

## **A Cryptocurrency Based Insurance Model**

(Full Paper)

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### **ABSTRACT**

Modern insurance has been operating in the same business model since its inception while its recent IT improvement is mainly for specific functions without overall structural review. This paper is to incorporate the concept of a cryptocurrency, called Risk Coin, as the foundation of a new model to enhance the risk financing efficiency with capital market. Risk Coin is 1) a shareholding token of the premium fund with benefits from law-of-large-numbers, and 2) a cryptocurrency with benefits from seigniorage as fiat currency anchored at value of coin fund formed by collected premium and refund from loss payments. Applications in current insurance environment of pipeline model as well as in an innovative environment of platform model are simulated. Both results show a self-balancing mechanism that higher coin value from less coin preference, therefore, encouraging coin receivers to keep coins. Overall the new model will enhance the effectiveness of risk funding by keeping risk coins and also turn insurance deal to a win-win situation from zero-sum game through premium payment as gaining ownership of risk fund.

*Keywords:* cryptocurrency, insurance model, insurtech, block chain

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### **INTRODUCTION**

Information Technology (IT) has been widely adapted to improve efficiency in insurance industry, but overall insurance model is maintained more or less same as pre-IT epoch especially in risk financing arrangements. However, recent development of FinTech vitalizes the research of potential new models for insurance.

In this paper we focus on commercial insurance with the capital circle of Risk – Insurance – Capital – Enterprise, and look into the two-dimension relation of Risk vs. Capital and Risk Owner vs. Capital Owner, where we review two current typical insurance models of Stock Insurance Companies as Risk-Insurance-Capital RIC model and Mutual Insurance Companies as Risk-Pooling-Capital RPC model. Then, a new model, Risk Coin RC model is introduced which is based on the concept of a cryptocurrency called Risk Coin. RC model is switching from RIC and RPC models depending on risk owners' decision to keep Risk Coins which is given to risk owner to a proportion of the paid premium as ownership token of premium fund. As RC model is issuing Risk Coins anchored at the received premium, it is taking the benefit of both currency seigniorage and direct acceptance of coins as risk financing channel.

The implementations of this new model under both current insurance company environment and an innovative environment are discussed and simulated. The results show self-balancing mechanism of Risk Coins which helps its acceptance, as well as better development of the premium fund which assures the success of this new insurance model.

### **LITERATURE REVIEW**

In the last few years, fintech has been adopted progressively in financial industry. Examples technology, insurtech, for insurance industry is also drawing more and more attention. There are many examples, such as bitcoin, have demonstrated the new development in various aspects. The following reviews are categorized to three groups (1) needs and opportunities for changes; (2) adoption and risks of technology; and (3) examples of cryptocurrency.

#### **(1) Needs and Opportunities for Changes.**

Many papers investigate the requirements and impact of changes. Catlin et al. (2017) conclude main threat for insurance industry is upending traditional business model of insurers, instead of insurtechs, to destroy value. Johansson and Vogelgesang (2016) study the impact of automation on insurance industry and conclude some full-time positions in the insurance industry may be consolidated or replaced. There is also paper reviews the landscape and potential of insurance technology for financial and insurance services (Yan et al., 2018). A four-step practical guide to build insurtech value chain ecosystems is proposed by Ivan Gruer (2018). Bernardo Nicoletti (2017) define a business model of insurtech initiatives for changes.

There are many studies point out opportunities to explore for changes. Godsall et al. (2017) focus on mass-market and middle-market in slow economy and propose four strategies to spur growth. Passler (2018) discusses the key differences that are potential to deeply change, or even disrupt, the insurance industry. Many studies further emphasize the opportunities of technology adoption in insurance industry. Gandhi et al. (2017) urge the insurance to embrace digital change quickly, Wilson (2017) describes the future of insurance from viewpoint of technology trend. Hagan (2018) emphasizes the importance of collaboration in development of an InsurTech sector, and Balasubramanian et al. (2017) emphasize the importance of analytics initiatives in

insurance industry.

## **(2) Adoption and Risks of Technology.**

Many papers focus on the track of technology adoption in insurance industry. Catlin et al. (2018) point out ecosystems and platforms as the main chance for new development in insurance industry. Jans (2018) discusses the general concept about insurtech and Nicoletti (2017) discusses the drivers of disruption for insurance industry. Kaniyar et al. (2017) discuss automation (e.g. robotics, cognition, artificial intelligence, and machine learning) at scale in insurance. Cappiello (2018) explain the loss of the interpersonal relationship due to adoption of digital distributive forms and imperative calls for market relationship. Balasubramanian et al. (2018) explore the impact of AI on insurance in 2030 from AI-related trends shaping insurance.

Some papers further explore how to achieve the goal in high level. Gaar and Hupfeld (2017) examine what potential impact Insurtechs could have on the insurer's value chain. Chester et al (2016) advocate insurance carriers and actuaries should adopt the advanced analytics and explain the four-stage journey for adopting advanced analytics. Some papers emphasize the challenges and risks issues. Collins (2018) points out the penetration rate for insurance in China remains low compared to Western measures. Catlin et al. (2016) explain digital transformation in insurance industry needs. Bloemers (2018) concludes insurers need to evolve into organizations offering a much broader set of risk management solutions.

## **(3) Examples of Cryptocurrency**

There are more and more papers from both academic and industry to discuss the application for Cryptocurrency used for insurance. The cryptocurrency and blockchain technology applied for financial industry were extensively discussed (e.g. Scott 2016). Sarasola explained insurers are aware of blockchain technology and how it might impact the industry, but not how it fits in with technology development plans (2018).

Sockiny and Wei Xiong develop a model to determine the fundamental value of a cryptocurrency (2018). Barlyn argues that major global insurers are starting to offer protection against cryptocurrency theft to tackle daunting challenges (2018a). Barlyn also shared that insurers test bitcoin with heist policies for the business (2018b). Several examples have been discussed recently. Ethereum is a good example for Decentralized insurance protocol to collectively build insurance products (2018). Temperley gives an introduction of crypto tokens in insurance (2018). News BT (2018) provides background of a peer-to-peer Ethereum-based decentralized cryptocurrency Insurance platform, BITRUST.

In the above, most of the studies concentrate on future trend, conceptual framework, and impact study. The challenges associated with risk issue are till the focal point. In this paper, we propose a framework of risk coin for insurance industry.

## **PRELIMINARY**

Risk Coin is a cryptocurrency and also a token of ownership of the insurance fund by collected premium and profit of the fund management as well as refund from loss payments. A new insurance operation model is designed to use Risk Coin as risk financing channel which allows switching from mutual insurance to company insurance depending on decisions, to keep or return received Risk Coin, of involve parties including Insureds and/or Risk Carriers by different models. Expectedly Risk Coin can be accepted by capital markets to broaden risk financing scope.

### **Capital Circle**

An insurable risk is a potential financial loss covered by Insurance Contract to pay for the loss when it occurs. Their valuations are in dollar amount, namely premium and Liability/Loss, and therefore can be reviewed in Capital Circle:

- Risk is from activities of Enterprises and requires protection of Insurance.
- Insurance protects Risks and returns profits to Capital for solvency support.
- Capital supports solvency of Insurance and fund Enterprises as investment.
- Enterprise is funded by Capital and upholding Risks from its operations.

Currently insurance is a type of Enterprise with Capital specifically supporting its solvency for amortization of claims payments from collected risks. In order to have broader view of the future of Insurance, we define the role of Insurance as a necessary function which can be performed in different ways and not necessarily by an Enterprise. When it is performed by an Enterprise, this Enterprise is different from Risk Owners, although it can be invested by one or a group Risk Owners.

On the other hand, Enterprise is Risk Owner that the insurable risks are resulted from its activities of business operations. Insurable risks including buildings and machineries for manufacturing; Enterprise's liability such as public liability and products liability from its business operation; estimated income as Business Interruption coverage and investment in new factories as Construction All Risks coverage.



Figure 1: Capital Circle

To simplify these roles in RICE circle, we focus on the relation of Risk and Capital so as to better verify the purposes of insurance:

- For Risk Owners: to obtain insurance protection at an affordable price;
- For Risk Carriers: to know the risk the risks to a level that a right price can be provided;
- From the overall view of Capital: to improve the capital efficiency to amortize the loss (or potential loss) via law of large numbers and fund management of collected premium.

From the first two points are addressing the legal definition of insurance that, once the price is agreed by both parties, the insurance contract is concluded that one party will have to pay the premium and the other will have to pay for the loss if the covered loss occurred. The third point is addressing the financial definition of insurance that the loss or potential loss is spread so that single Risk Carrier do not have to maintain substantial capital to sustain its operations/ activities, therefore improving the overall capital efficiency of the whole society.

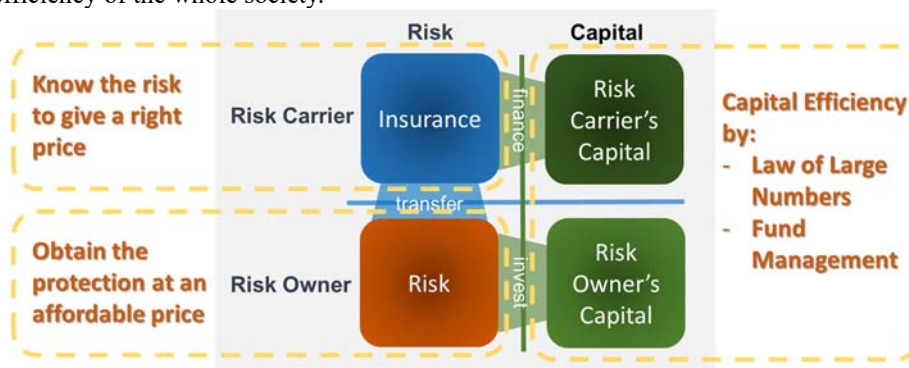


Figure 2: Purposes of Insurance

Any modification of this model will be of important value if it will bring better efficiency to serve these purposes.

### Insurance Models – Current and New

From financial definition, we can review insurance models from two dimensions:

- Risk vs Capital, where Capital can be formed by accumulation of risk premium or from other sources of capital market
- Risk Owner vs Risk Carrier, where risk carrier means the party other than original risk owner and pays for the risk losses.

