased novation of CDS to CCPs, an increase in the number of clearing members, or proliferation of both specialized and unspecialized CCPs.

Some single-name CDS and CDS indexes were already cleared voluntarily before Dodd-Frank. As the regulator of the CDS index market, the CFTC called for phased-in mandatory central clearing of most index trades for different types of market participants in 2013. The clearing requirement applies to specific tenors and series of the CDX.NA.IG and the CDX.NA.HY indexes: CDX.NA.IG 5Y, series 11; CDX.NA.IG 7Y, series 8; CDX.NA.IG 10Y, series 8; CDX.NA.HY 5Y, series 11; and all subsequent series of these four indexes. At the time of writing, the SEC had yet to finalize rules regarding clearing of single-name CDS, though some contracts are centrally cleared voluntarily.

In addition, standardized swap trades have to be executed on swap execution facilities (SEFs). U.S. rules governing these trades were finalized on May 16, 2013, and went into effect in August 2013. For CDS, these include all index transactions in the CDX.NA.IG, CDX.NA.HY, iTraxx Europe, and iTraxx Europe Crossover families. The rules also define the types of trading platforms that must register as SEFs, the core principles by which they must operate, and the execution method required to trade swaps. With the introduction of made-available-to-trade (MAT) on SEFs in January 2014, the current on-the-run and first off-the-run series of the five-year CDX.NA.IG, CDX.NA.HY, iTraxx Europe, and iTraxx Europe Crossover have been required to trade on SEFs since February 2014.

Most recently, mandatory initial margins for noncleared positions were introduced in the U.S. swap market in September 2016 and in the rest of the world in March 2017.[15] These reforms increase bilateral trading costs by requiring dealers as well as customers to post margin and by setting higher initial margin levels than in comparable cleared contracts. The changes incentivize market participants to migrate to cleared trades for clearing-eligible instruments.

2. Supervisory DTCC Data

Though CDS have been traded since 1994, the lack of detailed data on transactions and positions before the 2007–09 financial crisis limited our ability to study the decisions made by the wide range of participants that traded credit risk through these instruments.[16] Since the crisis, detailed trade-level information has become available. In this section, we describe the available data sets and what we can learn from them.

2.1 Review of Data Used in the Literature

Despite the CDS market's inherent decentralized nature, the DTCC has been collecting transaction information through its widely used lifecycle event processing service Deriv/SERV. The DTCC estimates this service covers approximately 98 percent of all standard credit derivatives contracts.[17] Following the financial crisis reforms, the DTCC began using these data in two ways. First, it publishes weekly statistics on CDS volume and activity through the TIW. Since November 2008, these statistics have included notional outstanding by participant type (dealer, nondealer, central counterparty), product type (single-name, indexes, and index tranches), term, and currency. Oehmke and Zawadowski (2016) exploit a subset of these data—total net notional amount of CDS protection written on the top 1,000 single-name reference entities—to investigate participant trading objectives.

Second, the DTCC provides global regulators with transaction- and position-level data, giving supervisory authorities a more granular view of the market. The transaction-level data include new trades, assignments (novations), and terminations. For each record, the DTCC data contain the names of the protection buyer and seller, submitter of the transaction to the DTCC, reference entity, trade date, termination date, notional amount, and currency. The DTCC distributes different subsets of its worldwide data set in different jurisdictions, supporting relevant authorities in regulating and supervising OTC derivatives markets.[18]

Chen et al. (2011) examine a three-month sample of global single-name (corporate, sovereign, municipal, asset-backed, and loan) and index CDS transactions to evaluate the market's size and composition, trading frequency, and the level of standardization of CDS products before post-trade public reporting began in the CDS market. Their sample comprises all CDS transactions occurring globally between May 1 and July 31, 2010, in which at least one of the fourteen major over-the-counter derivatives dealers was a counterparty to the trade. Shachar (2013) analyzes transactions in single-name CDS contracts on thirty-five financial firms, as well as transactions in CDX Index contracts. The sample includes all CDS transactions occurring between February 2007 and June 2009 regardless of counterparty region. Counterparty identity is masked, but counterparty type is shown.

Using these data, Shachar (2013) shows that bilateral exposures in the interdealer market are empirically relevant in determining counterparty risk, dealer intermediation capacity, and market resilience in times of stress. Applying a similar methodology, Gehde-Trapp et al. (2015) use single-name CDS with German firms as reference entities from January 2009 to June 2011. They show that CDS premiums reflect market frictions rather than the credit risk of the underlying reference entity. Du et al. (2015) observe CDS transactions from January 2010 through December 2013 in which at least one of the dealer banks regulated by the Federal

Reserve Board (FRB) is a counterparty to the trade or the reference entity. The FRB-regulated institutions are Bank of America Corporation, Citigroup Inc., Goldman Sachs Group, Inc., JP Morgan Chase & Co., and Morgan Stanley. The authors focus on how market participants price and manage counterparty risk. Siriwardane (forthcoming) uses a granular DTCC data set that identifies counterparties, terms of trade, and covers nearly all outstanding CDS exposures for transactions that reference North American entities and/or U.S. participants starting in 2010. Using the same data set, Eisfeldt et al. (2018) study the extent to which dealers exert pricing power in the index CDS market. They find that credit spreads in dealer-to-dealer trades are 6 percent lower than credit spreads in dealer-to-nondealer trades.

A few papers exploit nonsupervisory versions of the DTCC data or other data sources. Duffie et al. (2015) obtain a version of the DTCC data that encompasses gross and net bilateral exposures between any two counterparties for 184 single-name CDS (9 G20 sovereigns, 20 European sovereigns, and 155 global financial entities), with no restriction on counterparty origin. Their data set does not identify counterparties, trade dates, or position maturity. Loon and Zhong (2016) use publicly disseminated Index CDS transactions. As noted in Section 1, since December 31, 2012, index CDS transactions have had to be reported to an SDR, which in turn publicly disseminates transaction details, including price, size, and time. Loon and Zhong collected CDS Index transactions executed between December 31, 2012, and December 31, 2013, from the DTCC data repository. They merge these transactions with intraday and end-of-day quotes to calculate the transaction-level relative effective spread and other liquidity measures. Tang and Yan (2017) use transactions data from the GFI Group from January 1, 2002, to April 30, 2009. They argue that CDS spreads not only change in response to fundamentals, but also in response to supply–demand imbalances and market liquidity. Arora et al. (2012) use a proprietary data set from one of the largest fixed-income asset management firms, which contains both actual CDS transaction prices for contracts entered into by the firm as well as actionable quotations obtained from a variety of CDS dealers. Their data extend from March 2008 to January 2009.

More recently, SEF transaction data have become available.Collin-Dufresne et al. (2017) collect transaction data for multiple dealer-to-dealer and dealer-to-nondealer SEFs from October 2, 2013, to October 16, 2015, and find that average transaction costs are higher for dealer-to-client trades. Using May 2016 message-level data for two dealer-to-nondealer SEFs, Riggs et al. (2017) find that customers contact fewer dealers if the trade size is larger or nonstandard, while dealers are more likely to respond to customer inquiries if fewer dealers are competing, if the notional size is larger, or if more dealers are making markets.

Although these papers examine different parts of the network of CDS exposures, a consistent picture emerges. First, credit exposures fluctuate over time. Net credit protection sellers in one period can become net protection buyers in another. Second, the pricing of the exposure traded depends on the counterparties to the trade—though the literature has yet to arrive at a consensus on whether and to what extent dealers are able to exert market power—as well as the effect of mandatory clearing on the pricing strategies of other market participants.

2.2 Our Data

Our version of the DTCC data is obtained through the Federal Reserve System's supervisory authority. Each weekly snapshot reports all outstanding CDS positions in which at least one FRB-regulated dealer bank is a counterparty to the trade or the reference entity itself. We refer to this subset of all CDS trades collected by the DTCC as "supervisory DTCC."

For the positions the DTCC reports to the Federal Reserve, we observe detailed contractual terms, including the identities of the counterparties; pricing terms, including the fixed spread and the upfront payment; notional amount of the contract; trade date; maturity; and the restructuring clause. The sample period is January 2010 through June 2019, representing 497 observation weeks, 12,971,160 unique contracts, 3,427 unique reference entities,[19] 13,474 unique protection buyers, and 12,555 unique protection sellers. In a median week, 22,212 new positions are opened, corresponding to 829 unique reference entities, with exposures exchanged between 752 unique buyers and 766 unique sellers. Although these data cover only a subset of all CDS transactions and thus have inherent limitations, the six institutions for which we observe all open positions on a report date are major market participants and their trades cover a large fraction of overall activity.

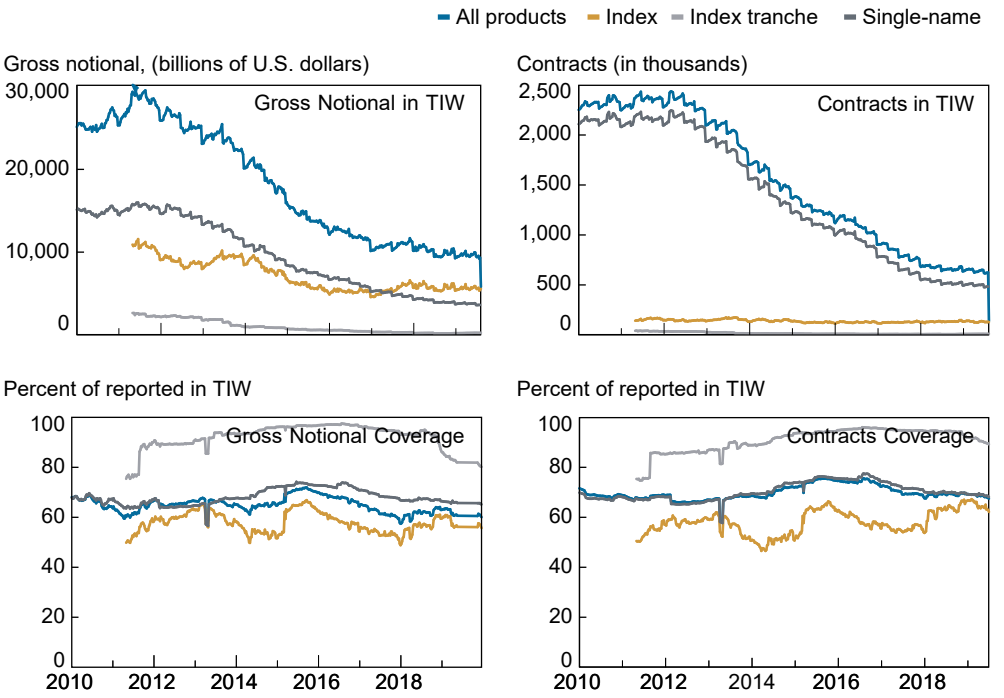
Overall activity

Summary statistics on the number of contracts and gross notional amounts for different subsamples of the supervisory DTCC data are presented in Charts 1 and 2. The top two panels of Chart 1 present overall activity in the market for single-name, index, and index tranche CDS instruments—specifically, the distribution of gross notional amounts outstanding in U.S. dollar billion equivalents and the number of contracts in thousands for the DTCC TIW. The bottom two panels show the fraction of the total reported in the supervisory DTCC data.

Comparing the positions observed in our data to total market activity captured by the DTCC TIW, the positions of the six supervised institutions account on average for 70 percent of total activity in single-name derivatives, 58 percent in index products, and 91 percent in index tranche products, as measured by the number of contracts and gross notionals. Aggregating the three types of contracts, in an average reporting week, the supervisory data capture 60 percent of the gross notional outstanding and 62 percent of the number of contracts.

Over our sample period, both the gross notional and the number of contracts outstanding for single-name contracts have declined steadily, driving an overall decrease in gross notional and contracts outstanding for the market. This significant decline is partly attributable to "compression," when redundant contracts on the same reference entity are terminated and replaced with new ones with the same net exposure. The gross notional outstanding for index and tranche index contracts have also declined somewhat since 2010, though not to the same extent as those of single-name contracts. Interestingly, while the number of single-name contracts traded is much larger than the number of index trades, the gross notionals are comparable. That is, while contracts using single-name reference entities are more frequent, the notional amounts of contracts written on single-name reference entities tend to be much smaller than those of index contracts.

