Contingent Commissions and the Management of the Independent Agency

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Abstract

Insurance agencies continue to exist as an important distribution mechanism because they give their contracting insurers advantages in risk selection and enable insurance applicants to transfer complex risks. While independent agencies are compensated by up-front commissions, a key component of their profitability is tied to contingent commissions. A contingency arrangement represents *ex post* compensation normally tied to underwriting profitability, volume and annual growth. We report two actual contingency contracts in the context of a decision process for choosing among contingency offerings by insurers. We incorporate both uncertainty and correlation among key variables to arrive at values for competing contracts, then use a downside risk approach that helps agency owners select the better contract. The approach offered in this paper is scalable to a selection problem for any number of contingency arrangements.

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I. Introduction

Commissions are at the core of insurance sales compensation schemes and such production-based incentives assist in aligning the interests of insurers with their sales forces. In the property-casualty market, producers are paid after they go through extensive search, prospecting and the closing of a new sale, and through effective service of existing clients who subsequently renew their business with the agency. For larger independent agencies, there can be a disconnection between the agency owner-manager and producers who don't hold an ownership interest because second tier commissions may supplement total agency revenue yet be of little consequence to producers who do not have a direct stake in the reward. Such commissions, normally referred to as contingent commissions, remain important to insurers as well as agency owners. Contingent commissions may help serve a risk selection function as well as help an insurer receive a volume of business that enhances the benefits from risk pooling.[1]

The contingency contracting relationship stems from an agency agreement which authorizes the agency owner(s) to place business with a carrier. While the commission by line of business is part of this insurer-agency relationship and paid with a placement, contingencies or bonuses are additional performance based incentives paid *ex post* placement. Given that contingencies are important to total agency revenue, the characteristics of contingency agreements and how the agreements are valued is important to the agency owner. Indeed, when the value of the contingency agreement links loss history, volume, premium growth and other factors which are inherently uncertain at the time of contracting, the agency owner's decision about contract value is complicated. In this paper, we capture the uncertainties in a model which an agency owner can use as a decision tool to select among candidate contingency contracts. Contractual details are shown to be very important as contractual values and preferred

[1]Cummins and Doherty (2006) provide an extensive review and analysis of insurer market channels in a paper that came in the wake of Spitzer (2004)

contractual choice differ depending on answers to such questions such as "what is an agency's likely loss ratio range," and "what level of premium growth can an agency be expected to deliver?" In other words, it would be reasonable to assume that insurers' attempt to promote certain business outcomes (risk selection, quantity of business, etc.,) through their contracts and the results reported in this paper confirm that premise.

After a brief review of the literature, we put contingency arrangements into a very specific context in section III by comparing and contrasting two (2) such arrangements so that the institutional structure behind a contingency or bonus is better understood. While there are a number of academic papers on compensation systems in insurance, there is a very little market information about these structures. In section IV, we propose how agency owner-managers can evaluate contingency contracts prospectively through a probabilistic model which captures the uncertainties inherent in these compensation arrangements. The two actual arrangements presented in section III are evaluated to determine the circumstances under which one contract is preferred to another. Section V offers concluding remarks.

II. Background

The choice of insurance distribution system and compensation structure has been grounded through an agency-theoretic lens to help explain a variety of circumstances that arise in the nexus between insurance applicant and insurer including whether an independent or exclusive agency channel is adopted.[2] Kim, Mayers and Smith (1996, p. 207) took this tack in their empirical analysis of distribution channel choice that associates certain insurer characteristics with exclusive and independent agencies which helps explain why insurers and their chosen channel are "strategic complements" in controlling certain types of behaviors.[3] Indeed, they note Grossman and Hart's (1986) explanation that commissions are a response by an insurer to the cost of monitoring sales effort, and that agency ownership of

[2]The starting point for research which looked at the costs and benefits of different market channels was Joskow (1973) which was extended by Cummins and VanDerhei (1979) and Barrese and Nelson (1992).

[3]page 207.

expirations inhibit an insurer from working directly with an insured in future years after the initial sale was made.[4]

Regan and Tennyson (1996) underpin theoretically the existence of an independent agency to its value in assessment of more complex risks and its capability to have multiple insurers to place a risk. Focht, Richter and Schiller (2013) assert that agencies are able to capitalize on their market power through the prevalence of contingency arrangements because an insurer that elects to not offer an agency a contingency arrangement would be an insurer that forsakes market share to a competitor who will do so.

Contingency arrangements are generally known to be structured to reward the agency for profit and volume. Cummins and Doherty (2006) reason that *ex post* contingent commissions linked to account profitability help mitigate the informational asymmetry that would otherwise exist between a higher-risk applicant and the insurer. In addition, volume-based compensation helps an insurer "reduce its unit costs of administering any given intermediary relationship." Insurers have an interest in linking a bonus to volume because more volume better diversifies an insurer's risk pool while offering economies of scale in other operational processes.

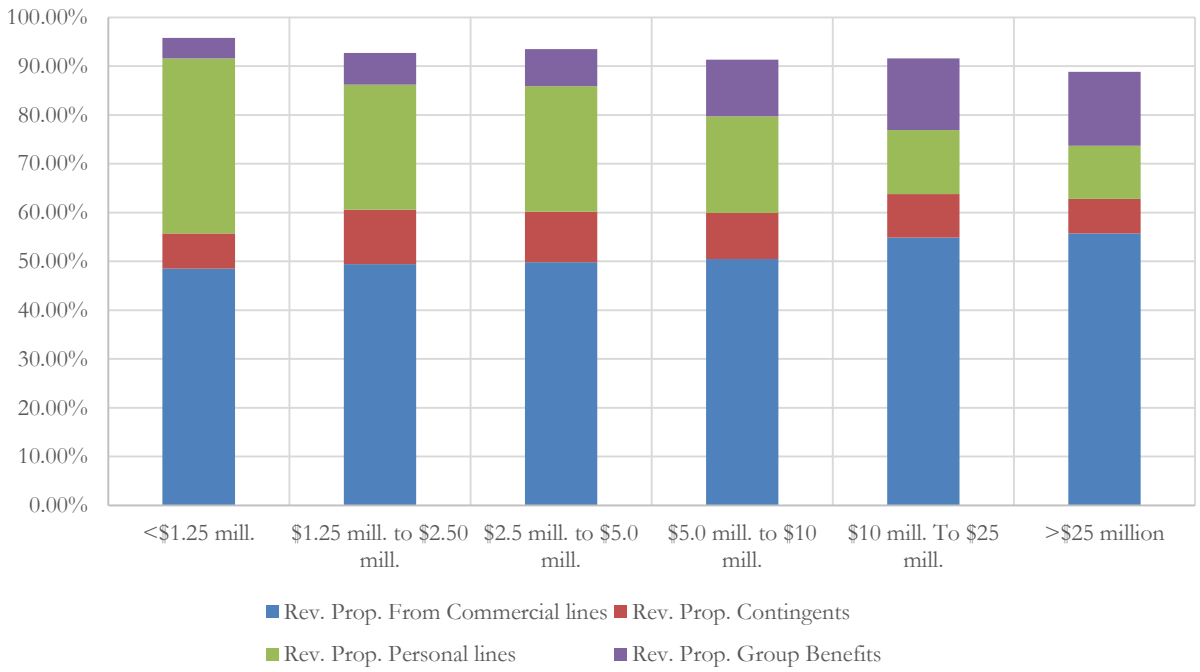
Browne and Tu (2014) explore how contingency arrangements support broker monitoring of premium adequacy. The authors hypothesize that insurer loss and combined ratio volatility is negatively related to the presence of a contingency arrangement and that insurers with higher rates of direct commissions are more likely to have volatile loss and insurer operating performance experience. Using financial data of 925 insurers from 1997-2004, the authors find that insurers that offer higher rates of direct commissions experience more volatile financial performances while insurers that offer contingency

[4]The value of expirations to the agency was analyzed by Trieschmann and Leverett (1987) who were motivated to consider how agency value changed under different interest rate and lapse rates, and a new change in the tax law during the time period of their study. They found that agency expirations were higher under the tax law change examined but were moderated under rising interest and lapse rates.

