INTERNATIONAL FINANCIAL REGULATION AND CROSS-JURISDICTIONAL ARBITRAGE:

EVIDENCE FROM THE DERIVATIVES MARKET REFORM

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We investigate regulatory arbitrage during the G20's global derivatives market reform. Using hand-collected data on staggered reform progress, we find that banks shift their trading towards less regulated jurisdictions. The result is driven by agenda items – such as the promotion of central clearing – that are costly, but do not directly benefit banks. We further document that subsidiaries in jurisdictions with more reform progress are more profitable but riskier, and – alleviating endogeneity concerns – that reform progress primarily relies on structural factors.

1. Introduction

In the aftermath of the financial crisis, commentators and policymakers quickly identified the largely unchecked over-the-counter (OTC) trading of derivative products as an important contributing factor. These products allowed companies – including, importantly, AIG – to accumulate excessively concentrated exposures and have been implicated in spreading losses from the US housing market across the world economy.[1] While the complexity and connectivity that derivative trading naturally entails can be difficult to manage even under full information, the problem – at the time – was amplified by a global lack of regulatory oversight, reporting requirements, and coordination. Insufficient information not only undermined the risk-sharing that derivatives were initially designed to facilitate, it also diluted signals available to policymakers and complicated the design and implementation of resolution policies.

The G-20 responded to the resulting need for a more comprehensive regulation of derivatives markets as early as 2009 by launching a global reform agenda. This agenda was designed to improve transparency and reduce (systemic) risk in global OTC markets. It comprised of the following five blocks: (i) Establish trade repositories to facilitate surveillance, (ii) promote central clearing of standardised OTC derivatives to reduce counterparty exposures and facilitate resolution, (iii) introduce exchanges/electronic trading platforms to reduce operational risk, and impose higher capital (iv) as well as margin (v) requirements to buffer losses *ex-post* and better align incentives *ex-ante*. The annual cost of the reform for the European derivatives market alone was estimated at 15.5

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[1] In his testimony to the Financial Crisis Inquiry Commission on June 30, 2010, for example, Michael Greenberger suggested that "*it is now almost universally accepted that the unregulated multi-trillion dollar OTC CDS market helped forment a mortgage crisis, then a credit crisis, and finally a "once-in-a-century" systemic financial crisis*". While this assessment has since then been refined (see, for example, Stulz, 2010), it serves to convey the sense of urgency at the time.

billion (bn) EUR, with 13 bn attributed to OTC transactions (Deloitte, 2014).[2] This suggests a potentially severe effect on banks' profits and thus motives for regulatory arbitrage. Such motives are particularly concerning in the context of global reforms, where countries stand to gain from the delayed implementation or weak enforcement of particularly contested agenda items. The concern, in other words, is not merely that traders reallocate their exposures to escape the regulatory burden, but also that countries have incentives to encourage cross-jurisdictional arbitrage and thus – ultimately – to jeopardize the overall success of the reform.

In this paper, we therefore, first, consider the potential endogeneity of cross-jurisdictional differences in regulation, and investigate drivers of reform progress. Controlling for the main drivers of reform progress, we then proceed to investigate the presence and severity of regulatory arbitrage and study implications for banks' riskiness. To this end we have assembled data from publicly available reports by the Financial Stability Board (FSB) and built indices of regulatory progress – for each of the reform blocks and across 18 countries and the European Union (EU) – covering the period from Q1 2010 to Q4 2016. Beyond tracking the adoption of the G-20 agenda, we then use these indices to analyse whether and to what extent US dealers consider reform progress in the destination country when moving their swap activity abroad. The focus on US dealers is interesting, not only because of their relevance for the global derivatives market, but also because it provides a clear opportunity and abundant anecdotal evidence of a motive for regulatory arbitrage. They were subject to early and stringent local regulation under the Dodd-Frank Act but lobbied heavily and successfully for the exemption of overseas affiliates.[3] Since they were nonetheless required to disclose their foreign positions to the Federal Reserve System, we can compare swap activities – in the US and abroad – before and after the adoption of Dodd-Frank. In combination with our reform indices, we can then

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[2] See Figure 1 for a classification of cost categories across the different reform blocks.

[3] See Reuters Special Report "U.S. banks moved billions in trades beyond CFTC's reach", Charles Levinson, August 21st, 2015.
US records show 13 meetings between the then chairman of the Commodity Futures Trading Commission (CFTC) Gary Gensler and representatives of the top 5 US banks in 2010, and 35 with other top CFTC officials in 2011.

investigate, in particular, whether countries were more likely to benefit from the US traders' reallocation if they were less committed to advancing the G-20 agenda.

Our results provide evidence of regulatory arbitrage and suggest that US banks are indeed less likely to move their activities into jurisdictions where the reform has progressed more. This effect, however, is driven by particularly costly reform blocks and not by those that tend to also generate direct benefits for banks (e.g. when electronic trading is promoted). The effects are further mitigated when the enforcement of the formal rule of law is weaker, or in the presence of political risks, i.e. when the gain from arbitrage is dominated by other risks. These findings confirm that banks search for and exploit regulatory loopholes and that countries – consequently – have incentives to delay reform progress. This, ultimately, re-iterates that global financial regulation requires credible commitment mechanisms and coordination if it is to truly eliminate – and not merely to redistribute – risks.

The remainder of the paper is organized as follows. Section 2 relates our analysis to the existing literature on regulatory arbitrage by banks. Section 3 presents our data, Section 4 discusses our econometric setup and identification, and Section 5 presents our results. Section 6 concludes.

2. Related Literature

Our findings align with papers that have documented banks' practice of cross-jurisdictional arbitrage (e.g., Buch, 2003, Houston et al., 2012; Ongena et al., 2013; Gao et al., 2018; Temesvary, 2018). They are also consistent with theory and evidence predicting that banks' risk-taking responds to changes in domestic regulation and/or banks' individual regulatory burden (e.g., Morrison & White, 2009; Laeven & Levine, 2009; Barth et al., 2014; Mariathasan & Merrouche, 2014). This literature has traditionally focused on regulation that affects banks' capitalisation requirement and/or restricts their activities and has paid less attention to the effects on transaction costs. Thus, Houston et al. (2012) study the impact of cross-border differences in banking regulation on international bank flows over the period

1996-2007. They provide evidence that bank capital flows from more restrictive to less restrictive jurisdictions. Temesvary (2018) focuses on US banks' international lending flows over 2003-2013. She shows that US banks' affiliates lend less and are less likely to have affiliates in more regulated jurisdictions. Based on data from 1995 to 2012, Karolyi and Taboada (2015) emphasize that cross-border bank merger and acquisition flows are more likely to involve acquirers in jurisdictions with stricter regulations than that of their target.

In addition, the derivatives market is also a particularly suitable environment for the study of cross-jurisdictional arbitrage, as it is a decidedly global market on which large, international banks trades highly standardized products. In what regards the specific case of the recent OTC derivatives market reform, the existing literature is still very scarce. Papers focus on studying the consequences of the reform on market efficiency and systemic risk. Thus, Benos et al. (2016) show that the US regulation on swap electronic trading reduces execution costs and thus enhances market liquidity. Faruqui, Huang and Takats (2018) point the risk of a destabilizing feedback loop between systemically important banks and central clearing counterparties in OTC derivatives markets. Other papers assess the effectiveness of the reform in terms of incentivizing central clearing (Ghamami and Glasserman, 2016) or for general financial stability (Duffie, 2017).

However, to the best of our knowledge, cross-border differences in the implementation of the recent G20 OTC derivatives market regulation and their consequences on the geography of banks derivatives' activity were not studied in the literature despite their crucial policy implications.