Chart 1
Worldwide CDS Positions and Coverage in Supervisory DTCC Data



Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: Number of contracts is reported in thousands. Notionals are given in billions of U.S. dollars. Coverage is reported as the ratio between the corresponding quantities in the supervisory DTCC data and the TIW data (in percentage terms).

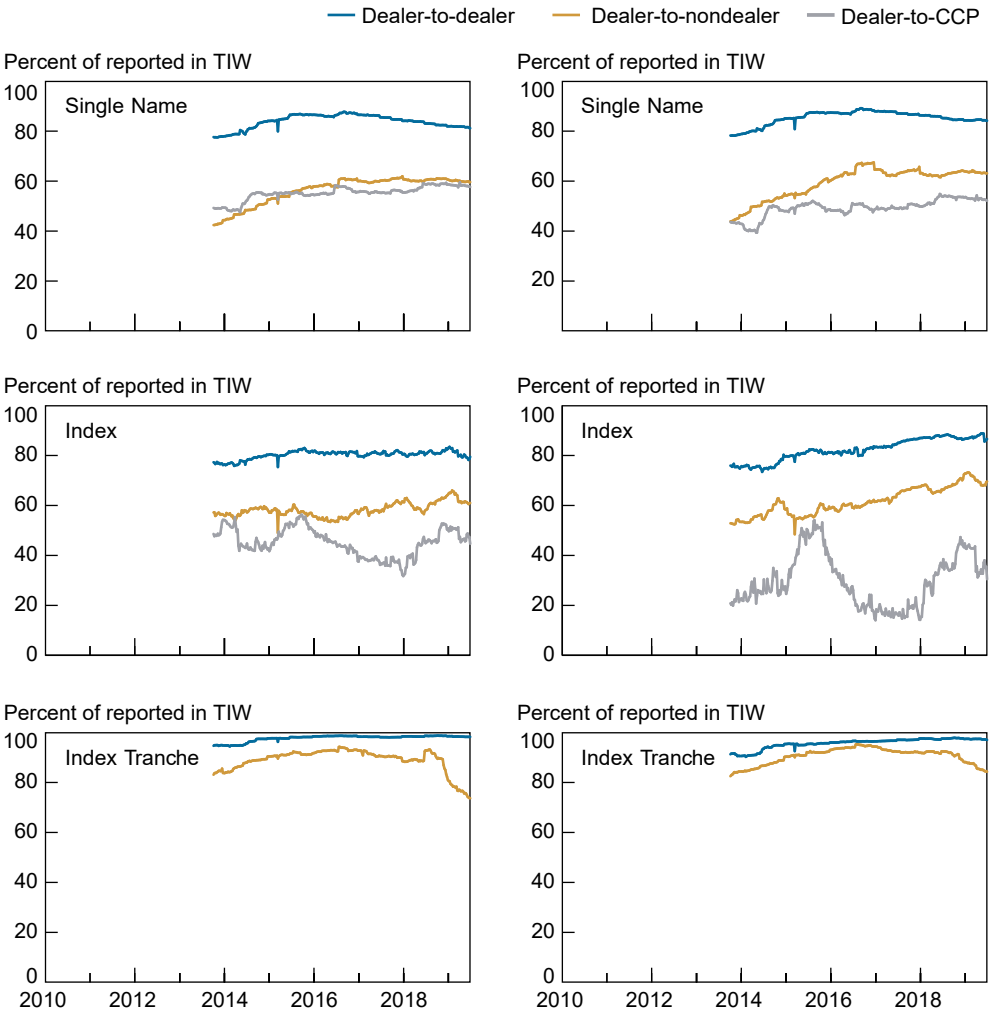
It is not surprising that the supervisory DTCC sample has the lowest coverage for index trades because the index provides more-diversified credit risk exposure. In addition, index product trading was standardized before the start of our sample and, therefore, the identity of the protection seller is less detrimental to the value of the contract. Moreover, index CDS trades frequently occur with a CCP as a party.

Trading by type of counterparty

In our sample, 7,493,715 contracts are exchanged between dealers, 1,968,379 between dealers and their customers, and 2,858,924 between dealers and a CCP. In a median week, 9,892 contracts are exchanged between dealers, 3,657 between dealers and their customers, and 5,417 between dealers and a CCP. Chart 2 shows the average number of contracts and gross notionals exchanged between different types of market participants by product category. We use the DTCC classification to designate institutions as dealers, nondealers (customers),

Chart 2

Comparison of Supervisory DTCC and TIW Data by Participant Type



Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: Coverage is reported as the ratio (in percentage terms) between gross notional in the supervisory DTCC data and gross notional in the TIW data (left column), and the ratio between the number of contracts in the supervisory DTCC data and the number of contracts in the TIW data (right column).

and CCPs. Overall, the supervisory DTCC data cover 83 percent of dealer-to-dealer and 58 percent of dealer-to-customer contracts, and 82 percent and 55 percent of gross notional, respectively. For dealer-to-CCP trades, the supervisory data cover approximately 48 percent of contracts and 55 percent of the gross notional.[20]

This relatively low coverage of trades between CCPs and dealers explains the relatively low coverage of index trades and the relatively high coverage of index tranche trades, since

index tranche positions cannot be traded with a CCP. The middle row of Chart 2 shows that, while the supervisory data capture around 75 percent of the number of dealer-to-dealer contracts, they capture only slightly more than a quarter of index contracts exchanged between a dealer and a CCP.[21] Combined with the relatively good coverage of transactions between dealers and nondealers in the single-name market, this suggests that nondealer participants prefer index contracts for taking credit risk exposure.

3. Aggregate Market Activity

3.1 Metrics of Activity

We examine weekly financial institution activity in each CDS market segment by computing each participant's buy- and sell-side positions in single-name, index, tranche, and option products, as well as the corresponding net positions. The net position is equal to the difference between the buy and sell positions for each underlying. A positive position indicates that an institution is, on net, buying protection. Formally, participant p's position in contracts on reference entity i with maturity τ at snapshot date h is the sum of notionals in contracts in which p buys protection less the sum of notionals in contracts in which p sells protection:

$$\text{Net Position}_{p,i,\tau,t} = \text{Notional bought}_{p,i,\tau,t} - \text{Notional sold}_{p,i,\tau,t}.$$

We construct two measures of market activity: gross and net notional. Gross notional sums the par amount of credit protection bought (or, equivalently, sold) in all the contracts. Net notional sums the net positions of all the participants that are, on net, buying or selling protection. These two concepts of notional for reference entity i on date t are defined as

$$\text{Gross notional}_{it} = \sum_{p,\tau} \text{Notional bought}_{p,i,\tau,t}$$

$$\text{Net notional}_{it} = \sum_{p} \left(\sum_{\tau} \text{Net position}_{p,i,\tau,t} \right) 1 \left(\sum_{\tau} \text{Net position}_{p,i,\tau,t} > 0 \right).$$

Net notional positions represent the maximum possible net transfer between protection sellers and protection buyers in a reference entity credit event. When the recovery rate in the credit event is above 0, the funds transferred are a fraction (equal to one less the recovery rate) of the net notional. Gross notional measures total transaction volume in the CDS market. An important caveat concerning these measures is that they are based on contract face value, and do not reflect the market value or the duration of the contracts. Thus, neither gross nor net notional captures market participants' exposure to credit events. In Appendix 2, we show that, overall, the qualitative properties of the duration-risk-adjusted positions are similar to those of the raw positions. We thus focus on the unadjusted gross and net notionals in the main body of this article.

Table 1
Sample Summary Statistics

Sample	RedCodes	Contracts	Buyers	Sellers
Original	4,049	14,641,667	13,997	12,934
...and 2010-2019 (June)	3,427	12,971,160	13,474	12,555
...and SN, Index Product Corporate	2,801	12,945,839	13,465	12,543
...and US/EUR Corporate	1,773	10,353,448	11,129	10,584
...and 5Y Maturity	1,351	3,673,703	10,264	9,521

Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW); Markit.

Notes: The first row of the table reports the characteristics of the full sample; subsequent rows describe how the data set changes with the specified filter applied. The "RedCodes" column presents the number of unique Markit RedIDs in the sample; "Buyers" ("Sellers") columns are the number of unique firm organization ID numbers in the sample that bought (sold) protection.

3.2 Sample Selection

We focus on single name, index, index tranche, or index option contracts entered into between January 2010 and June 2019 covering U.S. and advanced European corporate reference entities. Table 1 summarizes how the original sample changes with each filter applied. Appendix 1 describes the details of the overall sample construction and splits by characteristics used below.

3.3 Characteristics of Outstanding Positions

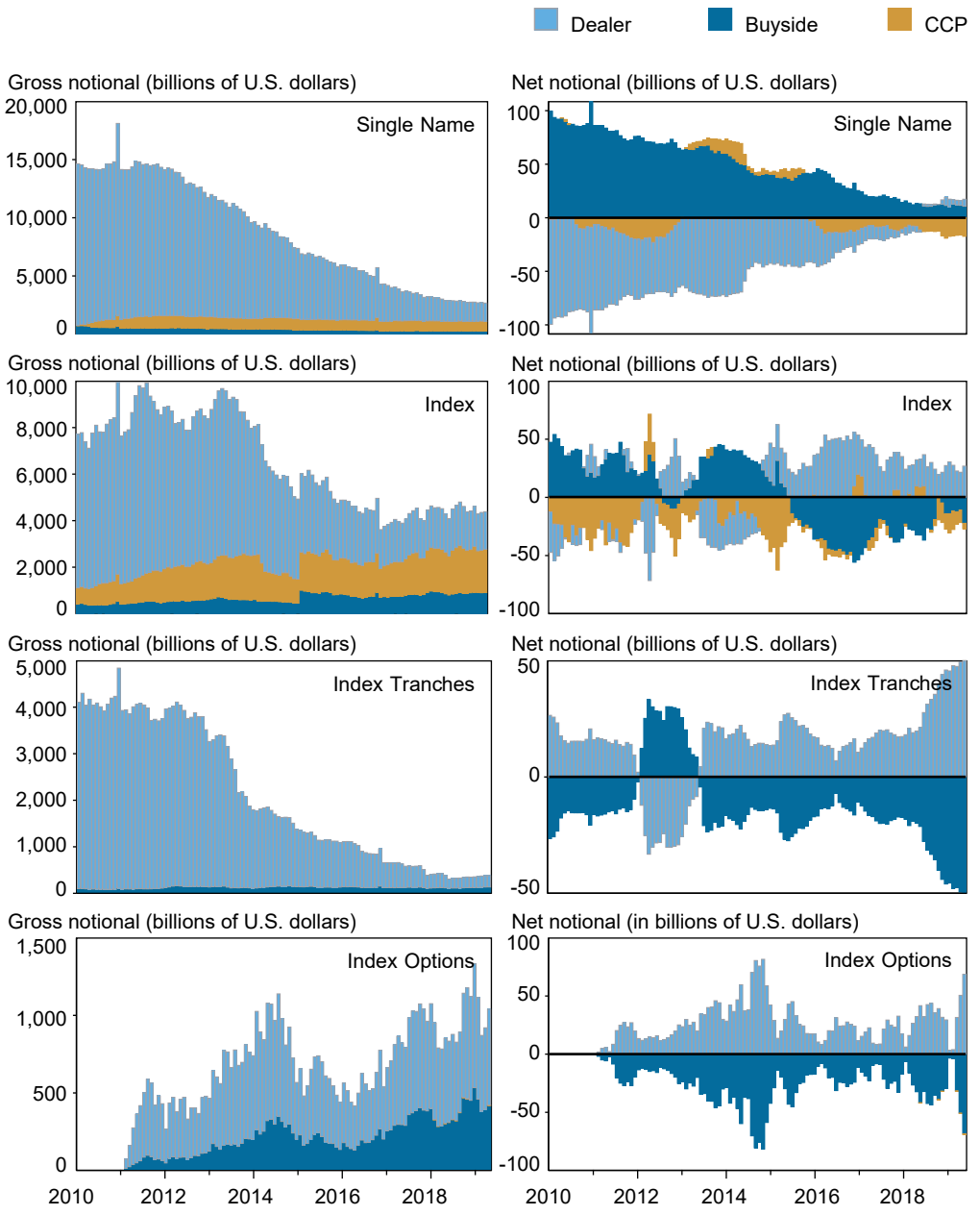
We examine the characteristics of all positions outstanding on a given snapshot date. The outstanding positions provide an overview of total exposures at a point in time and illustrate longer-term trends by capturing gradual exposure changes. Charts 3–7 plot monthly average gross and net notional of outstanding positions by counterparty type, counterparty location, on-the-run index membership, clearing eligibility, and master agreement type.

