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Out of sight, out of mind? On the risk of sub-custodian structures

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ABSTRACT

We analyse sub-custodian chains using a unique data set from a survey. Our key question is whether there is evidence for moral hazard in the delegation of asset safe-keeping to sub-custodians. Sub-custodian chains can be relatively long and frequently reach across several countries. The risk that securities are lost or the return to their owners delayed is not negligible. Our findings highlight that foreign or better informed banks are associated with shorter sub-custodian chains. Better capitalised banks seem to have longer, but safer sub-custodian chains. Our findings support the view that central securities depositories (CSDs) play a beneficial role in the management of sub-custodian structures. A CSD as the first sub-custodian reduces the country risk in sub-custodian structures. When we analyse the choice of a CSD, we find that better capitalised, larger and foreign banks are less likely to rely on CSDs as their first sub-custodian.

1. Introduction

This paper assesses the asset custody industry with a focus on risks in sub-custodians chains and the role of centralised securities depositories (CSDs) in these chains. Asset custody services consist in holding and administrating financial assets on behalf of customers. Custodian banks who offer these services typically delegate the safe-keeping of foreign securities to other banks acting as sub-custodians located in the countries where the securities have been issued and where they are traded.[1] CSDs play a central role in these chains as they frequently act as sub-custodians and provide a range of additional services for custodians.

The asset custody industry has experienced a dramatic growth in recent years due to a rising investor appetite for cross-border investments.[2] However, the delegation of safe-keeping to foreign sub-custodians can result in opaque structures involving chains of several sub-custodians in different countries. In the case of a sub-custodian defaulting or in cases of fraud, investors stand to lose their investment when local securities laws do not provide adequate protection (Micheler, 2014). This risk is further enhanced when various national securities laws applicable to the different levels in a security chain are not compatible (Thevenoz, 2007). As a consequence, long custody chains that transcend several jurisdictions are inherently more risky than shorter chains.[3] Examples where such custody risks have led to losses by investors are so far rather rare but can be material.

The most prominent example is the Madoff case, where investors in investment funds, including European feeder funds, faced losses of assets allegedly held in custody at one of Madoff's entities. Following the Maddoff arrest, 17 Luxembourg based investment funds had to suspend redemptions leading to a dozen lawsuits against custodians overseeing the funds. UBS and HSBC have been at the centre of these lawsuits and both banks have settled a number of cases.[4] In terms of losses to investors, UCITS funds had an exposure of EUR1.7 billion to Madoff.[5] Moreover, the custodian

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[1] According to globalcustody.net assets under custody are heavily concentrated among the top 10 custodian banks. The majority of these custodian banks are on the list of global systemically important banks. At the end of 2013, the top 10 custodian banks managed more than USD110 trillion of assets either directly or as sub-custodians.

[2] See for example http://www.forbes.com/sites/greatspeculations/2014/08/29/global-custody-banks-continue-to-see-strong-growth-in-asset-base-over-q2/.

[3] For further information, see "Explanatory Notes to the Preliminary Draft UNIDROIT Convention on Harmonised Substantive Rules regarding Securities Held with an Intermediary Examples" in Uniform Law Review 2005–1/2, 36–114.

[4] According to globalcustodynet, UBS and HSBC were among the 10 largest custodian banks worldwide at the end of 2013.

[5] See official statement by Luxembourgish supervisory authority under http://www.cssf.lu/fileadmin/files/Publications/Communiques/Communiques_2009/press_release_madoff3.pdf.

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banks have paid some of the affected investment funds more than USD 138 million in settlements.[6]

Before the financial crisis, the lack of incentives for custodians to act in the interests of investors may have given rise to riskier and more opaque sub-custodian structures. Currie (2010) reports that some custodian banks did not have a proper sub-custodian risk monitoring system in place. Instead they relied heavily on input from industry surveys and had limited ability to gain key information on the safe-keeping of assets by their sub-custodians. Especially for the smaller, low-volume markets within their networks, some custodian banks did not conduct regular on-site due diligence.

In order to address these shortcomings and to enhance investor protection, a set of regulatory reforms have been put in place in Europe. In July 2014, an amendment to the UCITS directive has been adopted, which will be transposed by member states into their national laws by 18 March 2016.[7] The new regulation will tighten the rules on the duties of custodians.[8] More specifically, custodians will be liable to return any financial instruments lost in custody, regardless of whether the loss has been due to the custodian's fault or negligence (so-called "strict liability").[9]

We analyse the structure of sub-custodian chains using a unique data set from a survey, which was conducted by the Deutsche Bundesbank in July 2011. In this survey, German custodian banks were asked to report detailed quantitative and qualitative data with regard to all securities belonging to German UCITS funds that were held in safe custody abroad. The main question which we address with our analysis is whether there is evidence for moral hazard in sub-custodian structures. We approach this question by analysing the length and risk of sub-custodian chains relating these variables to the information custodian banks had on their sub-custodian chains and presence of a CSD in the chain. Our hypothesis is that not all custodians adequately managed and monitored the risks in their sub-custodian chains given that they were not liable for any losses. We identify custodians that insufficiently monitored via their ability to provide adequate information during the survey. Some custodians delegated the safe-keeping directly to CSDs, which may have taken over monitoring of the sub-custodian chains. As result, the presence of a CSD as a first sub-custodian could potentially mitigate risks due to inadequate monitoring by the custodian.

Our contribution to the literature on the securities custody industry is twofold. First, we provide a number of stylised facts on the sub-custodian structure of custodian banks for German UCITS funds. To our knowledge, very little is known to date about this industry. Second, we provide an empirical analysis of the sub-custodian structure. Our findings suggest that custodians delegate the safe-keeping of assets via chains of up to five sub-custodians. While most custodians typically delegate the safe-keeping of assets to one sub-custodian per country, a few custodians rely on numerous sub-custodians in a single country. Also, the custodian banks in our sample differ with respect to the number of countries they are linked to via sub-custodians. While a few large custodians have sub-custodians in over 100 countries, some smaller and less specialised custodians maintain very few links to other countries.

More importantly, our empirical analysis highlights that better informed banks are associated with shorter sub-custodian chains, but provide safe-keeping of assets in riskier countries. Also, better capitalised banks seem to have longer, but less risky sub-custodian chains in terms of country risk. Moreover, foreign custodians, which typically benefit from greater economies of scale and scope, also rely on shorter and less risky sub-custodian chains. Sub-custodian chains where the first sub-custodian is a CSD are not significantly shorter. By contrast, CSDs as first sub-custodian appear to reduce the country risk in sub-custodian structures, highlighting the beneficial role they can play in the delegation of safe-keeping duties. When we analyse the choice of a CSD as first sub-custodian, we find that better capitalised, foreign and large custodian banks are less likely to rely on a CSD as first sub-custodian. These findings suggest that more specialised custodian banks with greater economies of scale and scope can avoid relying on CSDs, given that they can internalise many of the benefits attributed to CSDs.