#### (1) Risk – Insurance – Capital (RIC) Model

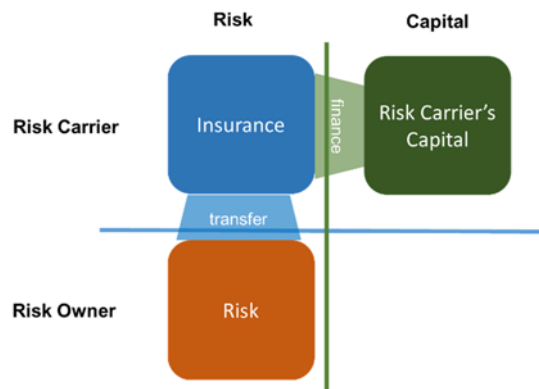


Figure 3: RIC Model

Usually called Stock Insurance Companies: “a publicly traded corporation owned by its stockholders. However, a stock company can be owned by other stock or mutual companies. The objective of a stock company is to make a profit for the stockholders. The policyholders do not directly share in the profits or losses of the company. To operate as a stock corporation, an insurer must

have a minimum of capital and surplus on hand before receiving approval from state regulators.”

## (2) Risk – Pooling – Capital (RPC) Model

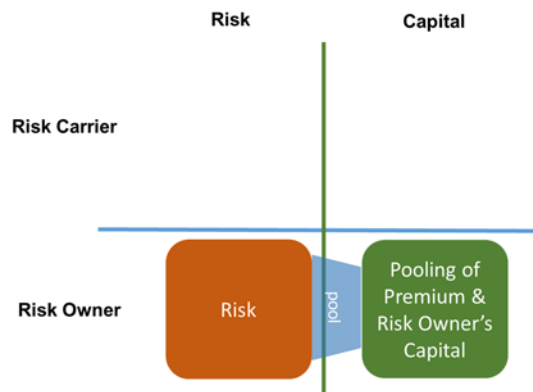


Figure 4: RPC Model

Usually called Mutual Insurance Companies: “a corporation owned exclusively by the policyholders who are "contractual creditors" with a right to vote for the Board of Directors. Generally companies are managed, and assets -- insurance reserves, surplus, contingency funds, dividends -- are held for the benefit and protection of the policyholders and their beneficiaries. Management and the Board of Directors determine what amount of operating income is paid out each year as a dividend to the policyholders. While not guaranteed, there are companies that have paid a dividend every year, even in difficult economic times.”

## A New Model – Risk Coin (RC) Model

In view of previous discussions of RICE circle and current insurance models, we devise a new Model based on a cryptocurrency called Risk Coins:

- Risk owners' receive Risk Coins equivalent or proportional to paid premium. Risk Coins are the proof of shareholding of collected premium fund.
- When claims, loss suffered risk owner can choose to return received Risk Coins for full claims payment, or to keep received Risk Coins by deducting the equal value of received Risk Coins from claims payment.
- Once the loss suffered risk owner chooses to return received Risk Coins the insurance is same as buy insurance from a Stock Insurance Company, Risk Coin model becomes RIC model.
- If the loss suffered risk owner chooses to keep Risk Coins the insurance the risk owner keeps its shareholding as a Mutual Insurance Company, Risk Coin model becomes RPC models.
- Risk Coin is the proof of shareholding and its unit value is defined as total premium fund divided by total number of Risk Coins in the market, namely not returned when claims occurred.
- As premium fund will grow due to investment and accumulation from previous years, its value will fluctuate. Mechanism is also designed and test to be sure of its positive development of value.

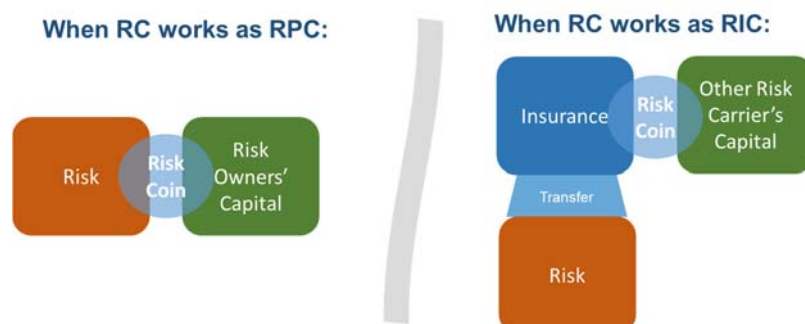


Figure 5: Risk Coins Model working as RPC and RIC models

The above figure “Risk Coins Model working as RPC and RIC models” expresses RC model switching to RIC model or RPC model, depending on Coin Receiver’s decision to keep or return Coins when loss occurred.

## Risk Coin model with external risk carriers

In this extension, reinsurance premium is paid in Risk Coins of equivalent value when reinsurance is arranged for:

- Stabilizing the performance during early stage of portfolio building;
- Representing an insurer’s retention if the insurer is adapting this model and participating the risk pool as a pure risk carrier.
- Making Reinsurers the additional party to pay for the loss, to expedite the collection of premium fund.

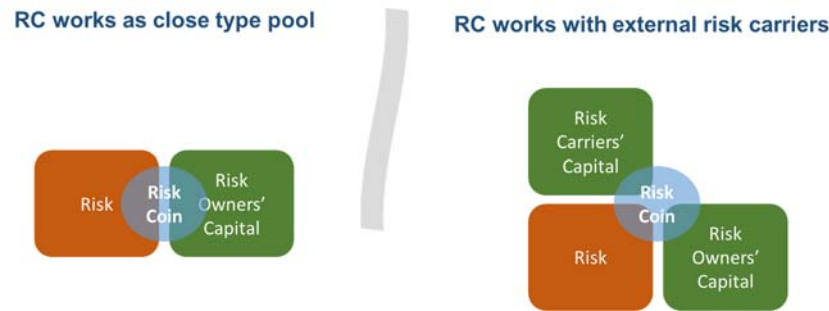


Figure 6: RC Model with External Risk Carriers

### ***Risk Coin model with external capital market***

Once Risk Coins are accepted in open market, the returned Coins or additional Coins can be issued as supplementary to the fund as a direct risk funding channel, and the more investors accepting Risk Coins will push up the value of Coins.

By doing this, there are three different risk financing channels and Network effect will be enhanced as more participants accepting the Coins. For capital market, Risk Coin is a type of fiat currency with anchoring its unit value, and its unit price may fluctuate in market which will be discussed in later chapter.



Figure 7: RC Model with External Capital Market

### **APPLICATION OF RC MODEL**

Two types of environments for implementation of RC model are discussed:

- Current Insurance Environment, CIE: This is to apply RC model to current insurance environment that insurance companies and brokers are same as today's insurance industry. Risk Coins will be issued to Insureds as incentive to join the pool and to Reinsurers as reinsurance premium.
- BlockChain Environment, BCE: This is to apply RC model in an internet environment with blockchain or similar technology, with new business entity to provide necessary functions. Risk Coins will be issued only to Insureds for there's no reinsurance arrangement.

The proposed percentages in following are applied to simulations in later chapter and be adjusted to fit the real implementations.

### **CIE Application**

The first method is to incorporate RC model in current insurance environment. Following points for this scenario, some of them are not exactly same as today's arrangements:

- All underwriting, accounting and claims handling are same as today's operations.
- All accumulated risks ceded by reinsurance treaty to reinsurers. Company's retention is considered as one of the reinsurers.
- Coins are issued to risk owners as incentive and to reinsurers for 100% of liability for claims payment.
- Insurance Company is making revenue from management of the premium fund, therefore no commission income.

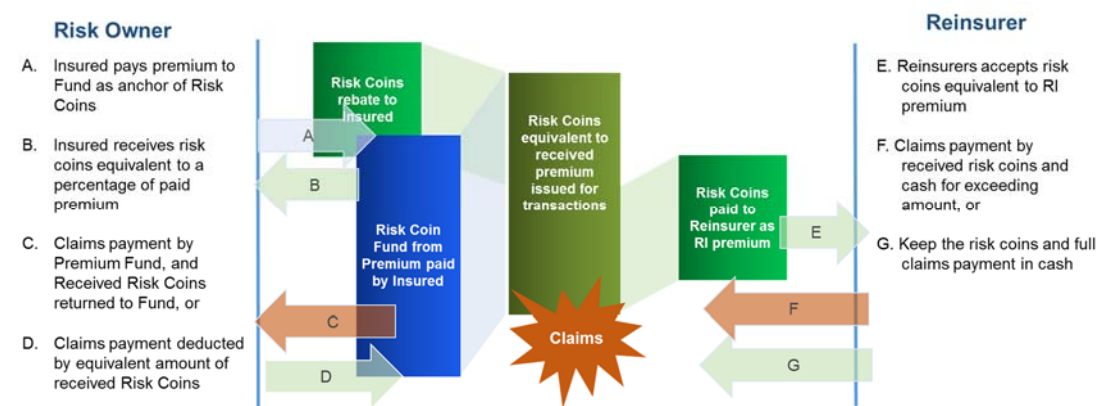


Figure 8: Procedure of CIE Application

A quick review of the performance of this design on assumption:

- \$100 as premium income with 65% loss ratio on underwriting year basis
- Insured and reinsurers can choose to keep risk coins or return risk coin for loss payment in cash.
- Risk coins kept by Insured and Reinsurer are considered risk coins in market.

Four scenarios as following are shown below and the results show self-balancing nature that less preference of keeping coins will make higher coin value.