Positions by counterparty type

The gross and net notional exposures in single-name, index, index tranche, and index option contracts of dealers, nondealer customers (buyside counterparties), and CCPs are plotted in Chart 3. The bottom two rows show that, while index options are a relatively new contract type, they have grown more prominent, replacing index tranches as the preferred levered position on the index. In both index tranches and options, dealers have historically been protection buyers from buyside counterparties. The only exception is from January 2012 to

Chart 3

Monthly Average Gross and Net Positions by Participant Type



Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the monthly average gross notional of outstanding positions in the four contract types by participant type. The right column shows the monthly average net notional of positions in the four contract types by participant type. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection. Participant classification is provided by DTCC.

mid-2013 when dealers were selling protection to buyside counterparties in the index tranche market. Comparing gross and net exposures shows that dealers also exchange a large fraction of the total index tranche gross notional with one another.

The top row of Chart 3 plots single-name exposures, showing that dealers again exchange a large volume of gross notional with one another. In contrast with levered products, dealers are net protection sellers throughout our sample while buyside counterparties are net protection buyers. Despite an increase over time in single-name contracts eligible for clearing, CCPs do not appear to have raised their gross exposure to single-name contracts and they oscillate between net protection seller and buyer positions. Overall, both gross and net exposures in the single-name market have fallen over time, consistent with the global trend illustrated in Chart 1.

In contrast, while we see some decreases in index contract gross notional before January 2014 (plotted in the second row in Chart 3), the net notional traded has remained mostly constant throughout our sample period. While dealers were primarily net protection sellers in the index CDS market until mid-2014, they have become net protection buyers, primarily from buyside counterparties and secondarily from CCPs.

Positions by counterparty location

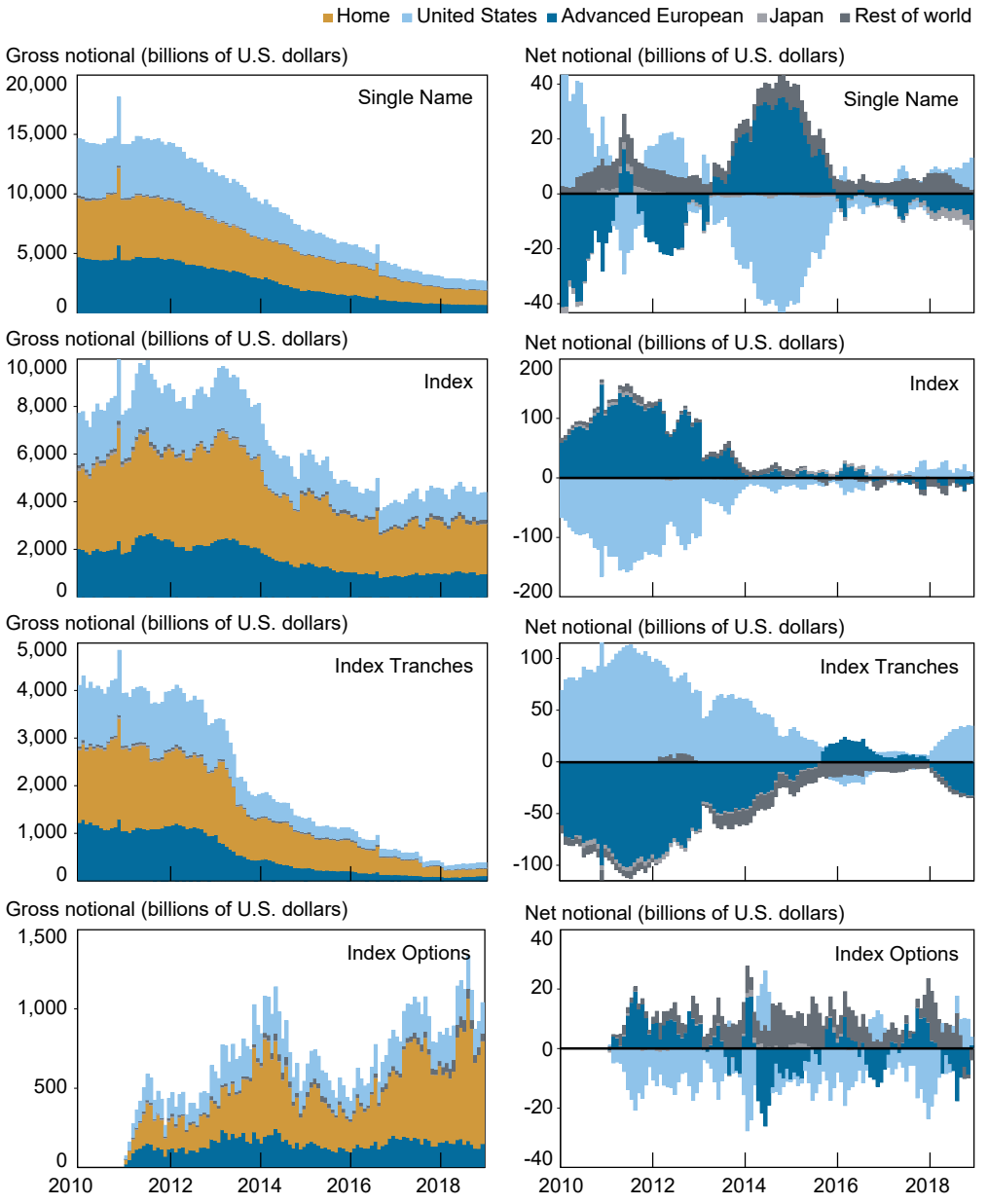
Credit exposures of the four CDS products by jurisdiction are plotted in Chart 4. The largest fraction of gross notional is traded between counterparties in the same jurisdiction, while exposure to counterparties outside the United States and advanced economy European countries is negligible. U.S. counterparties are primarily net protection buyers in the index tranche market, net protection sellers in the index and index option markets, and oscillate between net buying and net selling in the single-name market. In the index and index tranche markets, their primary counterparties are in Europe. While European counterparties also represented a sizable fraction of net notional traded in the single-name market before January 2016, more recently, institutions outside the United States, Europe, and Japan have been net protection buyers from U.S. and Europe-based counterparties. In the index option market, these "rest-of-the-world" institutions have been the principal protection buyers since January 2013, with European counterparties switching between net protection buying and selling in that market.

On-the-run versus off-the-run positions

Membership of outstanding positions in an on-the-run index series is plotted in Chart 5. A series is considered on-the-run if it is the latest series and version of an index on a given date. For single-name reference entities, we consider four cases: the entity belongs only to an index's on-the-run series, only to an off-the-run series, to both an index's on-the-run and off-the-run series, or it does not belong to an index. In both gross and net notional terms, the majority of single-name exposure is traded in contracts that belong to both on-the-run and off-the-run series. Little exposure is in the on-the-run-only category, reflecting the slow pace of index membership replacement. Single-names that do not belong to an index also represent a sizable fraction of gross and net notional traded, though their prominence has declined.

Chart 4

Monthly Average Gross and Net Positions by Location of Counterparty

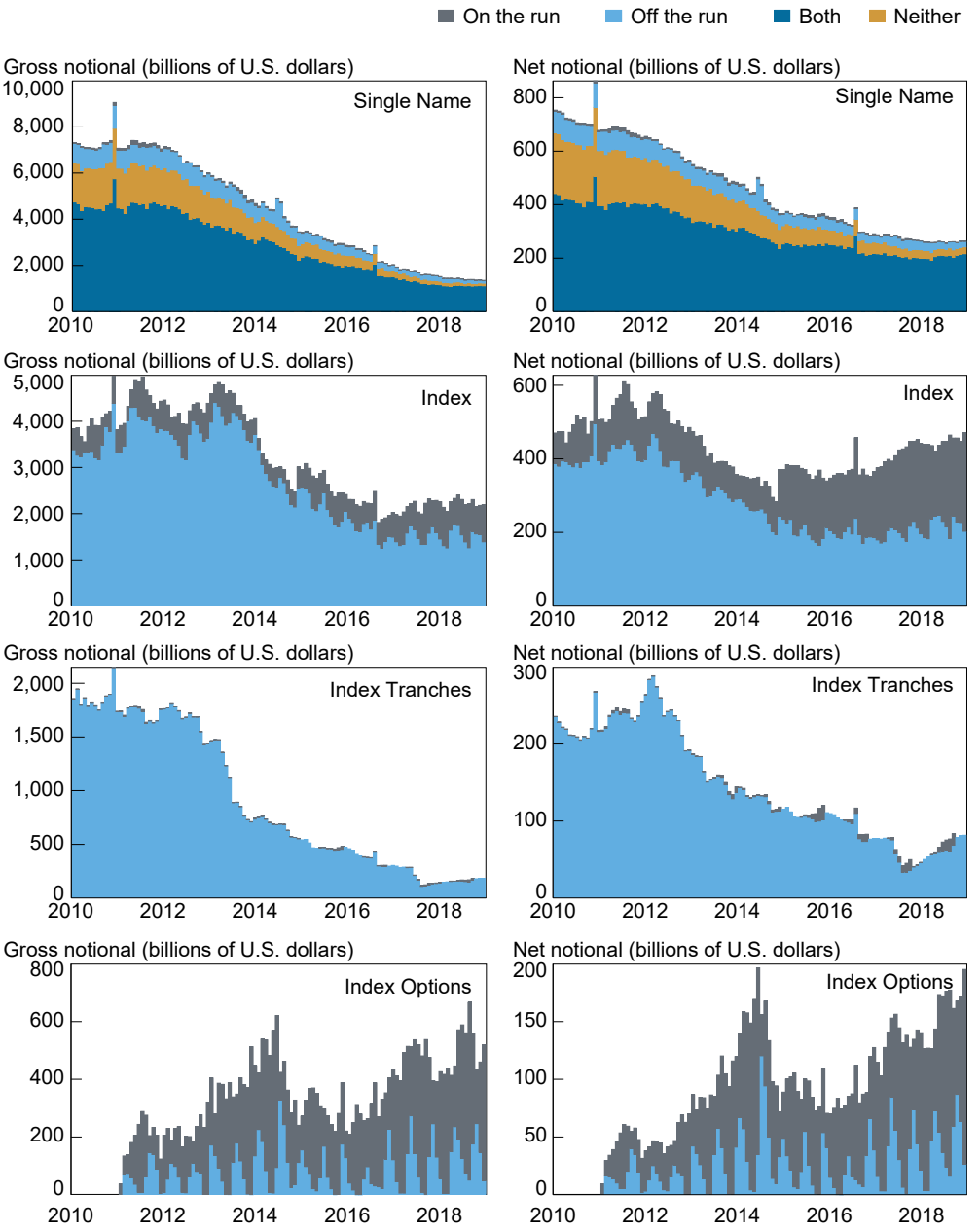


Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the monthly average gross notional of outstanding positions in the four contract types by location of the counterparty to the contract. The right column shows the monthly average net notional of new positions in the four contract types by location of the counterparty to the contract. "Home" refers to counterparties domiciled in the same jurisdiction. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Chart 5

Monthly Average Gross and Net Positions by Type of Index



Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the monthly average gross notional of outstanding positions in the four contract types by type of index. The right column shows the monthly average net notional of new positions by clearing eligibility. For index tranches and index options, "on-the-run" corresponds to those written on on-the-run indexes. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

In the index market, the on-the-run indexes represent about a fifth of the gross notional outstanding but nearly half the net notional bought. In contrast, index tranche exposures are almost exclusively written on off-the-run series, while index option exposures are primarily written on on-the-run series. This is because index options have maturities of less than one year so that the option market can adapt quickly to the introduction of new index series (see Chart 9, p. 27).

Positions by clearing eligibility

Outstanding positions have shifted in response to two market changes: the introduction of central clearing and the adoption of the ISDA 2014 Master Agreement. Chart 6 plots the gross and net notional traded according to clearing eligibility—that is, whether a contract is eligible for clearing on a CCP, not whether the contract was actually cleared. For index tranches and options, this means that the contract is written on an index eligible for clearing.