To our knowledge this is the first study which empirically assesses the sub-custodian structure in the custody services industry. The existing literature on the custodian industry is very scant. It has so far focused on competitive issues between central securities depositories (CSDs) and custodians (Kauko, 2007; Tapking, 2007; Holthausen and Tapking, 2004). Another strand in the literature examines the efficiency of the securities settlement industry and the potential to realise further economies of scale (Schmiedel et al., 2006; van Cayseele and Wuyts, 2007).

The next section briefly describes the survey among German custodian banks and provides some observations on the sub-custodian structure. Section 3 contains the empirical section and presents the results. The final section concludes.

2. Data and stylised facts

2.1. The survey

In June and July 2011, the Deutsche Bundesbank conducted a survey among custodian banks active in Germany. The aim of this survey was to gather relevant data to assess the possible impact of a more stringent liability regime on custodian banks for German UCITS funds. UCITS funds play an important role in the European financial markets. Net assets managed by European UCITS funds amounted to nearly EUR 7 trillion at the end of 2013, while German UCITS funds had assets of around EUR 277 billion under management.[10] Under the current UCITS directive there is no uniform EU-wide liability regime for fund custodians, in particular with regard to assets in sub-custody.

The issue of different national rules came to the fore in the context of both the bankruptcy of Lehman Brothers International Europe and the Madoff fraud.

The European Commission advocated harmonising the respective liability rules and proposed a "strict liability" regime in July 2012, which requires custodians to return instruments lost in custody irrespective of negligence on its own part. This liability regime was more stringent than the existing German law at the time.

[6] More specifically, HSBC and UBS have paid the Thema Fund, Kalix Fund Ltd. and Lux Alpha USD 62.5, USD 35.5 and USD 40 million respectively. However, the original amounts the investment funds sued for were well above these figures. Lux Alpha and the Thema fund were both UCITS. The amount repaid to Lux Alpha refers to the settlement with Oddo Cie.

[7] UCITS refers to Undertakings for Collective Investments in Transferable Securities. See http://ec.europa.eu/internal_market/investment/ucits-directive/index_en.htm for more information. At the end of 2013, net assets of UCITS amounted to around EUR 6.9 trillion.

[8] See Directive 2014/91/EU under http://ec.europa.eu/finance/investment/ucits-directive/index_en.htm.

[9] In October 2014, IOSCO published "Principles regarding the Custody of Collective Investment Schemes' Assets" with the aim of outlining principles to assess the quality of asset custody. In the US, the Securities and Exchange Commission similarly implemented a number of reforms targeted at the supervisory failures that made the Madoff incident possible, including measures to protect investors. See https://www.sec.gov/spotlight/secpostmadoffreforms.htm for further information.

[10] See http://www.efama.org/statistics/ for data on the European market and http://www.bundesbank.de/Navigation/EN/Statistics/statistics.html?nsc=truefortheGermanmarket.

The data was reported as of 31 December 2010. The questionnaire was sent to all 52 German custodian banks licensed under Section 21 of the German Investment Act. All 52 banks participated in the survey. During the survey period, two of the custodian banks merged and thus reported consolidated data. As a result, 51 German banks reported back. Of these 51 banks, only 31 banks administered German UCITS funds. Despite repeated inquiries by the Deutsche Bundesbank, one of these banks was unable to report reliable data. This bank was therefore removed from the sample. Of the final 30 reporting custodian banks, 22 were German banks.

The custodian banks were asked to report detailed quantitative and qualitative information on securities belonging to German UCITS funds that were held in safe custody in countries other than Germany. The specific questions were designed to obtain information on the exact properties of the various custody chains in place for each country. Further, banks were asked to provide the names of all sub-custodians in each custody chain and the market values of the securities in custody in each step of the custody chain.[11]

During the survey, including a pre-test in May 2011, it became clear that German custodian banks had limited information available on their various sub-custodian chains. Rather than having the data readily available, most of the data had to be gathered from its direct sub-custodians (in particular, global custodians and Clearstream Banking, which acted as a direct sub-custodian for 14 of the 30 German custodian banks). In several instances, the data reported initially was of poor quality and had to be corrected and amended by the respective custodian banks. Following these corrections, we now consider the data to be of high quality, in particular as regards the values of, and the sub-custodians involved in, the various custody chains.

2.2. Data description

Table 1 provides summary statistics for the variables in the dataset, while Tables A.1 and A.2 contain a description of the variables and the correlation matrix.

As a starting point, the overall number of sub-custodian chains reported by the 30 custodian banks is 1169, which presents the cross-section of our dataset. At the custodian bank level, the average amount of assets under custody across the 30 custodians banks was EUR 4,502 million and the maximum value equals to EUR 37,774 million. These figures provide a first indication on the magnitude of risk in case custodians need to assume liability for assets under custody.

The overall number of countries with which the custodian banks have sub-custodian chains varies widely with one bank having links to 101 countries and another bank having links to only 2 countries. Overall, the number of countries with which custodian banks active in Germany maintain sub-custodian links for the custody services of UCITS is 103.

With regard to the individual sub-custodian chains, the number of sub-custodians per chain ranges between 1 and 5 with an average of 2.71. The number of sub-custodian chains custodian's had with each country varies widely with the majority maintaining only 1 link per country (624 out of 1065) and 5 banks maintaining between 13 to 44 chains all to Luxembourg.

We create a dummy indicating banks, which were well informed about the structure of their sub-custodian chains. This dummy is based on the interaction of the Bundesbank staff with the custodian banks during the survey. As mentioned in the previous sub-section a number of custodians experienced significant difficulties to provide the requested information during the survey. While a dummy on the basis of the survey is subjective, a number of measurable facts determined the classification as informed banks including knowledge of sub-custodian chains and the availability of data. Moreover, the evidence in the subsequent empirical analysis supports the view that a simple differentiation in informed and less informed banks significantly contributes in explaining the structure of sub-custodian chains. The dummy shown in Table 1 indicates that 64% of all sub-custodian chains were managed by informed custodian banks.

Table 1
Summary statistics for survey data on sub-custodian structures.