3. Data

3.1. Regulatory Indices

We construct indices of regulatory progress from FSB reports tracking the implementation of the OTC Derivatives Market Reforms. Consistent with the agenda's main blocks, we separately account for progress in (i) trade reporting, (ii) central counter party (CCP) clearing, (iii)

electronic trading, and (iv) capital as well as (v) margin requirements. From the qualitative information in the reports, we construct quantitative indices by assigning values from 0 to 4 to the following circumstances:

0:	No authority exists to implement the reform and no steps are taken to adopt such an authority.
1:	A legislative framework is either in force or published for consultation.
2:	A legislative framework is in force and requirements – at least for some transactions – are published for public consultation.
3:	Requirements – at least for some transactions – have been adopted.
4:	Requirements have been adopted for over 90% of transactions

Values are available for 19 jurisdictions (18 countries + the European Union) and for each quarter between and including Q1 2010 and Q4 2016. We also construct a composite index (*DerivReg*) that is equal to the number of reform blocks for which a country has implemented a fully effective requirement (i.e., for which the sub-index takes on a value of 4). Our indices thus capture depth and scope of reform progress – at least coarsely – in any given country. Table 1 reports values from Q4 2016, for all countries in our sample and Table 2 identifies the quarter for each country and reform block, in which the respective regulatory requirement became fully effective. They primarily provide evidence of substantial heterogeneity across jurisdictions. We see, for example, that all countries have at least one reform block in full effect by Q4 2016, but that only Japan has completed the implementation of all 5 agenda items. It can also be observed that only 5 jurisdictions (Brazil, Japan, Mexico, Switzerland, United States) have fully implemented at least 4 agenda items by Q4 2016, and that these are fairly different in terms of development and/or institutional quality. At the same time, the adoption of the different blocks also fails to follow a clear sequential pattern: Argentina for instance only has capital regulation block in full effects, while the Republic of Korea has only achieved full adoption of the trade reporting block. Based purely on these descriptive statistics it is thus not

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immediately obvious what drives adoption of the G-20 in different countries, which motivates our more systematic analysis in Section 5.

3.2. Derivative Holdings

To investigate regulatory arbitrage, we combine our progress indicators with data on the derivatives holdings by foreign subsidiaries of the 5 largest derivatives traders in the US (Bank of America, Citigroup, Goldman Sachs, JP Morgan, Morgan Stanley).[4] We collect this information from the Federal Reserve System, which provides us with data on the notional values, in particular of the subsidiaries' interest rate and exchange/cross-currency swap positions (US Fed Forms 2314). Descriptive statistics in Figures 2 to 4 provide first evidence of a cross-jurisdictional allocation of these traders' activities. Figure 2 shows – for each bank – the fraction of its total consolidated swap positions that are held in foreign subsidiaries, for Q1 2010 and for Q4 2015, i.e. before and after Dodd-Frank becoming effective. It is evident that this fraction has increased for both interest rate and foreign currency (FX) swaps, and across all banks, with the effect being strongest for Citigroup's interest rate swap positions: they were entirely concentrated in the US in 2010, before more than 60% were shifted outside of the US jurisdiction. In Figures 3 and 4, we further illustrate the geographical distribution of the foreign holdings. We see, for example, that growth – from 2010 to 2015 – was highest in Australia, Brazil, and Mexico (for interest rate swaps) and Australia, China, and Brazil (for FX swaps). As with the descriptive statistics on reform progress, these patterns may be suggestive but are not conclusive; this motivates our more comprehensive analysis in Section 5.

3.3. Bank- & Country-Level Information

We complement our hand-collected reform data, and the information on derivatives holdings from the Fed, with consolidated bank-level data from US Call Reports, macroeconomic data from OECD and

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[4] These 5 institutions account for about 95% of the total US activity.

IMF statistics, and information on the size and liquidity of domestic derivatives markets from the Bank of International Settlement (BIS)'s Triennial Survey of foreign exchange and OTC derivatives trading. Measures of government effectiveness/quality, instead, are obtained from the Word Bank's Governance Indicators Database. Summary statistics for all variables are provided in Table 3. They show, in particular, that the foreign fractions of banks' interest rate swap (IRS) holdings are somewhat smaller than their cross-currency swap (FXS) holdings, with average shares equal to 2.2% and 3.2% respectively. As already indicated by Figures 2 to 4, it is also confirmed that there is substantial heterogeneity across time, banks and destination countries, with pooled standard deviations of 9.5% and 14%.

4. Econometric Setup & Identification

4.1. Hypotheses

Our main hypotheses is that tighter regulation induces regulatory arbitrage. Specifically, we want to investigate whether derivatives traders respond to tighter domestic regulation by moving their activity into less tightly regulated jurisdictions. Because the regulation in these target destinations might be endogenous, however, testing for our main hypothesis requires us to also analyse the drivers of reform progress.[5] Our econometric analysis therefore proceeds in two steps: We first identify the factors that drive reform progress across countries and then control for them in regressions explaining the foreign shares – in each of the non-US countries – of US bank holding companies' consolidated swap positions. The variation in foreign swap shares that is explained by regulatory indices in our second stage regression is then ideally net of structural factors – which are controlled for – and due to differences in the regulatory progress and stringency between the US (where Dodd-Frank meant

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[5] Endogeneity might occur if policymakers choose to relax regulation – or slow down the adaptation of global standards – precisely to attract the derivatives business from US traders.

the G-20 agenda was in full effect early) and the destination country. We complement this analysis by also considering a second dimension of regulatory arbitrage: in addition to moving their derivatives trading abroad, banks might also respond to tighter regulation of the derivatives market by moving away from derivatives trading and/or by compensating for the cost of regulation by engaging in other, potentially riskier but less regulated, activities. To test this additional channel, we thus also analyze subsidiary risk and profits in jurisdictions that implemented more of the reform.

4.2. Determinants of Reform Progress

To identify the determinants of reform progress, we estimate the following discrete-time multilevel logit model with random effects:

$$\log\left(\frac{p_{i,j,t}}{1-p_{i,j,t}}\right) = \log(d_{i,j,t}) \cdot \alpha + x'_{i,j,t} \cdot \beta + u_i + \varepsilon_{i,j,t}, \tag{1}$$

where $p_{i,j,t}$ is the probability of an event – i.e., reform progress – occurring in country i, during interval t of episode j, i.e., the period during which the index remains unchanged; $d_{i,j,t}$ is the cumulative duration by interval t, and $x_{i,j,t}$ is a vector of potentially time-varying covariates that includes cyclical factors such as GDP growth, non-performing loans (NPL), and the Z-score, as well as structural variables, such as derivatives turnover, GDP per capita and regulatory quality; finally, u_i captures unobserved heterogeneity between countries that potentially arises due to the omission of time-invariant variables and $\varepsilon_{i,j,t}$ is the residual error term. In this model, *exp(β)* compares the odds of reform progress for a one-unit increase in (components of) $x_{i,j,t}$, holding u_i constant.

4.3. Cross-Jurisdictional Arbitrage

To investigate cross-jurisdictional arbitrage we use data on the derivatives holdings – consolidated and at non-US subsidiaries – of the US' 5 largest derivatives traders, and the previously mentioned loophole in the Dodd-Frank Act. Building on the suggestive evidence in our descriptive statistics, we run maximum likelihood regressions on a three-dimensional panel, and explain, for each year-quarter (t), the share of each bank (i)'s derivative holdings in country j ($s_{i,j,t}$). Our main explanatory variables of interest are our own indices of reform progress ($I_{i,j,t}$), but we further include cyclical and structural country-level variables ($x_{i,j,t}$), as well as bank and time – or Bank*Quarter – fixed effects to capture unobserved heterogeneity across banks and time.

$$s_{i,j,t} = I_{i,j,t} \cdot \alpha + x'_{i,j,t} \cdot \beta + FE_i + FE_t + \varepsilon_{i,j,t}, \tag{2}$$

Although controlling for those variables that drive reform progress does – as discussed – not eliminate endogeneity concerns, we draw confidence in our estimates of model (2), from the fact that reform progress seems to be driven primarily by structural variables (see Section 5 for more detail), while one might expect derivatives trading to be a primarily cyclical variable. For additional robustness, however, we are currently extending our analysis to also include a genuine two-stage setup.

