Foreign Exchange Exposure: Evidence From The United States Insurance Industry[¤]

Donghui Li[a]

Fariborz Moshirian[a*]

Timothy Wee[b]

Eliza Wu[a]

[a] *School of Banking and Finance, University of New South Wales, Sydney, NSW 2052, Australia*

[b] *Equity capital markets, Citigroup Global Markets Asia Ltd, Hong Kong SAR*

Abstract

In this paper, we study the foreign exchange exposure of US insurance firms, comparing the exposure of life and non-life insurers for the first time. The evidence shows that no systematic difference exists in the foreign exchange risk profiles of these two segments within the insurance industry. This suggests that life and non-life insurers have similar risk exposure management strategies arising from similar risk pooling and financial intermediary functions. The empirical results reveal that a sizable proportion of U.S. insurers are exposed to foreign exchange movements to the seven largest U.S. trade partners in insurance services (these include the U.K., Japan, the Netherlands, Switzerland, France, Germany and Canada). The presence of an operational effect is also documented, suggesting that the geographic diversity of multinational insurers correlates with increased hedging activity. This paper also finds that the frequency of foreign exchange exposure increases with the time horizon, thus corroborating with the theory that multinational firms prefer to use derivatives to hedge shorter-term transactional exposure over the longer-term economic exposure that is harder to assess.

JEL Classification: G22, F31
Keywords: Insurance, financial services, foreign exchange exposure, international currencies, currency risk management

[¤]We thank seminar participants at the Institute for International Integration Studies, Trinity College; University College Dublin and an anonymous referee for valuable suggestions that improved this paper.
[*]Corresponding author. Tel: 61-2-93855859. Fax: 61-2-93856730. Email Address: f.moshirian@unsw.edu.au

1. Introduction

With the continued liberalization of international financial markets and the proliferation of trade in financial services, the role of international insurance services is becoming increasingly important. Within the area of international financial services, the importance of detecting and measuring foreign exchange exposure for international risk management strategies is increasingly being recognized.

The existing multinational currency exposure literature centers on the impact of foreign exchange volatility on international trade, firm value and the use of derivative and operational hedging strategies. For international financial services, besides the study by Li, Moshirian and Sim (2003) that discusses factors that contribute to the expansion of international trade in insurance services without reference to foreign exchange volatility, the current literature is concentrated around banks (Choi, Elyasiani and Kopecky (1992), Choi and Elyasiani (1997), Chamberlain et al. (1997) and Martin and Mauer, 2003)) and far less attention has been devoted to non-bank financial institutions, such as insurance companies. This is alarming given that it is recognized that there are potentially different impacts of currency exposure between financial and non-financial firms (see Allayannis and Weston (2001) and Koutmos and Martin (2003)).

The few existing studies examining foreign exchange risk faced by insurers focus more on the use of derivative instruments for hedging and risk management and its determinants (Colquitt and Hoyt (1997), Hentschel and Smith (1997), Cummins, Phillips and Smith (1997, 2001)) rather than specifically looking at the area of foreign currency risk exposure. Foreign exchange risk is one of the many risks that U.S. insurers face. With the increased internationalization of insurance operations, insurers have begun to undertake greater investments in foreign securities, either as a means of realizing portfolio diversification benefits or to hedge foreign liabilities. The recent study by Li, Moshirian, Pham and Zein (2006) shows the significance of the international investment environment on business expansion of financial institutions, including insurance companies. Thus, detecting foreign exchange exposure in the U.S. insurance industry provides an important starting point in identifying the determinants of exchange rate risk exposure and for evaluating the impact of currency risks within international insurance services. This paper contributes to the literature by providing, for the first time, direct evidence documenting the importance of foreign exchange exposure to the insurance industry and specifically its life and non-life insurance segments.

Unlike previous studies using aggregate data (Jorian (1990), Bodnar and Gentry (1993), Chow, Lee and Solt (1997b)) that may not account for firm-specific trade linkages, this paper conducts individual firm level estimations to avoid the averaging effects arising from the grouping of firms. The research design of such studies potentially disguises firm-specific information such as operational and managerial differences, making the identification of significant currency exposure difficult (Bartov and Bodnar (1994)). Furthermore, the potential estimation errors arising from investors' mispricing of currency exposure in stock returns is avoided by employing a cash flow based approach that can minimize the noise in foreign exchange exposure detection. Moreover, using a cash flow based methodology significantly contributes to the area of foreign exchange exposure management since a major reason firm managers seek to manage currency

risk comes from their desire to control cash flow volatility (Smith and Stulz (1985), Stulz (1984), Froot, Sharfstein and Stein (1993) and Bodnar et al. (1998)).

We find that there are no systematic differences in the foreign exchange risk profiles between life and non-life insurers. This suggests life and non-life insurers have similar risk exposure management strategies arising from similar risk pooling and financial intermediary functions. The empirical results reveal that a sizable proportion of U.S. insurers are exposed to foreign exchange movements to the seven largest U.S. trade partners in insurance services (these are: the U.K., Japan, the Netherlands, Switzerland, France, Germany and Canada, *Survey of Current Business* (2003)). We find the presence of both an operational effect and a size effect, suggesting that the geographic diversity of multinational insurers and their firm size correlates with increased hedging activity. This paper also finds that the frequency of foreign exchange exposure increases with the time horizon, thus corroborating with the theory that multinational firms prefer to use derivatives to hedge shorter-term transactional exposure over the longer-term economic exposure that is harder to assess.

The rest of this paper is organized as follows. Section 2 introduces the methodology used for detecting foreign exchange exposure across insurance firms. In Section 3, the empirical hypotheses are discussed in the context of the relevant literature on foreign exchange exposure and currency risk management. Section 4 details the data and sample used and Section 5 reports the main findings. Finally, conclusions are made in Section 6.

2. Methodology to detect foreign exchange exposure

Most existing studies examine foreign exchange exposure relative to firm value as measured by stock price returns (see Jorian (1990), Bodnar and Gentry (1993), Bartov and Bodnar (1994), Choi and Prasad (1995), and He and Ng (1998) amongst others). This induces potential estimation difficulties in detecting foreign exchange exposure should investors not price the currency exposure correctly. This is made even more difficult given the asymmetry in information between corporate insiders and outsiders. The use of unanticipated operating income avoids this potential problem; additionally, it models the unexpected component of cash flows that would be due to foreign exchange volatility, which is the basis of foreign exchange exposure management by multinational firms' managers (Bodnar et al. (1996)).

