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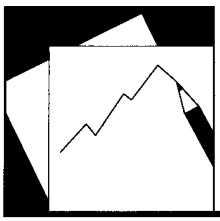

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External Linkages and Contagion Risk in Irish Banks

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External Linkages and Contagion Risk in Irish Banks

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Abstract

The large and growing international linkages of big Irish banks expose them to idiosyncratic shocks arising in other countries. We analyze international interdependencies of Irish banks—during both normal times and in periods of large shocks or extreme events—using an existing methodology with distance to default (DD) data constructed from the banks' equity prices. The data covers daily observations from January 1994 to November 2005. We first construct rolling correlations between DDs of Irish banks and those of banks from other European countries and the U.S. to analyze trends in cross-country interdependencies. We then use a multinomial logit model to estimate the number of banks in Ireland that experience a large shock on the same day as banks in other countries ("coexceedances"), controlling for Ireland-specific and global factors. We find evidence of increasing cross-border interdependencies over time; differing interlinkage patterns in the pre-Euro, post-Euro, and the post-September 11th periods; and significant cross-border contagion risk from the United Kingdom, the United States, and the Netherlands.

JEL Classification Numbers: C51, G21

Keywords: Contagion risk, Distance to default, Ireland

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I. INTRODUCTION

In the past decade Ireland has become increasingly financially open. Global trends in financial liberalization, innovation, and banking consolidation activity, as well as greater bank reliance on wholesale funding, increasing competition from foreign-owned incumbent banks, and the development of the Irish Financial Services Center (IFSC, now Financial Services Center or FSC) have led to increasing international exposure for the banking system. At the same time, the Irish domestic banking system has remained relatively concentrated, with Bank of Ireland (BoI), Allied Irish Banks PLC (AIB), and Anglo Irish Bank Corp. PLC (Anglo IB) representing about 45 percent of total banking assets but nearly 80 percent of the domestic retail market.

In this paper, following Gropp, Lo Duca and Vesala (2005)[2] and partly using De Nicolo and Tieman (2005) we explore whether recent developments in increasing international openness might have been accompanied by increasing financial risk for the three major Irish banks.[3] We explore trends in international interdependencies between Irish banks and banks in the major European countries and in the United States over the period 1994–2005, and analyze whether international linkages have led to possible contagion risk. We assess whether and to what extent large negative shocks in banks of these countries affected banks in Ireland. In particular, we measure the probability that a particular number of banks in Ireland will experience a large negative shock at the same time as banks in other countries ("coexceedances"). The existence and the magnitude of these effects have implications for the monitoring of financial stability, as contagion is widely perceived to be an important element of banking crises and systemic risk.

We use the term "contagion" to mean the transmission of an idiosyncratic shock affecting one bank or a group of banks to other banks or other banking sectors, using distance to default (DD) as a measure of bank risk, and after controlling for common shocks. There could be a number of possible contagion channels (Box 1) and several ways to measure contagion: estimating autocorrelation and survival time tests using historical data on bank failures (Calomiris and Mason, 2000), using the interbank market lending exposure matrix and measuring domino effects of insolvency in one bank spreading to others (Furhine 2003), or analyzing the correlations of stock returns of banks to measure interdependencies (De Nicolo and Kwast, 2002).

We follow the approach employed in the recent literature, which estimates contagion by using the DD as a comprehensive measure of default risk (Gropp and Moerman 2004, De Nicolo and Tieman 2005, Gropp, Lo Duca and Vesala 2005). The DD represents the number of standard deviations away from the default point, the point at which the book value of

[2] Gropp, Lo Duca and Vesala (2005) find evidence of significant cross-border contagion in Europe (Ireland not included in the sample) during January 1994 to January 2003.

[3] The choice of the banks was guided by the availability of data on their equity prices.

liabilities of the bank are just equal to the market value of assets. Unlike unadjusted stock returns, the DD combines information about stock returns with leverage and asset volatility information, thus encompassing the most important determinants of default risk. The higher the DD, the greater the distance of the bank from default point, and the lesser the risk or probability of default of the bank. The benefit of this approach is that co-movements in DD can be analyzed without specifying a particular channel of contagion. Rather, these co-movements reflect interdependencies between domestic and cross-border banks encompassing all potential channels of contagion, including that occurring in the absence of explicit links between banks.

Box 1. Sources of Contagion—A Literature Survey

Sources of cross-country contagion risk can be grouped into the following:

- Bank deposit runs: Traditionally, the literature has focused on the implications of bank deposit runs for the payment system, the money supply and financial intermediation. Liquidity shocks hitting one bank could cause depositors to also run on other solvent banks, in fear of lacking reserves of liquid assets in the banking system (Freixas, Parigi and Rochet 2000). The runs could be triggered by rumors on banking system fragility, reputation or operational risk in countries where banks may have subsidiaries, branches, and even representative offices.

- Wholesale funding channels: With the developments in technological change, deregulation, globalization and the increased use of financial markets, the focus has shifted to systemic risks arising at the wholesale level (intermediation, investment banking, securities trading, asset management, business banking), and concentrating on the largest and most complex financial institutions.

- Liquidity and credit risk in interbank markets: One possible channel of contagion is through the interbank market (Allen and Gale 2000 or Freixas, Parigi and Rochet 2000) in the form of liquidity shocks when banks withdraw their deposits at other banks, or in the form of credit risk when deposits at other banks are not being repaid.

- Unidentified channels: There could also be contagion in the financial markets in the absence of explicit links, when in the presence of asymmetric information difficulties in one market are perceived as a signal of possible difficulties in others (Morgan 2002).

We first use rolling correlations of changes in DD of Irish banks with major European and U.S. banks to analyze trends in cross-country interdependencies. Then, we use a multinomial logit model to estimate contagion risk: the probability of Irish banks experiencing a large shock on the same day (coexceedances) as banks in other countries after controlling for Ireland-specific and global factors—common shocks that could affect all banks simultaneously. Large shocks are defined by the bottom 15^{th} percentile of the weekly difference in the daily DD of all banks. The 15^{th} percentile threshold was used, instead of (say) the bottom 5^{th} percentile, since we wanted to include incidences that have a higher probability of occurrence—those that could be associated with large shocks, and not necessarily only with crisis scenarios.

Analyzing trends in rolling correlations in the percentage changes in DD, we find evidence of increasing simultaneous occurrence of shocks across countries, suggesting increasing global interdependencies over the last decade. Further, following the approach of Gropp, Lo Duca and Vesala (2005), we find evidence in favor of significant cross-border interdependencies from the U.K., U.S., and the Netherlands to Ireland. Moreover, it seems that contagion risk has shifted from coming from Europe in the pre-Euro period to coming from the U.S. in the post-Euro period.

However, all results come with significant caveats: we are using equity prices of banking *groups*, and yet mainly discussing international links typically associated with banking without explicitly stating links through securities and insurance (the top two banks have links to insurance companies). We are using data available for only a small group of listed banks in each country—so it might not be representative of the system, and the banks in Ireland comprise less than 50 percent of the system (although a much larger share of the retail market). The number of observations experiencing large shocks is low; the results could, therefore, be driven by the large shocks associated with the tech-bubble burst of the 2000.

The next section describes various external linkages of Irish banks. Trends in interdependencies using rolling correlations of DDs between the top three Irish banks and banks from other European countries and the U.S. are analyzed in Section III. A multinomial logit model, to estimate the probability of coexceedances in Irish banks, is presented in Section IV, while Section V summarizes and concludes.

II. Some Evidence of External Linkages of the Irish Banking Sector

This section aims to find the channels and the directions of potential contagion from other countries to Ireland, looking at external linkages of the Irish banks. The Irish financial system had been more closely integrated with the U.K. in the past, but in recent years links with continental Europe and the U.S. have been strengthening. There are many external linkages of the Irish banking sector, stemming from: direct equity exposures in cross-border banks; direct exposure through loan books in other countries; deposit and funding sources from other countries or from numerous foreign banks operating in Ireland; stock market participation—through securities and asset management firms—in other countries; holding of credit risk transfer instruments written on assets located in another country indirectly exposing Irish banks to international shocks. Each of these is explored in turn.[4]

First, Irish banks have foreign equity exposure through their expansion overseas. Both AIB and BoI have sizeable operations in the U.K. and have been growing their niche wholesale international businesses. Both banks own universal banks in Northern Ireland. AIB has a

[4] Some empirical evidence of foreign contagion risk in Ireland is provided by Gropp and Moerman (2004) who study the joint occurrence of both positive and negative extreme shocks in banks' distance to default among large EU banks in the period January 1991 to January 2003, and identify AIB and BoI as among the systemically important banks in the EU. Moreover, they find a contagion effect from the U.K. to Ireland.

large stake in a U.S. regional bank and majority owns a Polish bank—the U.S. and Polish investments contributed a combined 16 percent to AIB's pretax profit in the first half of 2005 (Standard&Poor's 2006), although the Polish operations also result in a relatively high non-performing loans. Table 1 shows the equity exposure of three major Irish banks.

Second, Irish banks have large loan-book exposures abroad. The two largest banks, AIB and BOI, are geographically diversified—each with almost equal share of domestic and foreign assets. Nearly 28 percent of AIB, 44 percent of BoI, and 41 percent of Anglo IB loan book exposures were in the United Kingdom. Although AIB held over 20 percent stake in a U.S. bank, U.S. operations were only 2 percent of its loan book. Anglo IB, on the other hand has about 5 percent of its loan book exposed to the U.S., without having equity exposures in the U.S., but operates through a representative office. Table 2 shows the overseas exposures of AIB, BoI and Anglo IB as percent of their total loan books.

Third, the increased reliance on wholesale funding in recent years, including interbank borrowing and capital market issues, is another potential source of international interdependencies. The average loan-to-deposit ratio for Ireland exceeds 150 percent, one of the highest for industrial countries. All of the major Irish banks are dependent for funds on the interbank and securities markets—AIB and BoI fund about 40 percent of lending in the market, while the market funding requirement for the Anglo IB is at about 35 percent. The overwhelming bulk of both nonresident interbank borrowing (83 percent) and debt securities issued and held by nonresidents (83 percent) in 2004 were vis-à-vis non-Euro area residents.

