The Supply of Catastrophe Insurance Under Regulatory Constraints[1]

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1. Introduction

The significant increase in the risk of natural disasters in the U.S. has strained private insurance markets and created troublesome problems for disaster-prone areas. The threat of mega-catastrophes resulting from intense hurricanes or earthquakes striking major population centers has dramatically altered the insurance environment. Estimates of probable maximum losses (PML) to insurers from a mega-catastrophe range from $50-$115 billion depending on the location and intensity of the event (RMS/ISO, 1995). Under current conditions, many insurers would become insolvent or financially impaired if a mega-catastrophe occurred, with rippling effects throughout insurance markets and the economy (ISO, 1996a).

Increased catastrophe risk poses difficult challenges for insurers, reinsurers, property owners and public officials (Kleindorfer and Kunreuther, 1999). Insurers have sought to raise their prices and decrease their exposure to catastrophe losses. However, state legislators and insurance regulators have resisted insurers' responses to increased risk in an attempt to preserve the availability and affordability of insurance coverage (Klein, 1998). Several states also have established supplemental financing mechanisms for catastrophe risk to ease market pressures, but the financial viability of these mechanisms is questionable; their financial structures are such that they would incur large deficits in the event of a severe catastrophe causing large insured losses (Marlett and Eastman, 1997). Government policies have imposed significant cross-subsides from low-risk to high-risk areas as well as cross-subsidies from non-catastrophe lines of insurance to the catastrophe lines. These policies undermine incentives for managing catastrophe risk. The current state of affairs is neither efficient nor sustainable. Private and public decision-makers are desperately searching for a politically feasible solution to this difficult problem.

Dissecting the dynamics of catastrophe insurance markets and understanding the effects of government actions is critical to identifying a set of private and public measures that will enable insurance markets to function effectively in managing catastrophe risks. There is a rich literature on the supply of and demand for insurance for non-catastrophic risks, but less is understood about how primary insurance markets respond to catastrophic risk. As concerns about natural disasters have assumed center stage, economists have begun to explore the special problems they pose and their implications for how insurance markets function (Russell and Jaffe, 1997).

This paper extends the existing literature by exploring several significant questions concerning the supply of catastrophe insurance for residential property and insurers' strategic responses to the increased risk of natural disasters. Our analysis encompasses insurers' decisions with respect to: 1) the structure and geographic concentration of their risk portfolios; 2) contract design, bundling of perils and cross marketing of products; 3) the purchase of reinsurance and use of financial instruments to hedge catastrophe risk; and 4) the pricing of insurance for low-probability, high-consequence (LPHC) events under significant uncertainty. We are particularly interested in how insurers' market strategies are affected by the tradeoff between the efficiencies in marketing, distribution/sales and claims adjustment gained from geographic concentration and the higher risk associated with concentrated exposures subject to catastrophic perils and correlated losses.

We examine insurers' decisions under two different regulatory regimes: 1) minimal or non-binding regulatory constraints; and 2) significant, binding regulatory constraints of the nature that have been imposed in some high-risk states. We show that the emergence of geographically concentrated, catastrophic perils and the imposition of binding regulatory constraints have significant implications for insurers' decisions with respect to supplying insurance and structuring their risk portfolios.

We limit our discussion to the risk of hurricanes which, for certain institutional reasons, may have moderately different implications than earthquakes. Our analysis is primarily conceptual and intuitive as an appropriate data set for empirical analysis is still being assembled. Where feasible, we examine certain empirical data for Florida to test and support some of our assertions. Florida faces the greatest hurricane risk, which has imposed severe pressure on its insurance markets and prompted the most restrictive regulatory responses of any state.

The paper proceeds as follows. In section 2 we describe the characteristics of residential property insurance and its regulation. In section 3, we propose a model to consider the tradeoffs in a multi-line insurance company, offering bundled catastrophic coverage, between the benefits of spatial economies in marketing and distribution of insurance products and the increased capital costs for catastrophic lines of correlated risks. This basic model serves as the motivation for an empirical analysis in section 4 of the market for homeowners insurance in Florida. Section 5 applies this analysis to the issue of cross-subsidies (among lines and among rating territories) and discusses the implications of other regulatory constraints. Section 6 offers preliminary conclusions and discusses further research.

2. Supply of Catastrophe Insurance

A. Characteristics of Residential Property Insurance

Our analysis focuses on the market for homeowners insurance which is the type of insurance most commonly used to cover residential properties. It is important to explain how homeowners insurance policies are designed and how they address catastrophic perils to assess their supply and demand characteristics. Homeowners multiperil insurance packages several different coverages for residential structures and their contents and inhabitants (Rejda, 1998). The perils covered typically include fire, windstorm, hail, riot, lightning, explosion, theft, malicious mischief, as well as personal liability. Homeowners multiperil coverage is confined to residential structures, including multi-unit structures (2-4 units), where the owner occupies one of the units. [2]

There are several different forms of homeowners multiperil coverage that differ in terms of the perils covered and the basis for loss replacement (e.g., actual cash value, market value, or replacement cost). Also, depending on the state and company, certain coverages may be included or specifically excluded in a specific policy form and special riders may be included to provide additional coverage in a specific contract. For example, in coastal areas of states such as Florida subject to hurricanes and tropical storms, the typical homeowners' policy may exclude damage by windstorm which is insured by separate state windstorm/beach pools. In states with significant earthquake risk, earthquake coverage will be typically sold separately or as a special endorsement[3]. The flood peril (including flooding associated with hurricanes) is insured through a separate policy offered through the federal National Flood Insurance Program (NFIP).

The major innovation of the homeowners multi peril policy (which emerged in the 1960s)

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[2] An owner occupying a multi-unit structure might purchase a homeowners policy that would cover the entire structure and the contents of the owner s particular unit as well as the owner s liability exposure. Alternatively, an owner-occupant of a multi-unit structure may purchase a dwelling fire insurance policy to cover the structure. Renters of the other units may purchase a renters policy (HO-4) that covers the contents of their unit and their liability exposure. Owners of condominium units also may purchase coverage (HO-6) for their contents, the interior features of their unit, and their liability exposure.

[3]Most of the earthquake insurance sold in California currently is provided through the California Earthquake Authority(CEA), established in 1996 to relieve pressure on private insurers. The CEA sells a "mini-policy" with a larger deductible and more limited coverage of external structures than conventional earthquake insurance policies. Some insurers offer " wrap-around" coverage to supplement the mini-policy and a few have begun to offer earthquake policies that compete with the CEA. California represents a special situation in that a 1988 law requires insurers to offer earthquake coverage if they sell homeowners insurance (see Roth, 1998).

was the packaging of liability and non-liability perils and providing broader coverage that previously had to be purchased in separate policies and policy riders. The concept of bundling perils and broadening coverage has driven product development over the last three decades, but the catastrophic risk problem may prompt insurers to rethink this strategy. At the same time, consumer attitudes and regulatory restrictions may impede insurers' efforts to restructure homeowners insurance policies, such as the unbundling of the wind peril (in the absence of state windstorm pools).

It is still possible to purchase a more limited dwelling fire policy to cover a residential structure against the major non-liability perils, including windstorms, with or without extended coverage for contents and less significant non-liability perils. Dwelling fire policies are less common and generally represent a small portion of insured homes. Hence, our data and analysis focus on homeowners multiperil insurance.

To simplify our analysis, we assume that the contract offered by insurers conforms to the provisions of the standard HO-3 homeowners policy as developed by the Insurance Services Office (ISO). This is the predominant homeowners policy form purchased by consumers and insurers' HO-3 policies tend to closely resemble the ISO standard form. The standard HO-3 policy provides replacement cost coverage on the insured dwelling (Dwelling Coverage A) and other detached structures (Coverage B) and actual cash value coverage on contents (Coverage C). Policy limits for other detached structures and contents are based on the dwelling coverage (A) policy limit. The other structures limit is 10 percent of the Coverage A limit and the contents limit is 50 percent of the Coverage A limit. Insureds are encouraged to purchase a dwelling coverage limit equal to 80-100 percent of the replacement cost of their dwelling. If insureds purchase less than 80 percent coverage, then insurers may settle partial losses on a pro-rata basis based on the ratio of the actual policy limit to the 80 percent limit.

B. Regulatory Constraints

Insurers and insurance market are regulated primarily at the state level (Klein, 1998). The federal government has not intervened in the regulation of homeowners insurance in any meaningful way. Hence, the regulations governing homeowners insurance transactions are set by the individual state legislatures and insurance commissioners, with legal disputes generally adjudicated by state courts. Regulatory policies vary among states based on market conditions, differing regulatory philosophies and political factors.

