The Impact of Margin Requirements on Voluntary Clearing Decisions*

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ABSTRACT

We analyze the determinants of financial entities' choices of whether to voluntarily designate trades for central clearing. In particular, we evaluate the impact of the Uncleared Margin Rule (UMR) on the trading and clearing decisions of firms transacting in the multi-trillion-dollar cash-settled foreign exchange swap markets. The UMR is a multi-jurisdiction rule that requires certain market participants to exchange collateral (margin) for uncleared transactions between themselves. We specifically study the effect of this rule for non-deliverable forwards (NDF) since similar contracts – FX deliverable forwards and swaps - are exempt from the rule in the U.S. and hence constitute a useful control group. In a difference-in-differences setting, we find that compared to FX forwards and swaps, the UMR resulted in firms choosing to clear a higher percentage of their swaps in the NDF market. To understand the forces behind firms' clearing decisions, we make use of a regulatory data set that includes the identities of the parties to each swap. We show that increased clearing is due almost exclusively to the actions of clearing members, suggesting that the differential cost of clearing for these entities plays a major role in clearing decisions. Consistent with theory, we find the ability to net swap exposure at the central clearing party is one of the drivers behind the decision to clear.

JEL classification: G18, G15

Keywords: Uncleared Margin Rule, NDF, CCP, clearing

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I. Introduction

For many over the counter (OTC) financial products, whether to designate a trade for clearing is a choice made by the trading parties. When a trade is designated for clearing to a central clearinghouse (which is also the central clearing counterparty, or CCP), the initial trade is novated and the CCP becomes the legal counterparty to each trader, rather than their initial counterparty (Menkveld and Vuillemey (2020)). Hence, clearing changes who bears the risk of trader default (Acharya and Bisin (2014)). Another aspect of clearing discussed in the literature is its impact on the amount of collateral (known as margin in the derivatives context) a trader needs to post when she makes a trade (Duffie and Zhu (2011); Cont and Kokholm (2014);Ghamami and Glasserman (2017)). The key aspect of how mandatory central clearing affects margins depends on how central clearing affects traders' abilities to "net" their positions across trades that were initially made with different counterparties. To see the basic logic of how margins can be affected by central clearing, suppose Trader A has a long dollar position in dollar/euro swaps with Trader B and a short dollar position in dollar/euro swaps with Trader C. If neither trade is cleared, then margins for each trade will be set as if the other trade had not occurred. In contrast, if both trades are novated to a clearinghouse, then Trader A's required margin with the clearinghouse will depend on the net of its positions across the two trades, and will generally be lower than the margin required of the two trades evaluated independently.[1]

As noted above, there are many financial instruments for which clearing is optional. There is a growing literature analyzing the impact of mandatory clearing on financial markets (Loon and Zhong (2016); Menkveld, Pagnotta and Zoican (2016)), and the

[1] As discussed below, in Duffie and Zhu (2011), the total effect of mandatory clearing on netting is also affected by cross-product netting effects, which may result in central clearing causing a reduction in netting.

impact of voluntary clearing on financial markets (Loon and Zhong (2014); Bellia et al. (2019)). We look at an intermediate case, examining the impact of a change in the relative cost of clearing on traders' voluntary decisions to centrally clear. We take advantage of a change in margin regulation, and a detailed regulatory data set with traders' identifiers, to study how differences in the benefit to clearing affect the choice of whether to clear each individual trade. Specifically, in 2016, the uncleared margin rule (UMR) went into effect, changing the calculus of some traders in deciding whether to clear certain trades. The regulation mandates that market participants who are covered by the rule are required to provide margin for their uncleared swaps. Prior to the rule, traders were free to choose the margin level for their uncleared swaps, and some traders chose zero margin for their trades. As such, the rule increases the cost of using uncleared swaps in some cases, and thereby creates an incentive for these participants to choose central clearing for some of their swaps. We study the clearing and trading decisions of market participants in a specific swap market, the non-deliverable forward (NDF) market.

Consistent with our expectation, we find an increase in clearing rates in our sample after the rule's initial implementation. We observe this increase both as an absolute measure, and also in comparison to changes in clearing rates in the FX forward market (our control group). Moreover, the identities of the entities who choose to clear their swaps are consistent with the premise that the UMR was the driving force behind those higher clearing rates. Specifically, the initial implementation of the rule was limited to the largest entities, and the aggregate change in clearing was driven by changes made by these implicated (covered) large entities.

It is important to note that the UMR is not a clearing mandate for NDF swaps. Rather, it increases the incentives of covered entities to clear, since the margins required for uncleared swaps are generally higher than for cleared margins (Roberson (2018)),

and (potentially at least) there may be netting advantages. At the same time, we find that these entities did not clear a majority of their swaps, which is consistent with the literature that suggests clearing may not always be optimal (Duffie and Zhu (2011); Antinolfi, Carapella and Carli (2018)). Even for trades between two covered entities, slightly under 50% of swaps are cleared. We explore the motivation for clearing by examining which covered entities choose to clear, and which swaps are more likely to be cleared. We show that the decision to clear is associated with 1) whether an entity had already made the capital investments required to become a clearing member (CM), including the "infrastructure" required in order to be able to clear, and 2) the marginal benefit a trader gets from clearing in the form of netting of its swap position. In regard to the first point, not only do we find that CM are more likely to clear than other entities, but it also appears that the UMR has induced some entities to become CMs. In regard to the second point, consistent with the netting benefits of centrally clearing a swap, our analysis points to about a 10 percent increase in the probability of a trade being cleared when the direction of the trade helps both traders reduce their net exposure at the CCP.

The implications of our analysis extend well beyond the effect of the UMR on the NDF market.[2] While our analysis of the NDF market is primarily due to data availability and presence of a viable control group, our findings regarding the incentives to clear can be extrapolated to other classes of derivatives for which clearing is optional, namely the interest rate, credit, equity, foreign exchange and commodity asset classes of swaps. The uncleared portion of all classes of derivatives comprises more than one-third of all swaps in the U.S., with a total outstanding notional amount of more than $100 trillion.[3]

[2]See CCP12 (2019) for evidence on increased clearing in other assets classes associated with the implementation of the UMR.

[3]https://www.cftc.gov/MarketReports/SwapsReports/L1GrossExpCS.html accessed on November 10, 2020.

The rest of the paper is as follows. Section II describes some relevant features of NDF trading, and provides details on the UMR. Section III summarizes related literature. Section IV describes our data and presents descriptive statistics. Section V presents results on which market participants choose to clear and why. Section VI concludes.

II. Institutional Background

NDFs are contracts for the difference between a foreign exchange rate agreed upon in the contract (typically the spot exchange rate when the contract is initiated) and the actual spot rate at maturity. They are typically settled with a single payment at maturity in US dollars from one party to the other. They allow hedging and speculation in a currency without the requirement to exchange that currency at maturity. This is particularly useful when there are restrictions that prevent direct payment in the non-dollar currency (Lipscomb (2005)). For NDF trading in the US, almost all trades have the US dollar as one of the two currencies. Central clearing was available for 14 of the most-heavily traded NDF currency pairs during our sample period, all of which had the US dollar as on one side.

For many derivatives, including swap contract such as NDFs, margins are essentially collateral that is posted by traders (typically to third-party depositories) when trades are initiated. Margins help to ensure that both parties to the trade meet their obligations and potentially mitigate the loss should one party not meet its obligation.[4]

In the US, prior to September, 2016, for swaps that were not novated to a clearinghouse, the trading parties were free to choose the terms of their swaps, including not posting margin at all. As part of the regulatory framework associated with the Dodd-Frank Act, the Commodity Futures Trading Commission (CFTC), along with US

[4]These contracts typically feature an initial collateral payment (initial margin), and on-going payments to maintain the original collateral as prices move (variation margin).

Prudential Regulators (such as the Federal Reserve Board), established rules mandating the posting of margins for all uncleared swaps for large entities.[5] Other G-20 countries imposed similar requirements that took effect in the same general time period.[6] The margin for uncleared swaps rule applies to swaps of all varieties in the US, except for the FX swaps and forwards that were explicitly exempted from the swap definition by the U.S. Treasury Department.

At the time of the preparation of this manuscript, the rule is still being phased in, with smaller entities being implicated over time. During the initial phase, which came into effect on September 1st, 2016, an entity was covered by the rule if it was part of a parent company (which we refer to as Covered Parent Companies - CPCs) whose daily average notional uncleared derivatives positions were more than $3 trillion. Any new swap for which both counterparties are Phase 1 entities is covered by the rule.[7] Subsequent phases reduced the $3 trillion notional threshold for determining which CPCs are required to post margin on their uncleared swaps. For example, during Phase 2, trades between two entities, each of whom was part of a CPC that had more than $2.25 trillion in notional uncleared derivative positions, became covered and therefore subject to mandatory margin on uncleared swaps.

Posting this collateral is costly for trading participants, in that there is an opportunity cost to the traders in tying up assets in this form. As a practical matter, prior to the UMR, it was fairly common for swap dealers to post zero margin on their uncleared trades. The rule provides a framework for calculating margins for uncleared swaps. As a

[5] 17 CFR Parts 23 and 140 Margin Requirements for Uncleared Swaps for Swap Dealers and Major Swap Participants; Final Rule (Jan. 2, 2016). 81 FR 635

[6] See https://av.sc.com/corp-en/content/docs/margin-reform-client-outreach.pdf.

