

**Kiel Institute of World Economics**  
Duesternbrooker Weg 120  
24105 Kiel (Germany)

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**What Determines Maturity?  
An Analysis for Foreign Assets of German  
Commercial Banks**

by

**Claudia M. Buch**

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# **What Determines Maturity?**

## **An Analysis for Foreign Assets of German Commercial Banks\***

**Abstract:**

Surges and reversals of short-term foreign liabilities are often held responsible for instabilities in international financial markets. Yet, empirical evidence on the factors determining the maturity of capital flows is scant. This paper analyzes the determinants of foreign assets of German banks for a panel of up to 73 countries for the years 1985–1997. Cross section estimates show that short- and long-term assets are highly correlated with foreign trade links but not necessarily with variables capturing regulatory restrictions. Trade activities are more important in explaining claims on banks versus non-banks. There is some evidence for a negative impact of exchange rate volatility on the share of short-term assets.

**Keywords:** foreign asset demand, maturity, regulations, Germany, panel cointegration

**JEL-classification:** F21, F23, G21

Dr. Claudia M. Buch  
Kiel Institute of World Economics  
24100 Kiel, Germany  
Telephone: +49-431-8814-332  
Fax: +49-431-8814-525  
E-mail: cbuch@ifw.uni-kiel.de

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# 1 Motivation

Surges and abrupt reversals of short-term (bank) loans are often held responsible for instabilities in international financial markets.<sup>1</sup> So far, the empirical literature has thus been concerned mainly with the volatility of short- versus longer-term capital flows. Claessens, Dooley, and Warner (1993) have argued that standard balance of payments labels provide relatively little information on the actual volatility of capital flows: short-term capital flows were found to be at least as predictable as other capital flows. Sarno and Taylor (1999) disentangle permanent and transitory components of capital flows. They find that there are relatively low permanent components of equity, bond, and official flows. Bank credits, in contrast, are relatively stable, while foreign direct investment (FDI) flows appear — as the conventional wisdom suggests — to be the most stable. Unfortunately, the study fails to provide a break-down of capital flows by maturity.

In order to derive policy implications from these studies, however, information not only on the volatility features of capital flows but also on the factors driving short-term capital flows is needed. On this count, the statistical record is relatively poor. Although a host of studies has been concerned with the determinants of capital flows, particularly to developing countries,<sup>2</sup> these studies do typically not distinguish capital flows of different maturities. An exception is the work by Rodrik and Velasco (1999). They find, for a panel of 32 developing countries, that the share of short-term debt is positively related to the ratio of M2 over GDP and to per-capita income. Chuhan, Perez-Quiros, and Popper (1996) study the univariate characteristics of short-term and FDI flows as well as the interaction between different types of capital flows. Their evidence suggests a greater instability of short-term capital flows compared to FDI.

The aim of this paper is to provide additional evidence on factors determining the maturity of external debt. It uses data on the foreign assets of German banks for a panel of up to 73 countries for the years 1985 through 1997. Additionally, time series data for the years 1969-1999 are used. We are particularly interested in

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<sup>1</sup> See Rodrik and Velasco (1999) for empirical evidence on the (positive) link between short-term debt and financial crises.

<sup>2</sup> See Calvo, Leiderman, and Reinhart (1993), Chuhan, Claessens, and Mamingi (1998), Fernandez-Arias (1996), Fernandez-Arias and Montiel (1996), or Hernández and Rudolph (1995).

analyzing the determinants of short- versus long-term foreign claims as well as of claims on banks versus claims on non-banks. *Inter alia*, this allows us to draw inference about the importance of information asymmetries, of risk, and of regulations on asset holdings.

While the dataset is confined to German banks, it provides evidence not available from other sources. It allows for the analysis of bilateral asset holdings, *including* data on asset holdings in OECD countries. Other data sources, such as the statistics on foreign bank loans provided by the Bank for International Settlements (BIS), focus on assets and liabilities vis-à-vis countries *outside* the BIS reporting area only. A recently compiled dataset on the foreign investment position of countries (Lane and Milesi-Ferretti 1999) also does not allow for an analysis of bilateral relations.

The following second part of the paper gives an overview of the theoretical and empirical literature on the determinants of foreign banking assets. The third part presents empirical estimates for German banks. Part four concludes and summarizes the main results.

## 2 Determinants of Foreign Banking Assets

In contrast to closed-economy models of bank lending, models of international lending need to take at least two specific features into account. First, foreign lending exposes banks to foreign exchange risks. Even if banks are perfectly risk neutral, risk enters the objective function because international banking regulations such as enshrined in the Basle Accord require banks to hold a certain amount of equity against their risky assets. Second, foreign differ from domestic lending activities because asymmetries of information tend to be more pronounced in an international as compared to a domestic context. In the following, we briefly summarize the theoretical and empirical literature on the determinants of (foreign) bank lending.

In a closed-economy model, Rajan (1992) analyzes the impact of information asymmetries on the choice of investment finance. He considers a firm which finances a two-period investment project and which can choose between short- and long-term bank loans as well as bond finance from arm's length lenders. Bank credits and bond finance differ in that banks learn about the type of investment projects after one period while bond holders remain uninformed. The superior information that banks obtain affords them with bargaining power over

the firm, and renegotiation of the initial contract terms may take place prior to the second period. It can be shown that, the lower the bargaining power of the owner of the firm, the greater are the firm's preferences for long-term loans. This is because, under short-term bank finance, the bank has an explicit right to renegotiate contract terms while, under long-term bank finance, renegotiation takes place only if the bank gives up some of its control rents. Choosing long-term contracts thus allows the firm to limit the bargaining power of the bank. Empirically, we should find that if the bargaining power of banks is high *ex ante*, debt maturity should be high as well.

On a more general level, the model shows that asymmetries in information have an important impact on the provision of finance. As bank lending typically takes place under conditions of imperfect information, it should be positively affected by factors which lower the resulting costs of acquiring information. Existing customer contacts and long-term lending relationships are one channel through which these costs can be reduced. Since information costs are likely to increase with the length of the project undertaken, these factors should tend to have a greater impact on long- rather than short-term financing.