Florida is subject to the greatest risk of hurricanes and its homeowners insurance market has suffered the greatest pressure because of this high hurricane risk (Lecomte and Gahagan, 1998). Florida's homeowners insurance market began to experience severe problems following Hurricane Andrew which caused an estimated $14.5 billion in insured losses. Experts estimate that had Hurricane Andrew passed through Miami, insured losses would be in the area of $50 billion. A more severe storm striking Miami could generate insured losses of approximately $80 billion (RMS/ISO, 1995). Other coastal areas of Florida with significant economic development also would experience huge losses if struck by a severe hurricane. Consequently, many insurers have sought to raise their rates and decrease their exposures in high-risk areas of Florida.

This prompted the Florida legislature and insurance commissioner to impose the most binding constraints on insurers of any state (Lecomte and Gahagan, 1998). Florida has constrained insurers' attempts to raise rates and reduce their exposures. Pricing constraints have taken two forms. One is a ceiling on the overall rate level that insurers can charge.[4] The second is

[4]This kind of constraint is typically implemented through regulatory disapproval of the overall rate level increases filed by insurers. For example, an insurer may file for a 10 percent rate level increase, but regulators will only

a constraint on insurers' rate structures, i.e., territorial rating factors or differences in rates among various geographic areas of the state. This latter constraint is significant because the expected loss for a given property can vary widely depending on its proximity to the coast where the force of hurricanes is most severe. Regulators have compressed rate differentials between high and low risk areas in attempt to keep rates in high-risk areas more "affordable". Insurers have been permitted to increase their rates to some degree, but they contend (with considerable support) that they have not been allowed to raise rates to the level necessary to adequately reflect the risk of loss, particularly in coastal areas (Muslin, 1996). We examine this question briefly in Section 5 below.

Ironically, rating constraints have conflicted with state officials' attempts to preserve the availability of coverage. After Hurricane Andrew, the legislature enacted a moratorium on policy cancellations and non-renewals, which is still in effect. Hence, unless insurers negotiate a special exemption with the insurance department, they can only shed exposures through cancellations and non-renewals instigated by insureds. As a result, it appears that many insurers have been forced to retain a higher number of exposures in high-risk areas than they would choose to in the absence of regulatory constraints.

Of course, some homeowners must still find coverage if they purchase a home or have to cancel or non-renew their existing policy. This has caused Florida's two residual market mechanisms to swell and complicate the management and financing of catastrophic risk.[5] The Florida Residential Property and Casualty Joint Underwriting Association (FRPCJUA) provides

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approve a 5 percent increase. To meet this constraint, an insurer must adjust its rating structure, i.e., all of its rates proportionately, to produce the approved rate level change.

[5] See "Residual Market Crisis Looms in Florida", National Underwriter, January 16, 1996, for a review of the current status of these mechanisms.

coverage for homeowners unable to obtain coverage in the voluntary market. It grew to 600,000 policies (approximately 30 percent of all policies) after Hurricane Andrew. Its volume has since decreased to approximately 240,000 policies as some insurers with limited hurricane risk and new companies have taken policies out of the facility with financial incentives. However, the facility has retained a high concentration of policies in coastal areas. Also, the facility imposes risk on insurers, as any deficit it incurs would be assessed proportionately against insurers based on their voluntary market shares. This has a detrimental effect on insurers' willingness to write policies in the voluntary market.

A second mechanism, the Florida Windstorm Underwriting Association (FWUA), has assumed the wind risk for many homes in coastal areas of Florida. Insurers are allowed to transfer the wind portion of policies they write to the FWUA in designated coastal areas. Participating insurers share premiums and losses through the pool and any deficits are assessed against the voluntary market. The FWUA currently has 500,000 members (insureds). While this mechanism has made it easier for insurers to retain their coverage of non-wind perils, its financial structure presents problems similar to those posed by the FRPCJUA. The FWUA's revenues and funds would not be sufficient to cover losses from a severe hurricane.

The high risk concentration and underfunding of these two facilities has prompted significant legislative and industry concern. Indeed, these facilities have generated $250 million in deficits and voluntary market assessments since 1995, a period devoid of severe wind losses. This reflects the tip of the iceberg relative to the huge deficits and assessments that would be caused by larger events under the current residual market structure. Legislators face a dilemma in terms of allocating the risk and costs borne by facility insureds and voluntary market insureds.

Florida's catastrophe reinsurance facility and insolvency guaranty fund impose additional risk on insureds, insurers and the public. In 1993, Florida established the Florida Hurricane Catastrophe Fund (FHCF) to allow insurers to transfer a portion of their catastrophic risk in Florida (see Lecomte and Gahagan, 1998). The Fund will reimburse a portion of insurers' losses from a severe hurricane. It is funded by premiums paid by insurers that write policies on personal and commercial residential properties based on insurers' property exposures. An important provision limits the Fund's obligation to pay losses to the sum of its assets and borrowing capacity. At the end of 1997, the Fund was estimated to have a total capacity of $8 billion; $2 billion in cash and $6 billion in borrowing capacity. Borrowed funds will be raised through the issuance of bonds to be repaid through a 4 percent assessment on all property-casualty insurance premiums in the state, excluding workers compensation. If the Fund lacks sufficient funds to pay all losses from a hurricane, each insurer will be reimbursed on a pro-rata basis from the funds available according to its share of the premiums paid into the fund for that contract year. Hence, the potential for special assessments as well as partial reimbursement for catastrophic losses imposes residual risk on insurers.

Like other states, Florida also has an insolvency guaranty fund that is intended to cover the claims obligations of insolvent insurers. The guaranty fund is important because it could experience severe stress if a large number of insurers became insolvent because of a catastrophe. The guaranty fund is supported by assessments on property-casualty insurance premiums in the state that are limited to 2 percent annually. Hurricane Andrew directly caused nine insolvencies and the resulting demands on the guaranty fund exceeded its capacity. The guaranty fund was forced to fully exercise its 2 percent assessment authority and the legislature authorized it to assess an additional 2 percent to repay funds borrowed to cover its capacity shortfall. The fund ultimately paid off its debts in 1997. Interestingly, the fund's assessments caused a tenth insurer to become insolvent. The experience from Hurricane Andrew reflects the guaranty fund's vulnerability to catastrophes and the potential pass-through of insolvent insurers' obligations and risk to other insurers.

3. Modeling the Market for Catastrophic Insurance

This section develops a model to illustrate the tradeoffs for insurers in a market like the Florida homeowners market where there may be significant regulatory frictions preventing optimal adjustment of the insurers' portfolios. We formulate a solvency-constrained, expected profit maximizing insurer model for a specific insurer. The model captures several tradeoffs. The level of the solvency constraint itself reflects the insurer's appetite for risk and, in particular, the tradeoff between the costs of increased reserves and the franchise value of the firm going forward, which is put at risk under insolvency. For any specific target level of insolvency probability, maximizing expected returns from a given equity base implies that the insurer will attempt to market its risk coverage to a geographically diversified portfolio of risks. On the other hand, scale economies in marketing, distribution and claims processing, may drive the company to market more intensively in some areas than in others, leading to increased (positive) correlation among the risks in the insurer's portfolio. The model thus is intended to embody the interaction of demand and marketing payoffs relative to the costs of the capital required to support the book of business chosen by the insurer. These tradeoffs will be further complicated if regulators contravene adequate rates or cause cross-subsidies through rate compression.

<u>The Solvency-Constrained Insurer's Problem</u>

Fix attention on a particular insurer in a specified region, e.g., the State of Florida. Denote by $x = (x_1, x_2, ..., x_n)$ the vector of exposures for the insurer, where x_i is the insurer's exposure in insurance zone i in the region. In keeping with the notion that the insurance market is workably competitive, we assume that the firm is a price-taker in the market, with price in zone i per unit of exposure given by p_i. Let $L_i(x_i)$ be the random variable representing losses in zone i and let $L(x) = L_1(x_1) + L_2(x_2) + ... + L_n(x_n)$ denote total losses. Losses in different zones may be correlated since the same "event" could create losses in more than one zone. Losses to different properties within a zone are correlated for the same reason. These losses may arise from catastrophe lines of business or from other lines. We return below to the interaction effects of multi-peril coverages.