4.4. Impact on profitability and riskiness of US banks' subsidiaries

Finally, we also investigate whether exposure to tighter domestic regulation of the derivatives market affects the profitability and riskiness of US banks' foreign subsidiaries in the same jurisdiction. That is, whether banks increase their activity in other – possibly less regulated and riskier – markets, either because they are moving out of the derivatives market or because they are compensating for the additional cost of regulation by pursuing a more aggressive strategy. Since we only have access to aggregate balance sheet data, we test this hypothesis by repeating our estimation of model (2) while

replacing the share of derivative holdings with (i) the 4-quarter rolling standard deviation of returns on assets (ROA) and (ii) ROA.[6]

5. Results

5.1. Reform Progress

We first report results for our "first stage" estimation, i.e. for model (1), which explains the determinants of reform progress across the 19 jurisdictions in our sample. Specifically, Table 4 provides discrete time proportional hazard model estimates for factors contributing to the implementation of the G20's derivatives market reform. The dependent variable is a dummy for a 1-unit increase in the regulatory progress indices and each column corresponds to results relating to each of the different reform blocks, i.e., trade repositories, central counterparties, electronic trading platforms and capital requirements.[7] Since Log turnover, as a measure of the depth and liquidity of local derivatives markets, government effectiveness and regulatory quality are highly correlated in our dataset, we include them separately in separate regressions.

We find that – for a given country – an increase in log cumulative duration since the last increase in the regulatory index has a positive and significant impact on the log-odds of a change in the regulatory index. The longer the interval since the last increase in the index, the higher is the probability of a new increase in the index; i.e., of progress in the implementation of the reform. This effect is robust for most regulatory blocks and across the three regressions that include distinct secular factors.

Similarly, a 1-unit increase in the secular factors (log turnover, regulatory quality and government effectiveness) has a positive and significant impact on the log-odds of an increase in the central

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[6] To give less weight to periods when dealers' derivative activity is smaller, we weight estimates by total derivatives notional by subsidiary and quarter

[7] We do not include margin requirements in our analysis because too few countries implemented this block by the end of 2016.

clearing and electronic trading regulatory indexes for a given country. This suggests that more developed and liquid derivatives markets increase the likelihood of an increase in the regulatory index for central clearing and electronic trading blocks. Better regulatory quality and higher government effectiveness are in a given country also plausibly increase the likelihood of regulatory progress, as does Log GDP per capita for trade reporting and central clearing.

The role of cyclical factors is less significant and less robust across different model specifications and regulatory blocks. The effect of the share of non-performing loans, for instance, is positive but not statistically significant, except for the central clearing block; a 1-unit increase in GDP growth, instead, has a positive and significant impact on the electronic trading index, but a negative (albeit less significant) impact on the index for trade reporting. Finally, coefficients for the capital and margin requirements are not significant, because too few countries have progressed with the implementation of this agenda item.

In summary, we conclude that secular factors appear to dominate as explanatory variables for the progression of the reform agenda, which suggests that disparities across countries are likely to be persistent.

5.2. Regulatory Arbitrage

5.2.1. Benchmark

Tables 5 presents the results for our main hypothesis, which uses the global derivative regulation index as an explanatory variable to explain foreign subsidiary shares of US traders' global swap activity. We find that a 1-unit increase in the host country global derivative regulation index has a statistically significant and negative impact on the fraction of both US banks' IRS and FXS activity in this country. This indicates that more advanced host-country derivative regulation reduces US banks' derivatives activity in this country in relative terms, which is in line with the literature on the determinants of banks' international activity and cross-border regulatory arbitrage (e.g., Houston et al., 2012; Karolyi

and Taboada, 2015; Temesvary, 2014, 2015, 2018). The finding is robust to the introduction of the control variables that might otherwise affect US banks' derivatives activity abroad; these variables include the size and liquidity of the local derivatives market, the volatility of local financial markets, and different macroeconomic indicators. It is also robust to controlling for the interaction of bank and quarter fixed effects.

To better understand the drivers of regulatory arbitrage we proceed to also assess which areas of the OTC derivatives market reform have the greatest effect on US banks' foreign derivatives activity. In Table 6, we observe that a 1-unit increase in the host country regulation index has diverse effects on the fraction of banks' swap activity. A 1-unit increase in the host country's central clearing index significantly decreases the fraction of banks' swap activity, especially after adding our control variables. The host country's trade reporting, capital and margin requirements and/or electronic trading indices, instead, do not appear as significant when we also control for other host country characteristics. A possible interpretation of these findings is that the different reform blocks are not equally costly for banks and that the enforcement may be different across areas of the reform. Costs of implementation, relative to direct benefits for the bank also provide an explanation for the central clearing block has the greatest impact; compulsory central counterparty clearing is particularly costly for banks as it implies IT costs in addition to collateral and margin requirements.

Overall, our results suggest that US banks have practiced cross-jurisdictional arbitrage following the implementation of the US OTC derivatives market reform. Moreover, progress in the adoption of central clearing has seemingly had the strongest effect.

5.2.2. Bank Risk & Profitability

Finally, we also report results for our regressions explaining the riskiness and profitability of US banks' foreign subsidiaries. According to Table 7 a, a 1-unit increase in the total derivative regulation index of the host country significantly increases the subsidiary's volatility of returns. When differentiating

by reform block, it appears that a 1-unit increase in the central clearing regulation index significantly increases volatility, whereas a 1-unit increase in the electronic trading index significantly decreases volatility. One possible interpretation of this result is that central counterparty clearing regulation is costly for banks whereas electronic trading enhances market liquidity, reduces costs, and thus attracts greater business (Benos et al., 2016). To compensate for higher regulatory costs, subsidiaries would then be more likely to increase risk-taking in countries where costly reform blocks are more advanced. This interpretation is also consistent with our results on subsidiaries' ROA: progress in central clearing regulation is associated with higher returns on assets whereas progress in electronic trading regulation is associated with lower returns on assets. Therefore, our results suggest that banks increase financial risk, which is associated with higher returns, in more regulated markets.

6. Conclusion

Indicators of progress for the implementation of the OTC derivatives market reform, which we build based on FSB Reports, reveal unequal progress of the reform agenda across G20 countries. These differences in the timing of adoption appear to be mainly related to country-specific structural factors. US banks, for which we observe derivatives holdings at the foreign subsidiary level, appear to have taken advantage of these cross- disparities by moving their swap activity abroad. Differences in regulation also impact returns on assets and risk-taking of US banks' subsidiaries. We observe, in addition, that the more costly, and less directly beneficial agenda items, such as central clearing, had the greatest effect on the migration of swap activity and subsidiaries' risk-taking.

Our results call for increased international coordination and risk-monitoring. They suggest that the global regulation of OTC derivatives markets should ideally be accompanied by tight micro prudential regulation to control for risk-taking. Indeed, our results emphasize that in the absence of worldwide coordination, regulation that increases transaction costs moves risk around but does not eliminate it.

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APPENDIX

A. Figures

Figure 1. Reform Costs

Regulatory block	Cost components	Costs
Trade repository	infrastructure (IT). maintenance. access	$*
Central clearing	collateral. margins. IT	$$$$
Electronic trading	IT. maintenance. access (transitional and fixed)	$*
Capital requirement	economic	$$$$
Margin requirement	economic	$$$$

(*) Can be reduced for small participants.

Figure 2. Main US Dealers' Swap Activity Abroad (Q1 2010 – Q4 2015).

