Conditions for Captive Insurer Value: A Monte Carlo Simulation

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Abstract: We construct two potential scenarios to depict the cash flows from the operation of a captive insurer. We then use Monte Carlo simulation to identify conditions that are sustainable in practice and under which captives have a high probability of creating positive shareholder value. We use realistic value ranges for both a class 1 Bermuda captive and a British Virgin Islands (BVI) general captive. On average, captives have a low probability of generating shareholder value. This outcome is consistent with much of the literature regarding captives. Well-managed captives, however, have an extremely high probability of generating value for their shareholders—even without favorable tax treatment. A well-managed captive is incorporated in the least costly captive jurisdiction during a soft insurance market, but remains dormant until a hard insurance market. The parent self-manages the captive's operations and uses non-cash assets to satisfy the captive's regulatory capital requirements while dormant; the captive calls for little reinsurance. Captives of parents with low systematic risk have the highest probability of generating shareholder value even when the captive invests conservatively. [Key words: captive, value, simulation]

INTRODUCTION

"Captive Growth Cools as Market Options Rise." This is the headline on page 11 of the March 6, 2006 issue of *Business Insurance*. On page 18, another headline reads "Hardening Market May Boost Bermuda Captives." These headlines suggest two divergent views on the future prospects of captive insurers. Such contrasting views reflect a general sense of disagreement on whether captive insurers actually benefit their owners.

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Paul Hopkin, Director of Risk Management for the Rank Group, for example, questions the benefits of his own captive in the January 2005 issue of *InfoRM*. Hopkin's article incited much debate, eliciting responses from *Captive Insurance Company Reports* (February 2006 issue), from Hugh Rosenbaum in an editorial published by *Captive.com* (February 24, 2005 issue) and from *Captive & ART Review* (August 2005 issue).[1] Hopkin's argument can be condensed into two themes: Captives do not reduce the parent's risk, and captives are expensive risk management tools. The rebuttals similarly center on two themes: Captives do reduce the parent's risk, and captives are not expensive risk management tools. A lack of empirical consensus makes it difficult to evaluate such views, especially since issues of a captive's risk and taxes are intertwined as Lai and Witt (1995) and Han and Lai (1991) explain. Most of the available evidence comes from event studies which examine whether the establishment of a captive insurer generates value for its shareholders. These event studies offer limited conclusions.

The use of a captive insurer adds value to shareholders only when the present value of the captive's net cash flow is positive. In this study, we construct two potential scenarios to depict the cash flows from the operation of a captive insurer. Using the Monte Carlo method, we then simulate a broad range of realistic data to identify sustainable conditions that allow captive insurers to generate positive shareholder value.

VALUE SOURCES FOR A CAPTIVE INSURER

Evidence on Captive Value

Event studies examine how a firm's stock price reacts to a particular bit of news. Cross, Davidson, and Thornton (1986, 1988), Diallo and Kim (1989), and Adams and Hillier (2000) all use event studies to examine whether the establishment of a captive insurer creates value for its shareholders. The event date in these studies is the date the parent announces or incorporates the captive insurer. On this date, market participants learn that a captive has been established. The parent company's stock price reacts depending on how this information is viewed. Event studies test the statistical significance of a stock's cumulative abnormal return, or the difference between observed return and the expected return, aggregated over time. The use of event studies to investigate whether the establishment of a captive insurer increases a firm's value does, however, involve several challenges.

One of these challenges is that the intention to establish a captive is often revealed prior to the official announcement or incorporation of the captive. For example, trade publications often predict (with amazing accuracy) captive announcements or incorporations. Bermuda, the largest captive domicile, requires that an advertisement appear in the local press communicating the intention to establish a captive insurer. This communication of intention precedes the official announcement and subsequent incorporation of the captive by several weeks. Another event study challenge is that, in relation to the overall value of the parent, the value a captive represents is often comparatively small. As a result, the establishment of a captive insurer, though it may represent value, may not represent value high enough to move the parent's stock price on the event date. Additionally, incorporation of a captive does not necessarily indicate that the captive will be used. Anecdotal evidence suggests that while many parent firms incorporate captive insurers, the captive remains dormant until needed. Thus, market participants may ignore the announcement or incorporation of a captive and rely instead on reports issued by the trade press of actual coverage placed with a captive.

Until 1977, under United States (US) law, the parent's insurance premium to the captive was tax deductible. The Internal Revenue Service (IRS) then issued revenue ruling 77-316. This ruling was a first attempt by the IRS to disallow the tax deductibility of the premium paid by the parent to its captive. Cross, Davidson, and Thornton (1986) use a sample of 93 captive insurers to examine whether the formation of a captive creates value for its parent under this ruling. They do not specify whether *formation* refers to the announcement date or the incorporation date of the captive. Given the source of the data, however, the study is likely to have used a captive's incorporation date. Of the 93 captives, 67 were formed before revenue ruling 77-316, 17 were formed the year of the ruling, and nine were formed the year after the ruling. The authors report results only for their total sample of 93 captives. The study finds a positive cumulative abnormal return of 2 percent for the interval from the event date to 30 days after the event date. The cumulative abnormal return drifts upwards during this interval, which is consistent with an environment where interested market participants learn the news of a captive's establishment at various points during the interval, rather than on one specific day.