[7] Specifically Phase 1 entities are those for whom the aggregate notional amount of derivatives (AANA) for all entities within the same parent company averaged over a three month period in spring of 2016 exceeded $3 trillion. Margin is required for any trade between two Phase 1 entities for which at least one entity is a swap dealer, and neither entity is an end-user (commercial entity) or other exempted entity.

result, the rule effectively imposes a requirement of a minimum margin on all uncleared swap positions when both traders were sufficiently large to be covered by the rule.

For this reason, the UMR raised the cost of trading some uncleared swaps.[8] Since the rule has no effect on the cost of trading cleared swaps, the implication is that the cost of trading cleared swaps has fallen relative to uncleared swaps. Hence, for some portion of their swaps, it makes economic sense for a covered entity to clear a swap that would have remained uncleared absent the UMR.[9] As a result, we would expect that swaps subject to the UMR (those between two covered entities) are more likely to be cleared than those same trades would have been prior to the UMR.[10]

To be sure, margin is not the only cost of trading a cleared swap. There are costs to accessing the CCP to clear trades, and those costs depend on whether an entity is a CM. The primary benefit to becoming a CM is that only CMs can directly clear trades with the clearinghouse. Non-members can only indirectly clear trades, by using the services of a CM, but face higher incremental costs of clearing than a CM does. Set against that benefit is that becoming a CM requires an upfront capital contribution to the clearinghouse, as well as costs involved in establishing the clearing infrastructure.[11] The implication of the difference between CMs and non-members is that CMs face lower marginal clearing costs, and hence we would expect them to clear their swaps at a higher rate.[12] We examine this prediction in Section V.

Broadly speaking, there are two margin-related considerations in making clearing

[8] While we do not directly estimate the effect of the UMR on the cost of margining a swap, Roberson (2018) does such a calculation for both typical cleared and uncleared swaps.

[9] There are a number of differences between a cleared and an uncleared swap in addition to required margin. Among other things, when a swap is cleared, the risk of non-performance is transferred from one's counterparty on the trade to the clearinghouse.

[10] Aggregate data confirm this prediction. See CCP12 (2019) and https://www.clarusft.com/bis-2016-fx-data-how-much-of-the-ndf-market-is-cleared.

[11] For more details on costs, see https://www.bloomberg.com/news/articles/2019-07-19/wall-street-trading-costs-to-surge-as-new-rules-hit-derivatives.

[12] Of course, the relationship may not be causal. It may be that for exogenous reasons, some entities both choose to become CMs and clear more of their trades.

decisions. First, for a simple position in a generic NDF swap such as a USD/INR, the margin charged for a cleared swap tends to be lower than that for an uncleared swap under the UMR. This will tend to induce covered entities to clear more swaps under the UMR.[13] A second effect relates to the "netting" of positions between counterparties. That is, margins are based on the portfolio of positions a trader has with each of its counterparties. Hence, if a trader receives dollars (long) in one USD/INR swap, and had paid dollars (short) in a previous USD/INR swap with the same counterparty, the required margin will be calculated based on the two positions, and will likely be lower than the required margin for either of the two positions individually. This is especially relevant for cleared swaps; once a trade is novated for clearing, the identity of the counterparty to the initial swap becomes irrelevant; and the relevant counterparty becomes the clearinghouse. Hence, any cleared NDF swap in a specific currency pair could be netted against any open cleared NDF swap in that same currency pair. Previous research suggests that if a trade reduces the entity's net exposure, and hence his required margin, at the CCP, the trade is more likely to be cleared (CCP12 (2019);Bellia et al. (2019)). We test this prediction on the NDF market in Section V.

While the UMR has unambiguous rules for determining which entities are covered during each phase of implementation, there is no publicly-available source enumerating the implicated entities in each phase. Using a combination of public sources, our calculations and discussions with industry sources, we identify the 20 CPCs that became subject to the UMR in September, 2016 (Phase 1).[14] In aggregate, these 20 CPCs represented at least one side of the trade for about 93% of notional NDF trading volume,

[13] An example of the magnitude of the difference is provided in Hermon (2019). He provides the examples of margins on Indian rupee and Taiwan dollar NDFs for CME cleared NDF trades, and uncleared NDF trades that are margined using the standardized model. Margins for the latter are 2.5 – 4 times as large.

[14] ISDA has made the number of phase 1 entities public – see https://www.isda.org/a/1F7TE/ISDA-Margin-Survey-Year-end-2019.pdf.

and both sides of about half the notional NDF trading, in the 3rd quarter of 2016.[15]

Importantly for our analysis, clearing membership is at the entity level, not at the parent level. That is, an entity within a CPC who is not a clearing member cannot directly clear trades at the clearinghouse, even if another entity within the same CPC is a CM. Hence, even within CPCs, there are differences in clearing costs across entities. We exploit these differences in clearing costs in explaining observed clearing and trading decisions.

III. Related Literature

Our paper is connected to three strands of the literature. First, our research analyzes traders' decisions to centrally clear trades, and provides additional quantification of the effects of voluntary central clearing, which sheds light on empirical and theoretical research on this issue. Second, we are analyzing the impact of a significant multi-jurisdictional change in swaps market regulation, and hence contribute to the literature on measuring the impact of financial policy. Third, our analysis of the NDF market adds to our general understanding of FX derivatives trading.

In regard to evaluating the costs and benefits of clearing, Duffie and Zhu (2011) base their analysis on the observation that there can be significant costs reductions due to lower required margin and reduced counterparty risk from netting the required margin on positions on two or more different correlated instruments (e.g., an exchange rate swap between dollars and euros and a swap between dollars and yen) within a pair of counterparties. They show that mandating a contract be cleared will tend to lead to

[15]More CPCs became subject to the UMR rule during the later implementation phases of the UMR. We estimate that 6 additional CPCs became subject to the rule in September, 2017 (Phase2), and additional entities the next two Septembers. For more details, see, e.g., Lukas Becker "Just six banks caught by phase two of IM regime" risk.net, 6/14/2017 available at https://www.risk.net/derivatives/5290656/just-six-banks-caught-by-phase-two-of-im-regime.

lower margin costs and lessen counterparty risk if the contract that is mandated for clearing is within the same 'clearing set' (i.e., contracts with highly correlated values) as other contracts offered by the CCP, so that the mandate would encourage netting, but might reduce netting if many other contracts within that clearing set cannot be cleared. Ghamami and Glasserman (2017) use data on bank holding company positions to empirically evaluate these off-setting effects. Cont and Kokholm (2014) show that having a single CCP that clears multiple assets can result in reduced interdealer exposures, but may lead to increased systemic risk issues.

There is some empirical evidence presented on the impact of voluntary clearing as well as traders' willingness to choose voluntary clearing. Loon and Zhong (2014) study the introduction of clearing to credit default swaps and find changes in the market that are consistent with a reduction in counterparty risk. In an interesting setup, Menkveld, Pagnotta and Zoican (2016) analyze both voluntary and mandatory clearing in a difference-in-differences setting in the equity market. They report minimal clearing taking place when voluntary clearing is introduced into the market, but also find that the daily price volatility of stocks significantly declines (compared to their control group) when trades become subject to mandatory clearing.

A paper which is in some ways similar to our paper is Bellia et al. (2019). Among other things, they empirically examine the extent to which whether a new trade will reduce a trader's net position with the CCP explains the decision to clear that trade, for contracts for which clearing is voluntary. Looking at trading in single-name sovereign CDS, they find evidence that the ability to net a trade against an existing position with the CCP helps explain the decision to clear the trade. However, the authors acknowledge in the paper that their data does not allow them to identify the two parties to any transaction, and hence they cannot distinguish between trades where one party has an incentive to clear because of the netting benefit, and trades in which both parties

receive netting benefits from clearing. As part of our study, we similarly examine the question of the role of netting in affecting the decision for whether to clear. Our data allows us to more accurately estimate the benefit to clearing a trade to both parties, and we find strong evidence that clearing is more likely when both parties receive netting benefits from clearing.

In addition to its effect on netting, clearing provides insurance against counterparty risk. Bellia et al. (2019) also find that the riskiness of one's counterparty explains some portion of the decision to clear. Antinolfi, Carapella and Carli (2018)) look at the incentive effects of that insurance. A key assumption in their paper is each trader has access to private information about their trading partner, and that information can be acquired by traders at a cost. In their model, clearing creates a moral hazard, as individual traders spend fewer resources monitoring their trading partners when trades are cleared. Hence, they conclude that mandatory clearing can lead to loss of information across markets.

Benos et al. (2019) analyze the costs to traders of fragmentation (i.e., multiple CCPs for the same product). While their focus is different, a critical element of their analysis is that fragmentation reduces the potential for netting, and hence increases the requisite margin. Their empirical results show that the higher margin cost due to fragmentation results in a 1-3.5 basis point difference in the price of IRS faced by end-users across markets. As discussed below, our analysis shows the empirical importance of netting at a single exchange, and hence, the magnitude of the potential harm from fragmentation. Greater netting also means less demand for collateral, as emphasized in Duffie, Scheicher and Vuillemey (2015). Duffie, Scheicher and Vuillemey (2015) analyze the credit default swaps (CDS) market and empirically estimate the impact of central clearing on collateral demand. Additionally, Cenedese, Corte and Wang (2019)) show that swap contracts that are bilaterally cleared trade at a premium relative to centrally cleared ones, due to higher

regulatory costs (e.g., higher risk weights) that are passed on to market prices via the so-called valuation adjustments.