Different risk characteristics additionally influence the choice between short- and long-term debt. In Rodrik and Velasco (1999), long-term debt is risky because, after one period, a certain amount of investors might decide to liquidate and not to roll over their loans. Premature liquidation, in turn, negatively affects the rate of return to holders of long-term claims. Rodrik and Velasco derive an endogenous term structure of foreign debt which arises from the fact that long-term debt typically has a higher risk of default. In addition to a default risk premium, long-term debt is more costly than short-term debt because of exchange rate, liquidity, or interest rate risk.

In the empirical literature on the determinants of foreign bank lending, activities of domestic firms in the foreign market have typically been used to proxy information costs and existing customer contacts.<sup>3</sup> This literature has primarily focused on US banks and on the determinants of FDI in banking, which has been shown to be positively related to FDI in the non-financial sector. This supports the hypothesis that banks follow their customers abroad. Yet, the direction of causality between foreign activities of banks and non-financial firms is typically not addressed explicitly. Likewise, it is conceivable that omitted factors are driving FDI in both sectors. Most studies thus control for market size (measured by

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<sup>3</sup> See Buch (2000) for a survey of the literature.

GDP or the size of the population) and foreign trade activities. Typically, market size and foreign trade links exert a positive impact on the foreign direct investment of banks. Entry regulations have a negative influence.

Buch (2000) uses data on foreign activities (FDI and foreign assets) of German banks. The results show a strong and positive correlation between foreign activities of banks and demand conditions as captured by (per capita) GDP and foreign activities of German firms, i.e. FDI in the non-banking sector or foreign trade activities. There is evidence that EU membership and the abolition of capital controls have promoted foreign lending but not FDI of banks, thus weakly supporting the hypothesis that the two are substitutes.

Moshirian and Van der Laan (1998) analyze the determinants of foreign assets of banks from Germany, the UK, and the US in a portfolio framework on the basis of quarterly data for the years 1985–1995. In contrast to earlier studies on the determinants of international asset choices of banks, they find that FDI of non-banks has a significantly *negative* influence for all three countries. This supports the hypothesis that FDI abroad is a substitute for bank credits to foreigners. Moreover, they find a positive coefficient on the foreign liabilities of the country under study, suggesting that capital in- and outflows are positively related.

Potthoff (1992) analyzes the determinants of short-term foreign claims and liabilities of German banks for the years 1984 to 1989 by distinguishing the currency structure of banks' foreign activities. He finds that, apart from exchange rate changes, net foreign claims of German banks are determined by credit demand of German firms on the Euromarket, activities of foreign investors on the German capital market, and market interventions of foreign central banks. Grüner (1996) studies the international portfolio decisions of German investors for the years 1975–1994 on the basis of a multi-sectoral, international portfolio model for investment in the US, Japan, and the rest of the world. However, the results of these studies do not provide evidence on the factors determining the maturity of foreign loans. Moreover, investment decisions of banks versus non-banks are not distinguished, and data disaggregated by country are not used.

Rodrik and Velasco (1999) provide one of the few empirical studies dealing with the determinants of short-term foreign debt. The share of short-term debt over total debt is used as the dependent variable in a panel regression for 32 emerging market economies. Per-capita income and the ratio of M2 over GDP are found to be positively related to the share of short-term debt. There is, in contrast, no statistically significant link between openness (measured by the ratio of imports over GDP) and short-term debt.

### 3 Determinants of German Banks' Foreign Assets

Activities of commercial banks in foreign markets can be expected to be influenced by factors such as market size, market opportunities, information asymmetries, regulatory restrictions, and risks. This section takes an empirical account of the determinants of German banks' foreign assets. We use data on the stocks of foreign assets of German banks which is provided by the Deutsche Bundesbank in its Balance of Payments Statistics (Deutsche Bundesbank 2000). Data on foreign assets of the branches and subsidiaries of German banks abroad are excluded mainly for three reasons. *First*, data for the domestic banks alone are available for a much larger country sample. *Second*, foreign branches and subsidiaries presumably have easier access to local market information. If anything, asymmetries in information will thus tend to be less severe than for the domestic banks. *Third*, evidence provided in Buch (2000) suggests that activities of branches, subsidiaries, and domestic banks are determined by similar factors nevertheless. Still, the presence of domestic banks in a foreign market via branches and subsidiaries may improve the information flow to the mother company. Hence, in future empirical work using micro-data, it might be useful to explore this link in more detail.

Data on foreign assets of German banks are broken down into short- and long-term assets as well as claims on banks and non-banks. The determinants of these activities can be expected to differ mainly for two reasons. *First*, holdings of short-term assets are less likely to be adversely affected by information costs. As regards the impact of exchange rate volatility as a measure of risk, the implications are less clear-cut. On the one hand, short-term fluctuations of exchange rates are likely to cancel out in the long-run. This, *ceteris paribus*, may make long-term asset holding less sensitive in exchange rate volatility. On the other hand, long-term assets can be less quickly withdrawn than short-term assets if exchange rates become more volatile, implying a negative relationship between exchange rate volatility and the share of long-term assets.

*Second*, lending to non-banks on the retail market is more likely to be negatively affected by asymmetries in information than lending to banks. This is because (short-term) interbank lending takes place on a well-organized interbank market on which information on borrower characteristics is more readily available than on the retail market.<sup>4</sup> Since foreign trade activities and FDI of the non-

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<sup>4</sup> Evidence on the greater degree of market integration on the money market relative to the degree of integration of the market for bank loans is provided by Centeno and Mello (1999).



financial sector are typically used to capture close contacts to existing customers, these are, a priori, more likely to affect lending to non-banks than to banks.

After presenting some stylized facts on the foreign activities of German banks, we use three different empirical tests to obtain evidence on the determinants of foreign banking assets. Tests on the cointegration properties of long-run, aggregated time series allow an assessment whether short- and long-term assets share a common trend. Yet, these estimates do not provide information on the structural parameters affecting asset demand. Hence, we present cross-section and panel cointegration estimates to capture these effects.