In a follow-up event study in 1988, the same authors use a sample of 54 captives formed six months before revenue ruling 77-316. They find a negative cumulative abnormal return of 8 percent for the interval of 90 days before the event date to the event date, and a negative cumulative abnormal return of 4 percent for the interval from the event date to 90 days after the event date. The results of Cross, Davidson, and Thornton (1986, 1988), taken together, suggest that market participants view the tax deductibility of premium payments to the captive as value- enhancing. Unfortunately, we cannot net out the results of the two studies because the 1986 study includes captives formed before, during, and after revenue ruling 77-316. Thus, it is not possible for us to determine whether participants view tax deductibility as the captive's only valuable feature or as one of several valuable features.

Diallo and Kim (1989), as well as Adams and Hillier (2000), also use event studies to examine whether the establishment of a captive creates value for its parent. Their event date is again the incorporation date of a captive insurer. Diallo and Kim (1989) separate their sample into two groups based on incorporation date. One group includes 46 captives incorporated prior to revenue ruling 77-316, while the second group includes 24 captives incorporated after the ruling. They conclude that, around the event date, the share value of the captive's parent remains unchanged even though the cumulative abnormal return displays a non-significant negative drift. Diallo and Kim (1989, p. 249) point out that "an amount negligible to all stockholders together may be significant for a handful of managers" and contend that "the welfare gain derived from the creation of captives most likely goes to the managers of parent firms."

Adams and Hillier (2000) use a sample of 120 captives incorporated by firms in the United Kingdom (UK). They find a negative cumulative abnormal return of less than 1 percent for the interval from the event date to three days after the event date. This result suggests that shareholders view captive insurers as detrimental to value. Adams and Hillier (2000) offer two possible explanations for their finding. One explanation is that reduced tax benefits for UK captives after the passage in the UK of the 1984 Finance Act in conjunction with the captives' inefficient use of reinsurance, and lack of expertise in using captives, prevents realization of the possible advantages of captives. Another explanation is that managers form captives to enhance their own consumption of perquisites. Indeed, Scordis and Porat (1998), using a sample of 3,978 observations of US firms, find that firms with captive insurers are more likely to have heightened manager-owner conflicts than firms that do not form captives. Heightened manager-owner conflicts make it easier for managers to engage in activities that create value for them rather than value for their shareholders.

Tax Treatment

There is a long debate on whether premiums paid to a captive insurer by its parent should be deducted from the parent's federal taxes. Lai and Witt (1995) and Han and Lai (1991) review and critically evaluate early arguments in this debate. Their evaluation suggests that tax benefits should be proportionate to the amount the parent's idiosyncratic risk contributes to the parent's total risk as a result of the captive's formation. This debate continue to be relevant today, because some suggest that it is still possible for a parent to deduct from its taxes the premium it pays to its captive insurer. For example, Wealth Management Solutions (WMS), a consultancy based in New Jersey, advertises that establishing a captive insurer will "result in a reduction of Federal and State Taxable Income in the amount of [the] annual premium deductions, up to $1.2 million a year."[2] This consultancy bases its claim on the assumption that it can generally apply a private IRS ruling even though private rulings do not create precedent. Elliott (2005a, 2005b, 2005c, 2006) examines in detail the position the IRS has historically taken on the taxation of captive insurers.

Three revenue rulings issued by the IRS in 2002 clarified what constitutes acceptable captive insurer arrangements for tax purposes. They also provided definitive guidance on the tax treatment of captives. In addition, the IRS announced that in certain cases it would consider issuing private rulings on the tax situation of captive insurers (such as the one obtained by WMS). The latest IRS guidance on captives, issued in 2006, holds that to qualify for insurance tax treatment, there must be *risk-shifting* and *risk-distribution*. In this guidance the IRS provides several scenarios to demonstrate its interpretation of risk-shifting and risk-distribution. Simply put, if it operates as a *bona fide* insurance company, including being regulated by a state, a captive insurer qualifies for the same tax treatment as any other insurance firm. It therefore seems unlikely that a single-parent captive, the most common type of captive insurer, qualifies for insurance tax treatment.

Garven (1987) advances the hypothesis that convex effective tax schedules create the opportunity for insurers (including captive insurers) to allocate unused tax shields by purchasing reinsurance. This hypothesis was further developed by Garven and Louberge (1996). The empirical findings of Garven and Lamm-Tennant (2003), however, do not support this hypothesis. Adiel (1996) is also unable to verify that insurance firms adjust their reinsurance purchases as a function of their tax rates. In addition, books written by well-respected practitioners of alternative risk transfer (ART), such as Culp (2002) and Lane (2002), do not document any tax benefits resulting from the combination of a firm's convex marginal tax schedule and the use of a reinsurance/ART arrangement.

Furthermore, empirical evidence raises questions regarding the practical benefits of convex tax schedules. Graham and Smith (1999) map the effective tax function of 80,000 firms and find that, out of all of the firms, only half actually have a convex effective tax function. Of those firms facing a convex tax function, only one-quarter have potential tax savings from hedging. Such tax savings, however, are substantial only in a small number of cases. For the other cases the tax savings are not material. In a follow-up paper, Graham and Rogers (2002) find no evidence that firms with convex tax schedules actually reduce their expected tax liability by managing risk.

This is because the convexity of the tax function is largest at low levels of income.

Reduced Costs, the Use of Reinsurance, and Flexibility

Compared to US commercial insurers, captive insurers operate with lower expense ratios. The A.M. Best Rating Company in *BestWeek* (November 7, 2005) reports the average underwriting expense ratio of non-US-domiciled captives over the years 2000 to 2004 at 15.9 percent. By comparison, over the same period, A.M. Best reports the underwriting expense ratio of the US commercial insurance industry at 27.2 percent. All other things being equal, a captive insurer is able to provide insurance coverage to its parent at a lower cost than a commercial insurer. Another possible cost benefit of a captive insurer is reduced moral hazard costs during the insurance transaction. According to Smith and Stutzer (1995) and Lee and Ligon (2001), reductions in moral hazard costs occur because the parent fully participates in the loss experience of the captive.