This study employs a two-step OLS regression approach to estimate the extent to which U.S. insurance companies exhibit exchange rate exposure. The unanticipated operating income for each firm and the foreign exchange variable are first estimated using a seasonal random walk model and a log linear model respectively to remove potentially confounding effects on the exchange rate-cash flow relationship. These variables are then used in the main estimation model following the Almon (1965) distribution lag technique to find the frequency of detecting significant exchange rate exposures in insurers.

We employ Martin and Mauer's (2003) technique of purging the unanticipated income before adjustments (UOI_{it}) variable in the form of estimated residuals from a seasonal random walk model. We regress four-quarter lagged values of each sample insurance company's operating

income before depreciation and foreign exchange adjustments on current operating income before adjustments.

$$OI_{it} = \alpha_i + \theta_i (OI)_{i(t-4)} + \mu_{it} \qquad (1)$$

Where α_i is the mean of the seasonal difference for insurer *i*, which is the *average annual trend* in the data and is assumed to be constant. This seasonal trend model is a special case of an Autoregressive Integrated Moving Average (ARIMA) model where there is only one order of seasonal differencing, a constant and no other parameters. Because of the nature of the seasonal specification, one significant advantage of such a model is that it is relatively stable and will not be affected by sudden changes in the data within a 4-lag period. The residuals (μ_{it}) divided by the standard deviation form UOI_{it}, the standardized unanticipated operating income variable which is used in the formalized estimation model.

The OI_{it} variables for all insurance companies are first tested for the presence of unit roots. This ensures the stationarity of the residuals and consequently the UOI_{it} variables. Doing so protects the formalized estimation model from having spurious regression results. Where a company exhibits non-stationary OI_{it}, the first difference of the OI_{it} variable in equation 1 is used instead. Since the *unanticipated* operating income (i.e. the residuals of equation 1) is what this stage is estimating, doing so does not change the economic meaning of the residuals for the first difference model, thus ensuring the consistency across the whole sample of insurance companies.

Next we measure the foreign exchange variable, *FOREX,* using the residuals of equation 2 shown below. It represents the unexplained change in foreign exchange rates where the natural log of foreign exchange movement is modeled as a function of the natural log of interest rate differentials[1] and economic output differentials (in local currencies). This is consistent with the use of unanticipated change in exchange rates in the existing literature (see Adler and Dumas (1984), Jorian (1990), Chow, Lee and Solt (1997a and 1997b) and Martin and Mauer (2003)) and provides a suitable basis for examining the effects on insurance firms. We estimate the following model:

$$LOG(FX_{jt}) = a_{jt} + \phi_{1\,jt} LOG\left(IR_{jt}\right) + \phi_{2\,jt} LOG\left(OP_{jt}\right) + FOREX_{jt} \qquad (2)$$

Where,

[1] Long-term government bond yields were used as short-term treasury bill rates are subject to central bank manipulations for effecting monetary policy.

$$FX_{jt} = \frac{E_{jt}}{E_{j(t-1)}}$$

$$IR_{jt} = \frac{INT_{jt}}{INT_{U.S,t}}$$

$$Op_{jt} = \frac{GDP_{jt} \big/ GDP_{j(t-1)}}{GDP_{U.S,t} \big/ GDP_{U.S,(t-1)}}$$

To proxy foreign exchange movements, FX_{jt} is used to represent the relative change in spot exchange rates, given by the ratio of $E_{jt,}$ the exchange rate for country j relative to the U.S dollar at time t to $E_{j(t-1)}$. The IR_{jt} variable represents the parity condition regarding spot interest rates given by the ratio of INT_{jt} and $INT_{U.S,t}$, which are the long-term government bond yields for country j and the U.S at time t respectively. The OP_{jt} variable acts as a proxy for the difference in the relative changes in economic output of country j and the U.S. Here, GDP_{jt} and $GDP_{U.S,t}$ are the level of real economic activity in country j and the U.S respectively at time t. $FOREX_{jt}$ represents the residuals of the estimated model, or the unexplained change in foreign exchange rates as represented by LOG(FX_{jt}).

Stationarity tests are also conducted for the three variables within equation 2 across the seven different currencies. For the IR_j variable, out of the seven currencies, three are diagnosed as having an I(1) process. Similar to the treatment of the OI_{it} variables, the first difference of the IR_j variable is used instead. Thus, given that our interest lies with the *unexplained* change in foreign exchange movement (the residuals of equation 2), taking the first difference will not change the economic meaning of that variable, ensuring consistency across the different currencies used.

The model consists of estimating the sensitivity of unanticipated operating income before adjustments, UOI_{it}, to contemporaneous and lagged foreign exchange variables, *FOREX*. The formalized model to be used here follows the Almon distributed lag and is presented as:

$$UOI_{it} = c_i + \sum_{q=0}^{L_i} \beta_{iq} FOREX_{t-q} + \varepsilon_{it} \qquad (3)$$

Where UOI_{it} is the standardized unanticipated operating income before adjustment for depreciation and foreign exchange gains or losses, as a proxy for cash flow for insurer i in time period t; $FOREX_{t-q}$ is the percentage change in the *unexplained* exchange rate factor in time period t-q; c_i is the intercept for insurer i; β_{iq} are foreign exchange exposure coefficients, which represent the sensitivity of cash flows to short term and long term exchange rate changes (to be estimated), for insurer i with q, quarters 0 through L. Here, β_{iq} follows the Almon technique where L_i is the lag length, up to 12 quarters and determined by the Akaike (1973) information criterion (AIC) for insurer i; ε_{it} is the stochastic error term.