### 3.1 Stylized Facts

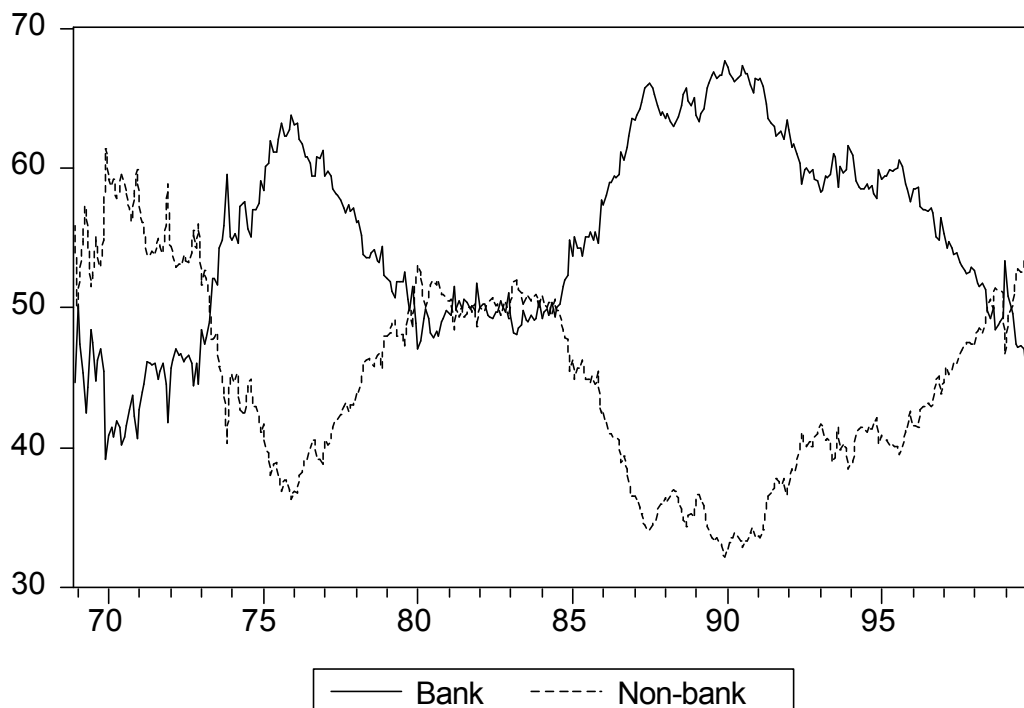
Over the past 30 years, total cross-border assets of German commercial banks have increased more than tenfold in real terms. Measured in relation to the balance sheet total of German banks, they have doubled from a share of about 3 percent in 1968 to over 7 percent at the end of 1998.<sup>5</sup>

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This could be taken as evidence for a lower degree of informational asymmetries on the former.

<sup>5</sup> Note that these shares might be biased downward somewhat because reporting on foreign assets is mandatory only for banks exceeding a certain threshold level in terms of size. Total assets, in contrast, are taken for the entire banking sector.

*Graph 1 — Composition of External Assets of German Banks by Customer (%) 1969–1995*

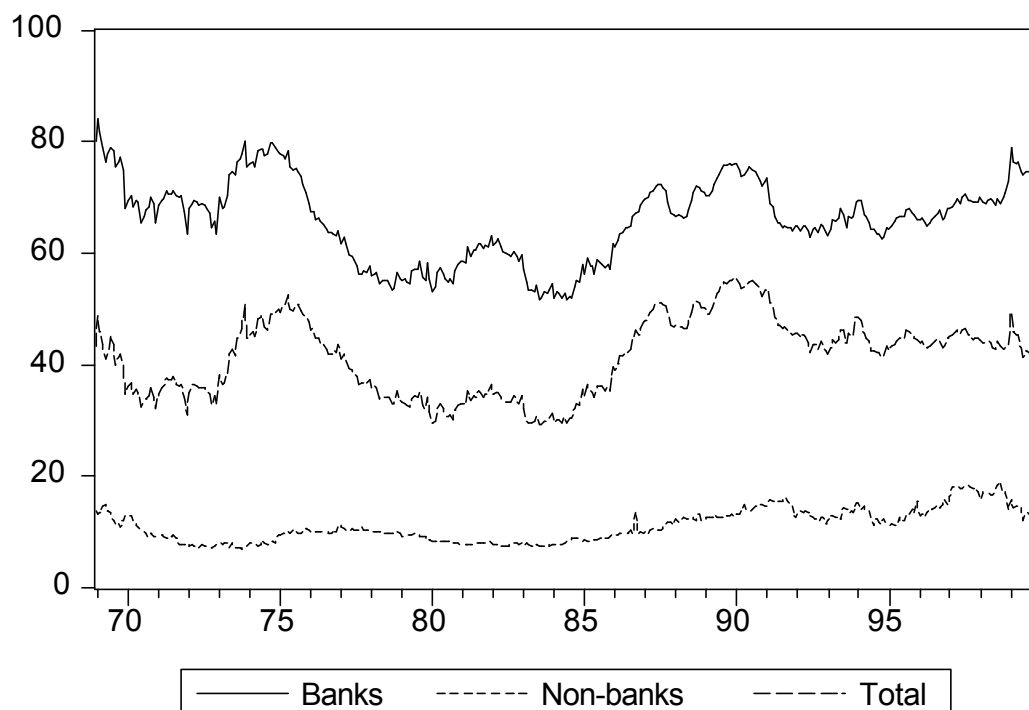


Source: Deutsche Bundesbank (2000); own calculations

Beyond these general trends, the composition of assets in terms of claims on banks and non-banks has shifted quite substantially over time. While the second half of the 1970s was characterized by a growing importance of claims on banks, this trend came to an abrupt halt in the second half of the decade (Graph 1). In the first half of the 1980s, claims on banks and non-banks were quite stable in relative terms, both accounting for roughly 50 percent of the total. The following decade was again characterized by a growing importance in claims on banks, triggered by a substantial increase in short-term assets. This trend has been reversed since the early 1990s.

Throughout, the maturity of claims on banks and non-banks has differed significantly (Graph 2). While less than 20 percent of claims on non-banks had a maturity of less than one year, this share has been around 70 percent for claims on banks. Following Rajan (1992), the preference of non-bank customers for long-term loans could reflect their inferior bargaining power as compared to banks. It is indeed conceivable that non-bank customers on average are smaller and more numerous than banks, which would limit their bargaining power in relative terms.

