Housing Finance Innovation and How Canadians May Evaluate Homeownership as a Critical Asset Allocation

by

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Dissertation Submitted in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Philosophy

in the
Segal Graduate School
Beedie School of Business Faculty

SIMON FRASER UNIVERSITY

Spring 2014

Approval

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Degree: **Doctor of Philosophy**

Title of Thesis: ***Housing Finance Innovation and How Canadians May Evaluate Homeownership as a Critical Asset Allocation***

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Date Defended/Approved: December 9, 2013

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Abstract

This research makes a significant and important contribution to the literature on Canadian housing finance by identifying four regimes that represent a continuum toward a market-based mortgage system where Canadian households can readily access mortgage credit. The history of housing finance in Canada, like many nations, has been plagued by a lack of an effective way to channel savings into mortgages, and this has influenced households in the process of making the rent versus buy decision to obtain housing services. Innovation and advancements in Canada`s mortgage lending system and integration of mortgage funding with capital markets from 1900 to 2010, specifically mortgage backed securities enhanced with mortgage loan insurance, allow more households to shift from renting to homeownership. A cross-country comparison of OECD nations illustrates that a domestic mortgage market system must be sufficiently liberal and flexible so that a representative household can evaluate homeownership as an investment decision. In addition, a stylized Markowitz optimal portfolio selection model looks at homeownership as a critical asset allocation in the presence of bonds and equities in two Canadian markets: Metropolitan Toronto and Metropolitan Vancouver. The conclusion is that when the long-term mortgage loan borrowing rate is used to construct the capital allocation line, the efficient frontier is a blend of bonds and equities, and housing only forms part of an optimal risky portfolio over long holding periods. The economic model and empirical results show that single detached housing and apartment condominiums offer households different economic returns. A household may respond to this reality through deferring maintenance and holding the housing asset for long periods to maximize the implied imputed return. The instructive finding is that homeownership is a long-term investment that hedges rent risk, and if a household does not over-consume housing, there are significant gains from imputed rent. The homeownership decision for most households is often based on maximum permissible mortgage credit granting rules rather than optimal portfolio selection. The equilibrium approach verifies the probability distribution of positive economic returns in both Metropolitan Toronto and Metropolitan Vancouver over long holding periods.

Keywords: Housing Finance; Mortgage Lending; Homeownership; Mortgage Backed Securities; Optimal Asset Allocation

I would like to dedicate this work to my wife Sophie for her love and
my children, Angeliki Victoria and Paul Charles,
who provide me the imagination to always learn and, finally,
to Dr. Michael A. Goldberg and Dr. Andrey Pavlov,
for their inspiration and determination.

Acknowledgements

I would like to first thank my Mother, Maureen Esther Beck. Teachers have taken their time to share their wisdom and ideas with me and this includes: Dr. Hok Lin Leung, Dr. Andrejs Skaburskis, Dr. Muhammad Qadeer and Dr. Ron Giammarino. There have been many medical experts that came to my aid when I suffered a cerebral hemorrhage and I must thank Dr. Oscar Benavente, Dr. Briar Sexton and the wonderful people at GF Strong Rehabilitation Centre. At Simon Fraser University I have been so lucky to meet and work with some brilliant people. Finally, I would like to thank Rabbi Zalman Nelson who lives in Tsfat, Israel and my Jewish ancestors and the family patriarch my Great Great Grandfather John Adam "Levi" Beck. Levi Beck was born in 1836 in Germany and came to America in 1852 to start a new life after his family's right to own land was taken away in the old country starting in 1848. It is to Levi Beck that I owe so much. Levi Beck had the foresight to place an image of the family Synagogue in Germany at the top of his headstone when he died in 1904. In America, Levi Beck first lived in Brooklyn, and for many years he had a pushcart and would walk up and down Flatbush Avenue selling fruits and vegetables. When Levi's life started to look like there was economic salvation the American Civil War started and Levi moved again. He first moved north to Wellington, Ontario in the 1860s and then he finally settled in Yorkton, Saskatchewan where his sons Levi and Charles both became Mayor. In the 1860s Levi Beck befriended John "Levi" Oli Howe who was also born in Germany (1818), and his grand-daughter Esther Howe, who was the Aunt of Hockey Legend Gordie Howe, married my grand-father Charles Wesley Beck. I must thank my Hebrew ancestors, the Norman Kings, who left France in the 1820s for the Isle of Wight after Napoleon died in 1821 and the rights of many Hebrew people were limited by edict and had to leave France. The Norman Kings settled in Newfoundland in the 1870s prior to moving to Canada.

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List of Acronyms

AHOP	Assisted Home Ownership Program
ALT-A	Alternative-A (borrowers)
ARM	Adjustable Rate Mortgage
BPs	Basis points
CAAMP	Canadian Association of Accredited Mortgage Professionals
CAL	Capital Allocation Line
CHT	Canada Housing Trust
CMB	Canada Mortgage Bond
CMHC	Canada Mortgage and Housing Corporation
CREA	Canadian Real Estate Association
FHA	Federal Housing Administration
GSE	Government Sponsored Enterprise
IMF	International Monetary Fund
LTV	Loan-to-value
MBS	Mortgage backed securities
MICS	Mortgage investment companies
MLI	Mortgage loan insurance
MLS	Multiple Listing Service
NHA	National Housing Act
OECD	Organization of Economic Cooperation and Development
PSID	Panel Study of Income Dynamics
RRSP	Registered Retirement Savings Plan
S&Ls	Savings & Loans

Glossary

Alt-A Mortgage Borrowers	This class of mortgage borrowers includes new immigrants without a credit rating or self-employed individuals that cannot verify either employment or income and specific mortgage products exist for this borrower class.
Collateral Mortgage Obligation	This is a special purpose investment vehicle that as a legal entity owns mortgage assets within a pool. The mortgage assets represent the collateral and the mortgage pool provides cash flows for a bond issue sold to investors whereby specified tranches, for example senior, mezzanine or equity, receive the distribution of cash flows subject to a contract which is referred to as the structure.
Credit Default Swap	This swap contract is an unfunded credit derivative that results in a buyer of the credit default swap making a series of payments to the seller of the credit default swap to obtain insurance like protection in the event of a credit default. However, credit default swaps are not insurance since the buyer of the credit default swap does not need to own the underlying asset and the seller may not be a regulated entity and is not mandated to set aside a reserve fund from the premium payments to pay claims in the event of a credit default.
Credit Derivative	This form of derivative is a bilateral contract and is negotiated over the counter, and not on an exchange, and is similar to other derivatives in that the seller of protection in a credit derivative contract receives premiums from the buyer of the protection until maturity, or until default, against the credit risk of the reference entity such as a mortgage pool. A credit derivative can be unfunded like a credit default swap or funded like collateralized debt obligations.
Credit Enhancement	The purpose is to enhance the credit rating of an investment often fundamental to the securitization transaction in structured finance. Similarly, it can reduce credit risk and provide, for example, a lender or investor, with a guarantee of compensation if a borrower defaults by way of collateral, insurance, and or some form of counterparty agreement.
Credit Risk	Credit risk in housing finance means the risk that the mortgage borrower will default on a mortgage loan and the mortgage lender is not able to cover its loss due to foreclosure.
Mortgage Backed Securities	Referred to as MBS, this asset backed security represents a claim on the principal and interest cash flows from a pool of mortgage loans originated from various financial institutions. MBS is typically sold as bonds and because mortgage borrowers can prepay mortgages there is the potential for prepayment risk. Credit risk also exists unless the mortgage assets are insured or guaranteed.

Mortgage Loan Insurance	On high loan-to-value mortgages, typically where the mortgage borrower does not have a 20% downpayment, there is often a legislative mandate to require mortgage loan insurance to be obtained from a mortgage loan insurance supplier. Mortgage loan insurance is also integral to MBS. The premium is paid to the insurance company at the time of mortgage funding to insure or guarantee the mortgage lender against loss due to foreclosure.
Subprime Mortgage Lending	The common misperception is that subprime mortgage borrowers can be defined by a type of mortgage product such as mortgages with zero down payments, extended amortizations or interest only payments. Subprime mortgage borrowers are properly defined by their respective credit rating. A subprime mortgage borrower is someone that obtains a mortgage loan even though they have an impaired credit rating, usually due to a recent bankruptcy or when payments on personal debt obligations including taxes have been missed and are in arrears.

Executive Summary

The history of housing finance in Canada, like many nations, has been plagued by a lack of an effective way to channel savings into mortgages, and this has constrained households which are in the process of making the rent versus buy decision to obtain housing services as a homeowner. Innovation and advancements in Canada`s housing finance system and integration of mortgage funding with capital markets, through the secondary mortgage market, and specifically mortgage backed securities enhanced with mortgage loan insurance, have allowed for an advanced mortgage market so that households can easily shift from renting to homeownership. This research makes a significant and important contribution to the literature on Canadian housing finance by identifying four regimes that represent a continuum toward a mortgage system that is sufficiently advanced so that a Canadian household can readily access mortgage credit for either home purchase or a home equity line of credit. Since 1900, a market based mortgage system has emerged in Canada with secure mortgage funding sources and an institutional framework to support homeownership of different housing types.

Investors benefit from financial innovation and often least understood is innovation related to the mortgage market as a necessary pre-condition for households to evaluate homeownership as an investment decision. Homeownership requires a substantial investment that not only dominates total household wealth but is often supported by a large mortgage loan obligation. In return, households will obtain consumption of housing services and also have the expectation to earn returns from potential capital gains and imputed rent. To gain insight into housing finance in Canada this research also evaluates the features and indicators of a mortgage market among advanced economies to determine whether a flexible and liberal mortgage market exists in Canada. Under such a system a representative household can use its wealth to become a homeowner and then manage the equity in a principal residence as a long-lived security. The household can then dynamically span its consumption needs through access to a mortgage loan which represents a second, long-lived security.

The research proposes two indices based on a comprehensive set of features and indicators present in a domestic mortgage market. The first index considers the

degree to which a domestic mortgage market is liberal and a second index considers the degree to which a domestic mortgage market is flexible. The liberal index relates to the domestic homeownership rate, while the flexible index relates to the domestic level of mortgage debt per capita. When the indices are combined on a matrix they serve to plot the relative position of a domestic mortgage market system to confirm whether it is dynamically complete, supporting homeownership as an investment. The indices proposed in this research are then applied to a cross-country comparison. The research represents a refinement and extension to the "synthetic index of mortgage market development" and "index of government participation in housing finance markets", both set forth by the International Monetary Fund (IMF) (2008, 2011) as well as other studies presented in the research. The conclusion of the research is that the mortgage markets of the U.S., U.K., Canada, Denmark, Ireland, Netherlands and Australia are sufficiently liberal and flexible so that a representative household can evaluate homeownership as an investment decision. The findings support research whereby investment in homeownership forms part of the investor's critical allocation decision within an optimal portfolio selection model.

This research draws from existing studies on portfolio selection. In these models housing is included among financial assets. The main finding of the literature is that housing, due to its high cost and need for a large mortgage loan, crowds out investment in equities. Most studies focus on the U.S. and the income tax deductibility of mortgage loan interest is a public subsidy that in and of itself, can influence homeownership preferences and mortgage credit demand. The motivation for this research is to refine and extend the theoretical approach on how a representative household, that has qualified to become a homeowner but requires a mortgage loan, evaluates housing investment in the presence of equities and bonds. The insight of this research contributes to finance theory and concludes that homeownership as a critical asset allocation is more complex than other asset classes. Households must consider housing type, holding period, property maintenance, and the mortgage lending system as part of the optimal portfolio selection. For the empirical research a Canadian market setting, Metropolitan Vancouver and Metropolitan Toronto where homeownership levels are 70 per cent. Canadian findings are an important addition to existing studies that focus on

the U.S. A Canadian approach avoids the influence of taxation deductibility of mortgage loan interest that shapes studies with a U.S. focus.

In this research a stylized Markowitz optimal portfolio selection model is presented. The guidance for expectation of returns and volatility of returns for equities and bonds are exogenous, based on long-term historic results, and three scenarios are presented for housing:

1. expectations of house price returns and imputed rents that follow historical returns;
2. an equilibrium approach where the change in house prices and imputed rents evolve together as a stochastic process; and
3. implied annual rates of housing returns necessary for housing to be an asset in an optimal portfolio selection above the global minimum variance portfolio.

Empirically, interest rates, specifically the mortgage loan borrowing rate and the household lending rate, shape the efficient risk-return opportunities when the portfolio selection includes housing and financial assets. When the long term mortgage loan borrowing rate is used to construct the capital allocation line (CAL), the efficient frontier is a blend of bonds and equities, and housing only forms part of an optimal risky portfolio in Metropolitan Vancouver for a single detached house under deferred property maintenance at a holding period of 25 years or more and an apartment condominium under deferred property maintenance at a holding period of 40 years. In Metropolitan Toronto housing is never part of the optimal portfolio selection. This would suggest that households would tend to avoid homeownership, yet homeownership rates are high in both markets. An important insight is that due to the separation property, when the CAL is defined by the risk free rate to represent the available lending rate or a short-term mortgage loan borrowing rate, then the global minimum variance portfolio is the optimal risky portfolio. While largely dominated by a holding of bonds and a modest holding of equities, the global minimum variance portfolio includes housing in the asset allocation for both market areas, but the initial net wealth requirements are very high, and greatly exceed that of maximum loan-to-value (LTV) mortgage lending ratios. As such, the homeownership decision for most households is based on maximum permissible mortgage credit granting rules and not optimal portfolio selection and homeowners bear

unique investment risk. The equilibrium approach verifies the high probability distribution of negative returns in both Metropolitan Toronto and Metropolitan Vancouver over a holding period of less than 25 years under full property maintenance. Without explicitly examining the benefits of renting, there is strong evidence to suggest that when a household requires consumption of housing services over the short or medium term the rental housing market should be regarded as the primary source of housing supply. The instructive finding from the results of implied annual housing returns suggests that an investor with a short term outlook on homeownership is expecting a high return and ownership control of a housing asset allows for high return property renovations, and this capacity is unique to housing as an asset. Finally, homeownership is a long-term investment that hedges rent risk, and if a household does not over-consume housing, there are significant gains from imputed rent.

Chapter 1.

Introduction

The motivation for this research is to provide a richer understanding of the evolution in Canada`s housing finance system and the household decision to own housing services. To address this in a thorough manner it is important to first identify the major turning points and advancements in the Canadian mortgage lending system and underlying institutional framework that link housing finance to homeownership. For the purposes of this research housing finance is understood to encompass mortgage funding. This also includes the sources of mortgage funds, the mortgage products and the mortgage funding channels that mortgage borrowers rely upon to secure finance to realize the goal of homeownership. Housing finance includes the secondary market system in which many mortgage lenders operate to fund mortgage loans. Housing finance gives a central role for government to provide the institutional framework and legal system to support mortgage lending. Moreover, government can offer homeownership tax incentives and subsidies. Government can even direct support and enhancements to offset the credit risk related to mortgage lending and securitization of mortgage pools.

This research considers that a market based mortgage market lending system and secure funding sources are a necessary pre-condition for households to make the choice between owning and renting housing services. An advanced mortgage lending system allows households to access home equity over time as needed to support household finance. With such a comprehensive outlook on housing finance this research contributes to the literature on housing finance and mortgage market development in an international context. It also adds significantly to the modest literature on Canadian housing finance. This research does not address all aspects of the legal system and the institutional framework integral to a market based mortgage lending system, and this will be more fully addressed in future research.

In Chapter 2 the research highlights the specific regimes that define the evolution of housing finance in Canada. It tracks the progress and advancements over the four regimes through a descriptive review. Appendix A provides a timeline of key dates to assist the reader. The researcher has found it necessary to highlight significant changes in the U.S. housing finance system as well. The importance of drawing from the U.S. experience will become evident as it either directly or indirectly relates to the evolution of housing finance in Canada. The concluding remarks will flow into the following chapters and allow some important conclusions to be drawn. Chapter 3 intends to contribute to the international housing finance literature in a significant way. It proposes a theoretical index and matrix to evaluate the degree to which a domestic mortgage lending system is sufficiently liberal and flexible to be defined as a dynamically complete, supporting homeownership as both an investment decision and to obtain housing services in a way that can smooth inter-temporal household consumption. Chapter 4 refines and extends existing literature on portfolio theory to consider investment in homeownership in the presence of bonds and equities as an optimal portfolio selection. Under this approach a household that qualifies for homeownership through the mortgage lending system can choose among different housing types over different holding periods and express strategic considerations related to property maintenance.

The motivation for this research is to better understand why some people choose to own while others choose to rent. Unlike the past, home equity and the appreciation of housing as an asset have formed an integral part of retirement planning. In today's world consumers are taking a more active role in how best to consumer housing services. Consumers are also taking a more active role in the mortgage lending system. With the advent of financial innovation and widespread use of computers a representative household can evaluate homeownership as part of the investor's critical allocation decision. Without fully realizing it, households are taking a portfolio optimization approach to homeownership. Households are evaluating the rent versus buy decision alongside equities, bonds and a risk free asset, such as a mortgage loan, within a stylized Markowtiz optimal portfolio selection model.

The mortgage lending system in Canada and the U.S. has undergone unprecedented change over the last few decades. There is a new paradigm in housing finance. Households are considering a range of goals as they decide on whether to own

or rent housing services. This is only possible with a more transparent and inclusive mortgage lending system that is both liberal and flexible. For the purposes of this research, a mortgage market that is both sufficiently liberal and flexible is defined to be dynamically complete. The economic reasoning of this conclusion draws from the work of Duffie and Huang (1985), but extended to the housing market, whereby under a Radner (1972) style equilibrium a representative household can dynamically span the consumption space provided by homeownership in a principal residence through the mortgage market. Given that housing services obtained by renting or owning are substitutes, Hornstein (2009), in those nations with a dynamically complete mortgage market, the percentage of households that are homeowners should outweigh those that are renters. There are specific economic benefits for households that view homeownership as an investment choice relying on mortgage funding as a household finance tool.

Chapter 3 is critical to this research. First, it presents a literature review with a Canadian focus on the investment qualities of homeownership including a description of the institutional framework of mortgage markets to support homeownership. This flows into a discussion on the limitations of housing markets to fit the traditional principles of complete markets and the notion of a dynamically complete market is proposed. A simple theoretical model is used to present comparative statics to highlight the important role of the mortgage market to support housing as an investment. The researcher uses these findings to look at housing finance in an international context. The ranking of domestic mortgage markets is based on a comprehensive set of inter-related features and indicators to create two indices. The first index considers the degree to which a domestic mortgage market is liberal and a second index considers the degree to which a domestic mortgage market is flexible. The liberal index relates to the domestic homeownership rate, while the flexible index relates to the domestic level of mortgage debt per capita. When the indices are combined on a matrix they serve to plot the relative position of a domestic mortgage market system to confirm whether it is dynamically complete, supporting homeownership as an investment. The proposed indices are applied to a cross-country comparison of Organization of Economic Cooperation and Development (OECD) nations, similar to the work of the International

Monetary Fund (IMF) (2008, 2011). Chapter 4 can then consider a homeownership investment as part of a household`s optimal asset allocation.

In Chapter 4 the researcher starts with the premise that the household decision to become a homeowner represents a significant share of a household`s net wealth and may mean that investments in financial assets are deferred since homeownership typically entails a large mortgage loan obligation. The economic intuition is that while the household choice to become a homeowner supports the need for consumption of housing services, it is fundamentally an investment problem. This contributes to the literature on portfolio selection, and this draws from the fundamentals of portfolio theory and asset selection beginning with Markowitz (1952), Samuelson (1969), and Merton (1971). Extensions to the literature that include homeownership in the portfolio selection consider whether housing impacts equity market participation, and how portfolio selection may differ depending on an investor`s financial wealth, income or age and the cost of housing. This research is useful and simple since it refines and extends existing research. It proposes a stylized Markowitz optimal portfolio selection model in which a household`s portfolio selection that includes housing among financial assets account for different housing types; length of holding period; imputed rent; property maintenance and the mortgage lending system.

This research does not address the challenges that many households face in obtaining acceptable housing services from both market and non-market sources and does not consider the supply and demand of housing. This research also moves beyond studies that address a household`s portfolio selection as a simple utility maximizing consumption model without fully accounting for the complete range of benefits and costs associated with homeownership as an investment and the mortgage lending system in which households finance homeownership. Advancements in mortgage markets allow home equity in a principal residence to be used as a household finance tool to smooth inter-temporal consumption. Undoubtedly, home equity will continue to play an important role in financing retirement needs given stock market volatility. This research is unique among the literature in that it considers different housing types, various holding periods and property maintenance. The model presented allows a household to choose between an apartment condominium and a single detached home. This model allows a household to consider finite holding periods. As such, it adds to other models that either

assume an infinite horizon, Miao and Wang (2007), or an optimal stopping time, Cetin and Zapatero (2010). Finally, households can also express strategic considerations related to property maintenance.

For simplicity, the model and empirical analysis follows a Canadian market setting, unlike the U.S., where the tax deductibility of mortgage interest and property taxes is a public subsidy that can influence demand for mortgage credit and therefore entice households to become homeowners. Canada is similar to the U.S. and elsewhere in that capital gains and imputed rent related to homeownership of a principal residence over time are tax-exempt. For the empirical work, the housing markets of Metropolitan Toronto and Metropolitan Vancouver have been selected since homeownership levels approximate 70 per cent, and these housing markets report high levels of sales transactions, with relatively high house prices, but without much influence of subprime mortgage lending as has been the case in many U.S. housing markets.

The stylized model assumes that a household, through the mortgage lending system, has qualified to become a homeowner and will make a portfolio selection that includes housing among financial assets such as equities and bonds at a specific point in time. The expectation of returns and volatility of returns for equities and bonds are exogenous, based on long-term historic results. There are three scenarios presented for housing:

1. expectations of house price returns and imputed rents that follow historical returns;
2. an equilibrium approach where the change in house prices and imputed rents evolve together as a stochastic process; and
3. implied annual rates of housing returns necessary for housing to be an asset in a portfolio selection above the global minimum variance portfolio.

Chapter 4 begins with a literature review on housing as an investment; the role of the mortgage lending system in supporting homeownership; and aspects of portfolio theory that include housing in the selection. The researcher then sets forth a simple economic model to evaluate a household`s portfolio selection that considers homeownership in the presence of equities and bonds. The empirical findings focus on Canada's two main housing markets: Metropolitan Toronto and Metropolitan Vancouver.

The summary discusses the implications when a household places homeownership within an optimal portfolio and highlights key findings related to household preferences in favour of homeownership.

Chapter 2.

Toward a Market Based Mortgage Lending System

There has been an evolution in housing finance in Canada which highlights the importance of the mortgage lending system to support households to make the rent versus buy decision to obtain housing services. Financial innovation allows households to weigh the economic costs and benefits of buying or renting housing services. This strengthens the rationale for a household to regard homeownership of a principal residence as an investor`s critical allocation decision, but this was not always the case. While homeownership rates for Canadians in urban markets have stabilized since the 1980s at about 70 per cent, according to Statistics Canada, this is about twice that of the 1920s when the rate was only 40 per cent. Rural households in Canada have predominantly chosen homeownership since rural housing markets are more affordable; the home and employment are often inter-connected in rural areas; and also due to the lack of available rental housing options in rural housing markets.

Housing finance in Canada, like many nations, has been plagued by a lack of an effective way to channel savings into mortgages. The evidence presented in research by Ambrose and Pennington-Cross (2000), Gabriel and Rosenthal (2005), Mayer and Pence (2007), Buckland and Dong (2008), Shiller (2008), Sherlund (2008), Mian and Sufi (2008), Haughwout, Mayer, and Tracy (2009), and Simpson and Buckland (2009) shows that without a market based mortgage lending system and without a secure mortgage funding source, households can be severely constrained from homeownership. A market based mortgage system where mortgage funding is integrated with capital markets through the secondary mortgage market and mortgage backed securities (MBS), allows households to openly evaluate the rent versus buy decision for consumption of housing services. At different times in Canada`s history, government participation, market practices and the mortgage lending framework have:

- mirrored changes in the U.S. mortgage system but with a lag;
- purposefully not replicated the U.S. mortgage lending system; or
- expressly followed the U.S. system, but often with the tendency for a larger role for public organizations and with generally less de-regulation than resulted in the U.S.

As a descriptive review will confirm, even though housing finance in Canada has similarities to the U.S. system and comparisons can be made to other systems around the world, it is unique. The process of change and advancement over the years can be defined as four distinct regimes.

2.1. Regime 1 (1900 to 1953): A Constrained Mortgage Market System

Canada, in the early 1900s, as described by Harris and Ragonetti (1998), had limited options for households to obtain mortgage credit, not dissimilar to many nations today where mortgage credit is just becoming available. During the early part of the twentieth century, equitable mortgages were typical and variations of this form of mortgage credit still exist in Canada at modest levels and are also found in other nations. In simple terms, under these informal and unregulated contracts, borrowers simply pledge property as security for mortgage debt and the mortgage lender is equally likely to be a private individual, commercial business or non-profit agency. This form of mortgage lending, as well as vendor take-back mortgages whereby the seller of a home will hold and underwrite a first or second mortgage loan of the new home buyer, were commonly seen throughout Canada until the 1950s, as documented by Miron (1988). Due to constrained mortgage lending, many households often had to make outright cash purchases for new housing or obtain a line of credit from a local lumber store and construct homes in phases as household finances allowed, as confirmed by Paterson (1991). This often forced households to defer homeownership for an extended period of time. In Québec, La Confédération des caisses populaires Desjardins du Québec played an important role in mortgage lending in Québec since 1900, setting the foundation and framework for the credit union system to develop across Canada.

Poapst (1993) explains that institutional residential mortgage lending in Canada was generally financed by life insurance companies from the early 1900s even until the 1960s, with the highest market share at 90 per cent between 1944 and 1954. Trust and mortgage loan institutions focused on residential mortgage lending and term deposits. Banks did not participate in the residential mortgage lending system as bank charters limited their lending practices to the borrowing needs of the business community.

During the first regime, Canadian households typically held 5-year term mortgages with loan payments usually made once or twice a year and sometimes quarterly. Mortgage credit was largely constrained by the LTV ratio extended to mortgage borrowers, typically set at 50 per cent of assessed property value. Mortgage payments included two components: a small amount of repaid principal with the greater payment being accrued interest. After 5 years, the principal outstanding became legally and fully due. Contracts did not offer borrowers a legal right to renew and rollover a mortgage, even though the lender would typically renew the mortgage if the borrower had made steady payments. Depending on economic conditions, many households were subject to unpredictable mortgage credit granting and foreclosure was common as a mature system of mortgage lending did not generally exist. Under this regime of housing finance, the risk of homeownership was high for both the lender and borrower, and the potential for capital appreciation associated with homeownership was relatively low.

The 1944 revision to Canada's National Housing Act (NHA) set mortgage loan rates at 4.5 per cent and allowed the amortization of mortgage loans up to 30 years. It also introduced direct mortgage lending and formed the basis for a national housing agency, Central (later changed to Canada) Mortgage and Housing Corporation (CMHC), to assist returning war veterans in obtaining adequate shelter. The mortgage system was liberalized once again and by the 1950s the maximum LTV of mortgage loans was increased to 93.33 per cent. Mortgage loan rates were capped by statute to keep costs down, and the interest rate ceiling on joint loans, whereby the mortgage loan was underwritten jointly by a financial institution and the federal government, was typically set at no more than 2 per cent above the yield on 12-year Canada Bonds. According to Steele (1993), this transformed the residential mortgage market, helping to assist middle-income households in obtaining mortgage financing. Some constraints on low

income households were evident, as outlined by Steele (1993), due to the level-payment structure of NHA mortgages; high construction standards (at the time) that prescribed a minimum house price; unfavourable policies for lending on owner-occupied duplexes and triplexes; exclusion from "qualifying income" of anyone other than the household head; and lending exclusively on new buildings, ignoring the lower cost existing housing stock. During the first regime, some provinces in Eastern Canada, notably Nova Scotia and Québec, directed homeownership strategies to low-income households. Starting in 1948, Québec`s Family Housing Act provided a 3 per cent interest rate subsidy to low-income households with specific exclusions for homes at the upper price range in the market, in contrast to NHA rules. During this time in Nova Scotia, low-income households could qualify for homeownership for unfinished homes and use sweat equity to finish the home as a replacement for a traditional down payment.

Even as late as the 1950s, over 25 per cent of all Canadian households purchased a new or resale home without a mortgage, as Miron (1988) documents. Mortgage finance was important in larger urban markets, as illustrated in Table 1. At this time, Toronto had a much higher level of mortgage credit using first and second mortgages than Vancouver, suggesting a constraint on overall mortgage loan amounts, likely due to higher home prices. Although homeownership levels without a mortgage were higher in Vancouver, this does not mean that mortgage credit was evenly distributed among all neighbourhoods. The establishment of Vancity Credit Union in 1946 had a goal to direct mortgage lending into lower income neighbourhoods, often restricted in obtaining mortgage credit. Vancity would eventually become the nation`s largest credit union. Since the 1950s, Canada`s credit union system has played a substantial role in providing mortgage credit to households in many previously under-served jurisdictions.

Table 1. Historic Mortgage Finance in Toronto and Vancouver

Toronto	1941	1951
Homeowner without mortgage	25,381 (40.5%)	81,375 (42.3%)
Homeowner with 1st mortgage	33,841 (54.0%)	90,845 (47.2%)
Homeowner with 1st and 2nd mortgage	3,447 (5.5%)	20,250 (10.5%)
Vancouver	**1941**	**1951**
Homeowner without mortgage	21,006 (59.0%%)	63,165 (60.5%)
Homeowner with 1st mortgage	14,383 (40.4%)	39,480 (37.9%)
Homeowner with 1st and 2nd mortgage	214 (0.6%)	1,685 (1.6%)

Source: 8th Census of Canada, 1941 and Ninth Census of Canada, 1951

The first regime saw the beginnings of a shift to higher homeownership levels in urban areas. The formalization of a mortgage lending system open to households with stable income and employment, often in defined geographic markets, was the start of the process. However, direct government intervention and programs were still necessary to overcome many market limitations. Households lacked access to a secure mortgage funding source and the burdens and risks of homeownership were known to lenders and borrowers making rental housing a viable, low-risk option to obtain necessary housing services in urban markets.

2.2. Regime 2 (1954 to 1968): A Secure Mortgage System with Some Constraints

A revision to Canada's NHA in 1954 replaced the joint (public – private) mortgage loans program with insured mortgage loans. The Canadian introduction of mortgage loan insurance (MLI) in 1954, which followed MLI in the U.S. by 20 years (1934), provided an important safeguard for trust and loan companies to become mortgage lenders. The 1954 Bank Act amendments permitted banks to participate in residential mortgage lending by way of NHA insured mortgages. MLI was originally required by statute for any mortgage borrower that could not provide a 33 per cent downpayment, and later this was changed to 25 per cent and then finally to 20 per cent, which continues to remain in effect. MLI was important for many prospective

homeowners looking to buy a home without adequate downpayment to qualify for a conventional mortgage. In effect, the provider of MLI safeguards the lender from borrower default and the risk of foreclosure, but the mortgage borrower pays the insurance premium which is typically included as part of the total mortgage loan, as Tracelet (2006) describes. However, MLI did not compel financial institutions to originate mortgage lending and did not expand mortgage credit in any meaningful way, and bank lending was constrained by a ceiling on mortgage loan rates that could be charged to borrowers.

Long term mortgage financing in Canada came about in the 1950s, and the renewable 10-year mortgage loan term was replaced with the longer 30 year loan term, eliminating the need to renew the loan before it was paid off. Prepayment was also permitted for the first time as the borrower was given a right to repay the loan in full on the third anniversary date of the loan, or thereafter. National mortgage lending was further enhanced into remote communities with federal funds to pay lenders for the administrative cost and travel expenses to make mortgage loans in small and remote communities. Up until 1967 and revisions to the Bank Act which took effect in 1969, life insurance companies, credit unions and trust and loan companies dominated the retail market for mortgage lending. In 1967, the Caisse de dépôt placement du Québec was established, and it expanded mortgage lending in Québec. However, there still was a need to modify the counter-cyclical behaviour in Canadian lending practices to better integrate mortgage funding with the capital market to increase the supply of mortgage funds eliminating sub-optimal financing constraints consumers often encountered in mortgage lending.

In the second regime, demographic changes, specifically increasing household formation, placed demand on housing finance to support homeownership. The housing market was changing as well with new condominium legislation that permitted developers in some provinces to sell townhomes and apartment units in multi-family buildings. Although share ownership in cooperative buildings was common in some markets prior to this, the purchase of shares in a cooperative had many drawbacks, the most significant being limited financing opportunities, and generally ownership in the cooperative entity could not be mortgaged. The introduction of legislation allowing for the development and sale of condominiums in 1966 in the provinces of B.C. and Alberta

was based on legislation from New South Wales in Australia. The original Strata Titles Act set out the procedure for obtaining title to parts of a multi-storied building; rules for strata plans and for corporations formed by owners; and legal rights and obligations regarding common property. This was a transformation to the housing market and further revisions came into effect in B.C. in 1974 that provided for phased strata plans and strata plans on leased land. The 1979 Condominium Act was passed in B.C. and has been generally mirrored in all Canadian jurisdictions.

During the second regime, homeownership was made more accessible to low-income households as downpayment and mortgage credit granting qualifications were relaxed, according to Steele (1993), and by 1965, 18 per cent of NHA borrowers fell in the bottom-third family income group, up from 6 per cent in 1954. NHA MLI coverage was extended in the late 1960s to include condominiums and existing homes, increasing homeownership options for households that may otherwise have only qualified to rent multiple-family apartment units or hold an ownership interest in a co-operative housing project, financed with a personal loan, not a mortgage loan.

2.3. Regime 3 (1969 to 2000): Toward a Market System with Mortgage Rate Volatility

In 1969, when the constraints on mortgage lending were lifted, abolishing the interest rate ceiling (6 per cent NHA interest rate), banks could make uninsured mortgage loans and enter into the conventional mortgage market. The dominant role of banks as the primary mortgage lenders in Canada was a result of expansion over the 1970s and 1980s and also the acquisition by banks of mortgage trust companies (permitted by 1992 Bank Act revisions) that were experiencing financial difficulty particularly during the economic slowdown of 1992 to 1994, as Freedman (1998) documents.

During the 1970s, CMHC was given the mandate to implement government policy to deliver large-scale subsidy to low-income households to become homeowners. To achieve 10,000 ownership units directed at low-income households, a $200 million “innovative low-cost housing programme” was announced in 1970. Steele (1993) notes

that this program did not provide loans at below the CMHC lending rate; and in 1971 the $100 million Assisted Home Ownership Program (AHOP) was introduced along with extended mortgage loan amortizations. The objective of AHOP was to make homeownership affordable by offering large initial monthly subsidies with a unique mortgage design where payments slowly increased over time. According to Steele (1993), underlying the innovation were the assumptions that the rate of inflation would be stable; that the inflation premium on interest rates would not change upon rollover; that incomes would move in line with inflation making the payment-to-income ratio under AHOP affordable; and that house prices would steadily appreciate allowing for gains in home equity. Funding supported approximately 161,000 homeownership units during the funding of AHOP, from 1970 - 1978. By 1985, 11 per cent of all units had defaulted, and regionally Ontario realized 60 per cent of total AHOP defaults, with a default rate of 20 per cent. Of course, during this period, NHA defaults were also high due to house price volatility and a macro-economic shock to the economy related to excessive inflation over the 1970s. In 1978, when AHOP was terminated, CMHC homeownership programs were largely confined to supporting mortgage product innovation initiated by financial institutions with NHA MLI and energy-savings programs such as the Canadian Home Insulation Program (1977 – 1986) and the Canadian Oil Substitution Program (1980 – 1985).

The 1980 Bank Act revision responded to globalization by allowing foreign banks to incorporate subsidiaries in Canada and accept deposits. Prior to this, foreign banks could only operate in wholesale banking. This change created a broad-based, competitive market for mortgage lending in Canada. However, mortgage loan costs could still vary and be subject to significant volatility that made mortgage credit risky for mortgage lenders, mortgage borrowers, and mortgage loan insurers. The majority of mortgage funding during the 1970s in Canada had come from savings deposits which accounted for the largest funding source for mortgage lenders. However, new financial products, primarily equity and bond mutual funds, offered investors the potential for diversified returns at higher levels than savings deposits, and therefore reduced a large share of savings deposits as a stable, low-cost residential mortgage funding supply. Homeownership and mortgage credit demand was increasing with incentives such as the Canada Home Buyer Plan, first introduced in 1992, to allow a first time home buyer

to direct savings within a registered retirement savings plan (RRSP) for the down payment of the purchase of a primary residence. The First Home Loan Insurance Program, also introduced in 1992, reduced the minimum down payment on a household`s first time purchase of a principal residence (subject to certain conditions) from 10 per cent to 5 per cent. In 1998, the 5 per cent down payment threshold was expanded to include repeat home buyers as well. According to the Office of Consumer Affairs and CMHC, 70 per cent of first time home buyers between 1992 and 1997 would have been unable to purchase their home without the 5 per cent down payment option.

The main challenge to mortgage funding in Canada during the 1980s and 1990s was due to mortgage loan rates that were both high and volatile exposing the mortgage system to significant interest rate risk, credit risk and prepayment risk. Mortgage funding was also impacted by a decline in bank savings deposits due to competing investments. Mortgage loan defaults were often directly related to economic shocks impacting local economies as well as volatile and high mortgage loan rates that often made homeownership unaffordable due to high mortgage loan interest costs. Mortgage contract features lacked flexibility to accommodate household mis-fortune due to loss of employment, strikes, or illness. There was a need to evolve the mortgage market further toward a fully market system with a consistent supply of low cost, stable mortgage funding sources. Integration of the capital market into mortgage lending was identified as the solution drawing from the U.S. experience. Securitization became common in the mortgage market in the 1980s through MBS in the U.S. and this expanded globally ever since. The reason this occurred in the U.S. highlights the institutional differences in housing finance and mortgage lending in the U.S. and Canada. Understanding the U.S. housing finance system provides the reader with a context for the evolution of Canada's housing finance system since the 1980s, paving the way for an era of low cost, stable mortgage funding in Canada in the fourth regime.

2.3.1. The U.S. Influence on Canadian Housing Finance

The following discussion highlights some key events in U.S. housing finance and mortgage market development, and while a full treatment of this topic is too large to address in this research, the timing of events and changes support the conclusion that the U.S. housing finance system has influenced developments in Canada's system.

The current U.S. housing finance system and mortgage market are rooted in an institutional framework dating back to the 1930s, Green and Wachter (2005). For many U.S. households the economic depression of the 1930s heightened existing constraints in the mortgage system as a large cross section of households were unable to initiate or renew a mortgage loan contract. The financial and credit crisis of this era exacerbated the already high number of foreclosures due to increasing unemployment and failure of many financial institutions. The estimate was that during the early 1930s about 40 per cent of U.S. households were renters and mortgage contracts were of a short term with LTVs generally not exceeding 50 per cent, Jameson (2002). Since the government did not want to directly hold mortgages, a number of institutional changes took effect to remedy market imperfections starting with the 1933 Home Owner's Act which supported the activities of Savings & Loans (S&Ls) to secure mortgage borrowers with a 25 to 30-year mortgage at a fixed loan rate. In 1934, with the passing of the National Housing Act in the U.S., the Federal Housing Administration (FHA) offered government-backed MLI as a credit enhancement for investors to purchase mortgages with confidence. The Federal National Mortgage Association, known as Fannie Mae, was established in 1938 to support a secondary mortgage market for FHA mortgages. The overall purpose of fixed long term mortgage contracts, combined with MLI, was to eliminate the destabilizing uncertainty of mortgage loan renewals rather than to directly promote homeownership.