The investigations of Meier and Outreville (2006) and of Weiss and Chung (2004) on the underwriting cycles of reinsurance firms suggest that price of coverage in the reinsurance market does not move in perfect step with price in the primary insurance market. It is possible, then, to obtain different prices on similar coverage in the reinsurance and insurance markets. This creates an arbitrage opportunity, a situation where firms possessing captive insurers can easily shop for the best price across two markets. Parents, however, seem to utilize the captive mostly as a retention device. The average Bermuda single-parent captive ceded 23.8 percent of its premiums (up from 17.4 percent in 2003) to a reinsurer in 2004.[3] That same year, commercial insurers filing Form 10-K with the US Securities and Exchange Commission ceded 40.0 percent of their premiums.

Anecdotal evidence suggests that a captive insurer provides flexibility for its parent company. When soft insurance market conditions prevail, the captive continues to focus on the accumulation of funds. When the insurance market hardens, these accumulated funds allow the captive to retain a larger proportion of its parent's risks. Furthermore, if commercial primary insurers refuse to cover certain risks, the captive's parent can insure these risks with the captive. Additionally, the ability to use a captive as an alternative may actually help the parent obtain better coverage terms and lower rates with commercial insurers. Over time, such flexibility reduces the parent's exposure to the insurance market cycle. Thus, by creating choice for the parent, the captive becomes a source of value. One way to quantify such value is to treat the captive decision as a real option.

Myers (1977) introduced academic audiences to the idea of real options but limited his introduction to viewing a firm's discretionary investment opportunities as growth options. In addition to the option noted by Myers, discretionary investment opportunities may also include options to defer, options to default, options to contract, options to abandon, or options to switch use (Trigeorgis, 1999). Myers (1977, 1984, 1987) proposed techniques similar to those used with financial options to value real options. These techniques are no longer preferred in real option valuation. In 1964, a series of articles in the *Harvard Business Review* proposed the use of simulation and decision tree analysis to capture the value of future operational flexibility. This is now the preferred approach to valuing real options. A binomial tree is used to determine the cash flows and probabilities associated with the each future choice. The net present value for each end-point on the binomial tree is calculated, and these end-point values are discounted to the present (Brandão, Dyer, and Hahn, 2005; Smith, 2005). Monte Carlo simulation allows for a practical application of this approach.

A MODEL FOR A CAPTIVE'S FLOW OF FUNDS

Commercial insurers are commonly thought of as leveraged investment trusts (*The Economist*, 1999). Leverage is underwriting leverage rather than traditional financial leverage such as interest-carrying debt. Similarly, the captive insurer can be thought of as an investment fund set up by the parent firm. To fund the captive, the parent firm must forgo the alternative use of investing these funds in its non-captive operations. If the captive does not have enough money to pay losses, the parent borrows funds to cover those losses; the captive may even decide to cede a part of its premium to a reinsurer. The reinsurer has a small probability of default. Each of these decisions results in either a cash inflow or outflow for the captive. The captive insurer generates value for its parent's shareholders when the net present value of these cash flows, discounted at the parent's cost of equity capital, is positive. We examine these decisions by arranging them in two scenarios.

Figure 1 depicts each of these cash flow scenarios. The main difference between the first and second scenario depicted in Figure 1 is that in the first scenario, the captive incorporates at time (t) but only commences operation at time (t+1) if a hard insurance market exists. By comparison, in the second scenario, the captive simultaneously incorporates and commences operation at time (t). The first scenario accounts for flexibility in the decision to use a captive insurer.

We fit distributions to our historic data using a chi-square test, the most widely used goodness-of-fit test. It is based on a comparison of the historic data with the values expected to be drawn from the distribution. An

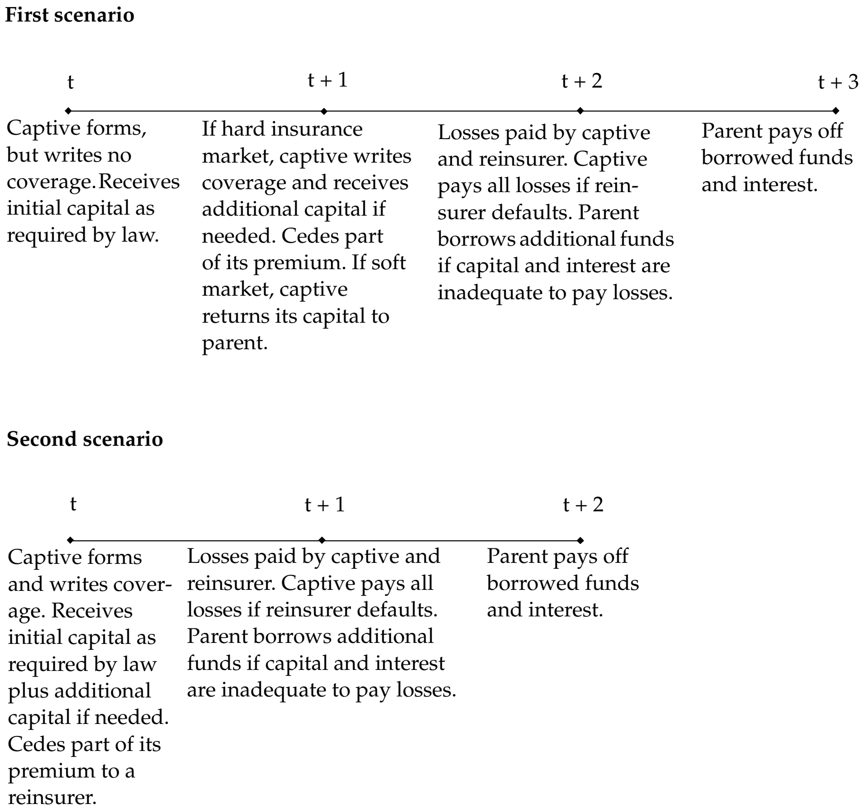

Fig. 1. A captive's flow of funds.

attractive feature of the chi-square goodness-of-fit test is that it can be applied to any univariate distribution for which we can calculate the cumulative distribution function.