Variable	Obs	Mean	Std. dev.	Min	Max
At sub-custodian chain level					
No. custodians	1065	2.71	0.87	1	5
No. chains per Cs	1170	4.25	8.65	1	44
Informed	1169	0.64	0.48	0	1
CSD first	1168	0.39	0.49	0	1
Foreign	1170	0.37	0.48	0	1
Assets in custody	1090	124	619	0.01	9,539
No. of CSD	1169	1.38	0.91	0.00	4.00
No. countries in chain	1169	1.97	0.82	1.00	4.00
Rating score	1154	3.29	3.53	1.00	19.00
Geo. distance	1.168	3.065	3.915	0.280	18.387
Eco. distance	1164	46	29	0.38	104
Legal rights	1154	6.40	2	1.00	10
At bank level					
Capital ratio	30	0.129	0.059	0.031	0.317
No. of countries	30	26.70	16.82	2.00	101.00
Assets in custody	30	4,502	8,021	54	37,774

Notes: The descriptive statistics are based on a survey conducted at the Deutsche Bundesbank. The data was reported as of 31 December 2010. 31 banks administered German UCITS funds. Assets in custody in EUR million.

As we also test the effect of central securities depositories (CSD) on the structure of the sub-custodian chain, we included a dummy equal to 1 if the first sub-custodian was a CSD. We define CSDs as institutions that operate securities settlement systems and, generally, are situated at the top of a custody chain. In 39% of all chains a CSD was the first sub-custodian. In addition, we also show the number of CSDs in sub-custodian chains in Table 1 highlighting the importance of CSDs in sub-custodian chains.

To shed further light on the risk within a chain, we include a numeric rating score of the country where the final sub-custodian is located. The idea behind this variable is that the riskier the country of the final sub-custodian, the more a custodian bank should aim to manage the assets at arms length keeping the chain short and simple. The long-term foreign currency debt rating for the sovereign serves as a natural proxy for the credit risk of the respective country.[12] The mean value for the rating score of 3.29 approximately corresponds to Moody's Aa2.[13] The sovereign risk could represent a first order consideration in the setup of a sub-custodian chain, i.e. a custodian may choose a specific custodian structure conditional on the risk of the country. Custodians may, for example, choose to delegate the safe-keeping at arms length or aim to have shorter custody chains.

Our dataset also covers several foreign custodians active in Germany. For these custodians we created a dummy equal to 1 to test for any systematic differences. Out of the 30 banks that reported back to the Bundesbank eight banks are foreign banks. Moreover, we add the banks' core capital ratio as a proxy for banks' risk preferences.

We also include two proxies for the geographic and economic distance between the location of the custodian i.e. Germany and the country of the final sub-custodian. The motivation for these

[11] A translation of the questionnaire can be obtained from the authors upon request.

[12] We use the long-term foreign debt ratings provided by Moody's at the end of 2010.

[13] A rating score of 1 corresponds to Aaa while 10 is assigned to a Baa3 rating.

two variables is derived from trade gravity models.[14] The basic idea behind trade gravity models is related to Newtonian physics stating that trade volumes - in our case asset custody services – between two countries depend positively on economic mass and negatively on distance and transportation costs. The geographic distance between two countries proxies information costs while economic distance measures the relative size of the economies. We hypothesise that custodians should minimise information costs by maintaining shorter sub-custodian chains with countries that are geographically more distant.

The geographic distance is given in thousands of kilometres between Berlin and the capital of the country where the final sub-custodian is located.[15] In contrast, more developed economies are likely to also have more developed financial systems reducing information asymmetries. While a more developed financial system may facilitate shorter sub-custodian chains it may also well be the case that given the ease to obtain information in more developed financial systems, custodian banks may care less about the length than the costs attached to sub-custody services. We are thus agnostic with regard the specific statistical relationship. To measure the economic distance, we use GDP per capita in thousands of US dollar.

Finally, we also explore the strength of Legal Rights Index provided by the World Bank, which aims to measure the degree of bankruptcy and collateral laws.[16] The underlying hypothesis for the index is that custodians should seek to minimise the length of sub-custodian chains to countries with weaker legal rights.

3. Empirical analysis

The summary statistics highlight a number of stylised facts about the sub-custodian structure, which require a more detailed analysis.

In this section, we analyse three of these facts given their potential to aggravate the complexity of sub-custodian chains and thus the risk for custodian banks. First, we examine whether the length of sub-custodian chains is related to a dummy for informed custodian banks. This is relevant given that longer chains increase the opaqueness of safe-keeping duties and also the risk that assets are lost. Evidence of longer chains by uninformed banks provides an indication that these chains are not effectively managed and potentially riskier. Second and closely related, we also assess the number of countries in each sub-custodian chain. Similar to the length of a chain, delegating the safe-keeping across several borders potentially increases risks along several dimensions including legal and political risk. In addition, we also empirically model the risk of sub-custodian chains more directly using country ratings. This approach provides a more risk-based perspective on the structure of sub-custodian chains.

Given the prominent role of CSDs in sub-custodian chains (see Table 1), we also study the decision to delegate the safe-keeping duties to a central securities depository in the first place rather than a sub-custodian bank. Schmiedel et al. (2006) and van Cayseele and Wuyts (2007) argue that there are significant scale effects, which provide CSDs a potential competitive advantage. Moreover, Holthausen and Tapking (2004) theoretically show that CSDs can exploit their monopoly powers to raise the costs of rival custodian banks. We thus postulate that larger banks are less likely to rely on CSDs in their sub-custodian chains.

3.1. Length of sub-custodian chains

The length of a sub-custodian chain should be chosen by a custodian bank based on cost and risk considerations. However, the survey clearly revealed that risk aspects did not necessarily figure prominently in the choice of sub-custodians.

In Eq. (1), we condition the length of sub-custodian chains on a dummy for informed custodians, a dummy for foreign custodians active in Germany and a dummy if the first sub-custodian was a CSD. We include a dummy for foreign custodians as they are typically very large and may thus benefit from scale and scope effects, translating into more efficient sub-custodian structures. Similarly, a CSD as the first sub-custodian may be better equipped to establish more efficient and less risky sub-custodian structures. In addition, we also include control variables for the custodian's capital ratio as a proxy of a bank's potential risk aversion and the number of links to any particular country as a proxy for diversification as well as economies of scope and scale.[17] Our regression model takes the following form:

$$\begin{aligned}\#SubCustodians_{i,c} = {} & \alpha_0 + \alpha_1 Informed_i + \alpha_2 Foreign_i \\ & + \alpha_3 CSD1_{i,c} + \alpha_4 CapitalRatio_i \\ & + \alpha_5 No.Links_{i,c} + u_{i,c} \end{aligned} \quad (1)$$

where the dependent variable $\#SubCustodians_{i,c}$ is the number of sub-custodians in a chain of bank i to country c.

Given that the dependent variable is an ordinal variable varying between 1 and 5, as shown in Table 1, we use an ordered probit model to test how the explanatory variables correlate with the length of the chain.[18] We report the results in Table 2.