Figures 2 a) and 2 b) present the evolution in the share of consolidated interest rate swap activity and the share of consolidated foreign exchange swap activity abroad for the top 5 US dealers (95% of total US activity): Bank of America. Citigroup. Goldman Sachs. JP Morgan and Morgan Stanley. Fractions were calculated with data from the FED Financial Statement of Foreign Subsidiaries of US Banking Organizations and from the FED Consolidated Financial Statement for Holding Companies. They are equal to the sum of the interest rate swap activity (resp. of the foreign exchange swap activity) by each of the banks' foreign subsidiaries over total consolidated interest rate swap activities (resp. over total consolidated foreign exchange swap activities) of the bank.
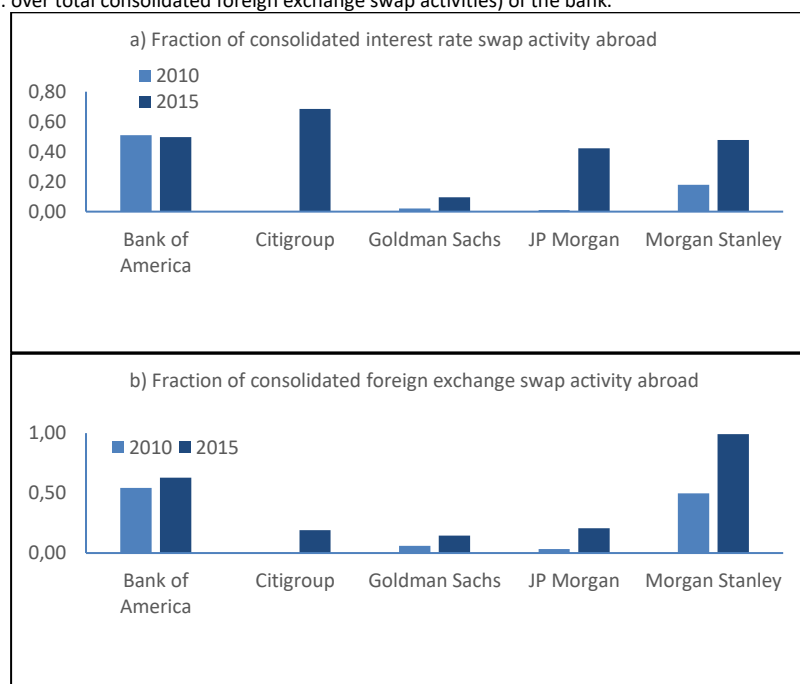
Figure 3. Location of US Banks' Interest Rate Swap Activity (Q1 2010 – Q4 2015).

Figure 3 presents the fraction (in %) of US banks' consolidated interest rate swap activity in each country of the world in Q1 2010 and in Q4 2015. In a given country. this share is calculated as the average of the interest rate swap activity of each of the 5 top US banks in this country relative to total interest rate swap activity operated by the bank. multiplied by 100. Source: FED Financial Statement of Foreign Subsidiaries of US Banking Organizations. FED Consolidated Financial Statement for Holding Companies.
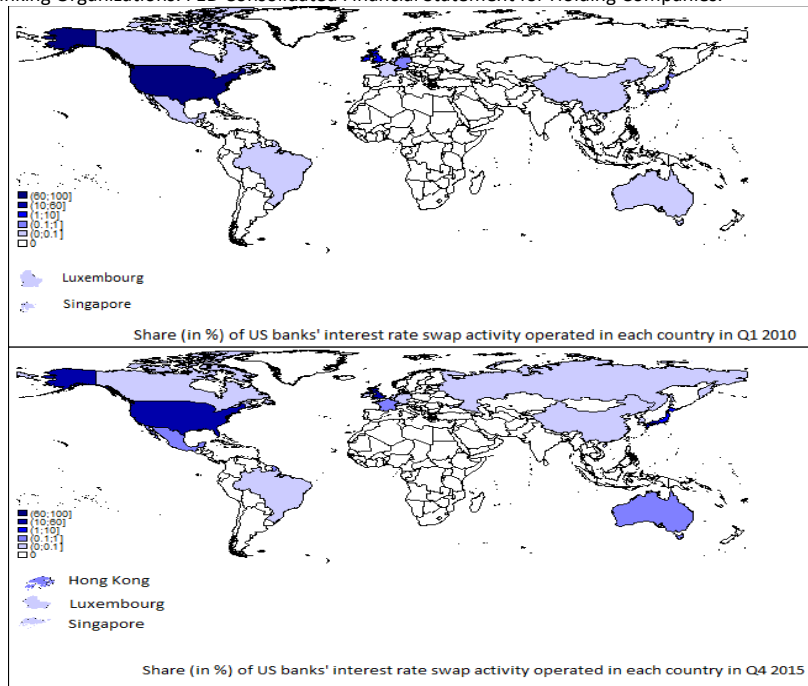
Figure 4. Location of US Banks' Foreign Exchange Swap Activity (Q1 2010 – Q4 2015).

Figure 4 presents the fraction (in %) of US banks' consolidated foreign exchange swap activity in each country of the world in Q1 2010 and in Q4 2015. In a given country. this share is calculated as the average of the foreign exchange swap activity of each of the 5 top US banks in this country relative to total foreign exchange swap activity operated by the bank. multiplied by 100. Source: FED Financial Statement of Foreign Subsidiaries of US Banking Organizations. FED Consolidated Financial Statement for Holding Companies.

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B. Tables

Table 1. Regulatory Indices (Q4 2016)

This table presents the values (from Q4 2016) of our regulatory indices for each country. *Trade reporting*. *Central counterparty clearing*. *Electronic trading*. *Capital requirements* and *Margin requirement* are all indices that measure progress in each individual area of the OTC derivative market regulation. using FSB progress reports for G20 countries. The indices take integer values between 0 and 4. where 0 corresponds to cases in which no auth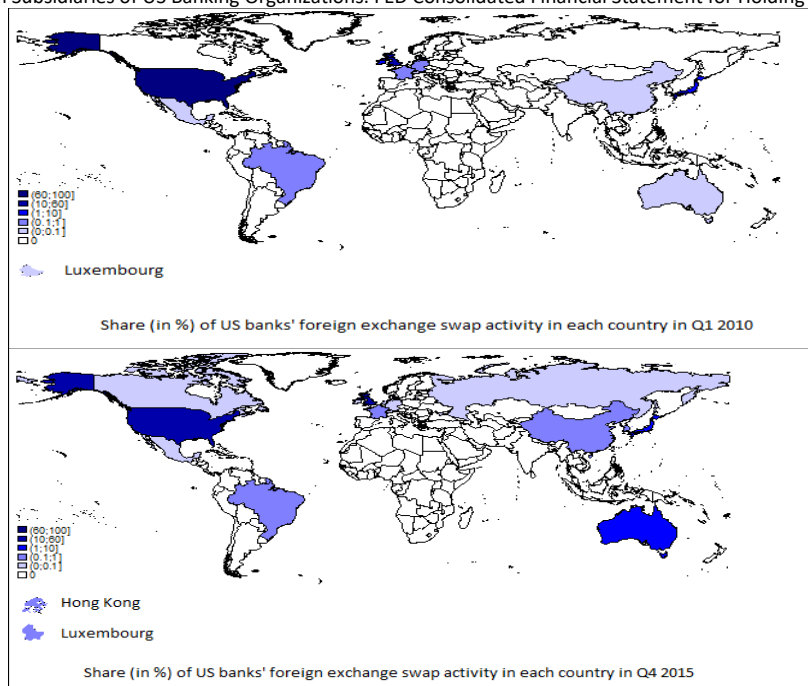ority exists to implement the reform and no steps are taken to adopt such an authority. and 4 corresponds to instances with a legislative framework. in which standards/requirements are in place for over 90% of all transactions. *Total regulation* counts the sub-indices that are equal to 4.

