



Credit Retained Loan (CRL™)

by

Thomas Ho PhD

President

Thomas Ho Company Ltd (THC)

and

Gnanesh Coomaraswamy PhD

CEO

Finzat LLC

November 2018

Summary

Credit retained loans facilitate loan transactions between investors and bank borrowers, creating a liquid market for credit risk transfer, reducing the deadweight loss of moral hazard, lowering the due diligence expense, and tightening transactional spreads. As a result, investors can attain a higher return while borrowing banks can achieve funding for their loans and can implement effective asset-liability management strategies.

Keywords: Credit Retained Loans (CRL™), Mortgage Partnership Finance (MPF), risk sharing, Current Expected Credit Loss (CECL), credit insurance, moral hazard, asymmetric information, loan transaction, loan loss provision, market-based CECL pricing

Acknowledgements: The authors would like to thank Yong Cai, Lindsay Elizondo, Mike Moore and Lawrence G Meding for their helpful comments.



For more information please contact: Lindsay Elizondo, VP. lindsay.elizondo@thomasho.com

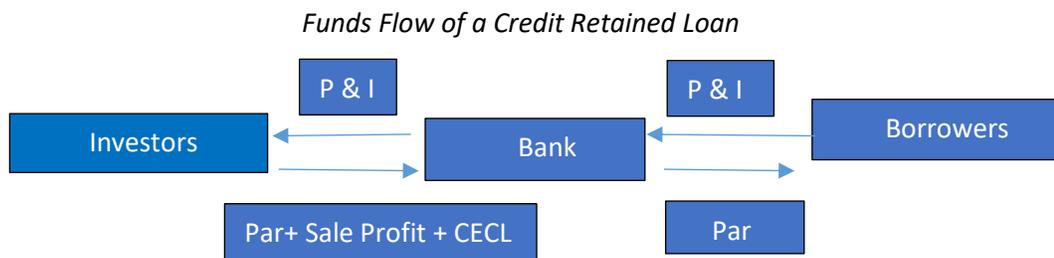
Credit Retained Loan (CRL™)

Overview

Investors can buy whole loans with *credit retained* by the sellers, particularly community financial institutions, allowing investors to purchase loans with the principal guaranteed subject to the occurrence of certain credit-related events. Credit Retained Loans (CRL™) allow sellers to eliminate interest rate risk and neutralize the impact of the loss provision on Tier 1 capital requirements. The buyer pays a credit premium, equal to the Current Expected Credit Loss (CECL) on the loans.

The funds flow can be represented by the schematic diagram below. Potential investors include: hedge funds, insurance companies, asset managers, and depository institutions. Investors pay a price that has three components: (1) Par, the face value; (2) the Current Expected Credit Loss (CECL), an implied accounting loss provision of the loan acquisition booked by the Bank; (3) the premium in addition to CECL. The all-in price that the Bank receives should represent an amount sufficient to cover the capital charge for CECL, plus credit loss potential in excess of CECL.

The return to the investor consists of the interest and principal payments of the loan. If the borrower defaults on the loan, based on a prespecified “default event” such as becoming 90 days delinquent the bank/loan seller is obligated to repurchase the loan from the investors at par.



Economics of Credit Retained Loans (CRL) The deadweight economic cost of asymmetric information between borrowers and lenders is well established. Lenders, without the benefit of all private information of the borrower, may well feel it necessary to charge a risk premium, which may become a barrier to a transaction. In particular, the asymmetric information may



lead to a moral hazard problem. That is, the borrower may have the incentive to withhold relevant credit information to obtain a lower interest rate.

Financial markets have multiple arrangements to minimize the cost of asymmetric information. First, there are risk sharing approaches. Typical risk-sharing arrangements include 1) subordination, whereby the originator subordinates the investor by a certain percentage, retaining a partial coupon as compensation; 2) skin in the game, whereby the originator retains partial economic interest in the loan while the investor receives the rest. Since 2008 “skin-in-the-game” has become prevalent to prevent similar credit problems that caused the 2008 crisis. Either of these approaches still requires investors to understand the economic drivers of credit risks.

Another approach is credit insurance. Prior to the 2008 financial crisis, private companies, (Monolines) provided significant bond insurance to the capital markets. However, these firms, without adequate information of the borrowers, suffered significant losses in the economic downturn. Private credit insurance for commercial lending has failed to become viable.

Public credit insurance is provided by United States Housing Government Sponsored Enterprises (GSE’s). Fannie Mae (FN) and Freddie Mac (FM) are two such GSE’s. The rationale for a credit guarantee on loans securitized by these two companies is to encourage home ownership. Federal Home Loan Banks (FHLB’s) offer the Mortgage Partnership Finance Program (MPF) and the Mortgage Purchase Program (MPP) to provide liquidity to member banks. MPF and MPP differs from FN and FM in that these programs allow the originators to partially retain the credit risk of the borrower, thus mitigating credit risk to FHLB investors while properly orienting the moral hazard to participating community bank members.