Denote by ? (x, A, K) the expected profits for the insurer for a typical year, where A are the assets of the insurer supporting the business x and K is additional risk-bearing capital described in more detail below. We write expected profits as:

$$\Pi(x,A,K) = R(x) - M(x) - \bar{L}^*(x,A,K) - rK$$
$$= \sum_{i=1}^{n} \left[R_i(x_i) - M_i(x_i)\right] - \bar{L}^*(x,A,K) - rK \qquad \textbf{(1)}$$

where

$R_i(x_i)$ = Annual revenue from zone i = $p_i x_i$

$M_i(x_i)$ = Marketing, Sales and Distribution (annual) Expenses for zone i

$\bar{L}^*(x, A, K)$ = E{Min [L(x), (R(x) - M(x) + (1-r)K + A)]} = Expected annual losses from all zones, truncated at the insolvency point L = R(x) - M(x) + (1-r)K + A.

r K = Payments to capital providers for K

Marketing expenses M_i will depend on company organizational variables such as its distribution strategy. We will think of K as reinsurance, but K could also be in the form of zero-coupon bonds. The important assumption we make about K is that the "premium" (or interest in the case of bonds) is prepaid, before losses are known, so that (1-r)K is actually available to pay losses if K units of reinsurance are purchased. The "shareholder equity" A that the insurer puts at risk may influence the rate r or the amount of reinsurance K obtainable. We take A and r as fixed here and assume that K is set to just satisfy a solvency constraint, specified below. Once A and K are exhausted, i.e., insolvency occurs, the insurer bears no further responsibilities for losses; losses are accounted for in the expected profit function only up to the point of insolvency. Thus, in the spirit of Herring and Vankudre (1987) and Greenwald and Stiglitz (1990), based on transactions costs of insolvency and the franchise value of the firm going forward, solvency constraints may be viewed as an endogenous outcome of the options value of continued operations. The price of the option in this case is the differential returns to capital devoted to the insurance business at the margin rather than to other market opportunities. An alternative and equivalent approach to making insolvency probabilities endogenous, driven by an exogenously specified franchise value of the firm going forward, is to take the level of insolvency probability as exogenous. This is the approach we take here. In the language of Herring and Vankudre (1987), Go-for-broke or gambling behavior corresponds to relatively high values of insolvency probability (reflecting for such firms low values of anticipated growth opportunities which cannot be converted to cash if insolvency occurs). Such behavior is to be contrasted with that of insurers with long-run profit prospects who would choose lower values of target insolvency probabilities reflecting the higher franchise of the firm going forward.

These considerations lead to model in which the insurer chooses its book of business x to maximize ? (x, A, K) subject to a solvency constraint based on a probable maximum loss (PML). This requires that underlying reserves and reinsurance A + (1-r)K be set large enough to avoid financial distress with a probability exceeding 1 -?, where ? represents the worst case or PML probability. Formally, we have the following requirement:

$$Pr\{L(x) > R(x) - M(x) + (1-r)K + A\} = 1 - F[R(x) - M(x) + (1-r)K + A; x] \le ? \qquad \textbf{(2)}$$

where F(L; x) = Pr{L(x) $\le$ L} is the cumulative distribution function (cdf) of the total loss distribution. The import of (2) is the following. The probability that the insurer will be unable to cover losses (from revenues R(x) and surplus (1-r)K + A) of its policyholders after paying marketing expenses M(x) is no greater than the prespecified insolvency probability?. The problem of interest is to choose x to maximize (1) subject to (2). It will be convenient to reformulate this problem by defining the "net surplus function" S(x, ?) as the unique solution to

$$F(S(x,?);x) = 1 - ? \qquad \textbf{(3)}$$

Using (3), we can state the problem of maximizing expected profits subject to the solvency constraint (2) succinctly as:

$$\underset{x \ge 0, K \ge 0}{Maximize}\ \{R(x) - M(x) - \bar{L}^{*}(x,A,K) - rK \mid R(x) - M(x) + (1-r)K + A \ge S(x,?)\} \qquad \textbf{(4)}$$

Intuitively, S(x, ?) is the amount of capital from all sources required to assure that the probability the insurer's losses in a given period exceed S will be no greater than ?. Alternatively, S(x, ?) specifies the amount of surplus required to avoid financial distress with probability 1-?. The net surplus S(x, ?) is increasing in both expected losses and the variance of total losses. To the extent that losses across zones are positively correlated, the variance in total losses will increase further. Meeting the solvency constraint (2) means putting enough premium revenue and capital behind the portfolio to assure assets of S(x, ?) to meet losses. The characteristics of the portfolio are clearly important in determining S(x, ?)-- the more highly correlated they are, the larger the required surplus.

Associating the shadow price ? ≥ 0 with the constraint in (4), we obtain the following first-order conditions (FOCs) for optimal exposures x for the insurer's problem[6]:

$$\frac{\partial ?(x,A,K)}{\partial x_i} = \frac{?}{1+?}\left[\frac{\partial S(x,?)}{\partial x_i} - \frac{\partial \bar{L}^*(x,A,K)}{\partial x_i}\right]; \quad i = 1,2,...,n \qquad \textbf{(5)}$$

By the defintion of $\bar{L}^*(x, A, K)$, one readily verifies that $\partial \bar{L}^*(x, A, K)/\partial K$ = (1-r)?. Thus, the FOC for optimal capital K* yields ? =? + r/(1-r), so that ?/(1+?) = [?(1-r) + r]/[?(1-r) + 1] in (5). Denote this quantity ß(r, ?) = ?/(1+?). Note that ß(r, ?) → r as ? → 0. Given our assumption that A is fixed, the optimal K* will be set to just achieve equality in (2) at the x* determined by (5).

Under regularity assumptions on the concavity and smoothness of the profit function, decreasing the required level of insolvency probability ? will, as expected, reduce the optimal book of business everywhere. To see this, assume that the expected profit function is concave for x > 0, although there may be discontinuities at $x_i = 0$, resulting for example from the fixed costs of setting up infrastructure to market in zone i. Assuming exposures give rise to losses which are positively interdependent, decreasing ? will increase the magnitude of the quantity in brackets in (5).[7] Given this fact, and noting that expected profits are separable across zones, (5)

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[6] The Lagrangean for the optimization problem in (4) is just $\mathcal{L}(x, ?)$ = [R(x) - M(x) - $\bar{L}$*(x,A,K) - rK] + ?[R(x) - M(x) + (1-r)K + A - S(x, ?)]. Taking derivatives and simplifying leads directly to (5).

[7] By positive interdependence, we mean that if exposures y (additional insured properties) are added to a book of business x, then Pr{L(x+y) = L(x) + L(y) ≤ L | L(y) = R} is non-decreasing in R. By definition of the net surplus function S, we have Pr{L(x+y) ≤ S(x+y, ?)} = Pr{L(x) ≤ S(x, ?)} = 1-?, so that S(x+y, ?) and S(x, ?) are the (1-?)th upper fractile of the cdf of L(x+y) and L(x) respectively. Given the positive interdependence between L(x) and L(y), the asserted monotonicity states that the difference between this fractile and the mean of the distribution is increasing as exposures increase. The most intuitive example of this is the normal distribution. In this case, S(x+y, ?) = E{L(x+y)} + k(?)σ(L(x+y)), so that S(x+y, ?) - E{L(x+y)} = k(?)σ(L(x+y)) which is clearly increasing in y for any given x; i.e., since L(x) and L(y) are not negatively correlated, as more exposures are added the variance of the loss distribution of the overall portfolio of business increases.

implies that the book of business x_i will be reduced in each zone for which $x_i > 0$ obtains in the unconstrained expected profit maximizing solution. In fact, the book of business will be scaled down in each zone to a level which depends on how sensitive increases in net surplus over expected losses are to changes in exposure in the zone. This, in turn, will depend on the degree of correlation of the losses within zone i to intrazonal and interzonal losses. Intuitively, the higher the correlation, the larger the impact on the right hand tail of the joint distribution of L(x) and the higher the marginal net surplus requirements $\partial S(x, ?)/\partial x_i$ over $\partial \bar{L}^*(x, A, K)/\partial x_i$.

Price Regulation

Regulation interacts with the above analysis in several ways, including determination of required solvency levels (1-?), price and profit constraints, underwriting constraints, and entry and exit constraints (see Klein, 1998). All of these can be important in shaping the market outcome for catastrophe insurance. We discuss only the effects of price constraints here, leaving to a discussion below the effects of other regulatory constraints.