Country	Trade reporting	Central counterparty clearing	Electronic trading	Capital requirements	Margin requirements	Total regulation (*DevReg*)
Argentina	3	3	3	4	1	1
Australia	4	4	4	4	3	4
Brazil	4	4	1	4	1	3
Canada	4	3	2	4	4	3
China	4	4	4	1	0	3
European Union	4	4	3	4	2	3
Hong Kong	3	4	1	4	2	2
India	4	3	3	4	3	2
Indonesia	4	3	4	1	1	2
Japan	4	4	4	4	4	5
Mexico	4	4	4	4	1	4
Republic of Korea	4	3	0	3	1	1
Russia	4	2	1	4	2	2
Saudi Arabia	4	1	1	4	1	2
Singapore	4	4	1	4	3	3
South Africa	2	2	1	4	2	1
Switzerland	3	4	4	4	4	4
Turkey	3	1	1	4	1	1
United States	4	4	4	3	4	4

Table 2. Quarter of Adoption

This table presents the quarters in which the regulatory (sub-)indices reach their maximum value. *Trade reporting*. *Central counterparty clearing*. *Electronic trading*. *Capital requirements* and *Margin requirement* are all indices that measure progress in each individual area of the OTC derivative market regulation. using FSB progress reports for G20 countries. The indices take integer values between 0 and 4. where 0 corresponds to cases in which no authority exists to implement the reform and no steps are taken to adopt such an authority. and 4 corresponds to instances with a legislative framework. in which standards/requirements are in place for over 90% of all transactions.

Country	Trade reporting	Central counterparty clearing	Electronic trading	Capital requirements	Margin requirements	4 Regulation Blocks implemented
Argentina				Q1 2013		
Australia	Q1 2014	Q4 2014	Q2 2016	Q1 2013		Q2 2016
Brazil	Q1 2010	Q4 2014		Q1 2013		
Canada	Q4 2014			Q1 2013	Q1 2016	
China	Q1 2013	Q3 2014	Q3 2013			
European Union	Q1 2014	Q1 2016		Q1 2014		
Hong Kong		Q2 2016		Q1 2013		
India	Q3 2012			Q1 2013		
Indonesia	Q1 2013		Q1 2013			
Japan	Q3 2012	Q3 2012	Q3 2015	Q1 2013	Q1 2016	Q3 2015
Mexico	Q1 2013	Q2 2016	Q2 2016	Q1 2016		Q2 2016
Republic of Korea	Q3 2012					
Russia	Q4 2015			Q1 2013		
Saudi Arabia	Q1 2013			Q1 2013		
Singapore	Q2 2015	Q4 2014		Q1 2013		
South Africa				Q1 2013		
Switzerland		Q1 2016	Q1 2016	Q1 2013	Q1 2016	Q1 2016
Turkey				Q4 2015		
United States	Q1 2012	Q3 2012	Q3 2013		Q2 2016	Q2 2016

Table 3. Descriptive Statistics

This table reports descriptive statistics for our main variables. *Country-level*bank variables* and *subsidiary* level data are quarterly data extracted from US form 2314 and cover the period Q1 2010 to Q4 2016. Consolidated data are from US calls reports. Country-level macroeconomic data are from the OECD database. Volatility is calculated as the 4-quarter rolling standard deviation of returns on assets (ROA). Sharpe ratio is ROA divided by volatility. 4-quarters rolling standard deviations are also used to calculate interest rate and exchange rate volatility. Turnover is from the BIS derivatives database. Government Effectiveness captures perceptions of the quality of public services. the quality of civil service and its degree of independence from political pressures. the quality of policy formulation and implementation. and the credibility of the government's commitment to such policies. Regulatory Quality captures perceptions of the ability of the government to formulate and implement policies and regulations that permit and promote private sector development.

Variable	Mean	Sd	25th pct.	50th pct.	75th pct.
Dependent variables					
*Country-level*bank variables*					
Fraction of bank's IRS activity in a given country	0.022	0.095	0.000	0.000	0.001
Fraction of bank's FXS activity in a given country	0.032	0.140	0.000	0.000	0.003
Subsidiary-level variables					
Returns on assets	0.037	0.181	-0.008	0.008	0.048
Volatility	0.098	0.332	-0.008	0.009	0.049
Sharpe ratio	1.024	1.017	0.188	1.010	1.709
Consolidated level					
Returns on assets	2.221	1.026	1.539	2.141	2.635
Volatility	2.231	0.716	1.747	2.051	2.485
Sharpe ratio	1.011	0.363	0.717	1.104	1.309
Explanatory variables					
Country-level variables					
GDP growth	0.680	0.940	0.200	0.600	1.100
Log GDP per capita	10.275	0.546	9.828	10.492	10.709
Inflation	2.558	2.546	0.881	2.156	3.615
Log turnover	11.337	1.724	10.244	11.018	12.550
Log turnover IRS	9.869	1.937	8.171	10.393	11.100
Log turnover FXS	11.445	1.375	10.377	11.595	12.427
Interest rate volatility	4.096	6.469	0.677	1.671	4.461
Exchange rate volatility	0.026	0.013	0.018	0.026	0.033
Regulatory quality	0.765	0.884	-0.004	0.796	1.691
Government effectiveness	0.865	0.838	0.073	0.758	1.627
Subsidiary-level variables					
Log total assets	15.970	1.745	14.792	15.813	17.190
Equity/assets	0.358	0.284	0.131	0.265	0.524
Loans/deposits	2.836	3.723	0.421	1.056	3.917

	I	II	III	IV
	TR	CCP	ETP	KA
GDP growth	-0.512	-0.284	0.457	-2.715
	(0.186)***	(0.283)	(0.234)*	(9.318)
Log GDP per capita	2.750	4.208	1.604	8.229
	(1.732)+	(1.626)***	(0.930)*	(20.503)
Log Duration	6.902	5.580	1.411	33.911
	(1.525)***	(2.277)**	(0.372)***	(258.331)
Constant	-47.038	-59.887	-24.788	-169.809
	(19.102)**	(23.524)**	(9.528)***	(858.169)
N	354	502	527	375

Impaired loans/total assets	0.000	0.001	0.000	0.000	0.000
Consolidated level					
Log total assets	21.103	0.466	20.579	21.364	21.503
Equity/assets	9.204	1.444	8.102	8.851	10.365
Loans/deposits	1.437	0.630	1.102	1.365	1.547
Impaired loans/total assets	0.005	0.006	0.000	0.003	0.007
Share of bank's IRS activity abroad	0.278	0.284	0.025	0.181	0.525
Share of bank's FXS activity abroad	0.406	0.401	0.046	0.206	0.848
Share of bank's derivative activity abroad	0.021	0.020	0.003	0.016	0.038

Table 4. Timing of the Reform

This table reports discrete time proportional hazard model estimates of factors that contribute to delays the implementation of derivatives markets reforms. Each column corresponds to results relating to each of the 4 blocks of the reform: trade repositories (TR), central counterparties (CCP), electronic trading platforms (ETP), and capital requirements (KA). Standard errors (not reported) clustered by country*year; * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table 5. Timing of the Reform (Robustness)

This table reports estimates of variables added one at a time in the regressions reported in Table 3. Zscore is an accounting-based measure of the distance to default of the banking sector. Higher z-score means greater stability. NPL is the ratio of banks total overdue loans divided by total assets. Log Turnover is the log of the turnover of derivatives markets in a given country. Regulatory quality and government effectiveness are from the World Bank governance indicators database (1)(2). Standard errors (not reported) are clustered by country*year; * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Covariates	I	II	III	IV
	TR	CCP	ETP	KA
Secular factors				
Log Turnover	1.163	1.972***	0.740***	0.284
Regulatory quality	1.159	5.291	1.267*	0.624
Government effectiveness	1.605	3.706*	1.687*	0.736
Cyclical factors				
NPL	0.039	0.265	0.124	0.536
Z-score	0.650	0.152	0.243**	0.299

Table 6. Regulatory Arbitrage (US Swap Activity Abroad)

a) <u>Evidence of regulatory arbitrage in US interest rate swap activity abroad.</u>