In the single-name market, as more reference entities have become eligible for clearing, both the gross and net notional of clearing-eligible contracts have increased. The drop in the overall gross notional of single-name contracts traded has been driven by the segment of the market not eligible for clearing. With the introduction of mandatory central clearing for index contracts in the United States in March 2013, both gross and net notional outstanding in index, index tranche, and index option contracts migrated quickly to clearing-eligible series. Overall, Chart 6 suggests that, as more single-name reference entities are accepted for CCP clearing, single-name activity will increasingly be conducted in clearing-eligible contracts, even without mandatory clearing rules.

Positions by master agreement type

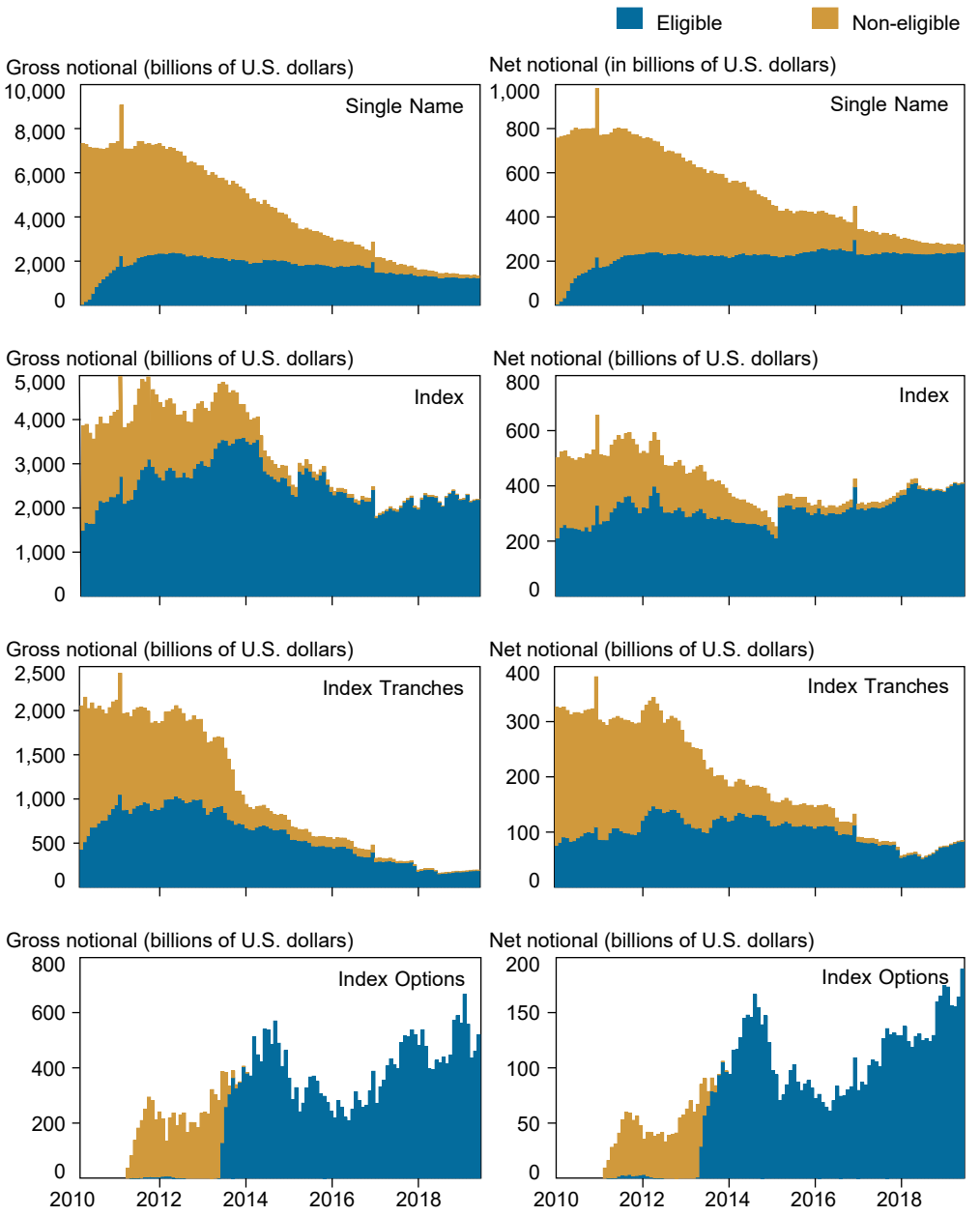
The gross and net notional outstanding by ISDA Master Agreement are plotted in Chart 7. As with the introduction of mandatory clearing of index products, outstanding positions in single-name, index, and index option products transitioned quickly to the ISDA 2014 Master Agreement. Contracts with the new Master Agreement represented most gross and net notional outstanding within six months of the agreement going live in October 2014. However, the index tranche market responded more sluggishly, with ISDA 2003 contracts representing at least 50 percent of gross notional outstanding as late as January 2017.

3.4 Characteristics of New Positions

New positions provide an overview of the risks market participants trade each week, capturing faster-changing features of the market than outstanding positions do. To examine the characteristics of new positions, we identify the first occurrence of a contract for which the effective date is reported to be after the trade date. We determine net and gross notional of new positions according to the credit rating of the underlying reference entity, initial contract maturity, reference entity sector, and contract currency.

Chart 6

Monthly Average Gross and Net Positions by Clearing Eligibility

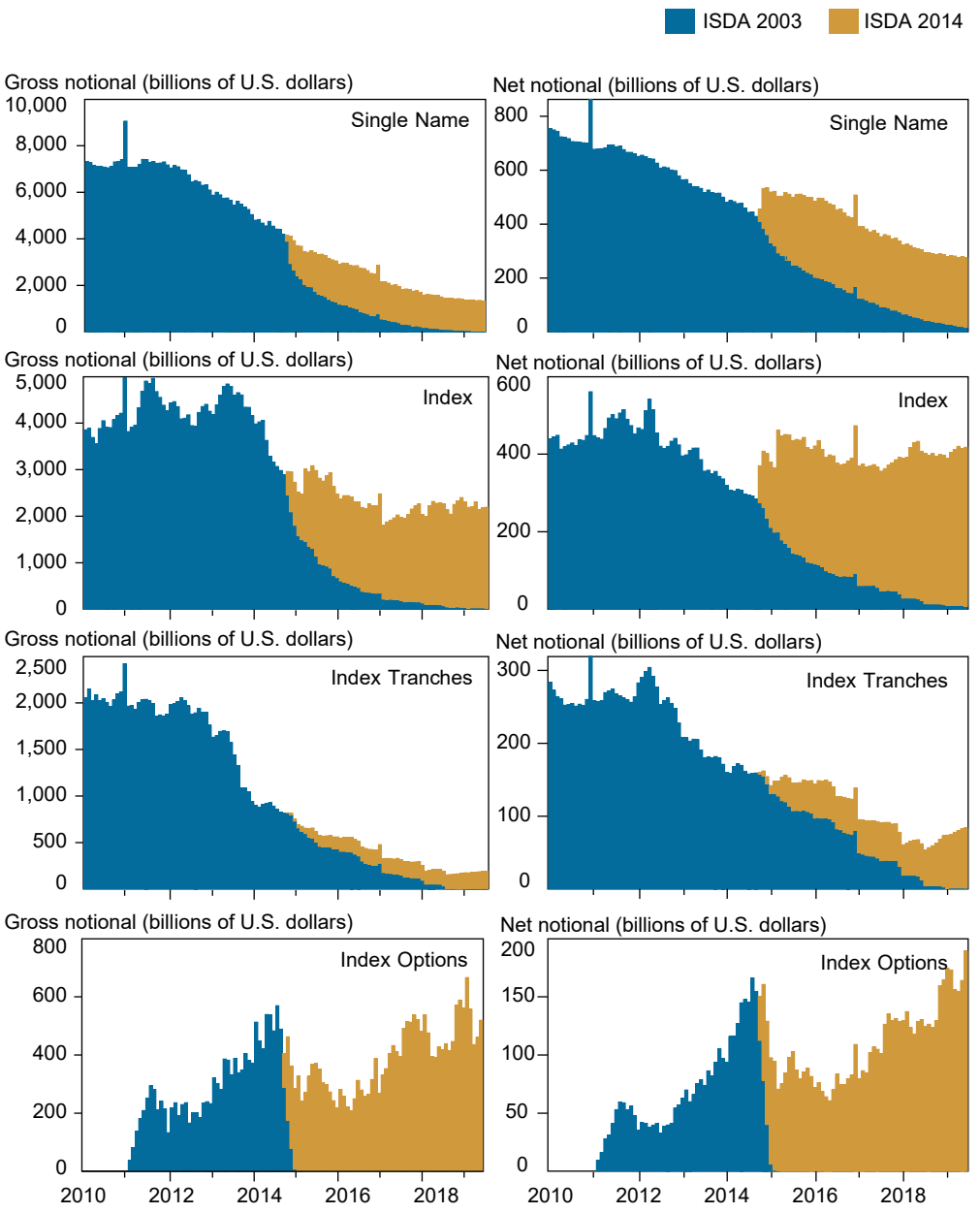


Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the monthly average gross notional of outstanding positions in the four contract types by clearing eligibility, determined as described in Appendix 1. The right column shows the monthly average net notional of new positions by clearing eligibility. For index tranches and index options, "eligible" corresponds to those written on clearing-eligible indexes. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Chart 7

Monthly Average Gross and Net Positions by ISDA Master Agreement



Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the monthly average gross notional of outstanding positions in the four contract types by ISDA master agreement. The right column shows the monthly average net notional of new positions in the four contract types by clearing eligibility. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection. ISDA is International Swaps and Derivatives Association.

Trading by credit rating

The distribution of credit ratings of the underlying reference entities is plotted in Chart 8. For both single-name and index products, the majority of new gross notional is investment grade. iTraxx Europe Crossover, the unrated category for index products, represents around 10 percent of new gross notional traded, and, interestingly, only includes index options, not index tranches. More generally, index tranche net notional is almost exclusively traded in the investment grade category, though tranche contracts written on high-yield indexes represent around 20 percent of new gross notional traded in the second half of our sample period.

For single-name reference entities, we break down the investment grade rating categories into AAA, (AA,A) and BBB. The top row of Chart 8 shows that around 40 percent of new gross notional is BBB, around 20 percent (AA,A), and a negligible amount is AAA. Contracts on BBB-rated reference entities also represent most new net notional exchanged. This ranking of CDS traded exposures according to reference entity credit rating corresponds to the relative amounts of debt outstanding in these categories. Most U.S. debt issuance since the financial crisis has been BBB, with only two AAA issuers remaining.[22]