#### Scenario I of CIE

Table 1: CIE - Insured returns coins and Reinsurer returns the coins

		RC Model		Insured		Reinsurer		Remark
		Fund	Risk Coin	Fund	Risk Coin	Fund	Risk Coin	
A	Insured pays premium to Fund as anchor for Risk Coins	100	100	-100				
B	Insured receives risk coins equivalent to 35% of paid premium		-35		35			
C	Claims payment by Fund and Risk Coins returned to Fund, or	-65	35	65	-35			Insured returns coins
D	Claims payment deducted by equivalent amount							
E	Reinsurer accepts Risk Coins equivalent to RI premium		-65				65	
F	Claims payment by Risk Coins and cash for exceeding amount, or		65				-65	Reinsurer returns coins
G	Keep Risk Coins and full claims payment in cash							
RESULT		35	100	-35	0	0	0	
Risk Coin in Market			0					
Fund for Risk Coin in Market			35					
Market Coin Value			N/A					

#### Scenario II of CIE

Table 2: CIE - Insured keeps coins and Reinsurer returns coins

		RC Model		Insured		Reinsurer		Remark
		Fund	Risk Coin	Fund	Risk Coin	Fund	Risk Coin	
A	Insured pays premium to Fund as anchor for Risk Coins	100	100	-100				
B	Insured receives risk coins equivalent to 35% of paid premium		-35		35			
C	Claims payment by Fund and Risk Coins returned to Fund, or	-65		65				
D	Claims payment deducted by equivalent amount	35		-35				Insured keeps coins
E	Reinsurer accepts Risk Coins equivalent to RI premium		-65				65	
F	Claims payment by Risk Coins and cash for exceeding amount, or		65				-65	Reinsurer returns coins
G	Keep Risk Coins and full claims payment in cash							
RESULT		70	65	-70	35	0	0	
Risk Coin in Market			35					
Fund for Risk Coin in Market			70					
Market Coin Value			2.00					

#### Scenario III of CIE

Table 3: CIE - Insured returns coins and Reinsurer keeps coins

		RC Model		Insured		Reinsurer Carrier		Remark
		Fund	Risk Coin	Fund	Risk Coin	Fund	Risk Coin	
A	Insured pays premium to Fund as anchor for Risk Coins	100	100	-100				
B	Insured receives risk coins equivalent to 35% of paid premium		-35		35			
C	Claims payment by Fund and Risk Coins returned to Fund, or	-65		65				
D	Claims payment deducted by equivalent amount		35		-35			Insured returns coins
E	Reinsurer accepts Risk Coins equivalent to RI premium		-65				65	
F	Claims payment by Risk Coins and cash for exceeding amount, or							
G	Keep Risk Coins and full claims payment in cash	65				-65		Reinsurer keeps coins
RESULT		100	35	-35	0	-65	65	
Risk Coin in Market			65					
Fund for Risk Coin in Market			100					
Market Coin Value			1.54					

#### Scenario IV of CIE



Table 4: CIE - Insured keeps coins and reinsurer keeps coins

		RC Model		Insured		Reinsurer		Remark
		Fund	Risk Coin	Fund	Risk Coin	Fund	Risk Coin	
A	Insured pays premium to Fund as anchor for Risk Coins	100	100	-100				
B	Insured receives risk coins equivalent to 35% of paid premium		-35		35			
C	Claims payment by Fund and Risk Coins returned to Fund, or	-65		65				
D	Claims payment deducted by equivalent amount	35		-35				Insured keeps coins
E	Reinsurer accepts Risk Coins equivalent to RI premium		-65				65	
F	Claims payment by Risk Coins and cash for exceeding amount, or							
G	Keep Risk Coins and full claims payment in cash	65				-65		Reinsurer keeps coins
RESULT		135	0	-70	35	-65	65	
Risk Coin in Market			100					
Fund for Risk Coin in Market			135					
Market Coin Value			1.35					

### BCE Application

Second method is to apply RC model in a full internet community, such as in a Block Chain environment, to avoid monopoly of business solicit and underwriting. An example can be as:

- Units are set up in community for both business solicit and risk underwriting, called SU units. Risks are solicited by SU and submitted to the community.
- Submitted risks for underwriting by SUs other than the SU submitting this risk, to avoid monopoly.
- Accepted risks are classified in pools to reach certain homogeneous level and scale to maximize the law-of-large-numbers principle.
- Classified pools can sustain itself, or supported by Capital Market.
- Coins of a certain percentage of written premium is given to risk owner, as incentive to join the fund. The effect of percentage will be discussed later.
- Additional coin issuance when necessary to supplement the fund or to finance large losses.
- Example of rules and mechanism in underwriting and solicit as following:
- Submitted risk to be underwritten by 3 SUs, and the middle price is treated as the price produced by the community.
- SU which submits a risk will get a reward. The submitted risk eventually been accepted as bound business will be additional reward.
- SU which quotes accepted price will get a reward. This reward can be the permission to submit new risks to the community.

The above rules are set to avoid any SU becoming monopoly at the same time encouraging SU to improve their capability in risk assessment for acceptable quotations.

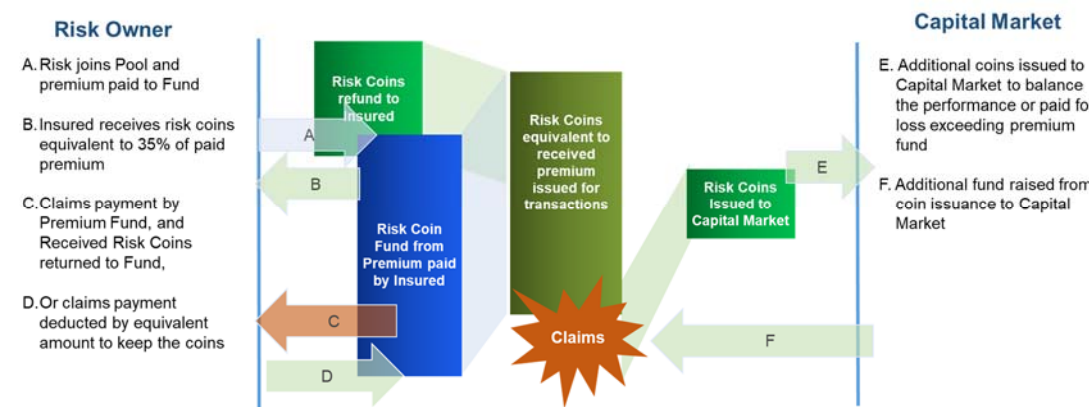


Figure 9: Procedure of BCE

Similar to CIE except no reinsurance, all losses will be financed by the premium fund. As only Insured's preference is concerned, there are only two scenarios and the results are similar to Scenario I and II under CIE.

As there is no reinsurers' involvement, we will calculate unit value under only two scenarios of Insured's decision to keep or return coins when loss occurred.

Following are two scenarios below show the changes of values of Coin in market and of the fund supporting the coin value, depending on the decisions of Insured and Reinsurer to keep or return received coins.

### Scenario I of BCE

Table 5: BCE - Insured chooses to keep coins

		RC Model		Insured		Reinsurer		Remark
		Fund	Risk Coin	Fund	Risk Coin	Fund	Risk Coin	
A	Insured pays premium to Fund as anchor for Risk Coins	100	100	-100				
B	Insured receives risk coins equivalent to 35% of paid premium		-35		35			
C	Claims payment by Fund and Risk Coins returned to Fund, or	-65		65				
D	Claims payment deducted by equivalent amount	35		-35				Insured keeps coins
RESULT		70	65	-70	35	0	0	
Risk Coin in Market		35						
Fund for Risk Coin in Market		70						
Market Coin Value		2						

### Scenario II of BCE

Table 6: BCE - Insured chooses to return coins

		RC Model		Insured		Reinsurer		Remark
		Fund	Risk Coin	Fund	Risk Coin	Fund	Risk Coin	
A	Insured pays premium to Fund as anchor for Risk Coins	100	100	-100				
B	Insured receives risk coins equivalent to 35% of paid premium		-35		35			
C	Claims payment by Fund and Risk Coins returned to Fund, or	-65	35	65	-35			Insured Returns the coins
D	Claims payment deducted by equivalent amount							
RESULT		35	100	-35	0	0	0	
Risk Coin in Market		0						
Fund for Risk Coin in Market		35						
Market Coin Value		N/A						

### Observations

Under CIE, the value of Risk Coins in market is not the highest when Coins are most popular that both Insured and Reinsurer are keeping risk coins. To generalize this observation we assume, under certain conditions, the less popular of coin the higher value of the coin value, and this will give extra incentive for coin receivers to keep them. We will be explore further in the simulations of later chapter.

Also in this quick review of performance, we assume one Insured and one Reinsurer in the scenarios. For Reinsurer side under CIE, this does not affect the result if to change to multiple Reinsurers. But for Insured side under both CIE and BCE, it does affect the results if change to multiple Insureds.

As losses among multiple Insureds occur randomly with loss amount usually much larger than the suffering Insured's paid premium. Even if all Insureds do not want to keep coins, those who do not suffer losses will not have chance to return coins and there's always some coins in the market. Therefore, a percentage of loss, called Refundable Loss Ratio, is defined to make the simulations closer to real situations with the basic trend of bring lower when the more Insureds in the portfolio, and higher with more evenly occurred loss amount.

## SIMULATION FOR GENERAL INSURANCE

Understanding from observations of quick performance review, general assumptions are setting as below for simulations in this chapter.

### General Assumption for Both CIE and BCE

First we set up a simplified growing insurance portfolio running for 20 years as the simulation basis with following assumptions:

- New premium at first year is 100, and incremental by 10% in every following year. Premium renewal ratio is 70%.
- Underwriting Year Loss Ratio is 65%, claims occurring evenly over 4 years.
- Collected Premium Fund is managed with 5% investment return.
- Refundable Loss Ratio/Amount to simulate single insured's received coins being part of total individual loss amount.
- Returning Ratio is defined as percentage of Refundable Loss Amount from 0%, increased by 10% to 100%, altogether 11 sets marked as R0% to R100%, to simulate different level of coin preference. Comparison is made for fixed preference levels over 20 years.



- Coins given to insured at previous years' coin value and first year coin value is 1.
- Coin issuance ratio to Insured is 35% of premium and 65% of premium to Reinsurer for CIE.
- Coin issuance ratio to Insured will be a range including 35% for BCE.
- Additional Coin Issuance Ratio is also tested to the maximum level that the self-balancing nature of Risk Coin can still be maintained.

Developments of coin value and fund value are derived from the above portfolio with different settings of Refundable Loss Ratio, Returning Ratio, Coin Issuance Ratio and Additional Coin Issuance Ratio.