Credit Retained Loans (CRL™) extends from the MPF program’s credit retained principle. However, the central design feature of CRL™ is to eliminate the moral hazard resulting from asymmetric information between loan originators, typically banks, and investors to facilitate loan transactions. Because CRL™ is not subject to government mandates to achieve a particular social goal like GSE’s, the CRL™ concept can be applied to a broad range of loans and transaction types.

The Current Expected Credit Loss (CECL), the measurement of credit losses on financial instruments, will be adopted by SEC filing Public Business Entity beginning in 2019. CECL will add impetus to the use of CRL™ to transfer credit risks, also enhancing the pricing of borrowers’ credit risk. CECL will introduce the market pricing of credit risk as a percent of face value, as opposed to a net credit spread, aiding in the facilitation of loan transactions. It is important to note that the market estimate of a loan’s CECL may differ from the bank’s CECL reported for accounting purpose. However, the market pricing of CECL does provide a market consensus value, the “implied CECL.”



Credit risk transfer is not a new a concept, nor is its integration into financial reporting and loan portfolio management. However, CRL™ will play an important role in the financial market going forward with growing demand for credit risk transfer in today's regulatory environment aided by the progress made in financial technologies, and an increasing number of "FinTech" companies can develop a secondary market for CRL™.

Specifically, the economic benefits to investors and borrowers can be summarized as follows:

- **Investors: eliminate the borrowers' credit risk component, access to broader sources of loans and transactional types, but retain the credit risk of the CRL™ originating banks.**
- **Bank originators: may enhance returns from the premium received from the investors for CECL relative to the Bank's actual expected loss, ability to offer broader lending products, focus on the core competitive advantage in credit analysis of the Bank's own local-market customers.**

About CRL™

CRL™ loans are sold by financial institutions ("Bank"). The Bank bears the default risk of the borrowers. Investors pay the Bank a purchase price, which has three components: par, premium (sale profit and capital provision), and CECL (credit). The investor receives principal and interest payments on a make whole basis.

The transaction price is negotiated by the buyer and seller. The seller retains a contingent liability for expected credit losses on the guaranteed principal. CRL™ is a passthrough product. When a loan is deemed uncollectible, investors will receive the remaining unpaid principal balance, but will receive no additional interest payments.

When a borrower suffers a "default event", e.g. becomes 90 day late on scheduled payments, the Bank will handle delinquent interest payments to the investor by remitting the interest payment to the investor until the loan is deemed uncollectible, called the *Make Whole* method. This method is analogous to that in servicing agreements. For example, banks can have P&I float accounts with agencies. Loans will not generally be deemed uncollectible until 90+ days past due.

The CRL™ is currently introduced for mortgage loans. The basic framework is expected to extend to Commercial Real Estate (CRE) and other types of loans as well.

In CRL™ Transaction



OCC Bulletin 2001-15 “Selling loans has become an increasingly important risk management tool for institutions seeking to manage concentrations, change risk profiles, improve returns, and generate liquidity. The agencies encourage the use of this risk management tool.”

The use of loan sales to manage balance sheet performance is particularly important today. Banks may need to sell long duration loans to lower the interest rate risk in the current rate rising cycle. Also, banks may need to reduce their balance sheet to increase the capital ratio, in anticipation of the introduction of CECL or to increase liquidity as funding rates rise. On the other hand, there are also demands for loans from other banks to increase earnings as the national residential loan growth has been stagnant for multiple years.

The originating banks, by retaining the credit risk, can sell CRL™ to out of state financial institutions, which will not take the credit risk of the loan borrowers, the state laws on borrower’s bankruptcy and tenants’ right. Therefore, CRL™ enhances transactions between the suppliers and demanders of loans.

The originating banks may also prefer selling CRL™ when the fair value of the loans has an unrealized loss. In selling the loans with credit risk guaranteed may mitigate the loss.

Investors may purchase individual CRL™ whole loans or purchase in pools, bulk or flow. Loans may be purchased service retained or released. THC models provide indications of the CECL value, along with the attributions of the bid or ask prices. The model analytics assists in the transaction; however, the seller and buyer ultimately determine the purchase price and the CECL value.

CRL™, designed by senior members of the same team that created the Mortgage Partnership Finance (MPF) program, including MPF’s lead architects, optimizes execution of residential mortgage loans which may not qualify for U.S. Housing Agency purchase in the same way MPF achieves the same objective for agency qualifying loans – creating an incentive for lenders to maximize the benefits of managing credit risk on their own loans while receiving a market-driven price for the loan itself. Description of the MPF program is provided in the Notes.