As it is very difficult to know the true shape of the *FOREX* variable, *a priori* this study follows Martin and Mauer (2003) in using a third degree polynomial "which is sufficiently flexible to allow for typical lag patterns" (p.858). Thus, it is assumed that the β_{iq}'s can be modeled by

$$\hat{\beta}_{iq} = \hat{a}_{0i} + \hat{a}_{1i}(q) + \hat{a}_{2i}(q)^2 + \hat{a}_{3i}(q)^3 \qquad (4)$$

Substituting equation 4 into equation 3, the model used for estimation is as below,

$$UOI_{it} = \alpha_i + a_{0i}Z_{0it} + a_{1i}Z_{1it} + a_{2i}Z_{2it} + a_{3i}Z_{3it} + \varepsilon_{it} \qquad (5)$$

Where

$$Z_{0it} = \sum_{q=0}^{L} FOREX_{i(t-q)} = FOREX_{it} + FOREX_{i(t-1)} + \ldots + FOREX_{i(t-L)}$$

$$Z_{1it} = \sum_{q=0}^{L} (q)FOREX_{i(t-q)} = (1)FOREX_{i(t-1)} + (2)FOREX_{i(t-2)} \ldots + (L)FOREX_{i(t-L)}$$

$$Z_{2it} = \sum_{q=0}^{L} (q)^2 FOREX_{i(t-q)} = (1)^2 FOREX_{i(t-1)} + (2)^2 FOREX_{i(t-2)} + \ldots + (L)^2 FOREX_{i(t-L)}$$

$$Z_{3it} = \sum_{q=0}^{L} (q)^3 FOREX_{i(t-q)} = (1)^3 FOREX_{i(t-1)} + (2)^3 FOREX_{i(t-2)} + (3)^3 FOREX_{i(t-3)} + \ldots + (L)^3 FOREX_{i(t-L)}$$

Using UOI_{it}, the coefficients a_0-a_3 in equation 5 are easily obtained via the usual OLS procedure. In this case, the estimates of α and a_0-a_3 have all the desirable statistical characteristics of ordinary least squares estimates should the stochastic error term satisfy all the well-known classical assumptions. These coefficients are then used to calculate the β_{iq} coefficients of the formalized model, equation 3.[2]

3. Hypotheses Tested

In conjunction with identifying currency exposure among U.S insurance companies, this study empirically tests three main hypotheses to better understand foreign exchange exposure in different segments of the insurance industry and the nature of these exposures.

Operational Scope Effects: Domestic and International Insurers

H1: Domestic insurance firms exhibit higher frequencies of foreign exchange exposure than international insurance firms.

Much of the literature looking at foreign activity and foreign exchange exposure utilizes accounting based measures to proxy operational exposure (Chamberlain et al. (1997), Allyannis

[2] Here, the standard errors for the coefficients of transformed model, a_0-a_3, are easily obtained from the regressions. These standard errors are then used to calculate the corresponding standard errors of the β_{iq} coefficients in equation 3 using the following formulae:

$$\begin{aligned}\operatorname{var}(w_i(q)) &= \operatorname{var}\left[\hat{a}_{0i} + \hat{a}_{1i}(q) + \hat{a}_{2i}(q)^2 + \hat{a}_{3i}(q)^3\right] \\ &= \sum_{j=0}^{3} (q)^{2j} \operatorname{var}(\hat{a}_{ji}) + 2\sum_{j>p} (q)^{(j+p)} \operatorname{cov}(\hat{a}_{ji}\hat{a}_{pi})\end{aligned}$$

and Weston (2001) and Choi and Kim (2003)). More recently, Martin and Mauer (2003) grouped U.S. banks according to whether they are domestic or internationally focused. The difference between these methods is that where the former method estimates the *extent* to which operational scope impacts on foreign exchange exposure, the latter allows us to identify systematic differences in the *type* (domestic versus international) of operations rather than the *scope*.

Chamberlain et al. (1997) look at cross-sectional determinants of U.S. banks' foreign exchange exposure estimates using accounting based measures of currency risk. To proxy operational scope and hence foreign activity, they use net foreign assets and find a negative correlation with the estimated foreign exchange exposure coefficients. This implies that the larger the short foreign currency position, the greater the foreign exchange exposure. Allayannis and Weston (2001) classify firms into two samples depending on the existence of foreign sales. They find that for the firms with foreign sales, users of foreign currency derivatives do exhibit higher mean and median levels of Tobin's *Q*, reflecting higher firm values. Allayannis et al. (2001) further find that firms with greater geographical scope tend to use more financial rather than operational hedges, implying lower levels of foreign exchange exposure for international firms compared to domestic firms.

In terms of operational scope, conventional wisdom would suggest that internationally focused firms would face foreign exchange exposure whereas domestic firms would not. This however deals with the case of direct exposure. Where indirect exposure to foreign exchange is considered, domestic firms may indeed be faced with foreign exchange exposure. These include the competitive effects of foreign firms, and an indirect cost exposure should the supplier of a domestic firm be exposed to direct foreign currency movements and pass on cost increases arising from a negative movement in exchange rates. Hentschel and Smith (1997), Chamberlain et al. (1997) and Martin and Mauer (2003) agree that insurance companies and banks are indeed exposed to such indirect influences. This exposure arises from the nature of their assets, which are particularly sensitive to insolvency risk and could be dependent on the level of foreign exchange exposure. One simple example is that of a borrower who uses the money to undertake highly risky overseas investments. Here, his probability of default would then be a function of his foreign exchange exposure.

The existing literature suggests that foreign exchange movements do have an impact on domestic companies (Wentz (1979), Hodder (1982), Jorian (1990) and Martin and Mauer (2003)). In particular, Martin and Mauer (2003) find that U.S. domestic banks exhibit more foreign exchange exposure than U.S. international banks. This supports the hypothesis of international firms hedging more in light of the more direct transactional and economic exposure that they face. Martin and Mauer (2003) place the foreign exchange risk of banks in the perspective of both direct and indirect exposure. Where international insurers face both forms of exposure, domestic insurers are indirectly exposed to adverse foreign exchange movements via channels such as the solvency of its policyholders, reinsurance, and foreign competitive effects. Hence, we seek to investigate potential differences in the frequencies of foreign exchange exposure between domestic insurers and international insurers.

Size Effects and Foreign Exchange Exposure

H2: Large (Small) insurers will exhibit lower (higher) frequencies of foreign exchange exposure than small (large) insurers.

The premise behind the size effect of firms stems from them reaping the benefits of economies of scale and scope to achieve informational and cost savings in production, marketing, and in this case, foreign exchange exposure management.

Chow, Lee and Solt (1997b) found that larger firms are better able to manage economic exposure to foreign exchange fluctuations by implementing operational hedges. Unlike transaction exposure management, this constitutes managing foreign currency inflows and outflows such that the net exposed amount is minimized. They credit this to operating, financial or informational scale economies that make it easier and more beneficial for larger firms to undertake the hedge.