This table reports results from regressions of interest rate swap (IRS) activity operated abroad by one of the top 5 US dealers: Bank of America, Citigroup, Goldman Sachs, JP Morgan and Morgan Stanley (95% of US activity) over the period 2010 Q1-2015 Q4. Each observation corresponds to the foreign subsidiary of one of the five banks, in a given country and a given quarter. The dependent variable, *fraction of banks' IRS activity in a given country*, is the fraction of consolidated interest rate swap that one of the five US dealers operates in a given foreign country in a given quarter. Activity is measured by notional. The aggregate index covers 5 areas: trade reporting, central clearing, electronic trading, capital and margin requirements. The index takes integer values between 0 and 5: it takes value 0 when regulation is not enforced in any of the 5 areas and value 5 when regulation is enforced and implemented in all 5 areas. *Inflation* is measured as the year-on-year growth rate of the CPI. *Log(GDP per capita)* is the logged gross domestic product at purchasing power parity divided by population. *GDP growth* is measured as the year-on-year percent change in GDP at constant prices. *Log(turnover)* is the logged daily average turnover of OTC interest rate swaps, i.e., the total amount of IRS contracts traded in a day at the country level. Data comes from the BIS Triennial Survey of foreign exchange and OTC derivatives trading. *Interest rate volatility* is measured as the standard deviation of the three-month interbank rate (extracted from the OECD database) over the last twelve months multiplied by the square root of the number of market days. For Brazil, the rate is the immediate interbank rate whereas for Singapore and Hong-Kong, the rate is respectively the 3-month SIBOR rate and the 3-month HIBOR fixing rate (extracted from national sources). Estimates are weighted by dollar amounts of interest rate swap notional by subsidiary and quarter to give less weight to periods when dealers' activity abroad is small. Standard errors clustered by country*year are reported in parentheses. ***, **, * respectively indicate statistical significance at 1%, 5% and 10% level.

Dependent variable:	Fraction of bank's IRS activity in a given country	Fraction of bank's IRS activity in a given country	Fraction of bank's IRS activity in a given country	Fraction of bank's IRS activity in a given country
	(1)	(2)	(3)	(4)
Derivative regulation index	-0.113**	-0.107**	-0.089***	-0.080***
	(0.045)	(0.053)	(0.026)	(0.029)
Inflation (%)			-0.087***	-0.084***
			(0.016)	(0.018)
Log(GDP per capita)			0.287***	0.342**
			(0.105)	(0.148)
GDP growth (%)			-0.013	-0.023
			(0.014)	(0.014)
Log(turnover)			0.037***	0.056***
			(0.011)	(0.007)
Interest rate volatility			0.073***	0.081***
			(0.015)	(0.020)
Bank FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Bank*quarter FE	No	No	No	No
R^2	0.56	0.70	0.70	0.82
N	946	946	926	927

b) Evidence of regulatory arbitrage in US foreign exchange swap activity abroad.

This table reports results from regressions of foreign exchange swap (FXS) activity operated abroad by one of the top 5 US dealers: Bank of America, Citigroup, Goldman Sachs, JP Morgan and Morgan Stanley (95% of US activity) over the period 2010 Q1-2015 Q4. Each observation corresponds to the foreign subsidiary of one of the five banks, in a given country and a given quarter. The dependent variable, *fraction of bank's FXS activity in a given country*, is the fraction of consolidated foreign exchange swap that one of the 5 US dealers operates in a given foreign country in a given quarter. Activity is measured by notional. Fractions were calculated with data from the FED Financial Statement of Foreign Subsidiaries of US Banking Organizations and from the FED Consolidated Financial Statement for Holding Companies. *Derivative regulation index* is an aggregate index of the OTC derivative market regulation in each bank subsidiary's country, that we constructed using FSB progress reports on reforms to OTC derivatives markets for G20 countries. The aggregate index covers 5 areas: trade reporting, central clearing, electronic trading, capital and margin requirements. The index takes integer values between 0 and 5: it takes value 0 when regulation is not enforced in any of the 5 areas and value 5 when regulation is enforced and implemented in all 5 areas. *Inflation* is measured as the year-on-year growth rate of the CPI. *Log(GDP per capita)* is the logged gross domestic product at purchasing power parity divided by population. *GDP growth* is measured as the year-on-year percent change in GDP at constant prices. *Log(turnover)* is the logged daily average turnover of OTC foreign exchange swaps, i.e., the total amount of FXS contracts traded in a day at the country level. Data comes from the BIS Triennial Survey of foreign exchange and OTC derivatives trading. *Exchange rate volatility* is measured as the standard deviation of the monthly log change in the bilateral exchange rates with USD over the last twelve months. Estimates are weighted by dollar amounts of foreign exchange swap notional by subsidiary and quarter to give less weight to periods when dealers' activity abroad is small. Standard errors clustered by country*year are reported in parentheses.

Dependent variable:	Fraction of bank's FXS activity in a given country	Fraction of bank's FXS activity in a given country	Fraction of bank's FXS activity in a given country	Fraction of bank's FXS activity in a given country
	(1)	(2)	(3)	(4)
Derivative Regulation Index	-0.133***	-0.167***	-0.144***	-0.208***
	(0.042)	(0.043)	(0.047)	(0.044)
Inflation (%)			-0.037*	-0.049**
			(0.020)	(0.024)
Log(GDP per capita)			0.022	0.014
			(0.159)	(0.193)
GDP growth (%)			-0.038*	-0.047
			(0.020)	(0.028)
Log(turnover)			0.002	-0.002
			(0.013)	(0.017)
Exchange rate volatility			-0.029	3.183
			(4.399)	(5.669)
Bank FE	yes	no	yes	no
Quarter FE	yes	no	yes	no
Bank*quarter FE	no	yes	no	yes
R^2	0.76	0.80	0.78	0.83
N	754	754	747	747

Table 7. Regulatory Arbitrage (Individual Regulation Areas)

a) <u>Evidence of regulatory arbitrage in US interest rate swap activity abroad: individual regulation areas.</u>

This table reports results from regressions of interest rate swap (IRS) activity operated abroad by one of the top 5 US dealers. The dependent variable, *fraction of bank's IRS activity in a given country*, is the fraction of consolidated interest rate swap that one of the 5 US dealers operates in a given foreign country in a given quarter. Activity is measured by notional. Fractions were calculated with data from the FED Financial Statement of Foreign Subsidiaries of US Banking Organizations and from the FED Consolidated Financial Statement for Holding Companies. *Trade reporting regulation index*, *Central clearing regulation index*, *Electronic trading regulation index* and *Capital requirements regulation index* are indexes that measure progress in each individual area of the OTC derivative market regulation. Each individual regulation area index takes integer values between 0 and 4: it takes value 0 when no authority exists to implement reform and no steps are taken to adopt such authority and it takes value 4 when a legislative framework or other authority is in force and when standards/requirements are in force with respect to over 90% of transactions. *Interest rate volatility* is measured as the standard deviation of the three-month interbank rate (extracted from the OECD database) over the last twelve months multiplied by the square root of the number of market days. Estimates are weighted by dollar amounts of interest rate swap notional by subsidiary and quarter to give less weight to periods when dealers' activity abroad is small. Standard errors clustered by country*year are reported in parentheses.