There is a growing literature on analyzing the impact of recent regulation on financial markets. For example, Haynes, McPhail and Zhu (2019) look at the impact of the supplementary leverage ratio rule on equity options, and Allahkra et al. (2019) and Bao, O'Hara and (Alex) Zhou (2018) analyze the impact of the Volcker rule on financial markets. More specific to the impact of financial regulation on swaps markets, Loon and Zhong (2016) show that the introduction of swap execution facilities and central clearing, which were part of the Dodd-Frank Act, lowered trading costs in Credit Default Swaps. Benos et al. (2019) analyze how the introduction of swap execution facilities (SEFs), and the requirement that certain swaps must be traded on them, affects the interest rate swaps market. Similarly, Riggs et al. (2020) study the trading decisions of customers and dealers on the Dodd-Frank mandated trading mechanisms that exist on Swap Execution Facilities (SEFs). Our study differs from these existing studies by analyzing the impact of the UMR on swaps markets, specifically FX swaps.

While NDFs are not a widely studied FX product, there are a number of studies documenting the principal features of this market.[16] McCauley and Shu (2016) report that NDFs represented a little less than 20 percent of all FX trading during the first half of this decade, and NDFs written against the US dollar accounted for 97% of the total. As noted above, NDFs are primarily used for currency pairs for which a developing county's currency is one side of the trade, and the US dollar is the other side of the trade. These currencies often have export controls or other factors that makes delivery of the currency impractical. McCauley and Shu (2016) suggest that NDF volume is a measure of currency liberalization, and find evidence consistent with that hypothesis.

[16]There is a larger literature on how NDF interacts with other FX products (Wang et al. (2017); Park (2001); Gu and McNelis (2013); Wang et al. (2014); Misra and Behera (2006)).

IV. Data

A. Description of Data Sets

Our primary source of trade data is regulatory data that is obtained by the CFTC through part 45 of the Dodd-Frank Act. Our data covers a six-month period of June 1st to December 1st of 2016, which is three months before and after the implementation date of the first phase of the UMR. The data includes fields identifying the two parties to each trade, as well as the two traded currencies and which party received which currency. It also details the terms of the trade, such as the exchange rate, the tenor, whether the trade is cleared, the currency in which payment will be made and other relevant economic terms. Parties are identified by their legal entity identifier (LEI). The trader identification is the main attribute that distinguishes this data from publicly-available data.[17] Knowing the identities of parties allows us to determine whether a specific trade is subject to the UMR. This in turn allows us to explore the determinants of the clearing decision, as described below.

As noted above, the determination of whether an entity is required to post margin on uncleared swaps is made at the CPC level. That is, a large financial firm typically consists of multiple LEIs (i.e., subsidiaries), and for the purposes of determining whether an entity is required to post margin under the UMR, the rule requires that LEIs' trading positions are aggregated up to the CPC level. If the aggregated positions of the LEIs within a CPC reach a specific level (e.g., $3 trillion for Phase 1), then all LEIs within that LEI are covered under the UMR. Because the parent affiliation link is not part of the information contained in the regulatory data, our analysis uses affiliate structure data from S&P's Cross Reference Services and manual classification by CFTC staff

[17] The public version of this data is known as Part 43 data and it contains most of the other information on the terms of the trade.

to determine whether an LEI-level entity should be combined with other entities to determine their status under the UMR.[18] Knowing which entities are affiliated with the largest companies is essential for determining which entities are subject to each phase of the UMR, and knowing which company is affiliated with each entity is also important to our analysis since inter-affiliate trades have different margin requirements.[19] As such, knowing the affiliate relationships allows us to distinguish between trades on the basis of how they are affected by the UMR. Specifically, for most of our analysis, we filter out inter-affiliate trades from our analysis of clearing decision, so that only market-facing trades are included.

In addition, to better understand clearing decisions, it is important to determine which entities are clearing members of the London Clearinghouse. To do so, we make use of a second regulatory data source; data submitted under part 39 regulations adopted by the CFTC. Part 39 is reported to the CFTC by clearing organizations and it lists all cleared position of clearing members and their customers. Using it allows us to determine which entities (at the LEI level) clear their own NDF trades, and which entities are clearing for other entities.

While we use the NDF market to understand voluntary clearing decision of traders, we would still like to determine whether the inferences we draw are based on a substantial portion of the market, and not just a small and unrepresentative sample. Specifically, we only observe the NDF transactions that are within the CFTC's jurisdiction (primarily trades made in the US). To illustrate the coverage of our NDF data, Table I compares the NDF market we analyze to the global NDF market. Table I shows the average daily

[18]Because there is no central source of this group subsidiary-ownership information, our estimates of a group's aggregate derivative position is inexact. This is one reason that identifying the entities implicated under each phase of the UMR using position data (known as AANA under the regulation) is not unambiguous.

[19]Specifically, inter-affiliate trades of non-banking CPCs are not subject to the UMR, and inter-affiliate trades of banking CPCs do not need to post two-way margin.

volume traded in the CFTC's jurisdiction during April 2016 and the same estimate for the global market from the Bank of International Settlements (BIS). The comparison suggests that we are likely observing a little more than one-half of global NDF trading. Analyzing our coverage by currency, we observe that our coverage of Asian currencies is slightly below 50 percent but coverage for the BRL and RUB are 83 and 93 percent respectively.

B. Summary Statistics

Table II shows the number of trades, trading volume in notional dollars, and the number of Phase 1 market participants, as well as the number of Phase 1 clearing members in our subsample around the implementation of Phase 1 of the UMR. Panel A provides summary statistics on the number of transactions in total and by different types of market participants, Panel B provides notional volume disaggregated similarly, and Panel C provides counts on the number of LEIs and clearing members that were subject to Phase 1 of the UMR. Our regulatory data shows that the 20 CPCs contained about 545 LEI-level entities. These 545 LEIs were on at least one side of the vast majority of trades - 95% over the entire 6-month period – and both sides of about 40% of trades.

Table II presents the statistics in Panels A and B separately for the three months periods before and after the implementation of the first phase of the UMR. One direct conclusion from Table II is that the trading measures associated with post-UMR period are higher than in the pre-UMR period in both panels. That is, both the total number of transactions and the total notional volume increase after the UMR. This increase is particularly pronounced (about a 24% increase in transactions and 27% increase in total notional) when both sides to the trade are clearing members who are covered by the UMR. The bottom row in panels A and B report an increase in the number and

notional value of cleared swaps, respectively, and the observed increase in both values is almost four-fold. Altogether, these statistics suggest a slight increase in trading in the NDF market but a large jump in the extent of clearing following the implementation of the UMR.

Based on the regulatory part 39 data, we observe only 17 Phase 1 LEI-level CMs (that is, entities that cleared their own trades) in 2016, as also reported in Panel C of Table II. Hence, some CPCs did not clear any of their own trades, and the vast majorities of LEI-level entities were not clearing members. These 17 represented at least one side of the trade on 95% of all post-UMR trades for which a Phase 1 entity was on both sides of the trade.

C. Initial Look at Clearing at the NDF Market

As discussed in Section II, the direct effect of the UMR is to raise the cost of using uncleared swaps, relative to cleared swaps, to establish a position. Hence, the implication is that entities should clear a higher share of their NDF swaps after the UMR comes into effect. To evaluate the impact of the UMR on clearing percentages, we turn to Figure 1. Figure 1 shows the percentage of NDF trades cleared in our sample from June 2016 until the end of 2019. The biggest increase in clearing rates comes after Phase 1 of the UMR implementation; clearing rates increase from less than 5 percent to more than 15 percent. There seems to be another increase associated with Phase 2 of the UMR implementation, clearing rates average about 25 percent between September, 2017 and September, 2018.[20] Visually, other phases do not seem to have a substantial effect on clearing ratios.[21] It is not surprising that Phase 1 had the largest effect; since the 20

[20] As noted above, this increase could also reflect the variation margin requirement for all NDF trades which went into effect on that date. Between September 2016 and September 2017, only trades between Phase 1 entities were subject to the variation margin requirement.

[21] Department (2018) find that clearing among trades reported to the Hong Kong Trade Repository rose dramatically after UMR was introduced across many jurisdictions.

largest CPCs were affected by Phase 1, whereas a smaller number of smaller entities were implicated in the next 3 phases. Based on this aspect of the implementation, as reflected in Figure 1, we focus the rest of our analysis on examining the changes induced by Phase 1.