We use the Monte Carlo simulation method, a general technique of numerical integration developed by Metropolis and Ulam (1949), to evaluate each scenario. To integrate a function over a complicated domain, Monte Carlo simulation selects random values over a simple domain that is a superset of the complicated domain. It checks whether each value is within the complicated domain and establishes the area of the complicated domain as the area of the simple domain multiplied by the fraction of values falling within the simple domain. The values are randomly selected from the distributions specified for each of the captive's cash flows. We use realistic data taken from the marketplace to establish these distributions.

Such empirical distributions are customary in modeling operational risks (Panjer, 2006). Our historic data consist of annual observations, or monthly observations converted to annual values when annual values are not available.

For the scenarios depicted in Figure 1, we draw 20,000 random values from each of the fitted distributions. We correlate the drawing of values from each distribution to avoid senseless combinations, like a rate of return on BBB-rated debt that is equal to or below the risk-free rate. These correlations also preserve the relative difference between values, such as the relationship between the simulated risk-free rate and its corresponding simulated market return. Each set of random values is one iteration in the simulation process. For each iteration, we discount the captive's net cash flow to time (t) using the parent's cost of equity capital. We collect these discounted net cash flows to obtain a distribution. The area under the distribution associated with positive net present values corresponds to the probability that a captive generates value for its shareholders. We report this probability, and the data assumptions associated with it, in Tables 1a, 1b, 2a, 2b, and 2c.

Bermuda is the most popular domicile for captive insurers. It categorizes single-parent captives as Class 1. To incorporate a Class 1 Bermuda captive, the parent firm must pay a fee of $4,000. The parent also needs to capitalize the captive with an initial sum of $120,000. In Bermuda, regulation requires local representation for the captive, facilities to hold annual meetings, and locally licensed professionals who can provide the captive with legal representation, investment-reporting services, actuarial audits, and accounting audits. Third-party management firms, for a percentage of the captive's premium, provide these facilities and services to Bermuda captives. According to a November 7, 2005 edition of *BestWeek*, the expense loading for a sample of captives (most of them single-parent captives domiciled in Bermuda) averaged 15.9 percent over the years 2000 to 2004. This average value is the only information we can obtain. We represent this average expense loading as a uniform distribution truncated at 11 and 21 percent of the pure premium. The mean and median values for the distribution are 16 percent.

Anecdotal evidence from captive insurance managers in Bermuda suggests that even if a parent does not place coverage with its captive, a minimum management expense of around $8,000 will still be required. By comparison, in the British Virgin Islands (BVI) the incorporation fee for a general captive (the BVI designation for a single-parent captive) is $2,600 and the minimum required capital is $100,000. There are simpler regulatory requirements in the BVI and no requirement for local legal representation or presence. For this reason, third-party management firms are willing to manage a BVI general captive for a flat fee that begins around $15,000.

As in Scordis and Porat (1998), we represent the commercial insurance market cycle by the combined ratio of the property-liability insurance industry. A combined ratio below one plus the risk-free rate indicates a soft market, while a combined ratio greater than one plus the risk-free rate suggests a hard market.[4] We simulate values for the combined ratio with an inverse Gaussian distribution truncated at a combined ratio of 0.8 and 1.2. These are the smallest and largest values of the industry's combined ratio for the years 1975 to 2005. The mean and median values for the distribution are 1.11 and 1.09, respectively. We obtained industry combined ratios from the A.M. Best Company.

The pure premium the captive receives at the beginning of a period is the discounted value of the expected loss at the period's close. The expected loss represents the historic average loss for commercial property insurance lines in the United States indexed by premiums during the years 1975 to 2005. The expected loss is $727,000 and its standard deviation is $12,000. This span of years includes periods of both favorable and unfavorable economic conditions for the captive. We use data compiled after 1975 because there was a substantial change in reporting format that year. For this reason, we are unable to reconcile loss data compiled prior to 1975 with loss data compiled after 1975. We discount the expected loss using the annualized risk-free rate. We simulate values for the risk-free rate with a normal distribution truncated at 1 and 19 percent, the smallest and largest values (rounded to significant figures) for the years 1975 to 2005. The mean and median values for the distribution are 7.9 and 7.2 percent, respectively. We obtain annualized risk-free rates from monthly rates reported on the Center of Research on Security Prices (CRSP) database.

In addition to the expense loading and pure premium, the captive also receives an actuarial risk loading. We use a conventional statistical technique, commonly found in actuarial training manuals, to establish this risk loading.[5] To establish this risk loading, we use the historic average loss and its standard deviation. We cannot determine a ruin probability for the captive. We therefore assume a ruin probability between 0 and 5 percent. We also assume that the captive will earn the market rate of return by investing its funds. We approximate the market return using the return on the S&P 500. We simulate market return values using a normal distribution truncated at –22 and 37 percent, the lowest and highest rates of return for the S&P 500 (rounded to significant figures) for the years 1975 to 2005. The mean and median values for the distribution are 11.7 and 12.3 percent, respectively. We obtain the annualized return for the S&P 500 from monthly returns reported by the CRSP database.