Dependent variable:	Fraction of bank's IRS activity in a given country	Fraction of bank's IRS activity in a given country	Fraction of bank's IRS activity in a given country	Fraction of bank's IRS activity in a given country
	(1)	(2)	(3)	(4)
Trade reporting regulation index	0.119	0.149**	-0.005	-0.012
	(0.072)	(0.071)	(0.058)	(0.047)
Central clearing regulation index	-0.150**	-0.192***	-0.107**	-0.142***
	(0.061)	(0.063)	(0.043)	(0.041)
Capital requirements regulation index	-0.148	-0.032	-0.112	0.054
	(0.117)	(0.103)	(0.102)	(0.100)
Electronic trading regulation index	0.012	0.028	0.030	0.050
	(0.039)	(0.041)	(0.041)	(0.032)
Inflation (%)			-0.091***	-0.095***
			(0.016)	(0.017)
Log(GDP per capita)			0.350***	0.294**
			(0.116)	(0.143)
GDP growth (%)			-0.024*	-0.037***
			(0.014)	(0.013)
Log(turnover)			0.050***	0.057***
			(0.005)	(0.007)
Interest rate volatility			0.073***	0.079***

			(0.015)	(0.020)
Bank FE	yes	no	yes	no
Quarter FE	yes	no	yes	no
Bank*quarter FE	no	yes	no	yes
R^2	0.57	0.71	0.70	0.83
N	946	946	927	927

b) Evidence of regulatory arbitrage in US foreign exchange swap activity abroad: individual regulation areas.

This table reports results from regressions of foreign exchange swap (FXS) activity operated abroad by one of the top 5 US dealers: Bank of America, Citigroup, Goldman Sachs, JP Morgan and Morgan Stanley (95% of US activity) over the period 2010 Q1-2015 Q4. Each observation corresponds to the subsidiary of one of the five banks, in a given foreign country and a given quarter. The dependent variable, *fraction of bank's FXS activity in a given country*, is the fraction of consolidated interest rate swap that one of the 5 US dealers operates in a given foreign country in a given quarter. Activity is measured by notional. Fractions were calculated with data from the FED Financial Statement of Foreign Subsidiaries of US Banking Organizations and from the FED Consolidated Financial Statement for Holding Companies. *Trade reporting regulation index*, *Central clearing regulation index*, *Electronic trading regulation index*, *Capital requirements regulation index* are indexes that measure progress in each individual area of the OTC derivative market regulation, using FSB progress reports on reforms to OTC derivatives markets for G20 countries. Each individual regulation area index takes integer values between 0 and 4: it takes value 0 when no authority exists to implement reform and no steps are taken to adopt such authority and it takes value 4 when a legislative framework or other authority is in force and when standards/requirements are in force with respect to over 90% of transactions. *Inflation* is measured as the year-on-year growth rate of the CPI. *Log(GDP per capita)* is the logged gross domestic product at purchasing power parity divided by population. *GDP growth* is measured as the year-on-year percent change in GDP at constant prices. Data comes from the OECD and the IMF Statistics. *Log(turnover)* is the logged daily average turnover of OTC interest rate swaps in a given country, i.e., the total amount of IRS contracts traded in a day at the country level. Data comes from the BIS Triennial Survey of foreign exchange and OTC derivatives trading. *Exchange rate volatility* is measured as the standard deviation of the monthly log change in the bilateral exchange rates with USD over the last twelve months. Estimates are weighted by dollar amounts of foreign exchange swap notional by subsidiary and quarter to give less weight to periods when dealers' activity abroad is small. Standard errors clustered by country*year are reported in parentheses. ***, **, * respectively indicate statistical significance at 1%, 5% and 10% level.

Dependent variable:	Fraction of bank's FXS activity in a given country	Fraction of bank's FXS activity in a given country	Fraction of bank's FXS activity in a given country	Fraction of bank's FXS activity in a given country
	(1)	*(2)*	*(3)*	*(4)*
Trade reporting regulation index	-0.029	-0.049	-0.034	-0.057
	(0.063)	(0.070)	(0.072)	(0.088)
Central clearing regulation index	-0.090	-0.076	-0.158***	-0.172**
	(0.060)	(0.069)	(0.055)	(0.067)
Capital requirements regulation index	-0.012	-0.024	-0.008	-0.077
	(0.035)	(0.043)	(0.087)	(0.102)
Electronic trading regulation index	0.026	0.024	-0.000	-0.000
	(0.025)	(0.035)	(0.030)	(0.041)
Inflation (%)			-0.059***	-0.072***
			(0.021)	(0.027)
Log(GDP per capita)			0.018	0.059
			(0.209)	(0.264)
GDP growth (%)			-0.045**	-0.055**
			(0.018)	(0.027)
Log(turnover)			0.009	0.006
			(0.013)	(0.017)

Exchange rate volatility			2.026	5.597
			(4.218)	(5.837)
Bank FE	yes	no	yes	no
Quarter FE	yes	no	yes	no
Bank*quarter FE	no	yes	no	yes
R^2	0.75	0.79	0.79	0.83
N	754	754	747	747

Table 8. Derivative Market Regulation and Subsidiary Risk and Return

a) <u>Impact of the derivative market regulation in the host country on the subsidiary's returns on assets</u>

Dependent variable:	Returns on assets	Returns on assets	Returns on assets	Returns on assets
	(1)	(2)	(3)	(4)
Derivative regulation index	-0.002	0.006		
	(0.019)	(0.010)		
Trade reporting regulation index			0.018	0.018
			(0.020)	(0.014)
Central clearing regulation index			0.047**	0.021
			(0.021)	(0.013)
Capital requirements regulation index			-0.047	-0.023
			(0.038)	(0.026)
Electronic trading regulation index			-0.045***	-0.016
			(0.016)	(0.012)
Log(total assets)	0.018	0.036***	0.024*	0.035***
	(0.011)	(0.010)	(0.012)	(0.010)
Equity/assets	0.071	0.096	-0.044	0.014
	(0.180)	(0.094)	(0.189)	(0.100)
Loans/deposits	0.000	-0.000***	0.000	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Impaired loans/Total assets	-2.324	30.179**	-17.153	17.892
	(15.047)	(14.486)	(19.247)	(12.570)
Inflation (%)	-0.035***	-0.019**	-0.028***	-0.016**
	(0.008)	(0.008)	(0.007)	(0.008)
Log(GDP per capita)	-0.214***	-0.197***	-0.170**	-0.166***
	(0.063)	(0.028)	(0.066)	(0.031)
GDP growth (%)	0.009	-0.004	0.017	-0.001
	(0.013)	(0.008)	(0.015)	(0.006)
Bank FE	yes	no	yes	no

Quarter FE	yes	no	yes	no
Bank*quarter FE	no	yes	no	yes
R^2	0.46	0.90	0.51	0.90
N	471	471	471	471

This table reports results from regressions of returns on assets of US banks' subsidiaries over the period 2010 Q1-2015 Q4. Each observation corresponds to the foreign subsidiary of one of the five banks, in a given country and a given quarter. The data are winsorized at level 1% and 99%. *Derivative regulation index* is an aggregate index of the OTC derivative market regulation, that we constructed using FSB progress reports on reforms to OTC derivatives markets for G20 countries. The aggregate index covers 4 areas: trade reporting, central clearing, electronic trading, and capital. The index takes integer values between 0 and 5: it takes value 0 when regulation is not enforced in any of the 5 areas and value 5 when regulation is enforced and implemented in all 5 areas. *Trade reporting regulation index*, *Central clearing regulation index*, *Electronic trading regulation index* and *Capital requirements regulation index* are indexes that measure progress in each individual area of the OTC derivative market regulation, using FSB progress reports on reforms to OTC derivatives markets for G20 countries. Each individual regulation area index takes integer values between 0 and 4: it takes value 0 when no authority exists to implement reform and no steps are taken to adopt such authority and it takes value 4 when a legislative framework or other authority is in force and when standards/requirements are in force with respect to over 90% of transactions. *Log(total assets)* is the logged amount of total assets of the subsidiary. *Equity/assets* is the ratio of the subsidiary's capital equity over total assets. *Loans/deposits* is the ratio of the subsidiary's loans over total deposits. *Impaired loans/Total assets* is the ratio of loans and leases past due 90 days or more over total assets at the subsidiary level. Data comes from the FED Financial Statement of Foreign Subsidiaries of US Banking Organizations. *Inflation* is measured as the year-on-year growth rate of the CPI. *Log(GDP per capita)* is the logged gross domestic product at purchasing power parity divided by population. *GDP growth* is measured as the year-on-year percent change in GDP at constant prices. Estimates are weighted by dollar amounts of total derivatives notional by subsidiary and quarter to give less weight to periods when dealers' derivative activity is smaller. Standard errors clustered by country*year are reported in parentheses.