Fourth, banks buy risk protection mainly from banks of other countries. The underlying asset in structured credit risk transfer (CRT) products include mainly: loans and bonds issued by financial and non-financial firms; mortgages (for asset-backed securities); and financial and non-financial firm debt as underlying asset for the more traditional CRT (for example, mortgage indemnity guarantee). The U.S. and the U.K. were the main counterparty locations selling risk protection to Irish banks. Other countries included France, Germany, Canada, Switzerland, Netherlands, Italy, and Poland. The major currencies of denomination were the Euro and the U.S. dollar, along with the Pound Sterling. Irish banks are also able to issue covered bonds—BoI has transferred the bulk of its domestic residential mortgage assets to a designated mortgage credit institution, which has a banking license to issue mortgage-covered securities—these are used both for hedging interest risk and for generating additional funding. Almost 60 percent of these securities were held by other Euro Area members, while 25 percent was held in USD by other countries.

Fifth, Irish banks are directly and indirectly exposed to property markets abroad. All the top three banks have loan-book exposures to the U.K. property market. At least AIB and Anglo IB sell mortgages in the U.S.—AIB through its U.S. subsidiary, and Anglo IB through its representative office. The latter is more focused on commercial property lending in the U.S. BOI had launched a new venture with a leading Spanish bank, La Caixa to provide extra mortgage options for Irish people buying property in Spain, which included equity release from existing BOI mortgages. Part of the real estate price risk is mitigated by the Irish banks

buying risk protection against these exposures. Irish legislation on covered bonds broaden the scope of risk protection by making loans from countries such as the U.S., Canada, Switzerland and Japan eligible for the collateral pool.[5] However, Irish banks could be indirectly exposed to property markets by *selling* risk protection (buying of covered bonds, credit default swaps, and mortgage backed securities) to other banks which are exposed to foreign property markets. From anecdotal evidence, some small IFSC banks, exposed to international property markets, are selling CDS to other domestic-oriented banks, making the latter indirectly exposed to these property markets even though their loan books are not.

Sixth, BIS data on banks *resident* in Ireland shows their net asset positions vis-à-vis banks and nonbanks in various countries (Figure 2). During 2001–05 the Irish resident banks had a negative net asset position vis-à-vis banks and nonbanks in the U.K., an overall positive net asset position vis-à-vis banks and nonbanks in the U.S., and large positive net asset position with Italy, Spain, and France. However, much of these positions could belong to foreign-owned banks operating through branches in the Financial Services Center (formerly the International Financial Services Center or the IFSC[6]) in Dublin—some of these banks operate almost exclusively with nonresidents and have some, but limited, links with the domestic economy.

Seventh, BIS consolidated statistics report Irish banks' on-balance sheet financial claims vis-à-vis the rest of the world. This type of data would give an idea of the extent of exposure of the Irish banks during a credit event in these countries. Figure 3 shows that Irish banks are mostly exposed to the U.K. and Germany among EU countries—and to the U.S. (although small in comparison) among non-EU countries.

Given the above evidence, we could expect the following possible channels of contagion: between Ireland and the U.K. and U.S., on equity exposure, loan exposure, and exposure via the interbank and the securities markets; between Ireland and the Netherlands, based on the presence of large Netherlands-owned banks in Ireland; and between Ireland and Italy, Spain, France, and Germany based on interbank market exposure. The direction of contagion is more challenging to establish. However, evidence from BIS data (Figure 2) and the discussion in this section suggests the following:

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[5] With the exception of Luxemburg, most European countries limit the asset pool to European Economic Area assets.

[6] Established in Dublin in 1987 to facilitate financial operations with nonresidents, and endowed with corporate tax benefits. These tax benefits have been now lifted. There are about 450 international institutions that have established offices in the IFS (accounting for about 40 percent of banking assets), including 50 percent of the Top 50 largest financial institutions in the world, including major banks from the United States, the United Kingdom, the Netherlands, Italy, and Germany. In turn, almost all domestic credit institutions also conduct business from the IFS.

- Countries with which Ireland has a net nonbank asset position would likely expose Ireland to **credit risk** in loans and other asset markets: Austria, France, Germany, Italy, the Netherlands, Spain, and the United States.

- Ireland's positive net bank exposure in Italy and Spain, and previously the U.S., Austria and France, possibly exposes Ireland to **credit risk that could lead to liquidity risk**.[7]

- If on the other hand, Ireland has a negative net bank-asset position, then it faces **liquidity risk** if some problem were to arise in the country from which Ireland is borrowing: Germany, U.K., Belgium, Netherlands, and currently the U.S., Austria, and France.

There could also be contagion in the absence of explicit links, when due to asymmetric information difficulties in one country/market are perceived as a signal of possible difficulties in others. The interdependencies mentioned above may be overstated to the extent they include banks resident in Ireland but operating in the IFS mainly with nonresidents; however data was not sufficient to exclude these from the BIS data sample. We next look at only the three largest domestic banks—that have nearly 80 percent of the retail market—and their interlinkages and possible contagion channels with banks in other European countries and in the United States.

III. Trends in Interdependencies Using Distance to Default Indicators

In this subsection, we describe correlations of banking risks between Ireland and other countries after a discussion of the data. We use the distance to default indicator to measure bank financial risk; the DD combines information about stock returns with leverage and asset volatility information, thus encompassing the most important determinants of default risk. The cross-country correlation of changes in DD would indicate interdependencies arising from a broad set of channels including contagion occurring in the absence of explicit links between banks. Box 2 gives details on calculation of the DD.

The DD is based on the Black-Scholes option-pricing model, and is estimated using stock price data. A bank's equity is viewed as a call option on the bank's assets, with strike price equal to the current book value of total liabilities. When the value of the banks' assets is less than the strike price, its equity value is zero. The DD represents the number of asset value standard deviations that the bank is away from the default point, where the default point is defined as the point at which the liabilities of the bank are just equal to the market value of assets (alternatively, the point where the stock price is zero). The market value of assets is not observable, but is estimated using equity values and accounting measures of liabilities.

[7] The Irish banking supervisors have a specific requirement for banks on liquidity maintenance: 25 percent of deposits and short-term liabilities have to be covered by liquid assets.

The banks in the sample are just about five standard deviations from the default point—the (pooled) average distance to default is 5.2, the median 5.0. There is some variation among banks—the mean distance to default by bank ranges from 3.3 (Italy) to 7.7 (Spain). The three Irish banks have mean distance to default about 6 (median about 5.7). Figure 4 shows the trends in the system-wide distances to default[8] by country, including an Eastern Europe average comprising Poland and Hungary. There seems to be a general increase in the DD starting in 2003 for all countries, indicating a global improvement in bank health in the last two years. There also seems to be an upward trend over the past decade for France, Italy, and Eastern Europe. Irish banks suffered a trend decline in DD around 1997 that continued until end-1999—this partly coincides with the experiences of the U.S., the U.K., and (partially) the Netherlands, Germany, and Spain, as does the continued recovery after 2003. They had suffered another negative shock during 2002—likely the after-effects of September 11, 2001 and possibly connected with the AIB's U.S. subsidiary scandal in 2002. Irish banks have recovered starting in 2003 and currently have distance to default levels comparable to the levels of the late 1990s.

[8] Weighted average DD of each listed bank.

Box 2. The Distance to Default Measure and Data Issues

The derivation of DD is described in detail in Gropp, Lo Duca, and Vesala (2005) and in Gropp and Moerman (2004), and in the case of a portfolio of bank assets in De Nicolo and Tieman (2005). The distance to default (DD) measure is based on the structural valuation model of Black and Scholes (1973) and Merton (1974), and is defined as follows:

$$DD_t = \frac{\ln(\frac{V_{A,t}}{X_t}) + (r - \frac{\sigma_A^2}{2})T}{\sigma_A \sqrt{T}}$$

where V_t is the firm's assets value with mean r and volatility σ_A, and X_t is the book value of the debt at time t, that has maturity equal to T. The market value of equity of the firm is viewed as a call option on the firm's assets, V_A, with time to expiration equal to T. The strike price of the call option is the book value of the firm's liabilities, X_t. Default occurs when the value of the firm's assets is less than the strike price – that is, when the ratio of the value of assets to debt is less than one. The DD tells us by how many standard deviations the log of this ratio needs to deviate from its mean in order for default to occur.

An estimation of DD requires knowing both the asset value and asset volatility of the firm. The required values, however, correspond to the forward-looking *economic* values rather than the accounting figures, and it is not appropriate to use balance-sheet data for estimating these two parameters. Instead, the asset value and volatility are estimated using equity data. The DD measures we use are estimated by IMF MFD FP Distance to Default Database, with the methodology described in Vassalou and Xing (2004), except that the value of assets is taken to be equal to the value of equity plus the book value of liabilities. At each date, the value of assets, the return on assets and its volatility is derived using the Black-Scholes option-pricing formula, using one year of daily equity return data preceding the estimation date, and the accounting value of liabilities for the relevant year.

Declines in the ($V_{A,t}/X_t$) ratio are equivalent to declines in capitalization. Thus, the DD measure combines information about equity returns with leverage and asset volatility information, thus encompassing the most important determinants of default risk. Empirical studies have shown that the distance to default is a good predictor of corporate defaults (Moody's KMV), and predicts banks' downgrades in developed and emerging market countries (Gropp, Vesala and Vulpes 2004, and Chan-Lau, Jobert, and Kong 2004).

We use a dataset of daily distance to default data for 40 banks in 8 countries: France (2 banks), Germany (4 banks), Ireland (3 banks), Italy (6 banks), the Netherlands (2 banks), Spain (4 Banks), the United Kingdom (5 Banks), and the United States (14 banks), for the period January 1994 to November 2005. The dataset includes all banks in these countries that are listed at a stock exchange and whose distances to default are available from the IMF FP Distance to Default Database. We dropped four banks for which the distances to default were not available for the entire period (one bank for France, one bank for the United Kingdom, and two banks for Italy). In general, the banks in the sample are quite large relative to the population of banks in the EU, and represent a high fraction of total assets of commercial banks in each country. For each bank, the sample contains 3105 daily observations (except one U.K. bank with 2522 observations and one bank from the Netherlands with 2803).