### Simulation - CIE

Firstly let's check Basic Conditions of Insured 35%/ Reinsurer 65% coin split, with 10% Refundable Loss Ratio and Returning Ratio from 0% to 100%:

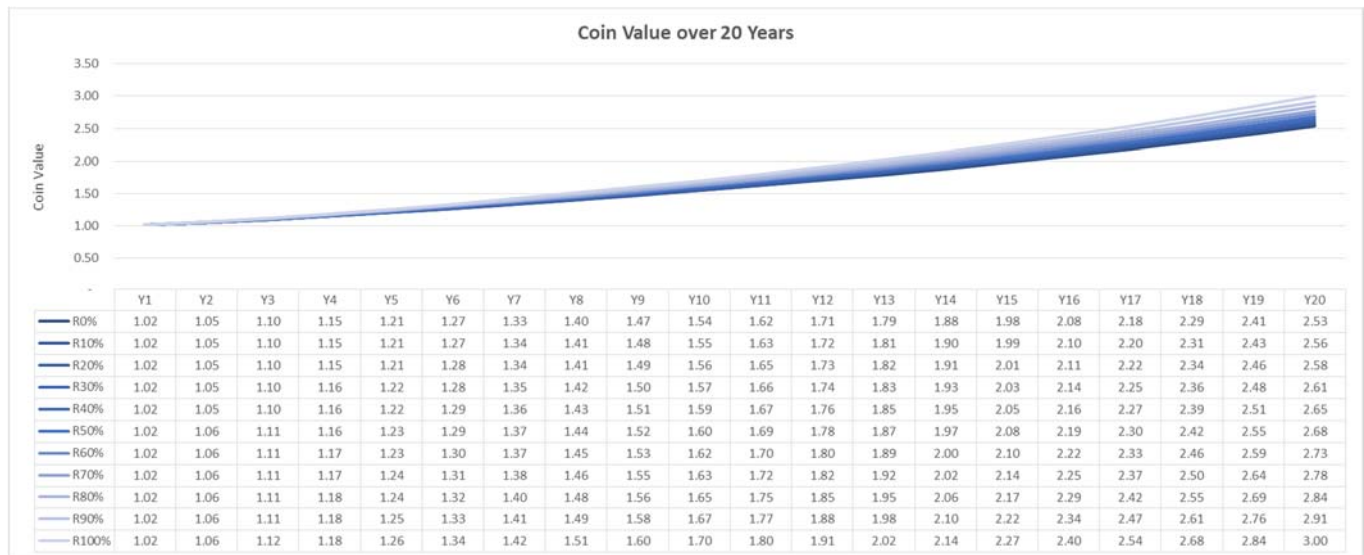


Figure 10: Coin Value over 20 Years under CIE

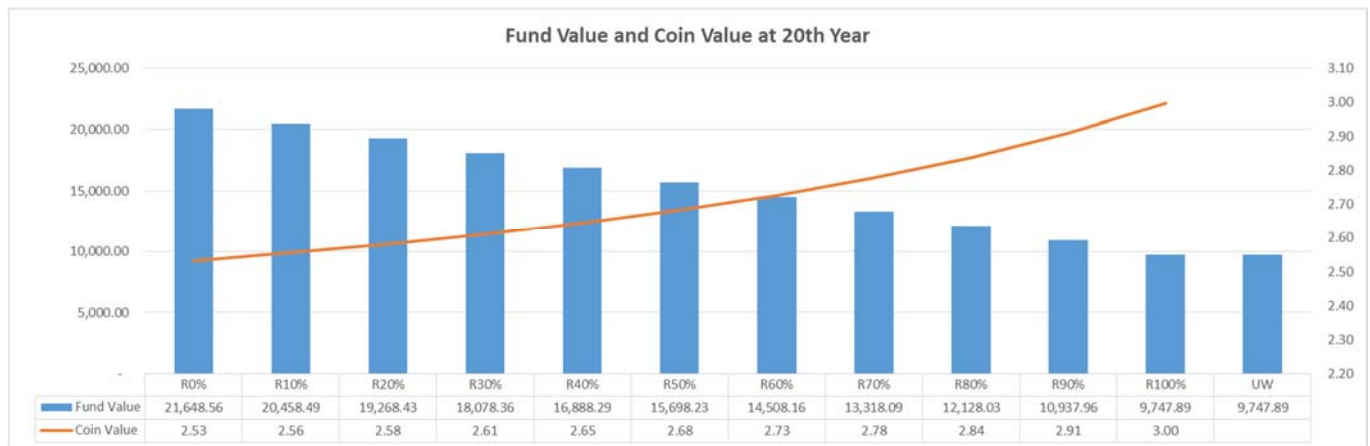


Figure 11: Fund Value and Coin Value at 20<sup>th</sup> Year under CIE

In the above chart, UW represents the result of no coin issuance as existing insurance model, to compare with different level of coin preference in RC model.

Overall, the coin value is increasing over 20 years, and the less preference of coin the higher coin value.

We can further check the effects of different Refundable Loss Ratio from 5% to 30%:

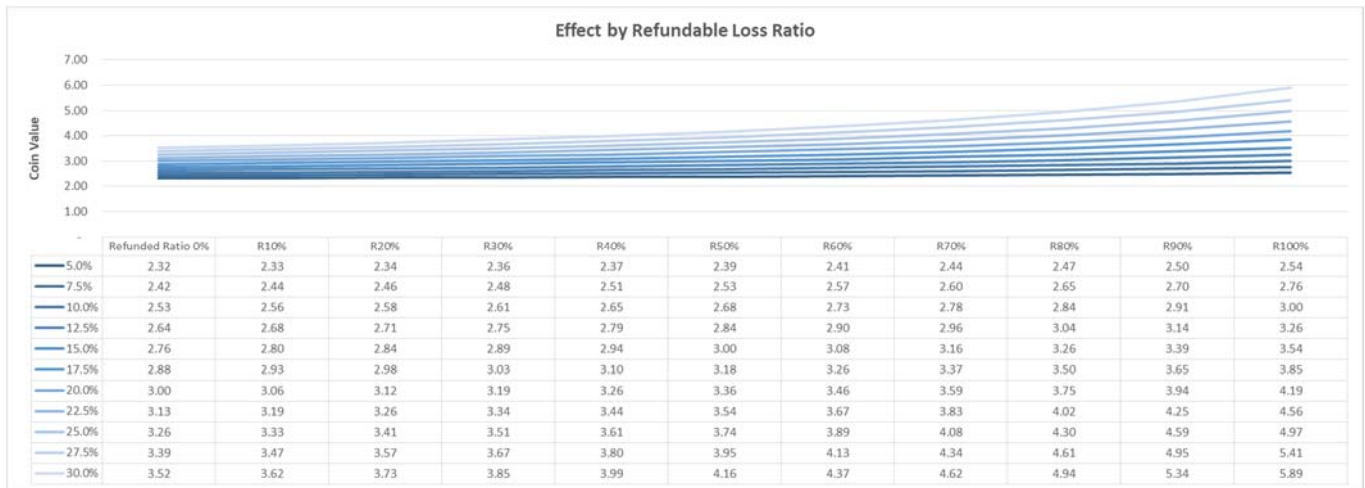


Figure 12: Effect by Refundable Loss Ratio on Coin Value under CIE

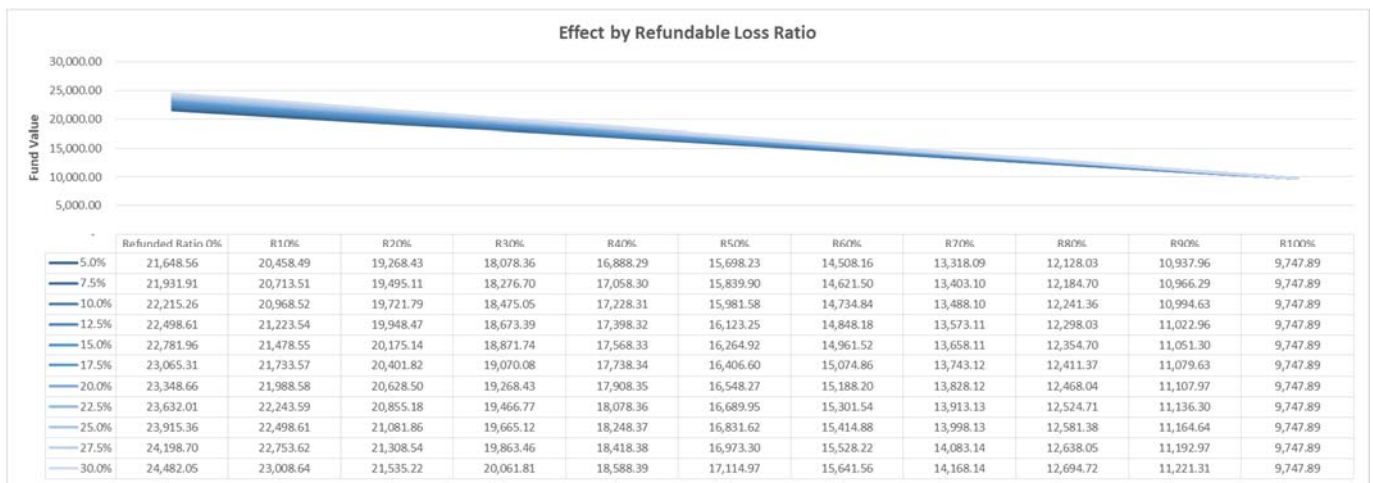


Figure 13: Effect by Refundable Loss Ratio on Fund Value under CIE

From the above charts, high Refundable Loss Ratio will cause both high Coin Value and Fund Value, but:

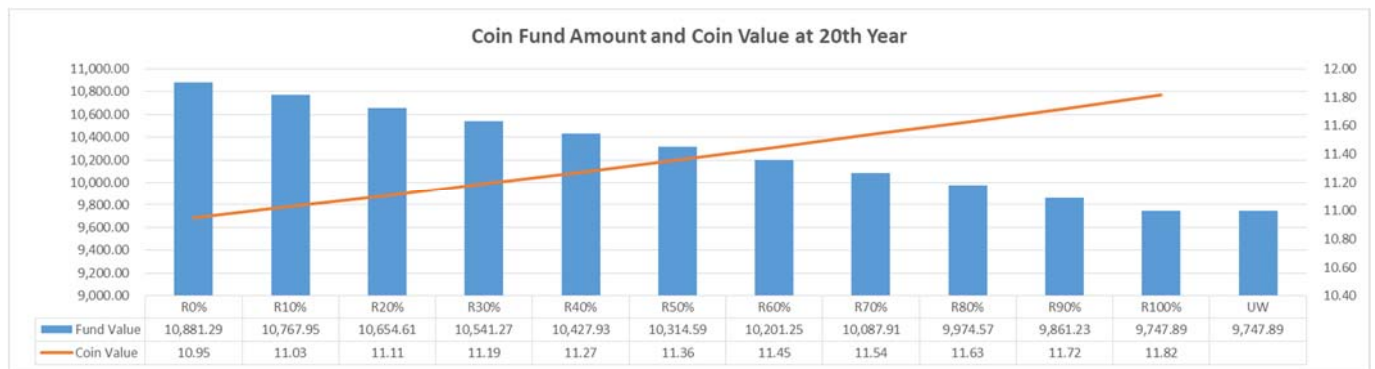
- More significant when Refunded Ratio is high for Coin Value;
- More significant when Refunded Ratio is low for Fund Value.