b) <u>Impact of the derivative market regulation in the host country on the subsidiary's volatility</u>

This table reports results from regressions of volatility of US banks' subsidiaries over the period 2010 Q1-2015 Q4. Each observation corresponds to the foreign subsidiary of one of the five banks, in a given country and a given quarter. The data are winsorized at level 1% and 99%. *Derivative regulation index* is an aggregate index of the OTC derivative market regulation, that we constructed using FSB progress reports on reforms to OTC derivatives markets for G20 countries. The aggregate index covers 5 areas: trade reporting, central clearing, electronic trading, capital and margin requirements. The index takes integer values between 0 and 5: it takes value 0 when regulation is not enforced in any of the 5 areas and value 5 when regulation is enforced and implemented in all 5 areas. *Trade reporting regulation index*, *Central clearing regulation index*, *Electronic trading regulation index* and *Capital requirements regulation index* are indexes that measure progress in each individual area of the OTC derivative market regulation, using FSB progress reports on reforms to OTC derivatives markets for G20 countries. Each individual regulation area index takes integer values between 0 and 4: it takes value 0 when no authority exists to implement reform and no steps are taken to adopt such authority and it takes value 4 when a legislative framework or other authority is in force and when standards/requirements are in force with respect to over 90% of transactions. *Log(total assets)* is the logged amount of total assets of the subsidiary. *Equity/assets* is the ratio of the subsidiary's capital equity over total assets. *Loans/deposits* is the ratio of the subsidiary's loans over total deposits. *Impaired loans/Total assets* is the ratio of loans and leases past due 90 days or more over total assets at the subsidiary level. Data comes from the FED Financial Statement of Foreign Subsidiaries of US Banking Organizations. *Inflation* is measured as the year-on-year growth rate of the CPI. *Log(GDP per capita)* is the logged gross domestic product at purchasing power parity divided by population. *GDP growth* is measured as the year-on-year percent change in GDP at constant prices. Data comes from the OECD and the IMF Statistics. Estimates are weighted by dollar amounts of derivatives notional by subsidiary and quarter to give less weight to periods when dealers' derivative activity is smaller. Standard errors clustered by country*year are reported in parentheses. ***, **, * respectively indicate statistical significance at 1%, 5% and 10% level.

Dependent variable:	Volatility	Volatility	Volatility	Volatility
	(1)	(2)	(3)	(4)
Derivative regulation index	0.019*	0.020**		
	(0.011)	(0.008)		
Trade reporting regulation index			0.016	0.011
			(0.013)	(0.012)
Central clearing regulation index			0.042***	0.031***
			(0.013)	(0.010)
Capital requirements regulation index			-0.007	0.005
			(0.032)	(0.024)
Electronic trading regulation index			-0.029**	-0.015**
			(0.011)	(0.008)
Log(total assets)	0.017**	0.035***	0.018***	0.032***
	(0.007)	(0.007)	(0.006)	(0.008)
Equity/assets	0.015	0.132	-0.070	0.053
	(0.148)	(0.095)	(0.146)	(0.087)
Loans/deposits	0.000	-0.000***	0.000	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Impaired loans/assets	-0.700	23.891*	-15.953	8.695
	(13.128)	(12.376)	(15.440)	(9.615)
Inflation (%)	-0.039***	-0.023***	-0.034***	-0.021***
	(0.006)	(0.005)	(0.005)	(0.006)
Log(GDP per capita)	-0.218***	-0.218***	-0.211***	-0.222***
	(0.043)	(0.033)	(0.035)	(0.035)
GDP growth (%)	0.005	-0.002	0.010	0.002
	(0.008)	(0.007)	(0.008)	(0.005)
Bank FE	yes	no	yes	no
Quarter FE	yes	no	yes	no
Bank*quarter FE	no	yes	no	yes
R^2	0.67	0.89	0.70	0.90
N	434	434	434	434

c) Impact of the derivative market regulation in the host country on the subsidiary's Sharpe ratio

This Table reports results from regressions of volatility of US banks' subsidiaries over the period 2010 Q1-2015 Q4. Each observation corresponds to the foreign subsidiary of one of the five banks, in a given country and a given quarter. The data are winsorized at level 1% and 99%. *Derivative regulation index* is an aggregate index of the OTC derivative market regulation, that we constructed using FSB progress reports on reforms to OTC derivatives markets for G20 countries. The aggregate index covers 5 areas: trade reporting, central clearing, electronic trading, capital and margin requirements. The index takes integer values between 0 and 5: it takes value 0 when regulation is not enforced in any of the 5 areas and value 5 when regulation is enforced and implemented in all 5 areas. *Trade reporting regulation index*, *Central clearing regulation index*, *Electronic trading regulation index* and *Capital requirements regulation index* are indexes that measure progress in each individual area of the OTC derivative market regulation, using FSB progress reports on reforms to OTC derivatives markets for G20 countries. Each individual regulation area index takes integer values between 0 and 4: it takes value 0 when no authority exists to implement reform and no steps are taken to adopt such authority and it takes value 4 when a legislative framework or other authority is in force and when standards/requirements are in force with respect to over 90% of transactions. *Log(total assets)* is the logged amount of total assets of the subsidiary. *Equity/assets* is the ratio of the subsidiary's capital equity over total assets. *Loans/deposits* is the ratio of the subsidiary's loans over total deposits. *Impaired loans/Total assets* is the ratio of loans and leases past due 90 days or more over total assets at the subsidiary level. Data comes from the FED Financial Statement of Foreign Subsidiaries of US Banking Organizations. *Inflation* is measured as the year-on-year growth rate of the CPI. *Log(GDP per capita)* is the logged gross domestic product at purchasing power parity divided by population. *GDP growth* is measured as the year-on-year percent change in GDP at constant prices. Data comes from the OECD and the IMF Statistics. Estimates are weighted by dollar amounts of derivatives notional by subsidiary and quarter to give less weight to periods when dealers' derivative activity is smaller. Standard errors clustered by country*year are reported in parentheses. ***, **, * respectively indicate statistical significance at 1%, 5% and 10% level.

	Sharpe ratio	Sharpe ratio	Sharpe ratio	Sharpe ratio
	(1)	(2)	(3)	(4)
Derivative regulation index	-0.253	-0.327		
	(0.178)	(0.256)		
Trade reporting regulation index			-0.490***	-0.585**
			(0.164)	(0.259)
Central clearing regulation index			0.187	0.244
			(0.198)	(0.240)
Capital requirements regulation index			-0.202	-0.166
			(0.179)	(0.247)
Electronic trading regulation index			0.086	0.110
			(0.179)	(0.217)
Log(total assets)	-0.053	-0.128	0.037	0.125
	(0.069)	(0.100)	(0.088)	(0.132)
Equity/assets	1.653	2.486	1.711	2.011*
	(1.287)	(1.825)	(1.121)	(1.196)
Loans/deposits	-0.000*	-0.000	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Impaired loans/assets	172.723	64.354	105.035	82.645
	(211.762)	(177.260)	(181.041)	(200.588)
GDP growth (%)	-0.066	-0.071	-0.034	0.008

	(0.057)	(0.048)	(0.064)	(0.055)
Log(GDP per capita)	0.254	0.357	0.040	-0.133
	(0.251)	(0.328)	(0.397)	(0.607)
Inflation (%)	0.096**	0.098**	0.087*	0.176**
	(0.037)	(0.038)	(0.050)	(0.077)
Bank FE	yes	no	yes	no
Quarter FE	yes	no	yes	no
Bank*quarter FE	no	yes	no	yes
R^2	0.70	0.87	0.70	0.88
N	434	434	434	434