We also use a simulated risk-free rate and its corresponding simulated market return to estimate the parent's cost of equity capital. We estimate the cost of equity capital using the Capital Asset Pricing Model (CAPM). To use the CAPM, we require not only the risk-free rate and market return, but also the beta of the firm's equity. We simulate values for the firm's beta with a loglogistic distribution truncated at 0.49 and 3.04. These are the smallest and largest values of beta (rounded to two decimal places) for firms tracked by Value Line in 2005. Value Line reports historic betas for over 7,000 US firms from all industries. The mean and median values for the distribution are 1.1 and 0.9, respectively. We do not have Value Line data for any year prior to 2005.

The pure premium, the expense loading, and the risk loading equal the gross premium. Gross premium less reinsurance ceded equals the net premium. According to the Bermuda Monetary Authority, the average single-parent captive ceded 23.8 percent of its gross premium to a reinsurer in 2004. This average is the only information we can obtain. Thus, we represent the premium ceded to a reinsurer as the average of a uniform distribution truncated at 10 and 38 percent. The mean and median values for the distribution are 24 percent.

According to Bermuda regulations, if the net premium is less than $6 million, the captive must hold capital that is the greater amount of either $120,000 or 20 percent of net premium. If the net premium is more than $6 million, the captive must hold the greater amount of either $120,000 or $1.2 million plus 10 percent of net premium. By comparison, if the net premium of a BVI general captive is less than $500,000, the captive must hold $100,000 in minimum regulatory capital. If the captive's premium is over $500,000 but less than $5 million, the captive must hold 20 percent of its net premium in capital. If the net premium is more than $5 million, the capital must equal $1 million, plus 10 percent of any net premium over $5 million.

When losses occur one period after the captive receives a premium, the captive and reinsurer pay losses in proportion to the amount they receive. We simulate losses with a logistic distribution truncated at zero. This distribution is based on the annual loss, per dollar, of premium for US commercial property insurance lines as reported by the A. M. Best Company for the years 1975 through 2005. The mean and median values for the distribution are $729,000. If the reinsurer defaults, then the captive pays all losses.

We allow the reinsurer's probability of default to vary between 0.02 and 0.5 percent. These default probabilities correspond to average default probabilities reported by the A. M. Best Company for insurers rated A++ to B+. If the captive's accumulated capital is less than the losses the captive must pay, the parent borrows the needed funds. We simulate values for this cost using rates for seasoned BBB-rated corporate debt. We simulate these rates with a lognormal distribution truncated at 6 and 19 percent, the lowest and highest rates (rounded to significant figures) for the years 1975 to 2005, respectively. The mean and median values for the distribution are 9.5 and 9.1 percent. We obtain the cost of BBB-rated bonds from the Federal Reserve Economic Data (FRED) series available from the Federal Reserve Bank of St. Louis.

One period after losses are paid, the parent must also repay any borrowed funds and interest. The interest is tax deductible at the parent's effective corporate tax rate. We simulate the effective tax rate with a beta general distribution truncated at 0 and 40 percent, the smallest and largest effective tax rates (rounded to significant figures) for each of the firms tracked by Value Line. The mean and median values for the distribution are 18.8 percent.

RESULTS

All simulations are identical except for the variable we investigate. For example, to investigate how the use of reinsurance influences the probability of positive shareholder value we run four simulations where we allow all variables to vary along the distributions we specify, except the percentage of premiums ceded. First, we assume no premiums ceded, then we assume premiums ceded to be 10 percent, then 20 percent and then 30 percent. We are able to replicate the exact sequence of the variables we allow to vary in all simulations by consistently using the same seed to generate random numbers. The seed is an integer that defines the starting point for generating a series of random numbers. A unique seed returns a unique random number sequence. In turn, this random number sequence determines which values in the distributions we specify are sampled. By using the same seed, we sample identical values in each simulation. Thus, we are able to determine how changes in premiums ceded (and the other variables we similarly manipulate) influence the probability of positive shareholder value. It should be noted that we replicate our simulations using a different seed to generate random numbers. The results are almost identical.

Table 1a shows the results of our sensitivity analysis conducted under Bermuda regulations. Table 1b shows the results of our sensitivity analysis conducted under the regulations governing a BVI general captive. In Table 2a, Table 2b, and Table 2c, we report simulated results for only the first scenario and only those attained under regulations governing a BVI general captive. We continue using the same seed to generate random

Table 1a. Sensitivity Analysis of the Probability of Positive Value to Shareholders.[a] Capitalization Rules for a Bermuda Class 1 Captive

		Probability of positive value in percent	
		First scenario	Second scenario
All inputs change		0.04	0.02
Premiums ceded held at	zero	0.50	0.36
	10 percent	0.10	0.05
	20 percent	0.03	0.02
	30 percent	0.01	0.00
Management fees held at	zero	5.00	0.12
	10 percent	0.03	0.02
	20 percent	0.02	0.01
Captive ruin probability held at	1 percent	0.04	0.02
	5 percent	0.04	0.02
Reinsurer ruin probability held at	1 percent	0.04	0.02
	5 percent	0.04	0.02
Cost of borrowed funds held at	5 percent	0.04	0.04
	10 percent	0.04	0.04
	15 percent	0.03	0.02
Captive's investment return held at	5 percent	0.06	0.03
	10 percent	0.07	0.03
	15 percent	1.71	0.04
Return to shareholders held at	5 percent	21.33	1.13
	10 percent	13.75	0.11
	15 percent	7.66	0.01

[a]20,000 iterations

numbers. We select which values to keep constant according to their sustainability and realism. While we agree that the favorable tax treatment of a captive insurer increases the probability of positive shareholder value, our results indicate that a captive can achieve substantial probabilities of positive shareholder value even without favorable tax treatment.