arrangements experience less volatile financial performance. The authors conclude that "this suggests that contingent commissions do result in a dampening of the underwriting cycle."[5]

While the literature has been operating under an assumed framework about contingency arrangements, there is remarkably little public information about how contingency arrangements are structured and vary across insurers.[6] What is better known is the importance of contingency arrangements to the financial functioning of the independent agency. The "Best Practices Study" or BPS conducted by Reagan Consulting and today in association with the Independent Insurance Agents & Brokers of America, Inc. (www.IIABA.com) has been reported since 1993 as a resource to agency management from which agency owners can assess their relative performance.[7] The charts below show revenue breakdowns by total agency revenue size for two years, 2007 and 2013.[8]

Figure 1
2007 Revenue by line



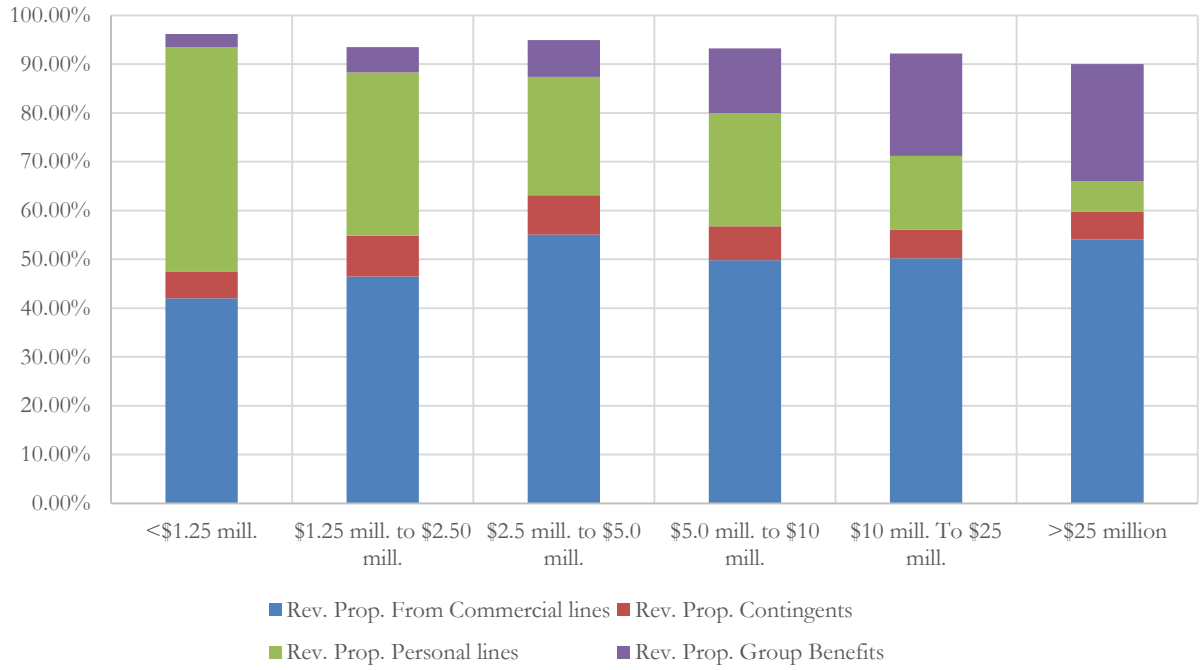
[5]See Browne and Tu, page 2384.

[6]Today, there consulting in this area where different scenarios are constructed for an agency to help them understand competing contingency contracts. See http://www.iiadallas.org/?page=64.

[7]http://bp.reaganconsulting.com/bp2013/intro.html

[8]Categories of revenue size before 2007 were somewhat different than after 2007. Size categories for 2013 were used and the earliest preceding year with the same size categories was used as a reference point.

Figure 2
2013 Revenue by line



The primary sources of revenue for the property/casualty agencies that responded to the survey were commercial and personal lines commissions, contingency commissions, and group life and health commissions. These four categories made up nearly 100% of the revenue flow.

Smaller agencies are much more reliant on personal lines commissions for revenue generation and group life and health business provides a larger proportion of revenue for large agencies. In 2013 the group life and health business contributed 24% of revenue for the largest agency size up from 15.1% in 2007; a 59% increase. Commercial lines revenue hovers around 50% for all but the smallest agencies, reflecting the importance of smaller and medium size businesses to the independent agent rather than standard personal lines. The personal lines market is dominated by exclusive agency insurers and direct writers.

In Figure 3, the average proportion of revenue by line of business and agency total revenue size for 2007 and 2013 is reported. The last row of each panel reports the average pre-tax profit. In 2013, average pre-tax profit ranged from 13.0% to 23.10% with smaller agencies earning higher returns. The

same general size relationship held true in 2007. Contingent commissions were relatively more significant to the revenue of the agencies among the middle ranges of revenue size, however their importance is magnified when focusing on profitability.

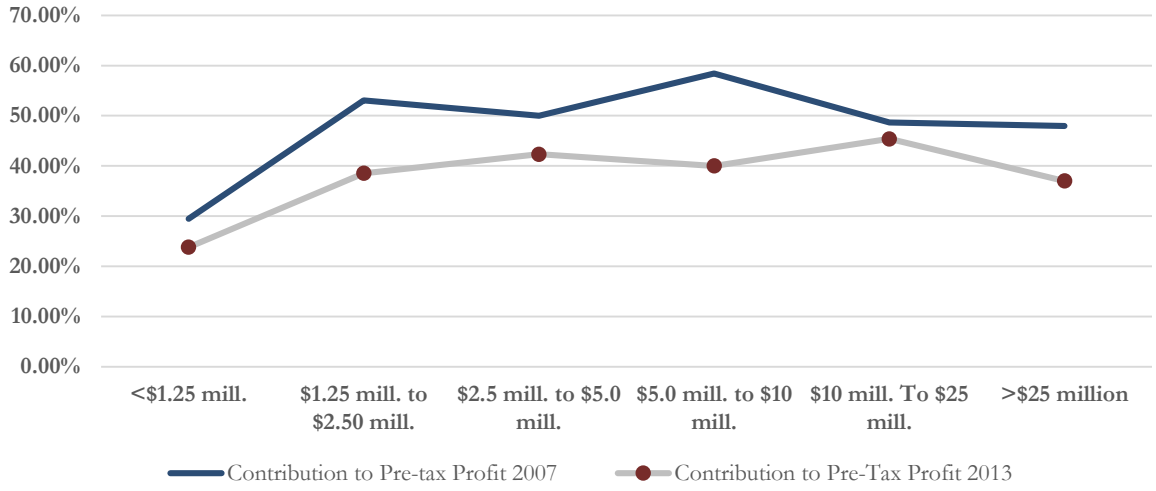
Figure 3
Revenue proportions by line

2007						
	<$1.25 mill.	**$1.25 mill. to $2.5 mill.**	**$2.5 mill. to $5 mill.**	**$5 mill. to $10 mill.**	**$10 mill. to $25 mill.**	**>$25 mill.**
Rev. % Commercial lines	48.50%	49.40%	49.80%	50.50%	54.90%	55.70%
Rev. % Contingents	7.20%	11.20%	10.40%	9.40%	8.90%	7.10%
Rev. % Personal lines	35.90%	25.60%	25.70%	19.80%	13.10%	10.90%
Rev. % Group benefits	4.20%	6.50%	7.60%	11.60%	14.70%	15.10%
Pre-tax profit	24.40%	21.10%	20.80%	16.10%	18.30%	14.80%
2013						
	<$1.25 mill.	**$1.25 mill. to $2.5 mill.**	**$2.5 mill. to $5 mill.**	**$5 mill. to $10 mill.**	**$10 mill. to $25 mill.**	**>$25 mill.**
Rev. % Commercial lines	42.00%	46.50%	55.10%	49.80%	50.20%	54.10%
Rev. % Contingents	5.50%	8.40%	8.00%	7.00%	5.90%	5.70%
Rev. % Personal lines	46.00%	33.40%	24.30%	23.20%	15.10%	6.20%
Rev. % Group benefits	2.70%	5.20%	7.50%	13.20%	21.00%	24.00%
Pre-tax profit	23.10%	21.80%	18.90%	17.50%	13.00%	15.40%

One of the more interesting features of contingency commissions is that they represent revenue generated on top of ordinary commissions without a complementary cost component. In other words, contingent revenue drops directly to the pre-tax bottom line of an agency. Thus, the incentive features of a contingency arrangement offered by insurers to independents are absent agency financial noise which promotes a cleaner understanding by agent-owners of their behaviors on financial performance; a feature preferred by the contracting insurers.