### Simulation - BCE

Starting from coin issued to Insured at 35%, with 10% Refundable Loss Ratio from 0% to 100%:



Figure 14: Coin Value over 20 Years under BCE

Figure 15: Fund Value and Coin Value at 20<sup>th</sup> Year under BCE

The result looks similar as that under CIE for fund value and coin value at 20<sup>th</sup> year, fund value is about half of CIE while coin value is about four times.

Result of different levels of Refundable Loss Ratio:



Figure 16: Effect by Refundable Loss Ratio on Coin Value under BCE



Figure 17: Effect by Refundable Loss Ratio on Fund Value under BCE

Similar result as in CIE that High Refundable Loss Ratio will cause both high Coin Value and Fund Value.

Levels of Coin Issuance to Insured while Refundable Loss Ratio fixed at 10%:

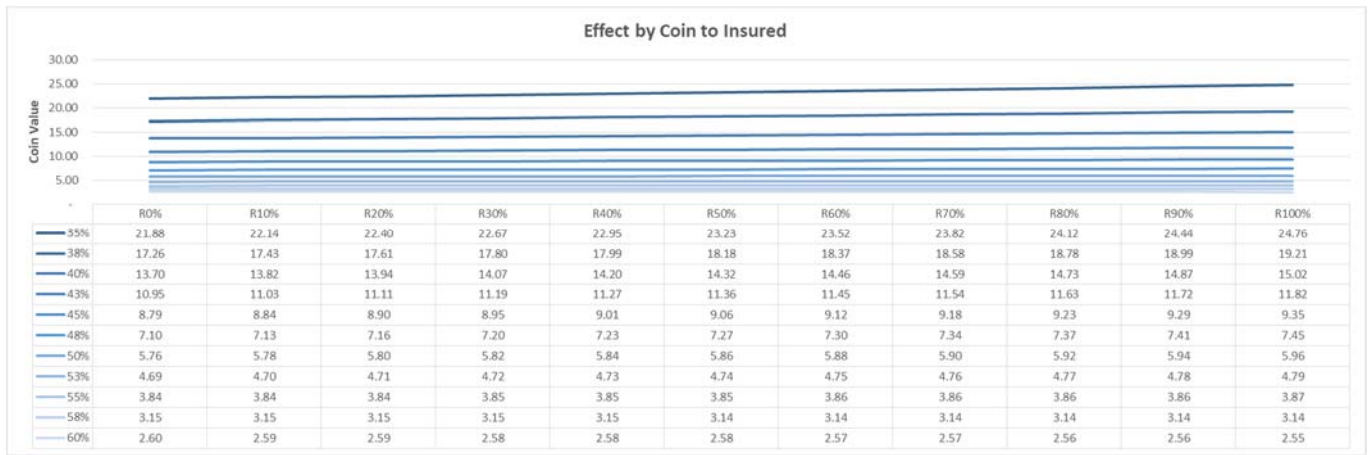


Figure 18: Effect by Coin to Insured on Coin Value under BCE – Refundable Loss Ratio at 10%

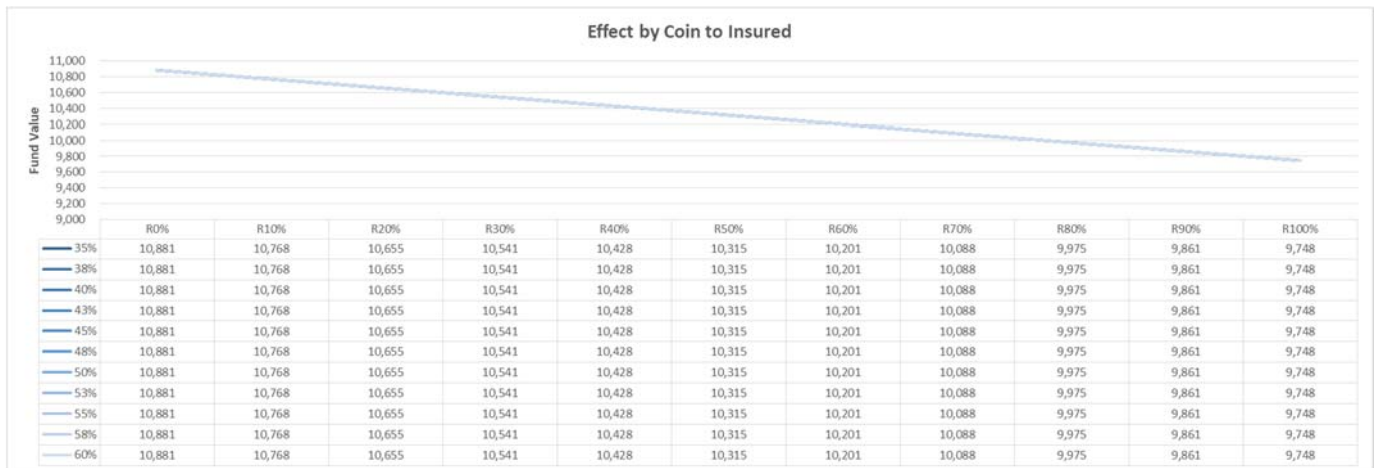


Figure 19: Effect by Coin to Insured on Fund Value under BCE - Refundable Loss Ratio at 10%

Levels of Coin Issuance to Insured while Refundable Loss Ratio fixed at 20%:

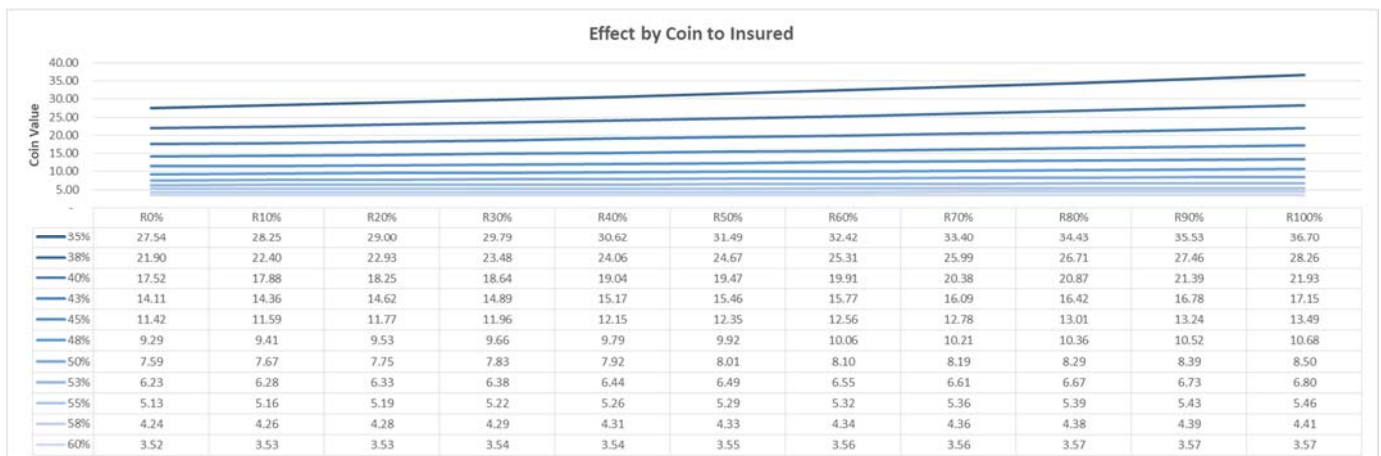


Figure 20: Effect by Coin to Insured on Coin Value under BCE – Refundable Loss Ratio at 20%





Figure 21: Effect by Coin to Insured on Fund Value under BCE – Refundable Loss Ratio at 20%

Higher ratio of Coin Issuance reduces coin value but Fund Value remains the same.

### Effect of Additional Coins

We will check the effect of Additional Coins for following scenarios, while self-balancing can be still maintained:

- CIE: Insured 35%/ Reinsurer 65% coin split, with 10% Refundable Loss Ratio
- CIE: Insured 30%/ Reinsurer 65% coin split, with 10% Refundable Loss Ratio, the 5% difference is extra room for additional coins.
- BCE: Coin to Insured at 35%, with 10% Refundable Loss Ratio
- BCE: Coin to Insured at 50%, with 20% Refundable Loss Ratio which is to reflect the higher ratio of Coin to Insured at 50%.