Not surprisingly, the probability of positive shareholder value is generally higher in the first scenario. This is due to increased flexibility in the

Table 1b. Sensitivity Analysis of the Probability of Positive Value to Shareholders[a]
Capitalization Rules for a British Virgin Islands Captive

		Probability of positive value in percent	
		First Scenario	Second Scenario
All inputs change		0.12	0.10
Premiums ceded held at	zero	10.11	2.29
	10 percent	10.11	0.53
	20 percent	10.10	0.04
	30 percent	10.08	0.01
Management fees held at	zero	5.00	0.12
	$15 thousand	0.12	0.10
	$30 thousand	0.07	0.06
Captive ruin probability held at	1 percent	0.12	0.10
	5 percent	0.12	0.10
Reinsurer ruin probability held at	1 percent	0.12	0.10
	5 percent	0.12	0.10
Cost of borrowed funds held at	5 percent	0.12	0.19
	10 percent	0.12	0.17
	15 percent	0.11	0.16
Captive's investment return held at	5 percent	0.27	0.20
	10 percent	0.29	0.20
	15 percent	0.58	0.57
Return to shareholders held at	5 percent	21.07	11.26
	10 percent	10.27	5.01
	15 percent	2.77	1.48

[a]20,000 iterations

use of the captive insurer. Comparing the results reported in Table 1a with those reported in Table 1b, we find that the probability that a captive generates positive shareholder value is generally greater for a captive in the BVI than a captive in Bermuda. We attribute this difference to decreased operating costs. Incorporation fees and minimum amount of capital required for a captive in the BVI are 42 percent and 17 percent less than the

Table 2a. Sensitivity Analysis of the Probability of Positive Value to Shareholders
First Scenario: Parent Self-Manages a British Virgin Islands Captive

	Probability of positive value in percent	
	Actual cash	Promissory note
Captive's investment return held at the median value of the risk-free rate (7 percent)	2.37	32.65
Captive's investment return held at 5 percent above the parent's cost of equity capital	25.75	48.69
Parent's systematic risk held at the 10th percentile (beta value of 0.49)	20.19	49.96
Parent's systematic risk held at the 10th percentile (beta value of 0.49) and captive's investment return held at 7 percent	2.22	34.49

[a]20,000 iterations

corresponding fees for a Bermuda captive. The relaxed regulatory code governing BVI captives likely enhance this cost advantage. This regulatory simplicity (legal representation and local presence are not required) makes self-management possible for BVI general captives.

By comparison, the relatively complex regulations in Bermuda, along with the strict requirement for local legal representation and presence, make self-management of Bermuda captives difficult. Furthermore, the use of reinsurance and the opportunity cost on the captive's funds appears to have a large impact on whether or not the captive generates positive value for its shareholders. That is, the higher the shareholder's opportunity cost, the higher the return from captive operations must be in order for the captive to enhance firm value.

It is unlikely that a parent would randomly select the captive's domicile or that the parent will operate its captive without setting a target return on the captive's invested capital. The parent may choose to self-manage the captive, may purchase no or little reinsurance, and may initially use promissory notes rather than cash to capitalize the captive. We report the probability of shareholder value under such conditions in Tables 2a, 2b, and 2c. Assuming that the parent incorporates the captive in the BVI, we

Table 2b. Sensitivity Analysis of the Probability of Positive Value to Shareholders[a]
First Scenario: Parent Self-Manages a British Virgin Islands Captive and Does Not Reinsure

	Probability of positive value in percent	
	Actual Cash	Promissory Note
Captive's investment return held at the median value of the risk-free rate (7 percent)	21.13	80.98
Captive's investment return held at 5 percent above the parent's cost of equity capital	100.00	100.00
Parent's systematic risk held at the 10th percentile (beta value of 0.49)	92.30	100.00
Parent's systematic risk held at the 10th percentile (beta value of 0.49) and captive's investment return held at 7 percent	29.61	99.36

[a]20,000 iterations

report results only for the first scenario. BVI general captives are the lowest in cost and are governed by the simplest regulations. The first scenario allows for difference between the periods of the captive's incorporation and use. We first assume that the parent self-manages the captive, and then that the parent hires a third-party manager. We also examine the probabilities of shareholder value when the parent capitalizes the captive with cash or with a promissory note initially before switching to cash.

In Table 2a we show results from simulations where the parent self-manages the captive. Investing the captive's funds at rates in excess of the parent's cost of equity capital results in the highest probability of shareholder value. A more conservative assumption, however, is that the captive will earn 7 percent on its investment. This is the median risk-free rate during the years of our sample. With a 7 percent return on invested capital and the use of a promissory note, the probability that a captive will generate positive shareholder value for its shareholders is 32.65 percent. If we assume that the parent's systematic risk reflects a beta of 0.49 while the captive's return holds at 7 percent, this probability increases to 34.49 percent. A beta equal to 0.49 is the 10th percentile of beta values of all firms

Table 2c. Sensitivity Analysis of the Probability of Positive Value to Shareholders[a]
First Scenario: Parent Uses a Third Party to Manage a British Virgin Islands Captive that Does Not Reinsure

	Probability of positive value in percent	
	Actual cash	Promissory note
Captive's investment return held at the median value of the risk-free rate (7 percent)	10.29	69.97
Captive's investment return held at 5 percent above the parent's cost of equity capital	62.62	100.00
Parent's systematic risk held at the 10th percentile (beta value of 0.49)	49.43	99.97
Parent's systematic risk held at the 10th percentile (beta value of 0.49) and captive's investment return held at 7 percent	13.97	90.25

[a]20,000 iterations

in our sample. The probability of positive shareholder value increases to 49.96 percent, however, if we assume that the captive invests its capital to earn the market rate of return.