Figure 4 illustrates the magnitude of the impact of contingency income on pre-tax profits. Among agencies of all but the smallest size, contingents represented from 47% to 58% of pre-tax profits in 2007 and 38% to 45% of pre-tax profits in 2013. Whether one elects to analyze contingency arrangements based on the insurer's interest in risk selection and diversification or an agency's interest in profitability, it is clear they serve an important function in the operation of the independent agency enterprise.

Figure 4
Contingent commissions as % of pre-tax profit



III. Agency Choice of Contingency Contracts

Imagine the managerial problem of knowing the significance of contingency income while being afforded the flexibility to choose a subset of insurers and their contingency arrangements among a larger pool of candidates. Contingency contracts are mostly standardized in terms of basing rewards on volume, loss ratios and year over year premium growth, yet can be complicated in their reward details that ultimately determine an agreement's contribution to agency value. While a given insurer may structure a standardized incentive arrangement consistent with its business strategy which it offers to all of its independent agents, the agency owner-managers must filter among competing contracts that serve to offer the agency markets for their customers and maximize agency profitability.[9] Importantly, the key variables in these agreements are inherently uncertain since the contractual elements of the incentive agreement normally consider the quantity and quality of business delivered by the agency to the insurer

[9]In a phone conversation with Scott Miles, COO of TexCap-Concord Insurance Services, Miles verified that admitted and standard insurers offer contingency arrangements as a normal part of their commission structures. On the face of it, the parameters of any one agreement offered by an insurer to multiple agencies can be subject to negotiation by influential agencies which hold market power by size, reputation, geographic location, or other variables valued by the insurer. As noted by Burand, "an agency usually needs at least $1 million in premiums to have any bargaining power." (See http://www.iiadallas.org/?page=64).

as well as year over year premium growth.[10] Once the terms of the agreement are finalized, an agency bears the risk that some of their agreements could be valueless if, for instance, loss ratios are higher than expected, or the delivered premium or premium growth to insurers is insufficient.

A better understanding of contingency arrangements by researchers has been hampered by little specific information in the public domain. In this paper, that door is opened slightly since the modeling approach in section IV uses two actual arrangements. Contingency contract (1) has been offered by a multi-billion dollar asset insurer and Contingency contract (2) has been offered by a much smaller, regional insurer to the same independent agency.[11] Contract (1) applies to an agency's commercial or "middle market" generated premium only, while Contract (2) combines commercial and personal lines for an agency to calculate the bonus. Table 2 represents the core of the contingency bonus arrangement for Contract (1) and Table 3 represents Contract (2). The nuances of both contracts deserve some explanation.

Contract (1) determines the incentive bonus by considering three dimensions: the quantity of premiums written, the premium growth from the prior year, and the loss ratio of the book. The left-hand side column represents premium written minimums necessary and the top row notes minimum levels of premium growth. To illustrate, for an agency that has generated $1.2 million in written premium that represents 4% growth from the prior year, the bonus factor is 1.55%. If the loss ratio of the book was 0.20, then the bonus factor is magnified by 1.35, and the bonus factor becomes 2.0925%.[12] The dollar value of the bonus is calculated as $1.2 million * 2.0925%, or $25,110. Of note, the loss ratio

[10]One of the agreements used in this paper includes an element described as the "retention" ratio which measures the percentage of customers in year t who were retained from year t – 1. This can lead to insurer rather than agent behavior that affects contract value since the insurer controls the premium rates which could lead to customers switching carriers.

[11]During this research it quickly became evident that independent agencies are not keen to publish or share their arrangements and, in fact, may be under a non-disclosure agreement. If such information were widely available then insurance economists would be able to address questions surrounding incentive compatibility, and the value of independent agency activity to their contracting insurers. While this paper is directed toward a decision tool, we think a glimpse into two actual agreements to be of value to students of this topic.

[12]The loss ratio of the book is calculated over the prior three year time horizon as losses incurred divided by three years of earned premiums. Also, loss ratio calculations may limit individual losses over a certain amount depending on the terms of the contingency arrangement. Essentially, this is an "insurance" option which may be offered by some insurers.

multiplier becomes 0 at a ratio value of 0.50 indicating one trigger for the incentive contract to become valueless.

Table 2: Contingency Contract (1)

	Premium Growth						
Premium written min.	**greater than -10%**	**-5.0%**	**0.0%**	**5.0%**	**10.0%**	**20.0%**	**30% or greater**
$500	0.00%	1.00%	1.30%	1.65%	1.80%	1.95%	2.25%
$1,000	1.00%	1.25%	1.55%	1.90%	2.05%	2.20%	2.50%
$2,000	1.30%	1.55%	1.85%	2.20%	2.35%	2.50%	2.75%
$3,000	1.60%	1.85%	2.20%	2.45%	2.60%	2.75%	3.00%
$5,000	1.95%	2.20%	2.55%	2.75%	2.90%	3.05%	3.30%
$10,000	2.25%	2.50%	2.85%	3.05%	3.20%	3.35%	3.60%
Loss ratio minimums	**Loss ratio multiplier**						
0.000	1.500						
0.200	1.350						
0.249	1.250						
0.299	1.150						
0.349	1.100						
0.399	1.050						
0.449	1.000						
0.500	0.000						

By contrast, contract (2) determines the bonus by including four dimensions. A retention percentage of prior year business is considered along with overall written premium and growth of the entire book of business.[13] The agency's loss ratio is compared to the maximum allowable loss ratio, assumed to be 60%, to determine the "profitability" of the agency's book of business.[14] Applying the prior example to Contract (2) and assuming that the agency has retained 90% of old business, the bonus calculation would begin by pulling the factor of 2.0% from the upper panel of Table 3 associated with

[13]The retention rate is measured as the % of old policies that renew. In an interview with Lynn Thomas, 21st Century Management Consultants, who consults insurers on the retention topic, she advised that the retention rate can vary from 0.75 to 0.95 and that it varies from personal to commercial business with the former being more persistent for an agency.

[14]In contract (2), the loss ratio is determined over the prior three year period which includes the bonus year in question and the two prior years. By definition, incurred losses explicitly consider reserves for individual losses plus a factor for IBNR. Contract (1) explicitly states that it does not include IBNR.

$1.2 million of written premium and growth of 4%. Added to this base factor would be a second factor for 90% retention which is 4.0% at this level of written premium. The total base factor of 6.0% is multiplied by the profitability of the book (0.60 max – 0.20 actual) to arrive at the bonus factor. In this case, 6% * 40%, or 2.4%. The dollar value of the bonus for contract (2) is $28,800 ($1.2 million * 2.4%).

Table 3: Contingency Contract (2)