S&Ls traditionally participated in residential mortgage lending on a property held by a mortgage borrower located within 50 miles of the main office of each S&L. Between 1945 and 1966 the yield on a 3-month treasury bill did not exceed 4 per cent and S&Ls could readily raise mortgage credit directly from depositors and offer long term fixed rate mortgages at relatively low cost. However, Regulation Q, imposed by the U.S. Congress on the S&Ls sector during the 1960s and 1970s, put a 5.5 per cent interest rate ceiling on interest paid to depositors. With rising inflation rates in the 1970s which exceeded 13 per cent in 1979, this resulted in disintermediation for S&Ls. The impact of Regulation Q on mortgage funding was immediate as depositors at S&Ls directed an increasing percentage of total deposits away from savings accounts to money market mutual funds, which reached 20 per cent of total deposits by the 1990s, Freedman (1998). Regulation Q was phased out in the early 1980s so that S&Ls could compete for

deposit funds by offering interest rates in line with market rates. By this time, however, an unsustainable gap due to maturity transformation highlighted the suboptimal practice between funding long term, fixed rate mortgage loans with short term deposits. When mortgage loan rates exceeded 20 per cent in the early 1980s this resulted in an almost complete shift in mortgage terms to adjustable rates before a return to lower, more stable inflation in the 1990s and 2000s when U.S. mortgage borrowers once again preferred long term, fixed rate mortgages. Deregulation of S&Ls was set out in the Depository Institutions Deregulation and Monetary Control Act and the Garn-St. Germain Depository Institutions Act of 1982. The economic value of thousands of S&Ls loan portfolios eroded following deregulation which allowed S&Ls to liberalize lending away from a business model based on residential mortgages to lending which included commercial property, credit cards, junk bonds, and other high risk lending ventures, Ferguson (2008). S&Ls clearly did not have sophisticated underwriting expertise, risk based pricing and default servicing capabilities to ensure viable lending. The S&Ls crisis lasted from 1986 to 1995. It highlighted the obvious flaws in the maturity mismatch of residential mortgage lending and the unintended consequences of Regulation Q as well as deregulation within the S&L industry that fostered moral hazard in lending practices, resulting in a $153 billion bailout of impacted S&Ls by the U.S. Treasury, Jameson (2002).

The growing loss of savings deposits as a mortgage funding source paved the way for MBS and the total percentage of U.S. residential mortgages securitized increased from almost nothing in the 1960s to 10 per cent by 1980, with an upward track to 50 per cent by 1990 and modest increase to 60 per cent through the 2000s, according to Freedman (1998) and the Mortgage Bankers Association. The U.S. housing finance system which relied on MBS flowed naturally from the institutional framework imposed on the S&Ls and the mounting financial risks that resulted in poor economic performance for these financial institutions. Mortgage lending shifted away from a funding model that relied on savings deposits at the same institution, towards one where the mortgage lender could focus solely on the origination of mortgage loans. The market structure of mortgage lending in general was also changing as dedicated mortgage brokers were working directly with mortgage borrowers to originate mortgage loans, earning fees and commissions from the mortgage lender. The financial institutions who

served households as mortgage lenders were also changing. De-regulation allowed a growing number of non-depository financial institutions, referred to as mono-line dedicated residential mortgage lenders as well as mortgage investment companies (MICs) to enter the mortgage market. The mono-line mortgage lenders relied on the MBS funding model for mortgage credit, and in many cases without access to any depositor savings accounts, had to partner with a wholesale funding source as an intermediate step in the securitization process.

Government participation in U.S. housing finance has included a range of tax incentives and subsidies for homeowners such as mortgage interest deductibility and exclusion from capital gains taxation at the federal level as well as state and local property tax deductions. While the U.S. MLI sector has a number of private sector companies, there has always been an important and direct role for government with significant activity recorded by government sponsored enterprises (GSEs), primarily Ginnie Mae and Fannie Mae that began as one organization. However, in 1968, Congress directed Fannie Mae to support the conventional market and Ginnie Mae to support mortgage lending for the FHA, Department of Veterans Affairs Home Loan Program for Veterans, Office of Public and Indian Housing, and the U.S. Department of Agriculture Rural Development Housing and Community Facilities Programs. Ginnie Mae does not purchase mortgages, nor does it buy, sell or issue MBS or debt securities. Private lending institutions approved by Ginnie Mae issue the MBS for which Ginnie Mae provides a guarantee. Moreover, Ginnie Mae only securitizes federally-insured or guaranteed loans. The 1968 creation of a new private Fannie Mae allowed the U.S. Treasury to remove Fannie Mae`s debt from the government balance sheet and buy and sell non-government backed mortgages. Freddie Mac was established in 1970 for the securitization of mortgages issued by S&Ls. Since the 1980s, the provision of MLI in the U.S. has represented a multi-billion dollar industry for those collecting MLI premiums and securitization fees, supporting mortgage product innovation for trillions of dollars or mortgage funds. The institutional framework to provide mortgage lenders and investors with a credit enhancement largely focused on MLI and the regulatory safeguard was to limit MLI to conventional, prime mortgages within specific property valuation ceilings. There was still a legacy of discriminatory U.S. mortgage lending practices, either based on geography or borrower class, Courchane, Surette, and Zorn (2004) and Benston

(1997). The American Dream Downpayment Act, signed into law in 2003, had the objective to increase mortgage lending, facilitating a wave of subprime borrowers to become homeowners. In support of this, structured credit derivatives, such as unfunded credit default swaps or funded credit debt obligations, supported mortgage product innovation and facilitated the sale of MBS to a broad spectrum of investor groups.

The U.S. housing finance system in the 2000s was being funded by MBS at an increasing level, and the process of mortgage product innovation driven by deregulation included the introduction of subprime mortgage lending; interest only mortgages; and jumbo mortgages which are mortgage loans that exceed the maximum $417,000 GSE lending limit set in most U.S. markets. Deregulation also resulted in innovation to important institutional processes. For example, a privately run Mortgage Electronic Registration System was created in 1995 to speed up the registration of mortgages for about 60 million residential properties that could not be processed quick enough for MBS purposes within the county-operated deed system, Powell and Morgenson (2011). Most importantly, Freddie Mac and Fannie Mae took an expanded role in mortgage lending, holding about $5.5 trillion in 31 million residential mortgages and related loan guarantees by 2010, Timiraos (2010). In September 2008 Fannie Mae and Freddie Mac had been nationalized through a conservatorship by the Federal Housing Finance Agency, and by June 2010 the U.S. Treasury had extended a total of $145 billion to the two GSEs and the stocks were delisted from the New York Stock Exchange. The international financial crisis started in 2007 with complex links to the U.S. housing finance system by way of subprime mortgage lending, credit derivatives, MBS, and other aspects of financial deregulation. Because of this, the role of the FHA and other public agencies in mortgage lending would begin to change and be subject to financial reforms under proposal by government officials and regulators since 2010.

2.3.2. Differences in U.S. and Canadian Housing Finance

The U.S. is unique in that many mortgage borrowers typically enter into 30-year, no prepayment penalty fixed rate mortgage contracts. Even though long term fixed rate mortgages of the form in the U.S. have been offered in Canada, residential mortgages in Canada are typically rollover loans that amortize over 25 or more years. The practice for Canadian mortgage lenders and borrowers has been to separate the mortgage loan

amortization period from the mortgage loan rate contract. While a mortgage borrower will choose a 25 year amortization or longer, a fixed mortgage loan rate of 5 years would be considered a long term mortgage contract in Canada. This is in keeping with deposit insurance offered to savings deposits at financial institutions served by the Canada Deposit Insurance Corporation (created in 1968), which fully covers deposits up to $100,000 up to a 5-year term. Typically, among Canadian mortgage borrowers, a 5-year fixed mortgage loan contract may prevail, for example, in the market during periods of volatile mortgage loan rates or among specific borrower classes such as first time home buyers who wish to avoid the risk of rising interest rates. Equally common for a mortgage borrower, would be a short term, 1-year mortgage loan rate contract or even a variable rate that adjusts with changes usually tied to the prime bank lending rate. For example, this may prevail in the market when the expectation is for declining interest rates. Prepayment penalties in Canada are limited by the Interest Act to three months of interest on loans after the first five years of the term has elapsed, and may even be avoided through effective mortgage loan contract negotiations by a mortgage borrower or mortgage broker. In contrast to the U.S., financial institutions in Canada have a more straight forward time matching the deposit book with the mortgage book. The institutional framework in Canada of nationwide branching has allowed large financial institutions to diversify mortgage lending geographically and thus avoid the risk of undue mortgage loan concentration. In the U.S. this risk is managed by financial institutions, either through MBS to diversify mortgage pools or by way of various risk management tools such as swaps and the existence of deep hedging markets for long-term interest rate risk.

Although there are a number of similarities, housing finance in Canada evolved in a different fashion than in the U.S. for a number of reasons, such as:

- historically, there was not a legislated interest rate ceiling on deposits in Canada, but rather a ceiling on a bank's mortgage loan rate;
- financial institutions in Canada were able to offer depositors market rates on savings accounts and term deposits to support mortgage lending;
- there was not a large segment of borrower classes or regional housing markets in Canada under-served by the mortgage system as Canada had a blended system of national banks and localized lenders such as credit unions and caisses des dépôts; and

- unlike Canada which has a mortgage lending system based on full recourse should the mortgage borrower default, the U.S. mortgage lending system is essentially nonrecourse. This creates a moral hazard, in the sense that should house prices decline or a mortgage borrower's economic situation deteriorate, U.S. mortgage borrowers can almost freely engage in strategic mortgage default without penalty.

The third regime was highlighted by direct government intervention to increase homeownership especially among lower-income households, and when the stability of these efforts eroded, supporting the increased market presence of mortgage lenders was seen as appropriate. De-regulation of financial institutions generally followed the same timing of the U.S., although the services and operating environment of the financial services sector in Canada differed greatly from that of the U.S. It became apparent that what was lacking in Canada related to secure, low cost mortgage funding sources to support mortgage product innovation, and this would come in the fourth regime.

2.4. Regime 4 (2001 to 2010): An Advanced Mortgage System

During the fourth regime the Canadian mortgage market exhibited the essential features of a market system with the presence of innovative mortgage products, increased numbers of mortgage lenders, and extended use of MLI and MBS. The introduction of home equity lines of credit occurred in this regime, allowing households to refinance an existing principal residence and draw upon home equity to better manage household finance. Similar to the U.S., this was often marketed to households as a low-cost household finance tool to manage debt consolidation at more favourable credit terms than personal loans or high cost credit cards. Financial institutions worked with dedicated mortgage professionals who advised households of the features and benefits of different mortgage products. In addition, mortgage loan risks were reduced for lenders and borrowers alike with progressive default management tools, enhanced with MLI. Most important to the system, was the presence of a broad range of mortgage lenders that relied on increasing use of MBS as a mortgage funding source that could ensure a consistent flow of low cost, stable mortgage credit to borrower classes with a prime credit rating. This was achieved by way of integration of the capital market into

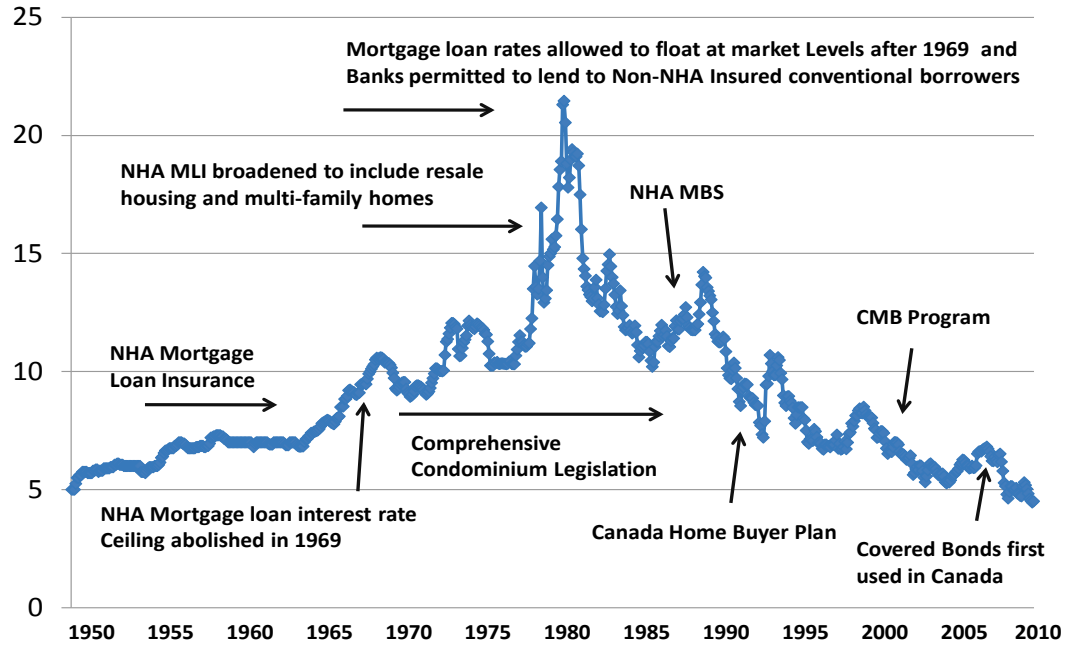
mortgage funding, drawing from the U.S. experience and success in MBS portfolios for conventional mortgages, supported by credit enhancements, such as MLI.

From 1961 to 1965 CMHC conducted 13 auctions of NHA mortgages to familiarize investment dealers with the instrument, but the experiment ended before the dealers took up a continual involvement in the secondary mortgage market, Poapst (1993). In 1973, federal legislation was introduced to establish a joint public-private market maker for mortgage securities but this was not acceptable to private investors. From 1981 to 1985 the secondary mortgage market for NHA insured mortgages averaged 10 per cent of NHA loans held outside CMHC and this accounted for $1.8 billion per year. However, many of these transactions were among affiliated organizations that were part of the mortgage loans origination. After 1990, mortgage lending in Canada was shifting toward a U.S. style of competition, with specialized residential mortgage lenders. However, the lending environment for financial institutions involved in mortgage lending was impacted by minimum capital requirements based on the Basel I Accord in 1988 and Basel II Accord in 2004. This set out capital adequacy of financial institutions, supervisory review and market discipline. The Basel III Accord, introduced in 2010, with a goal of full implementation by the end of 2013. Basel III sets out a new framework that requires banks and other deposit-taking institutions to maintain higher minimum levels of capital. Among other things, Basel III should, over time, improve the quality of a financial institution's capital, and imposes a new (non-risk-based) leverage constraint as well as two new liquidity standards, the liquidity coverage ratio and the net stable funding ratio.

While MBS gained market acceptance in Canada in 1987 with NHA MBS, only a fraction of mortgage lending credit was funded by NHA MBS during the first 15 years of the program. It was not until 2001 that the Canada Mortgage Bond (CMB) program transformed the mortgage market in Canada. Due to the monetary policy of central banks and macroeconomic factors, interest rates declined during the 2000s and NHA MBS and the CMB program have played a critical role in supplying mortgage credit to keep mortgage loan rates stable. Figure 1 outlines long-term posted mortgage rates in Canada since 1950, and while these rates do not reflect discounting that is common during the mortgage contract negotiation, there has been a lowering and stabilizing trend in recent years. Figure 1 also tracks some of the key turning points in modern Canadian

housing finance which still exist today as fundamental to a market based mortgage system.

Figure 1. Mortgage Loan Interest Rates (Canada 5-Year Posted) and Key Turning Points in Housing Finance



Source: Bank of Canada data for mortgage loan rates

In addition to obtaining MLI for high ratio LTV mortgage lending, mortgage lenders who participate in the NHA MBS and CMB program must obtain MLI for conventional, prime mortgage loans with less than 80 per cent LTV. This is called portfolio insurance and is structured when mortgage loans are pooled into a portfolio and then insured. Portfolio insurance is motivated primarily by capital management and liquidity benefits with the end purpose being to create securitization-ready assets. With portfolio insurance it is the mortgage lender, and not the mortgage borrower, who pays the MLI premium. From a mortgage lender's perspective, MLI assists with capital management and liquidity because it minimizes mandatory risk-based capitalization

requirements. It should be noted that under International Financial Reporting Standards, instituted in 2011, mortgage assets sold by financial institutions through NHA MBS and the CMB Program, will not generally achieve off-balance sheet treatment. As such, mortgage lenders will be required to consolidate securitized mortgage on their balance sheets.

NHA MLI offers a government guarantee to Approved Lenders for any mortgage loan for which a certificate of insurance is granted by the MLI provider, upon payment of a MLI premium. MLI in Canada is provided to the market through the state provider of MLI, CMHC, and there are also private MLI companies. NHA MLI allows Approved Lenders to keep mortgage assets on the balance sheet but with capital relief, 100 per cent for CMHC and 90 per cent for private MLI companies. NHA MLI also includes a process for MBS securitization, and CMHC manages the activities of financial institutions in this regard by granting the status of Approved Issuer. The status of Approved Issuer is granted by CMHC to a lending institution when certain operational guidelines related to profitability and minimum net worth are achieved. An Approved Issuer is permitted to transform residential mortgage loans into an eligible NHA MBS pool which becomes a security, guaranteed by CMHC, and then can then be sold directly to investors. Approved Issuers are federally or provincially regulated mortgage lenders as well as aggregators and dealers that do not originate mortgages but operate as warehouse facilities or make whole loan purchases from other mortgage lenders such as mono-line financial institutions. An Approved Issuer can directly sell a NHA MBS pool to investors after payment of a MBS guarantee fee to CMHC. As all of the underlying mortgages in NHA MBS are insured, this eliminates the credit risk for investors.

A refinement to the direct sale of a NHA MBS pool by an Approved Issuer to investors is the CMB program. The CMB Program uses a special purpose trust, the Canada Housing Trust (CHT), to purchase eligible insured mortgages packaged into newly issued NHA MBS pools, and it is the CHT that will sell the NHA MBS pool to investors, rather than an Approved Issuer. CMHC plays an integral role in the CMB program serving as the Guarantor and the Financial Service Advisor to the CHT. This includes establishing requirements that the CHT must meet in order to obtain the guarantee from CMHC and advising on the market demand for CMB issuance and engagement of an underwriting syndicate to underwrite the CMB issue. The CHT

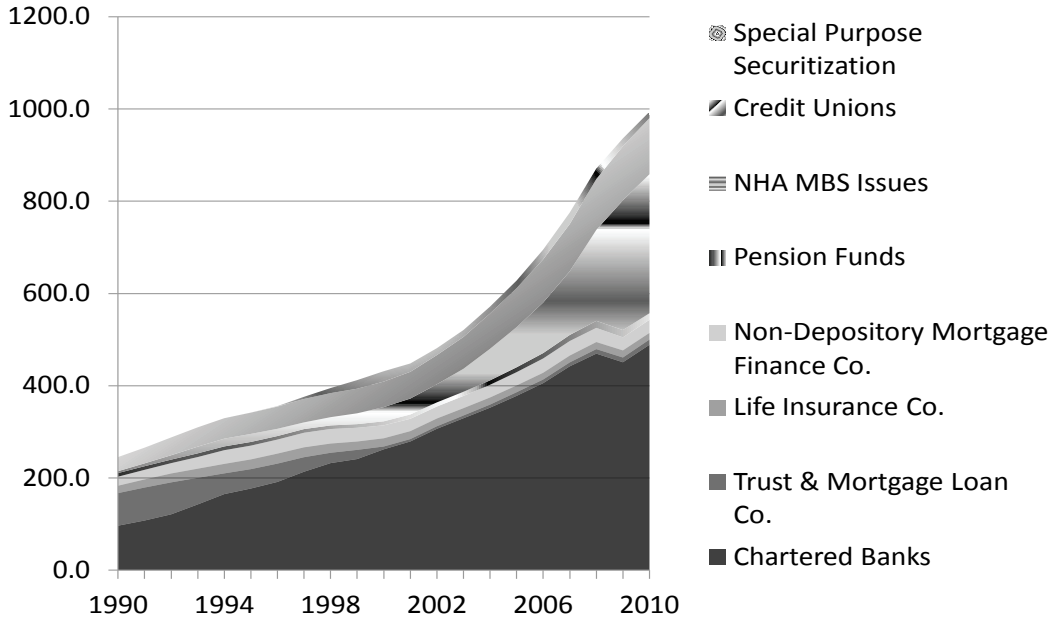
accesses the secondary mortgage market by selling non-amortizing CMBs to investors and uses the proceeds to purchase NHA MBS pools from Approved Issuers. In contrast to NHA MBS, and to provide investors with a bond-like investment, the CHT transforms the monthly cash flows from NHA MBS pools collected by MBS Sellers on behalf of the CHT into non-amortizing bond cash flows with fixed, semi-annual interest coupon bond payments over the CMB term and the repayment of principal at maturity. A Central Paying Agency acts on behalf of the CHT to collect monthly payments from NHA MBS purchased by the CHT and oversee the administration of cash flows. A key benefit of the CMB program is that mortgage assets can be replaced by the issuer in the case of prepayment, provided they are of the same risk and duration, fully utilizing the MBS fee, for example, paid on a 5-year mortgage pool.

The CMB program has been an important advancement for Canadian mortgage lenders in achieving a market based mortgage system with stable mortgage credit. To participate in the CMB program there is a basic requirement for an Approved Issuer to have a swap counterparty agreement in place to manage the payment obligations of the MBS pools as a safeguard to the CHT. The role of the swap counterparty is to receive all the cash flow payments from the mortgage pools and while the interest belongs (becomes owned) by the swap counterparty, there is a requirement on the part of the swap counterparty to offset risk inherent in a NHA MBS pool. This is to ensure the adequate cash flow to investors to support the coupon payments and hold and re-invest principal on behalf of the CHT in a separate account until the single bullet payment is due at maturity. A main benefit of the CMB program is that there is no reinvestment and prepayment risk for CMB investors.

While savings deposits remain the lowest cost source of mortgage funding, the CMB program was evaluated by KPMG (2008) and the conclusion was that the cost of funds obtained by banks through the CMB program was about 18 basis points less than the next lowest cost of long-term wholesale funding. The use of NHA MBS through the CMB program continued to rise since 2000, when less than $50 billion was reported outstanding, due largely to an increasing demand for mortgage credit. In response to the financial credit crisis that began in 2007, the Government of Canada created an Insured Mortgage Purchase Program, from October 2008 until March 2010. The purpose of the Program was to maintain the availability of Canadian lending credit,

whereby the Government through CMHC had the authority to purchase up to $125 billion in NHA MBS from Canadian financial institutions through a competitive reverse auction process managed by CMHC. During the Program period $69.35 billion in NHA MBS was purchased. Figure 2 tracks residential mortgage lending credit provided by the complete spectrum of Canadian financial institutions serving the homeowner mortgage market. While chartered banks dominate the market, there are a range of other mortgage lenders. The presence of a diversified group of mortgage lenders is an important and significant advancement in housing finance in Canada. Canadian mortgage lenders which are deposit taking institutions rely on deposits for the lowest cost of mortgage funding. However, as of 2010 the share of deposits as a source of mortgage funds represented about 60 per cent of Canadian mortgage funding, a decline from 72 per cent in 2006, according to CMHC`s Annual Reports. As of 2010, CMHC securitization of various forms accounted for almost one-third of total mortgage funding, a two-fold increase in the use of CMHC securitization since 2006 levels. Prior to NHA MBS and the CMB program, annual mortgage loans approvals in Canada averaged $400 million between 1949 and 1953 increasing to $18 billion annually between 1981 and 1985. For 2009, total mortgage approvals of $244 billion were reported, while the data on total credit showed annual mortgage growth of about $60 billion, (CAAMP, 2011). As of March 2011, total outstanding mortgage loans in Canada reached $1.042 trillion, and the average annual growth rate of mortgage loans was about 9.7 per cent since 2001.

Figure 2. Total Outstanding Residential Mortgage Credit by Type of Financial Institution ($ Millions)



Source: Data from Statistics Canada Table 176-0069

In addition to MBS, a covered bond (first issued by Royal Bank of Canada in October 2007) is a housing finance tool financial institutions can use to access the capital markets to support mortgage credit. Covered bonds, which are common in Europe, are secured debt instruments that give bondholders both a claim on the issuing bank and a priority claim on the bond's dedicated and specified collateral while being retained on the issuers' balance sheet. Covered bonds require strict mortgage credit granting geared toward prime, conventional mortgage borrowers, with underwriting standards that often preclude high LTVs and place limits on debt service ratios. Lenient personal bankruptcy rules, as exist in the U.S., are not conducive to covered bonds. The proceeds from the sale of covered bonds are passed to the mortgage borrowers to purchase a home, and the interest and principal payments are passed to the investors holding the bonds. The mortgage lender will add a margin to the cost of

mortgage funds to cover the administration of the bond as well as to price credit risk and allow for a profit. Bonds are issued on an ongoing basis by the mortgage lender in individual series backed by a specific pool of mortgage loans, resulting in large and liquid tradable bond issues. In 2009 Canadian financial institutions issued $1.43 billion in covered bonds. During 2010, based on the strong performance of both mortgage collateral and the banking system in Canada, five of the six large national banks marketed 12 new issuances of covered bonds totalling $17.3 billion, and this accounted for 2.5 per cent of mortgage funding. Further growth in use of covered bonds is likely. In addition, Canada will follow European countries with the introduction of legislation for covered bonds which, among other things, will detail priority rights to specific assets backing the covered bonds in the event of the issuer`s default. It is likely that a fifth regime in Canadian housing finance will witness a reduction in government guarantees and MLI support for residential mortgages and covered bonds will be central to this.

During the early part of the fourth regime Canada did mirror some of the mortgage innovations in the U.S., largely due to the presence of U.S. mortgage lenders operating in Canada. It is well documented that the U.S. witnessed the mass marketing of subprime mortgage lending which reached 20 to 25 per cent of U.S. originations between 2004 and 2006, Green (2008) and Shiller (2008). In addition to subprime mortgage lending and expanded use of credit derivatives, U.S. mortgage lenders expanded adjustable rate mortgages (ARMs) with teaser rates for the first 2 years on a 30 year fixed mortgage term; interest only mortgages; 50 year mortgage amortizations; and zero downpayment and negative equity mortgages. However, because of NHA MBS requirements, innovation in Canada was largely directed to conventional borrowers with prime credit ratings and stable employment. For much of the 2000s, NHA guidelines did allow for a maximum of 100 per cent LTV and therefore zero downpayments for new home purchases; interest only mortgages; Alt-A mortgages to self-employed households and new immigrants; home equity lines of credit and 40 year amortizations. In terms of subprime mortgage lending, Canadian mortgage lending to this borrower class was more constrained than in the U.S. and at its height in 2007 reached about 5 per cent of Canadian mortgage originations, as noted by Tal (2006). The reason is that in Canada subprime lending is typically equity lending to borrowers with a credit score below 600 and therefore ineligible for NHA MLI.

During the fourth regime, two important factors supported the evolution in Canadian housing finance to a market based mortgage lending system with secure funding sources. The first factor relates to the ability of mortgage lenders to support a Canadian household in the decision to become a homeowner and then access home equity in an ongoing manner by way of mortgage renegotiation. Due to product innovation, primarily the home equity line of credit, mortgage funds had become integral to household finance. The second factor relates to the resiliency of housing finance and the mortgage market to an economic shock impacting credit markets. This tested both the availability of mortgage credit and the cost of those funds to borrowers. The financial credit crisis hit Canada in August 2007, impacting the domestic asset backed commercial paper market first and then spreading throughout the credit markets. During the peak of the financial crisis, in 2008 and 2009, commercial debt was being rationed and spreads on commercial loans widened. At the height of the financial crisis, banks such as Credit Suisse (March 6, 2008 Credit Suisse Market Watch Weekly) quoted A rated 10-year commercial MBS at 1264 basis points (bps) over U.S. Treasuries, five to six times higher than the spread offered before and after the crisis. In contrast, at the same time, commercial credit was being constrained and spreads widening, the residential mortgage market was quoting the lowest mortgage loan rates in Canadian housing finance history. Just prior to the financial crisis of August 2007, the 5-year CMB spread over Government of Canada debt of the same maturity was as low as 7 bps, increasing to 70 bps in the Fall of 2008, and then declining back to 25 bps by year end 2010. As such, financial institutions and investors operating in Canada's residential mortgage market looked to NHA MBS and the CMB program as a necessary funding source to ensure liquidity for clients and meet government regulations pertaining to minimum capital requirements. The previously noted Insured Mortgage Purchase Program was also an important stabilizing factor to keep the cost of mortgage credit low.

The financial credit crisis did constrain subprime mortgage borrower classes. Mortgage lenders and MLI providers took extra pre-cautions to confirm property values; household capacity to debt service mortgage loan obligations; and other market and borrower factors before granting or insuring mortgage credit, especially when approving home equity refinances or withdrawals and lines of credit. It is true that smaller financial institutions which focused on residential mortgages may have ceased to operate due to

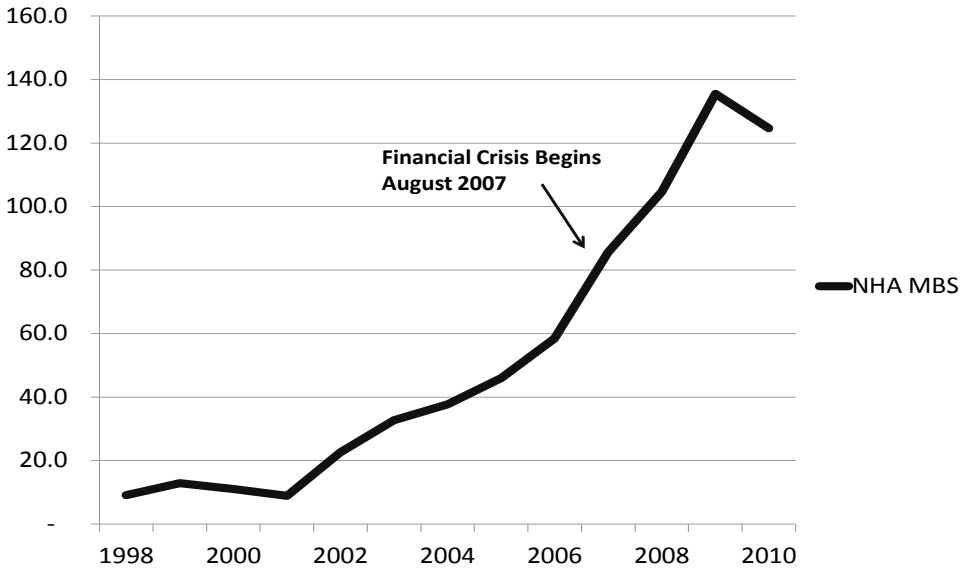
a range of factors such as insufficient capital reserves and deficiencies with warehouse facility funding sources that had to withdraw from mortgage lending due to the U.S. subprime mortgage crisis. Overall, during the financial crisis, Canadian financial institutions, including the non-deposit taking financial institutions, continued to offer the broad market with high levels of mortgage funding.

Figure 3 highlights the important and growing role of NHA MBS in Canadian residential mortgage lending since 2000. Prior to 2000, mortgage lenders tended to issue private label MBS and rely upon deposits to fund mortgage credit. Since 2000, growth in NHA MBS has been driven by expanded demand for mortgage credit largely fuelled by household finance management; competition among lenders and the increasing presence of non-deposit taking residential mortgage lenders and mortgage brokers, and very low cost mortgage funds. What Figure 3 understates is the total of CMHC`s MLI in force which, according to the CMHC 2010 Annual Report, was recorded at $514,156 million and not only includes residential mortgage loans for homeowners, but also MLI to support the finance and refinance of multi-unit rental apartment building types (construction and take out financing).

A market based mortgage system that is viable and resilient needs prudent policies and institutional safeguards for borrowers, lenders, investors, and others involved. Following the challenges with the U.S. subprime housing market due to over-valuations in residential real estate; lenient mortgage credit granting; and use of credit derivatives and enhancements, new regulation for Canadian mortgage lending took place during the fourth regime. In an effort to ensure that households could manage mortgage debt and to provide an incentive for a household to accrue home equity and pay the mortgage loan obligation at a quicker pace, and thus reduce overall mortgage interest paid, the Department of Finance in Canada proposed changes to NHA high ratio LTV MLI commencing on October 15, 2008. This eliminated zero down payments in favour of a minimum 5 per cent down payment and reducing extended amortizations to 35 years when the borrower could not provide a down payment of more than 20 per cent. There was also a change in mortgage lending rules, limiting each financial institution to no more than 3 per cent of annual mortgage originations to borrowers with credit scores below 600. This is principally to accommodate new immigrants to Canada without a credit history in Canada. In 2010, further refinements to high ratio LTV MLI

resulted in more stringent mortgage credit granting, by requiring mortgage borrowers to qualify on a 5-year fixed mortgage loan at the posted rate even if the mortgage contract negotiated was for a shorter term or at a discounted rate. This also included a reduction of LTV on refinances to 90 per cent from 95 per cent and set a minimum downpayment of 20 per cent for all residential properties purchased for rental purposes. In 2011, a third set of constraints was introduced, and resulted in a maximum 30 year amortization for NHA high ratio LTV MLI; maximum LTV on refinances at 85 per cent; and precluded from NHA MLI eligibility the non-amortizing part of a homeowner equity line of credit.

Figure 3. Securitization in Canada as Measured by Annual NHA MBS Volumes ($ Millions)



Source: Data from CMHC Canadian Housing Observer, 2010

2.5. A Summary of Canadian Housing Finance

The first regime began the process of transformation of housing finance in Canada from an informal system of equitable mortgages, vendor mortgages, cash purchases and joint loans with the federal government. By the fourth regime housing finance evolved to a market system with broad competition among mortgage lenders.

Fundamental to the fourth regime are a range of innovative mortgage products and securitization of mortgage pools with NHA MBS and the CMB program. NHA MLI is the preferred credit enhancement for mortgage funding in Canada, while credit derivatives are popular in the U.S. Canada experienced some U.S.-style mortgage lending practices, and the penetration of these practices into the housing finance system has influenced the marketing of mortgage loans to consumers. However, the presence of legislation related to NHA MLI directs most of the activities of financial institutions involved in Canadian mortgage credit granting and precludes subprime lending. Moreover, regulatory oversight by the Department of Finance since 2008 has resulted in significant constraints that have not received opposition from financial institutions offering residential mortgages. The limited Canadian experience with subprime lending has provided financial institutions and regulators with detailed information on mortgage loan performance for non-conventional mortgage products. Should the parameters to NHA MLI and general mortgage lending practices change in the future, toward mortgage innovation geared at borrowers at the bottom end of the credit curve, the experience with Alt-A and subprime lending will be important information to better apply risk based pricing of mortgage loans necessary to make a broad, liberal lending platform resilient and viable.

The evolution of housing finance should be of interest to many nations that continue to experience sub-optimal mortgage lending that constrains homeownership. There has been significant progress and advancements in Canada`s mortgage lending system since 1900. The evolution is important to highlight as financial innovation in the mortgage market evolved from direct government lending to joint loans to NHA MLI mortgage loans to mortgage securitization enhanced by NHA MLI. This allowed mortgage funding to flow more freely from the first regime which used set mortgage loan rates and the interest rate ceilings of the second and third regimes. Finally, by the fourth regime mortgage lenders and borrowers could operate within an open system of negotiated market interest rates with flexible mortgage contracts allowing for easy renegotiation and refinance. Appendix A provides a timeline of some key events in Canadian housing finance history.

Chapter 3.

Financial Innovation and a Dynamically Complete Mortgage Market

A representative household in any nation becomes a homeowner for many reasons such as more control over housing than provided by renting and consumption of housing services. Equally important, is that homeownership allows a representative household to accumulate and store of wealth in a principal residence which represents an asset in the household`s investment portfolio. Since there is an investment component related to homeownership, the decision to become a homeowner should naturally form part of an investor`s critical asset allocation.

Homeownership, for a representative household, provides tangible benefits in meeting housing service consumption needs that would otherwise be obtained in the spot rental market where lease terms are usually negotiated on an annual basis. Rental housing services can also lack consistent, quality choice of services, and present households with rental rate risk under certain future states of nature. The economic intuition is that the benefits of homeownership can and should be measured. From a financial perspective, homeownership is easily managed, highly leveraged, with predictable cash flow requirements, a combination unmatched by other real investment options, as Steele (1993) describes. Capital gains on a principal residence in some nations like Canada and the U.S. are excluded from taxation, and neither are the implicit returns to home equity. In the U.S. mortgage loan interest and state and local property taxes are deductible for personal taxation.

Research by Goetzmann (1993), Reichenstein (1998), Flavin and Yamashita (2002), Yao and Zhang (2005), Sinai and Souleles (2005), Himmelberg, Mayer and Sinai (2005), Cauley, Pavlov and Schwartz (2007), and Waggle and Johnson (2009), considers the investment qualities of homeownership in the U.S. However, there is still

a contribution to be made that considers the importance of a housing finance system to support homeownership as an investment decision. Incomplete markets are also a valid consideration, as it is not always possible to find adequate choice for housing services from the rental housing stock, since some housing types are only available on a continuing basis through homeownership and investors can neither buy a fractional interest in homeownership or readily hedge downside risk (Steele, 1993). Allen and Gale (1998, 1999), Allen (2001), and Pavlov and Wachter (2006), offer models that highlight underpricing of mortgage lending as leading to inflated house prices and constraints on mortgage lending curbing asset prices. Housing markets where lenders have underpriced mortgage lending experience deeper market corrections when markets begin to slide. The findings are also directed at a policy level, even though there are strong implications on the household decision to consider homeownership as an investment. Pavlov and Wachter (2004, 2006) and Herring and Wachter (1999) explain that lenders, if left unchecked by regulators or financial markets, will eventually under-price the credit risk in mortgage loans. Other models, Iacoviello (2005), illustrate that a general rise in consumer prices reduces the real value of a borrower's outstanding mortgage debt obligation, positively influencing net worth. Pavlov and Wachter (2009) include mortgage lending constraints, specifically what they define as aggressive mortgage lending instruments which came about due to financial deregulation and mortgage innovation, funded by securitization such as MBS often supported by credit enhancements. Mortgages in the U.S. are nonrecourse, and the research differentiates between homogenous prime and heterogeneous subprime borrowers by including the borrower credit score in the model. The general result is that house price appreciation churns homeownership investment returns. Households find it attractive to switch from renting to owning when mortgage financing costs are low or when credit constraints are relaxed. Nonrecourse mortgage lending in the U.S. can be advantageous for borrowers at the lower end of the credit curve. In reality, nonrecourse lending can present a moral hazard for some borrowers who wish to exercise strategic default should house prices fall.

Mortgage lending standards are identified as a significant factor in encouraging many households to become homeowners and can even influence the investment return of housing. It is generally understood that mortgage lending standards evolve in a pro-

cyclical fashion, resulting in powerful swings in house prices, Geanakoplos (2010). When mortgage lending standards are relaxed, often in good economic times, this drives up both credit and house price growth while a tightening of standards, often in poor economic times when credit is constrained, puts downward pressure on house prices. Research that has followed the U.S. housing boom of the early and mid-2000s, Green (2008) and Shiller (2008), shows that rapid growth in credit to prime and subprime borrowers was associated with a sharp deterioration in lending standards that in turn fuelled house price appreciation.

In advanced economies over the last two decades, a representative household will choose between renting and owning housing services at any point in the life cycle by access to mortgage credit. Homeownership has been acknowledged as having investment qualities similar to other financial assets as well as benefits derived from the imputed rent of owning housing services and hedging rent risk, Sinai and Souleles (2005). Himmelberg, Mayer and Sinai (2005) suggest that the correct calculation of the financial return associated with homeownership of a principal residence compares the imputed rent, defined as what it would cost a household to rent an equivalent property, with the lost income that a household would receive if the household had invested the capital in an alternative investment, defined as the opportunity cost of capital. The conclusion of these authors is that government tax subsidies reduce the annual cost of homeownership. Moreover, the expected appreciation rate a household associates with homeownership can be high in specific superstar U.S. cities, Gyourko, Mayer and Sinai (2004), where land is in short supply and economic growth is capitalized into land prices. The returns are further fuelled when real, long-term mortgage loan rates are low and alternative investments do not yield high returns. In the context of portfolio theory, Sharpe (1974) and Black-Litterman (1991), when an investor buys an asset they are expressing an implied view regarding expected asset returns.

There is broad understanding that an investment in homeownership results in an investor's portfolio allocation being dominated by a single asset class, Cocco (2004). Over time, home equity is gained as the mortgage debt obligation is paid down by way of loan amortization or as net worth increases due to home price appreciation, Reichenstein (1998). With increasing financial literacy among the public, especially first time home buyers, there is general recognition of the risk of a single claim on a real

estate asset especially in high house price markets, and many households as investors may even consider homeownership as an over allocation from an optimal portfolio perspective, Cauley, Pavlov and Schwartz (2007). There is recent market evidence of the important role of accessing home equity and the mortgage lending system is considered a financial planning tool to manage household finances. In turn, government participation in housing finance can be very significant and is often justified by the important role homeownership can have in supporting economic and financial stability at the household level, IMF (2011).