Column 1 contains the baseline specification shown in Eq. (1). As postulated, the dummy for informed banks is negatively correlated with shorter sub-custodian chains and statistically significant.[19] Foreign banks are also associated with significantly shorter sub-custodian chains. This is in line with expectations, given that foreign custodians are typically large international banks which can exploit economies of scale and scope. With respect to the role of CSDs as the first sub-custodian, we hypothesised that this could reduce the length of chains, given that their size and specialisation can provide them with an edge in the delegating of safe-keeping to other sub-custodians. However, our results are not supportive of this view. Instead, we find a positive, though statistically insignificant coefficient for this variable.

As regards the capital ratio, we find that ceteris paribus a higher capital ratio is positively correlated with the length of sub-custodian chains. The number of chains to any specific country is negative and statistically significant, possibly indicating that there is some diversification element present when banks rely on several different sub-custodian chains to delegate the safe-keeping of assets. In terms of economic significance, the results are meaningful. The probability to observe a chain with a length of 3 sub-custodians when the explanatory variables take their mean value

[14] This methodology dates back to Tinbergen (1962) and Pöyhönen, 1963.

[15] The source of the geographic distance is Centre D'Etudes Prospectives et d'Information Internationales (CEPII). Please see Mayer and Zignago (2011) for further information. The data on GDP per capita comes from the IMF World Economic Outlook.

[16] For further information see http://data.worldbank.org/indicator/IC.LGL.CRED.XQ/countries.

[17] Under Principle 7 of International Organization of Securities Commissions (2014), collective investment schemes are recommended to also assess the financial capacity to safekeep assets. To the extent that this already takes place, the custodian banks in our sample could have been selected as custodian on the basis of their capital ratio.

[18] We also considered a range of alternative estimators including Poisson, negative binomial and OLS on standardised values of the dependent variable. The results are very similar to those shown in Table 2 in terms of sign and statistical significance of the coefficients. Given that our dependent variable is characterised by under- rather than over-dispersion neither the Poisson nor the negative binomial estimator are fully suitable. Moreover, the Akaike information further confirmed a better fit of the data using the ordered probit estimator.

[19] A simple t-test on the equality of the mean for the length of a sub-custodian chains for informed and uninformed custodians further confirmed that informed banks had statistically significantly shorter chains. The mean value is 2.65 and 2.85 for the informed and uninformed group, respectively.

Table 2
Ordered probit: length of sub-custodian chains.

	(1) Baseline	(2) Geo. distance	(3) Eco. distance	(4) Legal rights	(5) Rating	(6) All	(7) Excl. LX	(8) Excl. large
Informed	−0.45***	−0.46***	−0.48***	−0.45***	−0.48***	−0.49***	−0.47***	−0.72***
	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]	[0.09]
Foreign banks	−0.55***	−0.58***	−0.61***	−0.56***	−0.60***	−0.64***	−0.68***	−0.91***
	[0.09]	[0.09]	[0.09]	[0.09]	[0.09]	[0.09]	[0.09]	[0.10]
CSD	0.04	0.04	0.06	0.04	0.05	0.06	0.04	0.04
	[0.09]	[0.09]	[0.09]	[0.09]	[0.09]	[0.09]	[0.10]	[0.09]
Capital ratio	1.82***	1.81***	1.53***	1.80***	1.53***	1.45***	1.39**	−0.65
	[0.53]	[0.53]	[0.55]	[0.54]	[0.54]	[0.56]	[0.56]	[0.62]
No. of links	−0.02**	−0.02*	−0.00	−0.02**	−0.02**	0.00	0.04**	−0.00
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.02]	[0.01]
Geo. distance		0.02**				0.01	0.02**	0.01
		[0.00]				[0.00]	[0.00]	[0.00]
Eco. distance			−0.01***			−0.01***	0.00	−0.01***
			[0.00]			[0.00]	[0.00]	[0.00]
Legal rights				0.01		0.01	−0.02	0.02
				[0.01]		[0.02]	[0.02]	[0.02]
Rating score					0.02**	0.00	0.02	−0.02
					[0.01]	[0.01]	[0.01]	[0.01]
No. of obs.	1065	1065	1061	1051	1050	1038	920	944
Pseudo R^2	0.027	0.029	0.033	0.028	0.030	0.035	0.038	0.058

Notes: The regression analysis is based on data from a survey conducted by the Deutsche Bundesbank. The data was reported as of 31 December 2010. 31 banks administered German UCITS funds. Constants are included, but not reported. Robust standard errors in brackets. ***, **, * indicates significance at 1, 5 and 10% levels.

is 44%. With regard to the individual explanatory variables, a one unit change in *Informed* and *Foreign* reduces the probability of observing a chain length of 3 by 6% and 7% respectively. With regard to the capital ratio, the economic significance is less relevant increasing the probability of observing a length of 3 by less than 1%.[20]

In the subsequent columns 2 to 5, we further explore the length of chains by considering the role of geographic and economic distance between Germany and the country of the final sub-custodian as well as the World Bank's Legal Rights Index and the Rating.[21] The inclusion of these variables, individually or jointly, does not materially change the results with the exception of the variable "No. of Links" which is insignificant when economic distance is included. When these four control variables are jointly included in the empirical specification only economic distance remains statistically significant. The negative coefficient between economic distance and the length of the sub-custodian chains suggests that custodian banks have shorter sub-custodian chains to countries with higher per capita GDP, possibly reflecting that fewer sub-custodians are needed to delegate the safe-keeping of securities to countries with more developed financial systems.

Turning to the rating score of the country of location of the final sub-custodian, as shown in column 5, the rating score is statistically significant suggesting that country risk is positively correlated with longer chains. However, when the rating score is included jointly with other control variables the rating turns insignificant possibly due to the correlation with GDP per capita.

In order to further assess the robustness of the findings, we exclude observations which may materially affect the results. In column 7, we exclude observations on sub-custodian chains where the final sub-custodian is located in Luxembourg. We do this because the sub-custodian structure to Luxembourg differs significantly from those of other countries, in particular with regard to the number of chains per custodian bank. To note, four custodian banks maintain more than ten different chains each with sub-custodians to Luxembourg. The mean of the variable "No. of Links" excluding Luxembourg is equal to 1.8 compared and 4.2 when Luxembourg is included (see also Table 1).

In column 8, we also exclude all sub-custodian chains for the largest custodian bank. This custodian accounted for nearly 10% of all sub-custodian chains in our sample and may thus have a material effect on our results. Indeed, when we drop these observations from our sample the capital ratio turns insignificant, while the dummies for informed and foreign banks remain robust.