To evaluate whether changes other than the UMR might have caused an increase in clearing in the NDF market, we compare the clearing rate on NDF to clearing rates for deliverable forwards and FX swaps (which together we refer to as FWD) in our analysis (as noted above, the UMR did not apply to these instruments). In Figure 2, we show the aggregate percentage of NDF and FWD that were cleared around Phase 1 of the UMR implementation. The figure shows that the Phase 1 implementation in the fall of 2016 is associated with a fairly dramatic effect in clearing for NDFs, but no corresponding increase in clearing for FWD trading. This suggests that the increase in NDF clearing was not due to factors affecting foreign exchange trading in general, but rather was due to the UMR.[22]

Table III provides some quantification of this effect and tests the hypothesis that the clearing rate in the NDF market is significantly higher than the clearing rate in the FX forward market after the UMR. We run the following probit regression using a difference-in-difference approach to evaluate the effect of UMR. Our treatment group is NDF transactions while the control group is FWD transactions.

$$P(Y_{imt} = 1) = f(NDF, UMR, Trend, UMR{*}NDF, UMR{*}Trend, UMR{*}NDF{*}Trend) \tag{1}$$

Where Y_{imt} takes the value of 1 if trade i of currency pair m on trade date t is cleared

[22]The extremely low FWD clearing trend continues even after the phase 1 dates we analyze. Collin-Dufresne, Hoffman and Vogel (2019) report virtually no trades in the FX Forward market were cleared between May 2018 and April 2019 for EUR/USD.

and $f(.)$ is the cumulative distribution function of the standard normal distribution. The explanatory variables include a dummy for NDF (vs FWD), a dummy for the period in which the UMR was in effect, the interaction of those two dummies, a time trend, and a trend interaction ($Trend*UMR*NDF$) term. The errors are clustered at the currency pair level and the coefficient on the $NDF*UMR$ interaction term indicates the extent to which there was a larger effect of the UMR on NDF clearing than FWD clearing. We show the marginal effects of our estimates in Table III, which makes interpretation easier. We find the marginal effect of NDF is 0.011; meaning clearing was 1.1% higher for NDFs compared to FWDs in the pre-UMR world. The marginal effect of the interaction term of UMR and NDF is 0.0014; suggesting that clearing was an additional .14% more likely for NDF at the UMR implementation date (day 0). Looking at the median of our post-UMR period (45 days) and multiplying by the coefficient on the differential trend (.000056), this implies that on median post-UMR day, the clearing rate for NDF increased by about .4% (.0014 + 45 * .000056 = .00392) relative to FWD. To put this in perspective, this represents a 36% (=.00392/.011) increase in the difference in clearing rates between NDF and FWD.

V. Analysis of Clearing Decisions

Section IV offered a test for the most direct implication of how the UMR's requirement of collateral for uncleared NDF swaps would affect clearing. Other implications follow from the institutional details described above. In particular, the UMR had different restrictions on different kinds of entities, and these lead to implications about how different entities would alter their clearing decisions. For example, since only trades between two parties that are both affiliated with CPCs that are covered are required to post margin on uncleared swaps, we should see different effects on trades between such

entities compared to other trades.

Another measurable effect stems from the differential cost of clearing for clearing members and others within the 20 Phase 1 CPCs. Specifically, while the cost of using uncleared swaps rose for all entities that were subject to the rule change, the cost of clearing a swap is lower for clearing members, so we would expect to see a more dramatic effect of the UMR on voluntary clearing by these entities.

As shown below, even for trades between CMs during the period in which the UMR is in effect, only about half of the trades were cleared. Hence, other factors beyond the UMR requirement and clearing member status affect the clearing decision. As emphasized above, the potential for netting a trade against existing positions (and thereby reducing margin requirements) is another factor which likely affects clearing decision. Specifically, we test the implication that a trade which allows both parties to reduce their margin obligations is more likely to be cleared. In this section, we empirically examine these three implications.

A. Do Covered Entities Make Different Clearing Decisions?

Under the UMR, only NDF swaps between two covered entities are required to post margin on an uncleared swap. As such, we anticipate that, comparing the September to December 2016 period to the pre-UMR period, the change in clearing will be concentrated among Phase 1 covered entities. Because our data allow us to know the identity of the traders, we know which trades would be required to have margin posted during the UMR period if they were not cleared. For the six-month period surrounding the implementation of the UMR, Figure 3 shows the clearing rates separately for trades between covered entities and other trades, looking only at trades in currency pairs for

which clearing was available.[23] Consistent with our earlier interpretation, we find that the effect of the UMR was primarily on trades between covered entities; the percentage of such trades cleared rose from about 8.6% before the rule change to about 28% afterwards. The corresponding change for trades for which one or both parties were not "covered" during the Phase 1 of the UMR was substantially smaller; from .01% to .1%.

While testing for the effect of the regime change on clearing rates using a difference in difference (DND) framework within NDF would have been desirable, the inapplicability of the (necessary) parallel trends assumption meant that DND was not an appropriate methodology here. As Figure 3 suggests, statistical tests show that the trends for clearing for trades between Phase 1 entities and for other trades were quite different in the pre-UMR period. For this reason, we instead estimate how the clearing decisions of covered entities were affected by the UMR

$$P(Y_{imt} = 1) = f(UMR, Trend, UMR * Trend, X_{imt}) \tag{2}$$

Where Y_{imt}, UMR, and $Trend$ variables and $f(.)$ are defined as in Equation 1. X_{imt} represents the control variables, which include the tenor of the swap, a dummy for whether its tenor is of a standard length, its notional size in USD, and whether is it traded on a SEF.[24] Table IV presents estimates of the effect of UMR on clearing for the NDF transactions between the entities that were covered under the Phase 1 of the UMR. The marginal effects from probit estimation are reported. Notably, the effects of the UMR dummy variable and the interactive term of UMR and trend variables are positive and statistically significant. This indicates that the level of clearing, and the slope of clearing over time, are both significantly higher after the UMR goes into effect.

[23] At the time of Phase 1 implementation, the London Clearinghouse offered clearing for 14 currencies pairs, all with the US dollar on one side.

[24] Standard size is the modal tenor of NDF trades in our sample. Riggs et al. (2020) show that modal trades tend to have lower trading costs.

As discussed below, the clearing trend nearly doubles after the UMR goes into effect.

To create a visual comparison, in Figure 4 we use the marginal effect from the probit regression to show the implied change in clearing from the UMR, relative to the implied clearing rate if the UMR had not gone into effect. The black line after the September 1st date is hypothetical, showing our estimate of what clearing would have been without the UMR, assuming the trend in clearing maintained its pre-UMR trajectory. The blue line represents the trend in clearing post-UMR, and the difference between these two lines illustrates the potential impact of the UMR on the clearing trend. For example, the probit estimates imply that by 30 days after the UMR went into effect, clearing is about 9 percentage points higher because of the UMR, which is nearly a 50% increase.

B. Which Trades are Likely to be Cleared?

We next turn to the question of which trades by "covered" entities are most likely to be cleared. As discussed above, the marginal price for clearing is lower for clearing members than other entities. If only one party is a CM, the non-CM party has to contract with a CM for clearing services in order for the trade to be cleared. As Table II indicated, there are about 545 entities that traded NDF during our sample period and were covered under Phase 1 of the UMR, and only 17 of them were clearing members (CMs) in 2016.[25] These CMs were parties to the vast majority of cleared trades, however. Of the roughly 90 thousand trades between two covered entities that were cleared in the three months following the UMR, more than 99% had a CM on at least one side, and 98% had clearing members on both sides. In contrast, virtually none of the trades between two non-CM covered entities were cleared. One implication of this is that, since several CPCs did not have any CMs among their covered LEIs, this means that some CPCs cleared very few

[25]That is, only 17 entities could clear their own trades. Some additional entities could clear trades for other entities.

trades. Another implication is that the costs of using the clearing mechanism apparently was substantially higher for non-CMs than CMs.

To test the hypothesis that the probability of a UMR swap being cleared is higher when that swap is between two CMs than otherwise, we run the following regression on the subsample of trades between two Phase 1 entities during the UMR period, with the dependent variable equal to 1 if the trade is cleared.

$$P(Y_{imt}^{Cov} = 1) = f(OneCM, BothCM, Trend, X_{imt}) \tag{3}$$

Where Y_{imt}^{Cov} is the indicator variable described above, which takes the value of 1 if trade i of currency pair m on trade date t between two covered entities is cleared. $OneCM$ is an indicator variable which takes the value of 1 when only one counterparty of a swap is a CM. $BothCM$ is also an indicator variable which takes the value of 1 when both counterparties to a swap are CMs. The rest of the explanatory variables are as defined in Equation 1. Table V presents the estimates from two different forms of estimation following the specification in Equation 3. Columns 1-3 show the estimates from probit regressions and column 4 presents the estimates from a simple OLS regression.[26] The strong and consistent result from Table V shows that the likelihood of a swap being cleared increases significantly when both counterparties are CMs; namely by close to 40% as indicated by the estimates in the OLS regression.

These results suggest that whether a Phase 1 entity is a CM has a substantial impact on whether it chooses to clear a trade. We infer from this that firms that have paid the fixed cost of becoming a CM find that many trades are less expensive to make if they are cleared (at least in part due to lower margin requirements). In contrast, non-CMs rarely clear, suggesting that such firms generally find it less expensive to not clear their

[26]While the results of these two regressions are qualitatively similar, estimates of the OLS regression seem to correspond to more economically plausible effects.

trades. One additional piece of evidence pertaining to the cost of clearing is that 11 of the entities that were non-clearing entities during our sample period (all of whom are apparently covered under the UMR), have chosen to become clearing members of the LCH in the three years after our sample period.[27] This is consistent with the premise that there is a trade-off between the fixed costs of becoming a CM and the resultant lower clearing costs, and that the UMR has increased the benefit to covered entities of having lower clearing costs.