Graph 2 — *Share of Short-Term Assets in External Assets of German Banks (%) 1969–1999*

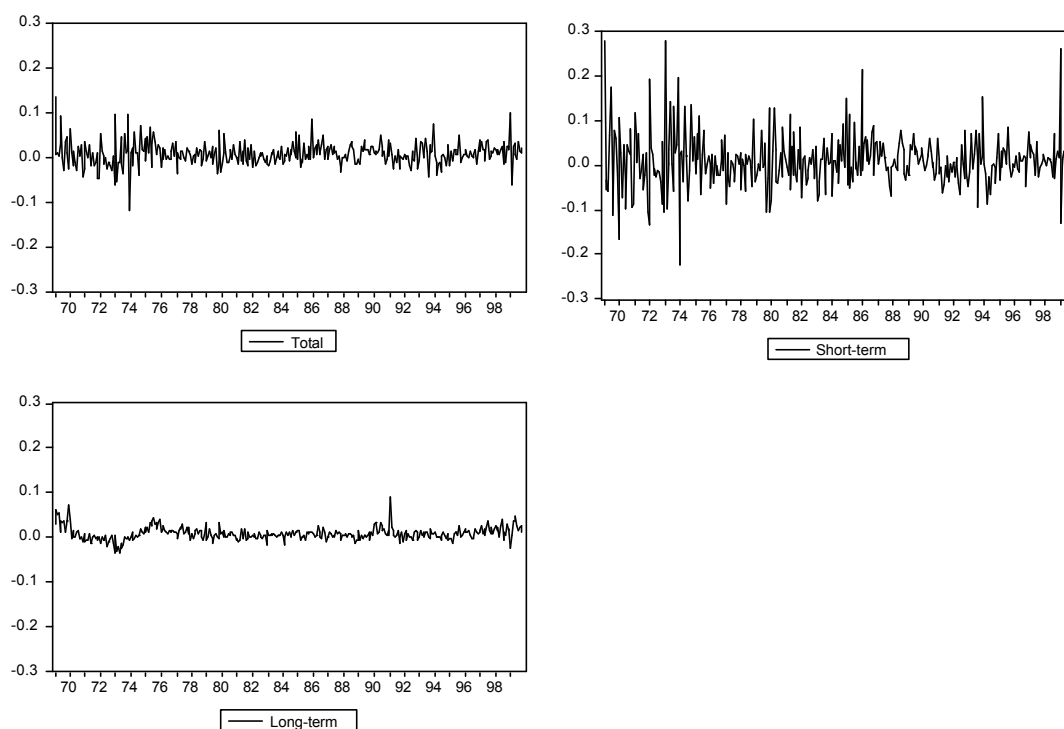


Source: Deutsche Bundesbank (2000); own calculations

As regards the regional composition of claims, industrialized countries have dominated, accounting for 81 percent of the total; 63 percent of all claims are on members of the EU. Interestingly, the share of short-term assets in industrialized countries was about 45 percent, as compared to only one fourth for developing countries. This is in line with the result of Rodrik and Velasco (1999) that per capita income and the share of short-term debt are positively related. The difference is driven almost entirely by differences in the debtor structure as 96 percent of claims on industrialized countries are claims on banks, as compared to only 43 percent for developing countries.

The share of foreign assets denominated in domestic currency (D-mark and euro, respectively) has been similar for assets of different maturity. In mid-1999, about two-thirds of total foreign assets were denominated either in D-mark or euro, this share being slightly above-average for short-term (69 percent) and below-average for long-term assets (63 percent). Taken in isolation, this would make it difficult to derive implications of exchange rate risk on the maturity of foreign asset holdings. The fact, however, that hedging instruments become less easily available for maturities exceeding one year, might make longer-term contracts more sensitive to exchange rate risks.

*Graph 3 — Volatility of External Assets of German Banks by Maturity (%) 1969–1999*



Volatility = percentage change of asset holdings over previous period (annualized).

Source: Deutsche Bundesbank (2000); own calculations

Finally, Graph 3 plots the changes of asset holdings over the previous period as a measure for their volatility. Measured in percentage terms, short-term assets show substantially larger fluctuations than long-term or total assets. Eyeballing Graph 3 thus confirms the conventional wisdom that holdings of short-term foreign assets are substantially more volatile than holdings of long-term assets.

### 3.2 Time Series Cointegration Tests

Since the hypothesis that the time series of asset holdings are  $I(1)$  cannot be rejected on the basis of the ADF-tests (Table 1), one way to determine whether short- and long-term assets share a common trend is to analyze whether there are cointegration relationships between the two.<sup>6</sup>

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<sup>6</sup> See Holmes (1997) for a similar application of cointegration techniques to bank credit markets in the EU.

Table 1 — Results of ADF Tests

	Levels	First differences
F	0.800	-6.936*
FK	0.411	-7.943*
FL	0.511	-4.573*
FB	-0.764	-7.771*
FBK	-0.432	-7.955*
FBL	-1.575	-4.895*
FNB	0.703	-5.452*
FNBK	0.793	-8.638*
FNBL	1.762	-4.747*

Test specification: four lags, constant term. All variables in logs. \* = significant at 5 percent level.

Source: own calculations.

More technically, there is a vector  $\mathbf{x}_t$  of  $n$  potentially endogenous variables, where  $\mathbf{x}_t$  can be modeled as an unrestricted VAR involving up to  $k$  lags of  $\mathbf{x}$ :

$$(1) \quad \mathbf{x}_t = \mathbf{A}_1 \mathbf{x}_{t-1} + \mathbf{A}_2 \mathbf{x}_{t-2} + \dots + \mathbf{A}_k \mathbf{x}_{t-k} + \mathbf{u}_t$$

We can reformulate this equation into an error-correction model:

$$(2) \quad \Delta \mathbf{x}_t = \Gamma_1 \Delta \mathbf{x}_{t-1} + \dots + \Gamma_k \Delta \mathbf{x}_{t-k+1} + \Pi \mathbf{x}_{t-k} + \mathbf{u}_t,$$

where  $\Gamma_i = -(\mathbf{I} - \mathbf{A}_1 - \dots - \mathbf{A}_i)$ ,  $\Pi = -(\mathbf{I} - \mathbf{A}_1 - \dots - \mathbf{A}_k)$ , and  $\Pi = \mathbf{a}\mathbf{b}'$ , where  $\mathbf{a}$  gives the speed of adjustment to equilibrium, while  $\mathbf{b}$  gives the matrix of long-run coefficients such that  $\mathbf{b}_{z_{t-k}}$  provides up to  $n-1$  cointegrating relationships in the multivariate model that ensure the convergence of the elements in  $\mathbf{x}_t$  to their long-run steady state values.