		Growth Factor			
Premium written min.	**G1**	**G2**	**G3**	**G4**	**G5**
$500	< 15.0%	15.0-24.90%	24.90%-50.00%	>50%	
	1.00%	2.00%	3.00%	5.00%	
$1,000	<7.00%	7.0-14.90%	14.90-25.0%	>25.00%	
	2.00%	5.00%	8.00%	14.00%	
$2,000	<4.00%	4.0-7.90%	7.90-12.90%	12.9-18.00%	>18.0%
	1.00%	3.00%	5.00%	10.00%	16.00%
$4,000	<2.00%	2.0-6.90%	6.90-11.90%	11.9-16.00%	>16.0%
	2.00%	3.00%	6.00%	11.00%	17.00%
$7,000	<0.00%	0.0-5.90%	5.90-10.90%	10.9-14.00%	>14.0%
	3.00%	4.00%	7.00%	12.00%	18.00%
$10,000	<0.00%	0.0-4.90%	4.90-9.90%	9.90-13.00%	>13.0%
	4.00%	5.00%	8.00%	13.00%	19.00%
$15,000	<0.00%	0.0-3.90%	3.90-7.90%	7.90-12.00%	>12.0%
	4.00%	6.00%	9.00%	14.00%	20.00%
$20,000	<0.00%	0.0-2.90%	2.90-6.90%	6.90-11.00%	>11.0%
	4.00%	7.00%	10.00%	15.00%	21.00%
$40,000	<0.00%	2.90%	2.90-5.90%	5.90-9.00%	>9.0%
	4.00%	8.00%	12.00%	17.00%	23.00%
		Retention Factor			
	R1	**R2**	**R3**	**R4**	**R5**
$500	85.00%	89.90%	95.00%	100.00%	
	1.00%	2.00%	3.00%	4.00%	
$1,000	85.00%	89.90%	95.00%	100.00%	
	2.00%	4.00%	6.00%	7.00%	
$2,000	80.00%	84.90%	89.90%	95.00%	100.00%
	2.00%	4.00%	6.00%	8.00%	10.00%
$4,000	80.00%	84.90%	89.90%	95.00%	100.00%
	2.00%	4.00%	6.00%	8.00%	10.00%
$7,000	80.00%	84.90%	89.90%	95.00%	100.00%
	2.00%	6.00%	8.00%	10.00%	12.00%
$10,000	80.00%	84.90%	89.90%	95.00%	100.00%
	2.00%	6.00%	8.00%	10.00%	12.00%
$15,000	80.00%	84.90%	89.90%	95.00%	100.00%
	2.00%	6.00%	8.00%	10.00%	12.00%
$20,000	80.00%	84.90%	89.90%	95.00%	100.00%
	2.00%	6.00%	8.00%	10.00%	12.00%
$40,000	80.00%	84.90%	89.90%	95.00%	100.00%
	2.00%	6.00%	8.00%	10.00%	12.00%

IV. A Model to Choose Among Contracts

The choice of contracts is both economically important and intellectually interesting because contract decisions have to be made in light of uncertainties surrounding the variables which are inputs to the bonus calculation. To explore how an agency can choose among competing contracts we've assembled and deployed a decision framework to evaluate the process.[15] We will engage the process for the two actual contracts discussed in the prior section; this process may be scaled for a variety of size scenarios such as a larger independent agency choosing the best ten (10) contracts from among a universe of fifty (50) carriers.

To establish the model in a more generalized framework, we start with an independent agency and owner-managers who will make decisions about the value of contingency arrangements prior to their actual experience over a contractual year. While the descriptions of the characteristics embodied in the contracts are known, the ultimate value of the contract is risky and individual measures of performance in these contracts are risky. Any existing agency with years of experience comes into the decision process with information about the existing book of business and prior year loss experience, but with uncertainty about current pricing in insurance markets, economic conditions surrounding the geographical positioning of the agency, actual business growth relative to expected growth and the difference between actual loss inducing events and expected losses. Moreover, there will be residual, unanticipated uncertainty remaining. A decision framework that embodies available information and weaves these uncertainties together can shed light on otherwise complex comparisons of risky contractual alternatives to help an agency attain its highest value.[16]

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[15]The importance of assessing contingency contract value is in practice today. During this research, Burand and Associates (http://www.burand-associates.com/index.html) was found to offer a consultative service for contingency contract valuation.

[16]As noted by a referee, there are a variety of factors outside the scope of the contingency arrangement which are important to the contracting relationship such as "underwriting flexibility/capability, mix of business, growth opportunities, brand recognition..," that serve an agency's decision about its contracting relationships. No doubt these may be important considerations as well.

For our modeling entry point we consider an agency's loss ratio, premium growth and new business written as lognormally distributed random variables.[17] Contract (2) has the added feature in which an agency's retention ratio, calculated as % of prior year policies retained in the current year, is explicitly considered along with the overall premium growth. This variable is considered as a normally distributed random variable. We assume a mean of 85% and a standard deviation of 3.5% based on a professional in the field.[18] Because agencies will have insurance market expertise for certain types of industries we will explore how contingency contractual value changes for an agency with a higher risk clientele that may push the agency toward a valueless contingency arrangement if loss ratios are too high.

A similar tack is taken for premium growth to measure whether contingency arrangements still have value for an agency that expects negative growth even though they have a large book of business that is very profitable for the insurer. Whether an agency's expectation is for positive or negative growth of various magnitudes, there remains risk in the forecast which is captured by what we label as low-risk and high-risk. These terms measure the confidence the owner-manager has about their forecasts. Simulating over different ranges and level of risk in each of the agency operational variables permits a wider exploration of both the expected value of the agreement and the risk in the value of the agreement. The approach permits a "stress-testing" to see if and when a contingency contract becomes better or worse compared to its competitors.

a. Results under independence

The initial set of results is based on an assumption of independence among the variables although that will be relaxed in the subsequent section. We are assuming an agency with prior year commercial

[17] Practice among actuaries to consider loss ratios as lognormally distributed random variables, see Dollinger, "Evaluating Loss Sensitive Treaty Terms," handout http://www.casact.org/community/sections/care/0807/handouts/ . In turn, we also assume that following year agency premiums are also lognormally distributed.

[18] Based on a phone interview with Lynn Thomas, 21st Century Management Consultant, who advised that the typical retention range is between 75% and 95%, *ceteris paribus*.

premiums of $2 million.[19] Table 4 displays the initial parameters used in developing the scenarios. We consider both positive and negative growth in subsequent year premiums of +/-10% under less and more uncertainty options, σ = 10% and σ = 20%, respectively.[20] Loss ratios vary from low expected values (25%) to medium (40%) and high (55%) expected values.[21] Loss ratios are assumed to be distributed under a low-risk assumption (σ = 5%) and a high-risk assumption (σ = 20%). Combinations of these scenarios creates 24 head-to-head contractual value measures for Contact (1) and Contract (2). The expected value of each contract along with a relative measure of risk is reported.[22]

Table 4

Agency loss ratios					
Low and low-risk	Low and high-risk	Medium and low-risk	Medium and high-risk	High and low-risk	High and high-risk
μ = 25%; σ = 5%	μ = 25%; σ = 20%	μ = 40%; σ = 5%	μ = 40%; σ = 20%	μ = 55%; σ = 5%	μ = 55%; σ = 20%
Agency premium growth					
	Negative and low-risk	Negative and high-risk	Positive and low-risk	Positive and high-risk	
	μ = -10%; σ = 10%	μ = -10%; σ = 20%	μ = 10%; σ = 10%	μ = 20%; σ = 20%	

[19]As noted by a referee, the approach offered in this paper assumes that 100% of written premium is allocated to one contract or the other. Whether the owner/manager elects to allocate business proportionately is an additional decision that could be undertaken. In just a two contract scenario, reducing volume to each contract by sharing would put an agency at risk for violating minimum premium requirements in both contracts unless the agency is very large and has a book of business that far exceeds the agency's written premium minimum to receive the maximum volume-based commission. Whether proportional allocation is to be considered depends on agency size and the minimum premium written thresholds in the contingency arrangements offered by insurers. Whether a contract becomes more (less) valuable to an agency when it receives less (more) premium could be a research extension.

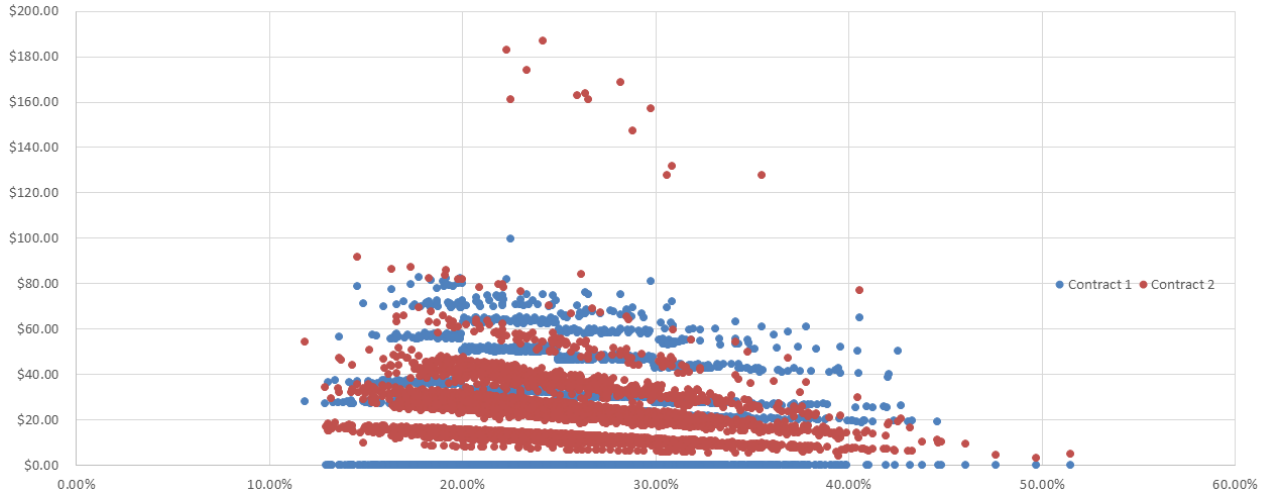
[20]As an example, the distribution of forecasted year premium under 10% growth and low-risk would be $2.2 million with a σ of $220,000.