These findings indicate that CMs are much more likely to clear their trades than other covered traders. Even for trades between two CMs, however, fewer than half were cleared in the UMR period. We next address the question of the determinants of which trades between two CMs get cleared. One hypothesis discussed above is that a trade will be cleared if it reduces the traders' net positions with the clearinghouse, which allows the entities to reduce the amount of margin they needs to post with the clearinghouse (netting). Bellia et al. (2019) find evidence in the single-name CDS market that netting does explain some portion of the clearing decision for CMs.

To test this, we calculate the net position of each CM with the clearinghouse by aggregating all of their existing, still open, cleared trades in our data dating back to June 1st, 2016.[28] This allows us to determine whether a trade between two CMs would be beneficial to both in terms of netting with the clearinghouse. For example, if a CM's aggregate net cleared trades in a certain currency pair results in an existing long position (in USD), then a new cleared swap in that currency pair for which she would be paying USD would be beneficial to her, as it would allow for a smaller exposure when netted at the clearinghouse level. Following this logic, we characterize a swap as beneficial

[27] We determine which entities are in scope from public sources. See, e.g., https://www.risk.net/derivatives/5290656/just-six-banks-caught-by-phase-two-of-im-regime.

[28] Since the UMR period begins 90 after the start of our data, and NDF trades with tenors in excess of 90 days represent only 3% of our sample, we believe our measure is a reasonable approximation of trader positions.

($Benefit = 1$) if both CMs entering into the swap will reduce their existing exposure with the CCP by virtue of the swap being cleared.

Using this variable, we run the following regression to test the hypothesis that the probability of a covered swap between two CMs being cleared is significantly higher when the direction of the swap allows both CMs to net and reduce their exposure at the CCP level.

$$P(Y_{imt}^{Clrd} = 1) = f(Benefit_i, Trend, X_{imt}) \tag{4}$$

Where Y_{imt}^{Clrd} takes the value of 1 if trade i of currency pair m on trade date t between two CMs that have cleared a previous transaction in that currency pair. Table VI shows the relationship between the likelihood a trade is cleared and the netting benefit of a cleared swap, along with the control variables described above, for trades between two CMs during the UMR period.[29] Our indicator variable $Benefit$ is similar to the variable used in Bellia et al. (2019), except that we set it equal to one if and only if both sides will reduce their net position with the clearinghouse by making the trade.[30] Similar to Bellia et al. (2019), we find that when $Benefit$ equals 1, a trade is more likely to be cleared. In the version estimated without fixed effects shown in Column (1) of Table VI, the marginal effect suggests that trades are a little over 4 percentage points more likely to be cleared if the trade benefits both counterparties through netting effects. Column (2) includes trader-specific and currency-specific indicator variables, and clusters the standard errors (for trades between each pair of clearing members).

[29] Our netting analysis is done at the currency pair level. While Duffie and Zhu (2011) emphasize that netting can take place across currency pairs, we do not have access to the model the CCP uses to determine if (and how) two currencies pairs can be netted against one another. In untabulated results, we assume all currency pairs with USD on one side can be netted, and we get similar results.

[30] Bellia et al. (2019) cannot observe both sides to each trade, so in their estimation, the dummy is set equal to 1 if a trader they observe will reduce its position with the clearinghouse by virtue of the trade (e.g., enters the trade with a long position and is taking the short side of the trade).

Inclusion of these fixed effects reduces the estimated marginal effect of $Benefit$ by about .6 percentage points. It also increases the $pseudo - R^2$ substantially, suggesting that there are important differences between CMs in their willingness to clear that are independent of their positions, as well as important differences between currencies. The estimates for the remaining variables tend to have similar magnitudes and signs as in previous tables. For example, the estimated marginal effect on *trend* suggests that the likelihood of clearing rose about 3 percentage points per week during the UMR period.

Table VI looks at whether clearing is affected by whether a trade lowers the outstanding position of a CM with the CCP in a specific currency pair. An issue that is central in the literature on the effect of mandatory clearing is that extent to which netting occurs not only within a currency pair, but across currency pairs (see, e.g. Duffie and Zhu (2011)). That is, if a trader has a long position in dollars in her rupee/dollar trades and a short position in dollars in her won/dollar trades, is the trader's required margin lower than would be required by the two individual positions? If it is, then it may be appropriate to calculate the $Benefit$ variable based on positions aggregated across currency pairs. Unfortunately, the exact model used by the London Clearinghouse to calculate these inter-currency offsets is not available to us. Instead, to examine if these effects are important, we use a simple model for offsets. We calculate whether each trader enters a trade long or short the dollar side in NDF trades overall. If the party taking dollars in the trade was short the dollar side in NDFs entering the trade, and the party paying dollars in the trade was long the dollar side entering the trade, we characterize the trade as beneficial to both party's margin obligations (i.e., $Benefit\_USD = 1$). Table VII estimates similar regressions as Table VI, with this alternative measure of netting benefit. While the marginal effects of the other variables are almost identical to those in Table VI, the netting benefit variable changes dramatically. Comparing column (2) in the two tables, we find that estimated effect of the netting benefit becomes an

order of magnitude smaller, and the statistical significance disappears. From this we conclude that to the extent cross-currency netting does occur at the LCH, positions in all 12 currencies cannot be used to freely offset one another.

C. Inter-Affiliate Trading

Our final empirical analysis looks at the hypothesis that the UMR has altered how non-CMs make their trading decisions. Specifically, for non-CM LEIs within the Phase 1 CPCs, the UMR alters how they have to set margin on uncleared swaps with outside (arm's length) entities, but does not change how they margin uncleared swaps with affiliates. That is, under the UMR, margin is not required for uncleared swaps between affiliates.[31] We hypothesize that one potential effect of this aspect of the UMR is that covered non-clearing entities will increase their trading with affiliates after the rule goes into effect, and reduce trading with outside parties. Further, since the CM within each CPC is in a better position to hedge a position acquired in an inter-affiliate trade than non-CM LEIs, (since it can more cheaply clear a swap), the hypothesis predicts that CMs will represent a higher percentage of a CPC's trades after the rule change.

We find evidence in support of both of these predictions. Specifically, we find for the CPCs with at least one CM, the percentage of trades that are inter-affiliate increases from 15% before the rule change to 16% after the UMR goes into effect. In regard to the activity of CMs, we find that CMs represent about 87.4% of trades and 77.7% of notional value traded before the rule change, and this increases to 89.4% of trades and 91.1% of notional value after the rule change.

[31] Inter-affiliate trades may be subject to regulations other than the UMR, however. While margin is required for inter-affiliate swaps if the CPC is a non-bank entity, CPCs that are banks are subject to rules made by prudential regulators (such as the Fed). These rules require swap dealers (including those subject to the UMR) to collect but not post initial margin to affiliates. For more information, see https://www.cadwalader.com/resources/clients-friends-memos/cftc-adopts-margin-requirements-for-uncleared-swaps.

To formally test our hypothesis, we run the following probit regression.

$$P(Z_{ibmt} = 1) = f(UMR, Trend, X_{imt}) \tag{5}$$

Where Z_{ibmt} takes the value of one if the inter-affiliate trade i between affiliates of CPC b on currency pair m on day t involves a CM. We run this regression for all the CPCs with at least one CM and as before, our explanatory variables include an indicator variable for the rule, UMR, a time trend, Trend, and control variables X_{imt}. Table VII presents the result from the regression described in Equation 5. The results point to half a percentage point to a two percentage point change in the CM's share of inter-affiliate trading after the implementation of the first phase of the UMR, depending on the specification. This evidence points to the existence of a fixed cost related to establishing a clearing relationship between an entity and a CCP. That is, we find that instead of establishing clearing relationships for many of their affiliates, CPCs preferred to modify their trading patterns and engage in more inter-affiliate swaps with their affiliated CMs in response to the UMR.

VI. Conclusion

This paper analyzes the clearing choices made by traders in regard to trades in a financial instrument for which clearing is voluntary. We first show that the aggregate clearing rate for NDFs increased with the introduction of the UMR, a regulation that mandates additional collateral for uncleared swaps. Taking advantage of a difference in coverage of the UMR between NDFs and a similar product (FX forwards), we show that this change is substantially greater for NDFs; clearing rates rose for NDF by 36% after the UMR came into effect, relative to the clearing rates observed in the FX products that

were not subject to the UMR. This suggests that the observed change was not due to factors that were common to all foreign exchange swaps, but rather was specific to those affected by the new regulation.

Additionally, we look at cross-sectional aspects of clearing. We show that the increase in NDF clearing was almost exclusively due to change in behavior by the entities who were directly affected by the UMR; CPCs that were covered under Phase 1 of the rule increase their clearing rates dramatically, while clearing rates for other entities have little or no change. Within those Phase 1 CPCs, the change in clearing was overwhelmingly the result of an increase in clearing by clearing members; clearing by non-CMs remains infrequent. Specifically, we find that the likelihood of a swap between two covered entities being cleared increases by 40% when both traders are CMs. Finally, we examine the clearing decisions for trades between CMs. We find that a swap is 10 percentage points more likely to be cleared if the trade brings netting benefits to both CMs entering into the trade.