3.1. The Institutional Framework of Property Markets

It is not the intent to offer a review of property law as this is a complex topic with a long established history which has been reviewed in detail by legal scholars. An appreciation of the features of the institutional framework for real property markets to support homeownership is important context. This was highlighted and detailed by the IMF (2011) in the Global Financial Stability Report in which the legal prerequisites for a housing finance system were discussed in detail. Although variations and unique domestic adaptations are common among OECD nations, the general institutional features can be summarized as follows:

- Private property rights and entitlements where the state guarantees an indefeasible title to those included in the register, such as the Torrens title system, that records easements and the creation and discharge of mortgages, supported with land surveys, and where appropriate, with title insurance;
- Enabling legislation for land development, new home construction and the purchase and ownership of title to parts of a multi-storied building to allow for the purchase and sale of different housing types;
- A market based system that allows for the sale and purchase of real property which includes the full disclosure of property attributes, condition and encumbrances with public and private technological systems that record, track, store and retrieve accurate detailed attributes of the property as well as market prices, used in property appraisals, mortgage credit granting and MLI underwriting;
- A regulatory framework that sets forth the rules of market conduct for real estate brokers and agents, mortgage brokers and agents, mortgage lenders, MLI providers and others involved in the sale, purchase and financing of real property;

- Mortgage loans that are secured by real property and the use of a mortgage note which evidences the existence of the loan and the encumbrance of that reality, by granting of a mortgage to secure the loan;
- A legal process for residential real estate default management so that mortgage lenders have some level of recourse through the judicial system to enforce negotiated contracts with mortgage borrowers and exercise a claim against the real estate property and related collateral that is used as security to guarantee the loan, and this includes the presence of MLI as a risk management tool;
- A housing finance system that ensures a stable, low-cost source of mortgage funding to households with the appropriate level of government participation and guarantees through a national housing agency; and
- Government incentives and taxation rules to support homeownership.

3.2. Complete Markets and Housing as an Investment

The challenge in housing markets as to whether homeownership can be evaluated as an investment similar to financial assets must consider the topic of complete markets. Research into complete markets traces back to Arrow & Debreu (1954), Debreu (1959) and Arrow (1968). Generally, a complete market system is one in which there are traded claims to consumption in each future state. This definition can be refined to specify the date and market state in which the good is consumed. This allows economists to apply utility theory and state-preference theory to study investor behaviour under uncertainty. A complete market is recognized to be one where all possible outcomes on possible future states can be constructed with existing assets. A market is defined to be complete when the cash flows for a specific trading strategy over a specified period can be replicated by a synthetic trading strategy. Complete markets also assume a Pareto-optimal allocation of economic resources among individuals such that no individual can be made better off without making some individuals worse off. With state-contingent goods claims and one round of trading, a complete market requires one market for each good to achieve Pareto optimality. This equates to the number of states multiplied by the number of goods. However, for elementary state-contingent wealth claims and goods markets that open after the state is revealed, a complete market only requires the number of states plus the number of goods to be complete. Arrow (1968) considered the separation of goods and wealth markets. In the first regime, investors observe state-contingent prices of goods. In the second regime,

investors must guess future goods prices correctly. Complete markets take advantage of market efficiency and financial innovation to provide consumers and investors in allocating payoffs and planning for uncertain contingencies. This provides justification in financial markets for innovation such as derivatives and options to accommodate state-contingent wealth claims.

As the theory of complete markets evolved, it was often concluded that in real world settings markets are not generally complete and rather it was more important to look at levels of completeness, Flood (1991). The notion of a complete market does serve as a benchmark so that completeness, or maybe more appropriately, relative incompleteness, can be assessed to determine if a market system functions efficiently. Additionally, the state-preference context is important because it provides a theoretical basis for derivatives and the presence of futures and options which are regarded as fundamental to complete markets and to improve market efficiency.

There have been efforts to make housing markets more complete, such as the Case Shiller (1987) index. Criticism of this index relates to the limited set of twenty U.S. housing markets for which data is reported as well as the two month lag in data release. The housing market in the U.S. does allow for a short sale, however the definition of a short sale in housing differs substantially from the definition of a short sale of a financial asset. A short sale in the U.S. housing market typically occurs when a lender who has taken control of a home due to mortgage borrower default and bankruptcy allows a new purchaser to buy the home for a value less than the outstanding mortgage amount. As such, the sale price falls short of the mortgage loan balance. A similar housing price index in Canada exists for a set of six Canadian centres called the Teranet–National Bank House Price Index. This index was launched in 2008 to sell financial products connected to the housing market while giving investors access to the residential real estate market as an asset class. However, even with the development and wide use of an index for housing prices, the market for housing is complex due to a number of factors such as the:

- relative length of time and high cost to complete a real property transaction;
- heterogeneous nature of the housing stock and varying degree of home quality which make it difficult to track and gauge home prices accurately when there are limited, actual comparable transactions;

- high per unit cost for a home, which cannot be broken down into fractional share ownership;
- highly regulated process which can encumber the purchase and sale of real property;
- lack of financial derivatives to adequately hedge background risk associated with homeownership; and
- constraints in a mortgage lending system and specific mortgage products and credit granting regulations and guidelines that set parameters on the purchase and refinance of a principal residence.

The last point is fundamental to homeownership in a principal residence being considered as an investment. It highlights the importance of a liberal and flexible mortgage lending system that is necessary for a household to both buy a home and also after purchase, renegotiate and refinance a mortgage to smooth household consumption patterns over a household`s life cycle. By providing the necessary financing for all home buyers to purchase and sell housing, the mortgage market supports a housing unit to function as a liquid, tradable security, by facilitating the clearing of housing markets and maintaining a housing price equilibrium. The topic of housing price bubbles is beyond the scope of this research, and Himmelberg, Mayer and Sinai (2005) provide an excellent review of the fundamentals and misperceptions of house price bubbles that offers an important and useful context.

In the case of housing finance and the mortgage market, research by Calza, Monacelli, and Straca (2007) provide evidence that there is significant divergence in the structure of mortgage markets across most industrialised countries and the correlation between consumption and house prices will increase with the degree of flexibility and development of mortgage markets. This is important given that homeownership in a principal residence will tend to dominate total household wealth over a household`s life span, Campbell and Cocco (2005).

In an Arrow-Debreu economy trading over time is not important since markets are complete at time zero, and for this reason among others housing markets are not generally regarded as complete in a traditional sense (Steele, 1993). The reason is that for a complete market to exist there are potentially an infinite number of states of nature and infinite payoffs from the heterogeneous supply of housing. As such, housing payoffs cannot be replicated by trading other securities. When the mortgage market is

constrained, the housing market only offers households an investment choice related to one security. The household either makes the decision in favour of homeownership and the required ownership holding is 100 per cent of the housing unit, or decides against homeownership with an ownership holding of 0 per cent of the housing unit. There is no fractional holding allowed. There is also no short selling. The household simply makes a decision to own or not (and thus rent) one housing unit. Housing markets are not complete in an Arrow-Debreu economy since an investor would need at least as many linearly independent securities in which to obtain the same utility (or total payoff) from one housing unit as states of nature. Moreover, Yao and Zhang (2005) conclude that compared with other financial assets such as stocks and bonds, the housing investment is highly leveraged and relatively illiquid.

3.3. A Dynamically Complete Housing Market

There is agreement in the literature of dynamically complete markets that an Arrow-Debreu equilibrium to require an infinite-dimensional space may be misleading, Hakansson (1970), Merton (1974), Lucas (1978), Harrison and Kreps (1979), and Duffie and Huang (1985). Hakansson (1970) found that the optimal investment strategies have the property that the optimal mix of risky (productive) investments is independent of the individual's wealth, noncapital income stream, and impatience to consume. The optimal asset allocation depends in each case only on the probability distribution of the returns, the interest rate, and the individual's one-period utility function of consumption. Hakansson identifies four models; with three of the models showing that a poor individual will always borrow, while under a fourth model a rich individual will always lend, and the borrowing and lending rates are important to the results. The research offers an approach to address the limitation of traditional complete markets and can be extended to housing markets, since a housing unit and a mortgage loan represent two, long-lived securities that can be continuously traded over time. Duffie and Huang (1985) illustrate that when an Arrow-Debreu economy is placed in a dynamic Radner (1972) setting agents can trade claims at any time. This overcomes the constraints of an Arrow-Debreu economy. Even if there are a finite number of securities the market can still be complete provided the “right” set of security markets exists. A Radner equilibrium

provides the framework for a dynamically complete market demanding the presence of only two long-lived securities.

Homeownership in a principal residence can be regarded as a long-lived security where returns follow a stochastic process, such as a geometric Brownian motion, up until some end period allowing a homeowner to accumulate and store wealth over this time. For example, until retirement or some other future household event that triggers the sale of the principal residence. The mortgage loan, which represents a second long-lived security, has a value secured against the home equity, and allows a household to withdraw home equity to smooth consumption needs over time, given different states of nature. The extent to which a domestic mortgage market is liberal influences homeownership levels and the opportunities a representative household has to qualify for homeownership. Similarly, we need to accept that the consumption payoffs and price processes for housing, as a long-lived security, can be constructed in the presence of a second long-lived security, the mortgage loan, in such a way that investors may be allocated trading strategies allowing them to consume their original Arrow-Debreu allocations within a Radner style equilibrium. Therefore, a flexible mortgage market allows a household to continuously trade its position in home equity and to dynamically span its consumption space, and transfer purchasing power over time, a necessary condition for a Radner equilibrium. This addresses the relative illiquidity of housing as an investment identified by Yao and Zhang (2005).

The economic theory proposed extends the work of Duffie and Huang (1985). Homeownership in a principal residence experiences gains and losses with the home itself functioning as a security to build and store wealth, Flavin and Yamashita (2002). The mortgage market provides the basis for the mortgage loan to be a second security that allows a household to dynamically span an infinite-dimensional commodity space and transfer purchasing power across time by continually trading home equity. To restate, a liberal mortgage market facilitates the transition of a household from renting to homeownership, while a flexible mortgage market provides households with easy mortgage renegotiation and refinance to access home equity to smooth consumption needs in a tax exempt tradable security.

Duffie and Huang`s elaboration on a Radner equilibrium provides sufficient and necessary economic reasoning of a dynamically complete market in the presence of only two long-lived securities. The structure of the mortgage market, which supports the real property market discussed in section 3.1, is understood to be the necessary pre-condition for homeownership to be considered as an investment similar to other financial assets in jurisdictions where private property rights prevail. Given that housing services obtained by renting or owning are substitutes, homeownership has an embedded investment in the property market; and the presence of government subsidies and tax incentives directed to homeowners. Therefore, in those nations with a dynamically complete mortgage market, homeownership tenure should outweigh rental tenure. The IMF (2011) has concluded this result, but only for an index that considers government participation in housing finance and not the complete features of the mortgage market, and neither has the IMF considered housing as an investment.

3.4. The Mortgage Market and the Household Choice to Own Housing Services

Some researchers have concluded that as each new representative household is formed the default tenure is, in fact, rental (Steele, 1993). It will follow that a representative household has a prime credit rating and homogenous beliefs about the evolution of housing prices and rents, and is assumed to undertake a two-stage decision process. The first is to continuously decide over time whether to rent or buy market housing services. The second relates to how best to finance this decision. The decision making process is complicated because stage one and two are not always independent. In the case of a conditional positive decision in favour of homeownership the financing decision may precede the decision to buy a principal residence as a search among mortgage lenders as part of mortgage pre-qualification. It could also occur simultaneously during the negotiation over the purchase price and conditions of sale between the home buyer and seller. Equally likely is for the financing to take place following purchase, and typically as part of a buyer's subject or conditional offer to buy.

To span a household`s consumption space through homeownership in a principal residence the mortgage market needs to be sufficiently flexible so that a household can

continuously renegotiate and refinance a principal residence to access home equity by varying the mortgage loan to property value (LTV). Homeownership, in effect, becomes a form of household finance so that a household can accommodate an infinite-dimensional commodity space. The domestic housing market becomes complete through a dynamically complete domestic mortgage market. A representative household can buy, sell and refinance a homeownership interest (home equity) over time. The permitted LTV ratio and amortization period have a strategic use. The principal residence which stores home equity, combined with the mortgage loan, become two securities that allow a household to effectively consider homeownership as an investment decision. The mortgage market also supports the sale of the principal residence thus returning the household to rental tenure, with a zero share of net worth in a principal residence.

Therefore, in the process of becoming a homeowner, a representative household must generally rely on an underlying housing finance system that supports mortgage lending. The presence of a mortgage market is not a necessary condition for all households to become home owners since households may possess adequate net worth or receive a substantial endowment that allows for an outright cash purchase. Under this situation all that is required is an institutional and legislative framework that supports the property rights necessary for a household to become a homeowner. However, given the high price of housing in prosperous urban markets and the point in the life cycle at which most households want to become homeowners, it is generally understood that a representative household actively participates in the mortgage market when the positive decision is made to buy a principal residence. As well, through continuous trading of a mortgage loan on a specific principal residence, which can include the refinance, prepayment or closing of the mortgage contract, a household can vary its ownership interest. More importantly, in order for a Radner-style equilibrium to exist, a household must have the ability to build and store wealth in a principal residence by way of homeownership, and given different states of nature, dynamically trade home equity to transfer consumption across time. This is done through the mortgage market and the mortgage loan as a debt instrument, against the home equity accrued in a principal residence.

There is an interplay between the mortgage lending system and household access to homeownership that can best be described with an economic model whereby a representative household lives in a two good world, and can either consume housing defined as X with an allocation of their income, α, which must carry the cost to service a mortgage contract and maintain the property including: utilities, strata fees, property taxes, and basic property maintenance, but not necessarily the full depreciation expense of the structure itself. All other consumer goods and services, including non-housing investments such as stocks and bonds, are defined as Y, with an allocation of household income, β, required to cover necessary household expenditures. The percentage of consumption on both housing and related costs, and other consumer goods and services is assumed to be $\alpha + \beta = 1$. This model is consistent with mortgage lending in that a representative household is qualified on the percentage of income used to debt service a mortgage and support the basic living costs associated with homeownership, and it should be noted that this allocation of income for housing even applies to a representative household that chooses to rent, so it is generally consistent with how housing markets function to provide housing services to households. However, in the case of rental housing a representative household is likely to be more diligent in consuming more exact levels of housing services to minimize overall expenditures.

A representative household will seek to maximize utility and the investment quality of housing services using leverage to compete in the open market for housing that offers the greatest return on investment. We describe a simple Cobb-Douglas utility function as follows:

$$U(X, Y) = X^{\alpha} Y^{\beta} \tag{1}$$

We can now solve for the utility maximizing values of X and Y for any prices (P_X, P_Y) and household income (I) which is set forth as

$$I = \frac{P_X X + P_Y Y}{F} \tag{2}$$

Within this model it is assumed that a representative household operates in a sufficiently liberal mortgage market to meet the necessary downpayment condition and mortgage credit granting associated with homeownership. Governments typically

participate to support households at varying levels in this regard, IMF (2011). In simple terms, a representative household is in a position to equally decide between renting and owning housing services. Given this, the parameter I is monthly household income and F allows for households to access housing finance by a specific mortgage contract that has been negotiated with regards to a specific borrower class. It is understood that $F \geq 1$, but if a household does not require leverage or mortgage debt of any kind $F = 1$. Therefore, as leverage increases, F increases monotonically above 1 within lending guidelines set forth by financial institutions that grant household mortgage credit, supported by credit enhancements such as MLI or even credit derivatives.

Since house purchases typically involve household borrowing, house prices are likely to be strongly driven by credit conditions and household leverage, IMF (2011). Research by Stein (1995) and Kiyotaki and Moore (1997), concludes that households can borrow only a fixed multiple of their down payment. This assumption of a fixed leverage ratio implies an accelerator mechanism to the household income available for debt service of the mortgage loan, where a positive or negative shock to income or net worth is amplified by an expansion, or contraction, in borrowing capacity, in turn influencing house prices. The parameter F represents the home buyer purchasing power, which is an income multiplier or accelerator embedded within the mortgage contract, geared by the interest rate and amortization period such that

$$F = \left[\frac{1}{r} - \frac{1}{r(1+r)^{T}}\right]^{1+m} \tag{3}$$

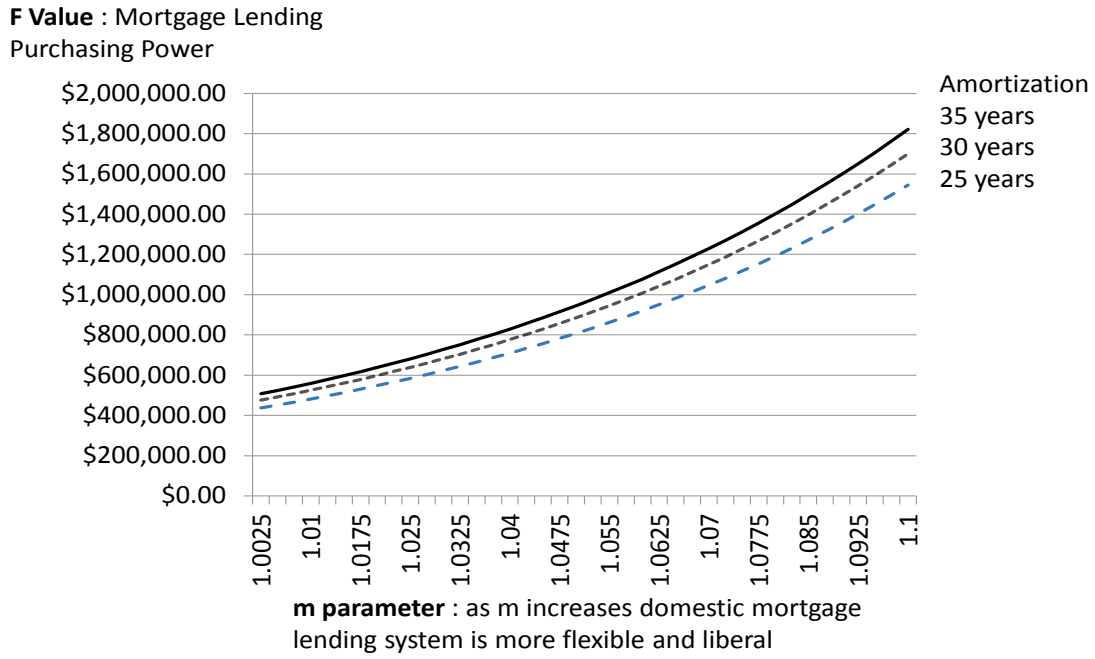
where r is the negotiated mortgage interest rate supported by a secure mortgage funding source, and T is the amortization period, which is the number of months that the mortgage term can last for under existing mortgage products available in the market. The m term is central to this model as it is the parameter that drives a household`s ability to leverage homeownership and dynamically change a household`s consumption patterns toward more non-housing goods and services or investments over time, as desired.

The m term is a parameter that either constrains mortgage credit or supports a dynamically complete market and, as a power weighting, it highlights the importance of

the domestic mortgage lending system in which households can access mortgage credit and the terms of the credit contract. When a domestic mortgage market does not exist or is significantly constrained, then -1 $\leq$ m < 0 and the value for F becomes constrained and when there is no domestic mortgage market $\mathrm{m} = -1$ and F becomes 1. Where the domestic housing finance system does offer mortgage lending $0 < m < 1$, and although m = 0 in most markets the more flexible and liberal the system the value of the m term increases monotonically above 0 to some amount that reflects the guidelines of mortgage credit granting that is generally offered in the market and negotiated between mortgage lenders and mortgage borrowers. For example, allowable mortgage debt levels relate to acceptance of non-traditional sources of income such as "offsets" related to rental income gained through accessory units in the principal residence; margin accounts that support investments in financial assets; and financing innovations such as the leasing of automobiles and other consumer durables. Limitations on the m term generally flow from regulations and guidelines imposed by government agencies on MLI providers as well as investment underwriting inherent as part of MBS and credit derivatives. As a power function it captures the extent to which a domestic mortgage market supports household finance leverage. Since mortgage loan contracts for a principal residence are negotiated on an individual basis the influence of the m term can vary in importance depending on market conditions largely due to competitive forces or government participation in mortgage lending, as noted by the IMF (2011).

Figure 4 illustrates the impact of changes in the m term on the output of F. It confirms that as a domestic mortgage market becomes sufficiently liberal and flexible, and the m term increases above 1, the F term experiences an increasing shift. This allows a representative household to leverage its income and make the shift from renting to homeownership, depending on local area house prices. Not surprisingly, some researchers have studied whether the mortgage market contributes to ever-rising house prices, especially in housing markets where there is a short supply of developable residential land, Gyourko, Mayer and Sinai (2004).

Figure 4. Illustrating the Impact of the Mortgage Market on Household Homeownership Purchasing Power



Note. Mortgage Contract: $100,000 household income; 5 per cent mortgage loan rate; 30 per cent debt service ratio; using 25, 30 and 35 year amortizations.

Figure 4 also outlines the effect of different amortization periods. This offers households more leverage by extending out mortgage payments, and this increases the debt servicing capacity of household income. Most developed mortgage markets allow for mortgage amortization of 25 years and many up to 35 years, and some domestic systems allow for even extended amortizations beyond this. Unlike most nations, the U.S. mortgage market is dominated by 30-year fixed-rate mortgages with the interest rates also fixed for 30 years, without prepayment penalty and without lender recourse to the mortgage borrower in the case of default. The ease in which mortgage loan terms can be renegotiated and refinanced underscores the importance of a flexible mortgage market, with the mortgage loan acting as an essential security in which a dynamically complete mortgage market allows a representative household to continuously trade in the underlying housing asset, X.

The economic model where households can access mortgage lending to support homeownership of housing services, in the presence of non-housing goods and services to consume as well as financial assets to invest in, can be solved as a constrained maximization problem by way of the Langrangian multiplier method. Setting up the Lagrangian expression

$$\zeta = X^{\alpha} Y^{\beta} + \lambda(IF - PxX - PyY) \tag{4}$$

yields the first-order conditions

$$\frac{\partial \zeta}{\partial X} = \alpha X^{\alpha-1} Y^{\beta} - \lambda Px = 0 \tag{5}$$

$$\frac{\partial \zeta}{\partial Y} = \beta X^{\alpha} Y^{\beta-1} - \lambda Py = 0 \tag{6}$$

$$\frac{\partial \zeta}{\partial \lambda} = IF - PxX - PyY = 0 \tag{7}$$

Taking the ratio of the first two terms shows that

$$\frac{\alpha Y}{\beta X} = \frac{Px}{Py} \tag{8}$$

or

$$PyY = \frac{\beta}{\alpha} PxX = \frac{1-\alpha}{\alpha} PxX \tag{9}$$

where the final equation follows because $\alpha + \beta = 1$. Substitution of the first-order condition in equation 9 into the budget constraint gives

$$IF = PxX + PyY = PxX + \frac{1-\alpha}{\alpha} PxX = PxX(1 + \frac{1-\alpha}{\alpha}) = \frac{1}{\alpha} PxX \tag{10}$$

solving for X yields

$$X^* = \frac{\alpha IF}{Px} \tag{11}$$

assuming that households are permitted to consume only one principal residence due to specific taxation benefits that relate directly to homeownership of a principal residence, and therefore $x^* = 1$, then we can drop the X term and re-arrange equation 11 to obtain the following

$$Px = \alpha IF \tag{12}$$

The domestic mortgage lending system allows a representative household to access homeownership by paying the purchase price of housing through an initial downpayment and ongoing payments to fulfill the mortgage loan obligation based on a mortgage amortization payment schedule, subject to specific mortgage loan contract features. The key parameter is α, which is the proportion of income that a household can invest in housing and must include a set aside for necessary maintenance, utilities and property taxes; I, which is a household`s income; and F, which is a parameter that provides the household financing or purchasing power by way of the mortgage market. The F term is driven by the m parameter which is exogenously supplied to the model.

From Cauley, Pavlov and Schwartz (2005) and re-defining the parameters to be consistent with the notation above, house prices follow a stochastic process

$$dP_x = P_x \mu_{Px} dt + \sigma_{Px} P_x dZ_{Px} \tag{13}$$

Extending this we define home equity, H, as the result of three terms: (1) the house price change over time, dP_x; (2) the payment of the principal component, P^*, of the mortgage loan obligation accrued during the amortization of the mortgage loan from the summation of each mortgage principal payment; and (3) the original equity investment in the home which we can define as the inverted LTV, with the notation of LTV'. Homeownership provides a store of wealth which can vary over time, formally defined as home equity, H, which can be defined as

$$H = \sum_t P^* + LTV' \tag{14}$$

When home equity is greater than the permitted LTV for a refinance and the mortgage system does allow for mortgage refinance and home equity withdrawal, the homeowner has the ability to access the store of wealth in the home on a continual basis by refinancing the mortgage loan to access home equity. Equally important is the home owner ability to renegotiate the amortization period of the mortgage loan contract to manage cash flows by lowering expenditures to debt service the mortgage loan. A household may choose these options to consume more non-housing goods or services, invest in other financial assets, or reinvest in the principal residence by way of property upgrades and improvements. In simple terms, through the ongoing renewal, rollover and renegotiation of the mortgage contract the representative household as a homeowner may decide simply to reduce the α term in equation 12. The effect of a flexible mortgage market is that a household has the option to increase the β term which allows consumption to be shifted toward non-housing consumer goods and services or investments in financial assets. A flexible mortgage market also allows a household to accommodate unexpected price increases for non-housing goods and services. This can be shown by rearranging equation 10 as follows

$$IF = \frac{P_y \alpha Y}{\beta} + P_y Y \tag{15}$$

$$IF = \frac{P_y \alpha Y}{1-\alpha} + P_y Y \tag{16}$$

$$IF = P_y Y \left(\frac{\alpha}{1-\alpha} + 1\right) \tag{17}$$

$$P_y Y = \frac{IF}{\left(\frac{\alpha}{1-\alpha} + 1\right)} \tag{18}$$

Therefore, as equation 18 shows, when there is a decrease in parameter α, households can make the choice to buy more Y, or accommodate higher prices for Y, by allocating more of the benefit in the decrease of α to P_Y. The relative importance of both the initial amounts and changes to the IF terms can allow households to allocate more wealth to non-housing consumption. It is obvious to show that if both or either parameter in the numerator, IF, increase due to increasing incomes over time or changes to make mortgage credit granting more liberal and flexible, this elevates the magnitude of the allocation to non-housing consumer goods and services and financial

investments. This can happen if the household so chooses to shift consumption away from housing.

The instructive point is that a liberal and flexible mortgage market, defined as a dynamically complete mortgage market, is integral to housing as an investment. The housing market relies upon the ability of homeowners to access mortgage credit to not only smooth consumption within an infinite-dimensional commodity space, but also support market clearing prices for homeownership housing units. This becomes more important given relatively high house price levels and low savings rates documented in the economy, especially among younger households. This is a typical scenario for a representative household who wishes to become a homeowner in an urban market where high house prices prevail. As such, the tenure choice in any housing market where there is competing demand for housing services, between rental and homeownership, hinges on the mortgage market and underlying institutional framework that directly and indirectly relates to trading the underlying value of the security, which is homeownership in a principal residence. Even among advanced economies, there are situations when constraints or imperfections in the mortgage market and an incomplete housing finance system can impede a household to become a homeowner, Chiuri and Jappelli (2000). This has implications for a household that wants the ongoing ability to consider an investment in a principal residence as a homeowner as a part of optimal asset allocation.

3.5. Relating Mortgage Market Development to Homeownership as an Investment

A housing finance system which promotes a liberal and flexible mortgage market supports the positive decision of a representative household to become a home buyer, and then as a homeowner manage its home equity as a household finance tool to span consumption needs over time. The evolution toward a liberal and flexible mortgage market relates to structural changes in domestic housing finance typically linked to de-regulation and competition among mortgage lenders; mortgage product innovation; advanced secondary mortgage markets to keep the cost of mortgage credit low and stable; and the presence of credit enhancements including MLI and government

participation in mortgage funding. There are socio-economic factors to consider such as:

- high urban house prices and the need to gain access to increasing levels of housing services;
- low savings rates and modest changes in annual income growth;
- changes in employment contracts with increasing levels of self-employment;
- aging baby boomers who will retire with positive levels of home equity, and the desire of many of these households to age in place as homeowners; and
- increasing levels of international immigration, with new immigrants lacking a domestic credit history.

Much of the research has a U.S. focus, and the IMF and International Union for Housing Finance have undertaken cross-country research on developments and advancements in mortgage markets. For comparative purposes researchers will cluster advanced OECD nations together. For example, research of a group of OECD nations by Calza, Monacelli, and Straca (2007) provide evidence that:

- there is significant divergence in the structure of mortgage markets across the main industrialised countries;
- the correlation between consumption and house prices increases with the degree of flexibility and development of mortgage markets; and
- the transmission of monetary policy shocks on consumption and house prices is stronger in countries with more flexible and developed mortgage markets.

These authors describe households as a mix of patient and impatient consumers, illustrating how the role of housing as collateral in the lending process may affect consumption. Impatient consumers do not smooth consumption based on permanent income, but prefer current consumption and their access to credit is constrained by the value of the housing asset. This supports the conclusion that a liberal and flexible mortgage market supports a dynamically complete housing finance system, and allows for a wide range of borrower classes to gain mortgage credit benefitting from high ratio LTV; extended amortization of mortgage contract terms; and renegotiation and refinance of mortgage contracts on an ongoing basis to access home equity in a principal residence. The instructive point is that given the presence of a liberal and flexible mortgage market, homeownership should be considered as an investment to achieve

both an optimal asset allocation and to manage household consumption over time, irrespective of whether consumers are patient or impatient.

3.6. Measuring the Relative Advancement of the Mortgage Market

Housing finance and the underlying mortgage market among OECD nations is relatively established, although important changes will continue to occur either as a matter of government policy or market innovation. There may be institutional changes in property law that encourage higher homeownership levels as well, but generally advancements in the mortgage market support homeownership and household finance, IMF (2008, 2011). These may include government participation in the mortgage market to encourage homeownership; innovation in mortgage products that allow mortgage borrowers to refinance for the purposes of home equity withdrawal; and an expanded role of secondary mortgage market in providing mortgage funding. For example, the most significant recent changes in housing finance in the U.S. have been based on mortgage product innovation directed to subprime mortgage borrowers and the home equity line of credit. As well, the mortgage origination to securitization funding model has been streamlined by de-regulation in financial markets and supported by credit enhancements such as MLI and credit derivatives, either funded collateralized debt obligations or unfunded credit default swaps.

The legislative and institutional framework that supports homeownership differs across nations. A cross-country survey of nations highlights the key elements of the housing finance system that support homeownership at a general level, recognizing that there are unique complexities in every jurisdiction. Often there is not further insight gained from understanding unique features which may exist due to a different interpretation of domestic laws, contracts and rules that govern property rights or implementation of mortgage lending. This is an important subject and there are many useful reference sources such as the International Union for Housing Finance which was established in 1914 to disseminate research on national housing finance systems.

A study by Chiuri and Jappelli (2003) considered the impact of financial market imperfections on household intentions and ability to become homeowners. The authors concluded that a cross-country variability in the volume of mortgage lending are traced to supply factors such as interest rate spreads and credit rationing which includes the institutions that govern housing finance as well as demand factors which include homebuyer earnings and savings, government incentives for homeownership and other factors, such as demographics and labour force characteristics. An important additional factor is the efficiency of the judicial system related to mortgage defaults and the costs and duration of mortgage foreclosure proceedings, for which data is not readily available, nor reliable.

In looking at the U.S. mortgage market, Green and Wachter (2005) draw from previous studies by Diamond (2004), Dubel (2004), Renaud (2004), Lea (2003), and Mercer (2003) and offer an international context for housing finance that provides a cross-country comparison of mortgage market advancement based on:

- Maximum mortgage LTV ratio;
- Mortgage debt to GDP;
- Mortgage terms and duration;
- Repayment for fee free redemption; and
- Levels of mortgage securitization.

The IMF (2008) undertook a study of mortgage market indicators derived from OECD nations. The methodology is based on an index to evaluate mortgage market development as a function of five indicators:

- Mortgage equity withdrawal;
- Refinancing (fee-free repayment);
- Maximum mortgage LTV ratio;
- Mortgage amortization length; and
- Development of secondary mortgage markets as measured by mortgage credit funded by MBS and covered bonds.

The IMF study presents an Index of Mortgage Market Development. The Index ranges between 0 and 1, and an index rating closer to 1 indicates that mortgage

borrowers have easier access to mortgage credit and the mortgage market is advanced, while an index rating closer to 0 indicates a constrained mortgage market. The conclusion of the IMF study is that due to considerable institutional differences among the housing finance systems in advanced economies there are large inequalities in the stock of household mortgage debt. According to the IMF findings, using data from 2005, the U.S., Denmark, Australia, Sweden, and the Netherlands appear to have the most advanced mortgage markets based on the features and indicators chosen. In these countries, typical LTV ratios are about 80 percent; the standard term of a mortgage is 30 years; mortgage products that allow for home equity withdrawal are widely marketed; and standard loans include an option to prepay the mortgage without (or with only partially) compensating the lender for capital or market value losses. Moreover, in these countries, the secondary mortgage market is mature playing a relatively important role as a funding source for mortgage credit.

U.S. mortgage lenders and financial institutions were highlighted due to a complex array of tools to facilitate residential mortgage securitization and wide use of credit derivatives. For instance, securitization accounted for about 60 per cent of mortgages in the U.S. at year-end 2004, compared with about 15 per cent in the advanced economies of the European Union. Canada was ranked in the middle of the OECD nations examined in terms of mortgage market advancement due to relatively low levels of mortgage debt outstanding (as a per cent of GDP), although Canadian households have experienced increasing usage of mortgage credit since 2005. The fact that countries in continental Europe rank at the lower end of the IMF study may suggest that mortgage markets in these countries offer limited access to mortgage credit among different borrower classes and lack mortgage product innovation. As well, minimum capital reserve requirements have an impact on mortgage credit offered by many financial institutions. It is hard to draw strong conclusions from the IMF Index due to the limited number of features and indicators and the changes in mortgage markets that have occurred more recently. While the methodology proposed by the IMF is important, an expanded list of features and indicators and more recent data would make the Index more robust, considering the financial crisis that started in August 2007.

Following on its previous work, the IMF in its 2011 Global Financial Stability Report set forth an index to measure the role of government participation in domestic

housing finance and the extent to which this relates to the level of homeownership in a specific nation. A broad cross-section of advanced economies as well as emerging and newly industrialized economies comprised the IMF sample set.

The IMF study found that government participation in the housing market takes many forms. It included social housing policies to benefit low-income and first-time home buyers; tax incentives; state-owned financial institutions that originate mortgage loans; and state-sponsored, or state-owned, housing finance agencies that generally provide liquidity facilities for the mortgage markets. The index is based on eight features present within a domestic housing finance system which collectively measure government participation. These include:

1. Subsidies to first-time home buyers or repeat home buyers;
2. Upfront subsidies to home buyers through savings account contributions or through preferential fees on mortgage loans;
3. Subsidies to select groups, such as low and middle income households;
4. Government permission for early withdrawal of provident funds (savings account geared to fund retirement or health care costs) for house purchases;
5. Housing finance funds, where the government housing agency provides mortgage loan guarantees or other credit enhancements such as MLI, or even direct mortgage lending;
6. Government permits both, or either, the tax deductibility of mortgage loan interest and state and local government property taxes;
7. Government excludes home price appreciation from capital gains taxation upon house sale; and
8. State-owned institution(s) represents the majority market participation in mortgage lending, accounting for more than 50 per cent of the mortgage market share.

An index between 0 and 1 is based on weightings taken from the features noted above and defined as an Index of Government Participation. Two indices were derived: (1) an Index of Government Participation with a higher weight to subcategory number eight which measures the mortgage market share of the state-owned institution, and (2) an Alternative Index of Government Participation, which gives equal weights to the eight subcategories.

The results of the first index were graphed by the IMF in its report since it was determined that when the state-owned housing finance agency accounted for more than 50 per cent of the mortgage market share this was a significant indicator of government participation in housing finance. The Index of Government Participation for each nation was plotted on the y-axis and the corresponding homeownership rate on the x-axis. The highest level of government participation, as measured by the IMF index, was recorded by Singapore, U.S., Netherlands, Russia, Canada, Japan, Chile, France, Australia, Poland and Slovakia, with the U.K. reporting the lowest level of government participation. The highest level of homeownership, as measured by official government sources referenced by the IMF, was Singapore, Slovakia, Hungary, Spain, Slovenia, Italy, Belgium, U.S., and Australia. The U.K. and Canada ranked in the middle, with Germany reporting the lowest level of homeownership. The IMF analysis and findings are important to highlight. For example, the IMF concluded that some of the features to encourage homeownership may conflict with mortgage borrower and homeowner safeguards. For instance, special laws can provide triggers for the termination of mortgage loans on terms more favourable for mortgage borrowers than would otherwise apply under a more general framework.

There was modest statistical correlation between the government participation features and homeownership with a R^2 of 0.04. The challenge with the Index and its relationship with homeownership is that government participation in housing markets may equally relate to homeownership tenure as well as rental tenure. The rationale for government participation in housing finance is often to promote homeownership. However, the two factors are not always correlated. Many countries in Western Europe, as well as Australia, have achieved high homeownership rates without extensive government participation. Some countries have lower rates of homeownership partly because of strong public support for rental housing. For example, Germany provides incentives for rental investment but not for homeownership. Overall, government participation in housing finance would be expected to relate to housing as an investment supporting both a liberal and flexible mortgage market that is dynamically complete. As such, this research draws from the IMF report, both for the methodology and specifically the output of the Index which provides a key input variable, as outlined in Table 2.

3.7. Refinements and Extensions to the IMF Models

This section presents refinements to the IMF 2008 and 2011 indices and other research, primarily Green and Wachter (2005). The refinements include a more comprehensive set of features and indicators to evaluate the mortgage market, than identified by the IMF (2008) and other cited studies. The IMF 2011 Index of Government Participation, when the state-owned housing finance agency accounts for more than 50 per cent of the mortgage market share, is extended and included as an indicator.

The intuition for using two indices to evaluate whether a domestic mortgage market system is liberal and flexible is an important refinement and extension to the existing body of research. Combined, the indices have direct relevance to measure the extent to which a dynamically complete mortgage market exists in any nation. The objective will be to validate the role of the mortgage market in supporting a household decision in favour of homeownership. Additionally, the principal residence must represent a security that can store wealth and through a second security, the mortgage loan, a household can access home equity to span consumption requirements. Within a general market equilibrium a representative household and mortgage lender can have rational expectations about housing prices offered in the market. A liberal and flexible mortgage market allows a representative household to be a price taker, and complete on the purchase of a home with a mortgage lender who provides the necessary mortgage loan, as required. This would be consistent with the economic reasoning of Dixit and Pindyck (1994), whereby the aggregation of households as representative households leaves equilibrium prices unchanged. If markets are complete and households behave as competitive price takers, in a stochastic process this must be interpreted to mean that each household takes as given the stochastic process of the price and has rational expectations about it, then the equilibrium condition is efficient. The scope of a mortgage market that is liberal and flexible, generally relate to the following:

- An adequate supply of low cost (relative to risk free securities) to meet demand for mortgage credit to meet mortgage credit nationally and this requires the presence of the secondary market to integrate housing finance with capital markets, principally by way of MBS or covered bonds;
- Mortgage loan rates that are stable and nationally available at either fixed or variable terms to assist households in managing mortgage credit risks over the long term;

- Credit enhancements that are nationally available to reduce the risk of residential mortgage lending and allow mortgage lenders to meet minimum capital reserve requirements; and reduce MBS investor risk;
- Mortgage credit granting guidelines that allows a household to leverage monthly income over an extended amortization period at debt service ratios that are comparable to renting housing services;
- A regulatory framework for housing finance and enforcement of mortgage loan contracts (including default and foreclosure) that also sets forth the rules of market conduct for real estate agents, mortgage brokers, mortgage lenders, MLI providers among others;
- Mortgage loan to property value amounts, LTV, that allow high ratio mortgage lending so that a household can access homeownership with moderate wealth levels and maintain this over time if needed;
- Mortgage contracts that allow households to easily renew, refinance or transfer a mortgage loan contract, with prepayment, transfer and cancellation clauses, either fee-free or without punitive penalties;
- Mortgage products that support household finance by allowing equity withdrawals; and
- Mortgage lending open to a wide range of borrower classes reflecting demographics such as new immigrant households; those with impaired credit ratings; or even to accommodate the increase in self-employment.

A liberal and flexible mortgage market allows a household to obtain a mortgage loan to become a homeowner and then continuously trade home equity through a mortgage loan which is secured against a principal residence. Continuous trading means that the household can renegotiate and renew a mortgage loan with ease; initiate home equity withdrawals and refinancing; and even prepay, cancel or transfer a mortgage loan. The features and indicators used to create each index can be categorized as follows:

- Liberal, in that a household from different borrower classes can become a homeowner through a high ratio LTV mortgage loan. A liberal system supports financial institutions to fund mortgage credit through savings deposits and the secondary market with mortgage credit enhancements to reduce the overall risk;
- Flexible, to facilitate a household`s need to continuously trade a mortgage loan to span consumption needs and these features relate to mortgage terms, amortization, loan type and duration, and contract provisions that allow for a household to modify a mortgage loan contract based on household finance needs; and

- Flexible and liberal, so that a household can access adequate mortgage funding, based on household size, and this may require government participation in the housing finance system.