CRL™ Maintenance

Buying or selling CRL™ execution is part of an overall ALM solution as related to the loan transaction in the secondary market. Loan originators and investors may need maintenance support in the loan origination and secondary market in transacting CRL™.



THC's Loan Desk¹ will assist market participants, such as broker-dealers, bank credit analysts, and consulting firms to maintain and grow the CRL™ market. THC Loan Central will centralize CRL™ pricing and analysis. Participants in CRL™ have access to account level CECL analytics and yield attribution which includes: the credit spreads of the originating bank, funding cost, option cost and clean OAS.

CRL™ also requires maintenance for ALM and accounting solutions. CRL™ transactions require the seller to book a contingent liability, as opposed to a credit loss reserve for a portfolio loan. The THC CECL reports can be modified and utilized to support the contingent liability reserve. The CECL reports include: Allowance of Credit Loss (ACL) activity report, loan acquisition report with CECL (FASB requirement), and the facilitation of the negotiation of the transaction. The THC CECL model is built on the same certified ALM financial models under federal bank regulations used for interest rate risk reporting, allowing the solution to be consistent with ALCO risk management processes, taking multiple rate shock scenarios into consideration. Since THC is providing mortgage servicing right (MSR) mark to market fair value reporting and fair value derivative hedge accounting, and embedded value bifurcation accounting reporting, THC can extend the fair value accounting services to loan originators for the credit retention.

¹ THC Loan Desk, the division of THC which provides loan trading support by voice and technologies, will assist market participants, such as broker-dealers, bank credit analysts, and consulting firms to maintain the CRL™ market. THC Loan Central, the part of THC's secure website that provides capital market access to THC clients will centralize CRL™ pricing and analysis in order to provide complete analytical support for CRL™ transactions.



Numerical Example:

A pool of two Stated Income Verified Assets (SIVA) loans is used to illustrate the design of a Credit Retained Loan. In this example, these SIVA loans have strong asset collateralization with CLTV 50%-55%. The borrowers have a high WA FICO score of 730. Since the income is not verified, investors may demand a risk premium to cover the lack of information on the borrowers. If the originating bank retains the credit risk, then the CRL™ would reduce that risk premium. This numerical example shows that the premium can be significant, estimated to be 2%.

A Hypothetical Loan Pool
SIVA ARM CRL Terms and Conditions:
Purchase price 103.83
Credit Retained CECL 0.67
Total Price Paid 104.50

10/15/2018

SIVA ARM 7.843% Loans \$5,100,000 Evaluated Price 104.50 @5.639%

2-2-6 cap 1y LIBOR 495 bpt Margin 25 bpts Servicing Retained

Loan #	Address	City	ST	ZIP	SS#	FICO	Current Interest Rate	Loan Type	Interest Only Payment
THC 10-007	N/A	xyz	NY	90000	N/A	730	8.500%	3/1 ARM	Y
THC 10-009	N/A	abc	NY	90000	N/A	730	6.750%	3/1 ARM	Y
Loan #	Loan Term	Amortization Type	Property Type	Occupancy	Loan Purpose	Lien	PrePay Penalty	Orig Balance	Current Balance
THC 10-007	360	HYBRID ARM	SFR	O/O	C/O	1	N	3,600,000	3,600,000.00
THC 10-009	360	HYDRID ARM	SFR	O/O	PUR	1	N	1,500,000	1,500,000.00
Loan #	Orig Value	Current Value	Orig LTV	CLTV	Second Lien Balance	DTI	Loan Doc	Payment Interest Only	P & I Payment
THC 10-007	6,500,000	6,500,000	55.38%	55.38%	N/A	41%	SIVA	\$25,500.00	\$27,681.00
THC 10-009	3,000,000	3,000,000	50.00%	50.00%	N/A	42%	SIVA	\$8,437.50	\$9,729.00
Loan #	Impound Waiver	First Payment Date	Next Due Date	Original Term	Remaining Term	Maturity Date	Appraisal Value	Price ave retained	yield
THC 10-007	Y	12/01/18	01/01/19	360	360	2048/12/1	6,500,000.00	\$105.03	5.843
THC 10-009	Y	12/01/18	01/09/19	360	360	2048/12/1	3,050,000.00	\$103.23	5.150
Loan #	PMI	Prepayment Penalty	Comments/ Issues with loan (Bankruptcy, Foreclosure, REO, etc)			MARGIN	CAP	INDICES	
THC 10-007	N	N	CLEAR			4.95%	2.2.6	1YR LIBOR	
THC 10-009	N	N	CLEAR			4.95%	2.2.6	1YR LIBOR	