Table 4 shows the correlation of the distances to default between Ireland and the other countries. We find that on average the correlations are positive, and quite high for the Netherlands, the U.K., the U.S., and Spain. However, if we analyze the past decade in three

separate periods—pre-Euro period 1/3/1994 to 12/31/1998, post-Euro period 1/1/1999 – 9/11/2001, and post-September 11th period of 9/12/2001-11/25/2005, we find that the correlations become generally much smaller or negative in the post-Euro period compared with the pre-Euro period, and then increase to very high levels in the post-September 11th period.

Figure 5 shows the trends in one-year rolling correlations in the distance to default for all countries, including an average across all country pairs. The latter, which should be more indicative of global trends, seems to be increasing over time, being stronger in the 2003–04 period. It seems that the average pair-wise correlation has decreased in 1999 with the introduction of the Euro, and has increased after 2001. It also seems that over the last couple of years of improving bank health the correlations seem to have diminished. The rolling correlations of Ireland and the U.K. seem to have been high during the whole period with the exception of 1999. The correlations of Ireland with France, Italy, and Spain seem to have increased over time. In general, the correlations of Ireland with continental Europe seems to have been negative during 1999–2001.

Occurrence of shocks, especially large shocks, in banks is captured by the weekly percentage change in the distance to default for each bank, ($\Delta dd_{it} / |dd_{it}|$). The mean of the percentage change in the distances to default is zero as expected, and the largest negative change is 237 percent, which represents a sizable shock. Figure 6 shows the trends in the percentage change in distances to default for all countries. The most volatile period for Ireland was 1999–2000, which was also volatile for the U.K. and France as well. On the other hand, Italy, the Netherlands, Spain and Germany seem to have experienced large shocks in 2001–03. Overall, it seems that for most countries there were fewer shocks in 2003–05 than in the decade before. This could reflect a general drop in credit events across the world mainly due to benign macroeconomic conditions and the benign credit cycle for the last couple of years. For instance, FitchRatings (2005) reported a sharp drop in credit events to 37 in 2005 from 94 in 2003.

In order to describe how interdependencies across countries have evolved during the last decade, we try to capture the simultaneous occurrence of shocks across countries through simple correlations (Table 5) and the one-year rolling correlations (Figure 7) in the percentage change in DD, between Ireland and the other countries. On average, the correlations between the ($\Delta dd / |dd|$) between Ireland and the other countries are positive. They seem to have a stronger magnitude for the U.K. and the U.S. than for the other European countries. Unlike the correlations in the distance to default, the correlations in the ($\Delta dd / |dd|$) seem to be strongest in the pre-Euro period, and weakest in the post-Euro period (but still positive), suggesting that the joint improvement in the distances to default in the last couple of years have been accompanied by fewer simultaneous shocks. Over the whole period of the past decade, the rolling correlations seem to be decreasing over time for Germany, the U.K., and the U.S., with no clear trend for the other countries. However, the average of the rolling correlations across all country pairs has a positive trend over the last decade, suggesting increasing global interdependencies.

IV. Econometric Analysis of Contagion Risk Using Coexceedances

Next, we use the methodology of extreme value theory to analyze contagion risk. Using extreme value theory to study contagion was proposed by Bae et al. (2003) in the context of stock market returns in emerging markets. Bae et al. and Gropp and Moerman (2004) show that it is useful to examine only the tails of the distributions of returns and of the distances to default, as the distributions exhibit fat tails, and the correlation among the observations is substantially higher for larger shocks. We use weekly changes in the distance to default to examine whether shocks in one bank/banking system appear in the distance to default of other banks, controlling for common shocks affecting all banks simultaneously. Econometrically, we use a multinomial logit model to estimate the number of banks in Ireland that experience a large shock on the same day ("coexceedances") as banks in other countries, after controlling for Ireland-specific and global shocks.

A. Methodology and Data

We follow Gropp, Lo Duca, and Vesala (2005) in arguing that contagion is associated with extreme negative movements in bank's default risk. These events can be identified from the negative tail of the distribution of the changes in the distance to default. We define large shocks as the negative 15th percentile of the common distribution of the percentage change in the distance to default across all banks. We compute the "coexceedances" of banks in a given country as the number of banks in a given country that were simultaneously in the tail on the same day.

We use a multinomial ordered logit model to estimate the probability of a number of coexceedances in Ireland (the number of banks simultaneously in the tail) as a function of the number of coexceedances in the other countries, controlling for Ireland-specific and global shocks:

$$\Pr_c[Y=j]=\frac{e^{\left[\alpha_j F_c+\beta_j C_{ct-1}+\gamma_j C_{dt}\right]}}{\sum_k^J e^{\left[\alpha_k F_c+\beta_k C_{ct-1}+\sum_{d\neq c}\gamma_{dk} C_{dt}\right]}}$$

where j=0,1,2 represents the number of banks in the tail simultaneously ("coexceedances") in country c—0 if no banks are in the tail, 1 if one bank is in the tail, and 2 if two or more banks are in the tail. The vector F_c comprises Ireland-specific and global shocks affecting Ireland. C_{ct-1} is the lagged number of coexceedances in country c, and C_{dt} represents the coexceedances in period t in country d.

We perform three sets of estimations—the base model, the extended model, and the extended model for each of the three large Irish banks. The base model consists of a set of Ireland-specific and common global shocks, F_c, and persistence in Irish coexceedances, $C_{ct-1.}$ We use four variables to represent F_c—

1) Systemic risk—we use a systemic risk indicator measuring the number of stock markets that are experiencing a large shock at time t. We construct this control similarly to the modeling of large shocks in banks: we use an indicator variable that we set equal to one if a stock market of a given country experienced a shock large enough to be in the bottom 15th percentile of the distribution of the weekly change in returns, and zero otherwise. We calculate such an indicator variable for the Euro Area stock market index (N100 or Euronext Top 100 Index), the U.S. (NASDAQ[9]), and the Irish stock market (ISEQ or Irish Overall Index) indices, from Bloomberg. The systemic risk control is the sum of the indicator variables measuring whether or not the European stock market, the Irish stock market, and the U.S. stock market were in the tail on a given day, and it ranges from 0 to 3. This control should be positively related to the number of coexceedances in Ireland.

2) U.S. stock market volatility—we use the weekly change in the volatility of the U.S. stock market to control for volatility spillovers from the United States. Owing to a large presence of U.S. software firms located in Ireland, we estimated the volatility in NASDAQ using a GARCH(1,1) model of the form: $\sigma_t^2 = \alpha + \beta\sigma_{t-1}^2 + \gamma\varepsilon_{t-1}^2$, using maximum likelihood. The regression results are reported in Table 8.

3) Irish stock market volatility—similar to above, the weekly change in the volatility of the ISEQ was calculated to account for an Ireland-specific shock.

4) Interest rate shock—the fourth control included the weekly change in the yield of the Irish 10-year government bond to reflect interest rate shocks. We would expect the interest rate control to be positively related to the number of coexceedances.

The extended model has, in addition, the number of coexceedances in other countries in the sample—U.S., U.K., Germany, France, Spain, Netherlands, and Italy. The model for each of the three main banks includes, in addition to the extended model regressors, coexceedances from each of the other two banks.

The summary statistics and the descriptive statistics for the number of coexceedances per country, i.e., the number of banks simultaneously in the tail on a given day, are presented in Tables 3, 6, and 7. Even though the number of banks per country differs somewhat, there is at least one day on which all banks experienced a large adverse shock simultaneously. We limit the number of outcomes to 0, 1, and 2 or more coexceedances.[10] The time pattern of coexceedances in Ireland is presented in Figure 8. The most turbulent period for Irish banks has been the period 1999–2000, and the calmest being the mid-1990s and the last couple of years.

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[9] The Dow Jones Industrial Average gives similar results.

[10] The number of coexceedances depends on the number of banks included in the sample and may not necessarily reflect the strength of the banking system per se. Still, comparing countries with equal number of banks in the sample suggests that Spanish banks tend to experience fewer shocks compared to German banks and that Dutch banks tend to be somewhat less frequently subject to shocks compared to French banks.

B. Econometric Model Results

The results for the basic and the extended models are given in Table 9. The dependent variable is the number of banks whose weekly percentage change in the distance to default was in the 15th percentile negative tail in a given day. In all countries with more than two banks, we limit the model to estimating three outcomes: 0, 1, and 2 or more banks simultaneously in the tail.

The basic regression results suggest that the probability of Irish banks being simultaneously in the bottom tail varies positively with systemic risk—real shocks experienced through large stock market movements in Ireland and elsewhere increase the probability of a higher number of Irish banks being simultaneously in the tail. However, controlling for global shocks, including that of the ISEQ, Irish coexceedances still respond positively and significantly to changes in a long term Irish interest rate. Long-term lending rates (especially mortgage rates) would likely follow movements in long term government bond yields. Given the large exposure of Irish banks to the real estate market and the prevalence of variable loan-rates, sudden increases in interest rates could be associated with credit events that might have a negative impact on banks. In addition, the notion that the number of coexceedances could be sticky is supported: the lagged (by one day) number of coexceedances is positive and significant. The stock market volatility controls are not significant, suggesting that the systemic risk variable might be sufficiently capturing stock market spillover effects.

Next, we extend the model to include contagion or coexceedances from other countries (Table 9). We measure contagion by including the first lag of the coexceedances in the other seven countries. If, after controlling for common shocks, any of these variables turn out to be significant, we interpret this as contagion from that country. We find evidence of contagion from the U.K., the U.S., and the Netherlands (with a negative sign) towards Ireland. Adding foreign coexceedances adds information to the specification, which is reflected in the fact that the significance of the controls remains largely unchanged.

How does the size of the contagion from the U.S. to the Irish banks compare with that from the U.S. to other countries? Although the coefficient estimates should not be interpreted as marginal effects, the relative effect of one variable compared to another can be gauged by the relative sizes of the coefficient estimates. To get the relative U.S. effect, we benchmark the U.S. influence with that of the U.K. That is, the relative size of the U.S. influence is the coefficient for the U.S. divided by the coefficient for the U.K. For the Irish banks, the relative U.S. influence on the three Irish banks is (0.27/|0.13|) 2.1. Next we run similar regressions for each of the other countries (not reported here) and calculate the relative U.S. influence where both the U.S. and the U.K. influences are significant. Figure 9 shows a bubble chart for the four Euro Area countries with significant coefficients for both the U.S. and the U.K. The relative contagion from the U.S. to the Irish banks is second only to Germany.