The probabilities of positive shareholder value increase further if we assume that the parent self-manages the captive and that the captive does not use reinsurance. Under the promissory note column in Table 2b, we show that the probability of generating positive shareholder value for a self-managed captive that does not use reinsurance and invests its capital at 7 percent is 80.98 percent. This probability increases to 99.36 percent if we assume that the parent's systematic risk reflects a beta of 0.49. It increases to 100 percent if we assume that the captive invests its capital to earn the market rate of return.

If we assume that the parent uses a third-party manager to operate the captive and that the captive does not use reinsurance, the probabilities of positive shareholder value are smaller than those in Table 2b but remain higher than those in Table 2a. Under the promissory note column in Table 2c, we show that the probability of generating positive shareholder value is 69.97 percent. The probability increases to 90.25 percent if the systematic risk of the captive's parent reflects a beta of 0.49. The likelihood of positive shareholder value increases further to 99.97 percent if we assume that the captive invests its capital to earn the market rate of return.

DISCUSSION AND CONCLUSION

The captive generates value for its shareholders when the net present value of its cash flows, discounted at the parent's cost of equity capital, is positive. We use the Monte Carlo simulation method, a general technique of numerical integration, to estimate the probability that the captive will generate value for its shareholders. We use two scenarios, taking into account a broad range of possible specifications. We use a realistic range of values taken directly from the marketplace.

The first scenario allows the parent to incorporate a captive insurer that remains dormant until a hard insurance market. This choice introduces an element of flexibility into the use of the captive. The second scenario does not allow for the same level of flexibility, as the parent incorporates and uses the captive at the same time. The amount of capital the captive receives, and the distribution of expected losses faced by the captive, determines the probability of insolvency. The captive can share its losses, for a share of its premium, with a reinsurer. The reinsurers modeled in our scenarios have a probability of default that corresponds to the average default probabilities reported by A. M. Best Company for insurers rated A++ to B+. If the captive cannot pay losses (either because of extraordinary losses or the default of the reinsurer), the parent must borrow funds equal to the amount of the outstanding losses. A year later, the parent repays borrowed funds at the prevailing rates for BBB-rated corporate debt. The interest on the debt is tax deductible at the parent's effective tax rate. In our scenarios, the costs of incorporating, capitalizing, and managing the captive are realistic for both a class 1 Bermuda captive and a BVI general captive.

We first allow all inputs in our scenarios to change simultaneously. We draw values for these inputs from the empirical distributions we have established. This generates a distribution of outcomes that allows us to determine the probability of positive shareholder value for an average captive. Our results suggest that an average captive has an extremely low probability of positive shareholder value. This outcome is consistent with much of the literature that has been written about captives. Our sensitivity analysis, however, reveals several drivers of captive value. Accordingly, our simulation assumes that parents that have established captives will hire managers who work to elevate captive value by acting on the driving forces we identify. We represent these management efforts by keeping selected inputs constant, while allowing all other inputs to change. When we do this, we find that a captive has probabilities in excess of 70 percent of generating positive shareholder value. We identify several value drivers.

All other things being equal, a captive increases its probability of generating positive shareholder value if it maintains flexibility in its operations, if it reduces its operating costs, if it parsimoniously uses reinsurance, and if it earns a return on its capital comparable to its parent's cost of equity capital. One way to maintain flexibility is for the parent to incorporate a captive but wait until a hard insurance market to use the captive. During this dormant period of the captive's life, the parent uses promissory notes (or other non-cash assets) to satisfy the initial capitalization requirements for the captive. To reduce operating costs, the parent can establish a captive in domiciles with less complex regulation, thus making it easy to self-manage the captive. The use of reinsurance, while transferring risk away from the captive, also transfers premium to the reinsurer. Once the captive purchases reinsurance, the reinsurance premium is no longer available to invest. The benefit of investment income appears to be more valuable to the captive than the benefit of reinsurance.

Despite drawbacks with the use of historical data to predict the future, and practical problems of measuring risk, the body of empirical evidence suggests that financial assets yield a return commensurate with their risk. Liquid markets, a constant exchange of information and analysis, and effective arbitrage make it so. To generate higher return on its invested capital, the captive will have to take on more risk. The greater return potential of investments with high risk, however, is also accompanied by equally higher risk of loss. It is unlikely, therefore, that relying on high risk investments is a tactic that a captive can sustain in practice, especially if the systematic risk of the parent is high. High systematic risk implies a high cost of equity capital for the parent. The higher the parent's cost of equity capital, the greater the investment return needed in order for the captive to generate value. We find, however, that a conservative investment return by the captive, in conjunction with a parent's low systematic risk, can still generate a high probability of positive shareholder value.

A conservative investment return by the captive, in conjunction with a parent with low systematic risk, is sustainable in practice and warrants further research. For example, it may be that firms with a low cost of capital form captives to enhance shareholder value, while earlier researchers have suggested that enhancement of managerial utility seems to motivate all captive formations.