Table 2 gives the results of Johanson cointegration tests. It shows that there are no significant long-run cointegration relationships for short- and long-term assets of German banks. Hence, the two types of asset holdings do not share a common stochastic trend.

Table 2 — Tests for Cointegration in Time Series of Foreign Assets

	Cointegration Rank		Residuals		Number of lags	Model
	Trace	Critical values	AR(1) (p-values)	AR(4) (p-values)		
	Total foreign assets: short- versus long-term					
$r = 0$	15.2	17.8	0.77	0.31	24	2
$r \leq 1$	4.4	7.5				
	Claims on non-banks: short- versus long-term					
$r = 0$	15.1	17.8	0.68	0.17	12	2
$r \leq 1$	3.3	7.5				
	Claims on banks: short- versus long-term					
$r = 0$	8.7	13.3	0.22	0.13	6	3
$r \leq 1$	0.0	2.7				

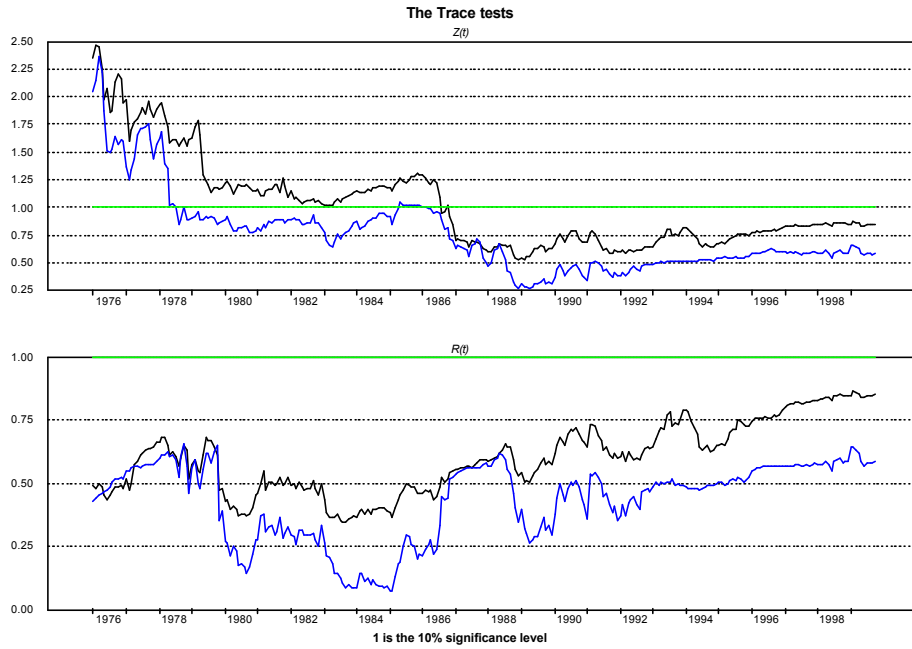
Tests for cointegration are Johansen's likelihood ratio test based on the trace statistic (Johansen and Juselius 1990), where  $r$  refers to the number of cointegrating vectors. Starting with 6 lags, additional lags have been added to remove autocorrelation in the residuals. Using the Pantula principle, estimates include a constant restricted to the cointegration space (model 2) or a constant in the cointegration space and a deterministic trend in the short-run dynamics (model 3). Significance levels have been taken from Hansen and Juselius (1995). Time period: 1969:1 – 1999:10. For all cases, the null hypothesis could not be rejected at the 10 percent level of significance, which indicates that the cointegration rank is zero and that there is no cointegration relationship in the system.

Source: own calculations.

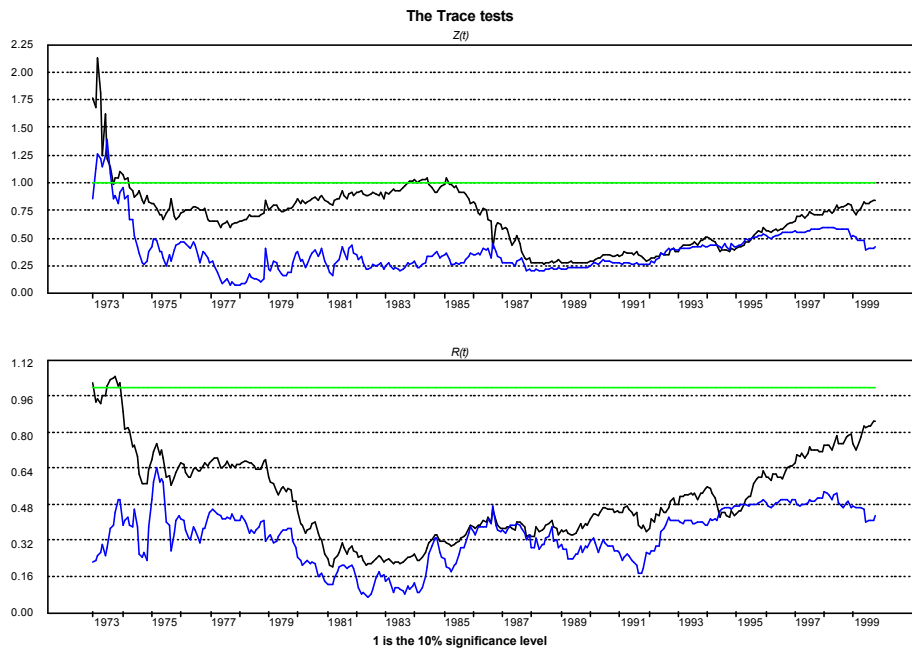
Since the previous descriptive statistics have shown that there have been quite noticeable changes in the composition of foreign assets, it could be argued that the links between short- and long-term assets might not have been stable over time. Hence, analyzing the presence of cointegration relationships over the full time period might be overly restrictive. In an additional step, recursive estimates of the trace statistics have thus been performed. Graph 4 plots the time paths of the trace tests with the number of test statistics above unity indicating the cointegration rank of the system at the given significance level. Two different specifications are plotted:  $Z(t)$  is derived from a system in which the short-run dynamics are specified for each estimation, whereas  $R(t)$  fixes the short-run dynamics to those of the full-sample estimation. Since the second specification addresses the question of the constancy of the cointegration rank, given the full sample estimates of the short-run dynamics, it is more relevant for a recursive analysis (Hansen and Johansen 1992). With a few short-run exceptions, the  $R(t)$  statistic does not exceed unity for the entire sample. Hence, we can reject the hypothesis that the time series under study have been cointegrated.