Figure 5 references and classifies the features and indicators of a liberal and flexible mortgage market. This is a much expanded and comprehensive set of features and indicators than presented in earlier studies. It is important to highlight that the features and indicators exclude the institutional framework that must be present in any mortgage market system as a necessary pre-condition for mortgage contracts. It is assumed that the institutional system of real property markets is a compulsory foundation that must be in place before a domestic mortgage market can be considered advanced.

The features and indicators outlined in Figure 5 can then be plotted on a two by two matrix. On the Y-Axis the features related to a liberal mortgage market will be plotted. On the X-Axis the features related to a flexible mortgage market. The use of two indices and a matrix is analytically appealing, and when each domestic system is plotted within a quadrant it will be evident whether the mortgage market is constrained or dynamically complete, as illustrated in Figure 6.

Figure 5. The Key Features, Indicators and Outcomes Used to Evaluate Mortgage Market Development

Features that are Flexible	**Features that are Liberal**
Home Equity Withdrawal : Ongoing access to mortgage refinancing (fee free) or allowing for withdrawal of home equity, linking homeownership to household finance. **Renegotiation or Prepayment** : Rollover renewals, renegotiations and prepayment of mortgages. **Loan Type and Duration**: Availability of either fixed or adjustable variable rate (and blended) mortgage loan products so that mortgage borrowers can manage perceived interest rate risk. **Amortization** : Availability of extended amortization mortgage loan periods (including interest only mortgages) that can be renegotiated so that a household can smooth consumption through household finance over the holding period of homeownership, as required.	**Loan to Value (LTV)** : Availability of mortgage products that permit high ratio LTVs. **Secondary Mortgage Market** : Integration of the capital markets with mortgage funding so that there is significant advancement of the secondary mortgage market to allow a wide range of mortgage lenders to participate in the mortgage market securing funds by way of MBS, covered bonds, and other structured investment vehicles. **Mortgage Credit Enhancements** : Availability of credit enhancements to support mortgage lending and mortgage credit primarily through direct lending or MBS supported by MLI and credit derivatives. **Borrower Classes** : Innovative mortgage products that offer mortgage loans to non-conventional borrowers, including new immigrants and self-employed (Alt-A) and borrower classes with impaired credit (Subprime).
Combined Indicators and Outcomes of a Flexible and Liberal System **Government Participation Index:** the IMF 2011 index captures this outcome. **Mortgage Debt to GDP:** availability of mortgage funds allows households to become homeowners and access home equity in a dynamically complete mortgage market	

Figure 6. Evaluating a Mortgage Market as Fully Constrained, Partially Constrained or Dynamically Complete

The two by two matrix provides important structure to the analysis, but the challenge is to weight the indicators and features. It is understood that housing finance has changed substantially since the excessively high mortgage loan rates reported in the early 1980s, Girouard and Blondal (2001). Traditionally, up until the mid-1980s in most advanced nations, the mortgage lending system was highly regulated with specialized mortgage lenders and limited market competition, such as the Savings and Loans (S&Ls) in the U.S. and Building Societies in the U.K. Regulations set interest rate ceilings and quantitative limits on mortgage credit and repayment periods. These regulations sometimes resulted in credit rationing in the mortgage markets among

OECD nations, making it difficult for households to access mortgage credit. Deregulation of mortgage markets, which began in the early 1980s in many OECD nations, introduced competitive pressures among mortgage lenders and broadened household access to mortgage credit. The process of deregulation, however, took different forms in various countries, Diamond and Lea (1992). A significant difference among various domestic housing finance systems relates to the specific features of mortgage loan products, mortgage funding sources, management of mortgage risk and credit granting rules among various borrower classes. The study proposes a weighting for each feature, indicator and outcome outlined in Figure 5. A summary of the weightings is presented in Table 2.

Table 2. Setting Weights to the Parameters Used to Measure Mortgage Market Development (weighting for each parameter is set from 0 to 1)

Flexible:

	None	**Partial/Limited**			**No limits**
Home Equity Withdrawal (Withdrawal amount/LTV limits)	0	0.5			1.0
	None	**Partial**			**Yes**
Renegotiation or Prepayment	0	0.5			1.0
	No Choice	**Fixed or Variable**			**Fixed, Variable or Blended**
Loan Type and Duration	0.0	0.5			1.0
	up to 15 years	**15 to 25**	**25 to 30**	**30 to 35**	**35 or more**
Amortization	0.0	0.25	0.5	0.75	1.0

Liberal:

	up to 50%	**50 to 65%**	**65 to 80%**	**80 to 90%**	**90% higher**
Loan to Value (purchase / refinance)	0	0.25	0.50	0.75	1.0
	None	**up to 15%**	**15 to 30%**	**30 to 45%**	**45% or more**
Secondary Mortgage Market, Covered Bonds or MBS as a % of residential loans outstanding	0	0.25	0.5	0.75	1.0
	None	**Mortgage Loan Insurance (MLI)**			**MLI and Credit Derivatives**
Mortgage Credit Enhancements	0	0.5			1.0
	Prime Only	**Prime and Alt-A**			**Prime, Alt-A and Subprime**
Borrower Classes	0	0.5			1.0

Combined Indicators/Outcomes from a Flexible and Liberal System:

This index is based on a IMF (2011) study and ranks each nation between 0 to 1, and measures whether the state-owned housing finance agency accounts for more than 50 per cent of the domestic mortgage market share

	Up to 20%	**20 to 40%**	**40 to 60%**	**60 to 80%**	**80% or more**
Mortgage Debt to GDP	0	0.25	0.50	0.75	1.0

The IMF, in its 2008 report, selected 18 nations in a cross-country comparison, while in its 2011 report selected 33 nations, 19 emerging and newly industrialized economies and 14 advanced economies. For Green and Wachter (2005) 13 nations were selected.

A cross country comparison of 12 of the largest, most advanced mortgage markets, is undertaken in this research based on the overall value or size of the domestic mortgage credit market with a legal and institutional framework that supports private market property rights and mortgage lending contracts. The focus is on advanced economies where there is an adequate legal system and institutional framework that supports real property markets; housing finance; and secondary market activity. This is not the case for many emerging and newly industrialized economies that lack a fully transparent regulatory framework for housing finance and enforcement of mortgage loan contracts (including default and foreclosure). The selected nations also sets forth rules of market conduct for real estate agents, mortgage brokers, mortgage lenders, MLI providers and others.

The index uses a simple methodology similar to the IMF, and based on Table 2 there are four separate and unique features assigned to either the liberal (L) or flexible (F) index. In addition to these, there are two combined (C) indicators and outcomes that are common to both the liberal and flexible index. This includes both the IMF Index of Government Participation and the domestic mortgage debt to GDP. Mathematically, the liberal and flexible mortgage market index can be expressed as the following function, so that

$$F = \frac{\sum_{i=1\ldots n} F_i + C}{n} \tag{19}$$

and

$$L = \frac{\sum_{i=1\ldots n} L_i + C}{n} \tag{20}$$

where

$$C = \sum_{i=1\ldots n} \frac{C_i}{n} \tag{21}$$

To obtain the final ranking for either the liberal index, defined above as L, or the flexible index, defined above as F, there is an equal weight given to the four features unique to the flexible and liberal features for a maximum index of 0.8. In addition, there is a further allocation of up to 0.2 from what are defined as combined (C) indicators and outcomes, and therefore the final maximum index is 1.0, so that

$$0 \leq (F, L, C) \leq 1 \tag{22}$$

The index for either the liberal or flexible features, among a cross comparison of nations, are summarized in Table 3. The first column is the cumulative total of the flexible features and the second column is the cumulative total of the liberal features and the third column totals the combined indicators and outcomes which are equally important to support either a liberal or flexible mortgage market system. The fourth column summarizes the final total for the flexible index and the fifth column summarizes the liberal index.

The findings in Table 3 draw from data taken from a range of sources including regularly published private and government organizations that track the mortgage market. The data availability and sources for the features and indicators to rank the degree to which a domestic system is flexible and liberal are based on the most recent published sources and most recent mortgage products and credit granting rules that could be obtained. The analysis is based on the mortgage lending system that was present in the market during 2010 and 2011, although it is understood that mortgage contracts are often negotiated on a case by case basis. Where required, contact was made with leading domestic financial institutions to gain information on specific mortgage products and relevant features to mortgage credit granting rules and guidelines. Therefore, the indices are based on what are deemed to be common practices generally available to households. In terms of the secondary mortgage market and mortgage debt to GDP, depending on data availability, the study relied on published data between the years 2005 and 2010 to obtain an average for comparability over a five year period. This was considered necessary due to the impact of the financial credit crisis which may have affected mortgage credit flows and the cost of mortgage credit differently in different nations, likely as a result of government intervention in housing finance and mortgage lending.

Table 3. Mortgage Market Development: A Cross Country Comparison

Country	Flexible Features (1)	Liberal Features (2)	Combined Features (3)	Flexible Index (1) + (3)	Liberal Index (2) + (3)
Australia	0.40	0.45	0.106	0.506	0.556
Canada	0.50	0.50	0.094	0.594	0.594
Denmark	0.65	0.45	0.100	0.750	0.550
France	0.15	0.40	0.056	0.206	0.456
Germany	0.20	0.25	0.069	0.269	0.319
Ireland	0.45	0.55	0.125	0.575	0.675
Italy	0.15	0.30	0.025	0.175	0.325
Japan	0.40	0.40	0.063	0.463	0.463
Netherlands	0.75	0.35	0.150	0.900	0.500
Spain	0.05	0.50	0.117	0.131	0.581
United Kingdom	0.60	0.60	0.113	0.713	0.713
United States	0.80	0.75	0.131	0.931	0.881
Maximum Index	0.80	0.80	0.200	1.000	1.000

Sources for the data include the European Mortgage Federation for the European nations; Bond Market Association and Federal Reserve for the U.S.; Bank of Australia and the Australian Bureau of Statistics; Bank of Japan and the Japan Ministry of Internal Affairs and Communications; Statistics Canada and Canada Mortgage and Housing Corporation; and the Organization for Economic Co-operation and Development and International Monetary Fund to obtain other data and for general data verification.

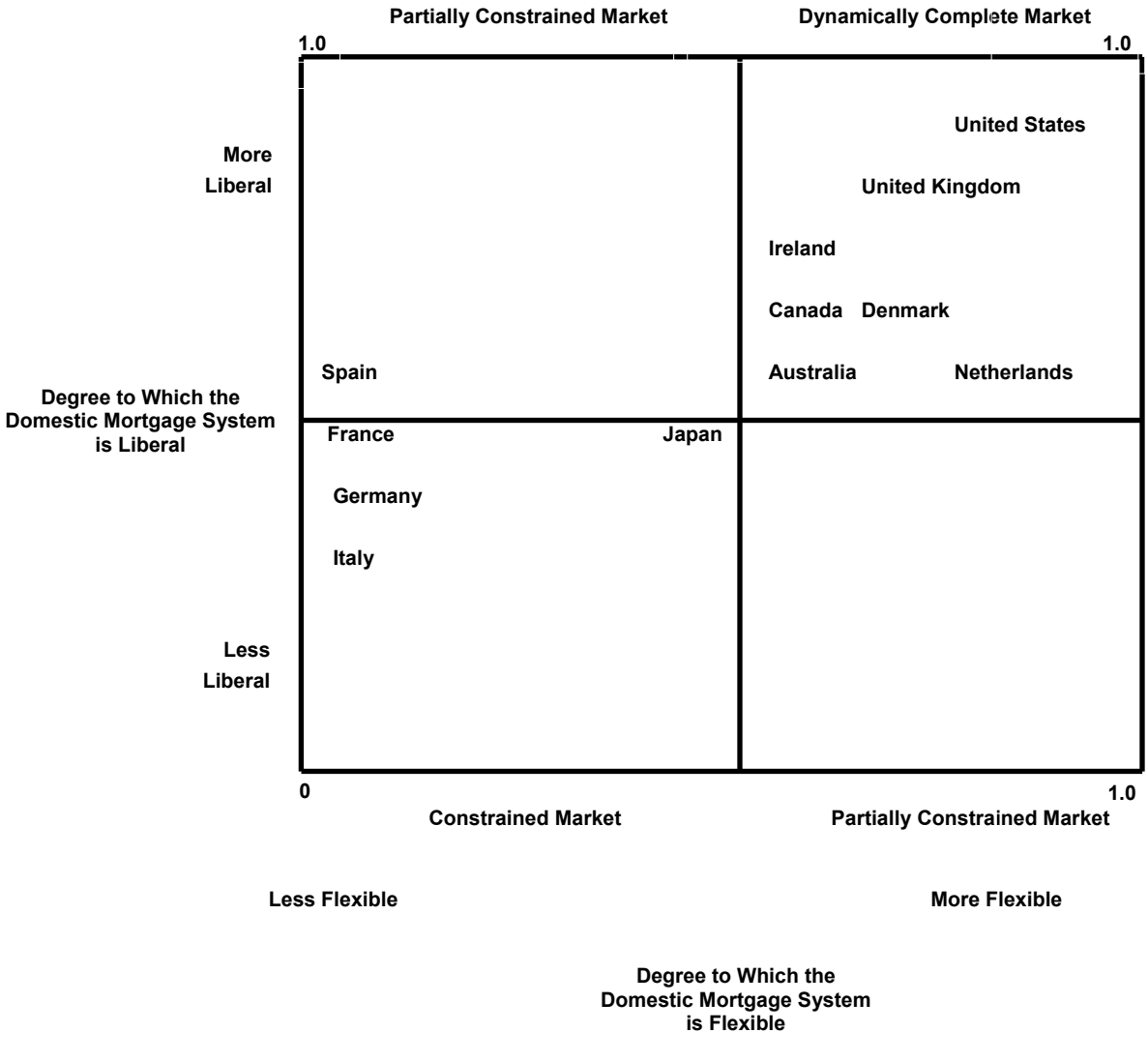
Figure 7 plots the liberal index and the flexible index on a matrix for each nation with the data summarized from Table 3. The classification of each quadrant is taken from Figure 6 which describes whether a mortgage market is constrained or dynamically complete. The intuition is that the y-axis plots the liberal index and is a measure of the extent to which a domestic system supports homeownership. Equally important, the x-

axis plots the flexible index and measures the ease to which a household can access mortgage funding over time.

The hurdle rate to move from the fully constrained quadrant to the partially constrained quadrant is determined to be an index rating of 0.5 for either the flexible or liberal index. This may be considered an arbitrary reference point, but it follows the economic reasoning of studies such as the IMF in the sense that some kind of simple threshold or benchmark is required for comparative analysis. The notion is that the index for both the flexible and liberal features is linear and at some point the mortgage market system becomes less constrained and more open and accessible as various features as well as outcomes and indicators support the mortgage borrower to consider homeownership as an investment and dynamically trade home equity over time to manage inter-temporal household consumption. To move into the quadrant for a dynamically complete market it is necessary for both liberal and flexible indices to exceed an index rating of 0.5. What has not been discussed is the appropriate homeownership rate for any nation, or just what would be the correct level of mortgage credit available in a nation to support homeownership targets as these do not explicitly exist. The overall objective offers a different focus, and supports the notion that if a household wishes to consume housing services through homeownership rather than the rental housing market, a liberal and flexible mortgage market system needs to be in place to support a dynamically complete market.

As Figure 7 illustrates, seven of the nations' plot in the dynamically complete quadrant, including the U.S., U.K., Canada, Denmark, Ireland, Netherlands and Australia. Five nations are partially or fully constrained with Italy, Germany, France and Japan the most constrained. These fully constrained mortgage systems are not flexible since households cannot easily renegotiate, transfer or terminate mortgage contracts. Moreover, home equity withdrawal is generally not permitted. These systems are not liberal due to constraints in raising mortgage funds in the secondary mortgage market and a lack of credit enhancements reduces the borrower classes that are eligible to qualify for mortgages. Spain is partially constrained, with a liberal system that has little flexibility in terms of mortgage loan types and duration as well as limitations in terms of renegotiation and home equity withdrawal.

Figure 7. A Two-by-Two Matrix to Plot the Domestic Indices of a Flexible and Liberal Mortgage Market



In continental Europe, de-regulation in housing finance has been slow and mortgage market innovation modest, with a larger role for public institutions which is similar to Canada but unlike the U.S. While Japan has experienced much de-regulation starting in the 1980s with the government no longer providing direct mortgage loans to borrowers, the government still plays a significant role in the mortgage market development which shows modest levels of innovation. The Canadian, U.S. and Australian systems display sufficient differences, while at the same time these systems have been successful in achieving high levels of homeownership. Simply due to the availability of mortgage credit and mortgage product innovation, the U.S. system is a benchmark model for any nation. In the U.S. there is a private mortgage lending system with strong mortgage product innovation and a very prominent role for credit derivatives as well as an important and direct role for government support to provide credit enhancements and secondary mortgage securitization. U.S. mortgage product innovation is unparalleled among nations and automated underwriting systems facilitate mortgage credit granting. Canada has maintained strong legislative and regulatory oversight on mortgage market systems with a direct role for government in credit enhancements and secondary mortgage securitization with less advancement in mortgage product innovation. The evolution of the Canadian housing finance system is interesting because many nations are grappling with housing finance challenges that Canada has faced during various periods in the past. Canada`s advancements map in a similar path to the U.S. often mirroring the U.S. housing finance system but with a lag, and most likely, any future change will be evaluated against the performance of the U.S. system following the financial crisis that began in 2007, King (2012). Australia has less government participation in the mortgage system especially when it comes to guarantees provided to mortgage lenders and investors in MBS, although private sector MLI is available.

In terms of which national systems are most flexible, nations either scored as strongly flexible or not, largely due to the regulation of home equity withdrawals, extended amortizations and ease of mortgage renegotiation, transfer or termination. The U.S., Netherlands, Denmark and U.K are the most flexible systems for home equity withdrawal and mortgage renegotiation. Canada and Australia rank as not quite as flexible as these nations, but more flexible than the majority of nations in the cross-

country comparison. Mortgage amortization periods in the U.S. can be extended to long periods and generally most nations allow for 25 to 30 year amortizations, and in Japan households can access 35 year fixed rate mortgages, which is similar to the U.S. However, Italy, France and Spain require shorter amortization periods. In Canada, residential mortgage loan terms are equally balanced as fixed or either variable or adjustable, and households equally choose between term duration based on socio-economic factors or even marketing by mortgage lenders to gain market share among competitors. In the U.S., fixed rate mortgages are common with between 70 to 90 per cent of mortgage holders choosing this term, similar to Japan. France`s mortgage market is the third largest in Europe after the U.K. and Germany, with 80 per cent of all households holding a mortgage. In France, 80 per cent of all mortgage loan terms are fixed rate. In the U.K and Australia the dominant mortgage term is for an adjustable or variable rate mortgage. Australia has an overall mortgage market similar to Canada in many respects; however, adjustable or variable mortgage loan terms dominate the system accounting for about 85 per cent of outstanding mortgage loans. This means that mortgage loan rates tend to move in line with changes in the monetary policy rate and mortgage borrowers bear significant interest rate risk, which is a risk that cannot be easily hedged and this may deter some households away from homeownership. In Canada and the U.S., the pass-through of monetary policy to mortgage loan rates is less immediate and clear, and mortgage loan rates are a function of competitive market forces with the secondary mortgage market playing a key factor in the pricing of mortgage funds.

In terms of which national systems are most liberal, the U.S. has a very innovative system where high ratio LTVs allow for a minimal down payment and the secondary mortgage market provides adequate mortgage credit, even to non-conventional borrower classes with the presence of a range of credit enhancements. A liberal mortgage market system allows for high ratio LTVs that typically exceed 80 per cent in most advanced OECD nations, except for Germany. The U.K., Ireland and Spain all score high on the liberal index comparatively to the U.S., largely due to mortgage credit being available to many non-conventional borrower classes. While the U.K. lacks the advanced secondary mortgage market that exists in Netherlands, Denmark and Ireland, there are also limitations on credit enhancements and credit derivatives that are

available for mortgage lenders and investors in the U.S. The secondary mortgage market is important to a liberal system, and in Europe retail deposits are still the predominant source of mortgage funding. Covered bonds vary regionally in terms of importance in Europe and account for 20 per cent of total outstanding mortgage debt funding. Generally, Europe lacks integration of the secondary market with the mortgage market and some jurisdictions have a legal framework that supports private property rights but has not been "modernized", when compared to the U.S. or Canada, and this potentially constrains mortgage credit. Canada is more in line with Australia and on par with Spain although the mortgage systems are fundamentally different. Spain is much more liberal in terms of high ratio LTVs which are supported by advancements in the secondary mortgage market. Canada and Australia have generally more conservative mortgage credit granting rules and the advanced secondary mortgage markets allow for high ratio LTVs. In Japan the overall system is constrained by the role of the Japan Housing Finance Agency which has a main purpose to take a lead role in purchasing MBS and therefore assumes the credit risk for most mortgage lending.

Households that are defined by mortgage lenders as non-conventional or subprime vary in significance and importance depending on the nation. But given changes in demographics (increasing levels of immigration) and labour conditions (toward more self-employment) this is important to account for. In terms of mortgage credit for non-conventional borrowers, the U.S. and U.K. are most liberal, while Australia and Canada also have mortgage products directed to non-traditional borrower classes, primarily new immigrants and self-employed households that either cannot document income or lack a credit score. European financial institutions supported subprime lending through the purchase of U.S. mortgage pools and collateral debt obligations, but this directly supported U.S. subprime mortgage lending and not European subprime borrowers to any extent. Credit enhancements can play a fundamental role in the secondary mortgage market, managing risk for investors. Most nations have access to credit enhancements and these are either MLI or government mortgage loan guarantees, with only the U.S. extensively using credit derivatives.

Overall, the features, outcomes and indicators provide useful and important results in which to evaluate the advancement of a domestic mortgage market. The liberal and flexible indices are not intended to conclude whether one system is better

than another. It represents an important refinement and extension to the methodology and research of the IMF (2008, 2011) to measure the degree to which a mortgage system supports homeownership as an investment. Finally, domestic tax policies, such as tax free capital gains in homeownership or mortgage interest deductibility as well as direct and indirect government homeownership policies, can influence household behaviour and have been addressed through the use of the IMF 2011 index.

3.8. The Mortgage Market and Household Behaviour

In presenting the summary statistics for the IMF 2008 Index of Mortgage Market Development, the IMF concluded that the correlation between the IMF Index and the residential mortgage-debt-to-GDP ratio was significant, with a R^2 of 0.80. In the IMF 2011 study, the Index of Government Participation was related to the domestic level of homeownership, and the R^2 was reported to be 0.04. Other studies that have looked at the features and indicators of the mortgage market generally discuss the cause and effect of advancements in housing finance and mortgage market with outcomes such as household choice to become homeowners, Chiuri and Jappelli (2003). Similarly, Green and Wachter (2005) offer a descriptive analysis of mortgage outcomes in nations with low levels of mortgage funding securitization and outcomes in nations with low mortgage debt outstanding.

In keeping with the literature, it is useful to relate the mortgage market indices to household behaviour. The focus is household behaviour associated with homeownership as an investment decision. As such, the first objective is to consider the relationship or causality that a liberal mortgage system has on homeownership levels, since the first action a household will take in choosing housing as an investment is to become a homeowner. The second objective decision is to consider the relationship or causality that a flexible mortgage system has on accessing mortgage funding. It is understood that a representative household that considers housing as an investment must have the capacity to dynamically span the consumption space provided by homeownership in a principal residence and this is done through a flexible mortgage market. It would therefore be expected that a representative household in any nation with a flexible mortgage market would experience commensurate levels of mortgage

debt to support homeownership and household finance to smooth inter-temporal consumption.

The expectation that a liberal mortgage market should promote homeownership and the correlation of the two factors is important. Similarly, a flexible mortgage market through ease of home equity refinance, different loan types and duration, and extended amortization periods should have a correlation with mortgage debt based on household size. This is evident among households that consider the investment qualities of housing since mortgage funding is often a low cost option to fund household consumption, when compared to credit card debt; unsecured personal loans; and even other lending sources such as automobile loans.

In summary, the Index of Liberal Mortgage Features in a nation is positively correlated with its domestic homeownership rate; while the Index of Flexible Mortgage Features is positively correlated with mortgage debt levels based on the size of the household. Figure 7 confirms that the U.S., U.K., Canada, Denmark, Ireland, Netherlands and Australia have dynamically complete mortgage markets consistent with Figures 5 and 6, but does not suggest that any of these systems are either too liberal or too flexible. Further research into understanding the indices of a domestic mortgage market and household behaviour would yield interesting results as to what is an appropriate mortgage market system to achieve intended objectives for government, financial institutions and households related to homeownership targets or mortgage credit availability. Appendix B summarizes the applications of the indices of mortgage market development. It identifies the expected household behaviour related to both a liberal and a flexible mortgage market. This includes the relationship of a liberal mortgage market with homeownership and the relationship of a flexible mortgage market with household mortgage debt levels.

3.9. Policy Implications of Mortgage Market Development

The usefulness of the indices for mortgage market development is important for government agencies and regulatory authorities that either supply or guarantee mortgage funding to mortgage lenders and the ultimate mortgage borrowers. For

example, it may be insightful for policy makers to consider whether there is an optimal level of mortgage market development. The normative analysis is complex but can be structured within an economic model.

The question is whether achieving the maximum index of one is the objective for any domestic mortgage market and whether the current domestic market structure, legal system, institutional framework and housing finance could ensure the viability of this. It may not be possible or desirable for either the liberal or flexible index to attain the maximum index level of 1. This raises criticism of what is the ultimate objective for financial markets and government in providing households with a liberal and flexible mortgage market. An economic model that considers the mortgage market within a broader social planning function is proposed. As such the construction of the economic model begins with

$$M = f(F, L) \tag{23}$$

and the implicit function that flows from this that

$$f(f, l) = 0 \tag{24}$$

which has a total differentiation of

$$0 = f_f df + f_l \, dl. \tag{25}$$

and this shows that

$$\frac{dl}{df} = -\frac{f_f}{f_l}. \tag{26}$$

Therefore, the derivative $\frac{dl}{df}$ can be found as the negative of the ratio of the partial derivatives of the implicit function, providing that $f_l \neq 0$.

The housing finance policy makers working in conjunction with mortgage lenders and financial institutions as well as government agencies that are involved in mortgage credit granting, mortgage funding and direct mortgage guarantees can set the necessary parameters for mortgage credit. The economic model can be structured as a household`s objective function. If we suppose that mortgage market development is a

function of the variables that can be defined as flexible and liberal to achieve the household objective function, defined as α, which is a parameter that expresses the household objective function as

$$\alpha = \mathrm{E}[\mathrm{u}(\mathrm{W_h})] \tag{27}$$

which says that a household desires to maximize expected utility of wealth from ownership of a housing unit, h. However, it is equally useful and possible that the α term be defined by households and policy makers as another objective function rather than expected utility of wealth and it is straight forward to revise the objective function. Therefore the model which relates the mortgage market development, m, to the flexible and liberal features which are present in the domestic system and the household objective, such as to maximize utility of wealth, from homeownership can be expressed as

$$\mathrm{M} = \mathrm{f}(\mathrm{x_1}, \ldots \mathrm{x_n}, \alpha) \tag{28}$$

where the set of x`s include the features, indicators and outcomes of a domestic mortgage lending system. Finding an optimal value for mortgage market development would consist of solving n first-order equations of the form

$$\partial \mathrm{m} / \partial \mathrm{x_i} = 0 \quad (\mathrm{i} = 1, \ldots . \mathrm{n}), \tag{29}$$

and the solution to this process would yield optimal values for these $\mathrm{x`s}\ (\mathrm{x_1^*}, \mathrm{x_2^*}, \ldots . , \mathrm{x_n^*})$ that would implicitly depend on the parameter α. The requirement would be that the second-order conditions are met, and therefore the implicit function theorem would apply and the next step would be to solve each $\mathrm{x_i^*}$ explicitly as a function of the parameter n described as

$$\mathrm{x_1^*} = \mathrm{x_1^*}\ (\alpha)$$

$$\mathrm{x_2^*} = \mathrm{x_2^*}\ (\alpha)$$

$$\vdots$$

$$\mathrm{x_n^*} = \mathrm{x_n^*}\ (\alpha)\ . \tag{30}$$

By substituting these functions onto the objective function we can obtain an expression in which an optimal value of $\mathrm{m}\,(\mathrm{m}^*)$ depends on the parameter α both directly and indirectly through the effect of α on the $\mathrm{x}`\mathrm{s}$ and therefore we have

$$\mathrm{m}^* = \mathrm{f}[\mathrm{x}_1^*(\alpha), \mathrm{x}_2^*(\alpha), \ldots . \mathrm{x}_\mathrm{n}^*(\alpha), \alpha] \tag{31}$$

Differentiating this expression with respect to α yields the following

$$\frac{\mathrm{dm}^*}{\mathrm{d}\alpha} = \frac{\partial \mathrm{f}}{\partial \mathrm{x}_1} . \frac{\mathrm{dx}_1}{\mathrm{da}} + \frac{\partial \mathrm{f}}{\partial \mathrm{x}_2} . \frac{\mathrm{dx}_2}{\mathrm{d}\alpha} \ldots + \frac{\partial \mathrm{f}}{\partial \mathrm{x}_\mathrm{n}} . \frac{\mathrm{dx}_\mathrm{n}}{\mathrm{d}\alpha} + \frac{\partial \mathrm{f}}{\partial \alpha} \tag{32}$$

Referring back to the first-order conditions, all these terms except the last are equal to zero if the x's are at their optimal values, and therefore we derive the envelope result consistent with the earlier result.

$$\frac{\mathrm{dm}^*}{\mathrm{d}\alpha} = \frac{\partial \mathrm{f}}{\partial \alpha} . \tag{33}$$

Chapter 4.

Homeownership as a Critical Asset Allocation Decision

The household decision to become a homeowner is important since it represents a significant share of a household`s net wealth and may mean that investments in financial assets are deferred since homeownership typically entails a large mortgage loan obligation. The economic intuition is that while the household choice to become a homeowner supports the need for consumption of housing services, it is fundamentally an investment problem. The research contributes to the literature on portfolio selection, and there is an extensive literature on portfolio theory and asset selection beginning with Markowitz (1952), Samuelson (1969), and Merton (1971). Extensions to the literature that include homeownership in the portfolio selection will be discussed, and they consider whether housing impacts equity market participation, and how portfolio selection may differ depending on an investor`s financial wealth, income or age and the cost of housing. The motivation is to refine and extend existing research and propose a stylized Markowitz optimal portfolio selection model in which a household`s portfolio selection that includes housing among financial assets account for different housing types; length of holding period; imputed rent; property maintenance and the mortgage lending system.

The researcher does not address the challenges that many households face in obtaining acceptable housing services from both market and non-market sources and does not consider the supply and demand of housing. The research moves beyond studies that address a household`s portfolio selection as a simple utility maximizing consumption model without fully accounting for the complete range of benefits and costs associated with homeownership as an investment and the mortgage lending system in which households finance homeownership. Advancements in mortgage markets allow home equity in a principal residence to be used as a household finance tool to smooth

inter-temporal consumption. Undoubtedly, home equity will continue to play an important role in financing retirement needs given stock market volatility. The research also moves beyond current research that only considers single detached housing and does not account for different housing types, various holding periods and property maintenance. The model presented allows a household to choose between an apartment condominium or a single detached home. The household will consider finite holding periods and this also differs from other models that either assume an infinite horizon, Miao and Wang (2007), or an optimal stopping time, Cetin and Zapatero (2010). Households can also express strategic considerations related to property maintenance.

For simplicity, the model and empirical analysis follows a Canadian market setting, unlike the U.S., where the tax deductibility of mortgage interest and property taxes is a public subsidy that can influence demand for mortgage credit and therefore entice households to become homeowners. Canada is similar to the U.S. and elsewhere in that capital gains and imputed rent related to homeownership of a principal residence over time are tax-exempt. For the empirical work, the housing markets of Metropolitan Toronto and Metropolitan Vancouver have been selected since homeownership levels approximate 70 per cent, and these housing markets report high levels of sales transactions, with relatively high house prices, but without much influence of subprime mortgage lending as has been the case in many U.S. housing markets. The stylized model assumes that a household, through the mortgage lending system, has qualified to become a homeowner and will make a portfolio selection that includes housing among financial assets such as equities and bonds at a specific point in time. The expectation of returns and volatility of returns for equities and bonds are exogenous, based on long-term historic results. There are three scenarios presented for housing:

1. expectations of house price returns and imputed rents that follow historical returns;
2. an equilibrium approach where the change in house prices and imputed rents evolve together as a stochastic process; and
3. implied annual rates of housing returns necessary for housing to be an asset in a portfolio selection above the global minimum variance portfolio.

4.1. Literature on Housing as an Investment and Critical Asset Allocation

Gau and Goldberg (1983) provide the inspiration to consider homeownership an investment comparable to finance assets. These authors cite the institutional framework and urban land patterns that shape housing development and homeownership strategies in Canada that differ to that of the U.S. The performance of homeownership as an investment continues to shape Canadian housing finance.

Traditional economic models with a housing perspective have focused on why a household may buy or rent housing services. An economic value is assigned by consumers on housing attributes. This theoretical approach traces back to Lancaster (1966) and an approach to consumer theory where the attributes of goods are in fact the primary units of consumption. Based on this economic reasoning, Nicholson's work, Microeconomic Theory (2005), profiles linear attributes as a standard utility model that works well to bundle consumption attributes together, and the bundles for durables would include housing while the bundles for non-durables would include food, clothing, recreation and the like.

Hedonic studies reference Lancaster as the basis for defining housing as a bundle of housing services rather than just a building. Arguea and Hsiao (2000) derive shadow prices for various attributes and this provides a framework to understand the determinants of demand for housing but does not address the rent versus buy decision. Graphical representations of the Lancasterian approach, as outlined by Nicholson (2005), can be adapted to illustrate that when a household with a specific budget constraint is faced with a rent versus buy decision and a third choice of non-durable consumption, a utility maximizing household would never consume positive amounts of both rental and homeownership housing. This approach allows for consumption patterns to change over time with respect to tenure. As such, goods that were previously consumed may cease to be bought, such as rental housing, and goods that were previously ignored due to constraints, such as homeownership in a principal residence, may experience a substantial shift in consumption. However, the linear assumptions inherent in the theoretical model require preference ordering (mapping) of all possible collection of goods and are often chosen by way of convenience to obtain

certain outcomes rather than confirmed in a real world setting. In the case of non-durable consumption, many attributes are non-additive and conflicting, and utility maximization subject to a budget constraint is not a robust linear programming problem. Rosen (1974) focuses more on how consumers and suppliers interact within a framework of bids and offers for characteristics, and this naturally leads to a non-linear hedonic price structure. It is not uncommon for hedonic studies to be plagued by highly unstable shadow prices, as concluded by Pendleton and Shonkwiler (2001). Another shortcoming is that housing consumption models ignore mortgage lending constraints which are not a unique property attribute, and generally these models fail in their usefulness to consider homeownership as an investment decision for households.

Basic theoretical models of housing choice adopt a Cobb Douglas utility function due to its analytical tractability. Davis, Lehnert and Martin (2008), Hornstein (2009), and Piazessi, Schneider and Tuzel (2007) conclude that households reduce expenditures on housing when house prices increase relative to non-durable consumption and suggest a value higher than one for the intra-temporal elasticity of substitution between housing and non-durable consumption. This is important research but the framework does not consider housing as part of an optimal asset allocation, where house prices can change over time and households can choose among different housing types and mortgage lending constraints can influence the homeownership decision.

While economic models can show the elasticity of housing services over time, housing tenure choice is more complicated and theoretical models have been adopted to handle different situations. Hornstein (2009) considers long run growth rates in house prices based on the balanced growth path of the housing market using the Campbell and Hercowitz (2006) representation of collateral constraints, finding that changes in collateral constraints hardly affect the balanced growth path of house prices. Household tenure and housing consumption choices typically fall within a life-cycle framework as proposed by Gervais (2002), Ortalo-Magné and Rady (2005), Fernandez-Villaverde and Kreuger (2005), Campbell and Cocco (2005) and Chambers, Garriga and Schlagenhauf (2008) among others. These models cannot overcome many of the complex realities of housing markets and strategic considerations a homeowner may exhibit with respect to homeownership investment such as holding periods and the choice to buy different housing types. Households also need to account for the actual impacts of transaction

costs, imputed rent and property maintenance and this can influence investment preferences. Structural parameters and their weighting can ultimately bias outcomes and housing is a unique asset class compared to other investment alternatives. Moreover, Green (2008) concludes that the mixing of subprime borrowers and speculators confound housing consumption models derived for prime, conforming borrowers, since the evidence shows that subprime borrowers and speculators are heterogeneous and quickly abandon housing markets in a nonrecourse market setting if real estate markets fall or mortgage lending costs increase above the rate of house price appreciation. In a finance context, mortgage underwriting structured to benefit prime borrowers with expeditious mortgage credit at low cost, resemble low cost call options when extended to subprime borrowers, investors and speculators. Pavlov and Wachter (2006) consider a lending environment where lenders misprice and under-price the put option, and in the context of a mortgage loan to securitization model, this leads to ruthless borrower default without recourse by lenders or investors of mortgage backed securities.

Given that mortgage credit is a significant factor in the household decision to become a homeowner, well cited research by Stiglitz and Weiss (1981) concludes that information imperfections in credit markets can result in different credit granting outcomes for different consumers, and this would apply to mortgage lending. Pavlov and Wachter (2004, 2005, 2009a, 2009b), Abraham and Pavoni (2008) and Green, Sanders and Wachter (2008) and Green (2008) show that strict mortgage loan underwriting in the U.S., in the form of employment and income verification and conservative debt service ratios along with risk based mortgage loan pricing, affects real estate markets immediately and can substantially alter home buyer demand for mortgage credit. This disproportionately impacts the rent versus buy decision for those at the bottom end of the credit curve such as minorities and low income households, new immigrants, and even self-employed borrowers. Using data from 1990 and 1991, Avery, Beeson and Sniderman (1999) conclude that denial rates were 30 per cent higher in low income and minority U.S. neighbourhoods than wealthy neighbourhoods, consistent with arguments that U.S. mortgage lenders had historically constrained mortgage lending by redlining certain high risk housing markets, Ferguson (2008). The

results give evidence that U.S. mortgage loan applications for low income and minority households were low prior to the 1990s, given the high likelihood of a denial.

Pavlov & Wachter (2004, 2006) and Herring & Wachter (1999) conclude that if lenders are left unchecked by regulators, financial markets may fail to properly price the credit risk in mortgage lending. In turn, housing markets where lenders underprice mortgage lending experience deeper market corrections when markets begin to slide. Allen and Gale (1998, 1999) and Allen (2001), offer models that highlight the underpricing of mortgage lending as leading to inflated house prices, while constraints on mortgage credit granting can equally curb house price growth. The findings have a policy level focus, even though there are strong indirect implications on the decision of a household to consider homeownership as an investment. Iacoviello (2005) illustrates that a general rise in consumer prices reduces the real value of a borrower's outstanding mortgage debt obligations, positively influencing their net wealth.

On a macroeconomic level, higher levels of household wealth and income play a key role to support homeownership and household behaviour is influenced both by the consumer need for housing services and the investment potential embedded in homeownership. Li, Lui and Yao (2008) conclude that as wealth increases homeownership will approximate 70 per cent for young age cohorts and 90 per cent for older age cohorts over a 40 year employment horizon and a 75 year life cycle. The authors extend the basic Cobb Douglas utility function and propose constant elasticity of substitution preferences over housing and non-housing consumption. The optimization problem uses a calibrated housing model implementing a two stage method of simulated moments, drawing from a comprehensive data set across three age groups. The model is based on strong empirical guidance regarding input parameters that are either classified as economic such as housing stock, housing prices, income wealth, transaction costs, and mortgage collateral constraints, or those classified as demographic including mobility and mortality. This accounts for many shortcomings in other works and is an important contribution in the theory of housing tenure. The results focus on policy issues and conclude that when income declines this triggers both lower house prices and lower house values, resulting in lower homeownership rates and lower non-housing consumption which is consistent with the economic reasoning that households regard homeownership as an investment. However, the complex model

relies on a comprehensive data set that limits its broad application, and proves of little value in considering utility maximization decisions for a household to consider alternative investments such as stocks and bonds.