Where the use of hedging results in lower foreign exchange exposure, Nance, Smith and Smithson (1993) suggest that larger firms tend to hedge more, suggesting larger firms have less exposure to currency risk. This is not particularly surprising given that larger firms would have significant cost economies of scale. Geczy et al. (1997) find that larger firms are more likely to use foreign currency derivatives, suggesting economies of scale in risk management. Allayannis and Weston (2001) also suggest that large non-financial firms are more likely to use currency derivatives than small firms given the potentially large start up fixed costs of hedging. The authors also find a positive relationship between currency derivative usage and firm value for internationally oriented firms. This is consistent with the findings of Chamberlain et al. (1997) where increased derivative usage leads to lower foreign exchange exposure. Thus, if larger firms tend to use more derivatives and if increased derivative use results in lower foreign exchange exposure, it follows, that larger firms should exhibit lower foreign exchange exposure, *ceteris paribus*.

For financial firms, the literature surrounding size and foreign exchange exposure remains unclear. Chamberlain et al. (1997) find that the largest U.S. banks generally exhibit larger foreign exchange exposures. This potentially stems from the role of many of these large banks as dealers in derivative contracts (this is also potentially true for insurers as some also act as market makers in derivatives) and suggests that the banks in their sample use their position as dealers in derivatives to undertake speculative positions. Thus, their finding contradicts the traditional view that larger derivative usage should correlate with lower and not higher foreign exchange exposure (Allayannis and Weston (2001)). The fact that financial institutions are different from non-financial firms in their use of derivative instruments due to their more central role in the derivatives markets could be the reason for the different result.

Specific to the insurance sector, Colquitt and Hoyt (1997) suggest that the size of an insurer could potentially have a positive or negative effect on the use of derivatives[3].
Cummins et al. (2001) analyze the derivatives holdings of US insurers and find that for both life/health insurers and property/liability insurers, the size (proxied by the logarithm of total assets) does have significantly positive impacts on their participation and volume decisions about

[3] This includes other forms of derivative instruments including those used for managing foreign exchange exposure.

derivatives holdings. They conclude that derivatives activities are subject to scale economies. Literature on the cost of financial distress[4] finds that such costs are lower for smaller firms. Given that hedging the volatility of firm value reduces the probability of bankruptcy, the use of derivatives to hedge is arguably negatively related to firm size. On the other hand, informational economies and cost economies of scale could also potentially apply to insurers, indicating a positive relationship with insurers' choice of hedging with derivatives.

Cummins, Phillips and Smith (1997) provide further evidence regarding the size effect on hedging in insurance. Their findings document greater usage of derivatives by insurers in the largest quartile (38 percent of life insurers, 20 percent of property-liability insurers and 35 percent of groups and unaffiliated insurers) as compared to insurers in the smallest quartile (less than 2 percent).

Based on the majority of findings on the size effects in the hedging of foreign exchange exposure, we hypothesize that large insurers will exhibit lower frequencies of foreign exchange exposure than small insurers due to more hedging activities arising from informational and cost economies of scale in foreign exchange exposure management. We also hypothesize that smaller insurers will exhibit higher frequencies of foreign exchange exposure than large insurers due to less hedging activities arising from informational and cost economies of scale in foreign exchange exposure management.

Time Horizon Effects: Short term and Long term Exposure

H3: Insurers exhibit more frequent (significant) long-term rather than short-term foreign exchange exposures.

Chow, Lee and Solt (1997b) find that the foreign exchange exposure of the firms in their sample increases with the time horizon. They suggest this indicates short-term foreign exchange exposure effects are mitigated by the use of short-term transaction exposure strategies comprising the use of forwards, futures, swaps, options and other derivatives. As longer-term exposure is based more on economic exposure management using operational hedges and is more difficult to undertake, such exposure would thus be more pronounced.

Belk and Glaum (1990) conduct a survey of senior financial managers in 16 large British multinationals and find that firms consider transaction exposure more frequently than economic exposure. Their results are however not conclusive as out of the 16 firms, 6 did not attempt to hedge economic exposure, with the other ten using either foreign exchange derivatives or foreign currency denominated debt to hedge long term foreign exchange exposure. Only three firms indicate that foreign exchange exposure management is influential in non-financial decision-making, such as product development and location and sourcing. In another survey, Hakkarainen et al. (1998) also find that among Finnish Industrials, there exists a much greater propensity to hedge transaction exposure over than economic exposure. These results serve to demonstrate the lack of widespread management in hedging longer-term economic exposure.

Nguyen and Faff (2003) document the existence of both long and short-term exposure for Australian companies and link the time horizon nature of these exposures with the use of foreign

[4] See Altman (1984).

currency derivatives. Their findings show that Australian firms are generally more exposed to long-term currency movements. They further find evidence that this in part could be due to the increased effectiveness of foreign currency derivatives in managing short-term currency movements over the longer-term economic exposure.

We expect insurers to show significantly more frequent long-term rather than short-term foreign exchange exposure. Following Martin and Mauer (2003), this study classifies short-term exposure as those insurers with optimal lags of 4 or less (< 1 year) and long-term exposure as insurers with optimal lags of 8 lags or more (≥ 2 years) based on the AIC statistic of the polynomial distribution model, equation 3.

4. Data and Sample selection

Sample quarterly data between the years 1990 to 2003 are used in this study. Operating incomes are obtained from the *Research Insight* database by COMPUSTAT. One of the reasons why we have used data from the *Compustat* is that it grasps the commonality (homogeneity) of the operating income measures of each firm across industries. The cash flow proxy used in this paper according to *Compustat*, is defined as "Sales (net) minus Cost of Goods Sold and Selling, General, and Administrative expenses before deducting Depreciation, Depletion and Amortization". The study by Martin and Mauer (2003) on foreign exchange exposures of US banks also used *compustat* as their source of data.

We also checked this information by comparing it with another data source and we find that other database (i.e, Lexis-Nexis) has used the same method to measure income statement of insurance companies. In addition, we also verified that the relevant numbers are not quantitatively different between *Compustat* and Lexis Nexis.

Companies are identified according to their insurance GIC industry group code, and comprise insurance brokers, life and health, multi-line, property – casualty, and reinsurance companies. Under this classification, 210 companies are identified. In addition to the GIC industry group classification, the insurance companies are filtered according to availability of data; in this case, companies with more than 30 quarterly observations are used leaving 73 companies in the final sample.[5] Exchange rate data (end of period)[6], long-term government bond yields and Gross Domestic Product (GDP) figures are taken from the *International Financial Statistics* database[7]. For countries that switched to using the Euro in 1999 (France, Germany and Netherlands), the exchange rates for these years are adjusted using the fixed exchange rate between the Euro and

[5] We excluded 11 insurance brokers with sufficient time-series data from our analysis as their business operations are substantially different from other insurance firms.