In addition, we also run a series of regressions to control for the potential endogeneity of the capital ratio. First, we use lagged values for the capital ratio in column 1 and 2 for Q2 2010 and Q4 2009 respectively. The results largely confirm the findings in Table 2 for *Informed* and *Foreign* but yield a larger coefficient for the capital ratio. In addition, we also use two-step least squares IV estimation.[22] We include different sets of variables as instruments in columns 3 to 7. In column 3, we use the CSD dummy, the legal rights indicator and a measure for the size of the bank.[23] In columns 4 and 5, return on equity and assets are included respectively and in columns 6 and 7, the capital ratio in Q4 2009 is also added. The correlation coefficient for informed and foreign banks remain robust in all specifications and statistically significant. With regard to the capital, we also find robust positive and statistically significant correlations. Another concern relates to unobserved time-invariant heterogeneity (Baetschmann et al., 2015). The Pseudo R^2 suggests a rather low explanatory power. We thus include a set of fixed effects for the custodian banks and the country of location of the final sub-custodian in Eq. (1). The results are shown in Table A.4. In columns 1 to 3, we include first fixed effects for the custodians, then for the countries and finally all fixed effects jointly in the baseline specification. In columns 4 to 6, we repeat the sequence but for the full specification. Again, the correlation coefficient for *Informed* and *Foreign* banks keep their sign and statistical significance but vary in terms of the size of the effect suggesting that there may be omitted variables that lead to a possible underestimation of the actual correlation coefficient. However, the inclusion of fixed effects in probit models requires a large number of observations within each group,

[20] A unit change in the capital ratio corresponding to this marginal effect is 1% point.
[21] We also included lagged values of the Legal Rights Index as well as in logarithms but none turned out to be significant.
[22] We use the standardised value of the length of the sub-custodian chain as a dependent variable to use an IV estimator.
[23] The size is measured by the total volume of assets in custody.

Table 3
Ordered probit: number of countries in sub-custodian chains.

	(1) Baseline	(2) Geo. distance	(3) Eco. distance	(4) Both	(5) Country rating	(6) Av. rating	(7) Av. rating* informed
Informed	0.40***	0.40***	0.38***	0.38***	0.37***	0.43***	0.15
	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]	[0.09]	[0.13]
Foreign banks	0.15*	0.17*	0.12	0.13	0.1	0.07	0.04
	[0.09]	[0.09]	[0.09]	[0.09]	[0.09]	[0.09]	[0.09]
CSD	0.30***	0.30***	0.33***	0.33***	0.33***	0.20**	0.19**
	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]	[0.08]
Capital ratio	−6.97***	−6.92***	−7.49***	−7.49***	−7.75***	−7.30***	−7.25***
	[0.67]	[0.67]	[0.70]	[0.70]	[0.70]	[0.71]	[0.72]
No. of links	−0.01***	−0.02***	0.00	0.00	0.00	0.01	0.00
	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.01]	[0.01]
Geo. distance		−0.01*		−0.02**	−0.02**	−0.01*	−0.01
		[0.01]		[0.01]	[0.01]	[0.01]	[0.01]
Eco. distance			−0.01***	−0.01***	−0.00***	−0.02***	−0.02***
			[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Rating score					0.01		
					[0.01]		
Av. rating						−0.13***	−0.21***
						[0.01]	[0.03]
Av. rating* Informed							0.09***
							[0.03]
No. obs.	1168	1167	1163	1163	1149	1163	1163
Pseudo R^2	0.0856	0.0866	0.0905	0.0929	0.0963	0.145	0.149

The regression analysis is based on a survey conducted at the Deutsche Bundesbank. The data was reported as of 31 December 2010. 31 banks administered German UCITS funds. Constant variable is included, but not reported. Robust standard errors in brackets. ***, **, * indicates significance at 1%, 5% and 10% levels.

which is not given when we use country dummies and possibly even for bank specific dummies. We thus report the results for both sets of dummies as robustness tests but prefer to show the results excluding the dummies in our baseline specification.

To further assess potential differences across subsets of countries, we estimate Eq. (1) for the G20, EU and euro area countries and the respective non-members in these subsets. We report the results in Table A.5 in the appendix. While the results for foreign and informed banks are largely similar across the subsets, there are two noteworthy differences. With regard to the capital ratio, we find a positive correlation for the sample outside the G20, EU and euro area countries. This is surprising given that one would expect to see that better capitalised banks, i.e. more risk-averse banks, should be associated with shorter sub-custodian chains to these countries. As to CSDs, they appear to have opposite effects on sub-custodian chains in EU and non-EU countries. Whereas to the former chains are shorter, they are longer for the latter when a CSD is the first sub-custodian.

3.2. Number of countries in sub-custodian chains

The empirical analysis in the previous subsection has provided some underpinnings for the view that the sub-custodian structure may not have been optimally chosen by all custodian banks. To further examine the sub-custodian structure, we analyse in this subsection the number of countries in each sub-custodian chain.

We use the number of countries within any given chain as dependent variable to describe the structure of sub-custodian chains. We consider a chain to become more complex when a sub-custodian chain crosses several borders. The summary statistics in Table 1 reveal that the average number of times a chain reaches across borders is around two but reaches up to four which is considerable given that the maximum length of sub-custodian chains is five.

From the viewpoint of the custodian bank a larger number of countries may imply higher legal and political risk and thus fewer countries may be preferable.[24] In order to analyse this issue, we use the empirical framework in Eq. (1) replacing the dependent variable by the number of countries in any given sub-custodian chain. We report the results in Table 3.

We observe a number of robust results across the eight specifications. First, better informed banks and CSDs as the first sub-custodian are associated with chains stretching across more countries. This highlights that the decision to cross several borders may be motivated by more complex decisions than we can model. Second, the capital ratio is negatively correlated with the number of countries in sub-custodian chains. This may be an indication that better capitalised banks are more risk-averse and thus minimise the legal and political risk when crossing additional borders. Regarding foreign banks, the evidence is less clear. While the coefficient is positive across all specifications, the statistical significance is weak. The positive sign is an indication that very large and internationally active custodian banks are less averse to country risk possibly due other risk-mitigating factors. Third, the number of links maintained with any specific country is negatively related to the number of countries, possibly showing that the custodian banks also minimise the country risk when diversifying across several final sub-custodians. However, this effect is not robust to the inclusion of our economic distance measure.

Geographic and economic distance are negatively correlated with the number of countries. In line with Table 2, this may indicate that shorter sub-custodian chains and fewer countries are needed to delegate the safe-keeping to a country that is geographically closer and with a higher per capita GDP and, potentially, a more developed financial system.