Trading by maturity

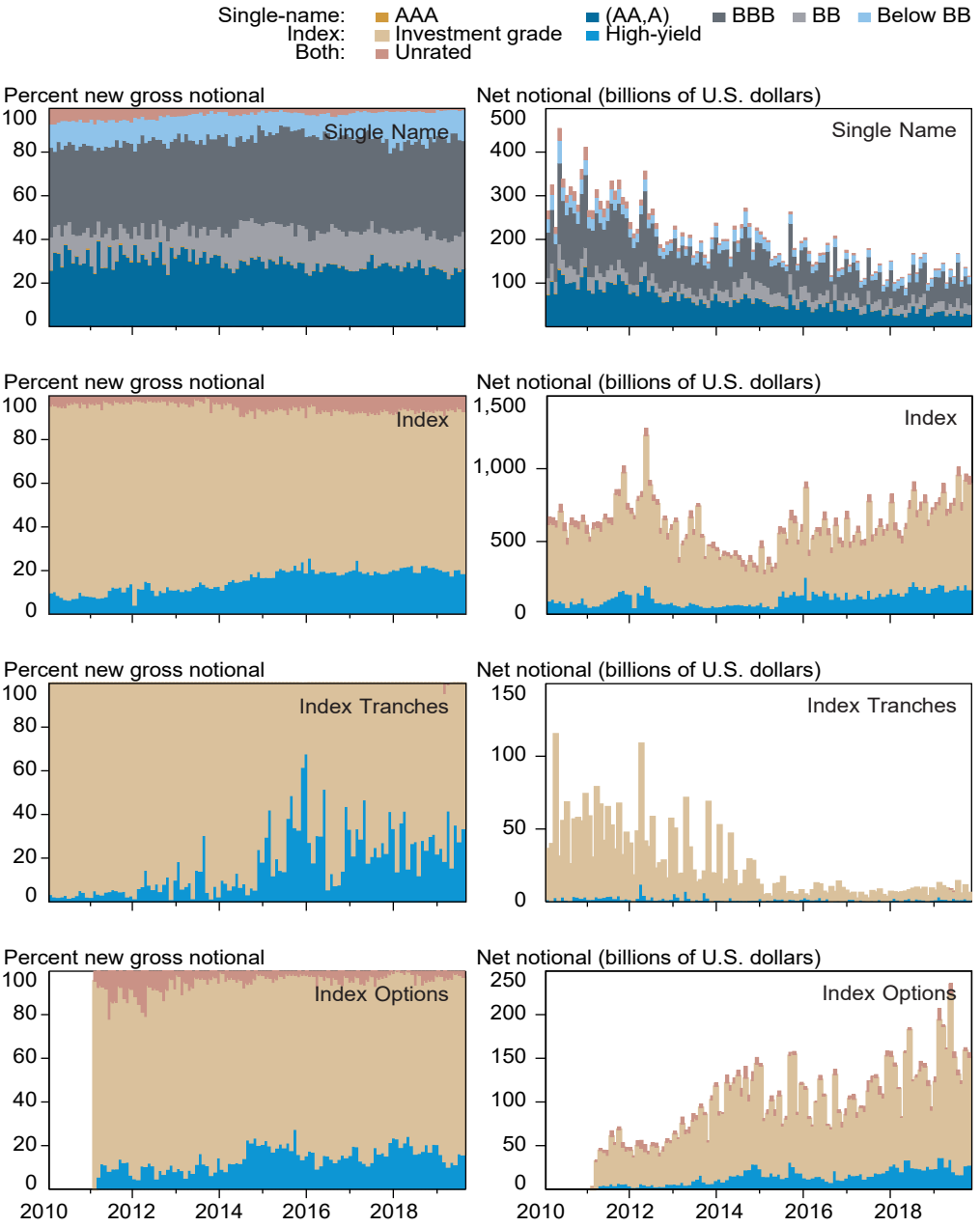
The distribution of new gross and net notional traded by initial contract maturity is plotted in Chart 9. Three striking features emerge. First, as noted earlier, index options have exclusively short maturities, probably reflecting the index contract's semiannual roll. In unreported results, we find that an overwhelming majority of index option contracts have initial maturities of less than six months. Second, while index and index tranche contracts are increasingly traded in five-year maturities, the distribution of initial maturities in the single-name market is less concentrated: 20–30 percent of gross notional is traded in the five-year category, around 60 percent in the one-to-five-year category, and a further 10–20 percent in the one-year-or-less maturity. Thus, a substantial fraction of single-name transactions have maturities of less than five years. Third, although index and index tranche contracts historically had as much as 15 percent of index-contract and 50 percent of index-tranche-contract gross notional traded in maturities of ten years and greater, such longer maturities were never prevalent in the single-name market. Thus, while market participants were willing to trade long-term exposures in index contracts, the single-name market has always been concentrated in intermediate maturities.

Trading by reference entity sector

Exposure by reference entity industry is plotted in Chart 10. Around 25 percent of new gross notional traded is written on manufacturers and around 20 percent on financial institutions, the two most prevalent industries. Contracts on energy companies have increased in share since January 2015, but still represent a negligible fraction of net notional traded.

Chart 8

Monthly Average Gross and Net Positions by Credit Rating

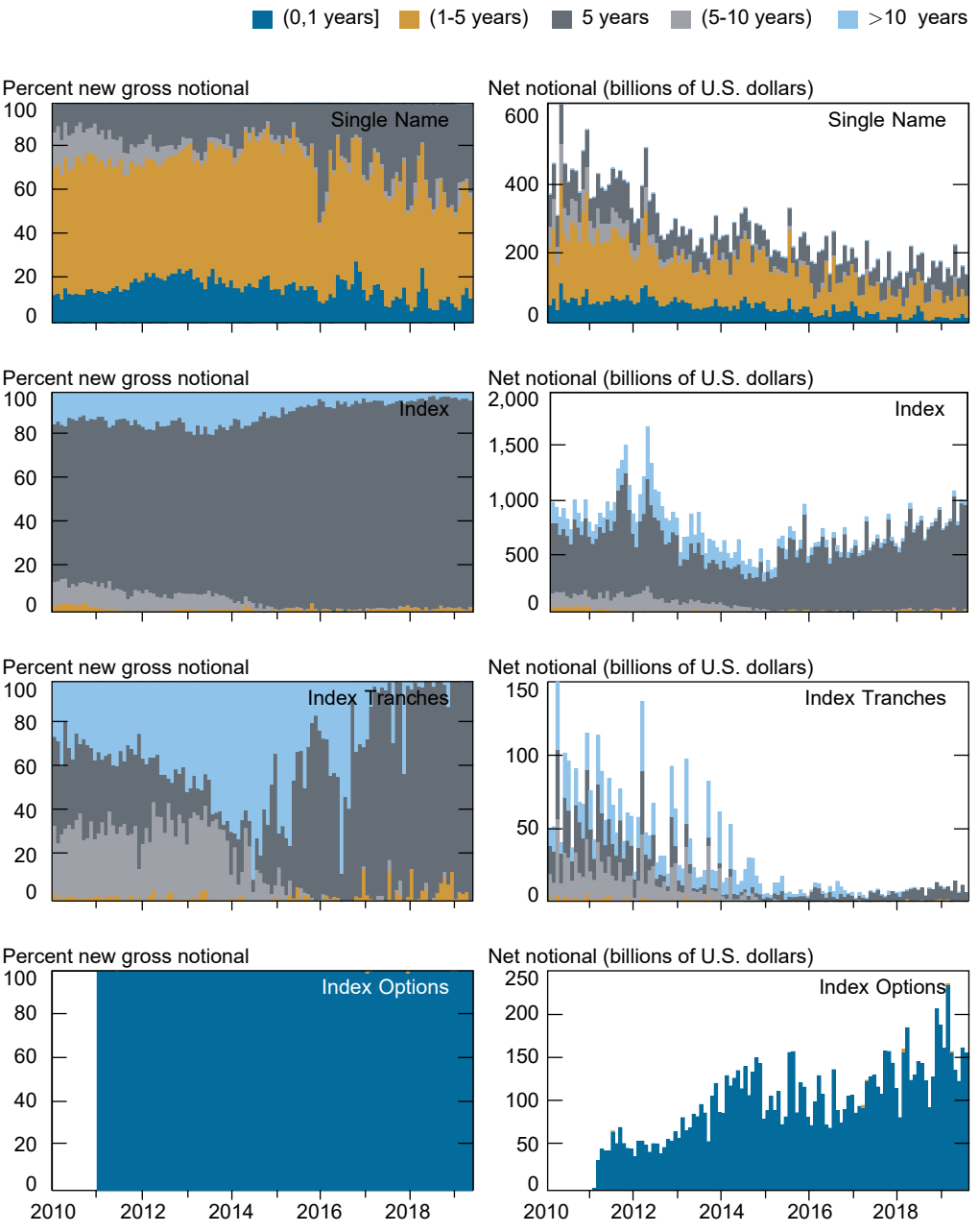


Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW); Markit (credit rating information).

Notes: The left column shows the percentage of monthly average gross notional of new positions in the four contract types by credit rating category. The right column shows the monthly average net notional of new positions in the four contract types by credit rating category. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Chart 9

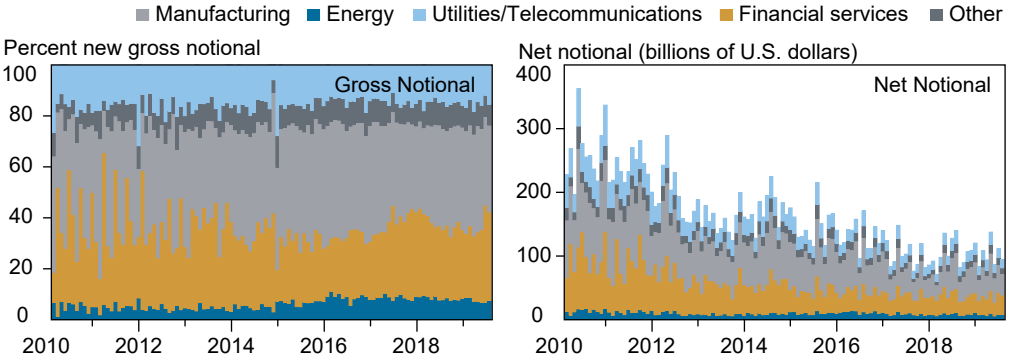
Monthly Average Gross and Net Positions by Initial Maturity



Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the percentage of monthly average gross notional of new positions in the four contract types across initial maturity buckets. The right column shows the monthly average net notional of new positions across initial maturity buckets. For index options, maturity is the maturity of the option, not the underlying index. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Chart 10
Monthly Average Gross and Net Positions by Sector



Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW); Markit (reference entity sector information).

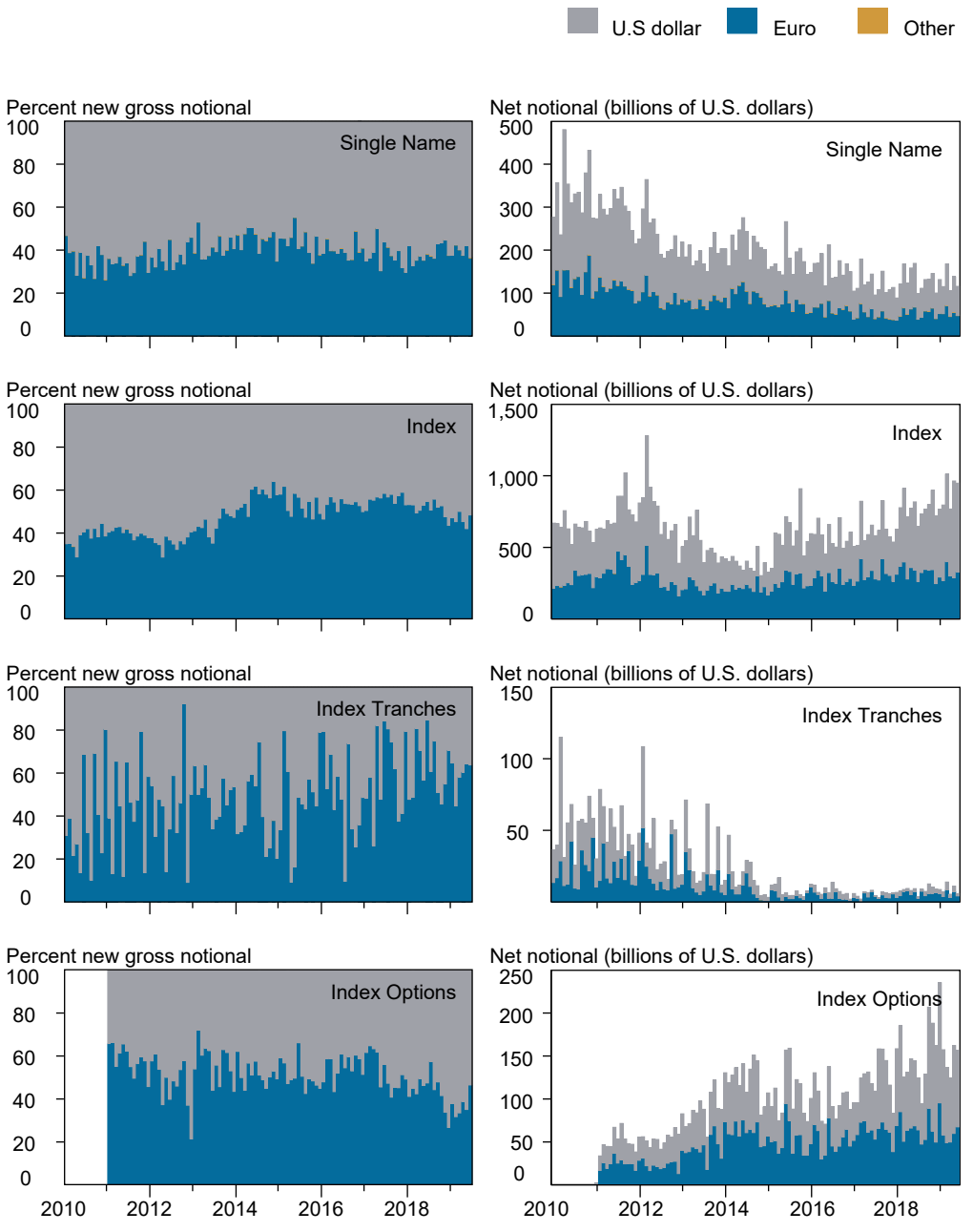
Notes: The left column shows the percentage of monthly average gross notional of new positions in single-name contracts by reference entity sector. The right column shows the monthly average net notional of new positions in single-name contracts by reference entity sector. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Trading by currency

Both new gross and net notionals in contracts on U.S. and European reference entities are split between contracts denominated in U.S. dollars and contracts denominated in euros, with very little notional exchanged in other currencies, as shown in Chart 11. Euro-denominated index contracts have slowly become more common, rising from around 30 percent of new gross notional traded in January 2010 to around 50 percent in June 2019. In contrast, the single-name market remains primarily denominated in U.S. dollars, creating a potential currency mismatch between the single-name and index markets.