[6] Following Chamberlain et al. (1997) and Martin and Mauer (2003), this study uses nominal exchange rates. According to Choi and Kim (2003), for industrialized countries, the random walk and efficient markets hypotheses make both real and nominal exchange rates acceptable.

[7] This is with the exception of France and Canada, where complete real GDP figures were unavailable. These figures are instead obtained from the OECD published *Quarterly National Accounts* available at www.sourceoecd.org.

the domestic currency as obtained from the European Central Bank. To identify large companies versus small companies, the median asset value of each company is considered and asset sizes of greater than US$1 billion are classified as large.[8] Companies are also classified under domestic or international according to data from the geographic segment of COMPUSTAT. For fiscal years ending after December 15, 1977, firms are required to report geographic segment data. These firms must report information for segments with assets, sales or profits that exceed 10 percent of consolidated totals. Where foreign sales data is not available, these companies are classified as being domestically focused.

The countries chosen for this study represent the main trading partners of the U.S. in terms of FDI in insurance. They are selected based on their significant contribution to the insurance sector of the U.S. Table 1 provides a summary on these main U.S partners in insurance. Using a measure of insurance activity given by the total average U.S inflows and outflows of FDI in insurance for the years 2002 and 2001, it can be seen that the seven countries in this study make up more than 64.4 percent of total insurance activity with the U.S. Out of this, outflows dominate inflows with these seven countries accounting for a respectable 84.1 percent of overall outflows out of the U.S. This is in comparison to the smaller but no less significant figure for average total inflows of 50.4 percent. Globally, these markets represent almost 79 percent of world premiums, with the U.S. market alone accounting for 38.1 percent.

Table 1
Summary of Main U.S Partners in Insurance

	2001		*2002*		*Average*		
	Inflows	Outflows	Inflows	Outflows	Inflows	Outflows	Total Insurance Activity
United Kingdom	5,126	40,710	9,064	47389	7,095	44,050	51,145
Japan	12,909	23,698	9,097	29,338	11,003	26,518	37,521
Germany	15,880	13,300	10,443	13,264	13,162	13,282	26,444
Switzerland	22,114	4,125	16,766	4,748	19,440	4,437	23,877
Netherlands	35,569	640	34,768	5449	35,169	3,045	38,213
France	28,873	2,283	32,015	2,183	30,444	2,233	32,677
Canada	25,289	26,055	25,332	23,498	25,311	24,777	50,087
Total	145,760	110,811	137,485	125,869	141,623	118,340	259,963
All Countries	174,109	225,556	162,853	244,480	168,481	235,018	403,499

Source: Survey of Current Business, Washington, Sep 2003; Vol.83, Iss.9

1) Numbers in US$ millions.

2) Inflows relate specifically to finance (except depository institutions) and insurance investments into the U.S. Outflows relate to U.S investments to external countries in the area of finanace (except depository institutions),

[8] This cutoff for large firms corresponds to the 47th percentile in our sample. As a robustness check, we also split the sample firms at the median and there were no qualitative differences in our results.

5. Main Findings

Overall Results: All Insurance Companies

The main focus of this study is to investigate the pervasiveness of foreign exchange exposure among U.S. insurance companies. To this end, the results are especially revealing. Table 2 reports the patterns of significant foreign exchange exposure of U.S. insurers based on the estimation of equation 3 using the Almon lag technique. As can be seen, substantial proportions of US insurers are exposed to foreign exchange exposure. Specifically, 73 percent are exposed to the British Pound, 71 percent to the Japanese Yen, 51 percent to the Swiss Franc, 42 percent to the Dutch Guilder, 55 percent to the French Franc, 59 percent to the Deutsche Mark and 37 percent to the Canadian Dollar. Importantly, 100 percent of insurers studied are exposed to at least one of these currencies. This is not surprising given that these currencies represent the seven most significant trading partners with the U.S. in terms of insurance. The high frequency of foreign exchange exposure further serves to highlight the importance of these currency values to the cash flows of U.S. insurance companies. Compared to the banking literature, these frequencies are consistent with Choi and Elyasiani (1997) but proportionately higher than Chamberlain et al. (1997), Choi and Kim (2003) and Martin and Mauer (2003) amongst others. This suggests that among financial institutions, operational and cash flow exposure is higher for insurance companies than banks due to lower levels of financial and operational hedging. This result could also point to other systematic differences in the risk management and hence, risk profiles of insurers and banks.

For the significantly exposed insurers, the distribution of the optimal lag lengths identified using the AIC is shown in Table 2. We note that the bulk of significant exposures are associated with longer optimal lags for all the currencies. This is consistent with firms' established preferences to financially hedge shorter term transactional exposure over longer term economic exposures which are more difficult to assess.

<See Table 2>

Life and Non-Life Insurers

Existing literature has thus far neglected to investigate differences in the currency risk profile between life and non-life insurance companies. This is examined for the first time in this paper[9] and we find that the frequencies of exposure are quite similar. The two sample z test of population proportions is used to compare life with non-life insurers and the results indicate that there are no statistical differences between the frequencies of significant exposures for life and non-life insurers. Furthermore, in categorizing exposure frequencies on the basis of operational scope, there remain no statistically significant differences in exposure proportions between domestic and international life and non-life insurers. Take together, the results suggest that the underlying transactional and operational exposure of life and non-life insurers are in fact similar.

Operational Scope Effects: Currency Exposure of International and Domestic Insurance Companies

[9] We do not show these results due to space constraints but they are available upon request.

Consistent with previous studies on U.S. companies with foreign operational exposures, we take into account unique firm-specific operational characteristics by distinguishing between domestic and international activities in our study (see Choi and Kim (2003) and Martin and Mauer (2003)). Domestic insurers appear to exhibit greater exposure to foreign exchange movements than internationally orientated insurers. This corroborates with the existing literature suggesting that domestic firms do have indirect exposures to foreign exchange fluctuations (Wentz (1979), Hodder (1982), Jorian (1990) and Martin and Mauer (2003)).

In comparing domestic with international insurers, we find that domestic insurers do show statistically more frequent foreign exchange exposures than international insurers to the British Pound and Dutch Guilder. This is consistent with the findings of Allayannis and Weston (2001) and Martin and Mauer (2003), and suggests that insurers with greater international operational exposure are more willing to hedge foreign exchange exposure given the recognition of their direct transactional and economic exposure to adverse changes in exchange rates. As a robustness check, we also control for size effects by splitting the domestic and international insurers into small and large firms. Our findings suggest that international insurers are more likely to hedge foreign exchange exposure in light of greater direct operational risk to cash flows.