**CIE: Insured 35%/ Reinsurer 65% split, with 10% Refundable Loss Ratio**

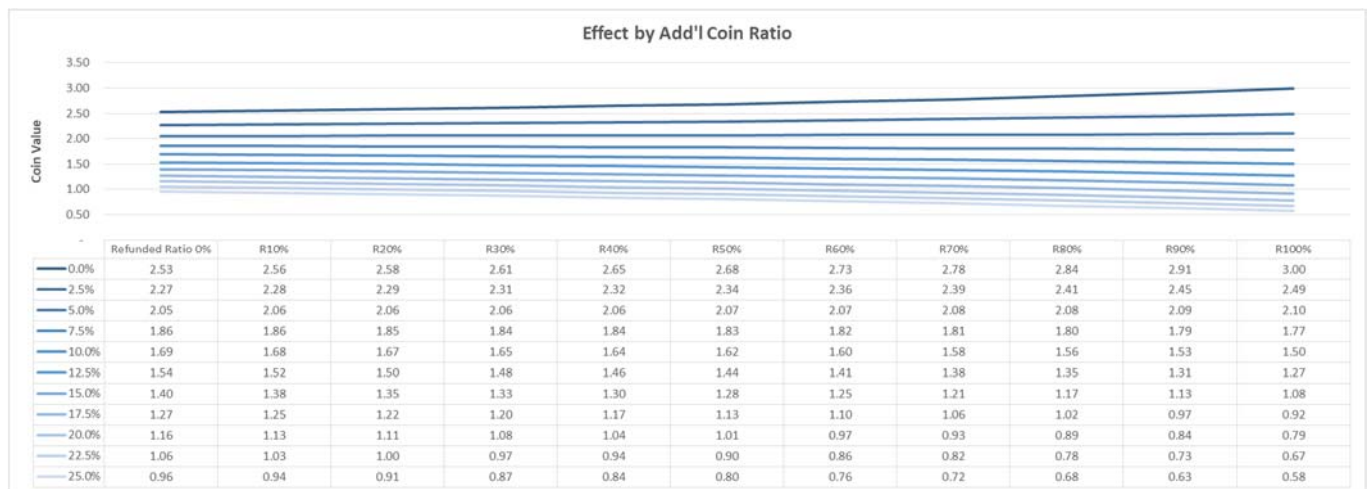


Figure 22: Effect by Additional Coin Ratio on Coin Value under CIE with 35%/65% Split

From the above chart, the maximum level of additional coin ratio is around 5% to maintain self-balancing mechanism.

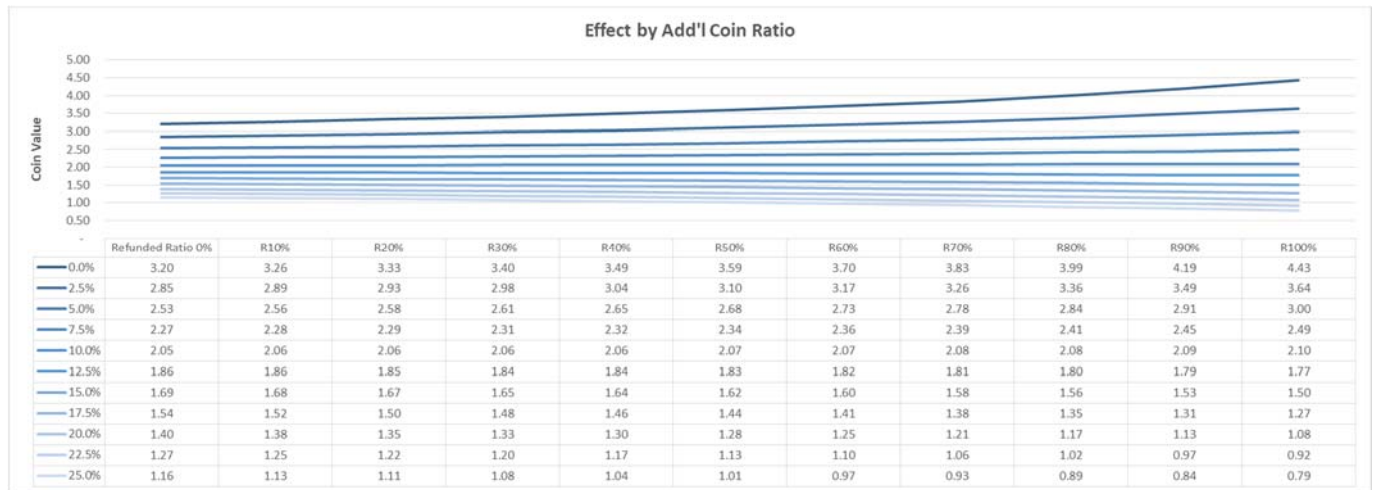
**CIE: Insured 30%/ Reinsurer 65% split, with 10% Refundable Loss Ratio**

Figure 23: Effect by Additional Coin on Coin Value under CIE with 30%/65% Split

From the above chart, the maximum level of additional coin ratio is around 10% to maintain self-balancing mechanism.

**BCE: Coin to Insured at 35%, with 10% Refundable Loss Ratio**

Figure 24: Effect by Additional Coin under BCE with 35% Coin to Insured and 10% Refundable Loss Ratio

From the above chart, the maximum level of additional coin ratio is around 20% to maintain self-balancing mechanism.

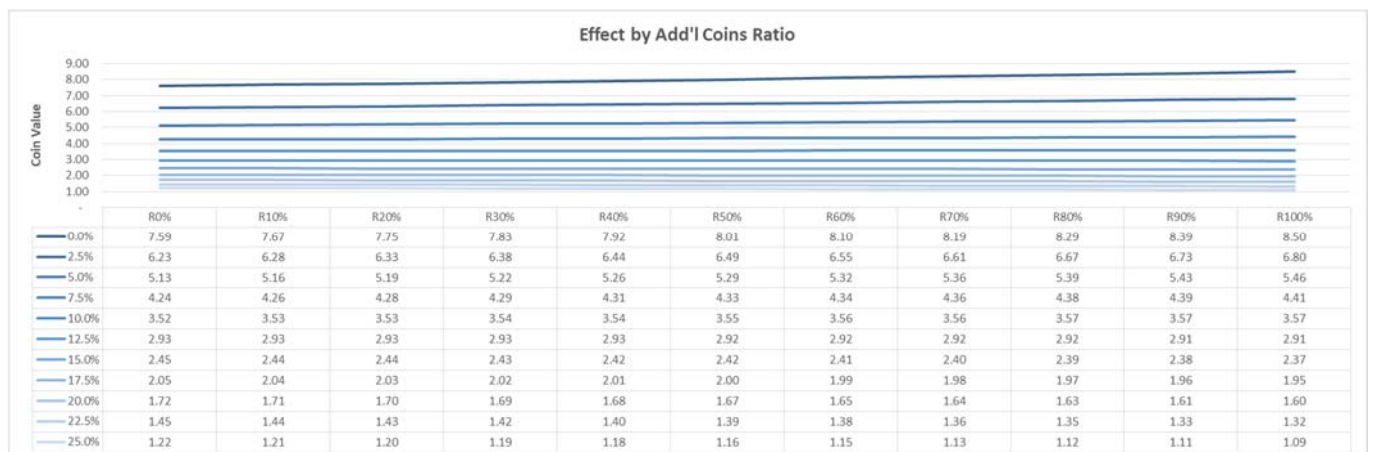
**BCE: Coin to Insured at 50%, with 20% Refundable Loss Ratio**

Figure 25: Effect by Additional Coin Value under BCE with 50% Coin to Insured and 20% Refundable Loss Ratio

From the above chart, the maximum level of additional coin ratio is around 10% to maintain self-balancing mechanism.



### Observations of Simulations

Under both CIE and BCE, the simulations show Premium Fund running over 20 years is better than that of current insurance model, and only when there's no preference of Risk Coins the result is same as current insurance model. As there is self-balancing nature of Risk Coins that less preference will cause higher coin value, it is reasonable to estimate the RC model will help in the scale of the premium fund. On top of that, capability of additional coin issuance gives the fund manager more resource for risk financing when facing expected large or catastrophe loss occurrences. Moreover, under CIE the fund value is increasing faster than that Under BCE, as more coins are issued to help building the fund.

### DISCUSSION AND CONCLUSION

The concept of Risk Coin is to explore alternate risk financing channel and therefore to be the basis for new insurance operation model. The purposes of Risk Coin are multiple:

- Being a token for shareholding of the coin fund/ premium fund, and Insureds are encouraged to keep the coins issued to them therefore it changes the premium payment from a zero-sum game to a win-win cooperation.
- Being a cryptocurrency anchored at the premium fund which guarantees the minimum value of Risk Coin, and with self-balancing mechanism which encourages the coin receivers to keep them instead of returning.

Beside its attraction turning premium payment to ownership of premium fund, Risk Coin Model is therefore taking the advantages of:

- Law of large numbers from risk pooling as traditional insurance;
- Seigniorage from issued Coin Issuance;
- Broader acceptance of Risk Coins by Insureds, Reinsurers or direct acceptance of Capital Market.

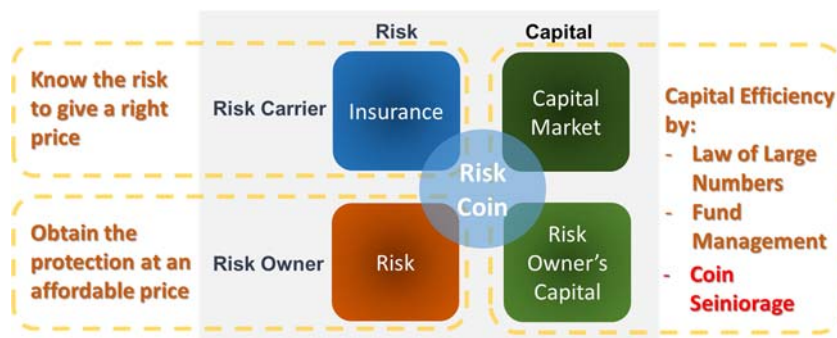


Figure 26: Effect of Risk Coin

Both of the implementations on current insurance and blockchain environments show self-balancing mechanism, even with additional coin issuance up to certain level. Although the application on blockchain environment seems less effective in fund building, it has high potential to be a platform insurance model of direct risk financing by risk coins.

Other future researches may include:

- simulation on portfolio with volatility in premium development and loss pattern;
- applications to life insurance or pension insurance;
- acceptance of Risk Coin as payment solution beyond insurance and the influences to Enterprise's operation;
- a dual-currency system if risk coin accepted as a general payment vehicle.

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## APPENDIX A: ROLE OF IT IN INSURANCE

Inferences are made based on the initiatives benefiting from the use of certain Information Technology. These inferences are not necessary in chronological order, though it shows reasonable developing sequence, that some innovations may make one initiative more appealing and materializing sooner than other initiatives.