To model the effects of price constraints, assume the regulator imposes constraints of the form $p_i \leq \bar{p}_i$, i = 1, 2, ..., n. From (5), there will be a direct effect of these price ceilings on the optimal coverages x_i^* the insurer can offer in zone i. Indeed, rewriting (5) to separate the marginal effects of revenue and marketing costs, we obtain:

$$p_i = \frac{\partial M_i(x_i)}{\partial x_i} + \frac{\partial \bar{L}^*(x,A,K)}{\partial x_i} + ß(r,?)\left[\frac{\partial S(x,?)}{\partial x_i} - \frac{\partial \bar{L}^*(x,A,K)}{\partial x_i}\right]; \quad i = 1,2,...,n \qquad \textbf{(6)}$$

Assuming that the right-hand side of (6) is increasing in x_i, it is clear that decreases in the allowed price p_i must result in decreases in coverage in zone i. The erosion in profits implied by pricing constraints will be both the direct effects through price ceilings and the indirect effects through decreased contributions from zone i to the company's overall net surplus requirements. A possible strategy for the insurer would be exit from the high risk, price-regulated zones, but this (as we note in Section 4 below) may be further constrained by the regulator.[8]

Two-Zone Example

To make the above analysis more concrete, we briefly consider an example in which there are only two zones, i = 1,2.[9] We are interested in the interacting effects of correlated demand on the net surplus and on possible economies of scale in marketing on total expenses at the solvency constrained optimal solution. Let the functions R, M and L be specified as follows:

$R_i(x_i) = p_i x_i$

$M_i(x_i) = F_i\, d(x_i) + b_i x_i^2$, where d(y) = 1 for y > 0 and 0 otherwise

$\bar{L}_i(x_i) = c_i x_i$

$S(x, ?) = \bar{L}(x) + k(?)(h_1 x_1^2 + h_2 x_2^2)^{.5}$

where $h_i > 0$ are constants and k(?) is decreasing in ?. The function S(x, ?) is motivated by the fractiles of the normal distribution together with an assumption that the coefficient of variation of total losses $L_i(x_i)$ in each zone is a constant. To simplify, assume that ? is sufficiently small that

[8] Indeed, let us think of the x vector above as having two entries for each actual insurance zone, the first being for non-cat exposures and the second for cat exposures in the same zone, and let us imagine a scenario in which there are demand synergies from offering multi-peril (bundled) coverages. In the case of bundled products (where marketing of cat and non-cat perils occurs jointly, e.g., though a multi-peril homeowners policy), increases in exposure would be pursued until net revenues from the bundled coverage were equilibrated at the margin against additional marketing and surplus costs, as required by (6). That is to say, one would simply reinterpret (6) as the price for the bundled coverage (with x being the sum of both components of exposure). If regulatory policy contravenes adequate rates for the cat coverage, insurers might still issue bundled policies that satisfy the above constraint on exposures, but in this case the non-cat revenues would be cross-subsidizing the cat risks. Clearly, absent regulatory restrictions or demand synergies, competition would assure the collapse of the market for catastrophe coverage when rates are inadequate. Absent the assured hostage of earnings from the non-cat coverage, insurers would be forced to exit the cat market in these inadequate rate zones. We should note that basic regulatory practice at this point generally prohibits the unbundling of cat and non-cat protection, underlining the potential for cross-subsidies in the manner described. The exception to this, as discussed above, is where an insurer can lay off hurricane risks to wind pools, maintaining bundled coverage for their policy holders, but effectively unbundling their exposures.

[9] Given our interest in the tail events driving insolvency, we refer to this example as "The Tail of Two Cities".

$\bar{L}^*(x) - \bar{L}(x)$ and ß(r, ?) $-$ r. Then, defining $a_i = p_i - c_i$, and assuming $a_i > 0$, expected profits can be expressed as

$$? \,(x,A,K) = \sum_{i=1}^{2} \left(a_i x_i - F_i \mathrm{d}(x_i) - b_i x_i^2\right) - rK \qquad \textbf{(7)}$$

If $x_i > 0$, then substituting the above expressions in the first-order condition (5) implies that

$$a_i - 2b_i x_i = \frac{rk(?)\, h_i x_i}{\left(h_1 x_1^2 + h_2 x_2^2\right)^{1/2}}\,; \quad i = 1, 2 \qquad \textbf{(8)}$$

with the optimal capital K* set to just achieve equality in (2) at the x* determined by (8). Serving zone i at exposure levels x_i^* would be optimal if sufficient expected profits are generated in zone i at this solution to balance the fixed cost F_i of establishing marketing infrastructure in zone i. Otherwise, the insurer will pull out of zone i (i.e., set $x_i = 0$).

Consider the effect of insolvency constraints for this case. From (8) and $a_i = p_i - c_i$, if $x_i > 0$ at optimum then reducing p_i will reduce the right-side of (8). But the right-hand side of (8) is easily shown to be increasing in x_i. Thus, the optimal solution to (8) decreases if the regulated rate ceiling $\bar{p}_i$ is decreased. If the rate ceiling $\bar{p}_i$ for is set low enough, and absent exit restrictions, the fixed cost F_i of infrastructure for zone i would not be recovered and the insurer would exit zone i altogether. For the above model, exit restrictions in the form of constraints $x_i \geq \underline{x}_i$ (i.e., floors, perhaps based on historical exposure levels) would have the direct effect of suppressing profits from operations in zone i and the indirect effect of suppressing coverage in other zones since the profits from zone i are used in part to provide the net surplus required for overall operations. Thus, coupling exit restrictions with price ceilings would have the anticipated double impacts on the zones in which they applied and, through net surplus erosion, on overall coverage.

Summarizing the insights from this analysis, we see the following. As the solvency constraint becomes more stringent (i.e., as ? decreases in (2)) insurers facing no price or exit restrictions will decrease their exposures. How fast exposures x_i will be reduced in each zone depend on marginal marketing and distribution costs and the magnitude of net surplus required over expected losses. If x_i falls far enough, a particular zone may fail to meet the ex ante profit threshold for establishing marketing infrastructure, thus leading companies to be represented in some zones and not others. Profits and presence thus depend in essential ways on the structure of spatially determined costs. For example, it is well known (see Berger, Cummins and Weiss, 1997) that direct writers face cost structures with larger fixed costs F_i and lower variable costs b_i than agency writers. One consequence of this is that, for companies of equal size, we would expect direct writers to exhibit higher variance in both their presence and their exposures across zones than agency writers.

In concluding this formal analysis, it will not have escaped the reader's notice that the key elements driving the structure of optimal insurance portfolios involve complex tradeoffs between the drivers of net surplus required to assure solvency criteria are met, and the structure of regulated prices across zones and marketing cost functions. It is therefore not surprising, in light of this complexity, that modeling companies have assumed such an important role in assisting insurers in the evaluation of the profit and solvency impacts of their exposures.

4. Empirical Analysis of the Florida Homeowners Market

Based on the model developed in Section 3, we consider the demand and supply for homeowners insurance, including coverage for hurricanes, in Florida. The detailed statistical data necessary for estimating supply and demand functions are not yet available. However, we can examine some preliminary data we have already obtained for Florida on insurers homeowners exposure and premiums, by county, for the first quarter of 1998. These data provide some intuitive corroboration for the tradeoffs suggested in Section 3 above.

The presence of economies of scale and spatial economies is reflected by how insurers have distributed their business regionally and within the state of Florida. As discussed above, we believe that there is a cascading series of spatial economies that vary with the specific functions that insurers perform. Certain corporate functions can be efficiently conducted at an insurer's central office, such as high-level management and financial activities, regardless of its proximity to the location of the insurer's policies. Certain other activities are most efficiently conducted at a regional level. These functions might typically include marketing, underwriting, and claims handling. Consequently, it is common for insurers to establish regional offices to conduct these activities. The number and locations of an insurer's regional offices will be influenced by the volume of business it writes in different areas of the country. Additionally, the smaller the insurer, the more likely it is to concentrate its business in fewer regions or states.[10]

Finally, the costs of some activities are significantly affected by an insurer's volume and concentration of business in areas and communities within a state. These activities include the services provided by insurance agents and on-site claims adjustment. Personal lines agents typically operate within a certain defined territory sufficient to generate an adequate volume of business to support their operation. Smaller geographic areas are easier to service in terms of

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[10] This could change if the internet becomes a preferred vehicle for at least some segment of the population in obtaining its homeowner policies. The internet would decouple much of the front end administration costs from geographic factors. Claims processing could still have some local economies of scale associate with it. On the face of it, internet marketing and sales would allow and promote greater diversification in exposures. Notwithstanding its transactions cost advantages, the market is still not very active in homeowners insurance, however, and we do not consider it explicitly here.

face-to-face contacts with insureds and on-site claims adjustment. This induces insurers to concentrate their marketing and sales in areas of a state where they can generate sufficient business to efficiently support their agent force. In effect, establishing the infrastructure to do business in a given area requires a fixed investment, some of which is also sunk. This gives rise to the tradeoffs we discussed in Section 3.

Note that the costs associated with local distribution and claims processing will vary by type of distribution system. In turn, the type of distribution system used by an insurer affects the volume of business necessary to support its agents. An independent agent represents multiple insurers so the amount of business he must write for any one insurer is less than that required to support an exclusive agent. An exclusive agent represents only one insurer and that one insurer must generate a sufficient volume of business to support the agent. Hence, all else equal, insurers utilizing exclusive agents would be expected to write a larger volume and concentration of business within particular communities or areas of a state to support their agent force. However, in reality, exclusive agent insurers tend to be very large to achieve the corporate economies of scale necessary to support the higher fixed costs of its distribution system. The greater size of direct writers may dominate their distribution of business within a state and result in greater uniformity in their market shares among areas than that found for independent agency companies.