The final set of estimations involves estimating the extended model for each of the three individual Irish banks (Table 9). There is evidence of contagion from the U.K. (at the

10 percent significance level), the U.S., Spain, and from the Netherlands (negative coefficient) towards AIB; contagion from Italy (at the 10 percent significance level) and the U.S. towards Anglo IB; and from the U.S. towards BoI. We find evidence of a two-way contagion between AIB and BoI, and between Anglo IB and BoI—these could reflect both interbank linkages and off-balance sheet or derivative positions where one bank is the buyer and the other the seller of various risk protections.

The results for the extended model qualitatively survive several robustness checks. First, when the number of U.S. banks was reduced from 14 to 5 (the top 5), the U.S. influence on Irish banks remains unchanged. Second, taking monthly changes in DD, rather then weekly changes, does not change the U.S. and the U.K. influence; the contagion from Netherlands disappears. Third, changing the threshold that defines the negative tail of the distribution of large shocks does not qualitatively change the results for the U.S. and the U.K. Finally, looking at the pattern of contagion over time, we find different linkages in the pre-Euro, post-Euro, and the post-September 11th periods (Table 10). We find evidence of contagion from the U.K. and Germany (at the 10 percent significance level) in the pre-Euro period, from the U.S. and the U.K. (at the 10 percent significance level) in the post-Euro period, and only from the U.S. (at the 10 percent significance level) to Ireland in the post-September 11th period. This suggests a changing pattern of linkages from stronger linkages with Europe in the earlier periods, to stronger linkages with the U.S. later on, consistent with the evidence presented above.

V. SUMMARY AND CONCLUSIONS

This paper examines the external linkages of the Irish banking sector and estimates an indicator of potential contagion risk—arising from idiosyncratic shocks in other countries—the three major Irish banks may be exposed to. Aggregate balance sheet data of Irish-resident banks suggest several channels of external interdependencies—these are foreign equity exposures, loan-book exposures abroad, and wholesale funding through interbank and capital market issues. However, apart from these links, there could also be foreign exposures through credit risk transfers (for example, Irish banks selling risk protection to cross-border banks that could be subject to credit events in other countries), and through operational risks that are difficult to measure but can quickly lead to large fluctuations in bank stock prices.

Since Irish-resident banks includes a large number of foreign banks operating in the Financial Services Center (Section II) that have limited Irish linkages in the retail market, we focus on the three major listed banks—BOI, AIB, and Anglo IB—who have nearly 80 percent of the domestic retail market. We proxy banking risk by DD measures constructed from bank equity prices and look at correlations of changes in the DD of Irish banks with banks in other countries (Section III). Following Gropp, Lo Duca and Vesala (2005), we then define large changes in DD of each bank—coexceedances—if the changes fall below the 15 percent of the negative tail of the joint distribution of the DD-changes across all banks of the sample. We use an ordered multinomial logit model to estimate the probability of the number of Irish banks being in the tail at the same time as banks in other countries, controlling for Irish-specific and global factors.

There is evidence suggesting contagion from the U.S. and the U.K. to Ireland, although the size of the U.S. influence dominates that of the U.K. in almost all regressions and across many robustness checks.[11] There are obvious balance sheet linkages of Irish banks with the U.K. through subsidiaries. The U.S. and the U.K. also remain the major countries selling risk protection to Irish banks. From Section II, aggregate data showed that Irish-resident banks (but not necessarily the three banks in the empirical study) had positive net-asset exposures in the U.S. that could give rise to credit risk from exposure to nonbank assets, and liquidity risk from Irish banks' (net) interbank borrowing from the U.S. from mid-2004. On the other hand, Irish resident banks have very large and *negative* net-asset exposure to the U.K., suggesting that risks in Irish banks' on-balance sheet exposures to the U.K. might have been mitigated by off-balance sheet risk-protection bought from the U.K. banks. Still, both the U.S. and the U.K. have had booming property markets that the Irish banks are exposed to, and could be affected in the event of a substantial downturn in any of these markets.

Some tentative policy lessons could be drawn from the results of this exercise. The Central Bank and Financial Services Authority of Ireland (CBFSAI) may want to stress test specific categories of exposures of Irish banks to both the U.S. and the U.K. Even though linkages with the U.S. do not come out strongly from *aggregate consolidated* balance sheet exposures, there might be derivatives or other off-balance sheet exposures that the bank supervisors may need to be vigilant of. The Irish authorities may need to collect more information about types and counterparties of derivative positions and risk transfers through structured products of Irish banks, as the use of these is likely to grow rapidly in the future.[12] This would especially be necessary if Irish banks are buying CRT products from foreign banks (that is selling risk protection) that are in turn exposed to property markets or other loan products in the U.S. or the U.K., thus exposing the Irish banks to these markets even though there is no direct loan exposure.

Finally, some caveats apply to the econometric results. We are using equity prices of banking *groups*, and yet mainly discussing international links typically associated with banking without explicitly stating links through securities and insurance (the top two banks are also involved in insurance and securities business). We are using data available for only a small group of listed banks in each country—so it may not be representative of the system, and the banks in Ireland comprise less than 50 percent of the system in terms of total assets (although nearly 80 percent of the retail market). The number of observations experiencing large

[11] Econometric estimates (not reported) suggest that while there is no evidence of contagion from Europe to the U.S., the U.S. is a source of contagion not only for Ireland but also for all the other European countries. Germany seems to be mainly a receiver of contagion risk rather than a source, which is consistent with the evidence from BIS that Germany is mainly "a buyer" of risk.

[12] See Chan-Lau and Ong (2006) for the regulatory and supervisory initiatives taken by the U.S. OCC and the U.K. FSA in this regard.

shocks is low; the results could therefore be driven by the large shocks associated with the tech-bubble burst of 2000.

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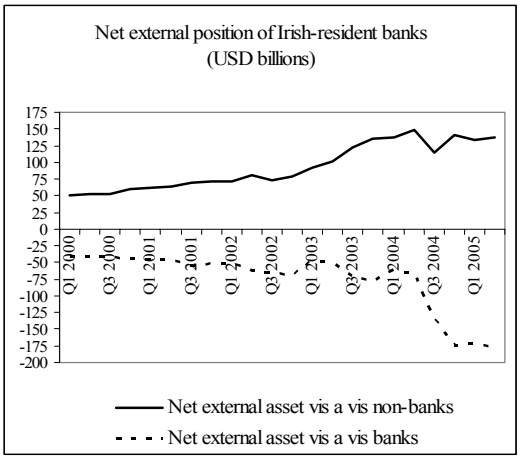
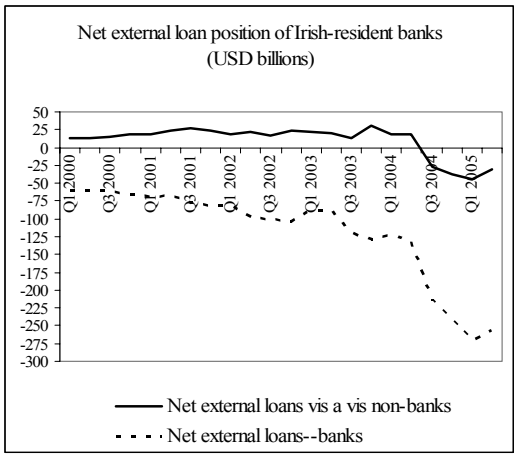
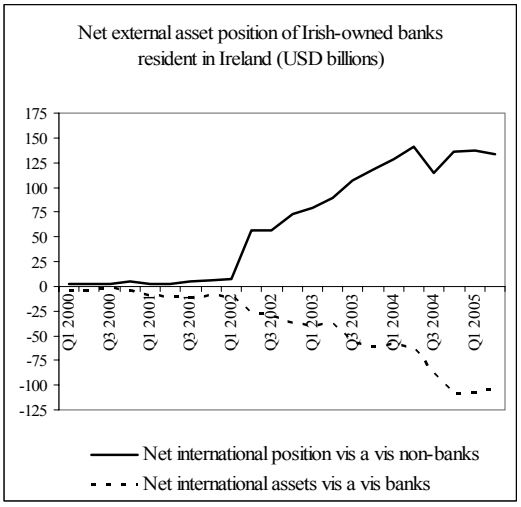
Figure 1. International Financial Claims and Liabilities of
BIS Reporting Banks Resident in Ireland