### A.1 IT as a Tool - Current Status

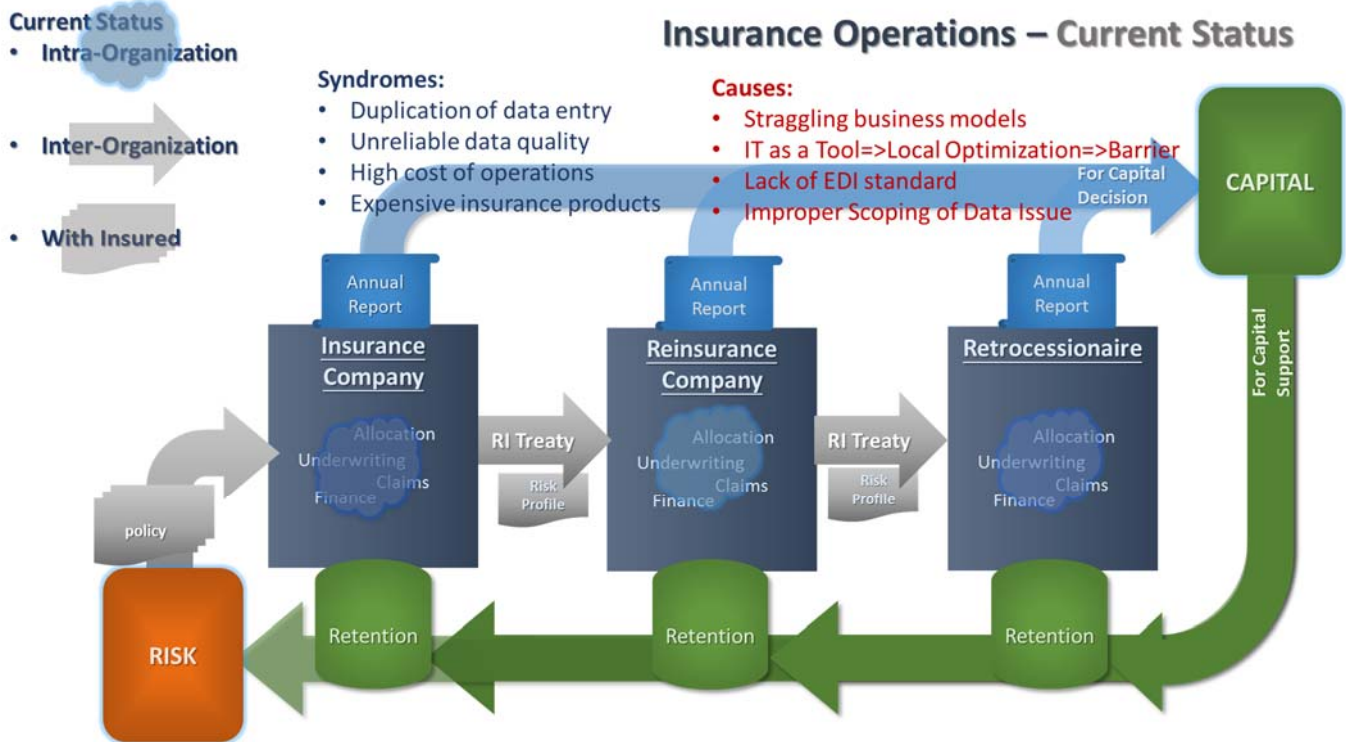


Figure 27: Current Status

The existing operation model of insurance industry is a legacy of pre-IT epoch, and IT is used as tools to improve the efficiency of manual work as on paper files. The overall structure of the industry is not reviewed for optimization to the purpose of insurance. Initiative is mainly to improve operation efficiency.

## A.2 IT as Information Channel

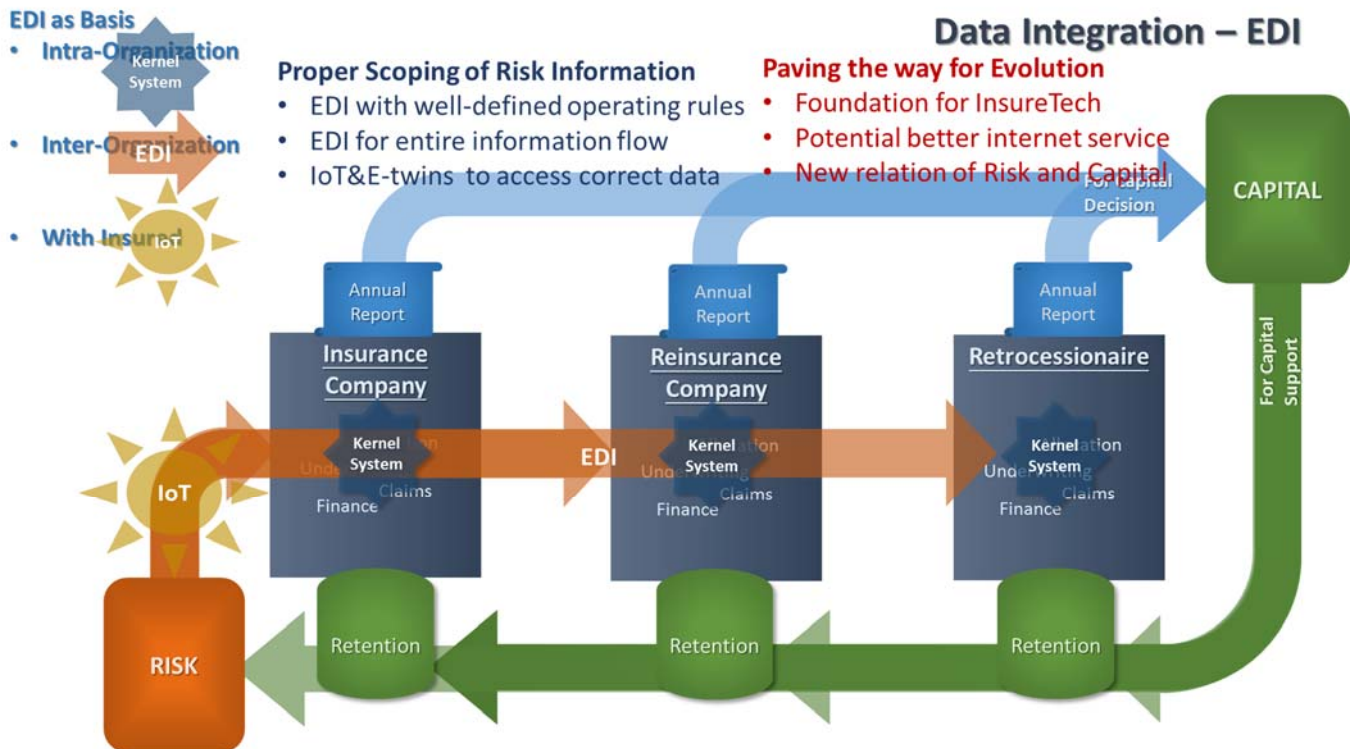


Figure 28: IT as Information Channel

EDI standard built within insurance industry and with risk owners so that risk information can flow from origin via IoT. Although the overall structure of industry remains, duplication of data entry is eliminated and transparency of data can be guaranteed. Initiative is mainly to improve risk assessment.



### A.3 IT as Information Platform

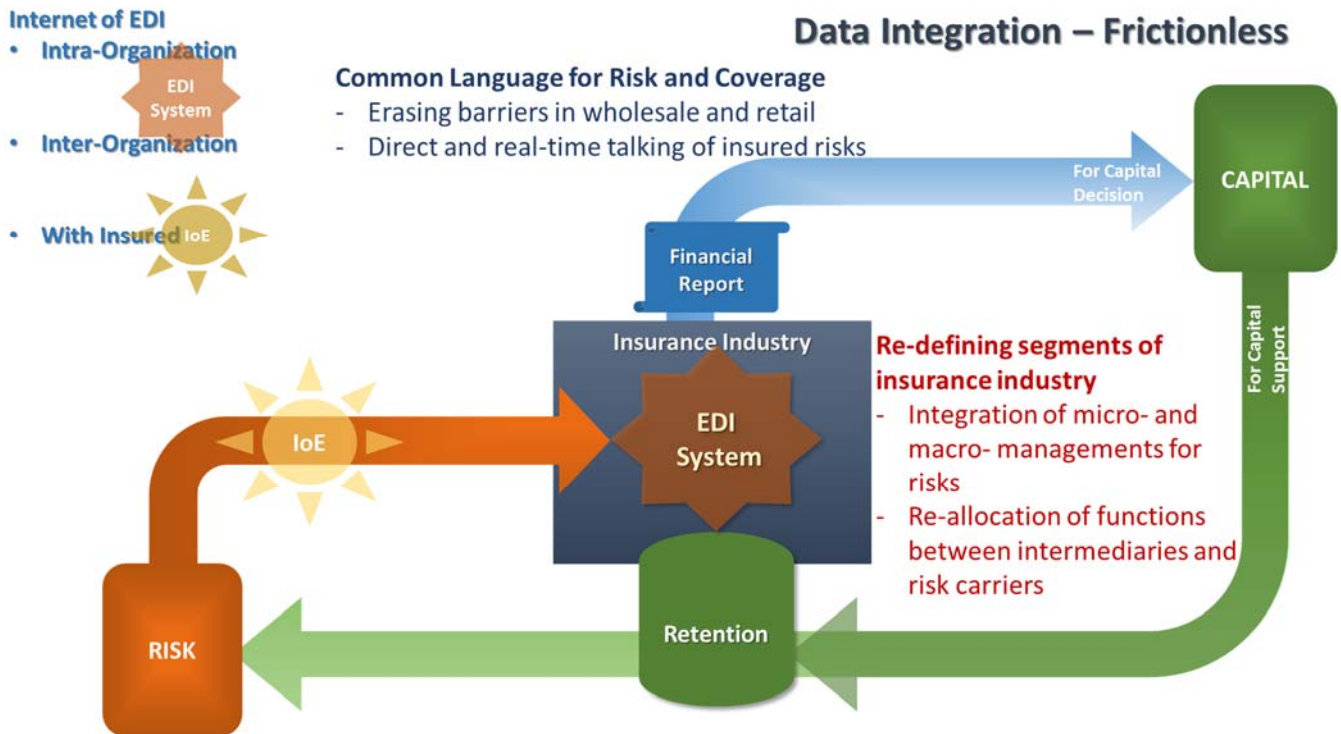


Figure 29: IT as Information Platform

Risk information available on micro and macro level, therefore erasing barriers between treaty/facultative reinsurance and direct insurance, and new management tools triggers the review of structural module and division of functions of brokerage, underwriting and risk financing. Initiative is mainly to reduce redundancy.