The literature on housing finance and homeownership generally conclude that households become homeowners based on net wealth, labour income and access to mortgage credit because they have access to an advanced domestic mortgage market and an institutional framework that supports real property markets, IMF (2008, 2011) and King (2012b). In a U.S. setting, homeownership has been acknowledged as having investment qualities similar to other financial assets, providing asset appreciation and dividends, which are defined as the imputed rent gained when a household owns its housing services, as well as the direct benefit of hedging rent risk, Flavin and Yamashita (2002), Yao and Zhang (2005), Himmelberg, Mayer and Sinai (2005), and Sinai and Souleles (2005). This is also the conclusion of Steele (1993) for a Canadian setting, but without an economic model. At the time an investment in homeownership is made this often results in an investor's asset allocation being dominated by a single asset class, specifically the housing unit. This changes over time as the mortgage debt obligation is paid down by way of loan amortization and net wealth increases due to home price appreciation, Reichenstein (1998). Homeowners, especially first time buyers, do recognize the risk of a single claim on a real estate asset especially in high house price markets, and may even consider this overexposure from an optimal portfolio perspective, Cauley, Pavlov and Schwartz (2007). For homeowners, a flexible mortgage market is an important innovation that supports homeownership as an investment and the consequence has been that home equity is being increasingly used as a finance tool to smooth inter-temporal household consumption, Campbell (2006) and King (2012b). In turn, some governments have responded to a household`s liquidity constraint and store of wealth in homeownership by allowing certain segments of the population, such as seniors, the option to defer property taxes, to be settled upon transfer of the property or probate of the estate.

Relating net wealth, mortgage debt levels and consumption of housing services within an economic model is complex. The research suggests that the level of real estate ownership needed for the consumption of housing services may differ from the optimal level of housing assets held within a portfolio and that rental housing is by no

means a perfect substitute for homeownership, Flavin and Yamashita (2002). To address this point, Sinai and Souleles (2005) present a simple tenure choice model with endogenous house prices, illustrating how the demand for owning trades off the rent and asset price risks. The conclusion is that homeownership will dominate the tenure decision for households with a long term horizon in markets with high levels of net rent risk and volatility since renters must purchase housing services on the spot market.

More recent models, Pavlov and Wachter (2009b), include mortgage lending constraints and can differentiate between homogenous prime and heterogeneous subprime borrowers by including the credit score in the model. Consumers find it attractive to switch from renting to owning when mortgage financing costs are low or when credit constraints are relaxed. The end result is house price appreciation which churns homeownership investment returns. The more wealth a renter household has relative to income the more likely the household will become a homeowner as requirements for mortgage credit, primarily LTV, can be met. This does address the complexity of placing subprime borrowers, investors, and speculators in the same mortgage credit granting regime as prime borrowers. This suggests a research opportunity to consider an economic model that examines the impact of mortgage borrower misrepresentation and fraud on housing markets, quantifying the potential for financial gain achieved from overly liberal and flexible underwriting standards, especially in a mortgage market without lender recourse as in the U.S. Mortgage lending constraints address much more than credit score and include sources of home purchase down payment, amortization periods, LTV ratios, acceptable sources of documented income and, most importantly, mortgage debt service ratios. Combined, the features of a liberal and flexible mortgage market support home buyer purchasing power, Himmelberg, Mayer and Sinal (2005). When credit granting allows borrowers to qualify with high debt service ratios at low mortgage loan rates, this in effect extends purchasing power, potentially fuelling house price appreciation generating high internal rates of return for home buyers. This may skew the household portfolio choice away from equities, biasing homeownership as a preferred asset allocation.

Research into mortgage credit granting in Canada by Buckland and Dong (2008) and Simpson and Buckland (2009) and in the U.S. by Gabriel and Rosenthal (2005), Mayer and Pence (2007), Shiller (2008), Sherlund (2008), Mian and Sufi (2008), and

Haughwout, Mayer, and Tracy (2009), show that liberal and flexible mortgage lending increases mortgage loan originations among all mortgage borrower groups. The research of Linneman and Wachter (1989) is an initial reference on the impact of housing finance constraints. There is evidence that mortgage credit easing prior to the 1990s occurred as U.S. lenders increased credit flows to risky borrowers in urban markets, supported by investor demand for mortgage backed securities, Harrison, Noordewier and Yavas (2004) and Shiller (2008). Abraham and Pavoni (2008) confirm broader mortgage lending, easing in smaller U.S. markets and among smaller U.S. financial institutions after 1990 due to mortgage securitization often enhanced by mortgage loan insurance, government guarantees, and credit derivatives. Moreover, the presence of U.S. mortgage lenders operating in Canada impacted mortgage credit granting throughout North America with more liberal and flexible mortgage credit, King (2012a). There are also political influences that need to be recognized. For example, the American Dream Downpayment Act, signed into law in 2003, had the objective to increase mortgage lending, facilitating a wave of U.S. subprime borrowers to become homeowners. Policy makers, influenced by the welfare benefits of homeownership, supported deregulation in mortgage lending, without underwriting rigour in mortgage credit granting in an effort to extend homeownership in the U.S. to subprime borrowers, Shiller (2008). Clearly, since 1990, the mortgage lending system in North America has allowed for a larger share of households to consider housing as an investment, that were traditionally constrained from homeownership. Housing finance continues to move beyond the simple economics of housing services consumption in which households are indifferent to tenure.

Basic life cycle theory related to housing begins with the notion that for each new household the default tenure is, in fact, rental (Steele, 1993). The underlying investment risk related to homeownership is valid for a household to consider. Households become homeowners for a range of reasons such as more control over housing than provided by renting and to accumulate and store wealth as an asset in the household`s investment portfolio. Homeownership is an investment that provides tangible benefits in terms of meeting housing service consumption needs, alternatively obtained in the spot rental market with lease terms negotiated usually on an annual basis. Incomplete markets are a valid consideration since some neighbourhoods lack rental housing choice, and the

rental housing that is available may lack consistent, quality choice of services and some housing units may only be available on a continuing basis through homeownership (Steele, 1993). Households that rent may also be subject to rental rate risk under certain states of nature. For example, when vacancy rates are low and rent increases are high and persistent. From a financial perspective, homeownership is easily managed, highly leveraged, with predictable cash flow requirements, which is a combination unmatched by other real investment options, as Steele (1993) describes. Capital gains and the imputed rent from a principal residence are not taxed in the U.S. and Canada. Mortgage interest and property taxes are tax deductible in the U.S. and the public subsidy makes homeownership attractive to many households with high incomes, Cocco (2004).

There is portfolio theory research that considers a household`s mixed asset allocation, and this includes financial assets along with housing in the portfolio selection. Grossman and Laroque (1990) offer equilibrium implications from a representative agent who derives utility from ownership of a good that is relatively illiquid since its sale involves a high transaction cost such as housing, and the model also allows for depreciation of the durable good. Goetzman (1993) sets forth a simple mean variance framework to show evidence that there are gains in creating large portfolios of residential properties. Pools of equity claims on thousands of houses are much less risky than a single equity claim on a home. However, most households are required to make an all or nothing decision when it comes to homeownership since a household can only buy one principal residence and not just part of a home, and neither a fraction of a diversified pool of residential real estate assets. The investment likely consumes most, if not all, of household wealth to just meet the down payment requirements and since a large mortgage loan is also required, diversification of a household`s portfolio is likely delayed until home equity is accumulated. Government sources, such as Statistics Canada through the Census, report that most households in Canada make the move to homeownership between the age of 25 and 39, and financial net wealth for most homeowners is concentrated in a principal residence. According to Statistics Canada, a typical Canadian will remain a homeowner for at least 30 years, although households may trade among residential real estate assets over the life cycle.

It is typical for portfolio optimization to exclude the ownership of a personal residence consumed for its housing services from the calculation of an investor's asset and liability mix. Reichenstein (1998) provides one of the first studies that analyses how a household should account for homeownership in an asset and liability mix, and how the portfolio can be used for retirement purposes. The notion is that a principal residence can be sold should the household wish to downsize and even change tenure, with the mortgage loan being treated as a short bond position. The economic insight is that if the household is willing to borrow or downsize against its homeownership in a principal residence, then it is appropriate for the real estate asset to be included in the portfolio selection. The scenarios examine the portfolio mix with after tax dollars based on a financial assets only view; home equity view; an expanded view to allow a household to downsize; and an estate planning view, allowing for the presence of defined benefit pension payments. In the case of the financial assets only view, the corporate bond is included as part of the portfolio but the mortgage loan is excluded. For the home equity view, the fixed rate mortgage is equivalent to a short position in corporate bonds. The expanded view allows a household to downsize during retirement, using the proceeds to buy a smaller home and include the remaining net wealth gained from the sale of the larger pre-retirement home as a position in real estate. The estate planning view includes proceeds from death benefits such as a life insurance policy.

Cauley, Pavlov and Schwartz (2007) confirm that when the investment in homeownership is exogenously determined by market conditions, new home buyers in effect constrain their ability to adjust their asset allocation between residential real estate and other assets. The authors conclude that homeownership results in a shift of asset allocation away from equities, but this constraint is less binding as the household ages and financial wealth is accumulated. The emphasis is on the household utility maximization objective in terms of obtaining housing services, rather than accumulating wealth. This work follows Yao and Zhang (2005) who present a theoretical model based on a household's life cycle with empirical results based on income data. The conclusion is that a household`s decision to continuously rent or buy housing services is suboptimal, suggesting welfare losses that drastically alter the investor's portfolio choices. When indifferent between renting and owning housing services, the homeowner substitutes home equity for risky stocks in household net wealth, yet

increases the equity proportion in a liquid financial portfolio to take advantage of the diversification benefit afforded by the low correlation between stock returns and housing returns. The findings also point to U.S. tax law related to mortgage interest deductibility as a significant factor and the presence of different housing types is not considered.

Equilibrium in the housing market implies that the expected annual cost of owning a house, also known in the literature as the imputed rent, will not exceed the annual cost of renting, Himmelberg, Mayer, and Sinai (2005). Therefore, while the house price-to-rent ratio may differ among cities, it is the change in the rent level that influences house price changes thus maintaining equilibrium between the ownership and rental of housing services. Equally important, is the limitation of much of the research that focuses on single detached housing type. This ignores the presence of multi-family condominium housing in more recent years within many housing markets, allowing housing services to be purchased at more exact levels of consumption by matching physical house size with household need, King (2012a).

Given the high price of housing and typical requirement for a household to finance a home purchase with a large mortgage loan debt obligation, the importance of risk aversion needs to be considered. Flavin and Yamashita (2002) found that for investors with relatively high levels of risk aversion, higher home values relative to net wealth lead to lower optimal allocations to stock, while the principal residence's share in the portfolio had almost no impact on investors with low levels of risk aversion.

Waggle and Johnson (2009) address the impacts of different levels of home value to net wealth and mortgage loan financing. The intuition is that it is appropriate to treat the single family home as an asset and the mortgage loan as a separate liability. Households are assumed to make their home investment decisions first, and then they examine the implications of homeownership on asset allocation decisions. Homeownership represents both a consumption requirement and an investment decision. The authors consider the investment benefits of the home, based on the total returns, which includes the capital gain from price change over time and a rental dividend. The focus is on the risk associated with an investment in a single family home. The model utilizes a mean variance utility function to consider the impact of homeownership and mortgage loan financing on the optimal asset allocation decisions of

households and contrasts this with a scenario that does not include the home in the portfolio. Optimal portfolio weights are dependent upon both the degree of risk aversion of the household and the relative importance of the home in the overall net wealth picture. The evidence suggests that the higher the home-to-net wealth ratio, the higher the portfolio allocation to stock holdings. Moreover, for most households that invest in a broad portfolio of assets, including the home in the optimization decision impacts the asset allocation to risky stock than suggested by traditional portfolio selection that ignores housing. Overall, the size of investment in a home is largely driven both by the potential housing returns and also to support a household`s specific consumption requirements for housing services, and 100 per cent mortgage loan financing is not optimal for all households. This finding differs completely from that of Flavin and Yamashita (2002) who conclude that optimal allocations to stock should decrease with higher home-to-net wealth ratios and mortgage loan financing ratios should increase.

In terms of portfolio theory it is useful to consider the household problem at a specific point in time irrespective of wealth and income, and this follows Hakansson (1970) who found that the optimal investment strategies result in an optimal mix of risky (productive) investments that is independent of the individual's wealth, noncapital income stream, and impatience to consume. Rather, the optimal asset allocation is case by case, and depends only on the probability distribution of the returns, the interest rate, and the individual's one-period utility function of consumption. Hakansson identifies four models; with three of the models showing that a poor individual will always borrow, while under a fourth model a rich individual will always lend, and the borrowing and lending rates are important to the results. As such, given the separation property, the model illustrates that optimal portfolio selection for an investor is determined by the borrowing and lending rate that define the slope of the CAL and this establishes the tangency point for the optimal portfolio selection of risky assets.

The Black Litterman (1991) model provides a structured theoretical approach to portfolio selection, and it serves a number of purposes. First, the model allows households to express expectations of returns, allowing for various constraints to influence the optimization problem. Moreover, it outlines the notion of equilibrium returns and when extended to housing markets, this allows for the rate of change in renting and owning housing services to follow the same stochastic process. Building on

this, the model can take an investor`s actual portfolio which can, for example, include homeownership in an optimal asset allocation, and derive the implied views which are the set of returns implied to form this portfolio selection. The intuition of the Black Litterman model sheds light on understanding investor preference in portfolio selection, and explains how investor expectations and implied views influence portfolio selection.

The economic reasoning of Dixit and Pindyck (1994), when applied to housing markets, confirms that if the risks of house prices and mortgage lending are complete, in the presence of necessary credit enhancements and regulatory safeguards, a representative household can be viewed as a price taker expressing rational expectations about prices being offered in the market. As long as the household owns the principal residence, the allocation of initial wealth to the homeownership investment is a function of exogenous market conditions. If markets are complete and households behave as competitive price takers, in a stochastic dynamic context this must be interpreted to mean that each market participant takes as given the stochastic process of the price and has rational expectations about it, then the equilibrium condition is efficient. This focuses the study on a household objective function, which is optimal asset allocation, and not the determination of the demand for housing or valuation of housing assets. The mean variance model of asset choice is worthwhile for its ease of use for empirical research, and its use is extensive since its development by Markowitz (1952). Under this model, as detailed by Huang and Litzenberger (1988), a preference for expected return and an aversion to variance is implied by monotonicity and strict concavity of an individual`s utility function. As the research shows, the mean variance model of asset choice is popular because of its analytical tractability and its rich empirical implications. By drawing from traditional portfolio theory, the mean variance model recognizes that investors are searching for the optimal asset allocation.

The research cited above supports the economic reasoning that consumption of housing services by way of homeownership includes an embedded investment. Due to the high price of housing and fluctuations in house prices and mortgage loan interest rates as well as property maintenance and taxes required to live in a owned principal residence, homeowners, especially first time home buyers, need to recognize the risk of a single claim on a real estate asset. Homeownership may even be viewed as overexposure from an optimal portfolio perspective at the time the household is

considering to shift from renting housing services. The holding period is important since this relates to the imputed rent associated with homeownership, while spreading out transaction costs to a future date. These factors do not exist to the same extent for the consumption of housing services in the rental housing market as renters are not exposed to significant transaction costs when they decide to move. Moreover, renter households do not need to bear the liability of a mortgage loan and neither do they attain a return on investment from the gain or loss in value of the home they rent, except where rent controls may support the payment of "key money," although this is likely limited to rent controlled markets. As well, property maintenance and depreciation are factors relevant to homeownership being evaluated as an investment, since equities and bonds do not physically wear out. As Blazenko and Pavlov (2004) note, property maintenance represents a risk with the cost being the responsibility of the landlord, which can be managed strategically. This is in keeping with Grossman and Laroque (1990) who set forth an economic model for optimal portfolio choice where the value of a durable good depreciates at a constant rate.

The researcher would like to acknowledge Grossman and Laroque (1990), Goetzmann (1993), Reichenstein (1998), Flavin and Yamashita (2002), Yao and Zhang (2005), Sinai and Souleles (2005), Himmelberg, Mayer and Sinal (2005), Blazenko and Pavlov (2005), Cauley, Pavlov and Schwartz (2007), and Waggle and Johnson (2009). The analysis will determine optimal portfolio selection where homeownership is part of the critical asset allocation along with financial assets. The household will consider different housing types and by including various constraints and strategic considerations related to holding periods, property maintenance, and mortgage lending, specific aspects of the investment problem are brought into focus. The literature on portfolio theory, specifically Markowtiz (1952), Hakansson (1970), Huang and Litzenberger (1988), Black and Litterman (1991), and Dixit and Pindyck (1994), offers a useful theoretical framework to address portfolio selection where expectations of house price returns and imputed rents can follow historical returns or the change in house prices and imputed rents can evolve together as a stochastic process. The separation property illustrates that optimal portfolio selection for an investor is determined by the interest rate and the CAL, and given a household`s level of risk aversion, this establishes the efficient set of assets. There are also important results obtained from implied annual rates of

housing returns necessary for housing to be part of the optimal portfolio selection above the global minimum variance portfolio.

4.2. The Economic Model

The following presents a stylized Markowitz optimal portfolio selection model that allows a household to evaluate homeownership as a critical asset allocation decision in the presence of alternative financial assets. This model allows households to consider different housing types as shaping portfolio selection for the first time. While previous studies consider single detached housing as an asset class in the portfolio selection, this study divides housing into two asset classes: single detached homes and apartment condominiums as alternative choices. This is an important contribution to theoretical models since housing is heterogeneous and households may wish to match housing service requirements to the consumption of housing services, and limiting the model to only single detached homes suggests that a household may significantly over-consume housing services. With the increasing development of multi-family condominium housing in more recent years, housing services can be purchased at more exact levels of consumption need and at lower price levels. Moreover, housing returns are different for single detached homes than apartment condominiums, since property value changes over time are strongly tied to the elasticity or inelasticity of the land supply, Himmelberg, Mayer, and Sinai (2005). It follows that the land component of a single detached home value is more significant than for an apartment condominium, and the degree to which this manifests itself will be a reflection of the local housing market.

The empirical work follows a Canadian market setting, Metropolitan Toronto and Metropolitan Vancouver, and this avoids the influence of the income tax deductibility of mortgage interest and property tax of a principal residence, which is not permissible under Canadian tax law. This public subsidy in mortgage lending can affect housing returns and demand for mortgage credit and ultimately bias homeownership preferences. A Canadian setting is similar to other taxation regimes like the U.S., where capital gains on housing price appreciation and imputed rent are not subject to taxation. The model accounts for the reality that an investment in residential property traditionally differs from financial assets due to liquidity, difficulty in converting home equity into cash

as well as property depreciation, since stocks and bonds do not physically wear out. The model allows a household to express preferences over different holding periods and apply strategic considerations to spread out transaction costs or even defer property maintenance expenses. The Canadian mortgage market is like the U.S., and is both liberal supporting homeownership, and flexible allowing easy conversion of home equity into cash, if the household needs to smooth household consumption needs, and is therefore dynamically complete King (2012b).

The economic model proposed considers that there is a representative household that has reached the threshold to become a homeowner and has qualified under the domestic mortgage lending system as an eligible home buyer. The time horizon for a representative household to consider homeownership occurs at t = 0 and extends up to a pre-defined holding period T, and this is a positive integer.

The economic model presented does not include a bequest motive. This has been considered, but the exclusion of a bequest motive does not change the important conclusions and findings in any significant way. The rent versus own decision is important and this research confirms that portfolio theory can be expanded in a meaningful way to consider housing along with equities and bonds. The care and effort to extend and refine portfolio theory to include housing along with equities and bonds has been considerable. Future research can address the bequest motive in the homeownership and maintenance decisions.

Yao and Zhang (2005) set forth a basic survival function and this is appropriate where λ_j is the probability that the household is alive at time j for $j = 0, \ldots\ldots, T$, conditional on being alive at time $j = 1$. It is enough to assume that $\lambda_j > 0$ for all j and that $\lambda_T = 0$. The probability that an individual investor lives up to period $t(t \leq T)$ is given by the following survival function:

$$F(t) = \prod_{j=0}^{t} \lambda_j \tag{34}$$

where $0 < F(t) < 1$ for all $0 \leq t < T$, and $F(T) = 0$.

Given the above, the model considers a representative household who may hold a portfolio of assets which can be represented as some amount of initial wealth at $t = 0$

which is comprised of financial assets and housing assets such that the wealth W_t for a household is given by:

$$W_t = X_t \ell + H_{i,t} P_t \tag{35}$$

where X_t equals a $(1 \times n)$ vector of amounts which, as is common, are expressed in terms of nondurable consumption good used as the numeraire held of the n risky assets, ℓ equals a $(n \times 1)$ vector of ones. The second term places homeownership of a principal residence in the portfolio composition with $H_{i,t}$ to represent the type of housing unit, i, which can either be a single detached home or an apartment condominium. The focus is on household preferences today and therefore only current income, and not expectations of future income, is relevant to mortgage credit granting to determine household preferences that includes homeownership in the portfolio selection. This approach accommodates lower income households, typically one- and two-person households, who will exhibit preferences for an apartment condominium that is smaller and lower priced. Moreover, the results address the permitted LTV ratio and required initial net wealth for the down payment to support homeownership in relation to the market price for housing. In either case the presence of a mortgage loan over a 25 year amortization will be compulsory. The housing unit offers a certain level of services and attributes at time, t, and P_t is the market value of the respective housing unit at time t. The last element of X_t represents the mortgage loan. This is a refinement to Flavin and Yamashita (2002) and Waggle and Johnson (2009).

The optimization problem requires that household wealth, which is in nominal levels, be transformed into shares of wealth, which is consistent with Flavin and Yamashita (2002) and this is simply done by dividing equation 35 by W_t and therefore equation 35 can be restated as

$$1 = x_t \ell + H_{i,t} \tag{36}$$

where

$$h_{i,t} \equiv \frac{P_t H_{i,t}}{W_t} \tag{37}$$

and

$$x_t \equiv \frac{x_t}{w_t} \tag{38}$$

Black and Litterman (1991) note that if a mean variance model only considers expected returns the results can be potentially flawed since small changes in expectations can lead to portfolio allocation of weights to one asset. The Black and Litterman model does not preclude the presence of real constraints in financing homeownership in a principal residence and therefore mortgage lending constraints are incorporated in the model. Therefore, when a home is purchased the homeowner`s interest in the property is equivalent to a portfolio comprised of the real property and a mortgage loan, consistent with Cauley, Pavlov and Schwartz (2007). Households are subject to real mortgage lending constraints such that the minimum amount of wealth for a representative household to make the shift from renting to owning a principal residence, or to withdraw home equity after initial homeownership to re-balance the portfolio allocation, is adhered to. Therefore, at any point in time a household`s wealth relates to the LTV of the property in the following way

$$W_t \geq P_t H_t \left(1 - \mathrm{LTV}(\mathrm{CE})\right) \tag{39}$$

where LTV is the maximum mortgage loan to house value, which takes a value $0 \leq \mathrm{LTV} \leq 1$, which is typically set forth by mortgage lenders, financial intermediaries that structure mortgage backed securities or collateral debt obligations, or even mortgage loan insurance companies and government agencies that qualify households for a mortgage loan guarantee. It follows that the approved LTV amount is often conditional on some form of borrower credit enhancement, CE, such as mortgage loan insurance or government guarantee and this applies to both high ratio mortgage lending as well as low ratio mortgage portfolios such as government guaranteed mortgage backed securities. Therefore, to make a homeownership investment in a principal residence the household needs to direct a portion of its wealth, δ_t, as a down payment to cover the LTV requirements where

$$\delta_t = P_t H_t \left(1 - \mathrm{LTV}\right) \tag{40}$$

This does not preclude house price changes over time where an economic shock places a homeowner into a negative LTV state. A mortgage loan can exceed the market

value of a home due to unexpected, negative fluctuations in house values. As a refinement to Flavin and Yamashita (2002), the corner constraints on the vector of financial assets at the time of home purchase or home equity refinance are given by:

$$-1 \leq \frac{X}{PH} \leq -\text{MaxLTV} \tag{41}$$

which is the constraint on mortgage borrowing which is conditional on the maximum LTV permitted by the domestic mortgage lending system for a specific housing type maintained at a certain level of quality and attributes at time, t, which represents either the date of home purchase or home equity refinance. The weight of the mortgage loan $X_{n,j}$ is constrained so that $P_t H_t$ is the portfolio weight of the house or the home-to-net wealth ratio. The mortgage loan liability cannot exceed the value of the house, and the portfolio weight of the mortgage loan cannot be positive. Also, the portfolio weights for stocks (X_S), bond (X_B), and the house (X_H), must all be non-negative, so $X_S, X_B, X_H \geq 0$.

Reichenstein (1998) and Campbell (2006) include the mortgage loan in the portfolio as a negative bond, whereas Waggle and Johnson (2009) treat the house as an investment that is separate from the mortgage loan. Interest rates are relevant to the outcome and Cocco (2004) assumes a risk free rate derived from short term government bonds at 2 per cent, with a mortgage loan borrowing rate as a premium of 2 per cent. The model presented considers different interest rates to shape the CAL and the mortgage loan borrowing rate and household lending are relevant to the results.

There are real constraints on other financial assets, as noted by Flavin and Yamashita (2002), when a household can hold a mortgage debt obligation up the maximum LTV permitted through mortgage credit granting to support homeownership in a principal residence. It is valid to assume that

$$0 \leq X_{i,t} \qquad i = 1 \text{ to } n-1 \tag{42}$$

which is the nonnegativity constraint on other financial assets where $X_{i,t}$ is the ith element of X_t. This means that a homeowner with a maximum LTV mortgage loan has a borrowing constraint limited to the mortgage loan and cannot borrow additional amounts

to purchase financial assets. The model focuses on the household decision as to asset allocation at t = 0 and does not consider how a household may choose to reallocate its portfolio over time. This follows the economic reasoning of Hakansson (1970) who found that the optimal asset allocation depends in each case only on the probability distribution of the returns, the interest rate, and the individual's one-period utility function of consumption.

The mortgage loan can be regarded as a household finance tool that allows a household to maintain maximum LTV levels over time, through home equity refinance, if this is required to dynamically span the household`s consumption needs. The mortgage lending system supports this, and the notion is that in each period the household operates within a frictionless mortgage lending system and can adjust the amount of mortgage through refinancing, by way of a second mortgage or home equity loan, consistent with Yao and Zhang (2005). Since the mortgage loan is amortized, and even if house prices remain constant, there are equity gains stored as wealth in the home and the household may decide to re-balance its portfolio over time to invest in other financial assets. A household may also wish to expand or reduce its consumption of housing services by shifting housing type from an apartment condominium to a single detached home, or vice versa. As will be shown, the returns and variances between different housing types vary and shifting housing type will impose a transaction cost.

The returns for assets are after capital gains tax, t_c, nominal returns. The expected return for financial asset i in year t will be defined as

$$\widehat{R}_{i,t} = \hat{\mu}_i(1 - t_c) + \varepsilon_{i,t} \tag{43}$$

where

$$i = (B, E, H) \tag{44}$$

and where the distribution of the noise is

$$\mathcal{E}_i \sim \mathcal{N}(0, \sigma_i) \tag{45}$$

The expected return for a bond will be defined as

$$\widehat{R}_{B,T} = \hat{\mu}_b(1 - t_c) + \varepsilon_B \quad (46)$$

The expected return for equity will be defined as

$$\widehat{R}_{E,T} = \hat{\mu}_E(1 - t_c) + \varepsilon_E \quad (47)$$

The returns for homeownership in a principal residence are not subject to taxation, and therefore expected returns can be expressly simply as

$$\widehat{R}_{GH,T} = \hat{\mu}_{gh,t} + \varepsilon_{h,t} \quad (48)$$

where μ represents the return in a specific geography or housing market, g, for a specific housing type, h, either single detached home or apartment condominium. This leaves the ε term which represents a stochastic component, which is expected to realize a return of zero.

Within the equilibrium approach the annual price appreciation, which can also be defined as the change in returns over time, from either renting or owning housing services, are in equilibrium. The model defines a general housing market for a respective geography, and the change in price will depend on the computed equilibrium annual price appreciation for the market area, and only the volatility of returns vary by housing type. The expression for equilibrium annual price appreciation is therefore,

$$\widetilde{R}_{GH,t} = \tilde{\mu}_{gh,t} + \varepsilon_{s,t} \quad (49)$$

The covariance matrix of returns is denoted by a (n + 1) matrix Ω as such

$$\Omega = E\left(\epsilon_t \epsilon_t^T\right) \quad (50)$$

The optimization problem to determine household preferences will maximize a function of the mean and variance of returns within a particular portfolio. It does not factor household income into the model, and this allows for the straight forward calculation of initial net worth and income requirement to qualify for mortgage credit, assuming a 90 per cent LTV, as a new homeowner of either a single detached home or an apartment condominium. If a household lacks income to qualify for a mortgage loan to purchase a single detached home or wishes to allocate less income to housing to

allow for a greater allocation to financial assets, then the household preference will be constrained to an apartment condominium. Overall, the notion of households expressing preferences for portfolio selection based on different holding periods is consistent with household finance behaviour and life cycle theory.

A mean variance optimization problem which considers housing follows the work of Flavin and Yamashita (2002), Waggle and Johnson (2009) and others. As is typical under this optimization problem, household utility maximization is a function of means and variances of expected returns from a portfolio of assets, such that investors desire to hold the portfolio weights at T = 0 that solve the following investor problem:

$$\max X_t \left\{ (x_t \mu + h_t \mu_{Hi}) - \frac{1}{2} A [x_t, h_{it}] \Omega [x_t, h_{it}]^T \right\} \quad (51)$$

Within this expression x is a vector of various assets (stocks, bonds, and housing) with an expected return μ; and h is the physical quantity of housing held of a specific housing type i, either single detached home or an apartment condominium; Ω is the variance, covariance matrix; and A is a parameter to measure the degree of relative risk aversion for the household as an investor.

Since exogenous variation in the expenditure shares between housing and non-housing services can result in a household acting as if they are more risk averse, it is necessary to assume a relatively large risk aversion coefficient. For a reference, Cauley, Pavlov and Schwartz (2007) assume a degree of relative risk aversion coefficient of 5, and this will be used in the model.

The utility function is subject to several constraints. The first simply implies that the portfolio is complete in that the weights of the asset portfolio sum to 1 and the model represents this as

$$\sum_{i=1}^{n} w_i = 1 \quad (52)$$

The second accounts for mortgage borrowing so that a mortgage holder follows mortgage credit granting rules related to LTV

$$-h_t \leq x_{n,t} \leq 0 \mid \mathrm{LTV}(H_{i,t}) \quad (53)$$

The third requires that there is a non-negativity constraint on financial assets held in the portfolio given a household holds a mortgage obligation, so that

$$0 \leq x_{i,t} \qquad i = 1 \text{ to } n-1 \tag{54}$$

The proposed model follows standard portfolio optimization whereby a household as an investor maximizes over its holding of financial assets and housing. The household will express preferences between housing types for a variety of reasons. For example, the choice between housing types may allow a household to better match housing services supplied by a housing unit with a household`s net wealth, income or consumption needs. The expectations of housing returns also differ over different holding periods and vary depending on property maintenance considerations.

The maximization problem for some models that include housing, Flavin and Yamashita (2002), Yao and Zhang (2005) and Waggle and Johnson (2009), is conditional on the current value of the state variable which represents the ratio of house value to net wealth which is defined as h_t. In this model, equation 51 is solved numerically and derives asset allocation shares that a household can simply relate to current net wealth, market house prices, and LTV ratios offered by mortgage lenders. The household operates within a housing and mortgage market structure that is dynamically complete, which means that the household can maintain homeownership and withdraw home equity at any point in time or sell the principal residence and take the house price being offered in the market and either change housing type or return to renting, but in so doing incur a transaction cost. Rather than make this a random event or the horizon infinite or model and optimal stopping problem or even include an exogenous moving shock, the model assumes households consider different holding periods as part of the investment decision at t = 0. For example, even though a household may have strong positive expectations about housing prices in the future, if the household has information that a move to another city is likely in one year this may influence preferences away from homeownership in favour of renting due to transaction costs. The intuition is that holding periods influence household preferences and are accounted for strategically in the investment decision. Of course many households choose to buy housing services not for investment purposes but rather to consume housing services not available in the rental market.

The model does account for transaction costs by adjusting returns to account for a sale of the property at the end of the holding period. This is consistent with Cauley, Pavlov and Schwartz (2007) who conclude that after the home purchase event, frequent transactions in the future are impractical due to high cost imposed and thus the purchase decision effectively constrains the household`s ability to adjust asset allocation when housing is included in the portfolio selection. If a household needs to increase or decrease housing services over time then this requires that the household re-optimize over the house, H_t, at the suitable time in the future. This is a refinement to Grossman and Laroque (1990) and Flavin and Yamashita (2002) which allow households to frictionlessly make shifts in housing size.

While financial assets can be constantly re-optimized, and typically portfolio selection models assume zero transaction costs, housing as an asset is purchased and held for more defined periods. However, a significant and unexpected household event may force an unexpected transaction for the household, not accounted for at the purchase decision, but this obviates portfolio optimization. For financial assets no transaction costs are assumed. The short sale of financial assets is not allowed and mortgage borrowing is allowed, provided the LTV ratio is respected for the mortgage loan and the household is not over-leveraged. As the household pays down the mortgage debt obligation, $X_{n,j}$, this is equivalent to increasing the holding of a bond by the same amount, satisfying the mortgage borrowing constraint.

The model also considers property maintenance of the principal residence as a real estate asset as an extension and refinement to the research of Blazenko and Pavlov (2004). This allows a homeowner of real property to express a choice to either maintain or defer property maintenance. While property upgrades and renovations add to property value and there is market evidence that home sellers may upgrade properties just prior to listing a property for sale to maximize the sales price, or new homeowners invest in property upgrades as part of moving into the new residence to realize on housing attributes that have been neglected, there is less evidence on the appropriate level of basic property maintenance. As such, property maintenance costs have strategic implications for households depending on the holding period being considered and influence preferences related to homeownership as an investment.

The housing constraint on the portfolio optimization is represented by the value of the state variable h_t. Following standard portfolio theory, the optimization problem for each value of h_t is calculated by the economic model as the mean variance efficient frontier available to the household, which is simply the value of x_t which achieves the minimum variance portfolio for a given expected return. The value of h_t determines the results of the constrained mean variance efficient frontier available to a household at a specific point in time given expectations of returns and variances.

For the preferences expressed in the equation above a household`s indifference curve is

$$\frac{\partial \bar{\mu}}{\partial \sigma} = A\sigma \tag{55}$$

where in vector notation

$$\bar{\mu} = x_t \mu + h_t \mu_h \tag{56}$$

and

$$\sigma^2 = [x_t h_t] \Omega [x_t h_t]^T. \tag{57}$$

The optimization problem is solved by numerical methods due to corner constraints. The model results consider after tax returns for assets, consistent with Waggle and Johnson (2009) and Flavin and Yamashita (2002), although these authors adjust returns for inflation. By using nominal returns for equilibrium and expected returns this assumes that inflation would equally affect all assets under consideration, and more importantly, that inflation poses a risk to renter households and therefore provides a benefit to a homeowner. This allows for comparability among returns under different scenarios and assumes that a household`s inflation expectations are consistent among all economic variables.

The challenge is how to measure risk and return of the capital appreciation of housing, which includes a measure of the price risk, or illiquidity, that characterizes markets for infrequently traded or heterogenous assets. Supply and demand considerations and the cost of housing construction are not adequate to consider,

Rosenthal (1999). A repeat sales measure of housing returns may address this concern, as noted by Goetzmann (1993); however this still represents a somewhat less than adequate approach to determine expectations of house price returns. Therefore, while it is not possible to observe a household`s expectation of future appreciation of housing prices, in the U.S., the Panel Study of Income Dynamics (PSID) has provided a longitudinal study of a representative sample of U.S. individuals and families and tracked items since 1968 through a formal survey with specific questions on the value of a principal residence; household mortgage lending; and the amount of monthly rent. The PSID data has been used in portfolio choice studies by Flavin and Yamashita (2002), Cocco (2004), Yao and Zhang (2005), among others. However, the PSID or an equivalent is not available for Canada.

In this model, which considers a Canadian setting, a number of refinements and extensions to the existing research allow for variations to model capital appreciation of housing. Guidance on the scenarios for house prices changes follows three scenarios: (1) future expectations based on historical returns; (2) an equilibrium approach; and (3) implied views. These can be summarized as follows:

A household has expectations of future housing price change and volatility and this is based on the observation of historic price changes, and there are different returns expected from homeownership price appreciation and the net rental dividend. These expectations can be subject to constraints, and this methodology was established by Gyourko, Mayer and Sinai (2004). As will be discussed, the study proposes to consider the rate of change of historic median house prices as a basis for households to express expectations of gains or losses. This overcomes some of the challenges in measuring house prices changes, while the inclusion of net rental dividend offers a robust way to account for the true costs and benefits of homeownership.

When the change in house prices moves in response to changes in rental rates, this establishes an equilibrium condition between the homeownership and rental housing markets. This follows the research of Himmelberg, Mayer, and Sinai (2005) and equilibrium returns do not require that rental and homeownership housing services are perfect substitutes, since the house price-to-rent ratio may differ among cities. However, it is the change in the rent level that influences house price changes. In setting

equilibrium returns, the rental and ownership of new and resale housing are considered perfect substitutes in consumption, consistent with Hornstein (2009). The equilibrium approach will assume that changes in house prices and imputed rents move together and evolve through a stochastic process to account for uncertainty and this provides a way to value the hedge of rental rate risk gained through homeownership.

If households become homeowners based on investment principles, asset allocation that includes homeownership must reveal implied returns to housing in the optimal portfolio selection. The economic reasoning of implied returns traces back to Sharpe (1974), and this was applied to housing by Himmelberg, Mayer, and Sinai (2005). The intuition is that if a household has chosen homeownership through portfolio optimization then there are implied views as to asset returns and volatility of returns among mixed-asset portfolio allocations.

To express housing returns the first step is to expand equation 48 to consider two variables, the capital gain or loss from homeownership and the value of the net rental dividend. The total expected returns for housing can be represented as

$$\mu_{gh,t} = G_{h,t} + D_{h,t} \tag{58}$$

where $\mu_{gh,t}$ is the expected average return on a specific housing unit over a specified time period, which represents both the expected capital gain, $G_{h,t}$, and the expected net rental dividend, $D_{h,t}$. The capital gain and rental dividend will be after tax, and this is straight forward in Canada since the sale of a principal residence and the rental dividend are exempt from capital gains taxation.

The right hand side of the equation captures the change in housing price levels over a specified time period. The $\widehat{G}_{h,t}$ variable is the simple expected price appreciation over a specified time period and this is consistent with other models such as Flavin and Yamashita (2002) and Waggle and Johnson (2009).

The capital gain for housing is from an observed time series of resale monthly data. The data source for house prices, $P_t H_{i,t}$, will be median resale prices as tracked by the Multiple Listings Service (MLS) of the Canadian Real Estate Association (CREA) between October 1993 and October 2011. The base level for the median home price by

housing type and respective housing market is derived from the approximate value recorded in the market by CREA as of October 2011, adjusted and rounded as an annual approximate average over 2011. The expected capital gain is based on the average of observed historic capital gains over each one month time period, which for any period of time is expressed as

$$\widehat{G}_{H,t} = \frac{P_t H_{i,t} - P_{t-1} H_{i,t}}{P_{t-1} H_{i,t}} \tag{59}$$

The rationale for deriving the expected rate of change for house prices on the rate of change of historic median MLS house prices is based on the following economic reasoning and guidance:

There is a key benefit with MLS median house prices from CREA to measure house price returns. Median house prices track in a consistent trend, but at a lower level than average prices, and a consistent trend but slightly higher level than a Case-Shiller type index of benchmark prices, developed by CREA. Moreover, MLS sales represent a consistent flow resale housing stock sales with higher priced new homes excluded, since the business practice among developers is to sell new housing by way of in-house marketing teams and not by MLS to avoid listing costs and high commissions, unless market conditions are in an extreme down cycle.

MLS median price changes are a key factor considered by government agencies that are responsible for establishing property assessments. These assessments are used by Canadian municipalities in setting property tax mill rates. In a Canadian setting, the property assessment values can be challenged by a property owner and confirmed by a quasi-judicial review, which is not the case for a house price index. Property assessment agencies do supplement MLS resale price changes with home improvement and building permit data, but general MLS price trends can be applied easily to larger markets, which is efficient given the large stock of housing. While property assessment data could have been used, the time series is only annual. Since assessments are directly related to MLS resale price data to support housing price levels, it was decided that monthly median resale housing price data would offer a more comparable and larger time series, consistent with monthly price data for financial assets.

Use of MLS resale data allows the model to be extended to all urban housing markets in Canada since CREA has a national scope of activity.

For the equilibrium approach, the capital gain in house prices, $\widetilde{G}_{H,t}$, follows a stochastic process, similar to Sinai and Souleles (2005) where house prices are endogenous to the economic model, in which

$$d\,\widetilde{G}_{H,t} = \mu_{\widetilde{G}_{H,x}} dt + \sigma_{\widehat{G}_{H,x}} \widehat{G}_{H,x} dZ_{\widehat{G}_{H,x}} \quad (60)$$

on the right side of the equation, includes as the mean the equilibrium annual price appreciation by market area, noted in Table 5, that varies in a stochastic process based on the volatility of returns by housing type and market area. Table 4 provides a summary of the standard deviations based on historic returns for each asset class.