Source: BIS Table 2B

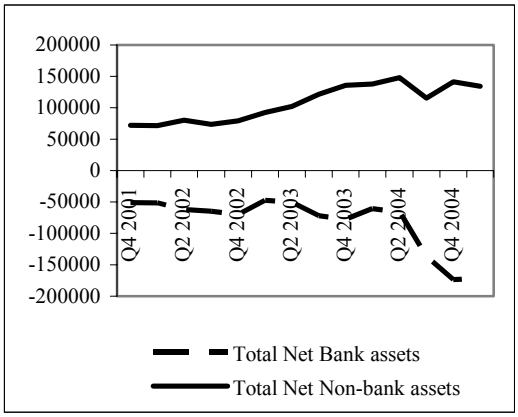


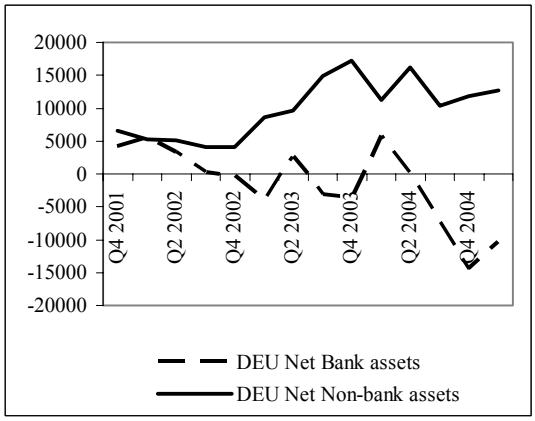
Source: BIS Table 3B

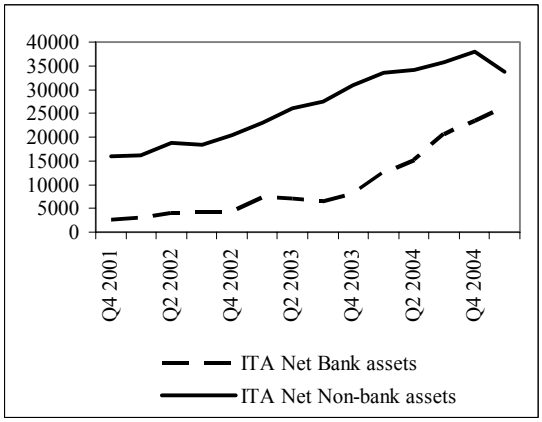


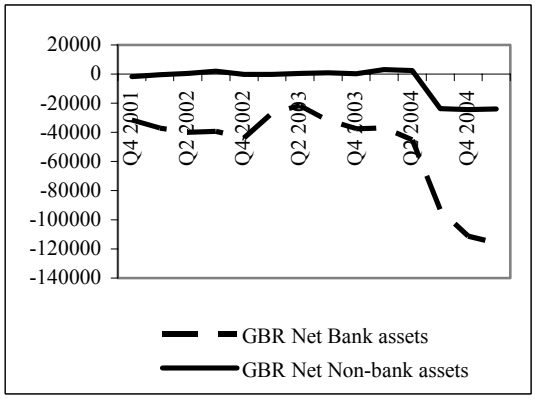
Source: BIS Table 8A

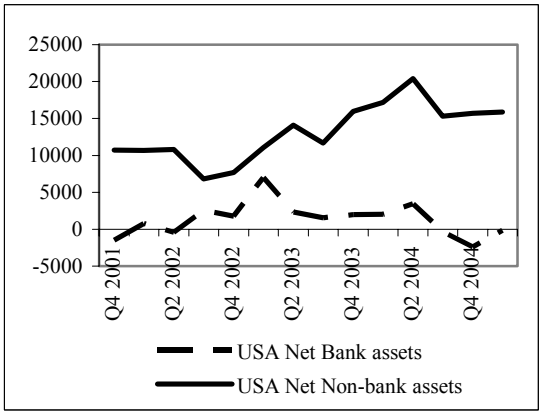
Figure 2. Ireland-Resident Banks Net Asset Position Vis-à-Vis Banks and Nonbanks in Various Countries











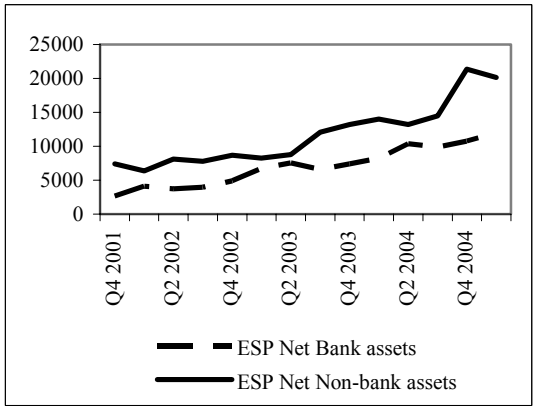
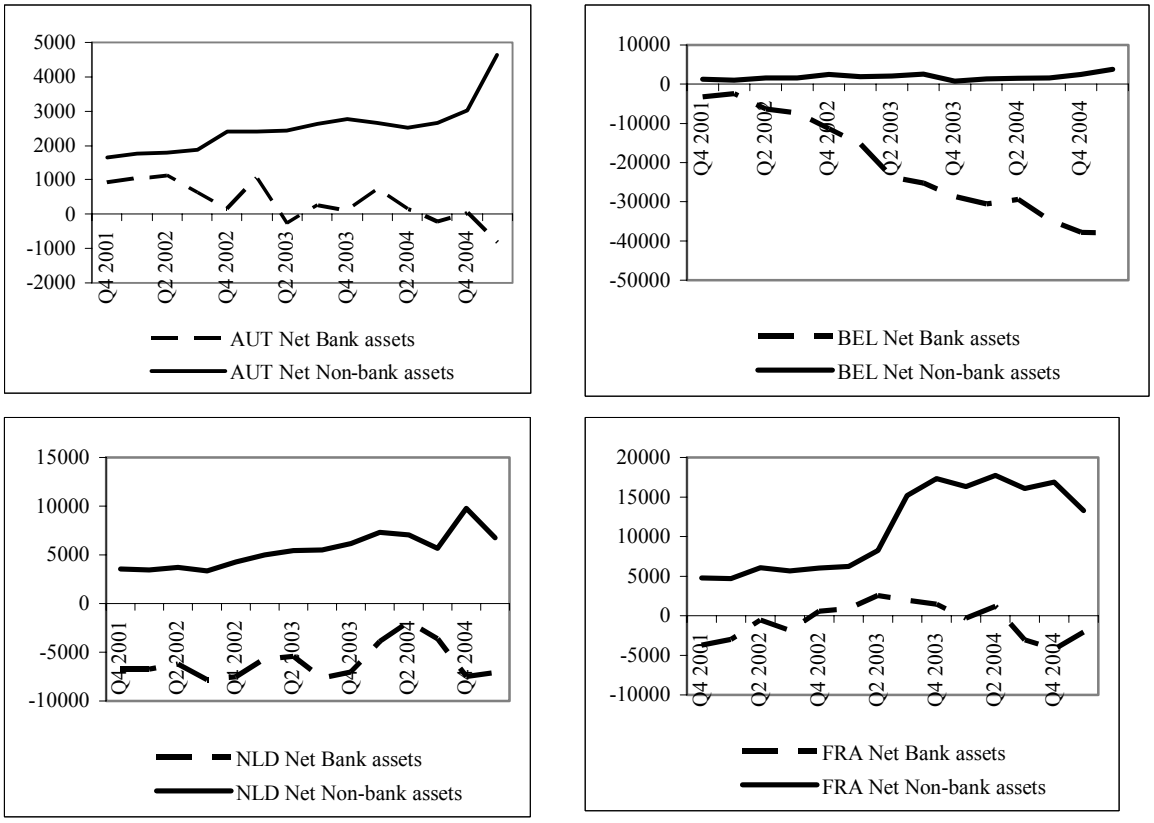
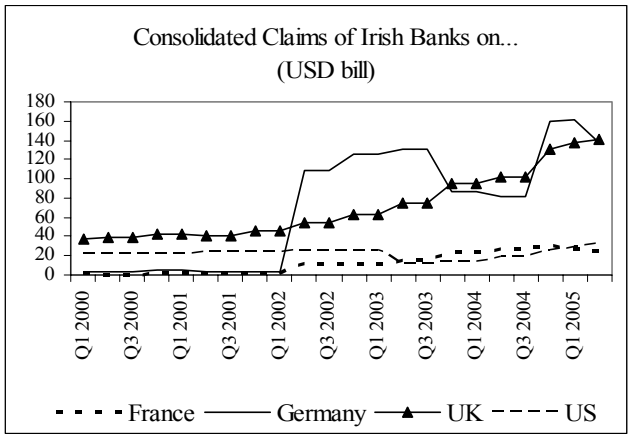


Figure 2. Ireland's Net Asset Position with Banks and Nonbanks in Other Countries (Contd)