Chart 11

Monthly Average Gross and Net Positions by Contract Currency



Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the percentage of monthly average gross notional of new positions in the four contract types by contract currency. The right column shows the monthly average net notional of new positions in the four contract types by contract currency. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

4. Conclusion

In the wake of the 2007–09 financial crisis, OTC markets have been a focus of regulatory reform. This article has examined the evolution of the CDS market in the current regulatory environment. We find that market participants have reacted quickly to changing circumstances. For example, the ISDA 2014 Master Agreement was adopted widely within six months of its introduction. Although central clearing of single-name CDS contracts is not mandatory in the United States, activity has been moving to products that are eligible for clearing. Reductions in the sectors of the market not eligible for clearing are almost exclusively driving the overall decrease in outstanding single-name contract gross notional.

Appendix 1: The DTCC Data

Market participants submit their trade records to the DTCC's Trade Reporting Repository (TIW) for operational purposes. The TIW holds the most current contract details on the official, or "gold," record for both cleared and bilateral CDS transactions. The DTCC estimates that it captures approximately 98 percent of all credit derivative transactions in the global marketplace. The DTCC's customer base includes all major global derivatives dealers and more than 2,500 buyside firms and other market participants located in over seventy countries.

Trade records are submitted by participants to the system. The quality of reporting varies across participants and time. We detail below the filters and data adjustments applied to the positions data to avoid biases in our empirical analyses.

Positions Data

We combine weekly snapshots of position data into a single data set. We then apply the following filters:

1. A single position is recorded from the point of view of each party. We remove duplicate records based on the transaction ID `(dtcc_reference_id)`, which is assigned by the DTCC upon submission, and the reporting date `(rpt_date_key)`.

   There are some records for which `rpt_date_key` is missing. When that is the case, we use the date in the file name, which corresponds to the date on which the data were captured.

2. We backfill RED code `(red_id)`. RED codes are alphanumeric codes assigned to reference entities and reference obligations, and are used to confirm trades on trade matching and clearing platforms.

3. We use the RED code to backfill key variables related to the reference entity: reference entity location `(reference_entity_jurisdiction)` and reference entity sector `(reference_entity_sector)`.

4. We use RED codes to backfill locations of the counterparties (`counterparty_settlement_location`).

5. We keep records where `transaction_status = Certain`.

6. We keep records where `reference_entity_type` $\in$ `{CORP, INDEX, missing}` and exclude records where `reference_entity_type` $\in$ `{CMBS, ECMBS, ELCDS, ERMBS, MUNI, Other, RMBS, SOV, STATBODY, STATE, SUPRA}`.

Appendix 1: The DTCC Data (Continued)

7. We create a variable called `prod_type` based on the values of two variables, `product_type` and `subproduct_type`, as follows:

prod_type	product_type	subproduct_type
Single name	CreditDefaultSwapShort	(missing)
Index	CreditDefaultSwapIndex	(missing)
Index option	CreditDefaultSwapIndex	('OPTION', 'SWAPTION')
Index tranche	CreditDefaultSwapIndexTranche	(missing)

8. The notional values in the positions data set as delivered by the DTCC are scaled down by a factor of 100 from January 2011 through April 2016. We multiply these values by 100.[23]

After the initial cleaning of the data, we apply the following conditions to construct the samples of outstanding and new positions used for Charts 3-11 in the main text of this article:

1. Exclude reference entities located outside of U.S. and advanced European economies.[24]
2. Exclude the following indexes: MBX, MCDX, LCDX, IOS, PO, ABX, IBOXX COCO, and IBOXX LOANS.
3. The location of a party is determined based on the reported settlement location rather than registered office, because the registered office data are far sparser; however, both contain almost the same information when both exist. The settlement location field (as well as the registered office field) is at the account level. Therefore, there are cases where a party with multiple accounts is associated with multiple locations in the same week. For such cases, we keep the location of the party as the location of the account through which the greatest notional amount is traded in that week.
4. The rating of a reference entity is assigned based on the rating at the reporting date rather than the rating at origination.
    a. Ratings for single-name positions are obtained from Markit's composites by convention data set. While the positions are at a weekly frequency, the rating data are at a daily frequency. We take the latest available rating from Markit in a given week as the rating for the reference entity for that week. If the rating in Markit is missing for the week of the trade date, we use the latest available rating within the month prior to the trade date.
    b. Ratings for index, index option, and index tranche products are assigned based on the name of the product. CDX.NA.IG is considered investment grade and CDX.NA.HY is considered high yield. Among regional iTraxx indexes, the Europe Series, Senior Financial, and Asia Ex-Japan are considered investment grade. The European Crossover is considered high yield.

Appendix 1: The DTCC Data (Continued)

5. The clearing indicator is constructed from an amalgamation of three sources: ICE, CCP trades in the DTCC, and the mandatory clearing dates for indexes. For each RED code, the reference entity is considered eligible for clearing starting on the first trade date identified across the three sources. The first source is the list of clearable instruments published by ICE. For single-name contracts not required for clearing, ICE reports the date included for clearing for each reference entity (red6). ICE clears single-name contracts conditioned on a specific ISDA definition, tenor, and tier. ICE also reports clearing eligibility for indexes and sovereigns. CDX and iTraxx indexes for which we do not find information through ICE are given a clearing date of April 26, 2013, the date of mandatory clearing for Category 1 indexes.[25] The iBoxx index family is never cleared. Lastly, we consider the earliest trade date at which one of the transacting parties is a CCP as a possible candidate for the clearing date dummy for a specific reference entity.
6. The splits by location of counterparty, documentation ID, participant type, clearing indicator, and reference entity location are performed on existing positions. The remaining splits are performed on new trades only. The new trade data set is generated by taking the cleaned positions data set and removing duplicate transaction identifiers based on trade date.

Appendix 2: Risk-Adjusted Positions

All splits are filtered based on the split sample variable and exclude missing split variables. The exceptions are for the split by rating, where we include missing as its own category (*Unrated* category), and for the split by reference entity sector (*Other* category).

In this appendix, we study the properties of risky duration-adjusted positions. More specifically, for each position of participant p in reference entity i at date t with time to maturity τ, we follow He et al. (2017) and compute the approximate risky duration of the position as

$$RD_{p,i,\tau,t} = \frac{1}{4}\sum_{j=1}^{4\tau_{p,i,t\tau,t}} e - \frac{j\left(\lambda_{it} + r_t^{j/4}\right)}{4},$$

where $r_t^{j/4}$ the risk-free yield on a Treasury maturing in $j/4$ years, and λ_{it} is the default hazard rate implied by the quoted (Markit) five-year spread on reference entity i, date t

$$\lambda_{it} = 4\log\left(1 + \frac{\text{Markit spread}_{it}}{4L_{it}}\right),$$

with L_{it} the priced loss-given-default for reference entity i on date t. The risk-adjusted gross and net notional for reference entity i on date t are then given by

$$\text{Risk-adjusted gross notional}_{it} = \sum_{p,\tau} RD_{p,i,\tau,t}\text{Notional bought}_{p,i,\tau,t}$$

$$\text{Risk-adjusted net notional}_{it} = \sum_{p}\left(\sum_{\tau} RD_{p,i,\tau,t}\text{Net position}_{p,i,\tau t}\right)1\left(\sum_{\tau}\text{Net position}_{p,i,\tau,t} > 0\right).$$

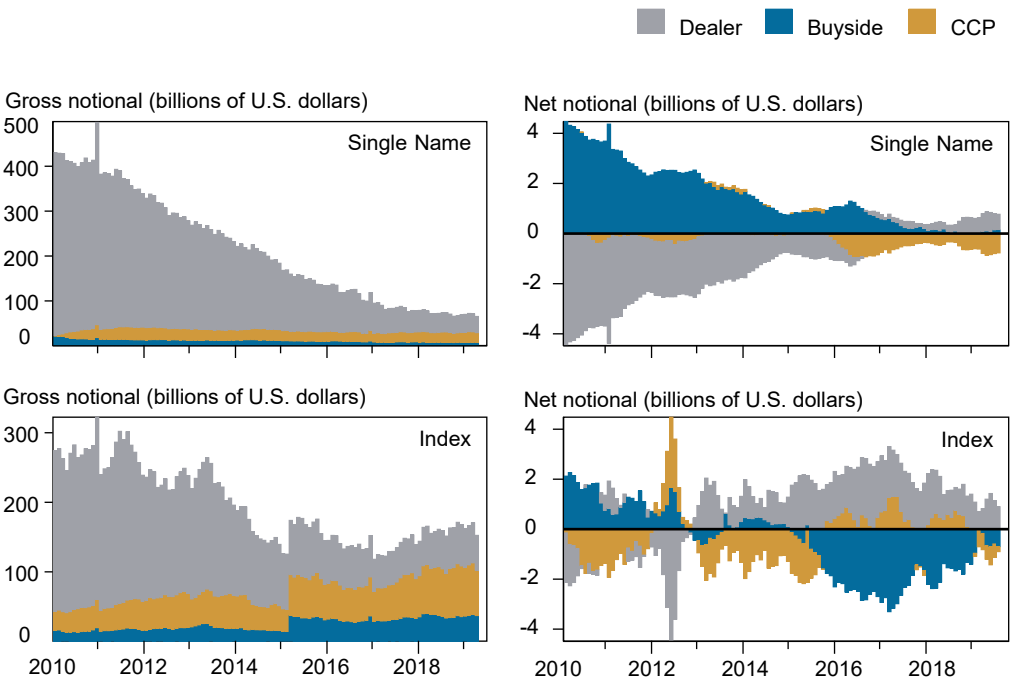
One caveat for this procedure is that it requires a match to a Markit quote on a five-year CDS contract on reference entity i on date t. We can compute the risky duration of the majority of positions in single-name and index contracts throughout our sample.

Appendix Charts 2A–2E plot monthly average duration-weighted gross and net notional of outstanding positions by counterparty type, counterparty location, on-the-run index membership, clearing eligibility, and master agreement type. Qualitatively, the results in Appnedix Charts 2A–2E are similar to the unweighted gross and net notional of outstanding positions plotted in Charts 1–5 of this article, with the only exceptions the net notional traded by participant type in the index market and the net notional traded by counterparty location in the single-name and index markets. On a duration-adjusted basis, dealers become buyers of protection in the index market in the second half of 2012, about two years earlier than on an unadjusted basis. Appendix Chart 2B further shows that, on a duration-adjusted basis, U.S. counterparties are buyers of protection from the rest of the world in both the single-name and the index market starting in the second half of 2015, while, on an unadjusted basis, U.S. counterparties have close to zero net positions throughout this period.