Table 4. Standard Deviation of Returns for Each Asset Class

Bonds	3.90%
Equities	29.8%
Metropolitan Toronto Single Detached House	5.19%
Metropolitan Toronto Apartment Condominium	5.83%
Metropolitan Vancouver Single Detached House	6.74%
Metropolitan Vancouver Apartment Condominium	6.10%

Except for times of economic recession or excessively high mortgage rates Canadian house prices generally exhibit increasing changes in price levels over time in urban markets such as Toronto and Vancouver and therefore house price changes are both stochastic and path dependent. The simple definition of a path dependent stochastic system in the context of the economic model presented means that the evolution of house prices at time t + 1 is the probability of being in any state i at time t + 1 conditional on having been in any state j at time t. The first order character of Canadian house prices signifies that it is only the current state of the house price and no anterior state in its history that affects the probability of where house prices will evolve to in the next time period. The equilibrium approach considers the distribution of returns and therefore relies on the probability results from 1,000 separate simulations. As noted earlier, if markets are complete and households behave as competitive price takers,

when following the reasoning of Dixit and Pindyck (1994), in a stochastic dynamic context this must be interpreted to mean that each market participant takes as given the stochastic process of the price and has rational expectations about it, then the equilibrium condition is efficient.

The more complicated variable is the rental dividend, $D_{H,t}$, and what is proposed is a refinement to the work of Flavin and Yamashita (2002), Yao and Zhang (2005), Sinai and Souleles (2005) and Waggle and Johnson (2009). This will address some unique features of Canadian housing markets and taxation law related to a principal residence, since the taxation deductibility of mortgage interest and property taxes needs to be excluded from the equation. We can therefore express the rental dividend as

$$D_{H,t} = \frac{CR_{H,t} - M_{ig,t}\left|_{d}^{f} - X_t - L_t - C_t\right|S_t}{P_{t-1}H_{i,t}} \tag{61}$$

$CR_{H,t}$ is the comparable or imputed rent that a household would have to pay if they did not own their own home. The concept of imputed rent is consistent with Himmelberg, Mayer, and Sinai (2005), Sinai and Souleles (2005), and Waggle and Johnson (2009). Conceptually, a household is considered to be renting to itself, but must incur all costs associated with homeownership. The imputed rent is the average cost of rent in the market that any household would otherwise have to pay for housing services. The objective for a renter household is to minimize rent paid, which is fundamentally different than a homeowner`s housing objective function. Imputed rent is a known value at the time of home purchase and renter households will be considered to be earning current rent payments as an annual homeowner dividend and this amount will increase over time at a rate conditional on the change in rental rates in the market. A two-bedroom rental apartment unit will be used as the comparable housing unit to determine imputed rent. This is consistent with the research of Himmelberg, Mayer, and Sinai (2005) who conclude that a two-bedroom rental apartment represents the most efficient and basic rental housing property to determine imputed rent, given that a renter household seeks to maximize utility by minimizing rent paid.

The CMHC October Rental Market Survey, which started to track rents in Canada since 1984, will be used as the data source to calculate both the base notional

amount for the imputed rent as well as the expected nominal change over time. This is based on the average historical change in rental rates between 1993 and 2011. This annual time series recognizes that tenants and landlords typically sign a fixed one year rental lease and there is no rental price volatility for a 12 month period after the lease agreement has been signed between the renter and landlord. The base rent level will be derived from CMHC`s October 2011 Rental Market Survey as an approximate rounded amount, and future rent levels will increase beyond this base amount using the historic average change in rent levels to determine the change over time.

For the equilibrium approach, the imputed rent will have the same base dollar level at t = 0, as described above, but the change over time will follow a stochastic process such that

$$dCR_{H,t} = d\mu_{CR_{H,x}}dt + \sigma_{\widehat{G}_{H,x}}\widehat{G}_{H,x}dZ_{\widehat{G}_{H,x}} \quad (62)$$

which, on the right side of the equation, includes as the mean the equilibrium annual price appreciation by market area, noted in Table 4 as the annual imputed rent growth rate, that varies in a stochastic process based on the volatility of returns by housing type and market area, noted in Table 5. The intuition to base future variance on past returns and past variance is based on the long-standing institutional framework which guides the Canadian rental market and keeps it stable with modest annual price increases that generally follow annual historic rates.

$M_{ig,t}\ \Big|_{d}^{f}$ is the annual cost of property maintenance and utilities for a principal residence, where the household can choose between full maintenance, f, and deferred maintenance, d, and this amount differs by different housing type, i, and since it will be based on property value, it will differ by geography, g, as well. Property maintenance primarily relates to the ongoing maintenance of the improvements on the property and not the land component. To account for depreciation in Canada there is provision for a capital cost allowance under current tax law for residential structures used for commercial investment purposes and not as a principal residence, and this provides for a 25 year useful life, suggesting a 4 per cent depreciation rate for commercial taxation purposes, although capital gains on investment properties are taxable. Research of the land title system for the City of Vancouver housing market confirms that the typical

useful life of a home before it is demolished and rebuilt is 70 years, which suggests that depreciation over the useful life where maintenance has been largely deferred is approximately 1.5 per cent of the improvements. Condominium owners must pay a monthly strata fee for the building envelope, mechanical features, general maintenance of the building, and these are building features that are external to the apartment unit, and this sometimes includes utilities such as heat. Single detached homeowners do not have a mandatory monthly property maintenance requirement, but utilities are a separate cost included in this parameter. Deferred property maintenance becomes a strategic consideration for a homeowner, and is more likely to occur among single detached homes where building maintenance is not mandatory, whereas for condominiums Strata Councils must comply with legislation to set aside funds for property upgrade, supported by mandatory strata fees.

For this analysis, a homeowner may apply strategic considerations to property maintenance, and can choose to fully maintain the residence allocating an annual percentage of property value equal to 2.5 per cent for a single detached home in Metropolitan Vancouver and 3.0 per cent for Metropolitan Toronto, and the difference adjusts for property values and climate. The option to defer maintenance can reduce a single detached homeowner`s maintenance by 175 basis points for basic, operational upkeep and utilities since a single detached homeowner has a relatively high level of discretion over maintenance. An apartment condominium homeowner can defer maintenance only partially due to mandatory monthly strata fees. For this analysis, a homeowner may apply strategic considerations to property maintenance, and can choose to fully maintain an apartment condominium with an annual cost based on property value of 3.0 per cent for Metropolitan Vancouver and 3.5 per cent for Metropolitan Toronto, and the difference adjusts for property values and climate. The option to defer maintenance can reduce the apartment condominium maintenance by 100 basis points for basic, operational upkeep and utilities since an apartment condominium homeowner has relatively less discretion due to mandatory strata fees.

X_t is the cost of property taxes, which on an annual basis in Canada tend to fall within a range of 0.4 to 0.8 per cent of the property value and is generally considered to reflect property tax mill rates in the markets under consideration. For this analysis the mid-point of 0.60 per cent will be used.

L_t is the cost of mortgage lending, which is discussed in detail by McDonald and Thornton (2008), and this takes in account the opportunity cost associated with the down payment investment. The Canadian practice is for mortgage holders to use an amortized mortgage loan which includes payments both for principal repayment and interest. Therefore, mortgage payments, MP, are expressed as

$$MP = MB_0(1 + r_t)^n \frac{r}{(1+r_t)^n} - 1 \quad (63)$$

where MP is the monthly mortgage payment and MB_0 is the initial mortgage balance, which is the total mortgage loan originated by the mortgage borrower and lender. Canadian mortgages, with the exception of variable rate mortgages, are compounded semi-annually. For example, this means that a household that is quoted a rate of 6 per cent, will actually have an effective annual rate of 6.09 per cent, based on a calculation of 3 per cent semi-annual. As such, the mortgage lender needs to use a monthly rate based on an annual rate that is less than 6 per cent, since this rate will get compounded monthly. Therefore, the rate that compounded monthly, rM, results in an effective annual rate of 6.09 per cent can be solved mathematically as:

$$rM = \frac{(0.0609)}{12} = 0.493862\%$$

The annual equivalent mortgage rate is not 6 per cent but 5.926 per cent (0.493862 x 12 = 5.926 per cent), which is equivalent to the 6.09 per cent annual rate. The amount of interest owed over a period of time defined as months, L_t, is the sum of each monthly payment of mortgage interest, l_i, which is based on the month`s initial mortgage balance, MB_0, multiplied by the effective monthly rate, rM. As such a Canadian mortgage is constantly amortizing each payment period with the interest calculation declining in a commensurate fashion. This can be expressed mathematically as

$$L_t = \sum_{i=m}^{n} l_i = (MB_0 * rM)_m + (MB_{n+1} * rM)_{m+1} \ldots \quad (64)$$

It is possible that the initial mortgage balance, MB_0, never changes and this would be an interest only mortgage or a mortgage such a home equity line of credit where the homeowner has the option to not make principal payments. More likely, the

mortgage balance declines over time as the amortized principal payment, A_p, is made. Therefore, after the initial mortgage payment is made each consecutive mortgage payment will be based on a declining outstanding mortgage balance. This means that

$$MB_{n+1} = MB_o - A_p \tag{65}$$

For the purposes of this analysis MB_o equals the full purchase price of the home. This does not mean that 100 per cent LTV are available in the mortgage market, but assumes that households as investors should be compensated for the opportunity cost of a down payment for a principal residence.

To determine an appropriate mortgage loan rate in a Canadian setting Allen, Clarke and Houde (2011) provide evidence of mortgage loan rate discounting, where lenders post one mortgage rate and mortgage borrowers negotiate a lower rate. The average discount off the posted mortgage loan rate in the 1990s was about 50 basis points while in the 2000s the typical discount was approximately 100 basis points with higher income households paying higher mortgage rates than lower income and younger households. Relating this to the Canadian bond market, Allen (2011) concludes that discounted mortgage rates have effectively traded at 200 basis points over the respective bond rate since 2000. The total cost of mortgage lending interest payments are equal to the sum of the interest payments determined by the mortgage loan rate, r_t, which will vary by term of the contract and the length of amortization period, n. This also serves as the opportunity cost of capital related to the down payment. Principal repayment is like an investment in a risk free bond, and the total cost of mortgage lending is a function of the total mortgage loan carried over a payment period minus the principal repaid as part of the amortization schedule. The longer the amortization period the lower the mortgage payment a household must make to the mortgage lender, but the total payment of mortgage interest will be higher since the principal loan amount is being carried over a longer time horizon, and a 25 year amortization has been used.

Canada`s housing finance system has benefitted from stable, low cost mortgage credit since 2000, King (2012a) and Allen (2011). As such, the outlook for mortgage loan rates draws from historical data from the Bank of Canada (Chartered Bank – Conventional Mortgage Rate) between 2001 and 2011. The expectation of mortgage

loan borrowing rates is based on an equivalent average of historic rates. This means, for example, that the outlook for 5 year mortgage loan rate is based on the 5 year historic average of the 5 year mortgage loan rate with an adjustment made for negotiated mortgage discounting.

$C_t|S_t$ is the transaction cost conditional on the sale of the property and this allows for the household to express certain views as to finite, discrete holding periods and therefore spread out the transaction cost over an expected holding period which is determined at the time of purchase. Transaction costs include both the sales transaction and a moving expense and are assumed to be between 5.0 and 7.0 per cent on the first $100,000 and between 2.0 and 3.0 per cent of the property value above this amount. For this analysis an estimate of 3.5 per cent of the total property value will be used as this will also include taxes, legal fees and an amount to cover moving expenses.

Guidance to determine the total return to equity financial assets is based on the change in the Toronto Stock Exchange composite index and generally reflects a cross-section of the large publically held corporations in Canada. The data was examined on a monthly basis to determine the correlation with other financial and housing price data. The total return calculation includes stock dividends paid in kind, stock dividends paid with the securities of an issuer other than the issuer declaring such dividend, rights distributions, and cash distributions less than 4 per cent of the underlying stock price based on the last traded board lot. The expected equity returns used in the analysis are based on S&P TSX Composite Total Returns Index calculated by Morningstar (2011 Andex Chart available at www.morningstar.com) and adjusted after tax. Currently 50 per cent of realized capital gains are taxed in Canada. To determine the applicable tax payable there is a federal tax of 29 per cent that is added to the provincial capital gains tax that varies by jurisdiction with lower incomes paying about 10 cent of realized capital gain climbing to about 22 per cent for higher incomes, so a mid-point of 16 per cent has been chosen. The individual's tax rate on the realized capital gain has been estimated to be 45 per cent and acknowledges the benefit of a dividend tax credit. Morningstar has determined the 10 year, 20 year and 30 year S&P TSX total equity return to be 8.0 per cent, 9.4 per cent and 8.9 per cent, respectively. Based on an average of these historic total equity returns to provide a basis for expected returns, a historic return of 8.8 per cent becomes an after tax expected total equity return of 6.75 per cent.

Guidance to determine the total return to bonds is based on the change in the DEX Universe Bond Index, formerly the Scotia Capital Universe Bond Index, which tracks the total returns of investment-grade (BBB or better) government and corporate bonds in Canada. The data was examined on a monthly basis for comparative purposes with the housing price data. Over the last five years, the 1 year, 2 year, 3 year and 5 year total bong return has been 6.32 per cent, 6.49 per cent, 6.58 per cent and 6.02 per cent, respectively (available at www.canadianbondindices.com). The return used in the analysis will be after tax. Similar to above, the individual's tax rate on the realized capital gain from an investment in bonds has been estimated to be 45 per cent. Based on an average of these historic total bond returns to provide a basis for expected returns, the historic return of 6.5 per cent becomes an after tax expected total bond return of 5 per cent.

4.3. The Empirical Research

This section presents the results of household preferences for asset allocation, with guidance on how to evaluate housing returns based on: (1) future expectations of housing returns based on historical returns; (2) an equilibrium approach where house price appreciation and imputed rent evolve together as a stochastic process; and (3) implied annual rates of housing returns necessary for housing to be an asset in an optimal portfolio selection above the global minimum variance portfolio. The study examines two primary housing markets in Canada, Metropolitan Toronto and Metropolitan Vancouver. These markets were selected since they are major urban centres that exhibit the highest home prices in Canada with strong levels of home sale transactions and international appeal as destinations for new immigrants and investors. For the purposes of the analysis a representative household is considered, and defined to be a renter household that has met the mortgage credit granting guidelines and has also the necessary income requirements to become a homeowner of either a single detached home or an apartment condominium. Table 5 summarizes the analytical structure to examine portfolio selection in which housing is an asset class in the presence of financial assets. Each scenario will be re-calibrated by market area and by housing type.

Table 5. Analytical Structure to Examine Portfolio Selection with Housing as a Separate Asset Class

Market Areas:	Metropolitan Toronto	Metropolitan Vancouver
Housing Types:	Single Detached House	Apartment Condominium
Housing Returns:	Future Expectations Follow Historic Returns and Constant Imputed Rent Growth	
	Equilibrium Approach and Returns and Imputed Rent Follow Stochastic Process	
	Implied Annual Rates of Housing Returns Necessary for Housing to be an Asset in an Optimal Portfolio Selection Above the Global Minimum Variance Portfolio	
Scenario #1 :	One Year Holding Period; Full Maintenance	
Scenario #2 :	Five Year Holding Period; Full Maintenance	
Scenario #3 :	Ten Year Holding Period; Full Maintenance	
Scenario #4 :	Fifteen Year Holding Period; Full Maintenance	
Scenario #5 :	Twenty Year Holding Period; Full Maintenance	
Scenario #6 :	Twenty Five Year Holding Period; Full Maintenance	
Scenario #7 :	Thirty Year Holding Period; Full Maintenance	
Scenario #8 :	Thirty Five Year Holding Period; Full Maintenance	
Scenario #9 :	Forty Year Holding Period; Full Maintenance	
Scenario #10 :	One Year Holding Period; Deferred Maintenance	
Scenario #11 :	Five Year Holding Period; Deferred Maintenance	
Scenario #12 :	Ten Year Holding Period; Deferred Maintenance	
Scenario #13 :	Fifteen Year Holding Period; Deferred Maintenance	
Scenario #14 :	Twenty Year Holding Period; Deferred Maintenance	
Scenario #15 :	Twenty Five Year Holding Period; Deferred Maintenance	
Scenario #16 :	Thirty Year Holding Period; Deferred Maintenance	
Scenario #17 :	Thirty Five Year Holding Period; Deferred Maintenance	
Scenario #18 :	Forty Year Holding Period; Deferred Maintenance	

The model requires a number of estimates for parameters and many of these have been previously discussed. Table 6 provides a summary of the default values for the parameters. Many of the variables are approximates that have been rounded and this simplification does not impact the outcome of the analysis to any significant degree. The price of the investment in assets (the numeraire) is fixed and normalized to one. The household investor derives utility from the different asset classes, and equation 51 is the household problem that determines the optimal portfolio weights to hold.

Table 6. Parameters of the Economic Model

Parameter	Description	Default Value
L_1	Discounted mortgage lending cost, 1 year, nominal	2.50%
L_5	Discounted mortgage lending cost, 5 year, nominal	4.50%
$L_{10 \rightarrow 25}$	Discounted mortgage lending cost, 10 years and longer, nominal	5.00%
n	Mortgage loan amortization period in years	25
$P_t H_{SMT}$	Initial property value single detached home, Toronto	$500,000
$P_t H_{AMT}$	Initial property value apartment condominium, Toronto	$300,000
$P_t H_{SMV}$	Initial property value single detached home, Vancouver	$850,000
$P_t H_{AMV}$	Initial property value apartment condominium, Vancouver	$375,000
$\hat{R}_B$	After tax expected total annual return on bonds	5.00%
$\hat{R}_{EB}$	After tax expected total annual return on equity	6.75%
A	Degree of Relative Risk Aversion – Household as an Investor	5.00
M_{FSMT}	Full annual maintenance cost, single detached home Toronto	3.00%
M_{DSMT}	Deferred annual maintenance cost, single detached home Toronto	1.25%
M_{FAMT}	Full annual maintenance cost, apartment condominium Toronto	3.50%
M_{DAMT}	Deferred annual maintenance cost, apartment condominium Toronto	2.50%
M_{FSMV}	Full annual maintenance cost, single detached home Vancouver	2.50%
M_{DSMV}	Deferred annual maintenance cost, single detached home Vancouver	0.75%
M_{FAMV}	Full annual maintenance cost, apartment condominium Vancouver	3.00%
M_{DAMV}	Deferred annual maintenance cost, apartment condominium Vancouver	2.00%
X_t	Cost of annual property taxes	0.60%
$C_t \mid S_t$	Transaction costs subject to sale of property	4.00%
CR_{MT}	Annual Imputed Rent Growth Rate , Toronto (Base Level : $13,500)	2.75%
CR_{MV}	Annual Imputed Rent Growth Rate, Metropolitan (Base Level $14,500)	3.00%
$\hat{G}_{SMT}$	Expected annual price appreciation single detached home, Toronto	5.00%
$\hat{G}_{AMT}$	Expected annual price appreciation apartment condominium, Toronto	5.50%
$\hat{G}_{SMV}$	Expected annual price appreciation single detached home, Vancouver	6.30%
$\hat{G}_{AMV}$	Expected annual price appreciation apartment condominium, Vancouver	5.25%
$\tilde{G}_{HMT}$	Equilibrium annual price appreciation, Toronto	2.75%
$\tilde{G}_{HMV}$	Equilibrium annual price appreciation, Vancouver	3.00%

The next step in the portfolio optimization problem is to derive the variance covariance matrix which is based on the returns presented in Table 6 as well as the standard deviation of returns and correlation of returns among the assets.

Table 7, Panels A – D, summarize the correlation matrix and the variance covariance matrix for each combination of asset classes. It is assumed that the covariance and correlation matrices will apply equally to a home irrespective of strategic considerations related to property maintenance or holding period. A number of points are worthwhile to highlight and are consistent with the general literature and survey of findings on the performance and relationship of financial assets as reported from financial analysts who actively manage portfolios. First, the historical correlation between bond and equity returns in Canada is negative. Second, the correlation

between bond returns and house price returns is much higher than the correlation between equity returns and house returns and this holds for both Metropolitan Toronto and Metropolitan Vancouver. The correlation between bond returns and house price returns ranges between 39 and 46 per cent for both market areas. The correlation between equity returns and house price returns ranges between 9 and 11 per cent for both market areas, and this suggests that house price returns are not closely related to returns for equities. However, structural changes in the macro-economy may have a similar effect on asset price changes, and for example, a lowering of interest rates tends to have a positive effect on equities and house prices. A covariance matrix was derived in Matlab using three parameters: (1) historic asset returns which is the change in price level from period to period, (2) the standard deviation of historic returns for each asset class over each period, and (3) the correlations of historic asset returns between the respective asset classes.

Table 7. Correlation and Covariance Matrices

Panel A – Financial Assets and Metropolitan Toronto Single Detached Housing

Correlation Matrix	**Bonds**	**Equities**	**Single Detached House**
Bonds	1.0		
Equities	0.109489	1.0	
Single Detached House	0.467712	0.094903	1.0

Covariance Matrix	**Bonds**	**Equities**	**Single Detached House**
Bonds	0.0015	0.0013	0.0009
Equities	0.0013	0.0888	0.0015
Single Detached House	0.0009	0.0015	0.0027

Panel B - Financial Assets and Metropolitan Toronto Apartment Condominium Housing

Correlation Matrix	**Bonds**	**Equities**	**Apartment Condominium**
Bonds	1.0		
Equities	0.109489	1.0	
Apartment Condominium	0.432218	0.105594	1.0

Covariance Matrix	**Bonds**	**Equities**	**Apartment Condominium**
Bonds	0.0015	0.0013	0.0010
Equities	0.0013	0.0888	0.0018
Single Detached House	0.0009	0.0018	0.0034

Panel C – Financial Assets and Metropolitan Vancouver Single Detached Housing

Correlation Matrix	**Bonds**	**Equities**	**Single Detached House**
Bonds	1.0		
Equities	0.109489	1.0	
Single Detached House	0.413439	0.08952	1.0

Covariance Matrix	**Bonds**	**Equities**	**Single Detached House**
Bonds	0.0015	0.0013	0.0011
Equities	0.0013	0.0888	0.0018
Single Detached House	0.0011	0.0018	0.0045

Panel D – Financial Assets and Metropolitan Vancouver Apartment Condominium Housing

Correlation Matrix	**Bonds**	**Equities**	**Apartment Condominium**
Bonds	1.0		
Equities	0.109489	1.0	
Apartment Condominium	0.39126	0.09756	1.0

Covariance Matrix	**Bonds**	**Equities**	**Apartment Condominium**
Bonds	0.0015	0.0013	0.0010
Equities	0.0013	0.0888	0.0020
Single Detached House	0.0010	0.0020	0.0045

4.3.1. The Results

This section summarizes the primary results of the analysis with the optimal portfolio weights for a household solved numerically using equation 51 under the different scenarios in Table 5 and the parameters outlined in Table 4. The household investment strategies have the property that the optimal mix of risky assets in the portfolio depend on the distribution of returns, interest rate and the household`s utility consumption at t = 0. The optimization results are reported as a percent of initial net wealth.

The analysis starts with the assumption that a representative household will consider an unlevered investment in financial assets equally desirable to a levered investment in housing. This follows the economic reasoning of Cauley, Pavlov and Schwartz (2007) which concludes that the effect of a homeownership constraint is largest at the beginning of a household`s life cycle for households with small net wealth relative to current income. Therefore, as a household accumulates net wealth in a principal residence the homeownership constraint becomes less binding and the household can change asset allocations within an investment portfolio.

The model output focuses on the preferences for households and assumes that a household has qualified through mortgage credit granting to become a homeowner. The analysis avoids portfolio selection outcomes based on positive income growth or an income shock, following Hakansson (1970) and Cocco (2004), and the model is an extension and refinement of Waggle and Johnson (2009). This allows the household to choose between housing types as the primary means to manage housing services consumption need and affordability due to initial net wealth and labour income constraints. To provide a useful context, Statistics Canada, in its 2006 Census, reports that of the 517,720 private owned dwellings in Metropolitan Vancouver area there is an equal share of single detached homes to multi-family housing and of the 1,217,170 private owned dwellings in Metropolitan Toronto there are about 60 per cent single detached homes. The representation of housing options between higher-priced single detached housing and lower-priced apartment condominiums suggests that households in these markets are diverse. Net wealth, labour income, house prices and household size are factors that likely influence the choice of housing type purchased. The higher

price of single detached homes in Metropolitan Vancouver compared to Metropolitan Toronto would not be contradictory to the finding that there is a greater proportion of apartment condominiums in Metropolitan Vancouver than Metropolitan Toronto. As a final assumption in the model, following Cauley, Pavlov and Schwartz (2007), the risk and rate of return to investments in residential real estate are independent of the price of a home. The output clearly explains the interaction among asset returns, mortgage lending constraints and net wealth. In terms of choice of housing type households with higher net wealth can more readily purchase a single detached home and this does relate to the research by Yao and Zhang (2005) which concludes that there is a correlation between the housing return and the labour-income growth rate. Households will move up in the market over time, and the first shift is the result of a household changing tenure from renting to owning, and many households first purchase an apartment condominium which more readily offers housing services at a lower priced than single detached housing.

As noted, the model allows households to consider discrete holding periods as illustrated in Table 4. This has positive implications on estimating the true transaction costs related to homeownership since transaction costs are spread out over this holding period. The mortgage loan is being amortized over a 25-year term and thus the mortgage balance is declining following a standard amortization schedule, but will not be paid off fully if the holding period is less than 25 years. Even so, home equity is being accumulated by repayment of principal as well as from any capital appreciation in house prices over time.

Households can express strategic considerations related to property maintenance and there are two options available that require different levels of cash outflow. Under the first option the household keeps the property under a state of full maintenance and upkeep. Under a second option the household defers property maintenance as noted earlier, and the ongoing property upkeep is equal to the mandatory payment of strata fees in the case of an apartment condominium, or a monthly payment for basic operational upkeep, utilities and repairs in the case of a single detached home.

Table 8 reports future expectations of the annual rate of return for house prices and imputed rent which is based on historical annual rates of return, as derived from equations 58, 59, 60 and 61 for each market area by housing type, holding period and property maintenance options.

Table 8. Expected Annual Rates of Return for Housing Based on Historic Returns

	Metropolitan Toronto		Metropolitan Vancouver	
	Single Detached	Apartment Condominium	Single Detached	Apartment Condominium
Full Maintenance				
One Year	-2.0	0.0	-1.2	-0.5
Five Years	0.6	1.2	0.3	0.8
Ten Years	0.1	1.8	1.2	1.5
Fifteen Years	0.7	2.5	2.2	2.3
Twenty Years	1.5	3.1	3.1	2.9
Twenty Five Years	2.2	3.6	3.6	3.5
Thirty Years	2.7	3.9	4.3	3.8
Thirty Five Years	3.1	4.0	4.5	4.0
Forty Years	3.3	4.1	4.8	4.1
Deferred Maintenance				
One Year	0.0	0.8	0.5	0.4
Five Years	1.2	2.2	2.2	1.9
Ten Years	1.9	2.9	3.1	2.5
Fifteen Years	2.7	3.3	4.0	3.2
Twenty Years	3.4	3.8	4.7	3.9
Twenty Five Years	3.9	4.3	5.1	4.4
Thirty Years	4.2	4.5	5.4	4.7
Thirty Five Years	4.4	4.7	5.6	4.9
Forty Years	4.6	4.9	5.8	5.1

Using Table 8 expected housing returns as an input, and drawing from other data from Tables, 5, 6 and 7, equation 51 is solved numerically in Matlab. All possible combinations of the risky assets, without including any holdings of the risk-free asset are plotted in risk-expected return space, and the collection of 1,000 possible different portfolios defines a region in this space. Figure 8 presents a series of graphs to highlight the left boundary of this region which is a hyperbola and the bottom part of the frontier is discarded because it is inefficient. When the mean variance efficient frontier does not change among the different scenarios, since the expected housing return falls below the expected return for bonds and equities, only one graphic is presented and this applies to

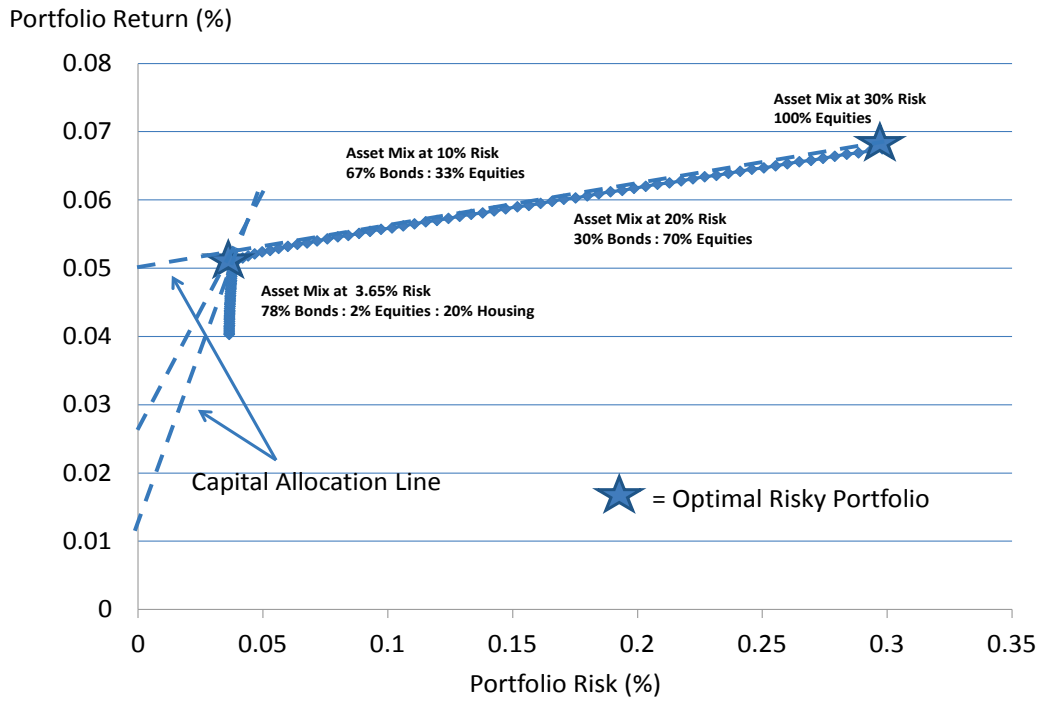
Metropolitan Toronto for both housing types. For Metropolitan Vancouver, there are five graphs presented for the relevant scenarios for single detached housing and two graphs presented for the apartment condominium.

The tangency point for the optimal portfolio selection of risky assets, given a household`s risk aversion, is determined by the separation property in that the interest rate defines the CAL. The current household risk free lending rate is about one per cent, similar to the Bank of Canada Overnight Lending Rate and one year Government of Canada bonds. When the lending rate or the one year mortgage loan borrowing rate of 2.5 per cent is used to draw the CAL the portfolio selection is defined as the global minimum variance portfolio. In Figure 8, Graph A, the mean variance efficient frontier is presented for a Metropolitan Toronto single detached house. The global minimum variance portfolio allocates 78 per cent to bonds; 2 per cent to equities and 20 per cent to housing. If the CAL is defined by the long term for the mortgage borrowing loan rate which is 5 per cent, the portfolio selection is a mix of bonds and equities along the efficient frontier and the optimal risky portfolio is 100 per cent equities. The instructive point is that housing may form part of the optimal risky portfolio even when expected returns fall short of expected returns for financial assets. This is due to the separation property, since the portfolio selection outcome is dependent on the interest rate which determines the CAL. The findings differ from research such as Yao and Zhang (2005) which highlight the important buffering role of home equity for negative shocks to stock returns but do not discuss the interest rate to plot the CAL. Given an initial house value of $500,000 and a 90 per cent LTV, the initial net wealth required to become a homeowner would be $2,500,000 under the global minimum variance portfolio. This is in stark contrast to the maximum permissible mortgage credit granting guidelines, when 100 per cent of initial wealth is allocated to housing under 90 per cent mortgage LTV, which only requires an initial wealth of $50,000, but this portfolio selection is not optimal. The minimum income requirements under maximum LTV, 5 per cent mortgage loan rate and 25 year amortization to be approved for a $450,000 mortgage loan obligation is approximately $106,000. If a 35 year amortization and 2.5 per cent mortgage loan rate is used the minimum income requirements drops to about $65,000. The instructive point is that if asset allocation is based on the global minimum variance portfolio a household is shifting asset allocation away from equities. Therefore, a high initial net wealth is

needed for homeownership, but this is not the case if the household decision is to simply maximize existing mortgage credit granting, specifically high ratio LTV ratios. Yao and Zhang (2002) conclude that the shift in obtaining housing services from rent to homeownership is more likely to occur among those households with a high net wealth, and homeownership investment risk is a consideration.

Figure 8. Mean Variance Efficient Frontier - Expected House Prices as Outlined in Table 8 With Different Scenarios as Outlined in Table 4

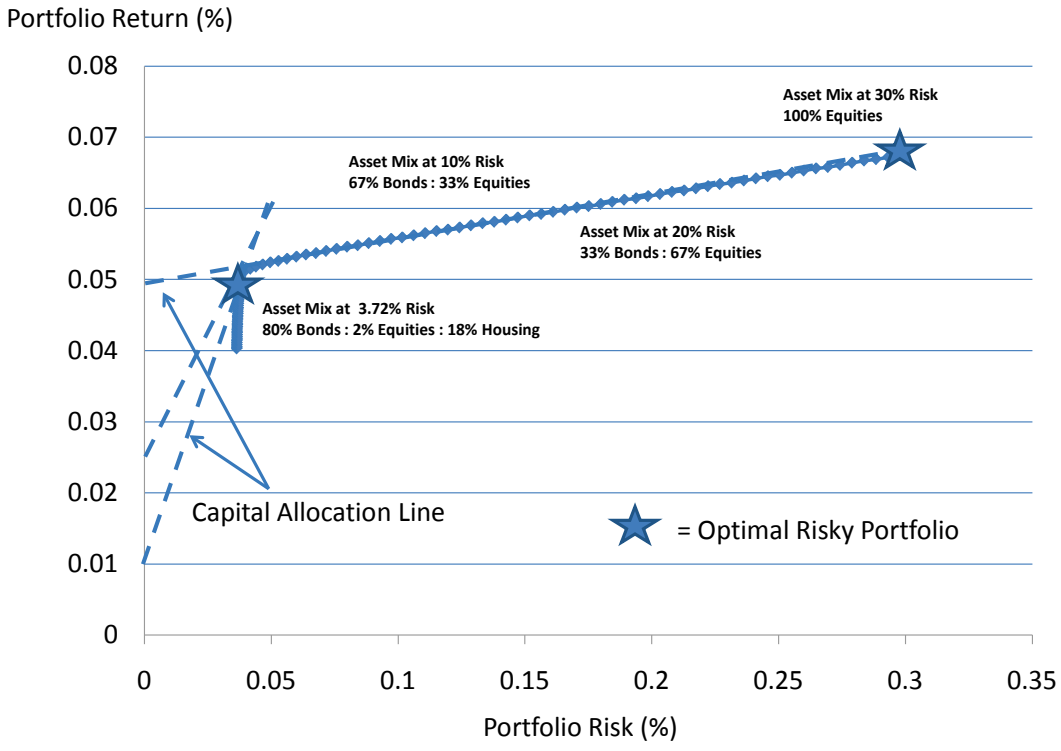
Graph A: Metropolitan Toronto Single Detached House For Scenarios 1 - 18



In Figure 8 Graph B the mean variance efficient frontier is presented for a Metropolitan Toronto apartment condominium. Housing is included as part of the asset allocation only at the global minimum variance portfolio when the CAL is drawn from a risk free lending rate of one per cent. When the CAL is based on the short term mortgage loan borrowing rate there is a 18 per cent allocation of the portfolio to housing. This portfolio selection would result in an under-representation of equities shifting the

allocation towards bonds and housing as compared to a CAL drawn from a long term mortgage loan borrow rate of 5 per cent. With the global minimum variance portfolio, and an initial house value of $300,000, a 90 per cent LTV would require a homeowner to have a net wealth of $1,670,000. Under maximum permissible mortgage credit granting a household could become an apartment condominium homeowner with only $30,000 initial net wealth, with 100 per cent asset allocation to housing. The minimum income requirements under maximum LTV, 5 per cent mortgage loan rate and 25 year amortization to be approved for a $270,000 mortgage loan obligation is approximately $64,000. If a 35 year amortization and 2.5 per cent mortgage loan rate is used the minimum income requirements drops to about $39,000. When a household allocates its entire initial wealth to housing obviously the holding of equities and bonds is zero per cent and the resulting portfolio is suboptimal and subject to homeownership investment risk.

Graph B: Metropolitan Toronto Apartment Condominium for Scenarios 1 – 18

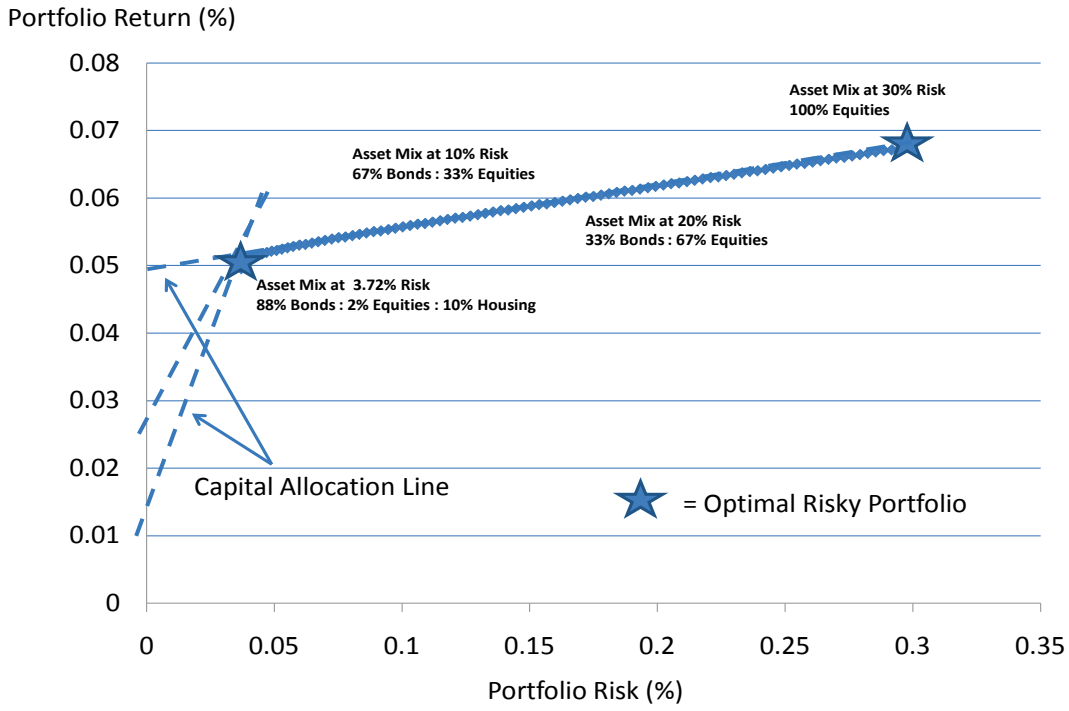


For Metropolitan Toronto, when the interest rate is tied to the risk free lending rate or the short term mortgage loan rate, the global minimum variance portfolio is determined to be the optimal risky portfolio. Under this portfolio selection housing forms part of the asset allocation, even though expected housing returns fall short of expected returns for financial assets. A household that bases a portfolio selection on holding the global minimum variance portfolio requires an initial net wealth that is much higher than that required under permissible mortgage credit granting guidelines, due to high ratio LTV ratios. Portfolio selection when a long term mortgage loan borrowing rate determines the CAL, suggests asset allocations geared to bond holdings rather than equities at low levels of risk tolerance, while higher risk tolerance favours more equities over bonds and housing is never part of the asset allocation. The optimal portfolio selection is 100 per cent asset allocation to equities when the CAL is based on the long term mortgage loan borrowing rate and the risk aversion parameter remains at 5.