Some indication of the significance of costs affected by scale and scope economies and geographic concentration is provide by Table 4.1. Table 4.1 provides a breakdown of insurers' homeowners insurance premiums, losses and expenses (by category). Several expense categories are affected by spatial economies including allocated loss adjustment expense, unallocated loss adjustment expense, commissions and brokerage fees, and other acquisition costs. Together, these categories accounted for 33.7 percent of insurers' direct premiums earned in 1997.

Some costs are more difficult to quantify but are nonetheless important in influencing insurers' market strategies. For example, the cost of information insurers utilizing exclusive agents would be expected to write a larger volume and concentration of business within particular communities or areas of a state to support their agent force. The cost of information also would be expected to influence insurers' geographic volume and concentration of business. The information used by insurers to assess risk, price their products, make underwriting decisions, and adjust claims has a geographic component. Certain risk factors vary by region, state and areas within a state. Insurers must incur certain fixed costs to acquire this information which can be spread more broadly as an insurer's volume of business increases within a geographic area. Additionally, some information can only be acquired by writing policies within a given area. Finally, the greater the volume of exposures that an insurer has in an area, the more statistically credible are the data generated by these policies. This enables an insurer to develop a competitive edge in terms of pricing and underwriting selection.

Another factor that contributes to insurers' geographic concentration is their tendency to differentiate themselves in terms of their pricing, underwriting stringency, quality of service and target markets. For example, some insurers tend to specialize in rural or suburban areas, and others tend to be more dominant in urban areas. Companies also differentiate themselves in terms of writing "preferred risks" (that pass the most stringent underwriting standards), "standard risks" and "non-standard risks". Additionally, some insurers target high-income households while others do not make such a distinction or tend to write more middle and low-income households. [12] As

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[11] This phenomena is reflected in recent redlining lawsuits brought against homeowners insurers. Statistical analysis by plaintiffs indicate that some insurers write relatively more business in suburban areas than in inner-city areas. The plaintiffs contend that this reflects unfair discrimination against urban areas by insurers. However, insurers counter that the geographic distribution of their marketing efforts and business reflects the opportunity to earn greater revenues and profits in suburban areas where household income levels and the amount of insurance purchased are greater.

the economic and demographic characteristics of households tend to vary geographically, this encourages geographic concentration by insurers.

Insurers' spatial economies at various levels interact in influencing the volume of business that they write in specific communities. Insurers can only write policies where homes are located. In order to achieve regional cost efficiencies, an insurer must write business in at least some of the populated areas of a region. For example, an insurer with a concentration in the Southeast may find it necessary to write a significant number of policies in communities along the coast where the majority of people live.

Evidence of spatial economies within a state is presented in Table 4.2. Table 4.2 provides summary statistics on the variation in insurers homeowners market shares (based on direct premiums written) among counties within Florida. This variation is measured by a coefficient of variation (COV) calculated for each insurer. A higher COV indicates that an insurer's business is less uniformly distributed or diversified among counties in relation to the total market in each county. The 231 insurers writing homeowners insurance in Florida were ranked by their COV and divided into quartiles. Table 4.2 indicates that there is considerable variation among each insurer's county market shares. The maximum COV values for the quartiles are 1.3, 2.1, 3.7, and 8.2. The differences in insurer characteristics among quartiles suggest that greater variation in county market shares is associated with larger company size (total countrywide direct premiums written), a larger share of the entire state market, and the use of an independent agency system.

Figures 4.1(a)-4.1(d) provide a stylized picture of the geographic concentration of four insurers, identified as Companies A, B, C and D. The companies are not identified by name but all are among the top 20 writers of homeowners insurance in the state. Each figure maps an insurer s relative market penetration by county. The maps divide Florida counties into five categories reflecting the range of each insurer's market shares. Note, the categorization of counties for each insurer is specific to its range of market shares among all counties. Hence, the maps demonstrate how these four insurers have concentrated their market penetration in various areas of the state. In some counties, an insurer's market share will be minimal or zero, while in others it will be much higher. The maps also indicate some geographic contiguity in the distribution of insurers' county market shares. In other words, for a given insurer, counties where it has a high market share will tend to be more geographically proximate and the same will be true for counties where it has a relatively low market share.

Table 4.3 explores the implications of some insurers' high number of exposures in the three coastal counties in the vicinity of the Miami metropolitan area: Broward, Dade and Palm Beach counties. The dollar amount of exposures for these counties was summed for each insurer and compared to its total policyholder surplus. Insurers with a ratio of exposures to surplus greater than 100 percent are shown in Table 4.3, ranked in descending order of this ratio. The ratio of exposures to surplus plus Florida homeowners premiums also was calculated and shown for each insurer. The names of insurers are excluded from the table.

Caution should be exercised in reviewing these results. We did not have information on insurers' catastrophe reinsurance arrangements so we could not calculate insurers net exposure to losses from a hurricane striking the Miami area. Still, the data do show that some insurers' Miami-area exposures are high relative to their surplus. For example, 22 insurers' Miami exposures were more than 10 times the amount of their surplus. Seventy insurers had exposure/surplus ratios greater than 100 percent. The insurers vary greatly in size and in terms of their overall Florida homeowners premiums. There are some large insurers among the companies with high ratios. Also, newer companies tend to predominate among the companies with the highest ratios. Hopefully, many of these companies are protected by catastrophe reinsurance as suggested by low net retention ratios. However, there is still cause for concern that companies that did not have adequate reinsurance could experience severe financial difficulty if a severe hurricane struck the Miami area because of their relatively high amount of exposures in this area.

Table 4.4 presents the results of a multiple regression analysis of some of the determinants of the degree of variation in insurers market shares across Florida counties. The dependent variable in this analysis is an insurer's market share COV as calculated for Table 4.2. Several explanatory variables were included in the regression equation. SIZE is the log of an insurer s countrywide direct premium written, which is expected to have a negative effect on geographic variation. FLDPW is the log of an insurer s homeowners direct premiums written in Florida, which is also expected to have a negative effect on variation. MUTUAL is a dummy variable equal to one if an insurer is a mutual company. Being a mutual may have a positive effect on variation of mutual companies tend certain markets that are most consistent with their base of policyholder-members.

DIRECT is a dummy variable equal to one if an insurer is a direct writer. This serves as proxy for identifying exclusive agent companies. The source of this information does not distinguish between companies that market insurance through the mail or over the phone from insurers that use exclusive agents. However, most companies identified as direct writers use exclusive agents. As discussed above, all else equal, exclusive agent companies would be expected to have greater market variation (than independent agency companies) because of their greater fixed costs in establishing and maintaining business in a particular area. However, as noted and indicated by Table 4.2, the reality may be that overall economies of scale dominate direct writers' variation in market shares because of their large size.

YEARS is the number of years an insurer has been in business. Older insurers would be expected to have less market variation given their ability to spread fixed costs over time and gradually expand their penetration into new areas. Additionally, several companies have been formed to write Florida homeowners insurance and take policies out of the FLRPCJUA which tend to be concentrated along coastal areas. Hence, YEARS is expected to be negatively associated with market variation.

NETRET is the percentage of gross premiums written that an insurer retains and does not cede to another insurer. An insurer that cedes more of its premiums may be able to afford greater concentration of its business in certain areas without jeopardizing its solvency.

EXPR is an insurer's overall expense ratio. Greater variation in market shares would be expected to be associated with lower expense ratios because of the greater efficiencies provided by market concentration.

The regression model tested was marginally significant with an r-squared of .117 and F-statistic of 3.794. Of the explanatory variables, only FLDPW, DIRECT and NETRET were statistically significant at a 5 percent confidence level. The coefficients for FLDPW and NETRET carried their expected signs, supporting the hypotheses that a smaller Florida market share and the greater use of reinsurance are positively associated with greater variation in county market shares. However, the coefficient for DIRECT was negative, consistent with results in Table 4.2 but counter to the prediction that direct writing will be associated with greater market share variation. Our explanation for this result is direct writers' large size that allows them to achieve more uniform market shares across a state.

In sum, this preliminary review of empirical data tends to support the view that many insurers are not geographically diversified within Florida, but rather tend to have much higher concentrations of business in some areas than others. The uneven distribution of insurers' exposures goes beyond what would be driven the distribution of homes in the state. The fact that insurers market shares vary greatly among counties indicates that other factors drive insurers to concentrate their business even further in certain areas. We believe that cost and competitive considerations underlie this phenomena. Further, regulatory policies impede attempts by insurers to diversify their business in response to the greater understanding of catastrophe risk following Hurricane Andrew. The effects of these regulatory constraints are discussed below.

5. Regulation and Cross-Subsidies

As described in Section 2, states impose a number of regulatory constraints on insurers, particularly states that are experiencing insurance market problems due to catastrophic risk. Two types of constraints are especially relevant to the subject of this paper: 1) constraints on insurers' overall rate level and price differences between insureds with different levels of risk; and 2) constraints on insurers' ability to terminate policies or limit their exposures in high-risk areas. Depending on how they are enforced, these constraints can interact in such a way as to create cross subsidies between low and high risk areas as well increase insurers' vulnerability to insolvency because of rate inadequacy and an excessive concentration of exposures in high-risk areas. How insurers and insureds respond to and are affected by such regulatory constraints depends on several factors, as discussed below.