[21]Oftentimes, agencies will be given the opportunity to limit the impact of any single loss on their loss ratio. In this illustration we are not including this explicitly through losses incurred; rather, large losses and contractual terms to mitigate large losses can be approximated implicitly by different parameterizations of the loss ratio distribution. This is the case with contract #2 and can easily be incorporated into a decision tool.

[22]A more stepwise description is as follows: a value for contract (1) is developed for each trial in a simulation in which a loss ratio, premium level and premium growth are generated by drawing on the relevant and parameterized probability distributions. Premium growth is calculated for a trial assuming the prior year premium is known and fixed at $2 million. Contract (2) also requires consideration of an agency's uncertain retention ratio. Once that value is generated then it is combined with the other generated values in a trial to arrive at a contractual value.

5,000 trials are undertaken for each given set of assumptions and probability distributions.[23] Figure 5 is a two-dimensional view of value for Contract (1) and Contract (2) under the "Low and low-risk" loss ratio and "Negative and low-risk" premium growth assumptions where the horizontal access is loss ratio. Outcomes also depend on the overall level of premium and retention rate for a given trial which are embedded in the plot. This visual depiction hints at the fact that Contract (2) is generally not valueless and has a larger range of outcomes compared to Contract (1). Yet, Contract (1) has a high concentration of trials between $5,000 and $60,000. Many trials for Contract (1) are valueless which is driven by any trial in which the premium growth rate is less than -10%. Contract (1) doesn't have many right-hand side outliers the bulk of the range of outcomes is between $0 and $80,000 and appears larger.

Figure 5
Contract value by loss ratio



The mean and standard deviation of the 24 contractual values (in 000s) are reported in Tables 5a and 5b. Moreover, a coefficient of variation (CV) is reported for a relative measure of risk.[24] The statistics for

[23]Code is written and Myerson's Simtools is utilized to generate distribution values that have been seeded with a random number generator. See http://home.uchicago.edu/rmyerson/addins.htm

[24]As noted by a reviewer, the results are presented in a manner that suggests that the stochastic properties of the variables are the same which would not be the case if the business was personal insurance rather than commercial insurance. Tables 5a and 5b (and forthcoming tables) could be viewed differently to accommodate this view. If we assume an agency that has only the two illustrative contracts in front of it and is pondering commercial insurance and more risky loss ratios v.

the scenario just plotted is a useful starting point because it illustrates that Contract (1) has both a higher expected value (about $21,630) and a lower overall statistical risk (CV = 0.60) which are referenced as "highlight" scenarios.[25] In Table 5a, 4 of the 5 highlight scenarios favor Contract (1). The majority of the scenarios in Table 5a have the joint attributes of higher expected value and higher risk, but in ten of the twelve scenarios Contract (2) is preferred.

In Table 5b, which reports more of the higher loss ratio scenarios, Contract (2) has 6 of 7 highlight scenarios, and overall has the higher expected value in 11 of the 12 scenarios reported in this table. This outcome persists, as expected, over higher loss ratio values where the risk of the 55% forecast is low since Contract (1) becomes valueless for any trial where the loss ratio exceeds 50%.

Table 5a

		Loss ratios					
		Low, low-risk		**Low, high-risk**		**Medium, low-risk**	
		μ = 25%; σ = 5%		μ = 25%; σ = 20%		μ = 40%; σ = 5%	
		Contract 1	**Contract 2**	**Contract 1**	**Contract 2**	**Contract 1**	**Contract 2**
Premium growth							
negative, low-risk	**mean**	$17.13	**$21.63**	$16.61	**$22.80**	$14.01	$12.30
μ = -10%; σ = 10%	**std.**	$20.25	**$12.94**	$21.22	**$17.37**	$16.43	$7.64
	CV	1.18	**0.60**	1.28	**0.76**	1.17	0.62
negative, high-risk	**mean**	$24.37	**$34.89**	$21.84	$33.82	$18.71	**$19.04**
μ = -10%; σ = 20%	**std.**	$30.70	**$44.06**	$30.54	$47.72	$24.42	**$24.48**
	CV	1.26	**1.26**	1.40	1.41	1.31	**1.29**
positive, low-risk	**mean**	$60.51	$68.25	$57.17	$69.99	**$47.84**	$38.33
μ = 10%; σ = 10%	**std.**	$20.82	$58.74	$28.27	$70.04	**$19.04**	$34.87
	CV	0.34	0.86	0.49	1.00	**0.40**	0.91
positive, high-risk	**mean**	$55.39	$78.84	$52.80	$82.35	$44.34	$45.08
μ = 10%; σ = 20%	**std.**	$36.62	$74.43	$41.02	$88.89	$30.42	$44.11
	CV	0.66	0.94	0.78	1.08	0.69	0.98

*highlight scenarios are noted by bold and underline

personal insurance and less risky loss ratios, then comparative results are within Tables 5a and 5b. For example, if a target loss ratio is 40% and premium growth is positive and high-risk, then the appropriate column of values for Contract 1 under the σ = 20% (high-risk loss ratio assumption) would be compared to Contract 2 under the σ = 5% (low-risk loss ratio assumption). Nonetheless, informed consideration of each variable's distribution and parameters is and important early step prior to running the model.

[25]Scenarios with higher means and lower standard deviations will be explored later when we discuss considerations for making the best decision.

Table 5b

		Loss ratios					
		Medium, high-risk		**High, low-risk**		**High, high-risk**	
		μ = 40%; σ = 20%		μ = 55%; σ = 5%		μ = 55%; σ = 20%	
		Contract 1	**Contract 2**	**Contract 1**	**Contract 2**	**Contract 1**	**Contract 2**
Premium growth							
negative, low-risk	**mean**	\$12.10	**\$14.04**	\$1.96	**\$3.39**	\$6.79	**\$6.85**
μ = -10%; σ = 10%	**std.**	\$17.87	**\$13.49**	\$7.59	**\$3.48**	\$13.84	**\$9.34**
	CV	1.48	**0.96**	3.86	**1.03**	2.04	**1.36**
negative, high-risk	**mean**	\$16.78	\$21.59	\$2.89	**\$5.15**	\$9.17	\$10.65
μ = -10%; σ = 20%	**std.**	\$26.17	\$34.45	\$11.36	**\$9.08**	\$20.00	\$21.67
	CV	1.56	1.60	3.93	**1.76**	2.18	2.03
positive, low-risk	**mean**	\$42.78	\$44.18	\$6.94	**\$10.41**	**\$23.00**	\$20.81
μ = 10%; σ = 10%	**std.**	\$29.51	\$51.14	\$17.52	**\$13.72**	**\$27.77**	\$33.19
	CV	0.69	1.16	2.52	**1.32**	**1.21**	1.60
positive, high-risk	**mean**	\$38.88	\$51.77	\$6.38	**\$12.30**	\$21.43	\$24.47
μ = 10%; σ = 20%	**std.**	\$37.69	\$65.80	\$18.37	**\$16.81**	\$31.23	\$40.40
	CV	0.97	1.27	2.88	**1.37**	1.46	1.65

b. Results with correlation among contractual inputs

In this section we relax the assumption of independence between premiums, loss ratios and retention rates. Our interest is how contractual value changes under correlated relationships which we would expect to exist between new agency premiums and loss ratios. Both the academic literature and anecdotal evidence is convincing about the importance of the independent agent to risk selection. In turn, we would expect that contingency arrangements that award both premium growth and lower loss ratios causes, potentially, a measured choice by the agency in the evaluation of more market share at the trade-off of higher loss ratios.