For Metropolitan Vancouver, the single detached house scenarios 1 – 14 result in similar asset allocations as Metropolitan Toronto because of the interest rate which determines the CAL due to the separation property. The optimal risky portfolio becomes the global minimum variance portfolio, when the CAL is based on a risk free lending rate of 1 per cent or the 2.5 per cent mortgage loan borrowing rate, and the asset allocation is 10 per cent to housing which is less than in Metropolitan Toronto, 88 per cent to bonds and only 2 per cent to equities. Given an initial house value of $850,000 and a 90 per cent LTV the initial net wealth required to become a homeowner and hold the global minimum variance portfolio would be $8,500,000. The optimal portfolio selection when the CAL is based on the long-term mortgage loan borrowing rate is 100 per cent asset allocation to equities. Maximum permissible mortgage credit granting does allow a household to purchase a single detached home with only $85,000 net wealth, with 100 per cent asset allocation of initial wealth to housing. The minimum income requirements under maximum LTV, 5 per cent mortgage loan rate and 25 year amortization to be approved for a $765,000 mortgage loan obligation is approximately $182,000, and this decreases to about $110,000 at a one year mortgage loan rate of 2.5 per cent over a 35 year amortization. This would result in a zero per cent holding of bonds and equities, and as the mortgage principal was repaid the household could re-allocate its asset allocation.

Generally, research on homeownership investment focuses on the U.S. where households with relatively low net wealth but high income often make a 100 per cent initial wealth allocation decision in favour of homeownership. This is due to the taxation deductibility of mortgage interest and property taxes. U.S. households typically become homeowners as soon as they can meet minimum mortgage credit guidelines, since the present value of the tax benefits from mortgage loan interest deductibility are decreasing in time, which provides an incentive to become a homeowner in the U.S., often as soon as a household meets minimum credit granting rules, Cetin and Zapatero (2010). The result is that the portfolio selection is over-weighted in housing. The conclusion of research from Yao and Zhang (2002) and Himmelberg, Mayer and Sinai (2005) is that mortgage loan interest and property tax deductibility may result in households choosing homeownership over renting, and this portfolio selection crowds out a more balanced portfolio asset allocation of bonds and equities. The empirical results from a Canadian market setting without the presence of this tax policy is that housing will always form part of the global minimum variance portfolio.

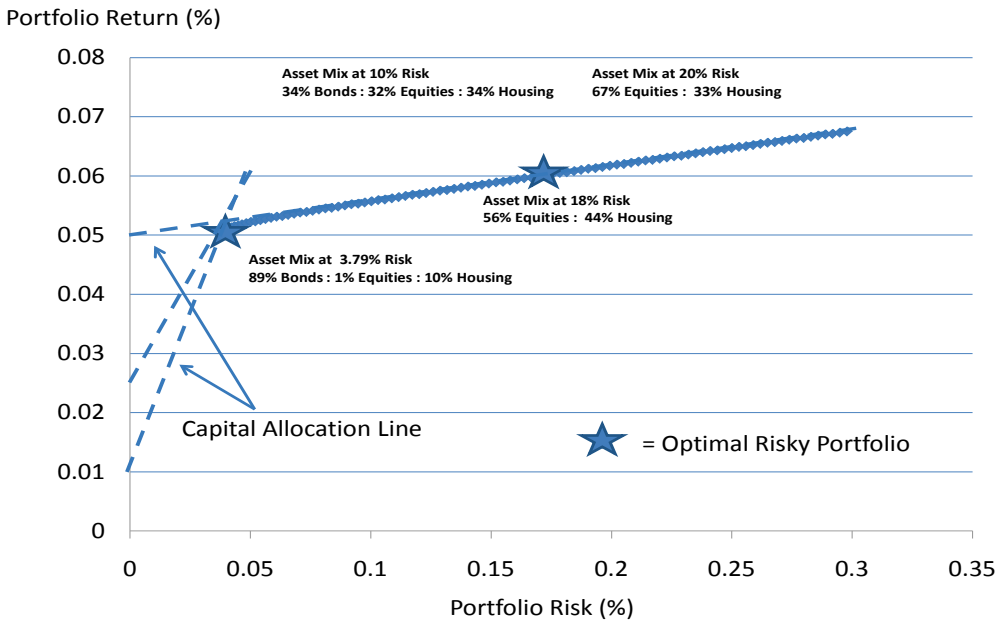
Graph C : Metropolitan Vancouver Single Detached House for Scenario 1 – 14



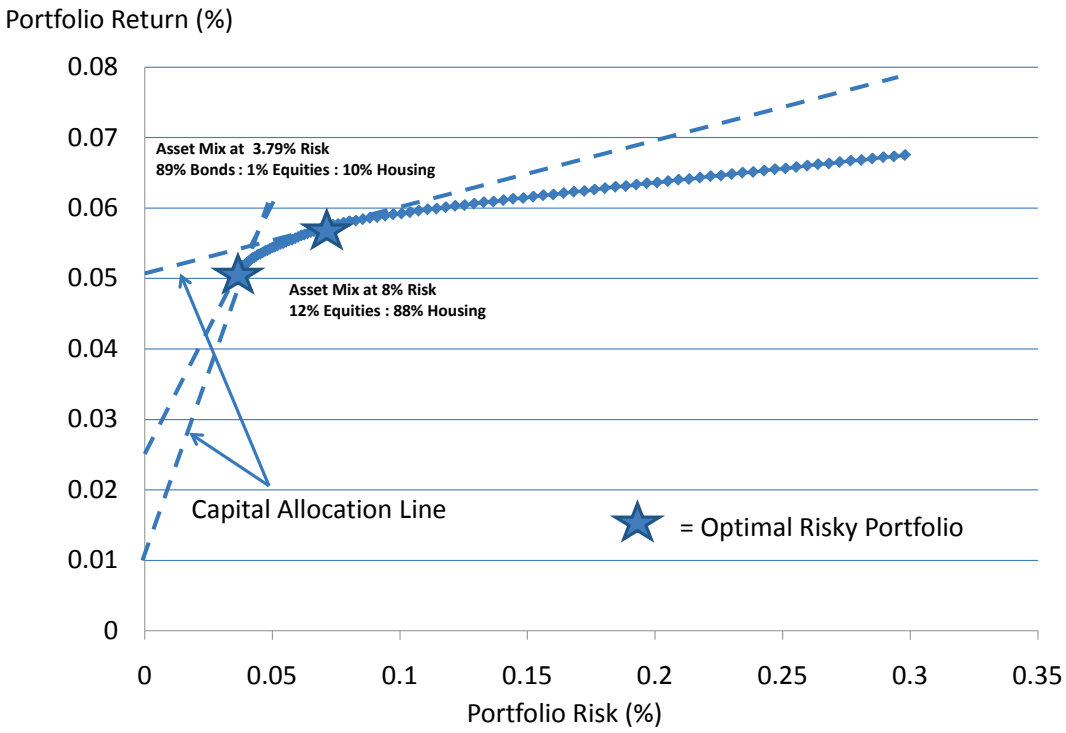
For Metropolitan Vancouver scenarios 15 – 18, where property maintenance is deferred, the optimal portfolio selection includes housing irrespective of what interest rate determines the CAL, although the asset allocations differ. What becomes relevant is the level of household initial net wealth to hold the optimal portfolio selection.

For scenario 15, as depicted in Graph D, when the CAL is based on a risk free lending rate or a short term mortgage loan borrowing rate, there is a 10 per cent allocation to housing under the global minimum variance portfolio. The initial net wealth requirement for homeownership is $8,500,000, given a single detached house price of $850,000, since the asset allocation to housing is 10 per cent and the LTV requires a 10 per cent down payment. When the CAL is based on a long term mortgage loan borrowing rate, the optimal portfolio risk is 18 per cent. The portfolio selection allocates 44 per cent to housing and given a single detached house price of $850,000 and 90 per cent LTV, the initial net wealth requirement for homeownership is approximately $1,930,200, much lower than that required under the global minimum variance portfolio. Under maximum mortgage credit granting rules a household could become an apartment condominium homeowner with only $85,000 initial net wealth, with 100 per cent asset allocation to housing.

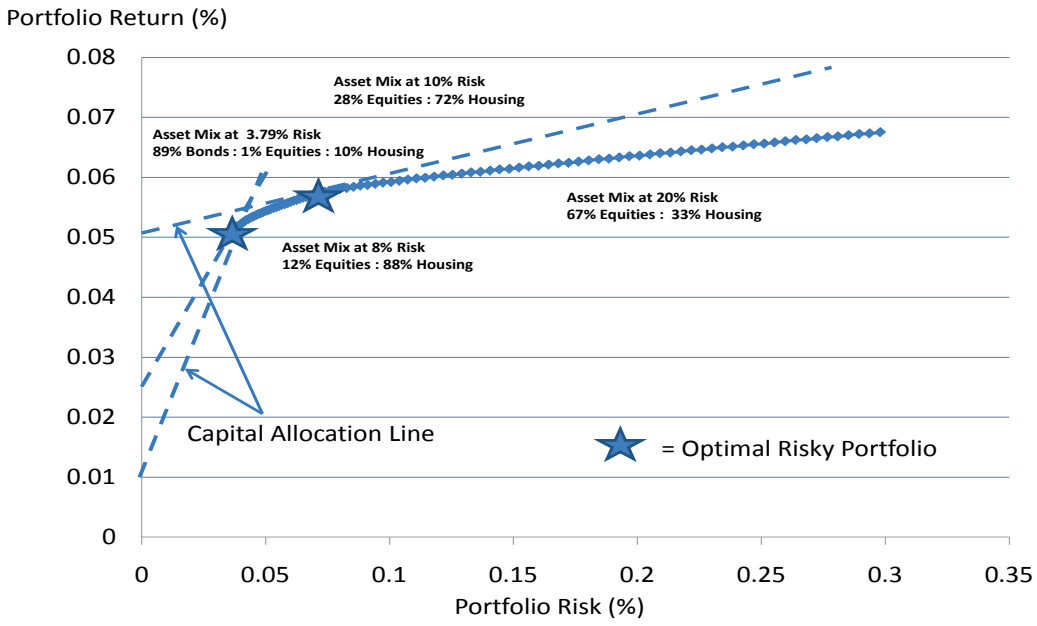
Graph D : Metropolitan Vancouver Single Detached House for Scenario 15



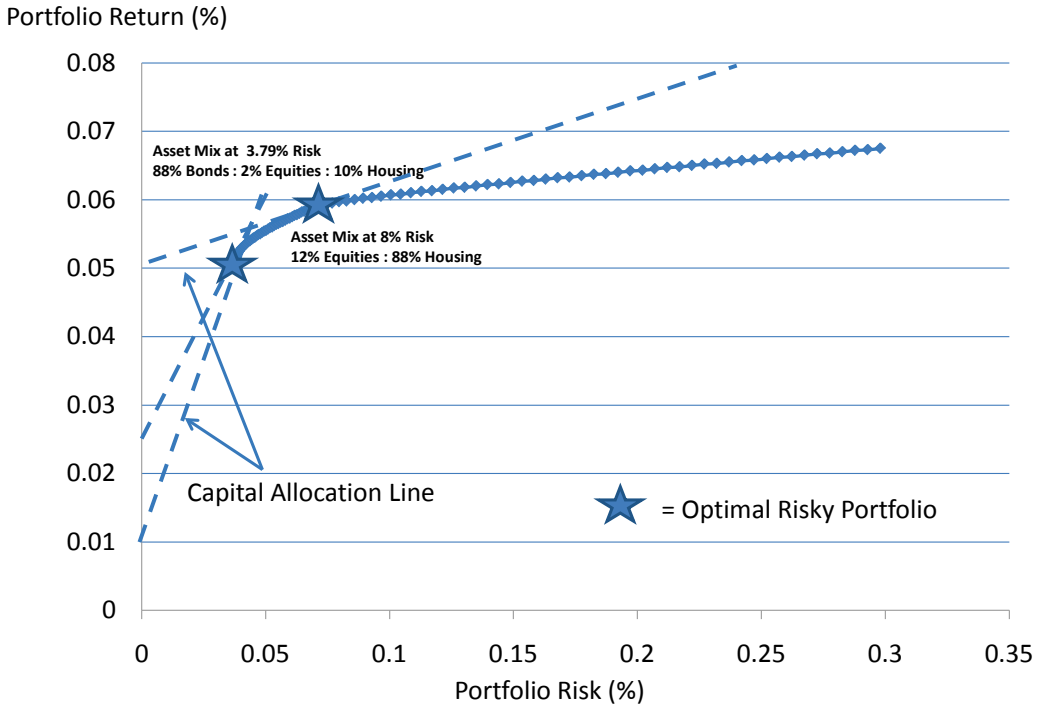
Graph E: Metropolitan Vancouver Single Detached House for Scenario 16



Graph F : Metropolitan Vancouver Single Detached House for Scenario 17



Graph G : Metropolitan Vancouver Single Detached House for Scenario 18



Under a long term mortgage loan borrowing rate the CAL allocates the remaining asset position in favour of equities at 56 per cent, which illustrates that a portfolio selection which uses a higher interest rate to determine the CAL, compared to the global minimum variance portfolio, replaces the bond holding with an asset allocation to both equities and housing. This more balanced asset allocation suggests that a single detached housing investment in Metropolitan Vancouver over a long holding period when the property maintenance is deferred almost replaces a bond investment for households with generally high levels of risk aversion which is an interesting and important result.

Scenarios 16 – 18, where the holding period is extended but where the household decides to defer property maintenance allows the expected return to housing to increase beyond that of bonds but still fall below that of a 100 per cent allocation to equities. This highlights an important shift in the optimal risky portfolio selection, as depicted in Graphs E, F and G. The results for the asset allocation for the global

minimum variance portfolio remain unchanged, the optimal risky portfolio when a long term mortgage loan borrowing rate is used to determine the CAL results in a decrease of the risk for the optimal portfolio to 8 per cent. There is a higher asset allocation to housing, at 88 per cent, and the remaining 12 per cent allocation to equities without an allocation to bonds. Given a single detached house price of $850,000 and 90 per cent LTV, the initial net wealth requirement for homeownership under the optimal portfolio selection is approximately $960,500, much lower than that required under the global minimum variance portfolio and Scenario 15. As in the previous scenarios, this finding is consistent with Cauley, Pavlov and Schwartz (2007) who conclude that homeownership crowds out asset allocation although a household`s tolerance for portfolio risk will influence housing asset allocation. These research findings do include the benefits of mortgage interest tax deductibility which is a significant parameter of the model.

It is worthwhile to mention that Flavin and Yamashita (2002) suggest that households hold quite different portfolios of financial assets because each household is optimizing their portfolio subject to a constraint on housing. This constraint relates to household net wealth and income and the binding non-negativity constraint on financial assets require a household to reach a specific level of net wealth and income as part of optimal portfolio selection. Cocco (2004) also concludes that among households with low net wealth the decision in favour of homeownership does crowd out a balanced portfolio selection that includes equities but this is a function of mortgage credit granting rules, specifically permissible LTV ratios and the household choice to maximize mortgage credit granting

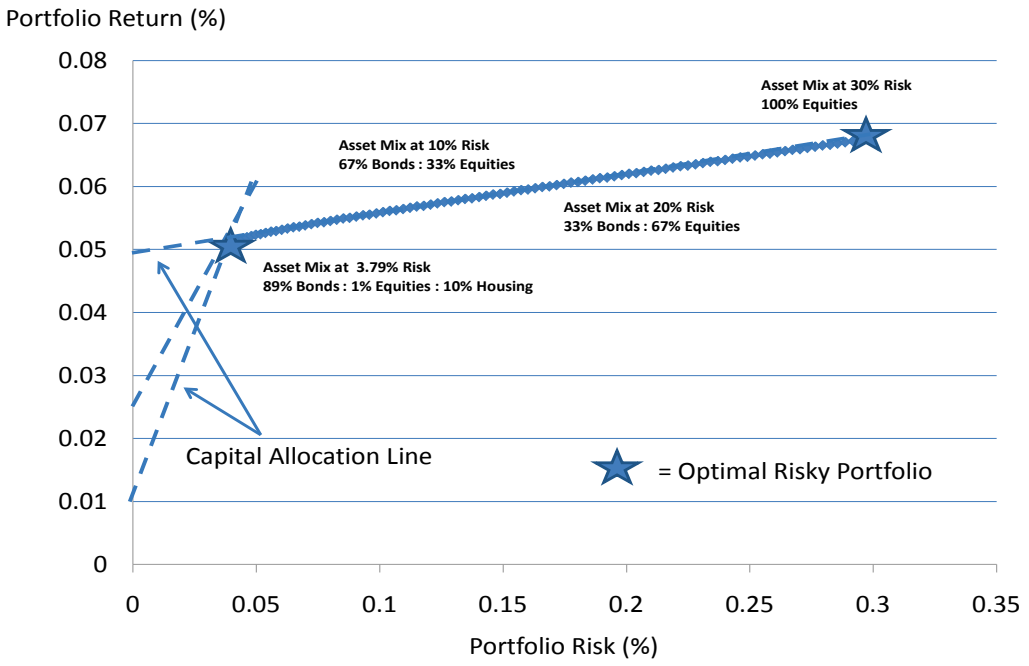
Since the price of a single detached home in Metropolitan Vancouver is 60 per cent higher than Metropolitan Toronto, homeownership in Metropolitan Vancouver will undoubtedly constrain portfolio selection due to affordability and higher initial wealth and income requirements to obtain a mortgage approval. Cauley, Pavlov and Schwartz (2007) conclude that the larger the investment in a house, relative to wealth, the greater the effect of the homeownership constraint and the more extreme the household`s initial asset allocation.

For Metropolitan Vancouver, households who select an apartment condominium the results for scenarios 1 – 17 are similar to the Metropolitan Vancouver single

detached house scenarios 1 – 14 and the results for all scenarios for Metropolitan Toronto. Housing is included as part of the asset allocation only when the interest rate is based on the risk free lending rate or the short term mortgage loan borrowing rate and the global minimum variance portfolio determines the asset allocation for housing at 10 per cent. Given an initial house value of $375,000 and a 90 per cent LTV, the initial net wealth required to become a homeowner and hold the portfolio is $3,750,000. Maximum permissible mortgage credit granting allows a household to become an apartment condominium homeowner with only $37,500 net wealth, with 100 per cent asset allocation to housing The minimum income requirements under maximum LTV, 5 per cent mortgage loan rate and 25 year amortization to be approved for a $337,500 mortgage loan obligation is approximately $80,000. The required household income would decrease to about $68,000 using a long term mortgage rate of 5 per cent over an amortization period of 35 years, and this decreases to about $48,600 when a borrower is qualified at a one year loan rate of 2.5 per cent over a 35 year amortization.

The work of Yao and Zhang (2005) is important to highlight in the case of housing in Metropolitan Vancouver since affordability is a concern among most local households. These authors conclude that the decision to purchase a home is based on obtaining housing services and not as an investment decision and therefore homeownership provides an alternative to renting housing service with an embedded hedging benefit. As housing is a heterogeneous good, there may be a difference in the level of quality of housing services provided in the purpose built rental market and the apartment condominium market. Moreover, as Sinai and Souleles (2005) conclude, the focus on the asset price risk of home owning neglects the fact that all households are born “short” housing services since they have to live somewhere. This is consistent with the research of Flavin and Yamashita (2002) who conclude that housing plays a dual role in both the consumption bundle and the asset portfolio of the household, and for this reason equilibrium returns where house price change is uncertain focuses the analysis on homeownership investment risk.

Graph H : Metropolitan Vancouver Apartment Condominium for Scenarios 1 – 17



Graph I illustrates the results for an apartment condominium in Metropolitan Vancouver over a 40 year holding period and under deferred property maintenance. This allows the expected return to housing to increase, as in scenarios 16 – 18 for Metropolitan Vancouver single detached housing, beyond that of bonds but still falls below that of equities. A number of important findings can be highlighted.

First, when the interest rate is based on the risk free lending rate or the short term mortgage loan borrowing rate the asset allocation for the global minimum variance portfolio. This is only slightly changed from previous market areas, housing types and scenarios, with an increase in the asset allocation to housing. The asset allocation is 87 per cent to bonds, 1 per cent to equities and 12 per cent to housing. This suggests a initial net wealth of $3,120,500 to hold the global minimum variance portfolio which is lower than the $3,750,000 initial net wealth requirement for scenarios 1 – 17.

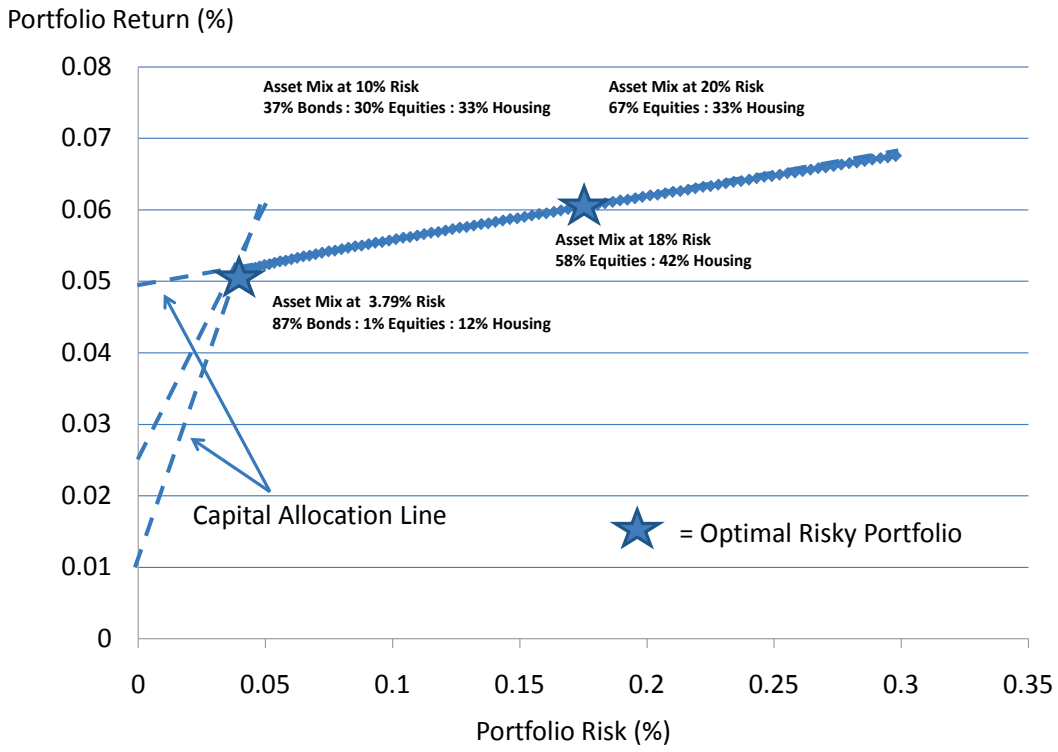
Second, when the interest rate is based on the long term mortgage loan borrowing rate the optimal asset allocation is 58 per cent to equities and 42 per cent to housing, without an allocation for bonds. The initial net wealth requirement to hold the

optimal risky portfolio is $890,285 which is much lower than the global minimum variance portfolio. However, under the maximum LTV ratio a household only needs an initial wealth of $37,500 to meet maximum permissible mortgage credit granting guidelines.

Third, under either lower or higher portfolio risk than that determined as the optimal risky portfolio, the holding of housing as an asset class remains unchanged at 33 per cent. At 10 per cent portfolio risk the remaining asset allocation is 37 per cent bonds and 30 per cent equities. At 20 per cent portfolio risk, equities assume the remaining asset allocation at a 67 per cent allocation. This finding aligns with Yao and Zhang (2005), as noted before, which highlight the important buffering role of home equity for negative shocks to stock returns.

The minimum income requirements to support the mortgage loan obligation based on the maximum LTV remains unchanged from scenarios 1 to 17.

Graph I : Metropolitan Vancouver Apartment Condominium for Scenario 18



The preceding empirical findings which evaluate asset allocation for Metropolitan Toronto and Vancouver by housing type where expected housing returns are based on historic returns. They uncover a number of instructive points, including:

1. Expected housing returns fall short of that for bonds and equities in Metropolitan Toronto under all scenarios and in Metropolitan Vancouver under most scenarios, this suggests that homeownership may be an inferior investment choice compared to financial assets.
2. When the CAL is based on a long term mortgage loan borrowing rate housing only forms part of an optimal portfolio selection in Metropolitan Vancouver when property maintenance is deferred, over long holding periods of at least 25 years for single detached housing and 40 years for an apartment condominium.
3. When the CAL is based on the risk free lending rate or short term mortgage loan borrowing rate the global minimum variance portfolio represents the optimal risky portfolio. Housing does form part of the asset allocation, ranging between 10 and 12 per cent for Metropolitan Vancouver and 18 to 20 per cent for Metropolitan Toronto depending on housing type, while equities only account for 1 or 2 per cent of the asset allocation and bonds dominate the portfolio selection.
4. Since reported homeownership rates in Metropolitan Toronto and Metropolitan Vancouver are relatively high, and given the high initial wealth requirements to hold the global minimum variance portfolio it is likely the case that households base the homeownership decision on maximum permissible mortgage credit granting rules and potential appreciation in house values and not optimal portfolio selection.
5. When portfolio selection is based on the global minimum variance portfolio this follows the research of Cocco (2005) that homeownership may result in low levels of equity participation, although as the mortgage principal is repaid or home prices appreciate a household has the option to re-calibrate its asset allocation.
6. Under high ratio LTV mortgage lending, a household can allocate all its initial net wealth to housing and provided that minimum income requirements can be met this supports homeownership. However, this decision poses households with a high degree of homeownership investment risk, especially over short holding periods.
7. The results of the portfolio selections indicate that the negative shocks to equity returns, largely a result of high levels of return volatility, can be offset equally by a portfolio selection that includes bonds or housing when examining portfolio risk ranges between 10 and 20 per cent.

4.3.2. An Equilibrium Approach

Under the equilibrium approach, homeownership and renting are not required to be substitutes, but the evolution of housing returns to homeownership and those for rental housing are in equilibrium, as noted before. To focus on homeownership investment risk the equilibrium approach allows the evolution in house prices and imputed rent to be uncertain and this is achieved when price and rent change follow a stochastic process. The historical movement in house prices are only relevant to determine the volatility of returns which provide the range of possible returns over each unit of time with the evolution in house price and imputed rent determined by a Brownian motion. Equilibrium housing returns are solved numerically derived from equations 58, 59, 60 and 61. Table 9 provides a summary of the observed equilibrium housing returns, which is the average return from 1,000 simulations for each scenario. The findings profile the impact of homeownership investment risk over short holding periods. Of course, if homeownership were infinite or if a household remained living, for example, with family or friends at no cost then homeownership would not be risky at all since there would be no risk associated with the evolution of house price and rental rate changes over time, as noted by Cocco (2004).

Sinai and Souleles (2005) found that a household which does not own housing must rent housing services on the spot rental market, and this will subject a household to rent risk, which is the uncertain annual fluctuation in rent. Homeownership therefore offers a household a guaranteed stream of housing services for a known up-front price. The rent risk is likely to dominate over long horizons increasing the demand for homeownership since a household needs life-long housing services. Finally, the rent risk increases in magnitude with the interaction of rent volatility and horizon, so the demand for owning increases faster with rent volatility for a household with a long horizon.

Table 9 . Equilibrium Housing Returns from Equations 58, 59, 60 and 61

Panel A : Metropolitan Toronto Single Detached House

	Full Maintenance	Deferred Maintenance
One Year Holding Period	-4.26	-2.38
Five Year Holding Period	-2.84	-1.15
Ten Year Holding Period	-3.19	-0.71
Fifteen Year Holding Period	-3.09	-0.52
Twenty Year Holding Period	-2.32	0.38
Twenty Five Year Holding Period	-1.01	1.25
Thirty Year Holding Period	-0.38	1.99
Thirty Five Year Holding Period	0.55	2.20
Forty Year Holding Period	1.00	2.25

Panel B : Metropolitan Toronto Apartment Condominium

	Full Maintenance	Deferred Maintenance
One Year Holding Period	-2.71	-1.87
Five Year Holding Period	-1.85	-0.82
Ten Year Holding Period	-1.21	-0.10
Fifteen Year Holding Period	-0.89	0.17
Twenty Year Holding Period	-0.10	1.20
Twenty Five Year Holding Period	0.88	1.97
Thirty Year Holding Period	1.55	1.33
Thirty Five Year Holding Period	1.97	2.76
Forty Year Holding Period	2.29	2.94

Panel C : Metropolitan Vancouver Single Detached House

	Full Maintenance	Deferred Maintenance
One Year Holding Period	-4.24	-3.42
Five Year Holding Period	-4.05	-1.55
Ten Year Holding Period	-4.23	-1.48
Fifteen Year Holding Period	-4.53	-1.21
Twenty Year Holding Period	-3.56	-0.25
Twenty Five Year Holding Period	-2.39	0.69
Thirty Year Holding Period	-1.26	1.58
Thirty Five Year Holding Period	-0.50	1.75
Forty Year Holding Period	-0.10	2.40

Panel D : Metropolitan Vancouver Apartment Condominium

	Full Maintenance	Deferred Maintenance
One Year Holding Period	-5.83	-3.98
Five Year Holding Period	-1.49	-0.01
Ten Year Holding Period	-1.32	0.68
Fifteen Year Holding Period	-1.03	0.97
Twenty Year Holding Period	-0.02	1.63
Twenty Five Year Holding Period	0.99	2.40
Thirty Year Holding Period	1.05	2.73
Thirty Five Year Holding Period	2.07	3.15
Forty Year Holding Period	2.30	3.34

The key insight gained from analyzing the distribution of returns from the equilibrium housing approach for Metropolitan Toronto and Metropolitan Vancouver by different housing type and over different holding periods, subject to different household considerations related to property maintenance, confirms that an investment in housing demands long holding periods to move from a negative return to a positive one. This finding supports the research of Sinai and Souleles (2005) and highlights the economic value of long holding periods and strategic management of property maintenance to minimize the probability of negative returns associated with homeownership investment. Therefore, without explicitly examining the rental housing market or the benefits of renting compared to homeownership, there is strong evidence to suggest that when a household requires consumption of housing services over the short or medium term the rental housing market should be regarded as the primary source of housing supply.

For Metropolitan Toronto, both the single detached house and the apartment condominium can realize a positive return under both full and deferred property maintenance but only after holding the property for at least 25 years. If property maintenance is deferred the optimal holding period is reduced substantially to about 15 or 20 years. This result complements the earlier findings of portfolio selection when future expectations of returns are based on historic returns. Homeownership in Metropolitan Toronto offers a household both housing services and a positive investment return thus offering economic value in terms of hedging uncertain changes in housing costs and this occurs over long holding periods.

For Metropolitan Vancouver the results also complement the findings of the preceding section. A single detached house under full property maintenance is unlikely to achieve a positive economic return and has a high probability of economic loss over all holding periods. An apartment condominium can achieve a positive economic return under full property maintenance when the holding period is at least 25 years and this is reduced to 10 years when property maintenance is deferred. Overall, due to the high cost of a single detached house, deferred property maintenance is a likely consequence for a household that is constrained by income or net wealth to pay for full property maintenance. Moreover, in high house price neighbourhoods an apartment condominium reduces the potential for an economic loss and will also realize higher returns than a single detached house.

To further emphasize the findings above, the results of the equilibrium approach were graphed to highlight the probability distribution of a loss from a homeownership investment in respective housing markets under different scenarios as presented in Table 4. Figure 9 illustrates the output as a series of graphs.

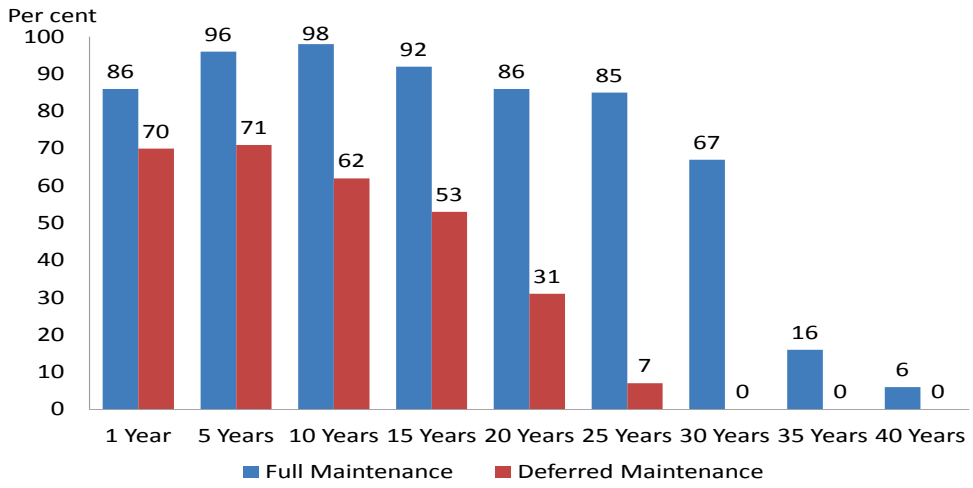
For Metropolitan Toronto, a single detached house under full property maintenance has a 85 per cent or greater probability of a loss with a holding period of 25 years or shorter. Under deferred property maintenance the probability of a loss is no more than 7 per cent at holding periods of 25 years or longer. For an apartment condominium the probability of a loss is lower than for single detached housing, and is close to zero for holding periods of 25 years or more under either full or deferred property maintenance. If property maintenance is deferred the probability of a loss is 50 per cent or lower for holding periods of 10 years or more.

For Metropolitan Vancouver, a single detached house under full property maintenance has a probability of loss no more than 82 per cent when the holding period is 25 years or less, and a loss of at least 94 per cent for holding periods between 5 and 20 years. Under deferred property maintenance the probability of a loss is less than 5 per cent for holding periods of 30 years or longer. For an apartment condominium the probability of a loss is 10 per cent or less for holding periods of at least 20 years under deferred property maintenance. If full property maintenance is carried out the probability of a loss increases to over 80 per cent for holding periods of 10 years or shorter.

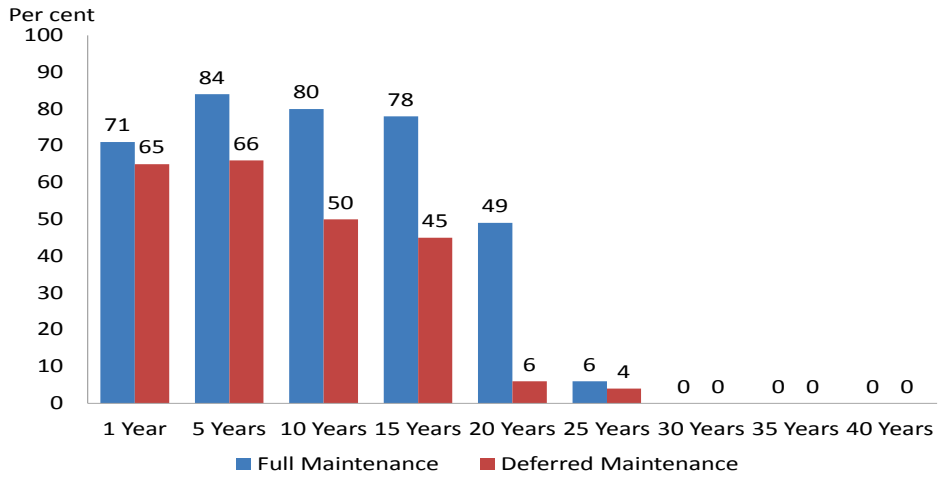
Figure 9. Probability of a Loss from a Homeownership Investment Based on Equilibrium House Price Returns from Table 9

The Equilibrium Approach Where Annual Home Price Appreciation and Annual Change in Imputed Rent Follow the Same Stochastic Process Over Time Based on Returns for Each Market in Table 2 and Volatility of Returns for Each Asset in Table 3.

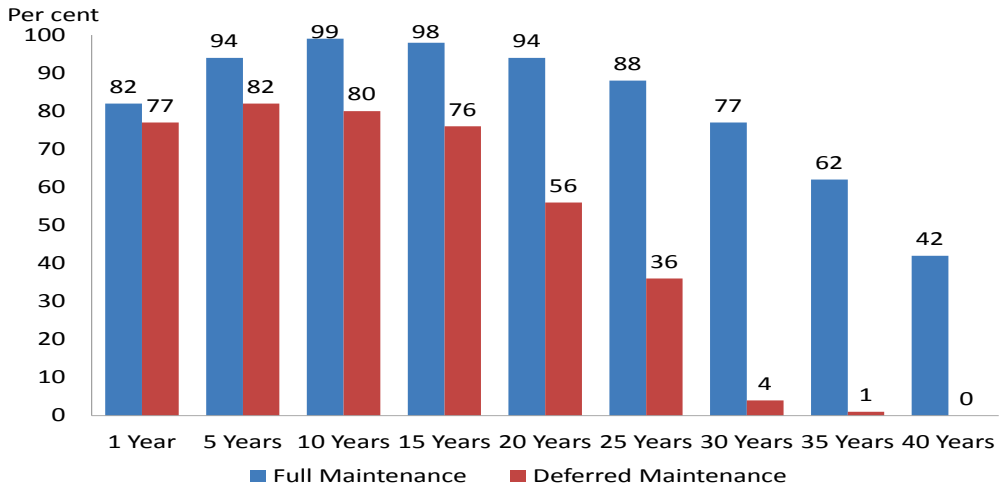
Graph A : Metropolitan Toronto Single Detached House



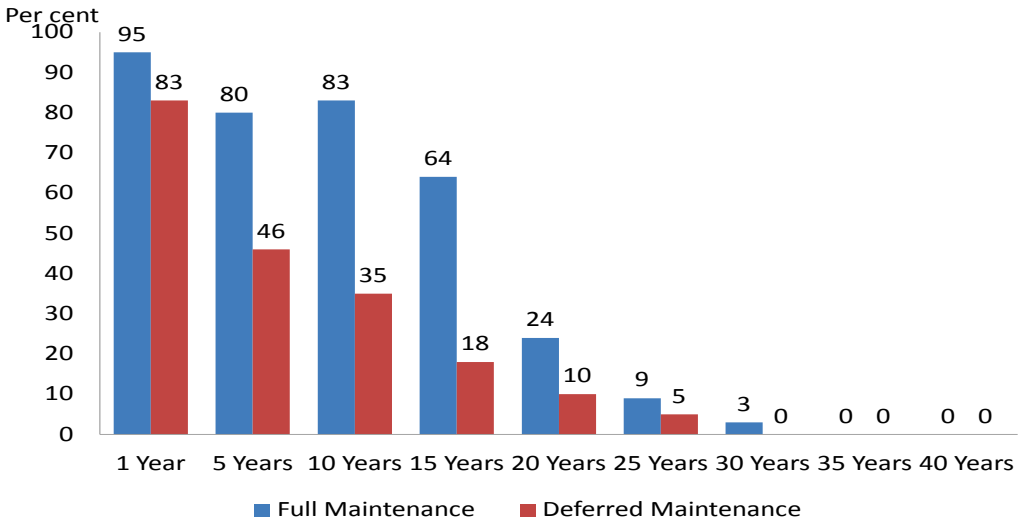
Graph B : Metropolitan Toronto Apartment Condominium



Graph C : Metropolitan Vancouver Single Detached House



Graph D : Metropolitan Vancouver Apartment Condominium



The equilibrium approach offers findings in support of Yao and Zhang (2002) who conclude that always renting is suboptimal for those households that have a long term desire to live within a specific community as households fail to realize on the consumption benefits associated with homeownership over renting. Moreover, since the economic return increases with time and the probability of loss decreases with time, a household with a long term housing horizon should become a homeowner sooner rather than later in life.

4.3.3. Implied Annual Housing Returns: Housing as an Optimal Asset Allocation

This section considers the implied annual housing returns a household is expecting to achieve so that housing is an asset in an optimal portfolio selection above the global minimum variance portfolio. For the purposes of analysis, the interest rate to determine the CAL will be based on a long-term mortgage loan borrowing rate of 5 per cent. It will be assumed that the expected returns from equities and bonds as presented in Table 5 are valid and will provide guidance on the general market outlook, given that the holding periods for housing can extend up to forty years. This analysis of implied views assumes that the asset returns for bonds and equities can remain fixed and exogenous. It could equally be possible that the expected housing returns in Table 9 hold and investors express different expectations on the returns for equities and bonds and this may be logical given the performance of financial markets following the 2007 financial crisis. However, in keeping with the housing focus, Table 10 summarizes the implied annual housing returns for housing to be included as an asset with a 33 per cent allocation. The optimal portfolio selection is above the global minimum variance portfolio and the CAL is determined by the 5 year mortgage loan borrowing rate, by numerically solving equation 51.