Graph 4 — Recursive Estimates: Trace Tests

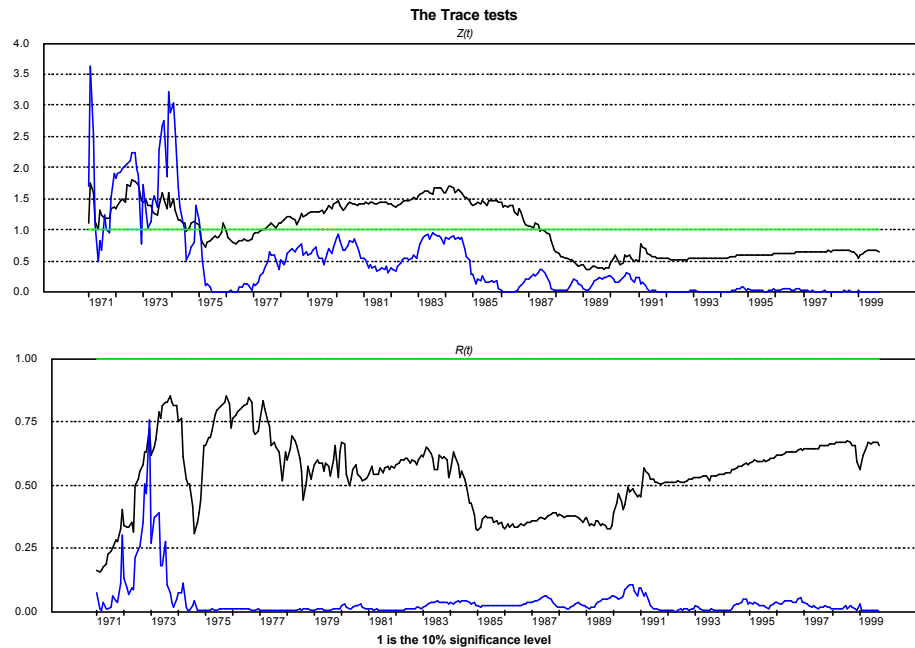
a) Total foreign assets



b) Claims on non-banks



c) Claims on banks



Note: For details of the test specification see Table 2.

### 3.3 Cross-Section Estimates

The finding that short- and long-term assets do not share a common trend provides first evidence that they might be driven by different factors. In this section, we exploit the cross-section dimension of our dataset to obtain evidence on the nature of these determinants.<sup>7</sup> Structural determinants of foreign asset holdings have been estimated by using the following equation:

$$(3) \quad y_i = x_i \mathbf{b} + \mathbf{e}_i$$

where  $y_i$  = (log of) foreign assets of German banks in country  $i$ , broken down by borrower and maturity,  $x_i$  = country-specific explanatory variables, and  $\mathbf{e}_i$  = error term. All data are in constant euro.<sup>8</sup> The possible determinants of cross-border banking activities have been captured as follows (expected coefficients in brackets):

*Excess returns*: lending rates (+), deposit rates (-), interest rate spreads (+)

<sup>7</sup> All estimates have been performed with the statistical software packages EViews 3.1 and RATS for Windows 4.20.

<sup>8</sup> See Table A1 for details on the definition and calculation of the variables.



*Market size:* GDP (+)

*Information on customers:* foreign trade links (+), foreign direct investment of non-financial firms (+)

*Risk:* exchange rate volatility (–)

*Regulatory restrictions:* dummy for EU membership (+), dummies for financial centers (Luxembourg, others) (+), dummy for OECD membership (+)

It could be argued that exchange rate volatility is not exogenous as it depends on the share of short-term foreign liabilities in the total. Yet, this argument can be ignored in the present context because claims of Germany on a given country are only a fraction of total foreign claims. Hence, the impact of short-term German claims on total volatility is likely to be negligible.

EU membership is included as a proxy for regulatory restrictions because the adoption of the Single Market program and the adoption of the Second Banking Directive in 1992 have been intended to level the playing field for financial institutions across Europe. The adoption of the principles of mutual recognition, home country supervision, and minimum harmonization of banking regulations should have tended to have eased the provision of financial services abroad. In a similar vein, the abolition of capital controls can be expected to have fostered cross-border asset holdings.

OECD membership could have a positive impact on cross-border lending because the capital adequacy standards of the BIS, which have been issued in 1988, assign a lower risk-weight for lending to OECD members as compared to non-members. Hence, it has frequently been argued that becoming members in the OECD has fuelled capital inflows into emerging markets. Also, short-term cross border lending is encouraged as it receives a lower risk weight than long-term lending (Rodrik and Velasco 1999).

We have started with a cross-section analysis for the year 1997 (Table 3). Foreign claims of domestic German banks have been used as a dependent variable. These claims have furthermore been broken down into claims on banks and claims on non-banks as well as short- and long-term loans.

Table 3 — Cross-Section Estimation Results

	log total claims			log claims on banks			log claims on non-banks		
	Total	short-term	long-term	Total	short-term	long-term	Total	short-term	long-term
<i>For the year 1997</i>									
Intercept	2.35		1.72	-1.24*		-2.71	2.29		2.79
log Trade	0.62	0.77	0.53	0.97	0.66	0.93	0.54	0.31	0.43
log GDP			0.26				0.17	0.32	0.18
Volatility		-3.06				3.26	-3.01		-2.71
DUMFIN	1.20	1.85	0.71*	1.51	2.33	1.38		1.92	
DUMLUX	3.15	3.92	3.33	4.57	4.77	3.83	1.89		2.07
DUMEU	0.31		0.42	0.29*	0.62				0.22*
DUMOED			-0.54	-0.70				0.88	
R <sup>2</sup>	0.75	0.64	0.67	0.74	0.64	0.72	0.74	0.55	0.70
N	73	63	66	58	67	52	51	61	50
<i>For the year 1990</i>									
Intercept		-1.58			-2.85	-3.58	2.83		
log Trade	0.86	0.88	0.79	0.80	1.09	1.10	0.33	0.33	0.67
log GDP					-0.29	-0.19*	0.22		
Volatility	1.49		1.86			3.66		2.48	2.83
DUMFIN	0.84	1.63		1.16	1.72	0.98		1.24	
DUMLUX	3.32	3.79	2.56	3.58	3.06	3.42	2.19		2.11
DUMEU									
DUMOED		0.58*			1.43		0.51	2.23	0.61*
R <sup>2</sup>	0.73	0.74	0.65	0.74	0.78	0.59	0.67	0.57	0.57
N	58	57	54	36	49	35	33	46	34

Coefficients are significant at least at the 10-percent level. \*) significant only at the 20-percent level.