NOTES

[1] The results of a February 2006 survey of captive insurers taken by Chris Mancini, the Chief Executive Officer of Captive.com, seem to support Hopkin's views, not the views featured in the editorial on Captive.com. The survey, and commentary on the survey, were accessed January 2007 at www.captive.com/survey/Results/SummaryFeb06.html and at http://captive.com/Blog/, respectively. The survey elicited 112 responses, 70 percent of them from single-parent captive insurers. A consultant from Tillinghast, a national risk and insurance consultancy, has written the accompanying commentary. Here is the commentary: "When captive insurance is compared to buying commercial insurance, 92.2% said the captive reduced their overall insurance-related expense. This is what we expected. However, when we asked how well the captive protected its parent's balance sheet compared to self-insurance, 78.4% said it did and 21.6% said it did not. In our view, because a single parent's captive's balance sheet is rolled up into the parent's balance sheet, this is similar to self-insurance. Therefore, we believe the respondents may not fully understand the big picture and the true financial benefits that a captive offers. We agree that captives can help protect the balance sheet of affiliates, but not the parent. If the respondents truly felt the captive led to more rigorous risk management that actually reduced losses, then they would have answered correctly. For the next question, 'Compared to self-insurance, my captive reduces the volatility of loss at the parent level,' the answer again should have been 'no,' as a captive's financial results are rolled up to the parent level. Nevertheless, 68.6% said yes, 13.7% said no, and 17.6% were not sure. In our view, a single-parent captive does not necessarily reduce volatility at the parent level upon financial consolidation. Finally, the response to the question 'Does your captive achieve returns on capital comparable to or better than returns that would be produced had that capital been invested at the parent level?' showed a more balanced, if still confusing, outcome: 51% said yes, 33.3% said no, and 15.7% were unsure. This response likely depends on the parent's business strategy for the captive: If the captive is designed to make a profit and show a high return on its capital, then it will of course look better than the return on the parent's core business. A key question is whether this return is better placed in the parent's business rather than in the captive."

[2] We found this claim on the firm's website, accessed January 2007 at www.wmsolutions-now.com/serv05.htm.

[3] We calculate the Bermuda figures from information provided by the Bermuda Monetary Authority, the insurance regulator of Bermuda. Bermuda is the largest domicile of captives. The data we report are the latest available and were accessed January 2007 at www.bma.bm/Insurance/Statistics.

[4] Assuming competitive markets, the results of Quirin and Waters (1975) imply that, at a competitive equilibrium, the underwriting profit margin will be equal to the negative of the risk-free rate of interest. Equivalently, if we use the combined ratio as a measure of underwriting profit margin, the results imply a combined ratio of one plus the risk-free rate. These results are consistent with Doherty and Schlesinger (1983) and Doherty and Garven (1986).

[5] Consider the first scenario of Figure 1. We represent the expected loss $E(L_{t+2})$ at the end of the period (t+2) as the sum of independent claims $X_1, X_2 \ldots X_N$, where the number of claims (N) is also independent of each claim (X_i). Claims are paid at the end of the period (t+2). Each claim amount is assumed to be identically distributed, each with mean (μ) and second moment about the origin (α_2). The expected number of claims (n) is thus the total number of policies multiplied by the frequency of claims per policy. Risk theorists have proven that $E(L_{t+2}) = n\mu$ and $Var(L_{t+2}) = n\alpha_2$. The capital of the captive at the end of the period (t+2) will then equal:

$$S_{t+2} = S_{t+1}(1+k_c) + n\mu - L_{t+2}$$

where (k_c) is the rate of return on the invested safety reserve. Note that $n\mu = E(L_{t+2})$. The actuarial convention expresses premium as $P_t = n\mu$, but this actuarial convention ignores the time-value of money. The payment of the premium at time (t) creates a risk-free situation for the policyholder, and the appropriate discount-rate for the premium is the risk-free interest rate (Kraus and Ross, 1982; Cummins, 1990). Thus, the economic premium is $P_{t+1} = E(L_{t+2})/(1+k_f) = n\mu/(1+k_f)$, or $P_{t+1}(1+k_f)$, where (k_f) is the risk-free interest rate.

To ensure the solvency of the captive $Pro((S_{t+1}(1+k_c) + n\mu - L_{t+2}) < 0) = \varepsilon$ where Pro(.) is the probability operator and (ε) is a small probability value. Rearranging terms:

$$Pro((S_{t+1}(1+k_c) + n\mu - L_{t+2}) < 0) = \varepsilon$$

$$Pro((S_{t+1}(1+k_c) + n\mu) > L_{t+2}) = \varepsilon$$

$$Pro((S_{t+1}(1 + k_c)) > L_{t+2} - n\mu) = \varepsilon, \text{ or}$$

$$Pro\left(\frac{S_{t+1}(1+k_c)}{\sqrt{n\alpha_2}} > \frac{L_{t+2} - n\mu}{\sqrt{n\alpha_2}}\right) = \varepsilon .$$

We know that $E(L_{t+2}) = n\mu$ and $Var(L_{t+2}) = n\alpha_2$. thus the distribution of $(L_{t+2} - n\mu)/\sqrt{n\alpha_2}$ is unit normal and is thus equal to (z_ε). Then:

$$\frac{S_{t+1}(1+k_c)}{\sqrt{n\alpha_2}} = z_\varepsilon$$

Rearranging terms:

$$S_{t+1} = \frac{z_\varepsilon\sqrt{n\alpha_2}}{(1+k_c)} .$$

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