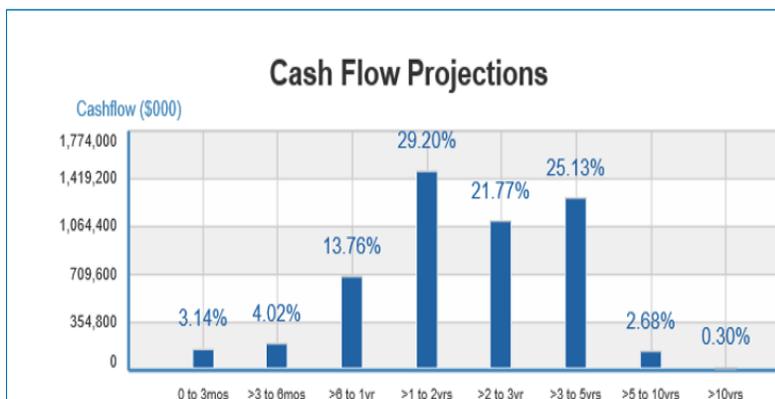
Comments/ Issues with loan: (Bankruptcy, Foreclosure, REO, etc.)

Pricing/Risk Summary: analysis is determined by the THC Model and may not represent Buyers or Sellers views on the trade. The Price/Risk Summary provides transparency of the risks and pricing, particularly important for non-QM or non-agency loans.

Price Attribution: THC valuation model determines the valuation of servicing (MSR servicing), present value of expected credit loss (CECL), option cost (comparing value with and without interest rate vol), TBA value (used as a reference profitability number based on similar TBA terms), and Excess profit (\$ profit excess of investment profit). Buyers/Sellers can use the Value Attribution to adjust the quote based on their own estimates of each factor.

Yield Attribution: ALCO and other functions may use yield to determine value. The THC model uses the price attributions above to determine the cashflow spreads of each factor, translating the \$ to Spreads (bps) via monte-Carlo arbitrage-free option pricing models. Therefore, the yield attribution is directly translated from the price attribution with no approximation, based on the same valuation model. The funding cost is based on Treasuries as the reference curve. Analogous to Price Attribution, buyers/sellers can use the Yield Attribution to adjust the yields based on their own estimates.

PORTFOLIO DESCRIPTION SUMMARY			
	Summary		Analytics
Principal Balance (\$)	5,100,000	Short Term CPR (%)	19.44
Participation Balance (\$)	5,100,000	Life Time CPR (%)	47.97
Number of Loans (count)	2	WAL (year)	2.26
Gross WAC (%)	7.99	Effective Duration	1.78
Servicing Fee (bpt)	25	Effective Convexity	0
NET WAC (%)	7.74	Weighted Average FICO	726
WAM (mos)	362	Weighted Average LTV (%)	54.00
Seasoning (mos)	0	Indicative Price	104.5
Servicing Retained By Seller	Yes	Yield (%)	5.64



Match Post Information				Sensitivity Calculator																	
Match Information				Pricing Information							Yield Attribution %					Interest Rate Risk			Price/Shock Relationship		
Loan ID	Description	Bid Price	Bid Yield (%)	Released Price	Retained Price	MSR (servicing)	CECL (credit reserve)	Option Cost	TBA Required Investment	Excess Loan Profit	YTM	Funding Cost	Option Spread	Credit Spread	Clean OAS	WAL	Eff. Dur	Eff. Con	OAS Duration	Long Term CPR(%)	Long Term CDR(%)
Summary		104.50	5.64	105.02	104.50	0.52	0.67	-0.03	1.95	0.05	5.639	2.877	-0.007	0.324	2.445	2.26	1.78	0.00	2.00	47.97	2.28
5510(\$5.1M THC 10-007		105.03	5.84	105.55	105.03	0.52	0.87	-0.03	1.96	0.28	5.842	2.877	-0.009	0.423	2.552	2.26	1.73	0.00	1.99	47.73	2.56
5510(\$5.1M THC 10-009		103.23	5.15	103.76	103.23	0.52	0.18	-0.02	1.93	-0.50	5.151	2.878	-0.003	0.089	2.187	2.27	1.90	0.00	2.03	48.54	1.61

Accounting Example

Topic 310 – Recievables

1. Loan originated for sale



- a. To be held at the lower of cost of FMV
 - i. Example: Loan pool originated @ \$5.1MM; FV (service & credit retained): \$5.4MM