Size Effects: Currency Exposure of Small and Large Insurers

In observing previous studies that have documented economies of scale in managing foreign exchange exposure (Nance, Smith and Smithson (1993), Chamberlain et al. (1997), Chow, Lee and Solt (1997b), and Colquitt and Hoyt (1997), Cummins et al (2001) amongst others), we investigate potential size effects in the frequency of foreign exchange exposure for U.S. insurers.

As expected, we find that large (small) insurers have proportionately lower (higher) frequencies of foreign exchange exposure. The one-tail z test results provide some support for the size effect as documented in existing studies (Chow, Lee and Solt (1997b), Cummins, Phillips and Smith (1997), Colquitt and Hoyt (1997), Cummins et al (2001) and Hunter (2005)). We find that small insurers are statistically more exposed to both Swiss and Canadian currencies than large insurers. The lower frequencies of foreign exchange exposure for larger insurers supports the theory that large insurers benefit from informational and cost economies which results in increased hedging strategies to manage unexpected movements in these bilateral exchange rates.

Time Horizon Effects: Short and Long Term Exposure

Table 3 presents the results concerning the time horizon effect on foreign exchange exposure. Panel A indicates the frequencies of foreign exchange exposure for all insurance companies according to whether long-term or short-term foreign exchange exposure is detected. For example, for the British Pound 58 percent of insurers with long-term optimal lags exhibit significant foreign exchange exposure compared to 51 percent of those with short-term optimal lags. Panel B provides the results for domestic insurers. The results are similar, with a range of 25-64 percent of insurers with long-term optimal lags showing significant exposure compared with a range of 20-58 percent for insurers with short-term optimal lags.

Table 3

Time Horizon Effect on Currency Exposure: Long and Short Term Exposure

*This table represents the number of significant insurers out of the total number found to have the optimal number of lags within the defined time frame. Here, long term is defined to consist of 8 quarters or more (≥ 2 years) and short term is defined to consist of 4 quarters or less (≤ 1 year). Comparisons between samples are based on the (one-tail) z-test statistic of population proportions where *, ** and *** represent the 10%, 5% and 1% levels of significance respectively.*

Panel A: Summary of Long and Short Term Exposures of U.S Insurers

	All Insurance Companies		(N=73)
Currency	*Long Term*	*Short term*	*Long vs Short*
United Kingdom (UK)	14 of 24 (58%)	20 of 39 (51%)	0.55
Japan (YEN)	18 of 29 (62%)	10 of 30 (33%)	2.21**
Switzerland (SWZ)	3 of 14 (21%)	16 of 52 (31%)	-0.69
Netherlands (NETH)	9 of 17 (53%)	11 of 52 (21%)	2.51***
France (FRA)	8 of 14 (57%)	13 of 45 (29%)	1.93*
Germany (GER)	9 of 16 (56%)	17 of 47 (36%)	1.41*
Canada (CAN)	6 of 14 (43%)	11 of 55 (20%)	1.77**

Panel B: Summary of Long and Short Term Exposures of Domestic Insurers

	Domestic Insurance Companies		(N=61)
Currency	*Long Term*	*Short term*	*Long vs Short*
United Kingdom (UK)	13 of 23 (57%)	18 of 31 (58%)	-0.11
Japan (YEN)	16 of 25 (64%)	8 of 23 (35%)	2.02**
Switzerland (SWZ)	3 of 12 (25%)	13 of 43 (30%)	-0.35
Netherlands (NETH)	9 of 17 (53%)	8 of 40 (20%)	2.49***
France (FRA)	8 of 13 (62%)	11 of 37 (30%)	2.03**
Germany (GER)	8 of 15 (53%)	15 of 39 (38%)	1.45*
Canada (CAN)	6 of 14 (43%)	9 of 44 (20%)	1.67**

Consistent with Chow, Lee and Solt (1997b) and Nguyen and Faff (2003) and Martin and Mauer (2003), this study finds that the frequency of foreign exchange exposure increases with the length of the time horizon. This supports the theory that firms tend to be more at risk from long-term exposure given the ease with which short-term exposure can be hedged using currency derivatives. One-tail z tests of proportions indicate that for the Japanese Yen, the Dutch Guilder, the French Franc, the Deutsche Mark and the Canadian Dollar, firms with long-term optimal lags show significantly greater frequencies of foreign exchange exposure than those with short-term optimal lags. In addition, these results agree with Pantzalis et al. (2001) in that they suggest insurers are more prone to long term operating exposure instead of the more short-term transaction exposure, which is more easily hedged with derivatives. It also verifies the survey results by Belk and Glaum (1990) and Hakkarainen, et al. (1998) on the preference of firms to hedge short-term transactional exposure with currency derivatives over longer-term economic

exposure given that such economic exposure is much harder to assess and measure and thus hedge operationally against, as compared to using derivative instruments.

Table 4 provides further evidence about time horizon effects in currency exposure for large and small insurers. For the Yen and the Dutch guilder, both small and large insurers with long-term optimal lags show significantly more foreign exchange exposure as compared to those insurers with short-term optimal lags. Regarding the exposure to the French Franc, the Deutsche Mark and the Canadian dollar, this is only true for large firms consistent with a lower usage of financial hedging for short-term exposure in smaller firms.

Table 4
Time Horizon Effects on Currency Exposure: Large and Small Insurers

*This table shows the number of significant insurers out of the total number found to have the optimal number of lags within the defined time frame. Here, long term is defined to consist of 8 quarters or more (≥ 2 years) and short term is defined to consist of 4 quarters or less (≤ 1 year). Comparisons between samples are based on the (one-tail) z-test statistic of population proportion where *, ** and *** represent the 10%, 5% and 1% levels of significance respectively.*

Panel A: Summary of Long and Short Term Exposures of Large Insurers

	Large Insurance Companies		(N=41)
Currency	*Long Term*	*Short term*	*Long vs Short*
United Kingdom (UK)	8 of 13 (62%)	10 of 21 (48%)	0.79
Japan (YEN)	9 of 17 (53%)	4 of 16 (25%)	1.64*
Switzerland (SWZ)	2 of 7 (29%)	8 of 32 (25%)	0.20
Netherlands (NETH)	4 of 6 (67%)	9 of 33 (27%)	1.88**
France (FRA)	5 of 8 (63%)	7 of 24 (29%)	1.69**
Germany (GER)	6 of 9 (67%)	11 of 27 (41%)	1.35*
Canada (CAN)	4 of 7 (57%)	3 of 33 (9%)	3.04***