Appendix 2: Risk-Adjusted Positions (Continued)

Chart 2A

Duration-Adjusted Monthly Average Gross and Net Positions by Participant Type



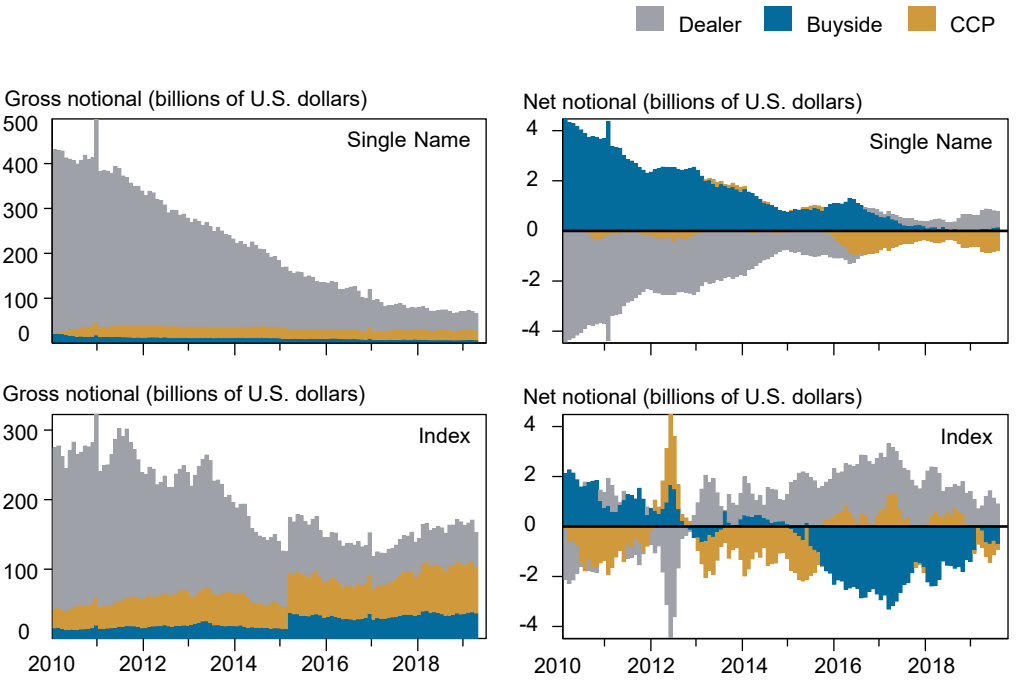
Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the duration-adjusted monthly average gross notional of outstanding positions in single-name and index contracts of different participant types. The right column shows the duration-adjusted monthly average net notional of positions in single-name and index contracts of different participant types. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection. CCP is central counterparty.

Appendix 2: Risk-Adjusted Positions (Continued)

Chart 2B

Duration-Adjusted Monthly Average Gross and Net Positions by Location of Counterparty



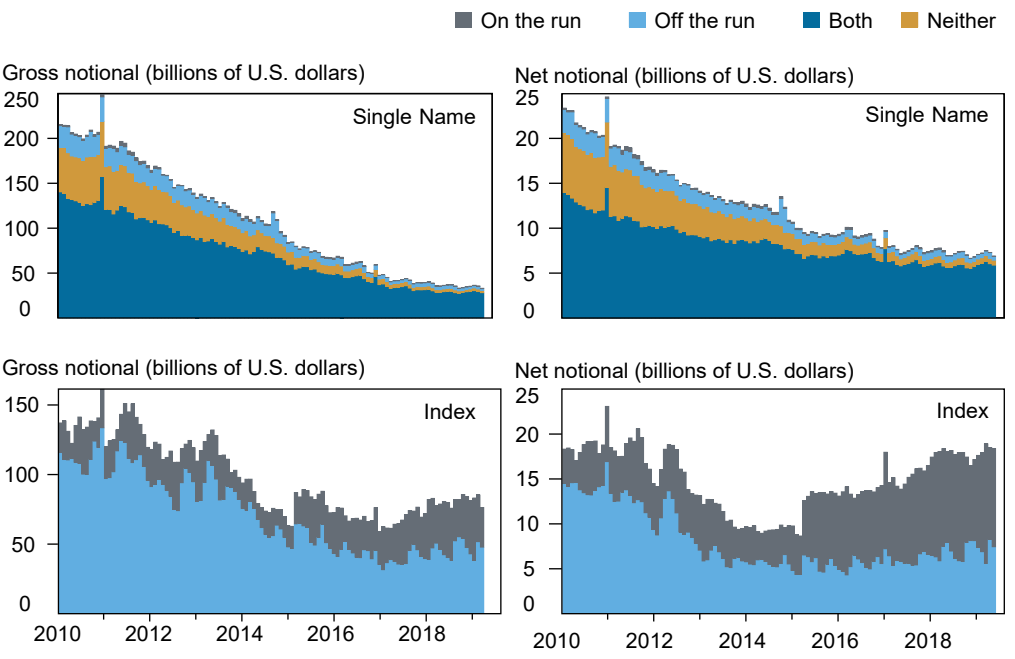
Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the duration-adjusted monthly average gross notional of outstanding positions in single-name and index contracts by location of the counterparty to the contract. The right column shows the duration-adjusted monthly average net notional of new positions in single-name and index contracts by counterparty location. "Home" refers to counterparties domiciled in the same jurisdiction. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Appendix 2: Risk-Adjusted Positions (Continued)

Chart 2C

Duration-Adjusted Monthly Average Gross and Net Positions by Type of Index



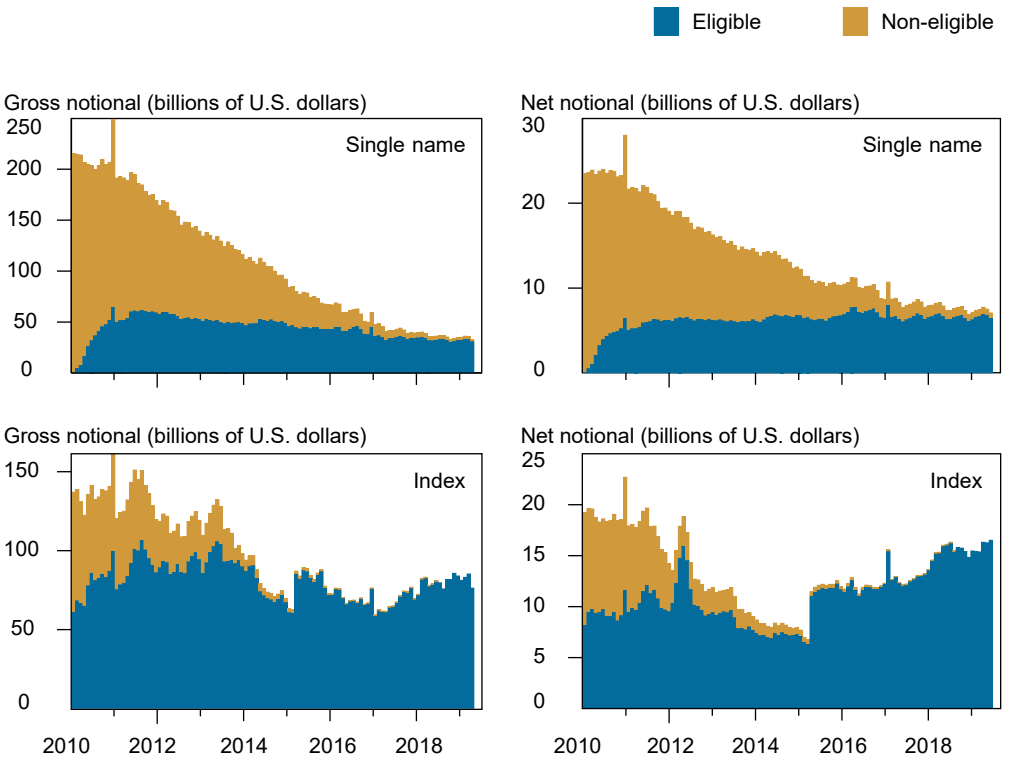
Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the duration-adjusted monthly average gross notional of outstanding positions in single-name and index contracts by type of index. The right column shows the duration-adjusted monthly average net notional of new positions in single-name and index contracts by type of index. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Appendix 2: Risk-Adjusted Positions (Continued)

Chart 2D

Duration-Adjusted Monthly Average Gross and Net Positions by Clearing Eligibility



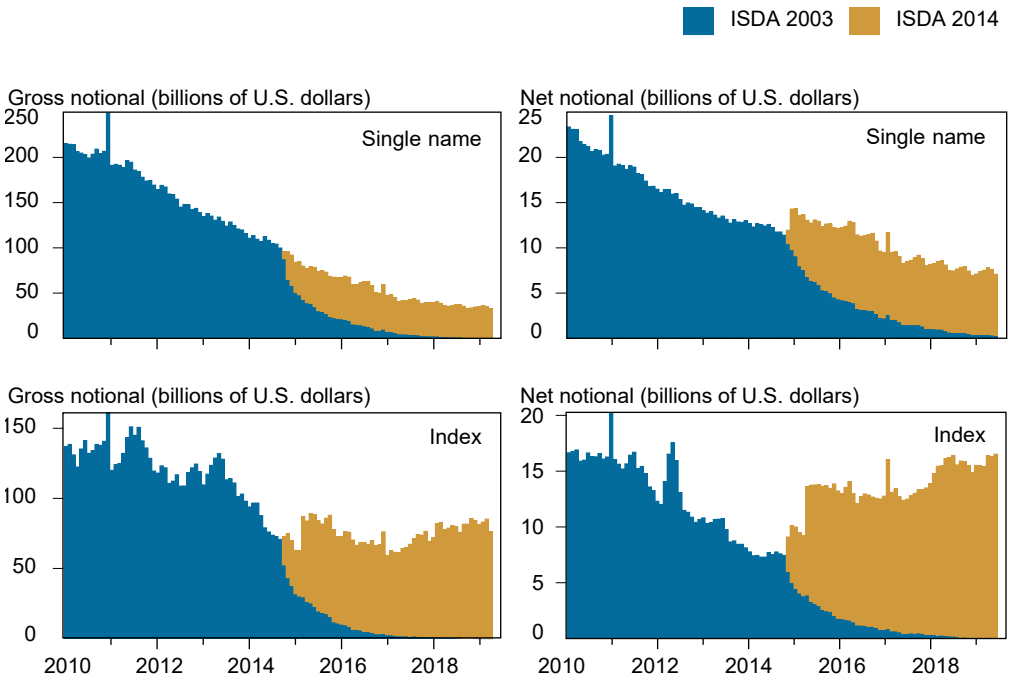
Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the duration-adjusted monthly average gross notional of outstanding positions in single-name and index contracts by clearing eligibility, determined as described in Appendix 1. The right column shows the duration-adjusted monthly average net notional of new positions in single-name and index contracts by clearing eligibility. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Appendix 2: Risk-Adjusted Positions (Continued)

Chart 2E

Duration-Adjusted Monthly Average Gross and Net Positions by ISDA Master Agreement



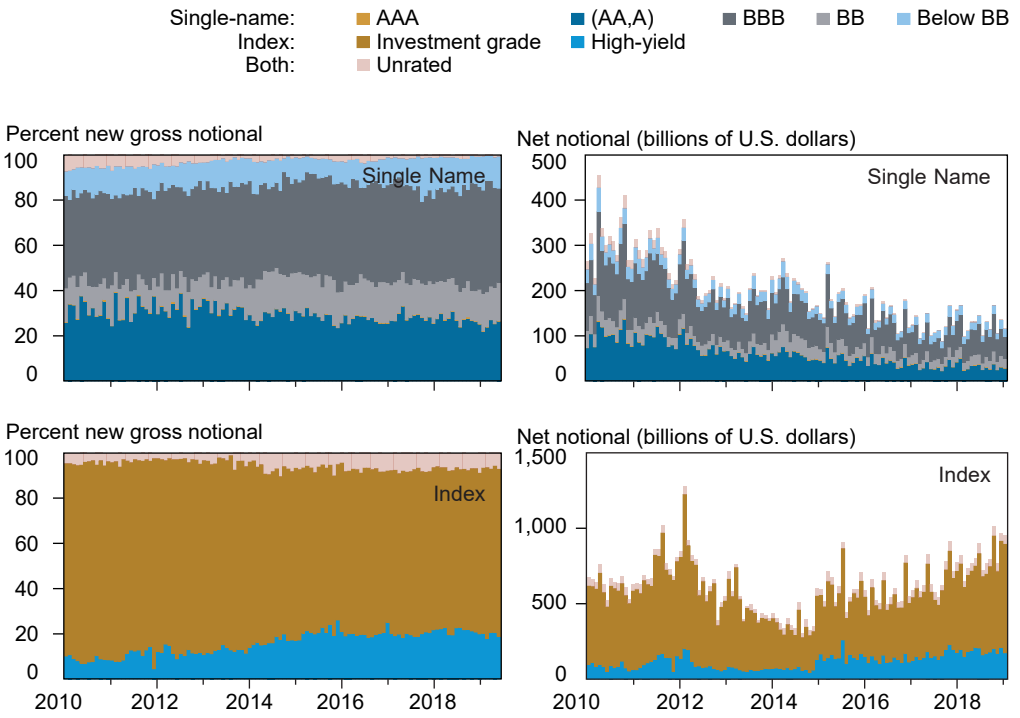
Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the duration-adjusted monthly average gross notional of outstanding positions in single-name and index contracts by ISDA master agreement. The right column shows the duration-adjusted monthly average net notional of new positions in single-name and index contracts by ISDA master agreement. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Appendix 2: Risk-Adjusted Positions (Continued)

Chart 2F

Duration-Adjusted Monthly Average Gross and Net Positions by Credit Rating



Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW); Markit (credit rating information).