### A.4 IT as Risk Pooling Platform

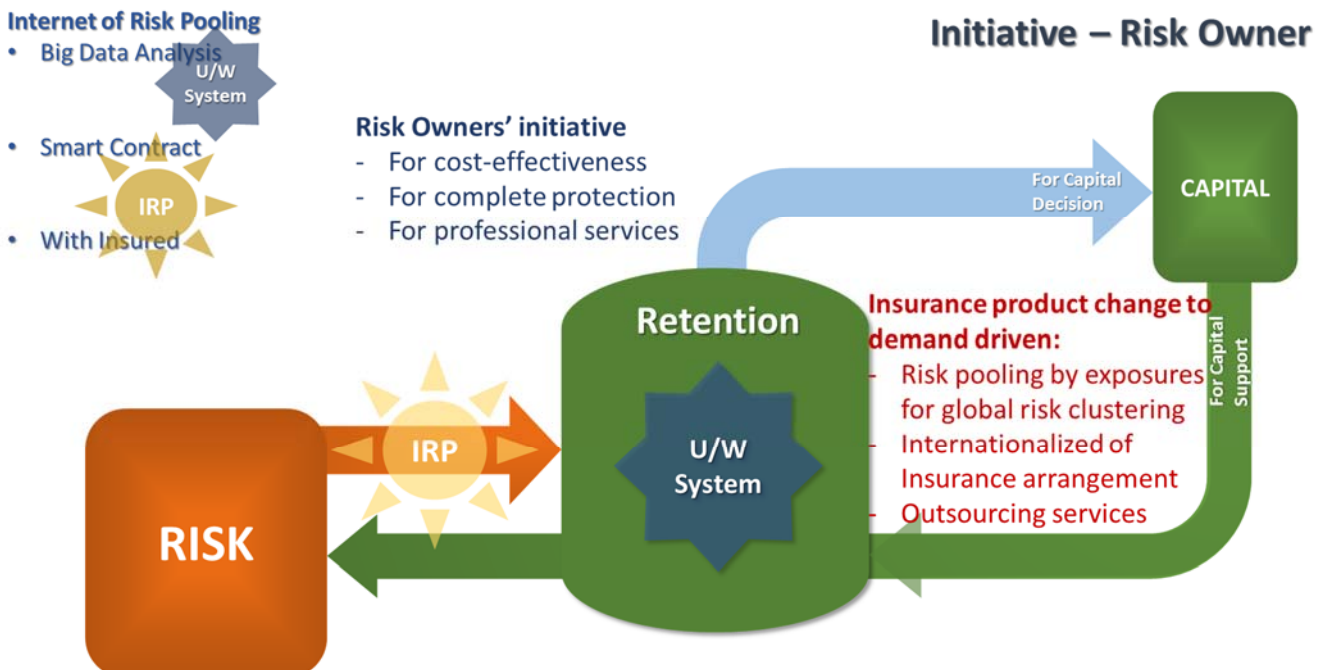


Figure 30: IT as Risk Pooling Platform

Real-time information of risk or loss available for assessments, and risk exposures pooled globally for analysis and acceptance. Insurance products are driven by demand of risk owners, instead of insurance companies' supply. Smart contracts in internet supersede local admitted policies. Initiative is to achieve cost-effectiveness and coverage completeness.

### A.5 IT as Financing Platform

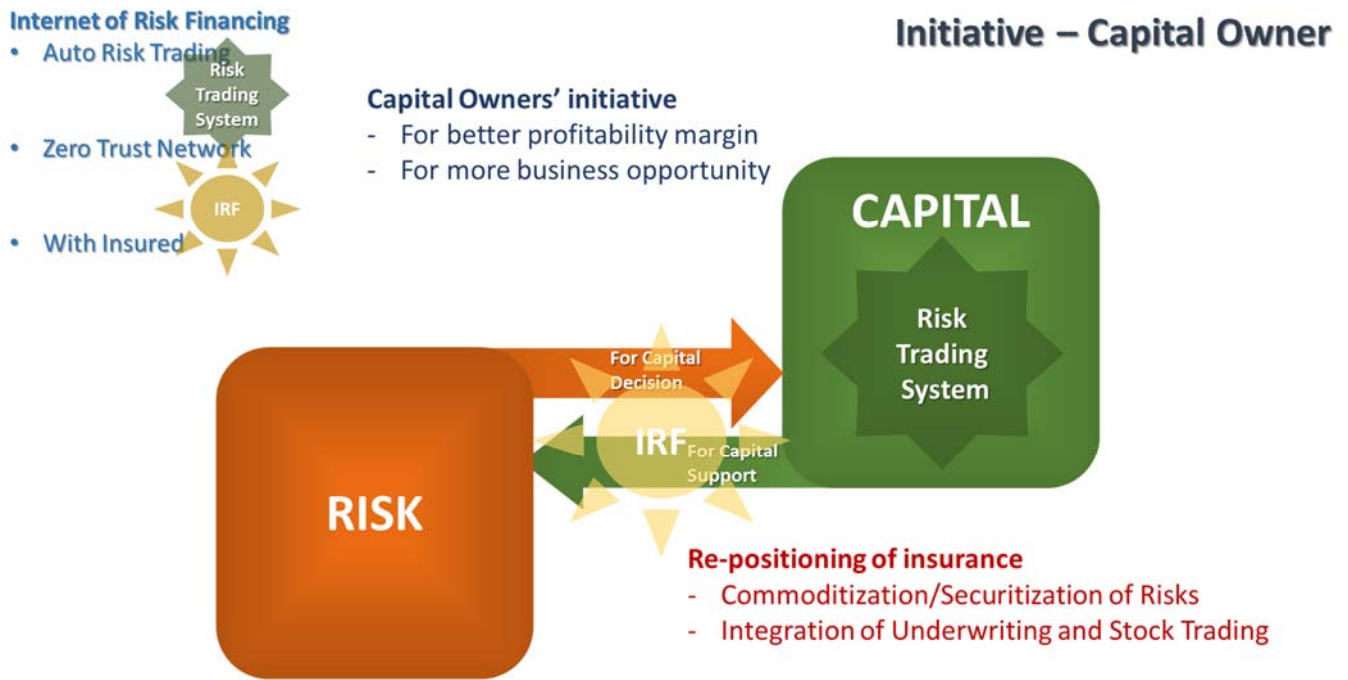


Figure 31: IT as Financing Platform

Reliable financing over internet and Risk as Commodity familiarized in Capital markets. Risk pooling and re-pooling for better application of Law of Large Numbers pushes the development of risk trading system in Capital market. Initiative is to get more business opportunity and better profitability for Capital Market.

#### A.6 IT as Capital Platform

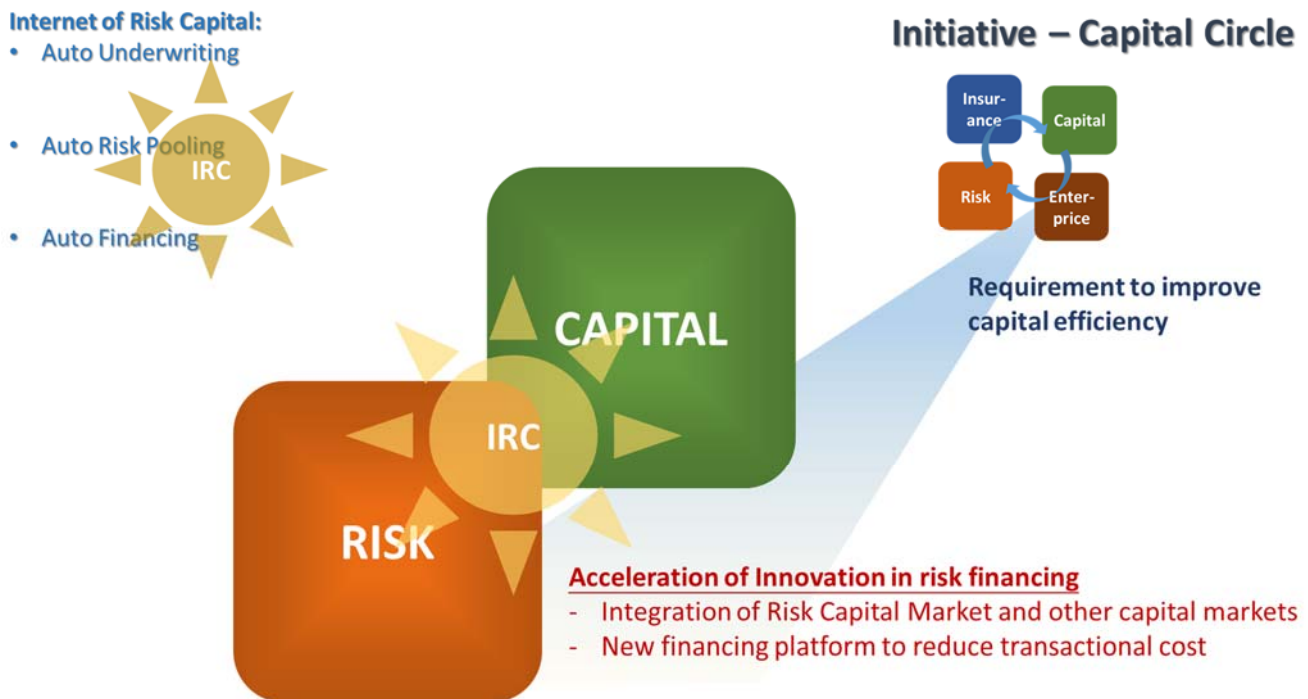


Figure 32: IT as Capital Platform

Insurance as necessary risk financing incorporated in other financing activities. Internet services are capable to support all necessary functions of Underwriting, Risk Pooling and Financing operations. Initiative is to review Capital Circle for practical and better efficiency of risk financing model.