A key issue of interest is the existence and magnitude of cross subsidies in the homeowners market. We define cross subsidies as differences between loss costs and prices. Then, focusing on the catastrophic coverage in the Florida homeowners market, we present preliminary results on the existence of cross subsidies and we discuss their likely origin in the interaction between regulation and the supply-demand model of insurance presented earlier. The argument is roughly this. Regulation distorts pricing in two ways. The direct effect is simply to undermine the equality between price and expense-adjusted loss costs. The indirect effect is to distort entry and exit decisions in specific territories within the state, as described in Section 3. Estimating the magnitude and direction of these two distortions will be the focus of this section.

In the absence of any regulatory constraints on insurers' adjustments in their portfolio of policies, regulatory suppression of rates will discourage insurers from writing policies, all else equal. Insurers will be disinclined to provide coverage to any homeowner for who they cannot charge an adequate risk-adjusted price. Depending on the severity of the rate inadequacy, insurers may delay policy terminations if they believe that rating constraints are temporary. Because of the fixed costs incurred in selling policies and earning the goodwill of policyholders, insurers will be reluctant to terminate policies if they believe that these fixed costs will exceed their losses from rate inadequacy. If the rate inadequacy is most severe for high-risk insureds, insurers will tend to terminate these insureds first and continue to terminate or non-renew policies as the prospects for regulatory relief dim. This will undermine regulatory efforts to suppress rates and impose cross subsidies.

In an effort to maintain the availability of coverage, regulators may impose restrictions on insurers' ability to terminate or non-renew policies, as they have done in Florida. To the extent regulators are successful in preventing policy terminations, they may be able to achieve cross subsidies from insurers and low-risk insureds to high-risk insureds, at least for a period of time. This regulatory policy also will impede insurers' ability to reduce their exposures in high-risk areas to a safe level, i.e., a level consistent with their target probability of ruin. However, insurers will still be dissuaded from entering areas and writing new business at inadequate rates. Insurers also will be forced to exit a state altogether if severe rate suppression continues indefinitely or if they are unable to achieve and maintain a "safe" diversification of exposures within the state.

There is strong evidence that Florida has sought to suppress rate levels and compress rate structures for homeowners insurance. This is revealed by Figure 5.1 which shows the difference between indicated loss costs and approved loss costs filed by the Insurance Services Office. As can be seen in this figure, the degree of rate inadequacy is higher for coastal rating territories where catastrophic risk is greatest. We would expect that regulatory treatment of individual insurer rate filings would reveal the same kind of pattern.

The extent to which these rating constraints actually result in cross subsidies depends on the effect of underwriting constraints and regulators' ability to prevent insurers from circumventing the rating constraints. We have not yet analyzed data that bears on this question, but there is reason to believe that the rating constraints have imposed some cross subsidy as well as caused other market distortions. Insurers in Florida have not been successful in obtaining regulatory approval to decrease their exposures in high-risk areas to the extent they have requested. At the same time, homeowners in high-risk areas that have had their policies terminated or otherwise needed to buy a new policy, have not been able to purchase coverage in the voluntary market. This has forced Florida's two residual market facilities to absorb these policyholders.

6. Conclusions and Further Research

The problem of catastrophic risk is exacerbated by the uneven geographic distribution of insurers' exposures. Insurers could significantly reduce their potential for correlated losses from a catastrophe by restructuring their portfolios to maximize the geographic diversification of their exposures. However, there are several reasons why this strategy would not be efficient nor realistic. First, homes are not evenly distributed across the country, but rather are concentrated along the east, southern and west coasts that are exposed to hurricanes and earthquakes. Second, because of spatial economies, a given insurer tends to concentrate its business in certain geographic areas, causing its market share to vary widely among geographic areas. This further contributes to a lack of geographic diversification. In the absence of any regulatory constraints, the optimal geographic structure of an insurer's portfolio depends on the tradeoffs between spatial economies, the risk of correlated losses and the cost of risk transfer through reinsurance and other financial mechanisms.

Regulation imposes further constraints on insurers' ability to achieve an optimal geographic distribution of exposures. In high-risk states, such as Florida, regulators have placed restrictions on insurers' rates and ability to terminate policies in coastal areas vulnerable to hurricanes. Rate suppression prevents insurers from charging prices adequate to cover the cost of insuring high-risk properties. This increases insurers' risk of insolvency and undermines their ability to purchase adequate reinsurance to cover their catastrophic risk. Underwriting constraints also impede insurers' ability to restructure their risk portfolios to decrease their concentration of exposures in high-risk areas and lessen their catastrophic risk.

The design of optimal private and public strategies to manage catastrophe risk must consider the cost tradeoffs identified in this paper as well as the impact of regulatory constraints. This paper is a first attempt to explore the nature of spatial economies in insurance and their implications for the geographic distribution of insurers' exposures and vulnerability to catastrophic risk. The implications of regulatory constraints, e.g., on pricing and underwriting, for decisions by insurers attempting to manage these spatial economies are clearly central questions in the catastrophe insurance area. Our work is preliminary and incomplete, but we establish the foundation for a line of research that will ultimately explain insurers' strategies in structuring their risk portfolios and responding to regulatory constraints in the market for catastrophe insurance. A number of political economic puzzles may also emerge for further research, including why cross subsidies appear to exist from a large number of inlanders to a smaller number of beach-front dwellers.[13]

[13] The general "economic" theory of regulation, as articulated by Peltzman (1976), may provide some insights here as the economic interests of coastal dwellers and developers are relatively concentrated compared to the more diffuse economic interests of homeowners who bear the cross subsidy.

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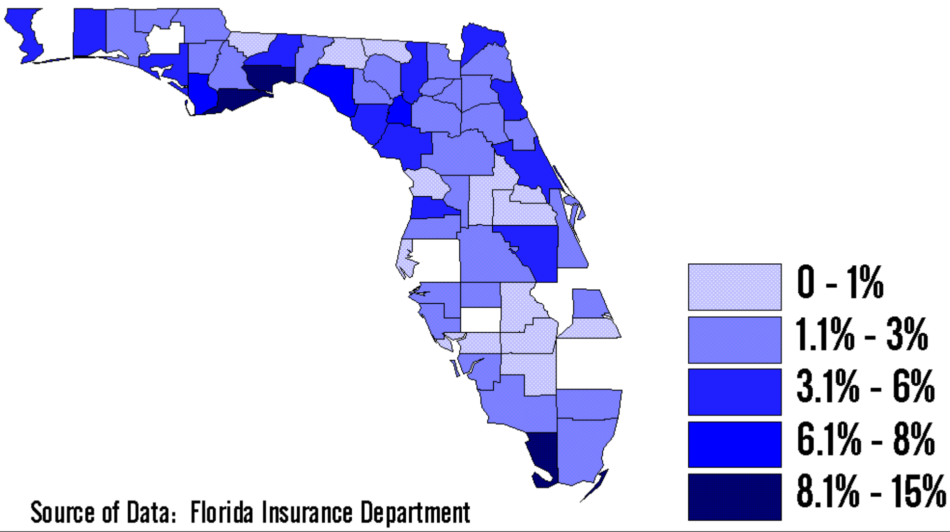
Table 4.1		
Homeowners Multiperil Insurance		
Direct Premiums, Losses and Expenses		
1997		
Item	**$000s**	**% of DPE**
Direct Premiums Written	27,373,559	
Direct Premiums Earned	26,633,249	100.0%
Dividends to Policyholders	101,319	0.4%
Incurred Losses	20,284,614	76.2%
Allocated Loss Adjustment Expense Incurred	1,004,440	3.8%
Unallocated Loss Adjustment Expense Incurred	2,186,639	8.2%
Commission & Brokerage Expense Incurred	3,913,586	14.7%
Taxes, Licenses, & Fees Incurred	687,193	2.6%
Other Acquisition, Field Supervision & Collection Expenses Incurred	1,861,243	7.0%
General Expenses Incurred	1,262,243	4.7%
Other Income Less Other Expenses	52,276	0.2%
Pre-Tax Profit or Loss	(4,612,267)	-17.3%
Expenses Directly Affected by Spatial Economies	8,965,908	33.7%
Source: Best's Aggregates and Averages 1997 (Insurance Expense Exhibit)		