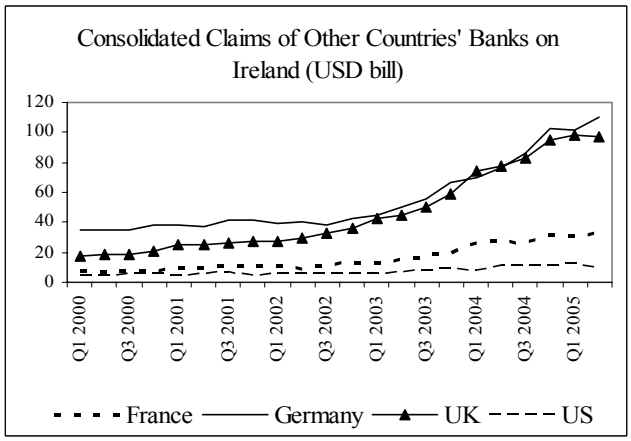


Source: BIS, Staff estimates

Figure 3. Consolidated Claims from BIS Data



Source: BIS Table 9B



Source: BIS Table 9B

Figure 4. Hodrick-Prescot (HP) Trend of Distance to Default (DD) by Country

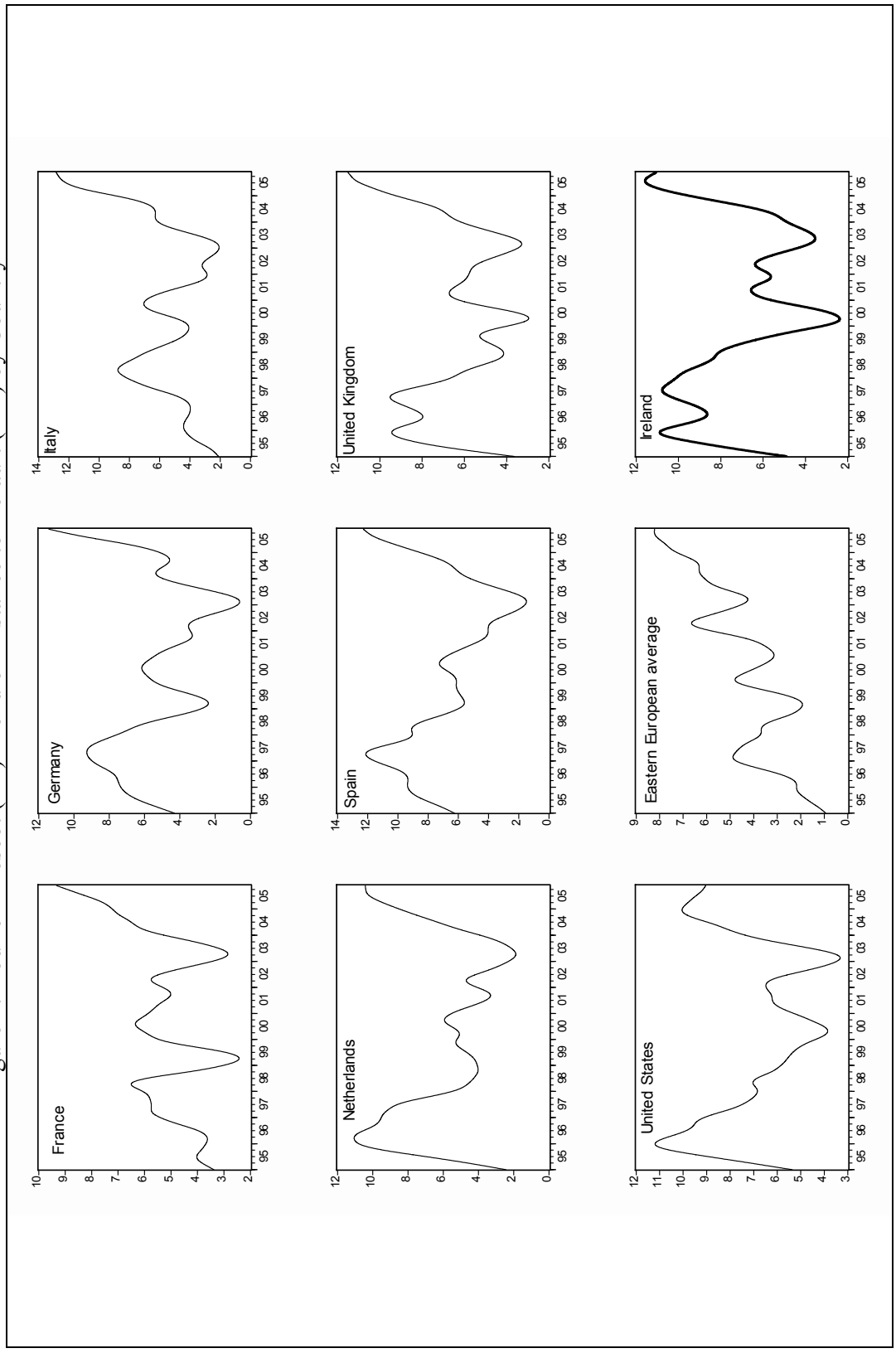


Figure 5. HP Trend of Rolling Correlations of DD—All Country Pairs Average, and Between Ireland and Other Countries