Account	DR	CR
Loans Held for Sale	\$5,100,000	
Cash		\$ 5,100,000

Topic 860 – Transfers and Servicing

- 1. Originator Sells the Loan, Credit Retained, to the Investor
 - a. Conditions for a sale of financial assets
 - i. Isolation of transferred financial assets (isolated from the transferor and beyond the reach of its creditors)
 - ii. Transferee’s right to exchange or pledge the assets
 - iii. The transferor does not retain effective control
 - 1. Example: Loan sold service & credit retained

Account	DR	CR
Cash	\$5,363,670	
Gain on Loan Sale		\$202,980.00
MSR		\$ 26,520
Recourse Reserve (Contingent Liability)		\$ 34,170
Loans Held for Sale		\$ 5,100,000

Topic 460 – Guarantees

- 1. As illustrated above, the originator sells the asset credit retained, guaranteeing the principal balance
 - a. As a practical expedient, the liability recognized at inception shall be the premium received or receivable by the guarantor (CECL premium). If at inception, the guarantor is required to recognize a liability under *Section 450-20-25, the initial measurement shall be the greater of the following:
 - i. The amount satisfying the fair value objective
 - ii. The contingent liability required by Section 450-20-30
 - 1. If some amount within a range of loss appears at the time to be a better estimate than any other amount within the range, that amount shall be accrued. When no amount within the range is a better estimate than any other amount, however the minimum amount in the range shall be accrued.

*1. Information available before the financial statements are issued or are available to be issued indicates that it is probable that an asset had been impaired or a liability had been incurred at the date of the financial statements

2. The amount of the loss can be reasonably estimated

Topic 326 – Financial Instruments – Credit Losses



1. An entity is required to adjust, at each reporting period, its estimate of expected credit losses on off-balance sheet exposures.
 - a. The adjustment shall be reported in net income as a credit loss expense or a reversal of credit loss expense
 - b. The liability for credit losses shall be reduced in the period in which any of the following occur:
 - i. The off-balance sheet financial instruments expire
 - ii. A recognition of a financial asset
 - iii. The credit exposure is otherwise settled
 1. Example: Guarantee settlement on THC 10-007, one of the loans in the pool.
Assume UPB: \$3MM; CECL 87bp; Fair Value: \$2.8MM

Account	DR	CR
Loans Held to Maturity	3,000,000	
Recourse Reserve (Contingent Liability)	\$ 26,100	
Credit Loss Expense	\$ 453,900	
Charged-off Principal Balance		\$ 480,000
Cash		\$ 3,000,000

Stress Testing Credit Exposure

THC’s coherent risk models will stress the impact of the credit reserve required on the off-balance sheet exposure. In a stressed crisis scenario, based on the 2009 experience, the required reserve would increase from \$34,170 to \$168,810, as shown below.

COA CECL *Crisis ▼ Save Save As Delete Rename Reset Download

* Those scenarios are pre-set by THC.

*Moderate is Gross Loss Rate of *Base multiply 1.1, Recovery of *Base multiply 0.8

*Severe is Gross Loss Rate of *Base multiply 1.2, Recovery of *Base multiply 0.64

*Crisis is Gross Loss Rate of *Base multiply 1.3, Recovery of *Base multiply 0.64*0.8

Name	Balance (\$000)	Percentage of Total Loans(%)	FICO	LTV	Quick Set Gross Loss Rate(%)	Quick Set Recovery Rate(%)	Net Loss Rate(%)	CECL (\$000)	CECL (%)	Risk Adjusted Margin (Clean OAS)%
<input type="checkbox"/> Loans	5,100	100.00	728	54	2.97	43.59	1.87	169	3.31	2.66
<input type="checkbox"/> 1-4 Family Mortgage	5,100	100.00	728	54	2.97	43.59	1.87	169	3.31	2.66
ARM 3/1	5,100	100.00	728	54	2.97	43.59	1.87	169	3.31	2.66





About MPF Programs

“Mortgage Partnership Finance™ (MPF) allows for the sharing of credit risk associated with home mortgage finance with Federal Home Loan Banks. MPF offers the ability to originate, sell, and service fixed-rate, residential mortgage loans and receive a credit enhancement (CE) fee for sharing the credit risk. FHLBanks manages the liquidity, interest rate, and prepayment risks of the loans while loan originators manage the credit risk of the loans. The credit risk sharing feature of MPF Original, for example, allocates future loan losses, if any, after borrower equity and private mortgage insurance are depleted between the FHLBank and the member. Structural similarities, and advantages, between MPF and CRL™ are obvious.” Michael Moore, former Executive Vice President and MPF team creation member of FHLB Chicago.