Our findings with respect to how the UMR affects clearing yield insights into the clearing process. The result that entities who were already CMs dramatically increased their clearing rate after the UMR went into effect suggests that under the UMR, clearing leads to substantial savings in the amount of collateral an entity is required to post. Despite these apparent savings, several covered CPCs chose not to have any of their subsidiaries become clearing members of the clearinghouse during our sample period. As such, it would appear that the costs of, and potentially delays associated with, becoming a CM are substantial.[32] At the same time, our finding that Phase 1 entities who are not CMs rarely clear their trades suggests there are substantial additional costs to non-CMs of using the clearing mechanism.

[32]We note that several Phase 1 entities became CMs subsequent to our sample period. As such, we can interpret the delay in becoming a CM as a cost of transitioning into CM status.

The UMR is one of several post-crisis regulations intended to ensure there is adequate collateral on swaps. Our evidence suggests that up to now, a principal effect of the UMR has been to increase clearing by large entities. Because cleared trades require collateral, and clearinghouses have considerable expertise in calculating suitable margin, it seems likely that these swaps now have appropriate collateral. As the next phases of the UMR will apply to smaller entities, it seems likely that many of those entities will choose not to become CMs (since becoming a CM is capital-intensive). Analyzing how these entities will adapt to the new environment will be informative about the costs and benefits of alternative means of ensuring adequate collateral. This information is likely to be valuable to decision-makers, such as regulators and market participants, as well as academics interested in the clearing process.

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Figure 1: NDF Clearing Ratio, June 2016 - Dec 2019

The figure shows the percentage of NDF swaps cleared from June 2016 until end of 2019. The thin dotted line shows the implementation date for phase 1 of the UMR. Thicker dotted line shows the implementation date for phase 2 of the UMR. The thin dotted and dashed line shows the implementation date for phase 3 of the UMR. Thicker dotted and dashed line shows the implementation date for phase 4 of the UMR. The actual clearing percentages are smoothed for easier visualization of any trends.

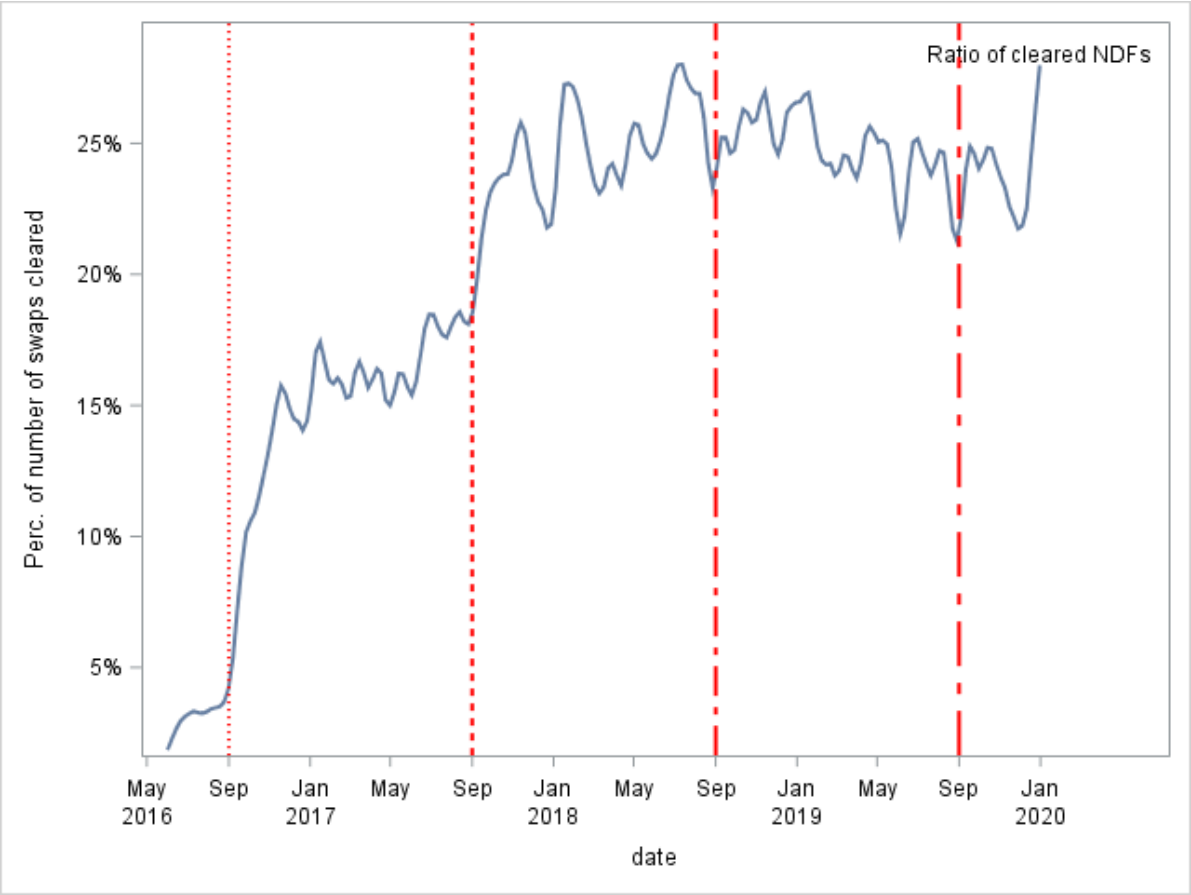

Figure 2: Phase 1 NDF and FWD Clearing Ratios

The figure shows the number of NDF swaps and FX swaps cleared around phase 1 of the UMR implementation. Blue line with circles present the NDF clearing ratio and the orange line with crosses present the FX forward clearing ratio. The vertical dotted and dashed line marks phase 1 of the UMR implementation date.

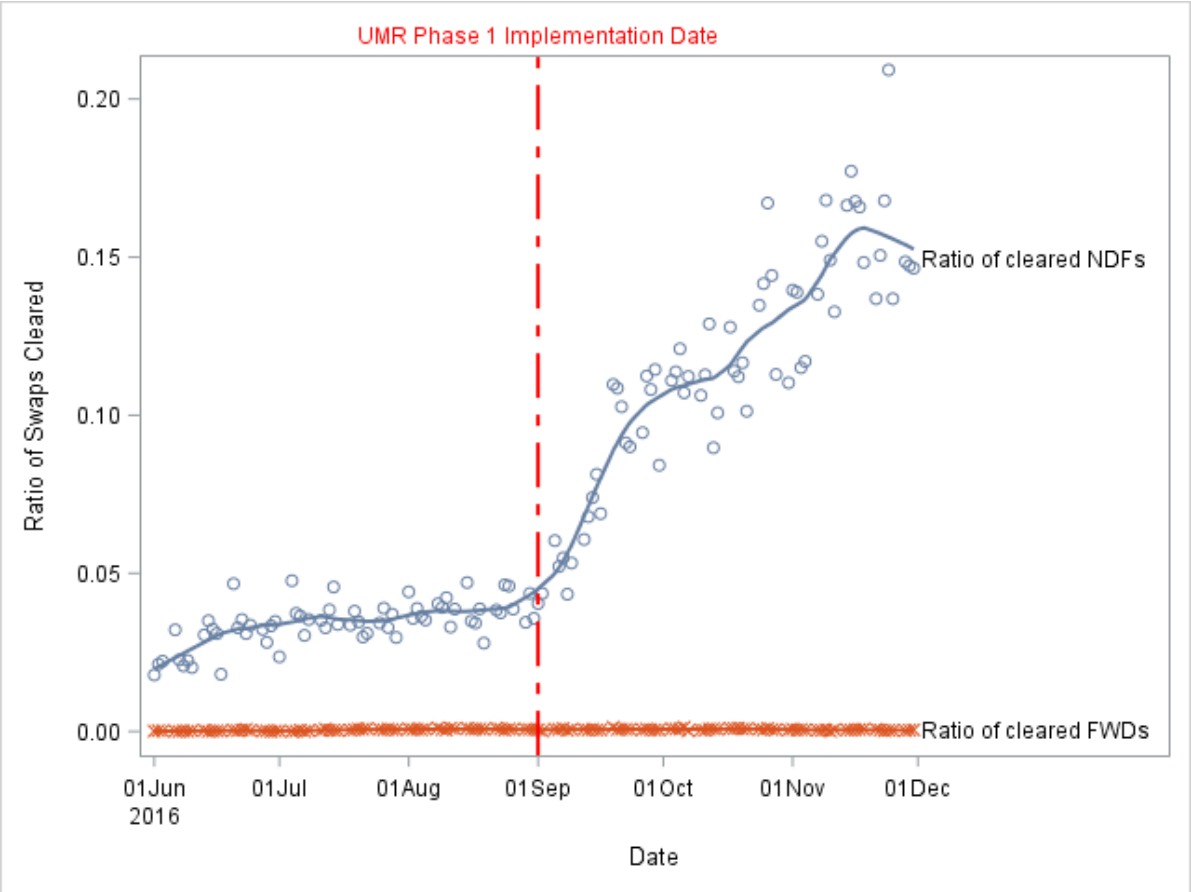

Figure 3: Covered and Non-covered Trades Clearing Ratios

The figure shows clearing rates three months before and after the UMR phase 1 date, separately for trades that are covered under the UMR rule and for those that are not covered. Blue line with circles indicates covered NDF trades and orange line with crosses indicate non-covered NDF trades.