To see how contractual value and potentially contractual choice is altered we propose that premiums and loss ratios are positively correlated lognormally distributed random variables. We look at contractual value when the correlation between variables is 0.5 under the same set of parameters as

described in Table 4. Furthermore, we would expect premium growth and retention rates to be related but the nature of the interaction is less clear. On the one hand, higher retentions of existing customers would be expected when premium rates are lower, but an agency could use lower premium rates to motivate new customer activity deploying significant resources to generate new business. An agency working to generate new business may be able to perturb the contingency bonus because overall growth is higher being driven by the development of new customers while retaining their existing book. Thus, in such a circumstance a negative correlation is prescribed. On the other hand, higher retentions of an existing book of business is less likely when premium rates are rising although higher premium rates make positive agency premium growth easier. Therein lies a reason to consider positive correlation. However, without an empirical hook on which we can hang an assumption, we explore both sides of the correlation dimension which will permit us to gauge whether the type of correlation is consequential to the decision.[26]

Table 6a

($\rho_{\text{loss ratio, growth}} = 0.50$; $\rho_{\text{growth, retention}} = -0.25$; $\rho_{\text{loss ratio, retention}} = -0.125$)

		Loss ratios					
		Low, low-risk		**Low, high-risk**		**Medium, low-risk**	
		$\mu = 25\%; \sigma = 5\%$		$\mu = 25\%; \sigma = 20\%$		$\mu = 40\%; \sigma = 5\%$	
		Contract 1	**Contract 2**	**Contract 1**	**Contract 2**	**Contract 1**	**Contract 2**
Growth expectations							
negative, low-risk	**mean**	\$15.71	**\$20.80**	\$13.55	**\$21.37**	\$12.80	\$11.80
$\mu = -10\%; \sigma = 10\%$	**std.**	\$18.77	**\$9.80**	\$18.10	**\$12.99**	\$15.67	\$5.85
	CV	1.19	**0.47**	1.34	**0.61**	1.22	0.50
negative, high-risk	**mean**	\$21.60	**\$30.49**	\$18.49	**\$28.74**	\$17.49	\$16.58
$\mu = -10\%; \sigma = 20\%$	**std.**	\$27.82	**\$33.02**	\$27.02	**\$32.46**	\$22.82	\$17.10
	CV	1.29	**1.08**	1.46	**1.13**	1.30	1.03
positive, low-risk	**mean**	\$59.37	\$65.04	\$54.98	\$59.91	**\$47.50**	\$35.34
$\mu = 10\%; \sigma = 10\%$	**std.**	\$19.21	\$49.57	\$25.98	\$52.70	**\$17.66**	\$27.03
	CV	0.32	0.76	0.47	0.88	**0.37**	0.76
positive, high-risk	**mean**	\$54.74	\$74.81	\$48.19	\$67.46	**\$42.38**	\$40.00
$\mu = 10\%; \sigma = 20\%$	**std.**	\$34.44	\$64.51	\$36.77	\$68.17	**\$29.31**	\$35.02
	CV	0.63	0.86	0.76	1.01	**0.69**	0.88

[26]Older agencies may have the opportunity to reasonably estimate this correlation depending on available historical data.

Table 6b

($\rho_{\text{loss ratio, growth}} = 0.50$; $\rho_{\text{growth, retention}} = -0.25$; $\rho_{\text{loss ratio, retention}} = -0.125$)

		Loss ratios					
		Medium, high-risk		High, low-risk		High, high-risk	
		μ = 40%; σ = 20%		μ = 55%; σ = 5%		μ = 55%; σ = 20%	
		Contract 1	Contract 2	Contract 1	Contract 2	Contract 1	Contract 2
Growth expectations							
negative, low-risk	mean	$8.55	**$13.03**	$0.62	**$3.09**	$3.42	**$6.10**
μ = -10%; σ = 10%	std.	$14.30	**$10.26**	$3.86	**$2.88**	$9.00	**$7.08**
	CV	1.67	**0.79**	6.26	**0.93**	2.63	**1.16**
negative, high-risk	mean	$11.19	**$15.88**	$0.88	**$3.76**	$4.33	**$6.93**
μ = -10%; σ = 20%	std.	$20.28	**$18.84**	$5.70	**$4.83**	$12.69	**$10.57**
	CV	1.81	**1.19**	6.50	**1.28**	2.93	**1.52**
positive, low-risk	mean	**$39.46**	$34.17	$5.35	**$8.15**	$19.78	$14.56
μ = 10%; σ = 10%	std.	**$26.78**	$34.48	$14.04	**$9.01**	$24.11	$19.98
	CV	**0.68**	1.01	2.63	**1.11**	1.22	1.37
positive, high-risk	mean	$32.80	$38.34	$3.23	**$8.57**	$14.73	**$15.28**
μ = 10%; σ = 20%	std.	$32.25	$45.43	$11.61	**$10.97**	$24.33	**$24.48**
	CV	0.98	1.18	3.59	**1.28**	1.65	**1.60**

We look at contractual values under both a slight negative (-0.25) and positive (0.25) correlation between premium growth and retention rates. Finally, for consistency among the three variables where correlation exists, we assume that the correlation between the loss ratio and the retention ratio is the product of the other two correlations.[27]

Table 6a and 6b, taken together, report 24 different contractual value comparisons under the assumptions that premium growth and loss ratios are positively correlated, while premium growth and retention is negatively correlated. Contract (2) has the higher expected value and lower risk for 13 of the 24 scenarios while Contract (1) has 3 of 24 such scenarios. Notable is that among the 8 scenarios with a mean loss ratio of 0.55, Contract (2) has higher expected value and lower statistical risk in 7 of

[27]Interested readers can see http://www.theactuary.com/features/2013/09/modelling-mastering-the-correlation-matrix/.

them. The economic value in the positive correlation of 0.5 between premium growth and loss ratios is still bounded by the 0.50 loss ratio restriction in Contract (1). Among the remaining 8 scenarios where higher expected contract value comes with higher relative risk, Contract (2) has both higher expected value and higher risk for 5 of them.

Development of Tables 7a and 7b is different only because of the change to positive correlation between growth and retention and loss ratio and retention. At the highest mean loss ratio, Contract (2) has higher expected value and lower overall risk in 6 of the 8, however, the other 2 scenarios where premium growth is positive, Contract (1) has those characteristics. The latter is the primary change in overall results due to the sign of the correlation between growth and retention. Positive correlation has perked up the relative risk of Contract (2)'s. Overall, Contract (2) has the higher expected value in 18 of the scenarios and in 13 of these scenarios has lower risk, too.

Table 7a

($\rho_{\text{loss ratio, growth}} = 0.50$; $\rho_{\text{growth, retention}} = 0.25$; $\rho_{\text{loss ratio, retention}} = 0.125$)

		Loss ratios					
		Low, low-risk		**Low, high-risk**		**Medium, low-risk**	
		μ = 25%; σ = 5%		μ = 25%; σ = 20%		μ = 40%; σ = 5%	
		Contract 1	**Contract 2**	**Contract 1**	**Contract 2**	**Contract 1**	**Contract 2**
Growth expectations							
negative, low-risk	**mean**	\$16.53	**\$21.52**	\$13.73	**\$21.02**	\$12.46	\$12.07
μ = -10%; σ = 10%	**std.**	\$18.94	**\$11.66**	\$18.53	**\$13.80**	\$15.58	\$6.82
	CV	1.15	**0.54**	1.35	**0.66**	1.25	0.56
negative, high-risk	**mean**	\$21.95	**\$31.67**	\$18.71	**\$29.16**	\$16.83	**\$16.98**
μ = -10%; σ = 20%	**std.**	\$27.99	**\$37.36**	\$27.23	**\$34.83**	\$22.75	**\$18.80**
	CV	1.27	**1.18**	1.46	**1.19**	1.35	**1.11**
positive, low-risk	**mean**	\$58.95	\$64.07	\$55.20	\$60.07	**\$47.43**	\$36.39
μ = 10%; σ = 10%	**std.**	\$19.22	\$52.18	\$25.94	\$56.67	**\$18.21**	\$29.86
	CV	0.33	0.81	0.47	0.94	**0.38**	0.82
positive, high-risk	**mean**	\$55.24	\$77.85	\$48.71	\$68.60	**\$42.14**	\$40.66
μ = 10%; σ = 20%	**std.**	\$34.85	\$69.67	\$36.87	\$72.70	**\$29.28**	\$37.90
	CV	0.63	0.89	0.76	1.06	**0.69**	0.93