The MPF program changed the paradigm for how the mortgage market treated the credit risk component of 1-4 family residential loans, placing credit risk with the loan originator instead of federal agencies. Properly aligning incentives results in best execution. With MPF, loan originators are rewarded for creating credit-worthy assets by being paid an ongoing credit enhancement fee for managing the borrower relationship in an effort to minimize credit losses.

The CRL™ product extends these “MPF-like” benefits to a large universe of investors and mortgage lenders, broadening loan types and the loan transactional community. CRL™ is made possible by recent progress in financial and system technologies.

A Comparison of the Mortgage Partnership Finance program and the Credit Retained Loans (CRL)

	MPF Program	Credit Retained Loan	Comments
Investor	FHLBanks	Any qualified investor	CRL broadens participation
Credit retained by	MPF qualified community financial institutions	Mortgage lenders	Lenders are not confined to FHLB members only
Loss Provision received by the Bank	Credit Enhance (CE) fee for the life of the loans	CECL upfront one-time payment	CRL has only one payment upfront
Loan types	Conforming	Conforming and non-conforming	A broad array of loan types
Servicing	Released or retained	Released or retained	Flexible servicing
Loan Pricing	FHLB set and administered	Negotiated per transaction	Flexibility in pricing
Administrator	FHLB	Negotiated transaction between buyers and sellers	CRL based on product design guidelines only
Secondary Market	Not currently available	CRL can be traded in the secondary market	Secondary market offers liquidity



CRL Provides a Solution to Challenges Presented by the New Current Expected Credit Loss (CECL) Accounting Requirements

Current Expected Credit Losses (CECL), a FASB accounting standard update (ASU), requires U.S. banks to estimate the lifetime expected future credit losses of loans and book this as a provision to the allowance for credit losses. CECL may increase the lender's reserve requirement, particularly for lower credit loans.

Loan originators have three basic options with respect to the disposition of non-QM loans:

- Keep the loans on the balance sheet, thereby accepting both the credit risk and interest rate risk associated with this the asset.
- Sell the loan, *credit released*, into a securitization trust, thereby avoiding the considerable challenges of managing interest rate risk of long-duration highly-convex assets, but at the same time forgoing added revenue associated with creating high quality loans that, while failing agency guidelines, are nonetheless credit worthy assets. Here, the costs of covering securitization overhead must necessarily be covered by someone – likely the originator/seller to a large extent.
- *Credit Retained* will all but certainly create the highest return while allowing the originating bank to continue managing the customer relationship.

From the originator/seller perspective, it is *status quo* with respect to credit risk management and capital requirements (subject to accounting determination) whether option one or three are chosen. A great benefit being staying completely in control of the customer/borrower relationship.

With option two, while interest rate risk is removed, so is the loss of control of the customer/borrower relationship along with the ability to generate returns as a result of managing the credit risk component. This approach also hinders investors' ability to price the loans appropriately due to the potential lack of accurate information on the borrowers.

In summary, option three, the CRL™ approach, resolves the moral hazard and asymmetric information problem between buyers and sellers. CRL™ provides a product allowing for a larger cross section of loan participants and loan types. The result: added liquidity and more efficient price discovery for all involved.



Term Sheet: An Example

Loan Pool Description: 1-4 Family Residential Loans. Term, Interest Rate, Amortization, Credit Information, Servicing Fees, Fixed Rates or Adjustable Rates, Cap/Floor Structure, Property, Purpose

Buyer: EXAMPLE INVESTOR

Seller: EXAMPLE BANK

Indicated Price includes the market-based CECL (which may differ from the bank's reported accounting CECL)

Effective Pricing Date

Target Closing Date

Default Event: 90 days delinquent. Borrower Bank will buy back to the loans from the investors at par. Borrower Bank will be responsible for all collection efforts after foreclosure.

Credit Transfer: Make Whole, non-recourse

Letter of Intent Conditions: the due diligence process should be simpler than a typical loan transaction. Due diligence process will focus more on the borrower, the bank.

Summary

Credit retained loans facilitate loan transactions among borrowers, originators and investors, creating a liquid market for credit risk transfer, reducing the deadweight loss of moral hazard, lowering the due diligence expense, and tightening transactional spreads. As a result, investors can attain a higher return while bank originators can achieve funding for their loans while implementing effective asset-liability management strategies.



About the Authors

Thomas Ho

Thomas S. Y. Ho, PhD is President/Founder of Thomas Ho Company Ltd (THC), a New York based financial engineering company. Prior founding THC, Tom was retained as a senior consultant to AIG Enterprise Risk Management and Office of Thrift Supervision (OTS) 1999 - 2012; Executive Vice President of BARRA, Inc., Founder/President of Global Advanced Technology (GAT); Professor of Finance of New York University's Stern School of Business.