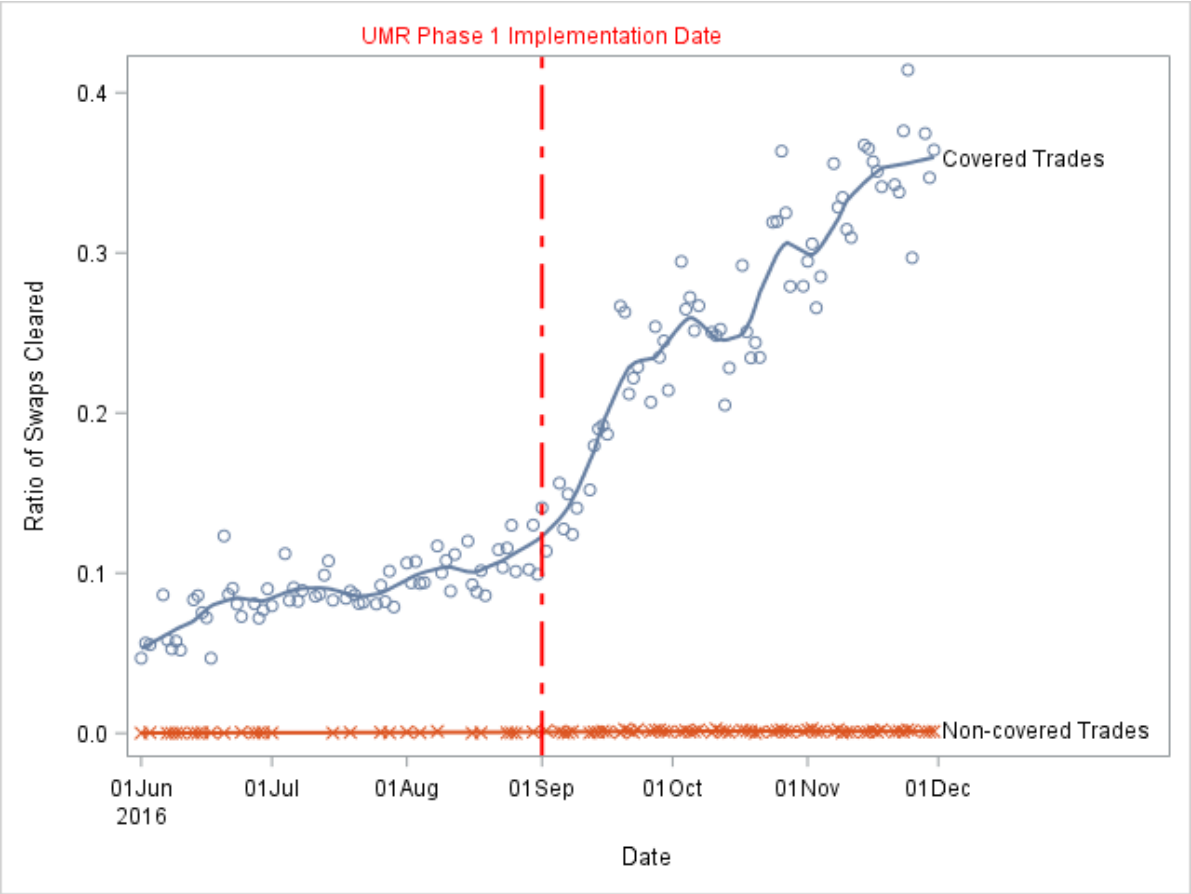

Figure 4: Clearing Rates with and without the UMR

The figure compares our estimate of what the clearing rate would have been after September 1st 2016 without the UMR implementation with the actual rate after UMR implementation. The black line to the right of the UMR phase 1 implementation date shows what the hypothetical clearing rate would have been had the pre-UMR trend continuted. The blue line and crosses show the actual clearing rates.

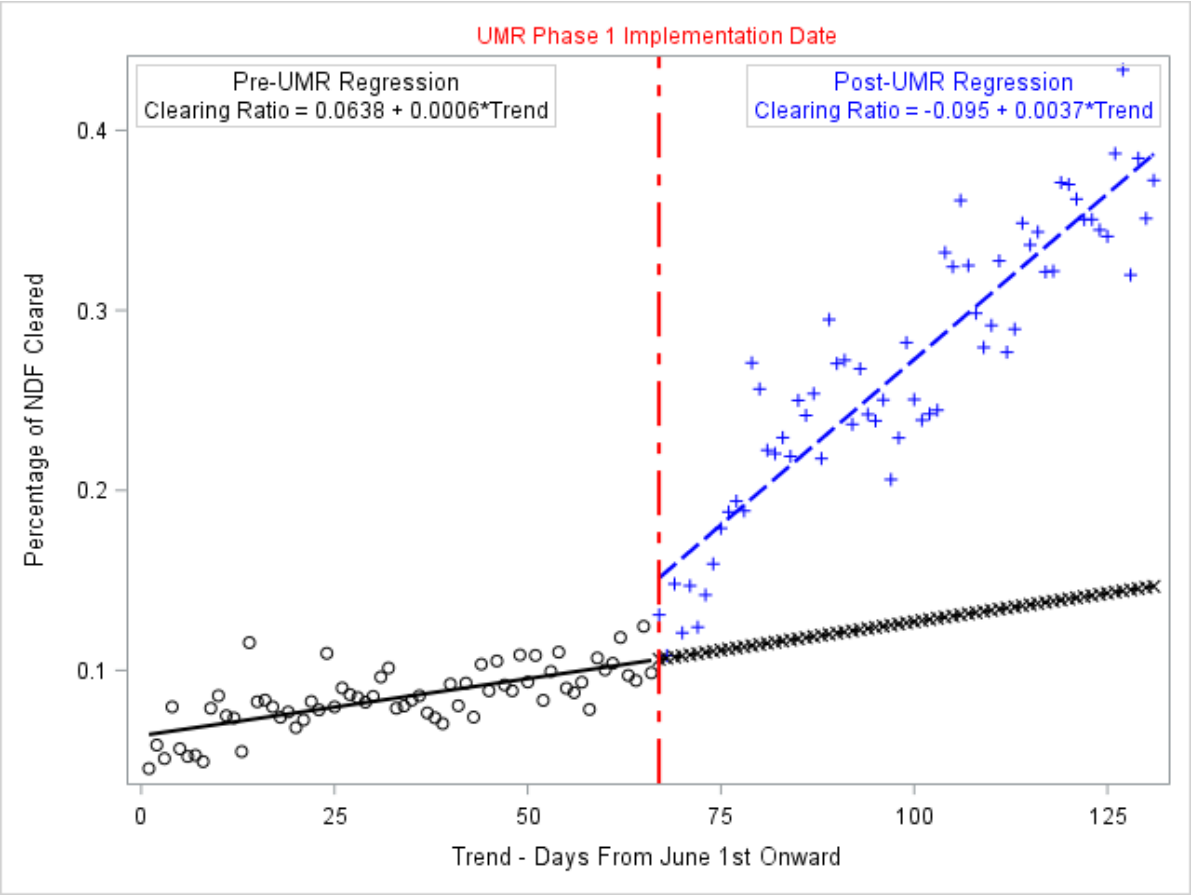

Table I: Data Coverage

The table displays a comparison of the NDF market we analyze with the global NDF market, comparing the average daily volume traded in the U.S. jurisdiction during April 2016 with the same estimate for the global market from the Bank of International Settlements (BIS). We present comparison for the following currencies: Brazilian Real (BRL), Korean Won (KRW), Indian Rupee (INR), Taiwanese Dollar (TWD), Chinese Yuan (CNY), and Russian Ruble (RUB).

NDF Average Daily Vol for April 2016 $bn			
Currencies	BIS	CFTC	Coverage (%)
BRL	19	15	83%
KRW	30	15	49%
INR	16	9	56%
TWD	12	5	47%
CNY	10	5	46%
RUB	3	3	93%
ALL Currencies	134	75	56%

Table II: Market Statistics

The table presents NDF market statistics around Phase 1 implementation of the UMR. Panel A shows the number of trades in thousands; first the total, and then those involving relevant groups of traders. All numbers are shown separately for three months before and three months after the Phase 1 implementation date. Panel B shows the notional value of trades in $ millions; again, both for the market as a whole, and then relevant groups of traders, separately for the pre and post-UMR period. Panel C shows the total number of legal entity identifiers (LEIs), the total number of covered parent companies (CPCs), and the total number of clearing members (CMs) in our data during the 6-month Phase 1 implementation sample.

Market Statistics		
	Panel A: Number of Trades (thousands)	
	June 1st 2016 – August 31st 2016	September 1st 2016- November 30th 2016
Total	811	869
One Phase 1 entity	493	503
Two Phase 1 entities	280	325
Two Phase 1 CMs	173	214
Cleared	23	90
	Panel B: Notional Value of Trades ($ millions)	
Total	5,060,074	5,798,213
One phase 1 entity	2,652,747	3,019,646
Two Phase 1 entities	2,139,512	2,427,525
Two Phase 1 CMs	1,258,429	1,604,308
Cleared trades	221,007	819,895
	Panel C: Number of Phase 1 Market Participants	
Number of Total LEIs	545	
Number of CPCs	20	
Number of CMs	17	

Table III: Difference-in-Difference Regression

The table presents the marginal effects from difference-in-difference probit regressions for the NDF and FWD transactions. The dependent variable is equal to 1 if the trade is cleared. NDF is equal to 1 if the swap is an NDF. UMR is equal to 1 for dates September 1st, 2016 and onward. Trend is a daily time trend. Column one shows the regression with no interactive terms. Column two adds two interactive terms to the regression. Column three uses errors clustered by currency pair.