Moreover, we also include the country rating of the final sub-custodian in column 5 as well as the average rating of the countries in a chain in column 6 as explanatory variables. With regard to the former, we do not find any significant relation with the number of countries in the sub-custodian chain, while a higher average rating is negatively related to the number of countries. This may indicate that custodian banks partially offset the riskiness of sub-custodian chains by relying on shorter chains. This interpretation is further underpinned by the results in column 7, where we interact the average country rating with the dummy for informed banks. Apparently, better informed banks choose longer chains across

[24] This is in line with International Organization of Securities Commissions (2014) which highlights country risk as key risk related to the custody of client assets.

Table 4
OLS: dependent variable country rating score.

	(1) Av. score	(2) Sum score	(3) Final sub. score	(4) Av. score	(5) Sum score	(6) Final sub. score
Informed	−0.09	1.19***	0.37**	−0.26	1.10***	0.29*
	[0.26]	[0.33]	[0.18]	[0.27]	[0.33]	[0.18]
Foreign banks	−0.89***	−0.29	0.19	−0.95***	−0.25	0.28
	[0.31]	[0.39]	[0.20]	[0.31]	[0.38]	[0.20]
CSD	−1.33***	−1.06***	−0.54***	−1.15***	−0.65**	−0.28
	[0.22]	[0.31]	[0.18]	[0.23]	[0.32]	[0.19]
Capital ratio	5.14***	−0.14	3.19**	5.46***	0.97	4.18***
	[1.95]	[2.62]	[1.48]	[2.10]	[2.77]	[1.55]
No. of links	0.06***	0.13***	0.07***	−0.31***	−0.32***	−0.18***
	[0.01]	[0.02]	[0.01]	[0.04]	[0.07]	[0.05]
Geo. distance	0.07**	0.09**	0.00	0.04	0.05	−0.02
	[0.03]	[0.04]	[0.02]	[0.02]	[0.04]	[0.02]
Eco. distance	−0.08***	−0.14***	−0.08***	−0.14***	−0.23***	−0.14***
	[0.00]	[0.01]	[0.00]	[0.01]	[0.01]	[0.01]
Constant	7.25***	11.89***	6.25***	9.76***	15.28***	8.29***
	[0.53]	[0.63]	[0.35]	[0.62]	[0.70]	[0.36]
No. of obs.	1163	1163	1149	998	998	984
R^2	0.33	0.37	0.4	0.4	0.44	0.5

Notes: The regression analysis is based on a survey conducted at the Deutsche Bundesbank. The date was reported as of 31 December 2010. 31 banks administered German UCITS funds. Robust standard errors in brackets. ***, **, * indicates significance at 1%, 5% and 10% level.

borders when faced with, on average, riskier countries, possibly as a way to mitigate these risks.

While the length of the chain is a potential candidate to assess the riskiness of a sub-custodian chain, more direct measures of riskiness are clearly desirable. As a step in this direction, we use three different country rating scores as the dependent variable using the specification in Eq. (1). We use the average rating score across the countries in each sub-custodian chain, the sum of the country rating score and the rating score of the country in which the final sub-custodian is located. We report the results in Table 4 below. Columns 1 to 3 include sub-custodian chains to Luxembourg while in columns 4 to 6 Luxembourg is excluded.

Informed banks are associated with higher overall rating scores i.e. riskier sub-custodian chains and with final sub-custodians in riskier countries. This may reflect a more specialised business strategy, where banks with more sophisticated risk management systems also offer investments in riskier countries. Interestingly, having a CSD as the first sub-custodian is negatively correlated with all three rating scores. This could be due to custodians relying less on CSDs when they provide safe-keeping assets for UCITS that invest in riskier countries. As to the alternative view that CSDs, owing to their larger scale, are better equipped to provide safe-keeping services leading to shorter chains, has already been refuted by our results in Table 2. We find a positive relation between the custodian banks' capital ratio and the country rating score in column 1 to 3. This suggests that banks' capitalisation is positively correlated when delegating the safe-keeping to sub-custodians in riskier countries. This may also indicate that better capitalised banks can offer a wider range of UCITS products, including investments in riskier countries. With regard to foreign banks, in column 1 we find that they delegate the safe-keeping of assets to sub-custodian chains which have, on average, less country risk.

As regards the number of links, we present the results including and excluding Luxembourg in columns 1 to 3 and 4 to 6, respectively. The coefficient for all three risk scores changes sign when we exclude sub-custodian chains to Luxembourg. This is likely to be a simple statistical artefact of the large number of chains with and the low rating score of Luxembourg.

All in all, the empirical analysis in this section highlights a number of relevant statistical correlations in our dataset. The most prominent results are that better informed custodian banks also have shorter sub-custodian chains, but provide safe-keeping of assets in riskier countries. This may be due to the potentially wider range of investments offered via their UCITS funds. Foreign banks are associated with shorter and less risky sub-custodian chains. As regards CSDs, while they are not correlated with the chain length, the evidence suggests that they are negatively related to country risk and positively correlated with longer cross-border chains. Finally, better capitalised banks have longer sub-custodian chains but cross borders less frequently and are also less risky in terms of country risk.

3.3. Who chooses CSDs as first sub-custodian?

The evidence in the previous subsections highlights that CSDs as a first sub-custodian in a chain can materially affect the structure of the sub-custodian chain. In this subsection, we thus examine the choice of a CSD as a first sub-custodian in more detail. For this objective, we use a probit model using as the dependent a dummy which is one when the first sub-custodian is a CSD and zero otherwise. We include as explanatory variables the specification in Eq. (1). Given the significant scale effects (Schmiedel et al., 2006 and van Cayseele and Wuyts, 2007) and the potential competitive price setting of CSDs for cross-border activities suggested by Holthausen and Tapking (2004), we postulate that larger banks are less likely to rely on CSDs in their sub-custodian chains. Therefore, we include a proxy for the size of the bank in order to capture potential scale and scope effects which may impact the choice of a CSD. As a our measure of "*Size*" we use the logarithm of total core equity capital but other size proxies for size yield similar results.[25]

The evidence in Table 5 allows us to draw three main conclusions. Better capitalised, larger and foreign banks are negatively correlated with a CSD as the first sub-custodian which suggests that they less likely to rely on CSDs as their first sub-custodian. Moreover, the higher the rating of the country of the final sub-custodian is, the less likely custodians were to delegate the safe-keeping of assets to a CSD as their first sub-custodian. When we exclude the largest sub-custodian (column (7)) and all sub-custodians located in Luxembourg (column (8)) the dummy variable "*Informed*" becomes positive and significant, suggesting that

[25] As an alternative, we also used the total risk-weighted assets and the total amount of assets under management for UCITS. Results were similar and can be obtained from the authors upon request.

Table 5
Probit: CSD as first sub-custodian.