Source: own calculations.

Each equation has first been estimated by including GDP as a proxy for market size, foreign trade activities as a proxy for information on customers, and exchange rate volatility. Without including additional dummy variables for the presence of financial centres, for EU, or OECD membership, only trade links have been significant. In the following, results from the equations including the dummies are used. Since variables capturing the rate of return on the foreign market (interest rates, spreads) were found to be insignificant throughout, they are not reported. Generally, the explanatory power of the equations is quite high with an adjusted  $R^2$  between 0.55 and 0.84.

For total assets, cross-section results for the year 1997 show a clear positive and significant link between the stock of assets of German banks abroad and bilateral trade activities. Likewise, host-country GDP enters with a significantly positive sign, primarily for claims on non-banks. Elasticities of foreign assets with respect to foreign trade tend to be higher than those for GDP. Exchange rate volatility has a negative impact on short-term claims, on total assets as well as on claims on non-banks. The impact of volatility on long-term claims on banks, in contrast, is positive.

The financial centre dummies have the expected positive sign throughout and tend to be more important in explaining claims on banks rather than those on non-banks. Evidence for the importance of EU and OECD membership is mixed. EU membership seems to have been more important for claims on banks than on non-banks. OECD membership has even had a negative impact on claims on banks and on total long-term assets while (short-term) claims on non-banks have been positively affected.

In order to check the robustness of our results, a number of different specifications have been used. Because bilateral foreign trade links and bilateral FDI activities are highly correlated, the two were not used in the same specification to avoid problems of multicollinearity. Like trade, FDI was found to have positive impact on foreign asset holdings, which supports the results of the earlier literature but is in contrast to Moshirian and van der Laan (1998). Yet, using FDI instead of trade to capture proximity to customers leads to insignificant coefficients of the volatility variables in four equations. Also, the OECD-dummy becomes insignificant in two cases.

Estimating the model for 1990 instead of 1997 yields significantly positive estimates for the volatility variable for some specifications. Including versus excluding the EU and the OECD dummy, in contrast, leaves the results essentially unchanged. Interestingly, the EU dummy has been insignificant throughout in the

1990-sample. This suggests that the 1992-Single Market program has indeed been effective in stimulating foreign activities of German banks in other European countries. OECD membership, in contrast, seems to have been more important in 1990 than in 1997, particularly as regards claims on non-banks. Finally, GDP has had a negative impact on claims on banks.

Additionally, Wald-tests have been performed to check whether the coefficients for short- and long-term assets are significantly different from each other.<sup>9</sup> Trade has been significantly more important for short-term than for long-term assets in 1997 but not in 1990. Differences in the coefficients on the financial centre dummies have been insignificant. Interestingly, trade has been significantly more important in explaining claims on banks as compared to claims on non-banks in both sample periods. Hence, the typical interpretation that foreign trade links proxy information on (non-bank) customers might need to be reconsidered.

Since volatility has not been significant in all equations and since its impact has not been stable over time, the results obtained so far do not yet provide a direct answer to the question which factors affect the share of short-term assets in total foreign claims. Hence, this share has been used as an additional dependent variable.<sup>10</sup> Overall, the explanatory power of this equation has been much lower than for the asset equations (adjusted  $R^2$  of about 0.25). In 1990 and in 1997, foreign trade links and the financial centre dummies had a positive and significant impact on the share of short-term claims. The impact of volatility, in contrast, has been negative.<sup>11</sup> The fact that short-term changes in exchange rates tend to cancel out in the longer run might explain this result.

### 3.4 Panel Cointegration Tests

Finally, the time series and cross-section properties of the data have been exploited. As in standard time series regressions, ignoring the non-stationarity of the data in panels leads to spurious regressions. In order to assess whether there are cointegration relationships between foreign assets of German banks and the explanatory variables used above, we have first constructed a balanced panel for the years 1985–1997. Due to incomplete data, the number of cross sections has

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<sup>9</sup> Wald tests have not been performed for the coefficients on the volatility variables because these were insignificant in at least one specification.

<sup>10</sup> Results are available from the author upon request.

<sup>11</sup> The same result was obtained when only the current change in the exchange rate was used.

been reduced to 28 countries only.<sup>12</sup> Also, we have not broken down the sample into claims on banks and non-banks anymore.

Tests for cointegration have proceeded in two steps following Pedroni (1996, 1999) (Table 4). First, we have established whether there are cointegration relationships between foreign assets of commercial banks, on the one hand, and trade, GDP, and volatility, on the other hand.<sup>13,14</sup> In a second step, the long-run coefficients  $\mathbf{b}_{ji}$  have been estimated from the following equation:

$$(4) \quad y_{it} = \mathbf{a}_i + \mathbf{d}_i t + \sum_{j=1}^n \mathbf{b}_{ji} X_{jit} + \mathbf{e}_{it}$$

where  $t = 1, \dots, T =$  number of observations over time,  $i = 1, \dots, N =$  number of cross-sections, and  $m = 1, \dots, M =$  number of regressors. Table 4 summarizes the results. The majority of the cointegration tests developed by Pedroni (1999) provide evidence for cointegration of total and short-term assets but not for long-term assets with the explanatory variables. The long-run parameters are in line with the theoretical presumptions: foreign assets of commercial banks react positively to changes in trade activity (long-run elasticity of about 0.6) and to GDP (long-run elasticity of about 1). Exchange rate volatility has a significantly negative effect only on short-term assets.<sup>15</sup>

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<sup>12</sup> See Table A2 for details on the country sample.

<sup>13</sup> Dummy variables for EU and OECD membership have been added but including these led to a rejection of the hypothesis of cointegration.

<sup>14</sup> Including a variable such as volatility which is stationary in a cointegration regression can be justified if economic theory predicts a relationship between the variables under study (Hansen 1993).

<sup>15</sup> Note that the parameter estimates are semi-elasticities.