Table 4.2				
Florida Homeowners Insurance				
Market Share by County by Company				
Mean Values by COV Quartile				
Variable	**Ist**	**2nd**	**3rd**	**4th**
Maximum Value	1.332363	2.115972	3.727885	8.198099
Percent Agency Cos	62.1%	81.0%	84.5%	89.5%
Direct Premiums Written	930,916	359,970	329,219	359,757
Net Premiums Written	909,060	340,004	275,855	309,338
Net Retention Ratio	58.60%	59.90%	57.30%	53.20%
Expense Ratio	28.70%	26.60%	35.00%	27.70%
Florida Market Share	1.76%	0.23%	0.11%	0.01%
Coefficient of Variation	0.98943	1.70621	2.80914	5.44064

Table 4.3										
Florida Homeowners Insurance										
Miami Area Exposures 1Q 1998										
RANK	YEAR	RATING	DPW(000s)	NPW(000s)	RET(%)	PHS(000s)	FLDPW($)	Miami Exp($)	%PHS	%PHS+
1	1993	B+	41,666	12,557	30.1	5,964	44,615,648	3,021,046,368	50654.7%	5972.8%
2	1962	B++p	48,889	16,598	34	9,719	18,870,697	1,757,038,824	18078.4%	6145.7%
3	1986	A-g	86,253	-	0	11,338	97,246,397	1,766,365,400	15579.2%	1626.7%
4	1989	B	6,260	3,836	61.3	3,474	4,279,884	523,404,846	15066.3%	6750.2%
5	1993	A-r	99,118	-	0	3,986	33,584,942	449,010,936	11264.7%	1195.1%
6	1936	A-g	105,635	49,252	40.7	113,677	49,380,424	11,153,331,117	9811.4%	6840.1%
7	1996	NR-2	32,181	11,590	22.1	10,158	32,425,131	913,152,075	8989.5%	2144.4%
8	1980	A+p	1,020,786	28,844	2.8	67,505	35,846,127	3,424,581,497	5073.1%	3313.5%
9	1970	A+r	391,931	-	0	34,801	8,629,996	1,567,816,129	4505.1%	3609.9%
10	1953	B++r	46,561	37,809	80.5	7,150	1,351,644	258,329,769	3613.0%	3038.6%
11	1989	B++	24,772	12,807	51.7	6,286	19,582,980	147,117,476	2340.4%	568.7%
12	1988	B++	311,203	121,055	38.9	406,140	289,615,603	9,281,827,184	2285.4%	1334.1%
13	1996	NR-2	5,419	2,476	45.7	3,593	4,705,891	81,242,845	2261.1%	979.0%
14	1997	NR-2	12,584	22,605	93.8	5,728	15,835,991	96,170,638	1679.0%	446.0%
15	1996	NR-2	83,997	70,979	84.5	106,310	38,366,052	1,684,085,394	1584.1%	1164.0%
16	1965	A-g	87,498	23,225	26.3	31,509	1,351,691	476,286,447	1511.6%	1449.4%
17	1989	B++u	46,133	40,449	87.7	26,752	1,593,556	347,395,000	1298.6%	1225.6%
18	1970	NR-2	11,283	10,702	92.5	9,221	11,549,589	106,678,100	1156.9%	513.6%
19	1935	A	8,695,245	8,004,456	91.7	5,125,298	545,498,281	56,390,387,443	1100.2%	994.4%
20	1979	B++	23,633	6,923	29.3	8,105	24,824,920	86,518,300	1067.5%	262.7%
21	1996	NR-2	28,066	6,052	19.8	5,055	2,715,096	53,939,139	1067.0%	694.2%
22	1986	A-	51,414	48,498	80.5	15,755	7,509,736	160,592,400	1019.3%	690.3%
23	1957	A+g	156,628	159,170	97.5	64,794	7,294,634	567,887,551	876.5%	787.8%
24	1984	B-g	76,104	32,976	43.3	13,389	4,901,688	104,509,280	780.6%	571.4%
25	1974	A-g	66,403	135,259	86.7	94,795	27,308,781	730,804,570	770.9%	598.5%
26	1978	NR-3	6,610	(1,817)	-24.8	24,539	486,753	179,203,390	730.3%	716.1%
27	1981	A+r	144,196	14,217	9.9	15,463	1,370,389	112,549,210	727.9%	668.6%
28	1979	A-	150,264	37,592	25	37,452	2,184,058	267,765,687	715.0%	675.6%
29	1968	Ap	420,989	165,342	39.3	205,529	22,828,397	1,400,257,580	681.3%	613.2%
30	1919	B+	58,480	(4,907)	-8.6	33,608	3,331,567	222,929,122	663.3%	603.5%
31	1956	B+	35,923	13,157	30.4	9,597	5,389,521	63,181,604	658.3%	421.6%
32	1982	Ap	168,627	37,730	22.4	28,515	2,611,467	178,184,899	624.9%	572.5%
33	1980	A+p	96,231	28,844	30	29,627	14,395,061	182,830,270	617.1%	415.3%
34	1908	A+p	3,461,434	578,482	16.7	702,050	38,529,738	4,069,773,614	579.7%	549.5%
35	1934	A+p	2,078,699	923,867	44.4	1,023,620	112,671,533	5,900,407,451	576.4%	519.3%
36	1987	B+	14,738	10,507	71.3	4,705	150,447	21,302,599	452.8%	438.7%
37	1989	A+p	53,173	5,785	10.9	15,370	775,761	67,056,250	436.3%	415.3%
38	1981	A+p	167,799	30,990	18.5	46,626	349,308	202,113,000	433.5%	430.3%
39	1910	Ap	719,424	566,824	78.8	685,842	30,762,588	2,679,968,579	390.8%	374.0%
40	1968	C+	87,480	43,873	50.2	14,383	901,595	52,375,480	364.1%	342.7%
41	1930	Ap	60,994	39,010	63.4	20,469	2,151,001	66,649,650	325.6%	294.6%
42	1972	A-g	1,071,319	1,064,024	90.6	945,752	32,106,760	2,953,623,559	312.3%	302.1%
43	1954	A-g	281,249	253,264	88.7	341,003	9,058,628	1,064,551,000	312.2%	304.1%
44	1963	A	109,507	74,656	64.4	97,890	1,587	302,777,600	309.3%	309.3%
45	1979	A	24,150	20,501	84.9	25,580	1,074,332	78,106,518	305.3%	293.0%
46	1968	A++g	1,482,763	1,642,477	97.2	879,659	29,704,669	2,632,217,950	299.2%	289.5%
47	1982	Ap	25,380	6,667	26.3	8,618	10,026,990	23,742,705	275.5%	127.3%
48	1938	A+g	312,286	218,747	68.8	168,502	16,516,558	429,506,800	254.9%	232.1%
49	1928	A+p	216,372	98,127	45.4	70,931	838,010	175,546,000	247.5%	244.6%
50	1967	A+r	334,967	33,075	9.8	34,177	1,676,804	79,657,803	233.1%	222.2%
51	1935	Ap	320,831	139,995	43.6	137,191	1,934,198	304,309,806	221.8%	218.7%
52	1989	B+	6,816	4,849	71.1	5,188	75,182	11,003,500	212.1%	209.1%
53	1988	Ap	97,351	1,317	1.4	11,525	956,218	23,730,460	205.9%	190.1%
54	1996	NR-2	53,467	25,658	44.4	11,814	55,712,213	24,154,880	204.5%	35.8%
55	1972	Ap	865,839	1,149,219	92.2	868,539	18,426,660	1,514,818,455	174.4%	170.8%
56	1987	NR-3	42	39	94.3	5,011	523,494	7,883,000	157.3%	142.4%

Figure 4.1(a)

Company A Market Share by County
Florida -- 1st Q 1998

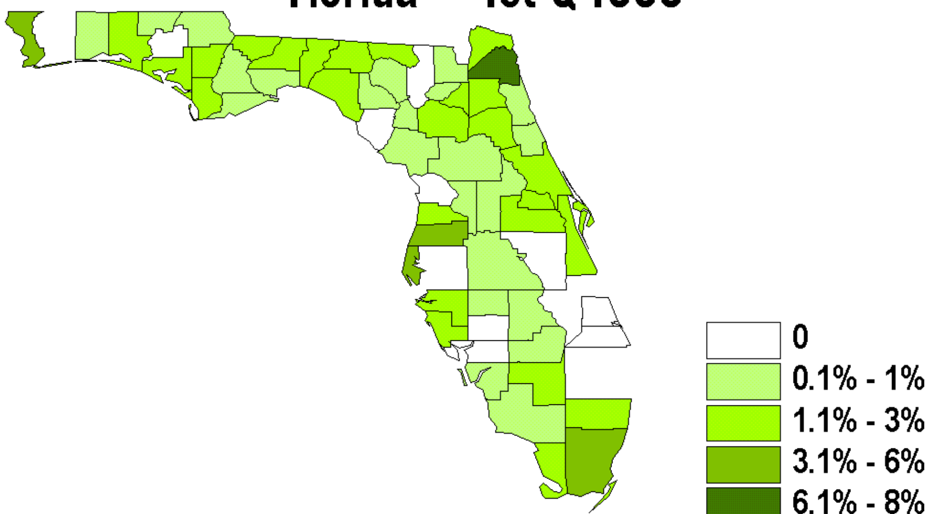


Source of Data: Florida Insurance Department

Figure 4.1(b)