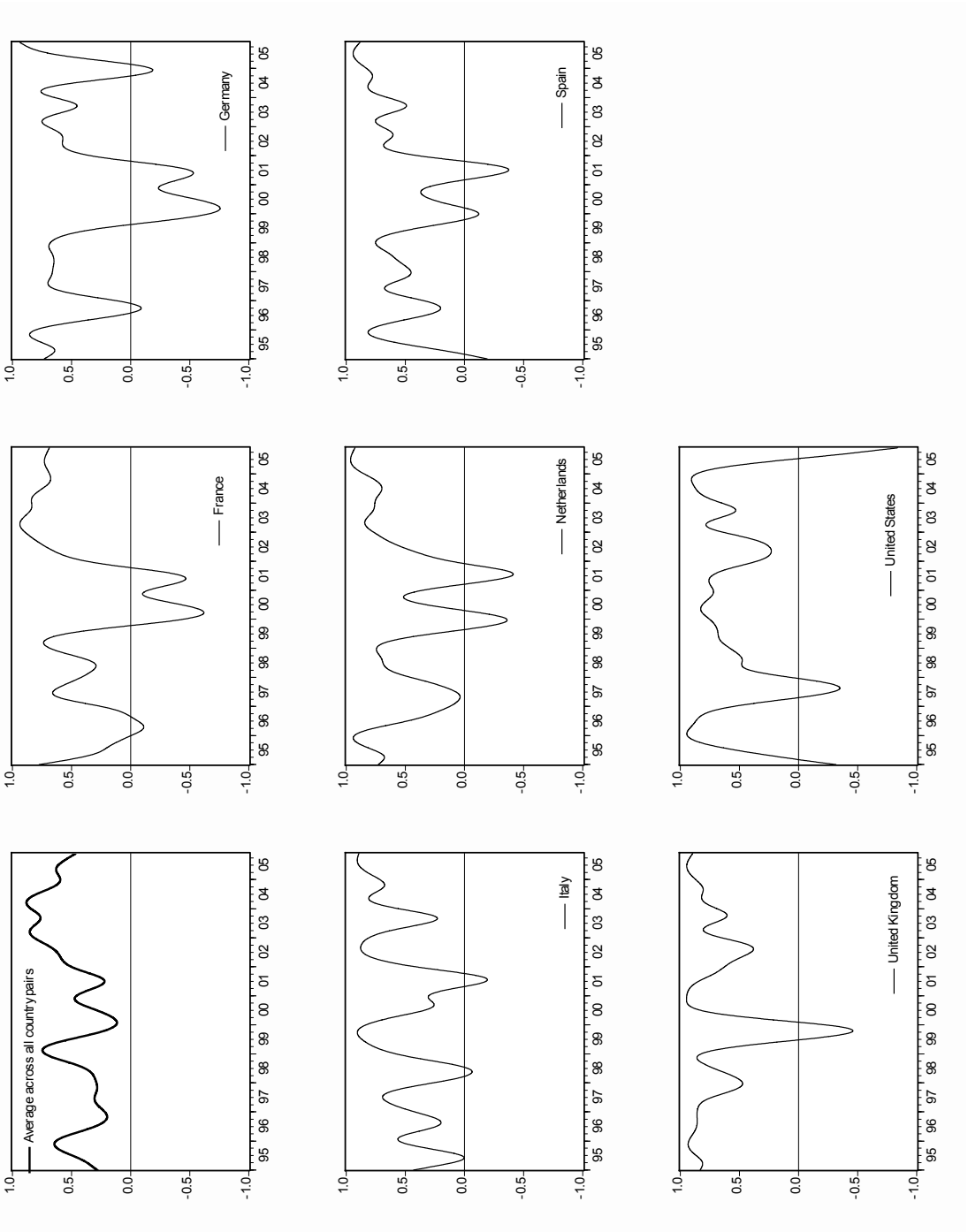


Figure 6. Trend in ΔDD/|DD| by Country

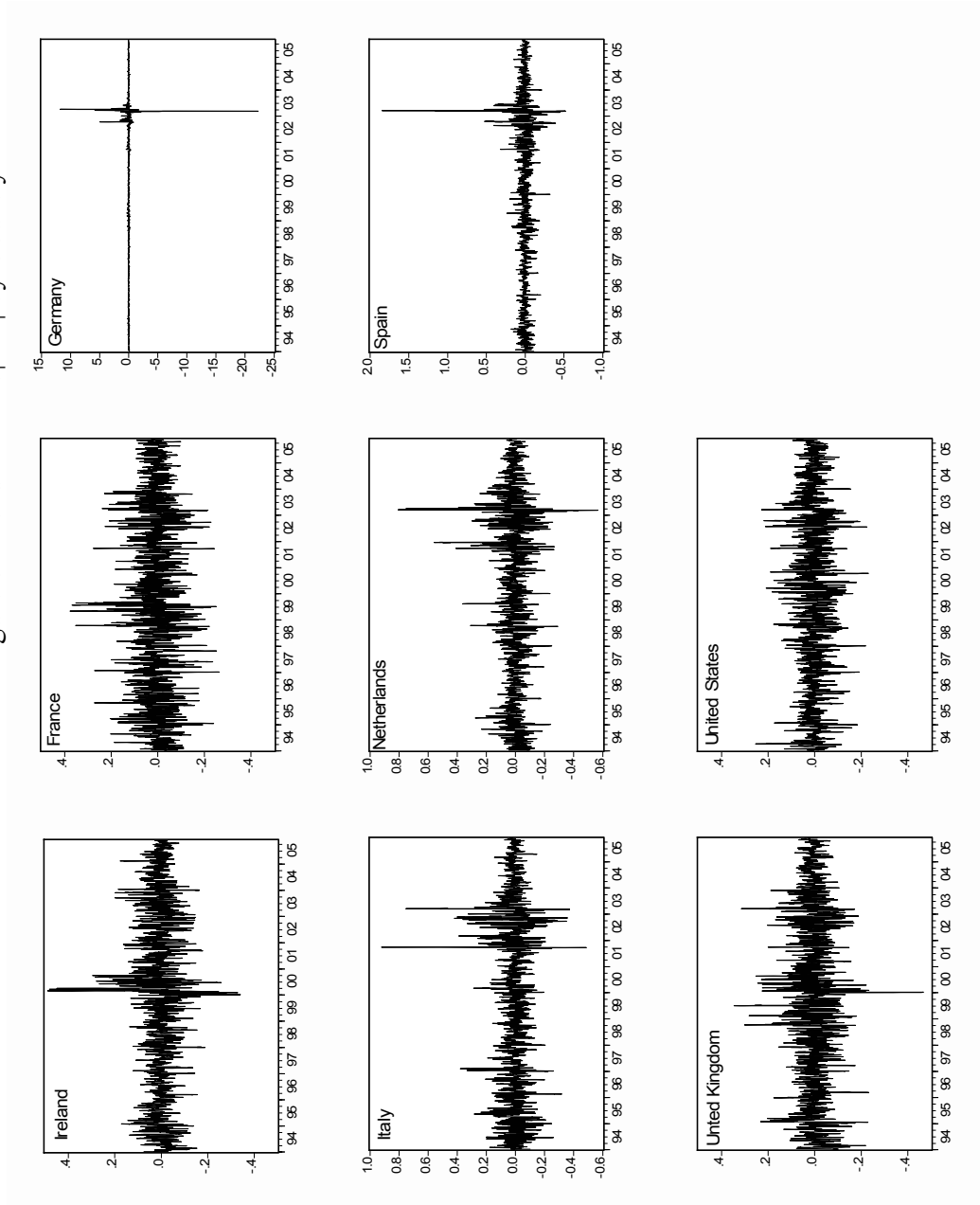


Figure 7. Rolling Correlations of ΔDD/|DD|—Between Ireland and Other Countries

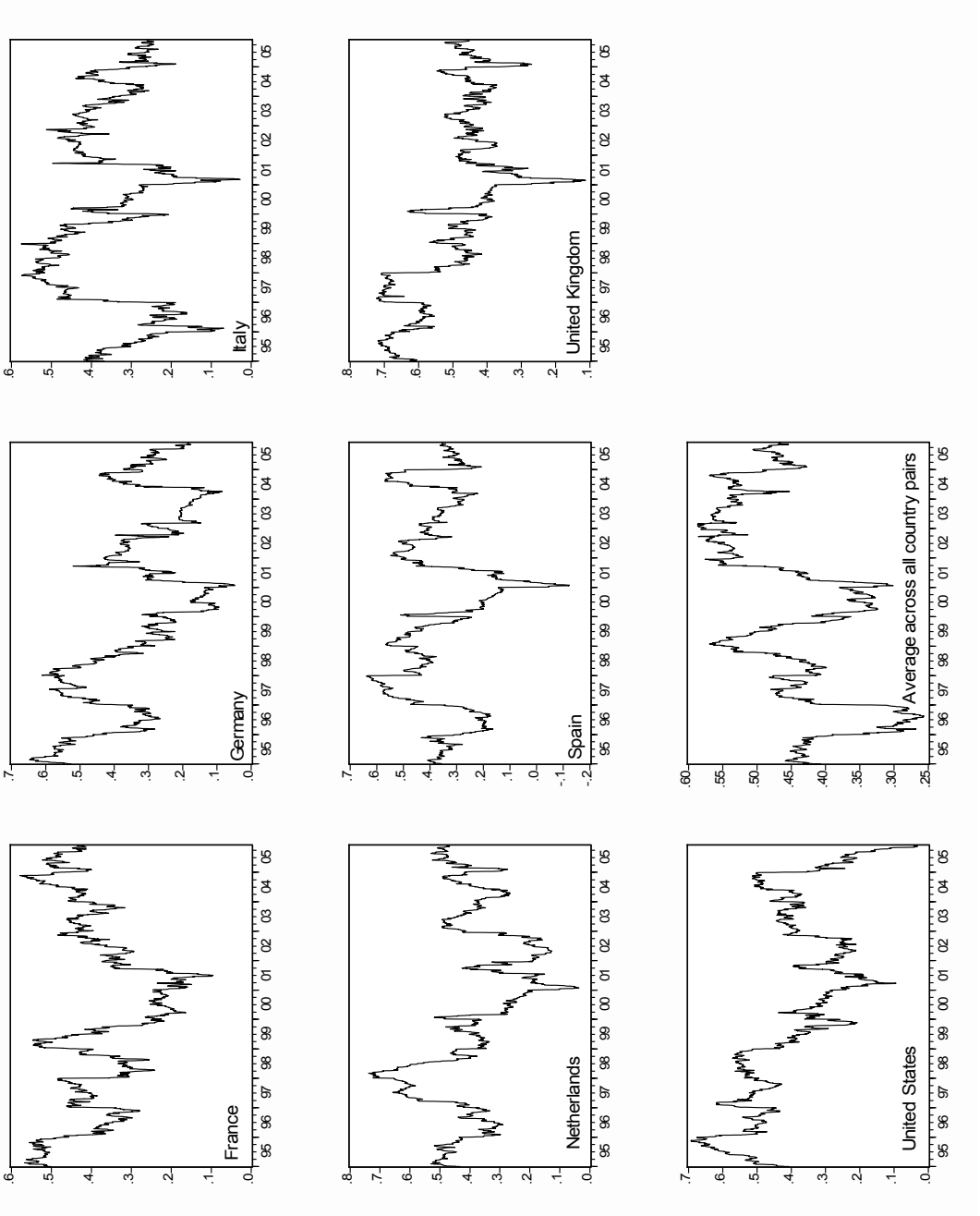
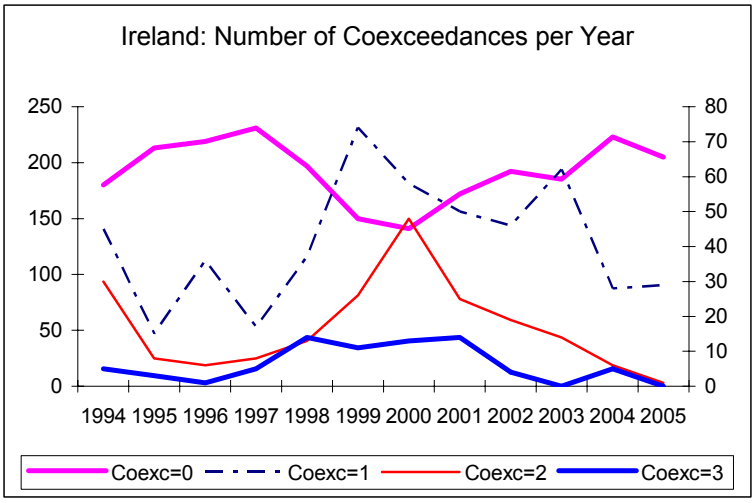


Figure 8. Time Pattern of Coexceedances in Ireland
(in number of days each year)

Ireland

Period	Number of coexceedances				
	0	1	2	3	1+2+3
1994	180	45	30	5	80
1995	213	15	8	3	26
1996	219	36	6	1	43
1997	231	17	8	5	30
1998	197	37	13	14	64
1999	150	74	26	11	111
2000	141	58	48	13	119
2001	172	50	25	14	89
2002	192	46	19	4	69
2003	185	62	14	0	76
2004	223	28	6	5	39
2005	205	29	1	0	30



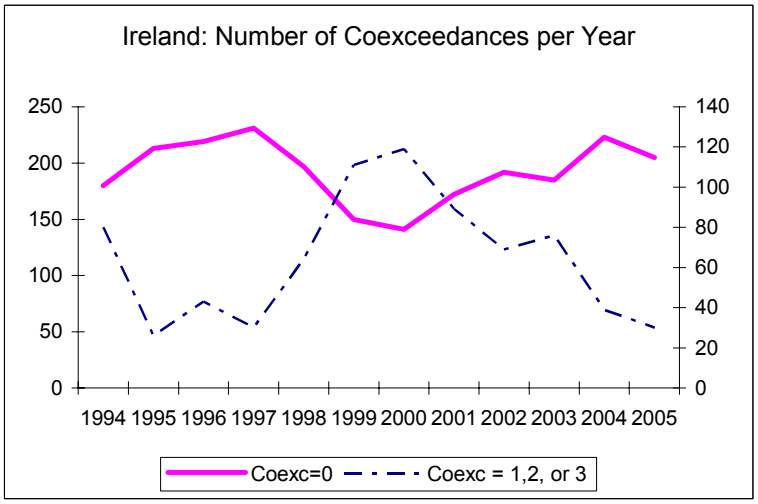
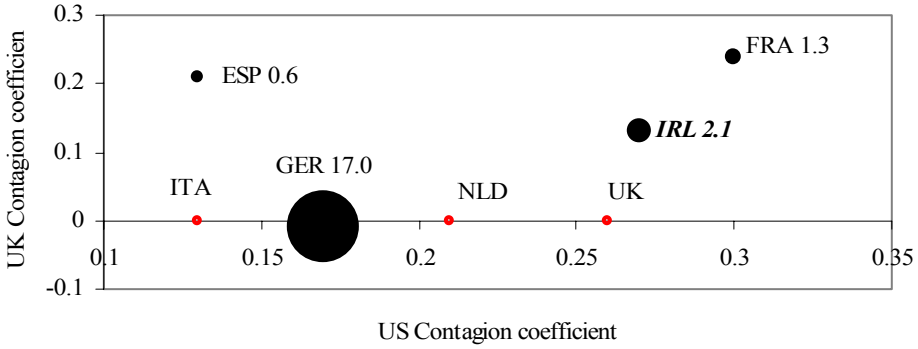


Figure 9. Relative Size of Contagion from the U.S. to other Euro-Area Countries 1/



1/ The black patches show the relative size of the U.S. influence benchmarked against the U.K influence. For example, for IRL it is 0.27/|0.13|=2.1. For Italy, Netherlands and the U.K., only the U.S. coefficient is shown, since the U.K. coefficient was not significant for Italy and the Netherlands, and not applicable for the U.K..

Table 1. Equity Exposure of Irish Banks, 2004

	Country	Company	Stake 1/	Total asset of the company (USD mill)
Allied Irish Bank (AIB)				
	United Kingdom	AIB Group (U.K.) Plc	WO	25,592
		Euroclear Plc	n.a.	13,053
	Poland	Bank Zachodni	70.47	9,225
	United States	M&T Bank Corp	22.82	52,939
Bank of Ireland (BI)				
	United Kingdom	BI U.K. Holdings Plc	n.a.	40,332
Anglo Irish Bank (Anglo IB) 2/				
	Netherlands	Steenwal BV	100	69
	United Kingdom 3/	Anglo Irish Limited	100	n.a.

Source: Bankscope.
1/ In percentage. WO refers to "Wholly-owned". Only significant equity participation (>20 percent) or companies bigger than USD5 billion are reported here.
2/ There are stakes in Austria and Switzerland for which only limited information is available. Also, Anglo Irish Bank operates in the U.S. commercial property loan market through a representative office.
3/ Stakes in the U.K. also include Anglo Irish Capital U.K. Limited Partnership, CDB (U.K.), Anglo Irish Property Lending Limited, Anglo Irish Asset Financial Place etc.

Table 2. Overseas exposure as Percent of loan book, 2004

	AIB	BOI	Anglo I.B.
Ireland	64	56	54
U.K.	28	44	41
US	2	n.a.	5
Poland	6	n.a.	n.a.