	1	2	3
NDF	0.0111***	0.0115***	0.0115***
	(-97.49)	(-98.59)	(-8.06)
UMR	-0.0027***	0.0002	0.0002
	(-23.50)	(-0.98)	(-0.56)
Trend	0.0000***	0.0000***	0.0000***
	(-57.33)	(-23.14)	(-5.41)
UMR*NDF	0.0040***	0.0014***	0.0014***
	(-33.3)	(-9.2)	(-4.99)
Trend*UMR		-0.0000***	-0.0000***
		(-10.18)	(-4.31)
NDF*Trend*UMR		0.0001***	0.0001***
		(-21.63)	-6.11)
$pseudo - R^2$	0.2953	0.2966	0.2966
Observations	5158155	5158155	5158155
t-statistics in parentheses	* p<0.05, ** p<0.01, *** p<0.001		

Table IV: Clearing Decision of Phase 1 Entities

The table presents the marginal effects from probit regressions for trades between Phase 1 entities made between June and November, 2016, for currencies for which clearing was available. The dependent variable is equal to 1 if the trade is cleared. Explanatory variables include an indicator variable, UMR, which is equal to 1 for dates September 1st, 2016 and onward. Trend is a daily time trend. Standard is the most common tenor observed (34 days), tenor is the number of days the swap is active, notional is the log of size of the swap, SEF is equal to 1 is the swap is executed at a swap execution facility.

	1	2	3	4
UMR	0.0663***	0.0611***	0.0593***	0.0593**
	(-29.14)	(-28.98)	(-29.63)	(-2.99)
Trend	0.0008***	0.0008***	0.0007***	0.0007***
	(-24.4)	(-24.38)	(-23.27)	(-4.31)
Trend*UMR	0.0010***	0.0010***	0.0011***	0.0011*
	(-23.92)	(-26.37)	(-28.42)	(-2.1)
Standard	0.0521***	0.0463***	0.0434***	0.0434***
	(-42.64)	(-40.95)	(-40.01)	(-6.33)
Tenor	-0.0153***	-0.0106***	-0.0150***	-0.0150***
	(-10.37)	(-8.11)	(-11.49)	(-3.51)
Notional (Log)	0.0289***	0.0257***	0.0328***	0.0328***
	(-188.26)	(-151)	(-159.45)	(-8.11)
SEF	-0.1130***	-0.1080***	-0.0832***	-0.0832***
	(-98.04)	(-94.50)	(-76.30)	(-4.06)
Fixed effects	No	CPC	CPC & Currency	CPC & Currency
Clustering	No	No	No	CPC
$pseudo - R^2$	0.1693	0.2379	0.2732	0.2732
Observations	540568	540568	540308	540308
t-statistics in parentheses		* p<0.05, ** p<0.01, *** p<0.001		

Table V: Clearing Decision Between Two Phase 1 Entities

The table presents marginal effects from regressions of the probability a trade between two phase 1 entities is cleared, for currencies for which clearing was available, against the number of traders that are CMs, and control variables. The One CM variable takes the value of 1 when only one party to a swap is a CM. Both CMs takes the value of 1 when both parties are CMs. Columns (1)-(3) present marginal effects from probit regressions and column (4) presents estimates from an OLS regression. Column (2) presents estimates with CPC and currency fixed effects, and Column (3) adds clustered standard errors.

	1	2	3	4
One CM	0.4400***	0.4090***	0.4090***	0.0086
	(-6.82)	(-7.52)	(-6.39)	(-0.41)
Both CMs	0.9920***	0.8970***	0.8970***	0.3910***
	(-16.48)	(-17.84)	(-15.82)	(-10.13)
Trend	0.0022***	0.0023***	0.0023***	0.0023**
	(-64.93)	(-65.03)	(-3.64)	(-3.66)
Tenor	-0.0225***	-0.0225***	-0.0225***	-0.0186**
	(-10.54)	(-11.32)	(-4.11)	(-3.40)
Standard	0.0670***	0.0590***	0.0590***	0.0663***
	(-37.43)	(-34.23)	(-5.67)	(-4.41)
SEF	-0.0666***	-0.0462***	-0.0462*	-0.0792**
	(-38.58)	(-27.89)	(-2.42)	(-3.17)
Notional (Log)	0.0330***	0.0385***	0.0385***	0.0333***
	(-94.4)1	(-87.36)	(-7.66)	(-7.93)
Constant				-0.8680***
				(-11.52)
Fixed effects	No	CPC & Currency	CPC & Currency	CPC & Currency
Clustering	No	No	CPC	CPC
$Pseudo - R^2$	0.2735	0.3553	0.3553	0.2358
Observations	293285	293100	293100	293285
t-statistics in parentheses		* p<0.05, ** p<0.01, *** p<0.001		

Table VI: Clearing Decision Between Two CMs Based on Currency Pair Exposure

The table presents the marginal effects from probit regressions of the likelihood a trade between two CMs during the UMR period will be cleared, against alternative measures of the netting benefit, for currencies for which clearing was available. Netting benefit is captured by a 0/1 indicator variable (Benefit), which equals 1 if the dollar payer in the trade has an existing long position with the clearinghouse and the dollar taker has an existing short position with the clearinghouse. In column (2), we include CPC and currency fixed effects and adjust the standard errors for clustering.

	1	2
Benefit	0.0436***	0.0374**
	(-16.72)	(-2.57)
Trend	0.0038***	0.0042***
	(-79.03)	(-7.04)
Standard	0.1340***	0.0942***
	(-52.33)	(-7.96)
Tenor	-0.0004***	-0.0004**
	(-13.55)	(-4.11)
SEF	-0.1383***	-0.0940
	(-56.83)	(-1.42)
Notional (Log)	0.0565***	0.0604***
	(-74.97)	(-5.73)
Fixed effects	No	CPC & Currency
Clustering	No	CPC pair
$PseudoR^2$	0.0659	0.1748
Observations	213110	211748
t statistics in parentheses	* p<0.05, ** p<0.01, *** p<0.001	

Table VII: Clearing Decision Between two CMs Based on USD Exposure

The table shows the marginal effects from probit regressions of the likelihood a trade between two CMs during the UMR period will be cleared, against the netting benefit of, across currencies for which clearing was available. Netting benefit is captured by a 0/1 indicator variable (Benefit_USD), which equals 1 if the dollar payer in the trade has an existing long position over all currencies with the clearinghouse and the dollar taker has an existing short position over all currencies with the clearinghouse. In column (2), we include CPC and currency fixed effects and adjust the standard errors for clustering.

	1	2
Benefit_USD	-0.0102***	0.0017
	(-4.07)	(-0.93)
Trend	0.0039***	0.0042***
	(-79.56)	(-7.06)
Standard	0.1335***	0.0940***
	(-52.22)	(-7.98)
Tenor	-0.0004***	-0.0004**
	(-13.68)	(-4.14)
SEF	-0.1390***	-0.0943
	(-57.10)	(-1.42)
Notional (Log)	0.0567***	0.0606***
	(-75.33)	(-5.71)
Fixed effects	No	CPC & Currency
Clustering	No	CPC pair
$PseudoR^2$	0.065	0.1741
Observations	213110	211748
t statistics in parentheses	* p<0.05, ** p<0.01, *** p<0.001	

Table VIII: Probability of a Market-Facing Trade Made by a CM

The table presents marginal effects from probit regressions. The dependent variable is the probability that a market-facing trade is made by a CM. The dependent variable is equal to 1 if the trade involves a CM on at least one side. We limit the sample to CPCs with at least one CM affiliate. Controls variables are defined the same way as in Table 4. Column (1) presents the univariate regression estimates. Column (2) presents multivariate estimates including control variables. Column (3) adds CPC and currency pair fixed effects and column (4) clusters the standard errors by CPC.

	1	2	3	4
UMR	0.0197***	0.0055**	0.0106***	0.0106
	(-22.78)	(-3.14)	(-3.67)	(-1.63)
Trend		0.0001***	0.0001***	0.0001
		(-7.41)	(-4.21)	(-1.35)
Standard		0.0159***	0.0100***	0.0100
		(-14.58)	(-5.45)	(-0.34)
Tenor		0.0000***	0.0000**	0.0000
		(-3.81)	(-2.6)	(-0.46)
SEF		-0.0754***	-0.0840***	-0.0840
		(-87.83)	(-56.27)	(-0.84)
Notional (Log)		-0.0002	0.0004	0.0004
		(-1.58)	(-1.57)	(-0.05)
Fixed effects	No	No	CPC & Currency	CPC & Currency
Clustering	No	No	No	CPC
$Pseudo - R^2$	0.0013	0.0217	0.1521	0.1521
Observations	540569	540568	295101	295101
t-statistics in parentheses		* p<0.05, ** p<0.01, *** p<0.001		