	(1) Baseline	(2) Geo. distance	(3) Eco. distance	(4) Both	(5) Rating	(6) Size	(7) Excl. large	(8) Excl. LX
Informed	−0.04	−0.04	−0.01	−0.01	0.0	0.14	0.19**	0.18*
	[0.09]	[0.09]	[0.09]	[0.09]	[0.09]	[0.09]	[0.10]	[0.10]
Foreign banks	−1.26***	−1.25***	−1.21***	−1.21***	−1.20***	−1.28***	−1.18***	−1.29***
	[0.10]	[0.10]	[0.10]	[0.10]	[0.11]	[0.11]	[0.12]	[0.12]
Capital ratio	−3.13***	−3.14***	−2.80***	−2.81***	−2.74***	−2.97***	−2.33***	−3.07***
	[0.81]	[0.81]	[0.80]	[0.80]	[0.81]	[0.78]	[0.81]	[0.84]
No. of links	0.01*	0.01	0.00	0.00	0.00	0.00	0.00	0.08***
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.03]
Geo. distance		−0.02		−0.01	−0.01	0.00	0.00	0.00
		[0.01]		[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Eco. distance			0.01***	0.01***	0.00	0.00	0.00	0.01*
			[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Rating score					−0.06***	−0.05***	−0.05***	−0.03*
					[0.02]	[0.02]	[0.02]	[0.02]
Size						−0.18***	−0.18***	−0.20***
						[0.03]	[0.03]	[0.03]
Constant	0.54***	0.59***	0.23	0.27*	0.60***	1.84***	1.67***	1.50***
	[0.11]	[0.12]	[0.15]	[0.15]	[0.18]	[0.27]	[0.28]	[0.31]
No. of obs.	1,168	1,167	1,163	1,163	1,149	1,149	1,052	984
Pseudo R^2	0.17	0.17	0.18	0.18	0.18	0.21	0.16	0.22

Notes: The regression analysis is based on a survey conducted at the Deutsche Bundesbank. The data was reported as of 31 December 2010. 31 banks administered German UCITS funds. Robust standard errors in brackets. ***, **, * indicates significance at 1%, 5% and 10% levels.

better informed banks are more likely to rely on a CSD as their first sub-custodian. As for the variables "*Geo. Distance*" and "*Eco. Distance*", the former is not statistically significant, while the latter is not robust across the eight specifications.

Overall, the empirical analysis suggests some potential relevant determinants for the choice of CSDs in the custodian services business.

4. Conclusion

In this paper, we use a unique data set from a survey, which was conducted by the Deutsche Bundesbank in July 2011 to carve out a number of stylised facts about the custodian services industry. More specifically, we examine the complexity and potential risk embedded in sub-custodian chains as measured by their length in terms of the number of sub-custodians, the number of countries and the risk measured by country ratings of the sub-custodians' domicile. We also assess the determinants of choosing a CSD as the first sub-custodian given the potential importance of CSDs in sub-custodian structures.

As regards our specific results, we find that sub-custodian chains can be relatively long, frequently reach across several countries and that, in many cases, a CSD is the first sub-custodian. Moreover, our empirical analysis highlights that better informed banks typically have shorter sub-custodian chains, which we interpret as evidence of agency problems in the custodian industry. At the same time, better informed custodian banks also seem to provide safe-keeping of assets in riskier countries. Further, better capitalised banks have longer but less risky sub-custodian chains in terms of country risk. In addition, their chains cross borders less frequently. Moreover, foreign custodians, which typically benefit from greater economies of scale and scope, also use shorter chains. However, sub-custodian chains where the first sub-custodian is a CSD are not significantly shorter. In contrast, CSDs appear to reduce the country risk in sub-custodian structures, highlighting the beneficial role they can play in the delegation of safe-keeping duties. When we analyse the choice of a CSD as first sub-custodian, we find that better capitalised, foreign and large custodian banks are less likely to rely on a CSD as first sub-custodian. These findings suggest that more specialised custodian banks with greater economies of scale and scope can avoid relying on CSDs

Table A.1
Variable definitions and sources.

Variable	Definition	Source
No. custodians	No. of sub-custodian in chain.	BBK Survey
No. chains per Cs	No. of sub-custodian chains per bank to each country.	BBK Survey
Informed	Dummy = 1 if the bank is informed about its chain.	BBK Survey
CSD first	Dummy = 1 if a CSD is the first-sub-custodian in chain.	BBK Survey
No of CSD	No. of CSDs in each chain.	BBK Survey
No. countries in Chain	No. of different countries in each chain.	BBK Survey
Capital ratio	Core Capital Ratio 2010 Q4	BBK
Foreign	Dummy = 1 if foreign custodian	BBK Survey
No. of countries	No. of countries with sub-custodian link	BBK Survey
Asset in custody	Assets under custody in million EUR	BBK Survey
Geo. distance	Distance in 1000 km between Berlin and the capital of the country where the final sub-custodian is located.	Center D'Etudes Prospectives et d'information Internationales (CEPII)
Eco. distance	GDP per capita in USD 1000 of final sub-custodian domicile.	IMF
Legal rights	Indicator ranging from 1 to 12. Higher values reflect stronger legal rights, end of 2010	World Bank
Rating score	Numeric country rating scale, Aaa = 1 and Baa3- = 10; average across countries in chain	Moody's long term foreign debt rating

Table A.2
Correlation matrix.

	No. custodians	No. chains per Cs	Informed	CSD first	No. of CSDs	Capital ratio	No. countries in chain	Foreign	Assets in custody	Rating score
No. custodians	1.00									
No. chains per Cs	−0.01	1.00								
Informed	−0.11	−0.33	1.00							
CSD first	0.14	0.04	0.03	1.00						
No of CSD	0.53	−0.04	0.05	0.64	1.00					
Capital ratio	0.01	−0.06	−0.08	−0.22	−0.18	1.00				
No. countries in Chain	0.60	0.03	0.07	0.19	0.56	−0.36	1.00			
Foreign	−0.22	0.02	−0.30	−0.45	−0.34	0.24	−0.20	1.00		
Assets in custody	−0.08	−0.05	0.08	−0.06	−0.05	0.09	−0.04	0.07	1.00	
Rating score	−0.02	−0.21	0.10	−0.16	−0.15	0.10	0.01	0.10	−0.09	1.00

Notes: The correlation analysis is based on a survey conducted at the Deutsche Bundesbank. The data was reported as of 31 December 2010. 31 banks administered German UCITS funds.

Table A.3
Ordered probit and IV robustness estimations I: length of sub-custodian chains.