Tom is an elected member of the US Financial Economists Roundtable, elected selection committee member of the Financial Engineering Award, named one of the most prolific authors in finance based on a study by Cooley and Heck, Journal of Finance (2003); author of the Ho-Lee model and key rate durations. He is an Associate Editor of Journal of Derivatives, Journal of Investment Management, and on the Advisory Board member of the Finance Mathematics Program, Courant Institute of Mathematics, New York University. He co-authored "Oxford Guide to Financial Modeling" and three other books and published extensively in the Journal of Finance, Journal of Financial Economics, Journal of Fixed Income, Journal of Investment Management. Tom received his Ph.D. in Mathematics from the University of Pennsylvania, 1978. Recipient of one of the most prestigious US scholarships, the Thouron Scholarship, available to all British students

Gnanesh Coomaswamy

Gnanesh Coomaswamy, PhD is CEO and Founder of Finzat Block LLC (FINZAT), a New Jersey based financial technology company (FinTech) focusing on loan portfolio solutions in mortgage finance. Prior to founding FINZAT, Dr. Coomaswamy has held senior positions in the finance industry, including Chicago Federal Home Loan Bank (FHLBC), GE Capital and Morgan Stanley. He was a senior executive officer with the FHLBC where he designed and implemented proprietary derivative-based hedging strategies for a \$50 Billion residential mortgage loan portfolio. The Chicago Bank consistently led the FHLB System in key performance metrics under Dr. Coomaswamy leadership. His role at Chicago FHLB included being a senior member of a team which developed the Mortgage Partnership Finance Program (MPF), the first mortgage product to successfully bifurcate credit risk and interest rate risk for residential whole loans. Subsequently adopted by 9 other FHLBs, MPF remains an important and profitable program for the FHLB System. He is a Certified Financial Analyst and Certified Financial Risk Manager. He has published numerous articles on cryptography and secure network authentication and has a PhD in Electrical Engineering with a concentration on cryptography from Northwestern University. He has recently been elected as a member of the Blockchain Community of Practice in the MBA's Standards Organization (MISMO).

Thomas Ho Company Ltd (THC)



THC specializes in Asset Liability Management solutions for Banks and Credit Unions. We have been helping clients since 1987 accurately and effectively identify, measure, monitor and manage their risks, including interest rate, liquidity and credit risks in a holistic and consistent model.

Selected the sole provider of interest rate risk reporting for Office of Thrift Supervision (OTS) for their regulated banks 2006-2012. THC Network™ is a cloud-based solution that provides comprehensive asset-liability management applications including comprehensive regulatory reports, interactive balance sheet simulations, capital planning and budgeting, and loan transactions,

Our founder, Dr. Thomas Ho, a proven leader who pioneered and revolutionized the financial services industry with a history of successful financial innovations:

- **Ho-Lee Model**-Co-Creator and the Co-Developer of the first arbitrage-free stochastic interest rate model, widely used in capital markets and asset/liability management used by all financial institutions. Regulators call this model, the stochastic interest rate model
- **Key Rate Durations**-Creator of the widely used interest rate risk measure used for managing over \$12 trillion AUM.
- **Dunsky and Ho (2007)**- Co-Developer Default-Prepayment model for FHFA Mortgage Analytics Platform.
- **Introduced cloud**-based ALM solution 2006
- **First utility blockchain solution to loan transaction** 2018

THC asset-liability management models have a proven track record. Global Advanced Technology (GAT) used the technologies to serve 200 major financial institutions globally, including nine of top ten insurance companies, Fidelity, First Tennessee and other regional brokerage firms.

Finzat Block LLC (Finzat)

Finzat offers blockchain solutions to make financial transactions **SAFE** – Simpler, Auditable, Fault-tolerant and Efficient by an in-depth understanding of financial markets, expert knowledge, and technical capabilities.

Founded by Dr. Gnanesh Coomaraswamy, and joined by a group of experienced financial professionals representing complementary disciplines, Finzat will offer blockchain solutions to a wide range of financial institutions whose businesses are driven by multi-step, data sensitive transactions.

Finzat focuses on the US residential and commercial mortgage market. The existing process, from mortgage application to final disposition, involves several steps that are often unnecessarily redundant and contain questionable data security safeguards. The blockchain solution designed by Finzat uses its SAFE approach to improve this existing process by eliminating unnecessary steps, reducing costs and creating a more streamlined, secure way of doing business.



THC DISCLAIMER

This report and the content contained herein ("Report") has been generated using the proprietary software and models of Thomas Ho Company Ltd ("THC") as of the date of this Report.

This Report contains confidential and/or proprietary information and is intended solely for the benefit of the authorized user of THC's services. If you are not the intended and authorized user, you should return this Report to THC immediately and in any event shall not disclose, use, copy, or reproduce this Report or its contents, and shall not display or distribute this Report or its contents to any other party without THC's prior written authorization.