Panel B: Summary of Long and Short Term Exposures of Small Insurers

	Small Insurance Companies		(N=32)
Currency	*Long Term*	*Short term*	*Long vs Short*
United Kingdom (UK)	6 of 11 (55%)	10 of 18 (56%)	-0.05
Japan (YEN)	9 of 12 (75%)	6 of 14 (43%)	1.65**
Switzerland (SWZ)	1 of 7 (14%)	8 of 20 (40%)	-1.24
Netherlands (NETH)	5 of 11 (45%)	2 of 19 (11%)	2.18**
France (FRA)	3 of 6 (50%)	6 of 21 (29%)	0.98
Germany (GER)	3 of 7 (43%)	6 of 20 (30%)	0.62
Canada (CAN)	2 of 7 (29%)	8 of 22 (36%)	-0.38

Taken together, the results show that the frequency of foreign exchange exposure increases with the time horizon. We find support for the theory that longer-term foreign exchange exposure

requires economic exposure management via operational or natural hedges (Chow, Lee and Solt (1997b)). For firms with international exposure, such hedges are much harder to undertake compared with using currency derivatives for transactional exposure management in light of the difficulty in ascertaining the value to hedge, as well as significant costs associated with the restructuring of foreign currency inflows, outflows and foreign currency assets and liabilities. Domestic insurers also show significantly more frequent long-term exposure than short-term exposure. This indicates that the same difficulty exists for domestic insurers given the difficulty in assessing long-term exposure without the option of undertaking operational hedging via the restructuring of foreign assets, liabilities and cash flows. In addition, the channel of foreign exchange exposure would be more indirect than direct, making the task of domestic risk managers even more difficult.

6. Conclusions

This paper extends the existing literature on foreign exchange exposure by documenting its pervasiveness in the U.S. insurance industry. In addition, several hypotheses are tested to determine if operational scope, firm size and the time horizon of exposure have an impact on the patterns of foreign exchange exposure faced by U.S. insurers. The existing literature predominantly looks at foreign exchange exposure on an aggregate level, which potentially masks the identification of currency exposure. This firm-level study allows for the heterogeneous nature of individual insurer's economic linkages based on the methodology employed by Martin and Mauer (2003) for banks with some innovations suited to studying insurance firms.

The results highlight the importance of exchange rate exposure management within the U.S. insurance industry. A large proportion of insurers show significant foreign exchange exposure to the each of the seven major currencies studied and to at least one of these currencies. The existence of systematic differences in the foreign exchange exposure of life and non-life insurers is also investigated for the first time. This paper finds that there does not appear to be any difference in the exposure frequencies detected, suggesting similar risk exposure management strategies between life and non-life insurers.

Evidence supporting several key theories from the existing literature on foreign exchange exposure and currency risk management is provided in this paper. The operational scope of U.S. insurers does affect their level of foreign exchange exposure. The significance of foreign exchange exposure to domestic and international insurers is found and the presence of both direct and indirect exposure faced by insurers as found by Martin and Mauer (2003) for banks is verified. For insurers, this is potentially due to the marketing of innovative bank-like products by insurers such as foreign currency endowment policies and other investment products that offer investors exposure to foreign markets. In comparing between domestic and international insurers, domestic insurers show significantly greater frequencies of foreign exchange exposure. This supports the theory that international firms tend to hedge more given that their exposure is more easily identified. Domestic firms on the other hand exhibit greater economic exposure since the indirect exposure they face are even more difficult to ascertain and execute.

Regarding the size effect, the lower frequencies of foreign exchange exposure for larger insurers support the theory that large insurers benefit from informational and cost economies which result

in superior hedging strategies (and risk management overall) to manage unexpected movements in these bilateral exchange rates.

In studying foreign exchange exposures in the short and long-term horizons, we find that the number of significant foreign exchange exposures faced by insurers increases with the time horizon. In accordance with the existing literature, this result suggests that U.S. insurers tend to focus more on hedging short-term transactional exposure with derivatives rather than longer-term operational exposure. It corroborates with the theory that the management of short-term foreign exchange transaction exposure is the more popular choice among financial risk managers.

This paper provides several key contributions by extending and relating the literature on foreign exchange exposure and currency risk management to the U.S. insurance industry. It applies a new cash flow based methodology as innovated by Martin and Mauer (2003) that is useful in detecting the presence of foreign exchange exposure to specific currencies, neglecting the deleterious effects of using aggregate data. The main trading partners of the U.S. in insurance services are chosen and to that extent, high frequencies of foreign exchange exposure are detected.

References

Adler, M. and B. Dumas, 1984, 'Exposure to currency risk: Definition and Measurement', *Financial Management* 13, 41-50.

Akaike, H., 1973. 'Information theory and the extension of the maximum likelihood principle. In: Petrov, B.N., Csaki, F. (Eds.), *Second International Symposium on Information Theory*, Budapest.

Allayannis, G. and J. Weston, 2001, 'The Use of Foreign Currency Derivatives and Firm Value', *Review of Financial Studies* 14, 1, 243-276.

Allayannis, G., Ihrig, J., and J. Weston, 2001, 'Exchange-Rate Exposure: Financial vs Operating Strategies', *American Economic Review Papers and Proceedings* 91, 391-398.

Almon, S., 1965, 'The Distributed Lag Between Capital Appropriations and Expenditures', *Econometrica* 33, 178-196.

Altman, E., 1984, 'A Further Investigation into the Bankruptcy Cost Question', *Journal of Finance* 39, 1067-1089.

Belk, P.A. and M. Glaum, 1990, 'The Management of Foreign Exchange Risk in UK Multinationals: An Empirical Investigation', *Accounting and Business Research* 21, 81, 3-13.

Bartov, E. and G.M. Bodnar, 1994, 'Firm Valuation, Earnings Expectations and the Exchange-Rate Exposure Effect', *Journal of Finance* 49, 1755-1785.

Bodnar, G.M., and W.M., Gentry, 1993, 'Exchange-rate exposure and industry characteristics: evidence from Canada, Japan and the U.S.', *Journal of International Money and Finance* 12, 29 - 45.

Bodnar, G. M., Hayt, G.S., and R.C. Marston, 1998, 'Wharton Survey of Financial risk management by U.S. Non-Financial Firms', *Financial Management* 27, 70-91.