Source: Moody's Banking System Outlook, October 2005

Table 3. Sample Banks

1	ALLIED IRISH BANKS	IRELAND
2	ANG.IR.BK	IRELAND
3	BANK OF IRELAND	IRELAND
4	CITIGROUP	USA
5	BANK OF AMERICA	USA
6	JP MORGAN CHASE &.CO.	USA
7	WELLS FARGO &.CO	USA
8	WACHOVIA	USA
9	US BANCORP	USA
10	SUNTRUST BANKS	USA
11	NAT.CITY	USA
12	BANK OF NEW YORK	USA
13	BB & T	USA
14	FIFTH THIRD BANCORP	USA
15	STATE STREET CORP.	USA
16	KEYCORP	USA
17	PNC FINL.SVS.GP.	USA
18	BARCLAYS	UK
19	HSBC HDG. (ORD $0.50)	UK
20	LLOYDS TSB GP.	UK
21	RYL.BK.OF SCTL.	UK
22	STD.CHARTERED	UK
23	BANKGESELLSCHAFT BERLIN	GERMANY
24	BAYER.HYPO-UND-VBK.	GERMANY
25	COMMERZBANK	GERMANY
26	DEUTSCHE BANK	GERMANY
27	BNP PARIBAS	FRANCE
28	SOCIETE GENERALE	FRANCE
29	BANCO ESPANOL DE CREDITO	SPAIN
30	'BANCO POPULAR ESPANOL'	SPAIN
31	BANCO SANTANDER CENTRAL HISPANO	SPAIN
32	BBV ARGENTARIA	SPAIN
33	ABN AMRO HOLDING	NETHERLANDS
34	FORTIS (AMS)	NETHERLANDS
35	UNICREDITO ITALIANO	ITALY
36	SAN PAOLO IMI	ITALY
37	CAPITALIA	ITALY
38	BANCA INTESA	ITALY
39	BANCA INTESA RNC	ITALY
40	UNICREDITO ITALIANO RNC	ITALY

Table 4. Correlations in DDs

Ireland and ...	1994-2005	Pre-Euro 1994-1998	Post-Euro 1999-2001	Post-Sept. 11th 2001-2005
France	0.31	0.34	-0.53	0.89
Germany	0.64	0.61	-0.69	0.81
Italy	0.50	0.37	0.18	0.88
Netherlands	0.71	0.61	-0.39	0.94
U.K.	0.81	0.68	0.63	0.92
US	0.73	0.45	0.83	0.76
Spain	0.76	0.74	-0.37	0.91
East Europe	0.03	-0.12	-0.71	0.81

Table 5. Correlations in Percentage Change in DDs

Ireland and ...	1994-2005	Pre-Euro 1994-1998	Post-Euro 1999-2001	Post-Sept. 11th 2001-2005
France	0.32	0.43	0.17	0.42
Germany	0.08	0.45	0.17	0.12
Italy	0.31	0.36	0.26	0.37
Netherlands	0.31	0.47	0.23	0.32
U.K.	0.45	0.60	0.37	0.44
US	0.36	0.50	0.28	0.34
Spain	0.27	0.41	0.19	0.33
East Europe	0.02	0.03	-0.00	0.26

Table 6. Variable Description and Summary Statistics

Variable	Definition	n	Mean	Median	Std Dev	Min	Max
Bank-specific variables							
dd_{it}	Distance to default of bank i in time t	123,304	5.19	5.00	2.33	-2.16	27.17
$\Delta dd_{it} / \lvert dd_{it-1} \rvert$	Percentage change in the distance to default	123,104	0.02	0.00	3.15	-236.53	895.32
Country-specific variables							
Coexceedances IRL	Number of banks in the 15th percentile negative tail of $\Delta dd_{it} / \lvert dd_{it-1} \rvert$ in IRL	3,105	0.36	0.00	0.71	0.00	3.00
Coexceedances US	Number of banks in the 15th percentile negative tail of $\Delta dd_{it} / \lvert dd_{it-1} \rvert$ in US	3,105	1.76	0.00	2.88	0.00	14.00
Coexceedances UK	Number of banks in the 15th percentile negative tail of $\Delta dd_{it} / \lvert dd_{it-1} \rvert$ in UK	3,105	0.78	0.00	1.24	0.00	5.00
Coexceedances GER	Number of banks in the 15th percentile negative tail of $\Delta dd_{it} / \lvert dd_{it-1} \rvert$ in GER	3,105	0.79	0.00	1.08	0.00	4.00
Coexceedances FR	Number of banks in the 15th percentile negative tail of $\Delta dd_{it} / \lvert dd_{it-1} \rvert$ in FR	3,105	0.33	0.00	0.64	0.00	2.00
Coexceedances SPA	Number of banks in the 15th percentile negative tail of $\Delta dd_{it} / \lvert dd_{it-1} \rvert$ in SPA	3,105	0.46	0.00	0.86	0.00	4.00
Coexceedances NL	Number of banks in the 15th percentile negative tail of $\Delta dd_{it} / \lvert dd_{it-1} \rvert$ in NL	3,105	0.32	0.00	0.59	0.00	2.00
Coexceedances IT	Number of banks in the 15th percentile negative tail of $\Delta dd_{it} / \lvert dd_{it-1} \rvert$ in IT	3,105	1.13	0.00	1.56	0.00	6.00
Memo items		**Cut-off point**					
negative 15th percentile of $\Delta dd_{it} / \lvert dd_{it-1} \rvert$		-0.070					

Table 7. Description of the Sample by Country

Country	Number of banks	Maximum of coexceedances	Coexceedances = 0		Coexceedances = 1		Coexceedances >= 2	
			Count	*Percent*	Count	*Percent*	Count	*Percent*
IRELAND	3	3	2329	*75.01*	497	*16.01*	279	*8.99*
USA	14	14	1616	*52.05*	498	*16.04*	991	*31.92*
UK	5	5	1909	*61.48*	556	*17.91*	640	*20.61*
GERMANY	4	4	1718	*55.33*	755	*24.32*	632	*20.35*
FRANCE	2	2	2355	*75.85*	465	*14.98*	285	*9.18*
SPAIN	4	4	2238	*72.08*	460	*14.81*	407	*13.11*
NETHERLANDS	2	2	2330	*75.04*	563	*18.13*	212	*6.83*
ITALY	6	6	1594	*51.34*	611	*19.68*	900	*28.99*
Total	40	40						

Table 8. Results from GARCH (1,1) model: $\sigma_t^2 = \alpha + \beta\sigma_{t-1}^2 + \gamma\varepsilon_{t-1}^2$

	coefficient	std error	z-stat	p-value
	US stock market volatility--NASDAQ			
Const	7.52E-05	6.54E-06	11.5	0.00
ε^2_{t-1}	0.65	0.03	16.97	0.00
σ^2_{t-1}	0.38	0.01	24.02	0.00
	Ireland stock market volatility--ISEQ			
Const	7.79E-05	4.46E-06	17.46	0.00
ε^2_{t-1}	0.67	0.04	15.34	0.00
σ^2_{t-1}	0.22	0.02	12.52	0.00

Table 9. Multinomial Logit Model: Contagion in Daily Coexceedances of the Weekly Percentage Change in Distances to Default, January 1994–November 2005

Dependent variable: number of Irish banks simultaneously in the tail ("coexceedances"). **, * indicate statistical significance at the 5% and 10% levels, respectively.

	Ireland				AIB				Anglo IB				BoI			
	Basic Model		Extended Model		Basic Model		Extended Model		Basic Model		Extended Model		Basic Model		Extended Model	
	Coeff.	St. Error	Coeff.	St. Error	Coeff.	St. Error	Coeff.	St. Error	Coeff.	St. Error	Coeff.	St. Error	Coeff.	St. Error	Coeff.	St. Error
Coexceedances own lagged	2.16**	0.07	2.08**	0.08	3.36**	0.14	3.11**	0.16	3.51**	0.14	3.36**	0.15	3.07**	0.14	2.77**	0.15
Systemic risk	0.81**	0.06	0.73**	0.06	0.87**	0.08	0.79**	0.09	0.62**	0.08	0.52**	0.09	0.81**	0.08	0.67**	0.08
Volatility ISEQ	-33.96	34.04	-34.41	33.97	37.56	53.89	11.23	55.89	5.9	47.39	-20.08	47.99	-19.56	41.21	-44.7	40.75
Volatility US	-18.66	11.74	-19.42*	11.52	-1.92	17.4	-0.96	16.96	-10	16.1	-10.29	16.03	-28.82*	16.67	-35.07**	15.91
Interest rate IRL	2.18**	0.41	1.92**	0.41	3.24**	0.58	3.03**	0.59	1.53**	0.59	1.15**	0.59	2.45**	0.54	2.03**	0.55
Contagion FR			0.11	0.08			0.12	0.11			-0.02	0.11			0.13	0.11
Contagion GER			0.01	0.07			-0.04	0.1			-0.02	0.1			0.006	0.09
Contagion IT			0.002	0.06			-0.13	0.09			0.05*	0.09			-0.05	0.09
Contagion NL			-0.21**	0.09			-0.36**	0.13			-0.17	0.13			0.019	0.12
Contagion SP			-0.04	0.07			0.21**	0.11			-0.07	0.11			-0.14	0.11
Contagion UK			0.13**	0.069			0.17*	0.09			0.15	0.1			0.06	0.09
Contagion US			0.27**	0.06			0.20**	0.08			0.23**	0.08			0.38**	0.08
AIB											0.03	0.2			0.51**	0.17
Anglo IB							0.19	0.19							0.34**	0.17
BoI							0.41**	0.18			0.39**	0.19				
Pseudo-R^2		0.31		0.32		0.393		0.408		0.351		0.362		0.327		0.347

Table 10. Multinomial Logit Model: Contagion in Daily Coexceedances of the Weekly Percentage Change in Distances to Default by Period

Dependent variable: number of Irish banks simultaneously in the tail ("coexceedances"). **, * indicate statistical significance at the 5% and 10% levels, respectively.

Ireland	**Pre-Euro Period (Jan. 1994 - Dec. 1998)**		**Post-Euro Period (Jan. 1999 - 11 Sept. 2001)**		**Post-September 11 Period (12 Sept. 2001 - Nov. 2005)**	
	Coeff.	St. Error	Coeff.	St. Error	Coeff.	St. Error
Coexceedances IRL lagged	1.73**	0.14	2.20**	0.14	2.05**	0.14
Systemic risk	1.17**	0.17	0.46**	0.12	0.76**	0.1
Volatility ISEQ	-120.12*	65.56	91.05	99.59	-27.86	60.73
Volatility US	33.86	48.71	-20.65*	12.81	-12.98	39.03
Interest rate IRL	2.52**	0.61	1.50*	0.91	-0.15	0.94
Contagion FR	0.12	0.14	-0.01	0.15	0.18	0.18
Contagion GER	0.22*	0.12	0.08	0.12	-0.14	0.13
Contagion IT	0.06	0.11	0.005	0.11	-0.002	0.12
Contagion NL	-0.24	0.16	-0.14	0.17	-0.03	0.17
Contagion SP	-0.01	0.13	-0.06	0.14	0.01	0.15
Contagion UK	0.29**	0.12	0.20*	0.12	-0.19	0.13
Contagion US	0.14	0.1	0.28**	0.11	0.18*	0.11
Pseudo-R^2		0.339		0.322		0.286