Nothing in this Report is intended to substitute for any party's obligations to comply with any applicable laws or regulations. This Report and any information herein may not be relied upon by any other person or entity, including any regulatory authority. Without limiting the foregoing, THC shall not be liable for any losses or damages which may arise directly or indirectly from such reliance, including any incidental, consequential or punitive losses or damages.

While due care is used in ensuring the content generated in the Report is accurate, the accuracy, completeness and currency of the Report cannot be guaranteed. The THC proprietary software and models may be changed or updated from time to time and future report(s) may be different from current Report, in form or in substance, including such arising from the same data input. THC has no obligation to notify you of any updates or changes of its proprietary software or models, or the existence or content of Report(s) that may be generated using updated or changed software or models. **THC MAKES NO REPRESENTATION OR WARRANTY, EXPRESS OR IMPLIED, AS TO THE ACCURACY, COMPLETENESS OR CURRENCY OF THE REPORT HEREIN.**

This Report is generated based on data input. It is the responsibility of the person or entity that provided the data input to verify the accuracy and completeness of such data input. THC shall not be responsible to verify the accuracy and completeness of the data input provided by any person or entity other than THC. THC shall not be held liable for any errors or omissions of such data input and shall not be held liable for any direct or indirect losses or damages as the result of or arising out of such errors or omissions, including any incidental, consequential or punitive losses or damages. THC shall not be obligated or liable for any errors or omissions of any third party or events beyond THC's reasonable control.

THC is not a registered investment advisor or broker/dealer and does not provide investment advice to any person or entity. Information contained in this Report shall not be construed as any advice or recommendation for trade or investment or otherwise, and is not intended to substitute for obtaining any investment or trade advice.

THC is not an accounting firm, legal or tax advisor. Information contained in this Report shall not be construed as any accounting, legal or tax advice, and is not intended to substitute for obtaining accounting, legal or tax advice.

Before acting on any information provided in this Report you should conduct your own due diligence to evaluate the accuracy, completeness and usefulness of the information therein, as well as the risks associated with using THC's



models and related services, and in particular, you should seek independent investment, legal, tax and accounting advice.

THC's models embedded in THC's proprietary software in generating the Report are based on theoretical simulations. The projections or other information generated using THC's models regarding the likelihood of various balance sheet outcomes or other outcomes are hypothetical in nature. While due care has been used in the operating or running of THC's models, actual results may vary in a materially positive or negative manner. Therefore, there is no guarantee of future results in using THC's models. Performance analysis is based on certain assumptions with respect to significant factor(s) that may prove not to be as assumed, such assumptions regarding future events are very difficult if not impossible to predict, and many are beyond THC's control. Accordingly, there can be no assurance that the projections, analyses or information this Report generated using THC's models will prove accurate, complete or consistent. THC shall not be liable for any losses or damages which may arise directly or indirectly from use of or reliance on THC's models, as well as the information contained in this Report, including any incidental, consequential or punitive losses or damages.

Without limiting the generality of the foregoing, THIS REPORT IS PROVIDED 'AS IS', WITHOUT REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED. TO THE MAXIMUM EXTENT PERMISSIBLE UNDER APPLICABLE LAW; THC HEREBY DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS AND IMPLIED, RELATING TO THIS REPORT OR ANY INFORMATION CONTAINED HEREIN. THC HEREBY DISCLAIMS, ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THC HEREBY DISCLAIMS, ANY AND ALL REPRESENTATIONS, EXPRESS OR IMPLIED, INCLUDING REPRESENTATIONS CONCERNING THE QUALITY OF THE THC MODELS AND DOES NOT PROMISE THAT THE MODELS WILL PRODUCE ANY ANTICIPATED OR PROJECTED RESULTS, ANALYSES OR INFORMATION, OR BE ERROR FREE. NEITHER THC NOR ANY OF ITS AFFILIATES SHALL IN ANY EVENT BE LIABLE FOR ANY DAMAGES OR LOSSES OF ANY NATURE WHATSOEVER, INCLUDING, BUT NOT LIMITED TO, DIRECT, INDIRECT, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY, SPECIAL AND PUNITIVE DAMAGES, LOSS OF PROFITS OR TRADING LOSSES, RESULTING FROM ANY PERSON'S USE OR RELIANCE UPON, OR INABILITY TO USE, THIS REPORT OR ANY ANALYSES OR INFORMATION CONTAINED HEREIN, EVEN IF THC IS ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR LOSSES OR IF SUCH DAMAGES OR LOSSES WERE FORESEEABLE.