Chamberlain, S., Howe, J.S., and H. Popper, 1997, 'The Exchange Rate Exposure of U.S. and Japanese Banking Institutions', *Journal of Banking and Finance* 21, 871-892.

Choi, J.J., and E. Elyasiani, 1997, 'Derivatives Exposure and the Interest Rate and Exchange Rate Risks of U.S. Banks' *Journal of Financial Services Research* 12, 267-286.
Choi, J.J., Elyasiani, E., and K.J. Kopecky, 1992, 'The Sensitivity of Bank Stock Returns to Market, Interest and Exchange Rate Risks', *Journal of Banking and Finance* 16, 983-1004.

Choi, J.J., and Y.C. Kim, 2003, 'The Asian Exposure of U.S. Firms: Operational and Risk Management Strategies', *Pacific-Basin Finance Journal* 11, 121-138.

Choi, J.J., and A.M. Prasad, 1995, 'Exchange Risk Sensitivity and its Determinants: A Firm and Industry Analysis of U.S. Multinationals', *Financial Management* 24, 77-88.

Chow, E.H., Lee, W.Y. and M.E. Solt, 1997a, 'The Exchange-Rate Risk Exposure of Asset Returns', *Journal of Business* 70, 105-123.

Chow, E.H., Lee, W.Y. and M.E. Solt, 1997b, 'The Economic Exposure of U.S. Multinational Firms', *Journal of Financial Research* 20, 2, 191-210.

Colquitt, L.L, and R.E. Hoyt, 1997, 'Determinants of Corporate Hedging Behavior: Evidence from the Life Insurance Industry', *Journal of Risk and Insurance* 64(4), 649-671.

Cummins, J.D., Phillips, R.D., and S.D. Smith, 1997, 'Corporate Hedging in the Insurance Industry: The Use of Financial Derivatives by U.S. Insurers', *The North American Actuarial Journal* 1, 13-49.

Cummins, J.D., Phillips, R.D., and S.D. Smith, 2001,'Dervatives and Corporate Risk Management: Participation and Volume Decisions in the Insurance Industry', *Journal of Risk and Insurance* 68, 1, 51-91.

Froot, K., Scharfstein, D., and J. Stein, 1993, 'Risk Management: Coordinating Corporate Investments and Financing Policies', *Journal of Finance* 52, 1624-1658.

Hakkarainen, A., Joseph, N., Kasanen, E., and V. Puttonen, 1998, 'The Foreign Exchange Exposure Management Practices of Finnish Industrial Firms', *Journal of International Financial Management and Accounting* 9, 1, 34-57.

He, J. and L.K. Ng, 1998, 'The Foreign Exchange Exposure of Japanese Multinational Corporations', *Journal of Finance*, 53, 2, 733-753.

Hentschel, L. and C.W. Smith, 1997, 'Risks in the Derivatives Markets: Implications for the Insurance Industry', *Journal of Risk and Insuranc*e 64, 323-345.

Hodder, J.E., 1982, 'Exposure to Exchange-Rate Movements', *Journal of International Economics* 13, 375-386.

Hunter, D. M., 2005, 'Time-varying exchange rate exposure of small and large firms', working paper, University of South Florida.

Li, D., F., Moshirian and A. Sim, 2003,International Financial Services: IIT in insurance services, *Journal of Risk and Insurance*, 70, 269-287.

Li, D., F.Moshirian, P.Pham and J.Zein, 2006, When Financial Institutions are Large Sharholders- The Role of Macro Corporate Goverance, *Journal of Finance*, forthcoming.

Jorian, P., 1990, 'The Exchange-Rate Exposure of U.S. Multinationals', *Journal of Business* 63, 331-345.

Koutmos, G. and A.D. Martin, 2003, 'First-and Second-Moment Exchange Rate Exposure: Evidence from U.S. Stock Returns', *Financial Review* 38, 455-471.

Martin, A.D., and L.J. Mauer, 2003, 'Exchange Rate Exposures of U.S. Banks: A Cash Flow-Based Methodology', *Journal of Banking and Finance* 27, 851-865.

Nance, D.R., Smith, C.W., and C.W. Smithson, 1993, 'On the Determinants of Corporate Hedging', *Journal of Finance* 48, 1, 267-284.

Nguyen, H. and R. Faff, 2003, 'Can the use of foreign currency derivatives explain variations in foreign exchange exposure? Evidence from Australian companies', *Journal of Multinational Financial Management* 13, 193-215.

Pantzalis, C., Simkins, B.J. and P.A. Laux, 2001, 'Operational Hedges and the Foreign Exchange Exposure of U.S. Multinational Corporations', *Journal of International Business Studies* 32(4), 793-812.

Smith, C.W. and R.M. Stulz, 1985, 'The Determinants of Firms' Hedging Policies', *Journal of Financial And Quantitative Analysis* 20, 4, 391-405.

Stulz, R.M., 1984, 'Currency Preferences, Purchasing Power Risks, and the Determination of Exchange Rates in an Optimizing Model', *Journal of Money, Credit, and Banking* 16, 3, 302-316.

Wentz, R.C., 1979, 'Towards a General Foreign Exchange Risk Consciousness', *Columbia Journal of World Business* 14, 127-135.

Table 2

Distribution of significant foreign exchange exposures for US Insurance firms

This table presents the distribution of optimal lag lengths established by the Akaike (1973) information criterion for the number of insurance firms that are significantly exposed to each of the 7 currencies. The percentage of firms exposed out of the total sample is also shown. Significant exchange rate exposure is defined at the 10% level or below.

Optimal Lags	UK	YEN	SWZ	NETH	FRA	GER	CAN
≤ 1	10	6	10	7	7	10	6
	19%	12%	27%	23%	18%	23%	22%
2 and 3	8	3	5	2	5	4	2
	15%	6%	14%	6%	13%	9%	7%
4 and 5	7	8	3	4	6	5	3
	13%	15%	8%	13%	15%	12%	11%
6 and 7	4	9	5	2	9	8	4
	8%	17%	14%	6%	23%	19%	15%
8 and 9	12	9	5	8	8	4	4
	23%	17%	14%	26%	20%	9%	15%
10 and 11	9	13	3	5	3	10	4
	17%	25%	8%	16%	8%	23%	15%
12	3	4	6	3	2	2	4
	6%	8%	16%	10%	5%	5%	15%
No. Exposed firms	*53*	*52*	*37*	*31*	*40*	*43*	*27*
N=73	*73%*	*71%*	*51%*	*42%*	*55%*	*59%*	*37%*