Company B Market Share by County

Florida -- 1st Q 1998



Source of Data: Florida Insurance Department

Figure 4.1(c)

Company C Market Share by County
Florida -- 1st Q 1998

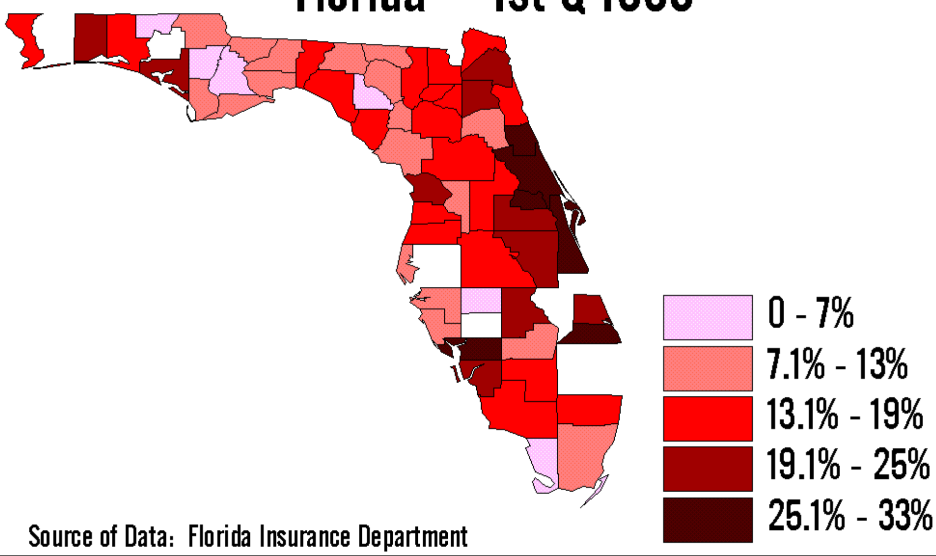
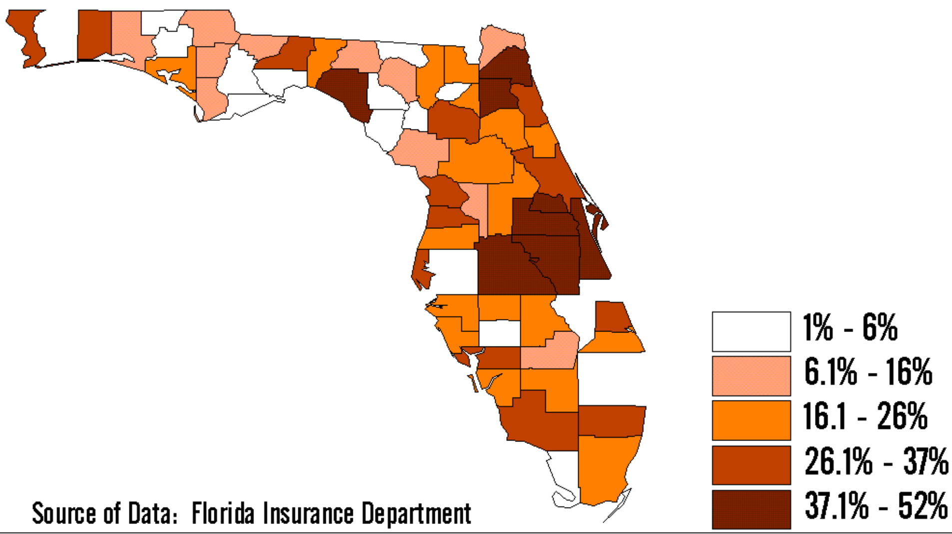


Figure 4.1(d)

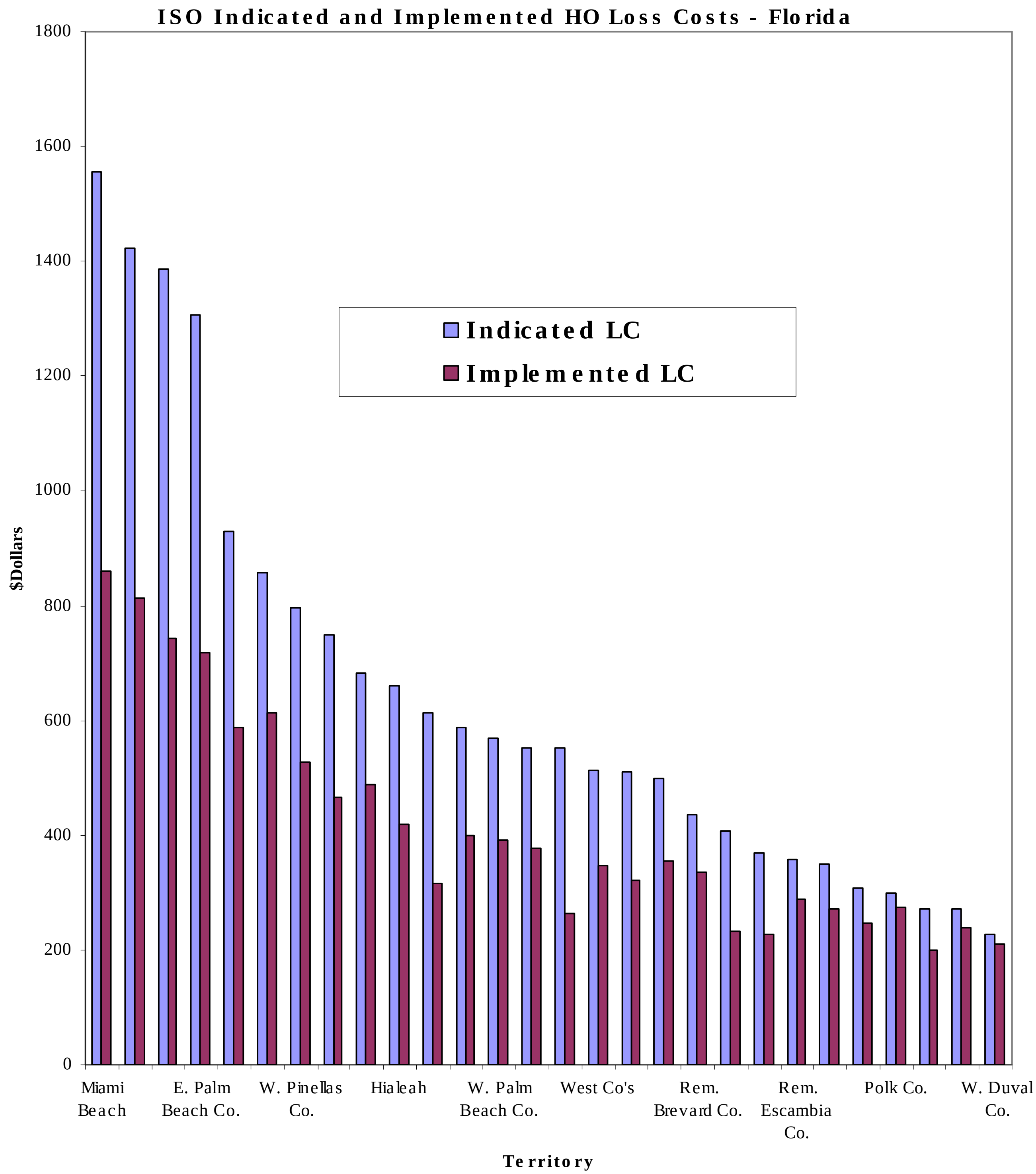
Company D Market Share by County
Florida -- 1st Q 1998



Source of Data: Florida Insurance Department

Table 4.4		
Regression Analysis of Market Share Variation		
Ordinary Least Squares		
Dependent Variable: Florida Market Share COV		
Variable	**Coefficient**	**T-Statistic**
Intercept	2.769259188	12.465
SIZE	9.42168E-12	0.098
FLDPW	-6.43883E-09	-2.563
MUTUAL	0.280538079	0.859
DIRECT	-0.752735749	-2.695
YEARS	0.002091183	0.788
NETRET	-0.006160439	-1.959
EXPR	0.000550733	0.170
R2	0.117	
F-Statistic	3.794	
N	208	

Figure 5.1


ISO Indicated and Implemented HO Loss Costs - Florida
1800
1600
1400
1200
1000
800
600
400
200
0
$Dollars
Indicated LC
Implemented LC
Miami Beach
E. Palm Beach Co.
W. Pinellas Co.
Hialeah
W. Palm Beach Co.
West Co's
Rem. Brevard Co.
Rem. Escambia Co.
Polk Co.
W. Duval Co.
Territory