Table 7b

($\rho_{\text{loss ratio, growth}} = 0.50$; $\rho_{\text{growth, retention}} = 0..25$; $\rho_{\text{loss ratio, retention}} = 0.125$)

		Loss ratios					
		Medium, high-risk		**High, low-risk**		**High, high-risk**	
		$\mu = 40\%; \sigma = 20\%$		$\mu = 55\%; \sigma = 5\%$		$\mu = 55\%; \sigma = 20\%$	
		Contract 1	**Contract 2**	**Contract 1**	**Contract 2**	**Contract 1**	**Contract 2**
Growth expectations							
negative, low-risk	**mean**	\$8.45	**\$12.50**	\$0.70	**\$3.05**	\$3.77	**\$5.92**
$\mu = -10\%; \sigma = 10\%$	**std.**	\$14.14	**\$10.32**	\$4.02	**\$2.74**	\$9.68	**\$6.91**
	CV	1.67	**0.83**	5.75	**0.90**	2.57	**1.17**
negative, high-risk	**mean**	\$11.38	**\$15.88**	\$0.79	**\$3.62**	\$4.30	**\$6.68**
$\mu = -10\%; \sigma = 20\%$	**std.**	\$20.39	**\$20.36**	\$5.15	**\$4.64**	\$12.71	**\$10.14**
	CV	1.79	**1.28**	6.51	**1.28**	2.95	**1.52**
positive, low-risk	**mean**	**\$38.79**	\$33.17	\$5.54	**\$7.80**	**\$19.52**	\$13.49
$\mu = 10\%; \sigma = 10\%$	**std.**	**\$26.92**	\$36.19	\$14.07	**\$9.24**	**\$24.11**	\$19.79
	CV	**0.69**	1.09	2.54	**1.19**	**1.24**	1.47
positive, high-risk	**mean**	\$32.65	\$37.92	\$3.46	**\$8.77**	**\$16.14**	\$16.13
$\mu = 10\%; \sigma = 20\%$	**std.**	\$32.42	\$47.36	\$12.38	**\$11.73**	**\$25.17**	\$26.91
	CV	0.99	1.25	3.58	**1.34**	**1.56**	1.67

c. The decision process

The agency owner-manager wants to make their best decision regarding contract choice and the initial set of results from the uncertainty analysis contains useful information. Importantly, however, is that while the coefficient of variation is the relative statistical measure of the entirety of risk, it doesn't easily meld contractual value and therefore choice with the decision-maker's taste for risk.[28]

For a given scenario, contractual values are bounded by \$0 at the lower end then are distributed with varying degrees of frequency toward an upper end. The decision-maker might want to know, for instance, a worst case contract value for a given scenario. The worst case is subjective but could be described as the 5th or 10th percentile of contract values for a given incentive arrangement under a set of

[28]There is a large literature in "stochastic dominance" which brings together preferences with uncertain choices to help explain decision-making under uncertainty. One starting point for the reader is Levy (1992).

assumptions about the variables that impact value. In essence, the decision-maker is expressing a tolerance for a level of downside risk about uncertain contractual values that will guide the ultimate choice.

To illustrate, suppose an agency structures their decision about a contract based on a 10% downside risk level. In Table 8 we report the 10th percentile for each of a variety scenarios which were reported in Tables 5a through 7b. This subset of scenarios includes premium growth scenarios of +/- 10% with an associated risk of 10% and loss ratios of 25%, 40% and 55% with associated risks of 5%. Loss ratio scenarios were considered at the lower risk level because both incentive arrangements calculate the loss ratio over a three year time horizon and agencies have some actual loss history under current incentive arrangements which can be used to make a decision about whether to switch from their current contracts. Contract values were obtained across the three different assumptions about correlation among premium growth, loss ratio and retention ratio.

To begin, consider contract values under independence in Table 8 when the loss ratio is set at its "low, low-risk" level (μ = 25%; σ = 5%) and premium growth is expected to be negative with low-risk (μ = -10%; σ = 10%). The 10th percentile of contract values for Contract (2) is $10,720 while the 10th percentile of outcomes for Contract (1) is $0. Similar results hold when there is correlation among the variables. Based on these parameters used for this simulation, the chance of Contract (2) having a value below $10,720 is only 10% and, conversely, there is a 90% chance the value will be above $10,720. There is a much higher chance of Contract (1) being valueless and the actual chance of that occurring can be obtained from looking at the full distribution of contract values. We can also note that the overall average contractual value for Contract (2) is higher and overall risk (CV) is lower, and that this scenario was one of the "highlight" scenarios in Tables 5a, 6a, and 7a. However, as will be seen in a moment, relying just on a higher overall average, lower overall risk decision rule may lead to poor choices.