	(1) CR_{t-2}	(2) CR_{t-1}	(3) IV-Size	(4) IV- RoE	(5) IV-RoWA	(6) IV-RoE-CR	(7) IV-RoWA-CR
Informed	−0.62***	−0.68***	−0.51***	−0.51***	−0.51***	−0.52***	−0.55***
	[0.09]	[0.09]	[0.13]	[0.10]	[0.10]	[0.10]	[0.11]
Foreign	−0.74***	−0.60***	−1.36***	−1.00***	−0.98***	−0.88***	−0.98***
	[0.09]	[0.09]	[0.48]	[0.12]	[0.13]	[0.21]	[0.22]
Capital ratio	6.76***	5.80***	15.06***	3.25***	2.62***	1.99***	2.20***
	[0.65]	[0.68]	[5.56]	[1.22]	[0.90]	[0.69]	[0.69]
No. of links	−0.02**	0.09	−0.00	−0.01	−0.01*	−0.01*	−0.01*
	[0.01]	[0.09]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
CSD	0.13	−0.02***					
	[0.09]	[0.01]					
Constant			1.49***	2.98***	3.06***	3.12***	3.13***
			[0.56]	[0.21]	[0.17]	[0.14]	[0.14]
No. of obs.	977	977	1,051	827	827	740	740
R^2	0.05	0.04	0.06	0.06	0.07	0.05	0.04

Notes: Columns 1 and 2 show ordered probit and columns 3 to 7 IV regressions. Constants are included in column 1 and 2, but not reported. Robust standard errors in brackets. ***, **, * indicates significance at 1%, 5% and 10% levels. CR indicates the capital ratio with $t-1$ corresponding to Q2 2010 and $t-2$ corresponding to Q4 2009. RoE is the return on equity and RoWA the return on risk weighted weighted assets.

Table A.4
Ordered probit robustness estimations II: length of sub-custodian chains with bank and country fixed effects.

	(1) Baseline	(2) Baseline	(3) Baseline	(4) Full	(5) Full	(6) Full
Informed	−2.85***	−0.56***	−2.90***	−2.86***	−0.56***	−2.88***
	[0.28]	[0.08]	[0.30]	[0.28]	[0.08]	[0.29]
Foreign Banks	−3.54***	−0.73***	−3.94***	−3.78***	−0.74***	−3.90***
	[0.32]	[0.09]	[0.34]	[0.32]	[0.09]	[0.33]
CSD	0.61***	0.01	0.62***	0.67***	0.01	0.61***
	[0.19]	[0.09]	[0.20]	[0.19]	[0.09]	[0.20]
Capital ratio	26.94***	0.91	28.64***	26.67***	0.84	28.15***
	[1.85]	[0.61]	[2.18]	[1.94]	[0.61]	[2.18]
No. of links	−0.07***	0.02	0.03	−0.02	0.02	0.03
	[0.01]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]
Geo. distance				0.00***	0.00***	0.00**
				[0.00]	[0.00]	[0.00]
Eco. distance				−0.01***	−0.08***	−0.02
				[0.00]	[0.03]	[0.03]
Legal rights				0.03	0.11***	0.05**
				[0.02]	[0.03]	[0.02]
Rating score				−0.03**	−0.37***	−0.14
				[0.02]	[0.09]	[0.10]
FE bank	Y	N	Y	Y	N	Y
FE country	N	Y	Y	N	Y	Y
No. of obs.	1065	1065	1065	1038	1038	1038
Pseudo R^2	0.47	0.06	0.51	0.49	0.06	0.51

Notes: Robust standard errors in brackets. ***, **, * indicates signi cance at 1%, 5% and 10% levels.

Table A.5
Ordered probit: length of sub-custodian chains by regional subsets.

	(1) Non-G20	(2) Non-EU	(3) Non-Euro area	(4) G20	(5) EU	(6) Euro area
Capital ratio	1.581**	3.644***	2.248***	1.4	0.313	0.328
	[0.722]	[0.985]	[0.771]	[0.916]	[0.783]	[0.924]
Foreign banks	−0.686***	−0.362**	−0.462***	−0.574***	−0.775***	−0.843***
	[0.113]	[0.163]	[0.128]	[0.147]	[0.111]	[0.129]
No. of links	0.001	−0.058	0.055	0.057	0.009	0.017
	[0.013]	[0.117]	[0.035]	[0.039]	[0.014]	[0.016]
Informed	−0.427***	−0.307**	−0.356***	−0.588***	−0.573***	−0.611***
	[0.097]	[0.141]	[0.110]	[0.138]	[0.101]	[0.118]
CSD first	0.012	0.730***	0.348**	0.115	−0.169*	−0.189
	[0.112]	[0.193]	[0.143]	[0.151]	[0.102]	[0.117]
Geo. distance	0.00	0.000*	0.000**	0.00	0.00	0.00
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Eco. distance	−0.006***	0.005	0.004	0.007	−0.007***	−0.010***
	[0.002]	[0.004]	[0.004]	[0.010]	[0.002]	[0.003]
Legal rights	−0.001	−0.038	−0.035	−0.018	0.023	0.055*
	[0.021]	[0.033]	[0.028]	[0.035]	[0.020]	[0.028]
Rating score	−0.002	0.039*	0.026	0.025	−0.015	−0.003
	[0.014]	[0.022]	[0.021]	[0.045]	[0.016]	[0.020]
No. of obs.	707	353	521	331	685	517
Pseudo R^2	0.036	0.067	0.041	0.047	0.044	0.055

Notes: The regression analysis is based on a survey conducted at the Deutsche Bundesbank. The data was reported as of 31 December 2010. 31 banks administered German UCITS funds. Constant variable is included, but not reported. Robust standard errors in brackets. ***, **, * indicates significance at 1, 5 and 10% levels.

given that they can internalise many of the benefits attributed to CSDs. With regard to capitalisation, we interpret the negative relation with the CSD as a strategy to enhance the reputation of their custody services.

All in all, the analysis in this paper can only be seen as a first step in the direction of providing a better understanding of the custody services business. This industry has so far received very limited attention. It is likely that the industry will undergo a significant transformation due to regulatory changes and particularly the EU implementation of a strict liability regime. The results in this paper suggest that the industry has room for improvement in terms of reducing risk related to assets in custody. While this risk is typically small, the growing amount of cross-border assets managed by custodians suggest that the impact of losses could become more material. Moreover, losses of assets under custody could have systemic implications not only due to the amounts of assets under custody but also in view of the involvement of systemically important banks in the custody service industry.

Further research is thus needed to assess how, as a result of regulatory reforms, the sub-custodian structure is changing, how this affects the embedded risks in asset custody services with a view to further strengthen regulation to address emerging shortcomings. For this purpose, a follow-up survey should be conducted to further assess how the introduction of full liability of assets lost under custody has impacted the custodian services industry. Future research should also assess a broader set of investment vehicles and seek information on the investment vehicles in order to provide a better understanding of the underlying motivations for specific structures and a more comprehensive view on the risks of this business activity.

Appendix A

(See Tables A.1–A.5).

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