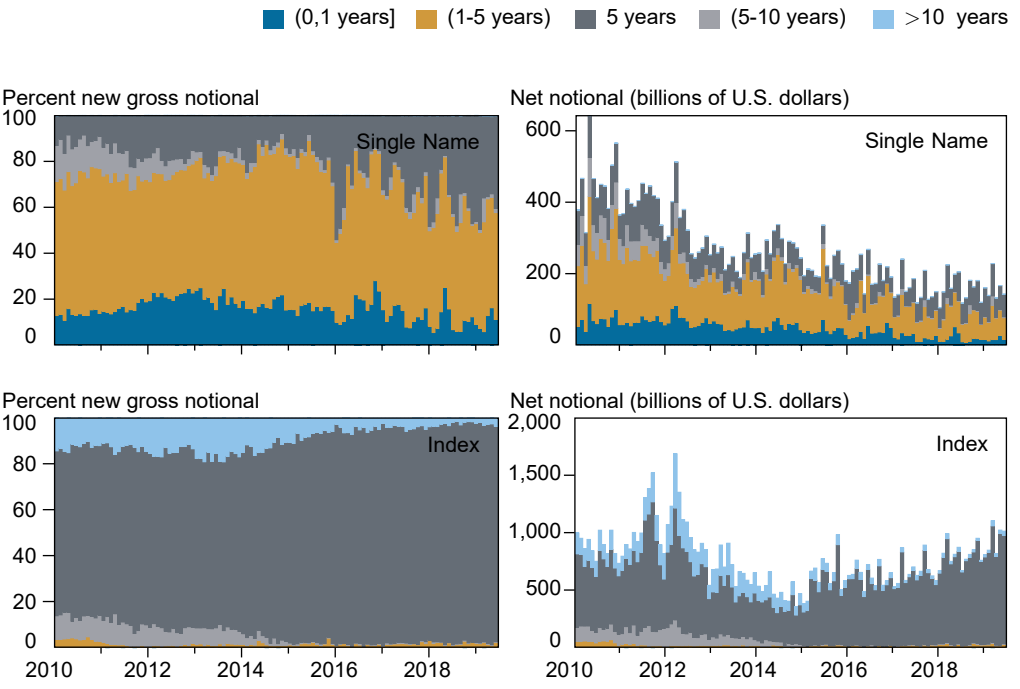
Notes: The left column shows the percentage of duration-adjusted monthly average gross notional of new positions in single-name and index contracts for different credit rating categories. The right column shows the duration-adjusted monthly average net notional of new positions in single-name and index contracts for different credit rating categories. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Charts 2F-2I plot the duration-weighted net notional of new positions by credit rating of the underlying reference entity, initial maturity of the contract, reference entity sector, and currency of the contract, together with the duration-weighted percent of new gross notional amounts traded represented by each category. For new positions, the duration-adjusted positions are similar across the board to the unadjusted positions.

Appendix 2: Risk-Adjusted Positions (Continued)

Chart 2G

Duration-Adjusted Monthly Average Gross and Net Positions by Initial Maturity



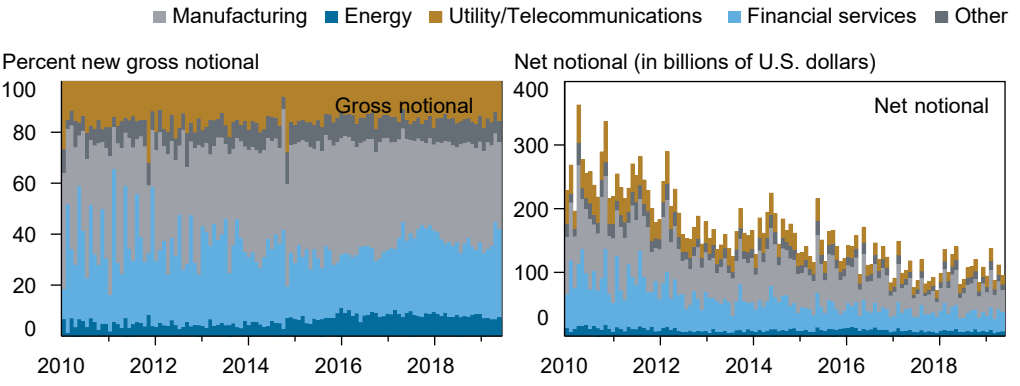
Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the percentage of duration-adjusted monthly average gross notional of new positions in single-name and index contracts across initial maturity buckets. The right column shows the duration-adjusted monthly average net notional of new positions in single-name and index contracts across initial maturity buckets. For index options, maturity is the maturity of the option, not the underlying index. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Appendix 2: Risk-Adjusted Positions (Continued)

Chart 2H

Duration-Adjusted Monthly Average Gross and Net Positions by Sector



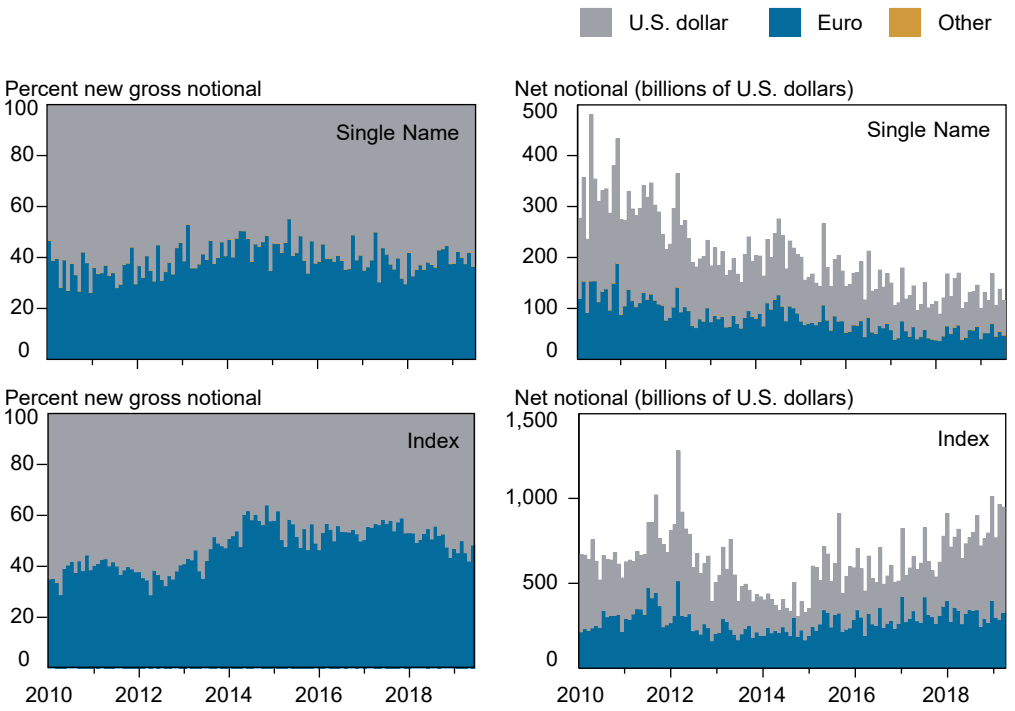
Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW); Markit (reference entity sector information).

Notes: The left panel shows the percentage of duration-adjusted monthly average gross notional of new positions in single-name contracts by reference entity sector. The right panel shows the duration-adjusted monthly average net notional of new positions in single-name contracts by reference entity sector. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Appendix 2: Risk-Adjusted Positions (Continued)

Chart 2I

Duration-Adjusted Monthly Average Gross and Net Positions by Contract Currency



Sources: Depository Trust and Clearing Corporation (DTCC); DTCC's Trade Information Warehouse (TIW).

Notes: The left column shows the percentage of duration-adjusted monthly average gross notional of new positions in single-name and index contracts by contract currency. The right column shows the duration-adjusted monthly average net notional of new positions in single-name and index contracts by contract currency. Notionals are measured in U.S. dollar billion equivalents; positive net notional indicates net buying of protection.

Notes

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[1] Additional changes to the regulatory environment not discussed here include changes to capital charges for derivative positions; the introduction of liquidity requirements, which are also affected by the amount of derivative positions an institution holds; and the introduction of the Volcker Rule, which restricts banks from participating in proprietary trading and owning or investing in hedge funds and private equity funds.

[2] DTCC estimates that the TIW covers about 98 percent of globally traded CDS.

[3] The coverage of index tranche trades between dealers and customers has declined to about 75 percent at the end of 2018. This suggests that customers have shifted their activity to institutions not regulated by the Federal Reserve. Our results pertaining to index tranche contracts are robust to this coverage decline.

[4] See http://www.creditfixings.com to view auction results.

[5] For a detailed discussion of the auction mechanism and its efficiency, see Helwege et al. (2009), Gupta and Sundaram (2015), Chernov et al. (2013), and Du and Zhu (2017).

[6] See the ISDA SwapsInfo website at http://swapsinfo.org.

[7] For example, as we discuss next, index tranches were a popular product. The attachment and detachment points—that is, the range of percentage losses on reference entities the tranche absorbs—of the new version of the index tranches can only be determined when the auction results are finalized.

[8] For an analysis of the effects on the single-name CDS spreads of entering and exiting the index, see Bai and Shachar (2015).

[9] For comparison, while there is no periodic adjustment of the S&P 500, changes are made when needed, including removal of a company from the index when it violates one or more inclusion criteria or when it is involved in a bankruptcy, merger, takeover, or other significant corporate restructuring. As a consequence, 25–50 index replacements take place every year, which represents a 5–10 percent turnover of the index composition.

[10] Markit creates a "Liquidity List" after each publication of the "6 month Analysis Top 1,000 Single Names" report by DTCC. The list is used to determine roll exclusions and inclusions.

[11] For current index rules for CDX.NA.IG, CDX.NA.HY, and iTraxx, see Markit's website.

[12] The rapid growth of the CDS market in the early 2000s was reflected not only in the enormous levels of gross notional amount outstanding, but also in an operational backlog. In response, the CDS contract and its trading conventions were changed in April 2009 as part of the Big Bang Protocol in order to create a more standardized contract. Standardization streamlines netting across trades and facilitates centralized clearing.

[13] The emerging market CDS index, 12 CDX.EM, has semiannual payments.

[14] For further details, see Acharya et al. (2010).

[15] That is, bilateral positions between non-CCP market participants.

Notes (Continued)

[16] For a comprehensive review of the literature, see Augustin et al. (2014).

[17] Comparing the gross notional of contracts reported by the DTCC and the gross notional of contracts that banks and dealers voluntarily reported in a Bank for International Settlements (BIS) survey, ECB (2009) concludes that while the DTCC covers 98 percent of CDS contracts involving a dealer, it captures only 29 percent of contracts reported to the BIS that do not involve a dealer.

[18] See BIS (2013) for a consultative report on authorities' access to centralized trade repository data.

[19] An index type (for example, CDX.NA.IG) is counted as a single reference entity, regardless of the series and version.

[20] The TIW also reports the number of contracts and gross notional for customer-to-customer and customer-to-CCP trades. Since the supervisory DTCC data do not cover these trades, we omit them from Chart 2.

[21] This represents, however, 45 percent of the gross notional of index contracts exchanged between a dealer and a CCP.

[22] As of July 2018, the total of BBB-rated corporate bonds outstanding was $2.56 trillion, bonds rated higher than BBB totaled $2.55 trillion, and high-yield bonds totaled $1.21 trillion. Source: Bloomberg Opinion, "The Corporate Bond Market is Getting Junkier," July 10, 2018, https://www.bloomberg.com/opinion/articles/2018-07-10/corporate-bonds-are-getting-junkier.

[23] We confirmed with the DTCC that this factor should indeed be taken into account. We do not know, however, whether this data issue affects other regulatory agencies using these historical data.

[24] Advanced European economies include Austria, Belgium, Denmark, England and Wales, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Scotland, and the United Kingdom.

[25] See https://www.cftc.gov/PressRoom/PressReleases/pr6607-13.

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