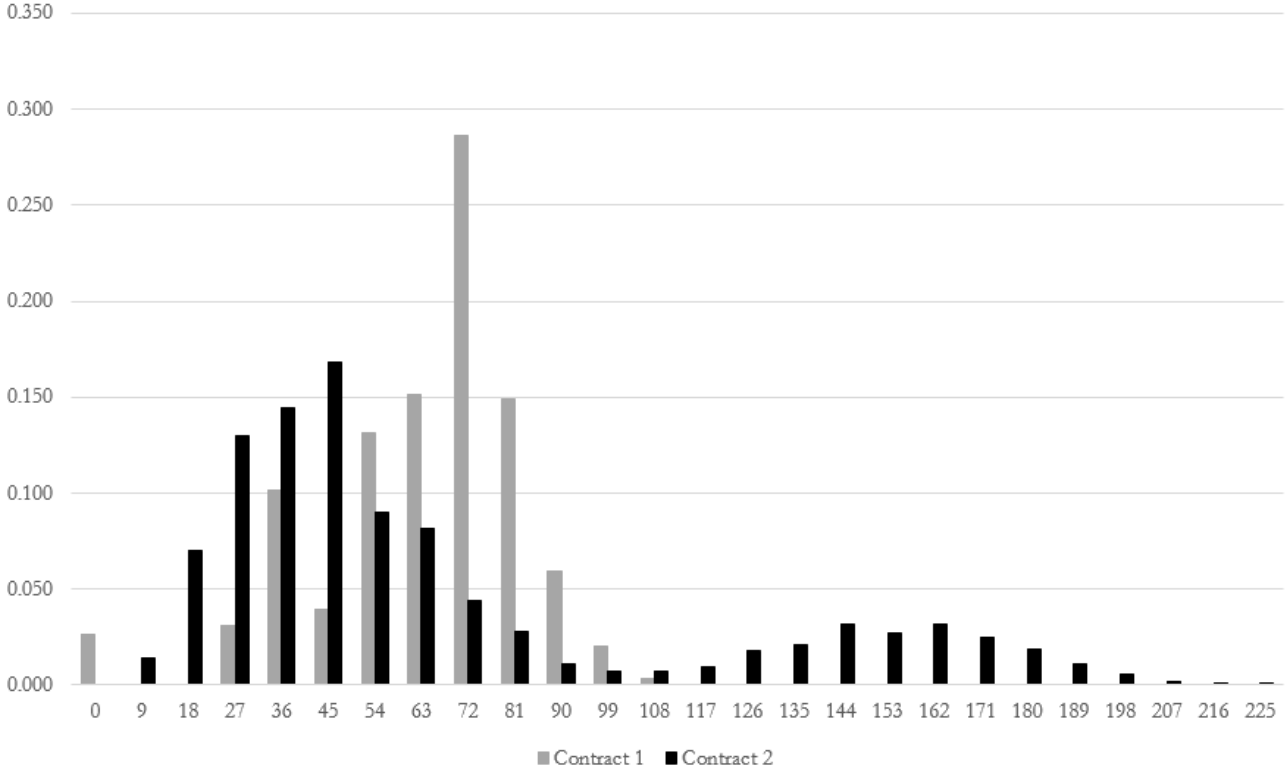
Table 8

		Loss ratios					
		Low, low-risk		**Medium, low-risk**		**High, low-risk**	
		μ = 25%; σ = 5%		μ =40%; σ = 5%		μ = 55%; σ = 5%	
Growth expectations							
I. independence	**Decision threshold**	**Contract 1**	**Contract 2**	**Contract 1**	**Contract 2**	**Contract 1**	**Contract 2**
negative, low-risk							
μ = -10%; σ = 10%	10% value	$0.00	$10.72	$0.00	$5.49	$0.00	$0.00
positive, low-risk							
μ = 10%; σ = 10%	10% value	$30.49	$14.92	$20.76	$8.26	$0.00	$0.00
II. ($\rho_{r,g}$ = 0.50; $\rho_{g,r}$ = 0.25; $\rho_{r,r}$ = 0.125)							
negative, low-risk							
μ = -10%; σ = 10%	10% value	$0.00	$11.29	$0.00	$6.03	$0.00	$0.00
positive, low-risk							
μ = 10%; σ = 10%	10% value	$31.98	$15.05	$21.31	$9.14	$0.00	$0.00
III. ($\rho_{r,g}$ = 0.50; $\rho_{g,r}$ = -0.25; $\rho_{r,r}$ = -0.125)							
negative, low-risk							
μ = -10%; σ = 10%	10% value	$0.00	$11.32	$0.00	$5.90	$0.00	$0.00
positive, low-risk							
μ = 10%; σ = 10%	10% value	$30.95	$20.50	$23.10	$10.92	$0.00	$0.00

Contrast the prior result with the 10th percentile threshold values when loss ratios are low and premium growth is positive. Inspection of Table 8 shows that in each instance of low loss ratios and positive premium growth that Contract (1) has a higher 10th percentile contract value than Contract (2). More specifically, focus on the "low, low-risk" loss ratio with positive premium growth and section III correlations. The decision thresholds for Contracts 1 and 2 are $30,950 and $20,500, respectively. But, in considering the overall average and overall risk results for the complementary scenarios in 5a, 6a and 7a, Contract (2) has the higher expected contractual value albeit with higher overall risk.[29] Figure 6 is relative frequency descriptions of contract value for Contract (1) and Contract (2) for this scenario.

[29]Note that the results reported were based on fresh simulations from those in Tables 5a thru 7b. The large number of trials makes the results comparable.

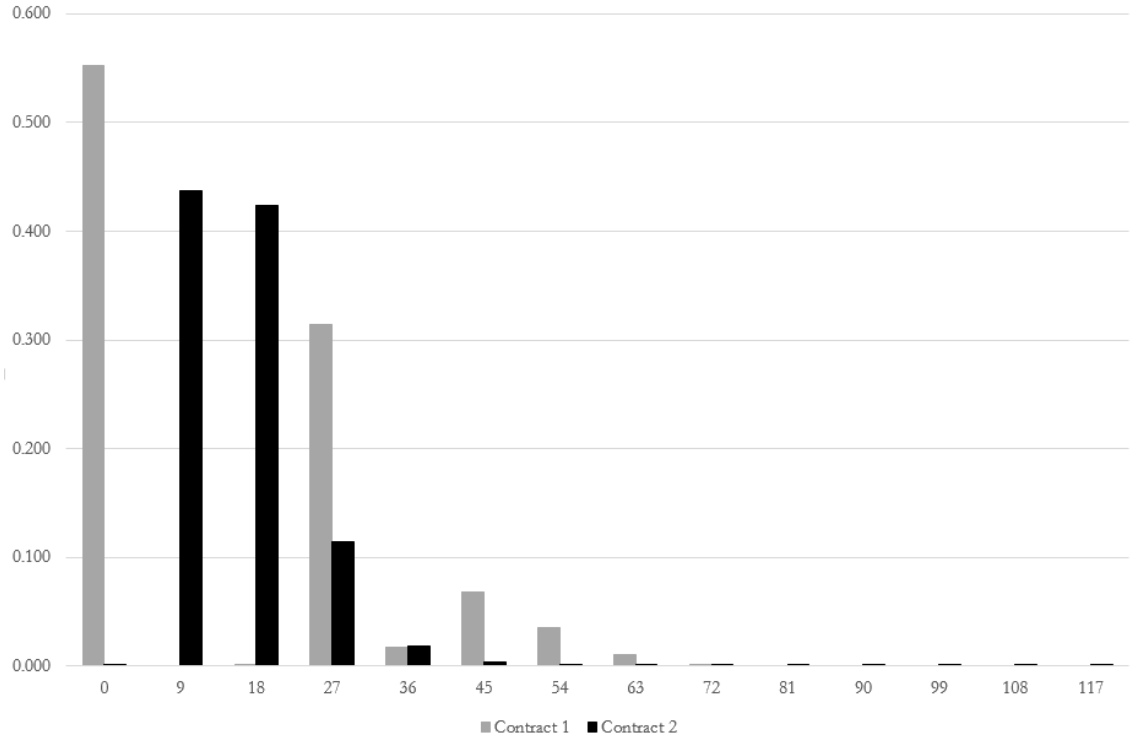
Figure 6
Distributions of contract values*



*Contractual value outcomes based on the low, low-risk loss ratio, positive, low-risk growth expectations and section III correlations

The horizontal axis is Contract value and measured in 000s. It is apparent that most of the outcomes for Contract (1) are situated to the right of the bulk of values for Contract (2), and that Contract (1) is absent outliers that are present in Contract (2). Contract (2) is spread over a much wider range which is driving its higher overall average and higher overall risk. Given the scale of Figure 6 it is difficult to visually observe the relatively few right-hand side outliers; numerically, the 90th percentile of contractual values for Contract (1) is $79,443 and $150,856 for Contract (2). The maximum value for Contract (1) is $107,580 and $221,640 for Contract (2).

Figure 7
Distributions of contract values*



*Contractual value outcomes based under the medium, low-risk loss ratio; negative, low-risk growth expectations and section II correlations

Let's take another scenario. The "medium, low-risk" loss ratio with negative premium growth and section II correlations yields a $6,030 value for Contract (2) at the 10th percentile decision threshold compared to $0 value for Contract (1). Yet, the corresponding scenario in Table 7a shows that Contract (1) has a higher expected value and higher overall risk. Figure 7 can help the decision-maker understand what is driving the overall results. In this figure, 55% of the outcomes for Contract (1) are valueless outcomes and only 1 trial out of 5,000 is between $0 and $27,000. Numerically, 11.6% of the outcomes for Contract (1) are above $45,000 whereas only 0.58% of Contract (2)'s outcomes are above that number. However, only 0.04% of Contract (2)'s outcomes are valueless and 97.5% of Contract (2)'s outcomes reside in the range of $9,000 thru $27,000. What *should* an agency-owner decide? The answer to the question isn't that most decision-makers would elect Contract (2) because it is very likely to have positive

value while Contract (1) is more likely than not to have no value. Rather, the inherent transparency of the more complete analysis leads to more informed decision-making. Combining a worst case methodology with an odds-based understanding of the range of contingency contract values helps decision-makers avoid potential missteps and provides an informed basis from which the agency owner can make more effective decisions.

V. Concluding Remarks

Independent agencies are important to the distribution of property-casualty insurance yet their size and non-public form has not permitted insurance researchers to explore aspects of their operations. After showing the importance of contingency commissions to the cash flow of an agency, this paper offers an analytical approach for agency owners to select among contingency arrangements when the agency is faced with prospects about losses, retention, and premium growth that are inherently uncertain. Important is a reasonable parameterization of the problem prior to valuing competing arrangements through a simulated experiment. Critical, though, is how a decision-maker views the data from the experiment. We offer to the agency owner a downside risk threshold approach to help structure choice that enables agency owners to make value-enhancing choices when confronted by the uncertainties of this decision. The process is scalable to the evaluation of a large number of contingency agreements.

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