Table 4 — Panel Cointegration Tests 1985–97

	Total assets	Short-term assets	Long-term assets
	<i>Long-run parameters<sup>a</sup></i>		
log trade	0.67*** (3.65)	0.83*** (6.91)	0.46 (1.04)
log GDP	0.86*** (10.06)	0.92*** (8.19)	1.03*** (7.18)
volatility	–33.47 (–1.00)	–23.02** (–2.81)	–50.12 (–1.00)
	<i>Cointegration tests</i>		
panel v-stat	0.43	1.79*	–0.64
panel rho-stat	–0.63	–1.55	–0.08
panel pp-stat	–2.15**	–3.19***	–1.19
panel adf-stat	–1.93*	–3.70***	–1.08
group rho-stat	0.20	–0.33	1.22
group pp-stat	–2.72***	–3.32***	–0.61
group adf-stat	–2.42**	–4.55***	–0.82
***, **, * = significant at the 1, 5, 10 percent level. — a) Results from computing panel group mean estimators, modified for small sample adjustments, and allowing for heterogenous time dummies. <i>t</i> -values in brackets. See Pedroni (1996, 1999) for details.			

Source: own calculations.

## 4 Summary

This paper has analyzed determinants of German banks’ foreign assets, distinguishing short- and long-term assets as well as claims on banks and claims on non-banks. Cointegration tests for long-term time series have suggested that the time series of these asset holdings do not share a common trend. Static estimates for a cross-section of up to 73 countries for the years 1990 and 1997 have revealed that both short- and long-term assets are highly correlated with foreign trade links. In relative terms, short-term assets are affected to a greater degree. This is in line with the earlier literature but contradicts Rodrik and Velasco (1999). Interestingly, bilateral trade activities have been more important in explaining claims on banks rather than non-banks, which could be taken as evidence against the follow-their-customer hypothesis. Instead, trade activities might be capturing market opportunities in a more general form. Market size, as

proxied by GDP, seems somewhat more important for claims on non-banks as compared to those on banks.

As regards the impact of regulatory restrictions, the evidence has been mixed. While the presence of financial centres (and thus a relatively liberal regulatory regime) has had a positive impact on foreign banking assets throughout, EU and OECD membership have been of smaller statistical and economic significance. There is even some evidence for a negative impact of OECD membership, which runs counter to the argument that the BIS capital adequacy standards have biased lending decisions towards lending to these countries. When analyzing case studies of countries for which membership in the OECD has been associated with greater capital inflows, it should thus be taken into account that increased capital inflows could also have been triggered by other economic reforms.

Panel cointegration tests have pointed to different determinants of short- and long-term banking assets. There has been evidence for a statistically significant link between short-term assets, on the one hand, trade, GDP, and exchange rate volatility, on the other hand. Long-term assets, in contrast, were related to trade activities only. These results suggest that an increase in short-term assets might be a by-product of economic development in the sense of lower exchange rate volatility, increased trade activities, and growth in GDP.

At the same time, an assessment of the welfare implications of increased short-term asset holdings has been beyond the scope of this paper. In order to address this issues, additional evidence on the interaction between (short-term) assets of commercial banks and those of other sectors, on the implications of economic development on financial stability as such, or on the impact of short-term asset holdings on volatility would be needed.

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formance of capital flows to developing countries: an empirical investigation. *Journal of Development Economics* 59: 337–364.

*Table A1 — Data Definitions and Sources*

<i>Variable</i>	<i>Definition</i>	<i>Source</i>
<i>DUMEU</i>	dummy variable for EU members (= 0 before membership and abolition of capital controls, = 1 membership but capital controls remain, = 2 membership and full abolition of capital controls)	
<i>DUMFIN</i>	dummy variable for financial centres (Great Britain, Hong Kong, Ireland, Switzerland, Singapore)	
<i>DUMLUX</i>	dummy variable for Luxembourg	
<i>DUMOECD</i>	dummy variable for OECD membership (= 0 for non-members, = 1 for members)	
<i>EX</i>	German merchandise exports; in million euro, deflated by the German price index	Deutsche Bundesbank (2000)
<i>F</i>	total foreign assets of German banks; in million euro, deflated by the German price index	Deutsche Bundesbank (2000)
<i>FB(FNB)</i>	foreign claims of German banks on banks (non-banks); in million euro, deflated by the German price index	Deutsche Bundesbank (2000)
<i>...L</i>	long-term assets (maturity over one year)	
<i>...K</i>	short-term assets (maturity less than one year)	
<i>GDP</i>	gross domestic product in billion current national currency, converted into euro with the average annual euro/US-dollar exchange rate and deflated by the German price index; in million euro	IMF (1999)
<i>TRADE</i>	Export plus import value; in million euro, deflated by the German price index	Deutsche Bundesbank (2000)
<i>IM</i>	German merchandise imports; in million euro, deflated by the German price index	Deutsche Bundesbank (2000)
<i>VOLATILITY</i>	absolute value of average percentage change of the D-mark exchange rate (annualized, current and past four years)	IMF (1999), own calculations

Note: Single missing observations in stock data have been extrapolated. Data in constant prices of 1980, deflated by German consumer price index.

Table A2 — Country Samples

Cross section estimates		Panel cointegration
Algeria	Malaysia	Australia
Argentina	Morocco	Austria
Australia	Mexico	Belgium
Austria	Netherlands	Chile
Bahrain	New Zealand	China
Belgium	Nicaragua	Denmark
Bolivia	Nigeria	Egypt
Brazil	Norway	Ecuador
Bulgaria	Pakistan	Finland
Canada	Panama	France
Chile	Paraguay	Great Britain
China	Peru	Hong Kong
Croatia	Philippines	Hungary
Cyprus	Poland	Iran
Czech Republic	Portugal	Ireland
Denmark	Romania	Israel
Egypt	Russia	Italy
Ecuador	Zambia	Japan
Finland	Saudi Arabia	Luxembourg
France	Singapore	Mexico
Great Britain	Slovakia	Netherlands
Greece	Slovenia	Norway
Hong Kong	South Africa	Poland
Hungary	South Korea	Singapore
Iceland	Spain	Sweden
India	Sri Lanka	Switzerland
Indonesia	Sweden	Thailand
Iran	Switzerland	United States
Ireland	Syria	
Israel	Thailand	
Italy	Tunisia	
Japan	Turkey	
Kenya	Ukraine	
Kuwait	United States	
Luxembourg	Venezuela	
	Zimbabwe	