Table 10. Implied Annual Rates of Return When Housing is an Asset in an Optimal Portfolio Selection Above that Defined as the Global Minimum Variance Portfolio

	Metropolitan Toronto		Metropolitan Vancouver	
	Single Detached	Apartment Condominium	Single Detached	Apartment Condominium
Full Maintenance				
One Year	12.0	10.8	12.9	10.9
Five Years	10.1	9.2	10.5	9.0
Ten Years	9.2	8.5	9.4	8.4
Fifteen Years	8.4	7.8	8.4	7.7
Twenty Years	7.8	7.3	7.8	7.2
Twenty Five Years	7.3	6.9	7.3	6.8
Thirty Years	7.0	6.7	7.0	6.5
Thirty Five Years	6.8	6.5	6.8	6.4
Forty Years	6.6	6.3	6.6	6.3
Deferred Maintenance				
One Year	10.4	9.8	11.1	9.9
Five Years	8.6	8.4	9.0	7.9
Ten Years	7.8	7.6	8.0	7.5
Fifteen Years	7.0	7.0	7.2	6.9
Twenty Years	6.5	6.6	6.6	6.4
Twenty Five Years	6.2	6.3	6.2	6.1
Thirty Years	5.9	6.0	5.9	5.8
Thirty Five Years	5.8	5.9	5.7	5.6
Forty Years	5.6	5.8	5.6	5.4

Figure 9 clearly shows that the implied annual housing always exceed that of bonds, and this holds also for equities except at long holding periods, even though deferred maintenance is important to the results. At first glance the high level of implied returns to housing suggests a large risk to homeownership over short holding periods or unrealistic expectations of housing returns. Some households may also express short term expectations that housing price appreciation will exceed that of financial assets. This may be possible where constraints in land development and housing supply, combined with higher than anticipated levels of household demand for housing, leads to short-term dis-equilibrium and put upward pressure on house prices, but housing assets likely exhibit mean reversion to historic averages similar to financial assets. So the implied housing returns must be considered more closely.

The results in Table 10 suggest that if an investor of speculator purposefully enters the Metropolitan Toronto or Metropolitan Vancouver housing market for a short

holding period the implied returns are high over short holding periods and higher for a single detached house than an apartment condominium and obviously higher under full property maintenance. The implied return declines over the holding period with an apartment condominium under deferred property maintenance recording the lowest implied housing return. But this begs the question as to why investors and speculators buy housing over short term holding periods? Policy makers identify the negative consequence of this activity as fuelling house price appreciation, making housing less affordable for local residents. For example, the Mayor of the City of Vancouver in his December 5, 2011 inaugural speech proposed a blue-ribbon panel to investigate affordable housing in the City with one idea being profit-taking measures on housing speculators. Similar concerns have been raised with speculation in Metropolitan Toronto where the estimate is that 40 per cent of new housing is bought by investors hoping to realize high, short term returns from housing investments. Canadian Business explored this in the September 13, 2010 issue. Given that there are relatively high implied returns to housing compared to expected housing returns (Table 8) and equilibrium housing returns (Table 9), this suggests that housing is an asset that investors can gain unique value from through enhancements and usage by direct ownership control that does not exist for financial assets.

There are a number of possible reasons to hold housing as a short term investment. First, to realize on a high short term return properties can be upgraded through high return renovation activity or a full tear down and re-build. Investors may have experience in construction, and therefore are in the market seeking specific properties to purchase, likely those properties in need of significant repair and renovation. The Appraisal Institute of Canada has developed RENOVA, an interactive web-based guide designed to give consumers and real estate professionals an estimate of the return on investment for a variety of home improvements. Table 11 lists the top home renovation items by return on investment, and a combination of these renovations, given the high level of deferred property maintenance on any specific property, could offer the returns necessary to support the implied returns from a short holding period and these apply to Metropolitan Toronto and Metropolitan Vancouver.

Table 11. Returns on Investment from Various Renovation Activities

Renovation Type	Expected Return on Investment
Add New Bathroom	80 – 100 %
Bathroom Renovation	75 – 100 %
Kitchen Renovation	75 – 100 %
Replace Door Handles, Hardware and Fixtures	75 – 100%
New Interior Painting	50 – 100 %
New or Add Light Fixtures	60 – 70 %
New Flooring	50 – 75 %
New House Entryway	50 – 75 %
New or Add Fence and Patio Deck	50 – 75%
Upgrade and Replace Landscaping	25 – 50%

Source: Appraisal Institute of Canada *Renova,* 2011 http://www.aicanada.ca

Second, a homeowner owns 100 per cent of the housing unit, and this differs from owning a fractional interest in a financial asset. While housing renovations offer positive returns on investment, a homeowner can also gain utility from a housing unit when part of the home can be used for economic gain. This can be achieved by establishing, for example, a home office or even storing the household`s means of production or even renting out an accessory rental suite. Finance theory supports a premium for a shareholder to gain "control" over a corporation through acquisition of a majority shareholder position and this may not be dissimilar from homeownership where the household must, in the open market, outbid other multiple control seekers for a housing unit. The share price premium for corporate control after the announcement can be as high as 40 per cent before the takeover, Jensen and Ruback (1983) and Kraizberg and Teall (2009).

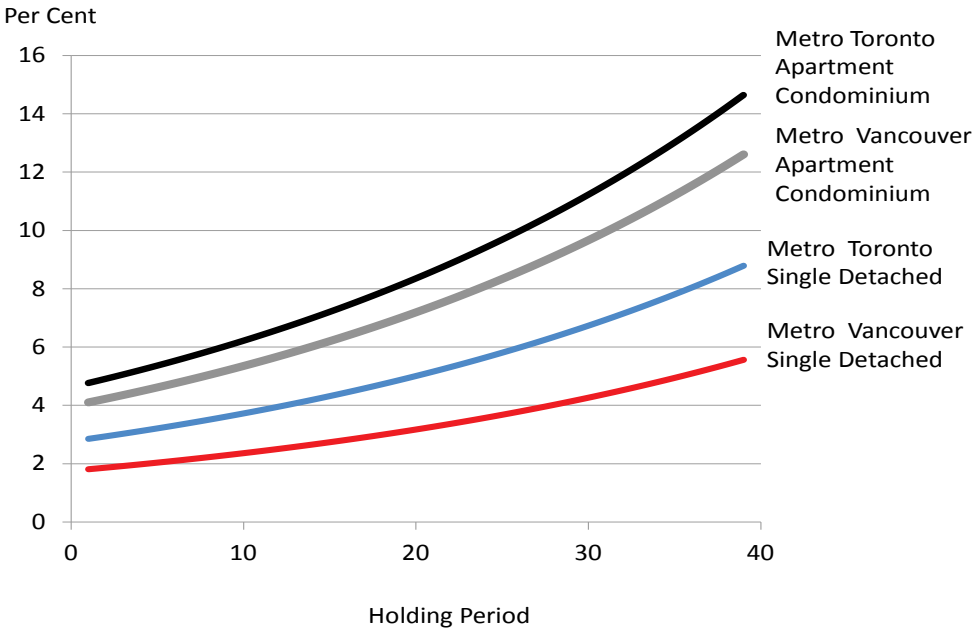
Third, what Table 10 does not highlight is the consistent upward movement in rental rates over time, and the research of Sinai and Souleles (2005) suggests that homeownership represents a hedge against the cost of renting. The risk is essentially stabilized at the decision to shift from renting to owning housing, since a household no longer obtains housing services in the spot rental market. The imputed rent yield begins at t = 0, when homeownership commences, and reflects rental rate increases. The computation of imputed rent yield assumes that the initial property value remains fixed and that rental rate levels rise steadily over time. Figure 10 illustrates the imputed rent yield by housing market and property type over time. At 40 years, the imputed rent yield

gained through homeownership makes the return to housing significant exceeding that of financial assets in all cases except for Metropolitan Vancouver single detached housing. Moreover, in the case of deferred property maintenance the imputed rent yield offsets the cost of property maintenance and property taxes providing a positive net cash flow to the homeowner.

Figure 10. Imputed Rent Yield Based on Initial Property Value

Over Different Holding Periods by Market Area and Housing Type

$P_0 H_{i,t} / CR_{H,t}$



Note. The calculation takes the initial property value from Table 5 in the numerator and divides this by the annual imputed rent which begins at the stated base level and increases over the respective holding period at the annual imputed rent growth rate from Table 5.

The imputed rent yield is a very simple financial metric that a household can measure to gauge the economic value of homeownership by housing type. It is particularly relevant if the household decides not to sell but remain in the house "infinitely" or until a significant life event. It raises an important investment reality for households that retire as homeowners, and offers a growing annuity equal to the cost of an alternative, but comparable rental housing unit. Using homeownership as a strategic household finance tool to hedge the inflation of renting housing services is a valid

consideration for households no longer earning labour income and whose income source is not indexed to inflation. Through homeownership the cost of housing services is fully hedged and all that remains are effective means to manage property maintenance and pay for property taxes. For households no longer earning labour income and not holding an indexed pension, selling a principal residence may be deleterious to financial well-being as the household enters retirement years, and this is in contrast to the findings of Yao and Zhang (2005).

The empirical results support the household decision in favour of homeownership, particularly when the choice is for a long term hold of an apartment condominium as a way to obtain housing services and to hedge uncertain house price changes. This suggests that if a household, particularly one and two person households, can gain adequate housing services from an apartment condominium, and not over-consume housing services by owning a single detached home, the imputed rent yield will exceed returns from financial assets and imputed rent yields will increase over time at a rate equal to the rise in rental rates. For Metropolitan Vancouver and Toronto, the imputed rent yield increases with time and apartment condominiums offer a higher yield than single detached housing due to the lower initial house price and the basis of calculating imputed rent which uses a two bedroom apartment. In Metropolitan Toronto the imputed rent yield for an apartment condominium exceeds 14 per cent by year 40, while in Metropolitan Vancouver the yield exceeds 12 per cent. These findings are consistent with Sinai and Souleles (2005) who conclude that unlike standard financial assets, a homeownership interest in housing pays out an annual dividend equal to the ex post spot rent, and so provides a hedge against rent risk. The imputed rent yield benefit also is evident for single detached housing in Metropolitan Vancouver and Toronto, although more muted. However, a household that owns a single detached home has the option to gain efficiencies through ownership of a property that may be too large for personal consumption requirements. This can be done by renting out an accessory rental unit such as a basement suite, or using part of the property for a home office or to store items related to the household`s means of production such as equipment and supplies.

Chapter 5.

Concluding Comments: Today Homeownership is an Investment Decision for Canadians

During each of the four regimes in Canadian housing finance the institutional framework for housing development and mortgage lending evolved at varying levels but generally in ways to support homeownership. For example, while MLI came into effect in Canada in 1954 for new housing, it was not until the late 1960s that resale homes and multi-family apartment and townhouse units were eligible for NHA MLI. By the 2000s, multi-family condominium developments became the dominant housing form in Canada`s main urban markets, offering affordable, smaller housing options (in contrast to the standard single-detached subdivisions) for a wide range of households. Various incentives such as the Canadian Home Buyer Plan have been expanded and continue to allow households to access wealth in a tax sheltered RRSP for home purchase downpayment, confirming that the government and financial services sector recognize the importance of homeownership in a principal residence.

The retail platform for mortgage loans has also changed with the increasing presence of dedicated mortgage lending specialists and mortgage brokers. Through sophisticated direct marketing, mortgage lenders and brokers widely promote the benefits of homeownership in a principal residence as an investment decision and home equity as a household finance tool. But if homeownership is to be considered as part of a critical asset allocation consistent with portfolio theory, it is the integration of housing finance with the capital market that is integral to the current market based system. Two securities, the principal residence and the mortgage loan, can be managed by a household to smooth inter-temporal household consumption if adequate home equity is available.

The expansion of mortgage securitization which began in 1987 with NHA MBS gained international respect among investors with the CMB program in 2001. This stabilized and lowered mortgage lending costs while providing the funding source that allows many financial institutions to meet minimum capital reserve requirements. The CMB program, secured by NHA MLI, sets the foundation for a market based mortgage system addressing many of the risks that constrained mortgage funding historically. The system was fully tested during the 2007 to 2011 financial credit crisis. During this time, in contrast to commercial lending, households with prime credit ratings that could adhere to NHA mortgage credit granting rules, obtained mortgage funding at low mortgage loan rates, and with the most flexible mortgage terms in Canadian housing finance history.

This research focuses on the role of the domestic mortgage lending system in support of households that have the option to become homeowners. The research proposes two indices based on a comprehensive set of features and indicators present in the domestic nation. The first index considers the degree to which a domestic mortgage market is liberal and a second index considers the degree to which a domestic mortgage market is flexible. The liberal index relates to the domestic homeownership rate, while the flexible index relates to the domestic level of mortgage debt per capita. When the indices are combined on a matrix they serve to plot the relative position of a domestic mortgage market system to confirm whether it is dynamically complete, supporting homeownership as an investment.

The indices proposed in this research are applied to a cross-country comparison, and represent a refinement and extension to the “synthetic index of mortgage market development” and “index of government participation in housing finance markets”, both set forth by the IMF (2008, 2011) as well as other research. The conclusion is that the mortgage markets of the U.S., U.K., Canada, Denmark, Ireland, Netherlands and Australia are sufficiently liberal and flexible so that a representative household can evaluate homeownership as an investment decision. The findings support the analysis of an investment in homeownership as an optimal portfolio selection in the presence of bonds and equities. This occurs when a household can choose among different housing types over different holding periods and expresses strategic considerations related to property maintenance.

Household preferences in favour of homeownership are complex and ultimately the rent versus buy decision is shaped by the need to obtain housing services over time as well as the investment qualities of different housing types over various holding periods and strategic considerations related to property maintenance. The mortgage lending system is also relevant. This includes the available mortgage loan borrowing rates, as well.

The empirical results highlight a number of instructive points. First, the mortgage loan borrowing rate and the available household lending rate shape household asset allocation when a stylized Markowitz optimal portfolio selection model includes equities, bonds and housing among the asset mix. If the CAL is defined by the long term mortgage borrowing loan rate, housing only forms part of an optimal portfolio in Metropolitan Vancouver for a single detached house under deferred maintenance at a holding period of 25 years or more and an apartment condominium under deferred maintenance at a holding period of 40 years. In Metropolitan Toronto housing is never part of the optimal portfolio selection. This would suggest that households would tend to avoid homeownership, yet homeownership rates are high in both markets. An important insight is that due to the separation property, when the CAL is defined by the risk free rate to represent the available lending rate of one per cent, or a short term year mortgage loan borrowing rate of 2.5 per cent, then the global minimum variance portfolio is the optimal portfolio selection. While largely dominated by a holding of bonds and a modest holding of equities the global minimum variance portfolio includes housing for both market areas even though the expected returns to housing is inferior to the returns from financial assets. However, initial net wealth requirements for housing within this portfolio selection are substantial than that required under maximum permissible mortgage lending credit granting if a household allocates all of its initial net wealth to qualify for a mortgage loan and assumes the maximum LTV ratio. As such, the homeownership decision for most households is based on mortgage credit granting rules and not optimal portfolio selection and homeowners bear unique investment risk.

Second, the equilibrium approach highlights the potential homeownership investment risks and verifies that when house prices and imputed rent evolve together in a random fashion there is a high probability of economic loss in both Metropolitan Toronto and Metropolitan Vancouver. In Metropolitan Toronto a single detached house

under full property maintenance has a probability of loss of at least 82 per cent when the holding period is 25 years or shorter. Under deferred property maintenance there is a zero per cent probability of an economic loss at 30 years or longer. In Metropolitan Vancouver a single detached house under full property maintenance has a probability of loss greater than 82 per cent when the holding period is 25 years or shorter. Under deferred property maintenance there is a 4 per cent probability of an economic loss at 30 years or longer. In both market areas, for an apartment condominium, the probability of a loss is 10 per cent for holding periods of 25 years or more under either full or deferred maintenance. If property maintenance is deferred the probability of a loss is no greater than 50 per cent for holding periods of 10 years or more. Therefore, without explicitly examining the rental housing market or the benefits of renting compared to homeownership, there is strong evidence to suggest that when a household requires consumption of housing services over the short or medium term the rental housing market should be regarded as the primary source of housing supply.

Third, the implied annual rate of returns for housing to represent the dominant asset allocation in an optimal portfolio selection always exceeds that of bonds and equities, except at long holding periods even though deferred property maintenance is important to the results. The instructive point is that the high level of implied returns to housing suggests a risk to holding housing over short holding periods unless the expectation of households is that housing price appreciation will exceed that of financial assets. In this regard, the findings also suggest that implied housing returns, especially if the market has consistent demand among short term investors, may fuel house price appreciation in some markets. There are possible reasons why implied housing returns are high. First, to realize on a high short term return, there is an immediate intention for the new property owner to upgrade the property through high return renovation activity or a full tear down and re-build. Second, in keeping with finance theory on corporate control, utility from homeownership is increased when a homeowner can use part of the home for economic gain by establishing, for example, a home office, renting out an accessory suite or even storing the household`s means of production. Third, homeownership represents a hedge against the cost of renting. Rental risk is essentially stabilized at the decision to shift from renting to owning, since a household no longer obtains housing services in the spot rental market. The empirical results support the

household decision in favour of homeownership, particularly when the choice is for a long term decision in favour of homeownership as a way to obtain housing services and to hedge random house price changes. This suggests that if a household does not over-consume housing services, the imputed rent yield will not only exceed returns from financial assets but also increase over time at a rate equal to the rise in rental rates, and as a secondary benefit a homeowner will gain from capital appreciation of housing.

In summary, households do not likely make the choice to become homeowners as part of an optimal portfolio selection due to initial wealth requirements. There is evidence to suggest that permissible mortgage credit granting rules impact the homeownership decision, and over a long-term horizon homeownership allows rent risk to be hedged and offers gains from imputed rent yield. The high implied return from holding housing over the short term suggests that there are positive economic gains to be made from specific renovation activities. Not only are there economic risks to over-consuming housing services as a homeowner, but when a household requires housing services over the short term the rental housing market should be regarded as the primary source of housing supply. For policy makers, future research may investigate the use of tax credits to support property maintenance so that households can live in adequate housing over the long term, rather than mortgage loan interest deductibility (similar to the U.S.) which may simply encourage households to carry a large mortgage loan obligation. The tax deductibility is in effect a public subsidy to minimize personal taxation. Other future research may focus on the impact of homeownership and high house prices on household participation in equity markets.

References

Abraham, A. and N. Pavoni, 2008. Efficient Allocations with Moral Hazard and Hidden Borrowing and Lending: A Recursive Formulation. Review of Economic Dynamics, 11(4), 781-803.

Allen, F. 2001. Presidential Address: Do Financial Institutions Matter? The Journal of Finance, 56, 1165-1176.

Allen, F. and D. Gale. 1998. Optimal Financial Crises. Journal of Finance, 53, 1245-1283.

Allen, F. and D. Gale. 1999. Innovations in Financial Services, Relationships, and Risk Sharing. Management Science, 45, 1239-1253.

Allen, J. and R. Clarke and F-F. Houde. 2011. Discounting in Mortgage Markets. Bank of Canada. Working Paper, 2011-3.

Allen, J. 2011. Competition in the Canadian Mortgage Market. Bank of Canada Review. Winter, 2010-2011, 1-9.

Ambrose, B. W. and A. Pennington-Cross, 2000. Local Economic Risk Factors and the Primary and Secondary Mortgage Markets. Regional Science & Urban Economics, 30:6, 683-702.

Arguea, N. M. and C. Hsiao, 2000. Market Values of Environmental Amenities: A Latent Variable Approach. Journal of Housing Economics, 9:1-2, 104-126.

Arrow, K. J. and G. Debreu. 1954. Existence of an Equilibrium for a Competitive Economy. Econometrica, 22, 265–290.

Arrow, K. J. 1968. Economic Equilibrium. in International Encyclopaedia of the Social Sciences edited by D. L. Sills. London and New York: Macmillan and the Free Press, 376–388.

Avery, R. B., P. E. Beeson, and M. S. Sniderman, 1999. Neighborhood Information and Home Mortgage Lending. Journal of Urban Economics, 45:2, 287-310.

Benston, G. J. 1997. Discrimination in Financial Services: What Do We Not Know? Journal of Financial Services Research, 11, 209-213.

Black, F., and R. Litterman 1991. Asset Allocation: Combining Investor Views With Market Equilibrium. The Journal of Fixed Income, 1:2, 7-18.

Blazenko, G and A. Pavlov. 2005. The Neighbourhood Effect of Real Estate. The Journal of Real Estate Finance and Economics, 30:4, 327–340.

Buckland, J. and X.Y. Dong. 2008. Banking on the Margin in Canada, Economic Development Quarterly 22:3, 252-263.

CAAMP: Canadian Association of Accredited Mortgage Professionals, 2011. Annual State of the Residential Mortgage Market in Canada.

Calza, A., T. Monacelli, and L. Stracca. 2007. Mortgage Markets, Collateral Constraints, and Monetary Policy: Do Institutional Factors Matter?. CEPR Discussion Paper No. 6231, London: Centre for Economic Policy Research.

Campbell, J. 2006. Household Finance. Journal of Finance. 61:4, 1153- 1604.

Campbell, J. R. and Z. Hercowitz, 2006. Welfare Implications of the Transition to High Household Debt. Federal Reserve Bank of Chicago, Working Paper Series: WP-06-27.

Campbell, J. and J. F. Cocco. 2005. How Do House Prices Affect Consumption? Evidence from Micro Data. Journal of Monetary Economics, 54:3, 591-621.

Canada Mortgage and Housing Corporation, 2010. Canadian Housing Observer, Canada Mortgage and Housing Corporation.

Case K. E. and R. J. Shiller. 1987. Prices of Single Family Homes since 1970: New Indexes for Four Cities. New England Economic Review, September/October, 45-56.

Cauley, S. D., A. D. Pavlov and E. S. Schwartz. 2007. Homeownership as a Constraint on Asset Allocation. Journal of Real Estate Finance and Economics, 34:3, 283-311.

Cetin, C. and F. Zapatero. 2010. Optimal Acquisition of a Partially Hedgeable House. Marshall School of Business Working Paper No. FBE 25-09.

Chambers, M., C. Garriga, and D. Schlagenhauf, 2008. Mortgage Innovation, Mortgage Choice, and Housing Decisions. Federal Reserve Bank of St. Louis Review, 90(6), 585-608.

Chiuri, M.C. and T. Jappelli. 2003. Financial Market Imperfections and Home Owner Ship: A Comparative Study. European Economic Review. 47:5, 857-876.

Cocco, J. F. 2004. Portfolio Choice in the Presence of Housing. The Review of Financial Studies, 18:2, 535-567.

Courchane, M., B. Surette, and P. Zorn. 2004. Subprime Borrowers: Mortgage Transitions and Outcomes. Journal of Real Estate Finance and Economics, 29:4, 365-392

Davis, M. A., A. Lehnert, and R. F. Martin, 2008. The Rent-Price Ratio for the Aggregate Stock of Owner-Occupied Housing. Review of Income and Wealth, 54:2, 279-284.

Debreu, G. 1959. Theory of Value. Cowles Foundation Monograph 17. New Haven: Yale University Press.

Diamond, D. 2004. Overview of Housing Finance Systems. Wharton School Working Paper, June.

Diamond, D. B. and M. J. Lea. 1992. Housing Finance in Developed Countries: An International Comparison of Efficiency. Journal of Housing Research, 3:1, 1-271.

Dixit, A. K. and R. S. Pindyck. 1994. Investment Under Uncertainty. Princeton University Press.

Dubel, H. J. 2004. European Mortgage Markets: Efficiency and Completeness. Presentation to American Enterprise Institute, March.

Duffie, D. and C. F. Huang. 1985. Implementing Arrow-Debreu Equilibria By Continuous Trading of Few Long-Lived Securities. Econometrica. 53:6. 1337-1356.

Ferguson, N. 2008. The Ascent of Money: A Financial History of the World. Penguin Books. New York, New York.

Fernandez.-Villaverde, J. and D. Krueger, 2005. Consumption and Savings over the Life-Cycle: How Important Are Consumer Durables? Working Paper, University of Pennsylvania. www.econ.upenn.edu/~dkrueger/research/durables12192005sec.pdf.

Flavin, M. and T. Yamashita. 2002. Owner-occupied Housing and the Composition of the Household Portfolio Over the Life Cycle. American Economic Review, 92:1, 345-362.

Flood, M. 1991. An Introduction to Complete Markets. Federal Reserve Bank of St. Louis, March/April, 32-57.

Freedman, C. 1998. The Canadian Banking System. Bank of Canada. Technical Report No. 81. March.

Gabriel, S., and S. Rosenthal. 2005, Homeownership in the 1980s and 1990s: Aggregate Trends and Racial Gaps. Journal of Urban Economics, 57:1, 101–127.

Gau, G. W. and M. A. Goldberg. 1983. Interest Rate Risk, Residential Mortgages and Financial Futures Markets. AREUEA Journal, 11:4, 445-461.

Geanakoplos, J. 2010. Solving the Present Crisis and Managing the Leverage Cycle. Federal Reserve Bank of New York Economic Policy Review, August, 101-131.

Gervais, M., 2002. Housing Taxation and Capital Accumulation. Journal of Monetary Economics, 49:7, 1461-1489.

Girouard, N., and S. Blöndal. 2001. House Prices and Economic Activity. OECD Economics Department Working Paper No. 279, Paris: Organization for Economic Cooperation and Development.

Goetzmann, W. N. 1993. The Single Family Home in the Investment Portfolio. Journal of Real Estate Finance & Economics. 6:3, 201-222.

Goldberg, M. A. 1985. American Real Estate and Urban Economics: A Canadian Perspective. AREUEA Journal. 13:1.

Green, R., 2008. Imperfect Information and the Housing Finance Crisis: A Descriptive Overview. Journal of Housing Economics, 17:4, 262-271.

Green, R, and S. Wachter. 2005. The American Mortgage Market in Historical and International Context. Journal of Economic Perspectives, 19:4, 93-114.

Green, R, A. B. Sanders, and S. Wachter, 2008. Special Issue on Subprime Mortgage Lending. Journal of Housing Economics, 17:4, 253.

Grossman, S. J. and G. Laroque. 1990. Asset Pricing and Optimal Portfolio Choice in the Presence of Illiquid Durbale Consumption Goods. Econometrica, 58, 25-51.

Gyourko, J., C. Mayer, and T. Sinai. 2004. Superstar Cities. Columbia Business School and Wharton School. Working Paper.

Hakansson, N. 1970. Investment and Consumption Strategies Under Risk for a Class of Utility Functions. Econometrica, 38:5, 587-607.

Harris, R. and D. Ragonetti. 1998. Where Credit is Due: Residential Mortgage Finance in Canada, 1901 to 1954. Journal of Real Estate Finance and Economics, 16:2, 223-238.

Harrison, J. and D. Kreps. 1979. Martingales and Arbitrage in Multiperiod Securities Markets. Journal of Economic Theory, 20:3, 381-408.

Harrison, D. M., T. G. Noordewier, and A. Yavas, 2004. Do Riskier Borrowers Borrow More? Real Estate Economics, 32:3, 385-411.

Haughwout, A., C. Mayer, and J. Tracy, 2009. Subprime Mortgage Pricing: The Impact of Race, Ethnicity, and Gender on the Cost of Borrowing. Brookings-Wharton Papers on Urban Affairs, 10, 33-56.

Herring, R. and S. Wachter. 1999. Real Estate Booms and Banking Busts - An International Perspective. Washington, DC: Group of Thirty.

Himmelberg, C., C. Mayer, and T. Sinai, 2005. Assessing High House Prices: Bubbles, Fundamentals and Misperceptions. Journal of Economic Perspectives, 19:4, 67-92.

Hornstein, A., 2009. Problems for a Fundamental Theory of House Prices. Economic Quarterly - Federal Reserve Bank of Richmond, 95:1.

Huang, C. and R. Litzenberger. 1988 Foundations for Financial Economics. North-Holland.

Iacoviello, M., 2005. House Prices, Borrowing Constraints, and Monetary Policy in the Business Cycle, 95:3, 739-764.

International Monetary Fund. 2011. Housing Finance and Financial Stability – Back to Basics? in Global Financial Stability Report, Chapter 3, April, 111 - 153.

International Monetary Fund. 2008. The Changing Housing Cycle and the Implications for Monetary Policy in World Economic Outlook, Chapter 3, April, 1 - 30.

Jameson, R. 2002. U.S. Savings & Loans crisis. ERisk.com Case Study, August, 1-6.

Jensen, M. C. and R. S. Ruback. 1983. The Market for Corporate Control : The Scientific Evidence. Journal of Finance. 11:1-4, 5-50.

King, C. 2012a. Toward a Market Based Mortgage Lending System With Secure Funding Sources: The Evolution of Housing Finance in Canada From 1900 to 2010. Simon Fraser University. Working Paper.

King, C. 2012b. Financial innovation and the Features and Indicators of a Dynamically Complete Mortgage Market to Support Homeownership as an Investment. Simon Fraser University. Working Paper.

Kiyotaki, N. and J. Moore. 1997. Credit Cycles. Journal of Political Economy, 105:2, 211–248.

KPMG LLP. 2008. Canada Mortgage Bonds Program Evaluation. Prepared for Canada Mortgage and Housing Corporation, June.

Kraizberg, E. and J. L. Teall. 2009. The Distribution and Valuation of Corporate Control. The Open Business Journal, 2, 28-42.

Lancaster, K. J., 1966. A New Approach to Consumer Theory. Journal of Political Economy, April, 132-156.

Lea, M. 2003. The Fixed-Rate Model. Mortgage Banking. April, 52–67.

Li, W., H. Liu and R. Yao, 2009. Housing Over Time and Over the Life Cycle: A Structural Estimation. FRB of Philadelphia Working Paper No. 09-7.

Linneman, P. and S. Wachter, 1989. The Impacts of Borrowing Constraints on Homeownership. Real Estate Economics, 17:4, 389-402.

Lucas, R. E. 1978. Asset Prices in an Exchange Economy. Econometrica, 46:6, 1429-1445.

McDonald, D. J. and D. L. Thornton. 2008. A Primer on the Mortgage Market and Mortgage Finance. Federal Reserve Bank of St. Louis. January/February.

Markowitz, H. M. 1952. Portfolio Selection. The Journal of Finance 7:1, 77–91.

Mayer, C., and K. Pence, 2007. Subprime Mortgages: What, Where, and To Whom. Working Paper 14083, Cambridge, Mass.: National Bureau of Economic Research.

Merton, R. 1971. Optimum Consumption and Portfolio Rules in a Continuous-time Model. Journal of Economic Theory, 3:4, 373-413.

Mian, A. R., and A. Sufi, 2008. The Consequences of Mortgage Expansion: Evidence from the U.S. Mortgage Default Crisis. University of Chicago School of Business. Manuscript. Available at SSRN (http://ssrn.com/abstract= 1072304).

Miao, J. and N. Wang. 2007. Investment, Consumption and Asset Pricing. Journal of Financial Economics. 86, 608-642.

Mercer, O. W. 2003. Study on the Financial Integration of European Mortgage Markets. Brussels: European Mortgage Federation.

Merton, R. 1974. On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. Journal of Finance, 29:2, 449-470.

Mian, A. R., and A. Sufi. 2008. The Consequences of Mortgage Expansion: Evidence from the U.S. Mortgage Default Crisis. University of Chicago School of Business. Manuscript. Available at SSRN (http://ssrn.com/abstract= 1072304).

Miron, J. P. 1988. Housing in Postwar Canada: Demographic Change, Household Formation and Housing Demand. McGill-Queen's Press.

Nicholson, W., 2005. Microeconomic Theory: Basic Principles and Extensions. Thomson South-Western.

Ortalo-Magné, F., and S. Rady, 2005. Housing Market Dynamics: On the Contribution of Income Shocks and Credit Constraints. Review of Economic Studies, 73, 459-485.

Paterson, R. 1991. Housing Finance in Early Twentieth Century Suburban Toronto. Urban History Review, 20, 63-71.

Pavlov, A. and S. Wachter, 2009a. Systemic Risk and Market Institutions. Yale Journal on Regulation, 26:2, 445-455.

Pavlov, A. and S. Wachter, 2009b. Subprime Lending and House Price Volatility. Working Paper.

Pavlov, A. and S. Wachter. 2006. The Inevitability of Market-Wide Underpricing of Mortgage Default Risk. Real Estate Economics, 34:4, 479-496.

Pavlov, A. and S. Wachter, 2005. The Anatomy of Non-recourse Lending. Working Paper.

Pavlov, A. and S. Wachter. 2004. Robbing the Bank: Non-recourse Lending and Asset Prices. Journal of Real Estate Finance and Economics, 28:2-3, 147-160.

Pendleton, L. H. and S. J. Shonkwiler, 2001. Valuing Bundled Attributes: A Latent Characteristics Approach. Land Economics, 77:1, 118-129.

Piazzesi, M., M. Schneider, and S. Tuzel, 2007. Housing, consumption and asset pricing. Journal of Financial Economics, Elsevier, vol. 83:3, 531-569.

Poapst, J. V. 1993. Financing of Post-war Housing in House, Home and Community: Progress in Housing Canadians 1945 – 1986. McGill-Queen`s University Press, and Canada Mortgage and Housing Corporation, 94-109.

Powell, M and G. Morgenson. 2011. MERS? It May Have Swallowed Your Loan. New York Times, March 6. BU 1 and 6.

Radner, R. 1972. Existence of Equilibrium of Plans, Prices and Price Expectations in a Sequence of Markets. Econometrica, 40:2, 289-303.

Reichenstein, W. 1998. Calculating a Family's Asset Mix. Financial Services Review, 7:3, 195–206.

Renaud, B. 2004. Mortgage Finance in Emerging Markets. Presentation at 13th Annual AREUEA Conference, Fredericton, New Brunswick, July.

Rosenthal, S. 1999. Residential Building and the Cost of Construction: New Evidence on the Efficiency of the Housing Market. Review of Economics & Statistics. 81:2, 288-302.

Rosen, S., 1974. Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. Journal of Political Economy, 82:1, 34-56.

Samuelson, P. 1969. Lifetime Portfolio Selection By Dynamic Stochastic Programming. Review of Economics & Statistics, 51:3, 239-247.

Sharpe, W. 1974. Imputing Expected Returns From Portfolio Composition. Journal of Financial and Quantitative Analysis, June, 463-472.

Sherlund, S. 2008. The Past, Present and Future of Subprime Mortgages. Finance and Economics Discussion Series 2008-63. Washington: Federal Reserve Board, Divisions of Research & Statistics and Monetary Affairs.

Shiller, R. J. 2008. The Subprime Solution: How Today`s Global Financial Crisis Happened, and What to Do About It. Princeton University Press.

Simpson, W. and J. Buckland, 2009. Examining Evidence of Financial and Credit Exclusion in Canada from 1999 to 2005. Journal of Socio-Economics, 38:6, 966-976.

Sinai, T., and N. S. Souleles. 2005. Owner-Occupied Housing as a Hedge Against Rent Risk. The Quarterly Journal of Economics, 120:2, 763-789.

Steele, M. 1993. Income, Prices and Tenure Choice in House, Home and Community: Progress in Housing Canadians, 1945 – 1986 edited by John R. Miron. McGill-Queen`s University Press, Montreal and Kingston.

Stein, J. 1995. Prices and Trading Volume in the Housing Market: A Model with Down Payment Effects. Quarterly Journal of Economics, 110, May, 379–406.

Stiglitz, J. E. and A. Weiss, 1981. Credit Rationing in Markets with Imperfect Information. American Economic Review, 71, 393-410.

Tal, B., 2006. Household Credit Analysis. CIBC World Markets. July 5.

Timiraos, N. 2010. Fannie, Freddie Elicit Grim Forecast. The Wall Street Journal, October 22, p. A.3.

Tracelet, V. 2006. Structure of the Canadian Housing Market and Finance System. Bank of Canada, Department of Monetary and Financial Analysis.

Waggle, D. and D. T. Johnson. 2009. Homeownership and Mixed Asset Portfolio Allocations. Quarterly Review of Economics & Finance, 49:2, 484-500.

Yao, R. and H. H. Zhang. 2005. Optimal Consumption and Portfolio Choices With Risky Housing and Borrowing Constraint. Review of Financial Studies, 18:1, 197-239.

Appendix A.

Timeline of Some Key Events in Canadian Housing Finance

1900 – 1935

- Mortgage credit constraints often resulted in homeownership being achieved by way of cash purchases, sweat equity, vendor mortgages, and equitable mortgages provided by non-institutional lenders through private, nonregistered contracts.
- Residential mortgages typically offered by financial institutions such as Life Insurance Companies and Trust and Mortgage Loan institutions.
- 1918 federal mortgage loan plan introduced with a set 5% mortgage loan interest rate.
- Desjardins in Québec established to serve retail and commercial lending needs in Québec.
- Direct government lending and set interest rates.

1934

- U.S. Federal Housing Administration introduces mortgage loan insurance.

1935

- Dominion Housing Act allowed financial institutions to participate in a joint system with the federal government to offer amortized residential mortgage loans to qualifying households.

1938 – 1944

- Creation of National Housing Act (NHA) in Canada. Revised in 1944 setting NHA mortgage loan rates at 4.5% permitting up to 30 year amortizations.

1946

- Central (later Canada) Mortgage Housing Corporation established.
- Mortgage borrowers offered loan-to-value ratios of 93.33% of the property value.
- Joint loans between government and banks.

1954

- Mortgage loan insurance introduced in Canada for mortgage borrowers without a 33.33% down payment.
- Insured mortgage loans and interest rate ceilings outlined by legislation.

1966

- BC and Alberta introduce strata title condominium legislation allowing for homeownership in parts of multi-family buildings, and then introduced in Ontario in 1970.

1967

- Canada's Bank Act amended to allow banks to fully participate in mortgage lending and abolishing interest rate ceiling.
- Caisse de dépôt placement du Québec established.
- Market interest rates took over from interest rate ceilings.

1971

- AHOP provides subsidy to low-income households to become homeowners

1980

- Bank Act Amendment to allow international banks to establish Canadian subsidiaries.

1987

- NHA MBS introduced.

1992

- Canada`s Home Buyer Plan and First Home Loan Insurance Program offered 95% LTVs.

2001

- CMB Program introduced.

2007

- Covered Bonds first used in Canada following the financial credit crisis.

2008 to 2013

- Canada's Department of Finance prescribes limits on mortgage credit granting rules for NHA Insured Mortgage Loan Insurance Products.

1998, 2004 and 2013

- Basel I (1988) and II (2004) and III (2013) Accords set capital reserve requirements.

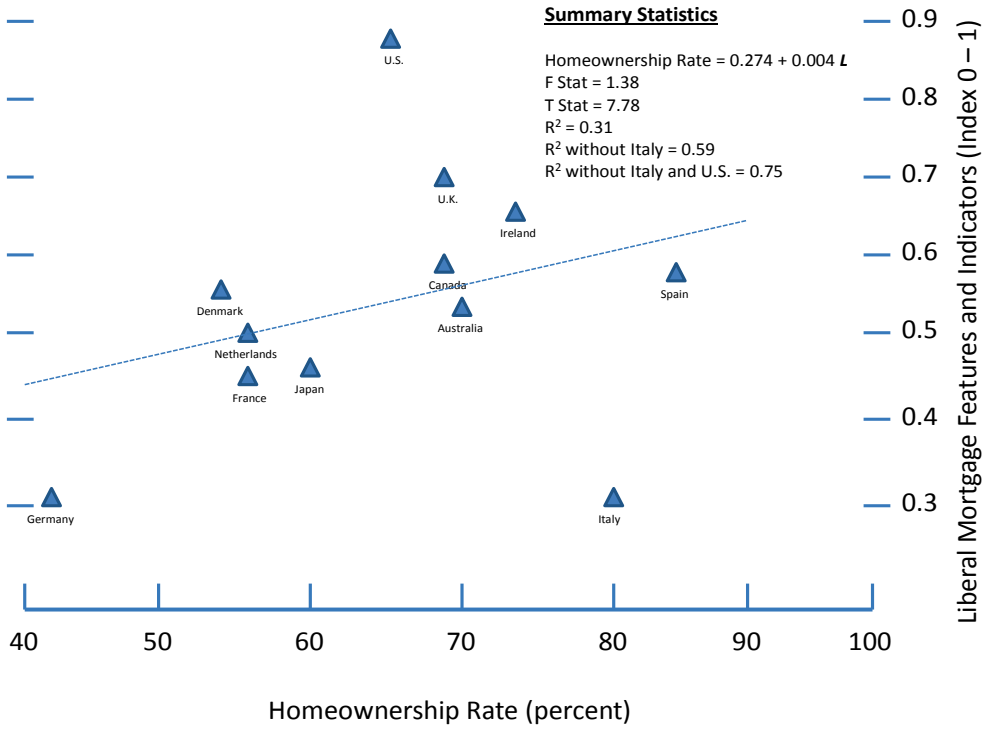
Appendix B.

Statistical Analysis of the Index of Mortgage Market Development

Figure B1 summarizes the applications of the use of the indices of mortgage market development. It identifies the expected household behaviour related to both a liberal and a flexible mortgage market. This includes the relationship of a liberal mortgage market with homeownership and the relationship of a flexible mortgage market with household mortgage debt levels.

Figure B1:
Statistical Analysis of the Index of Mortgage Market Development

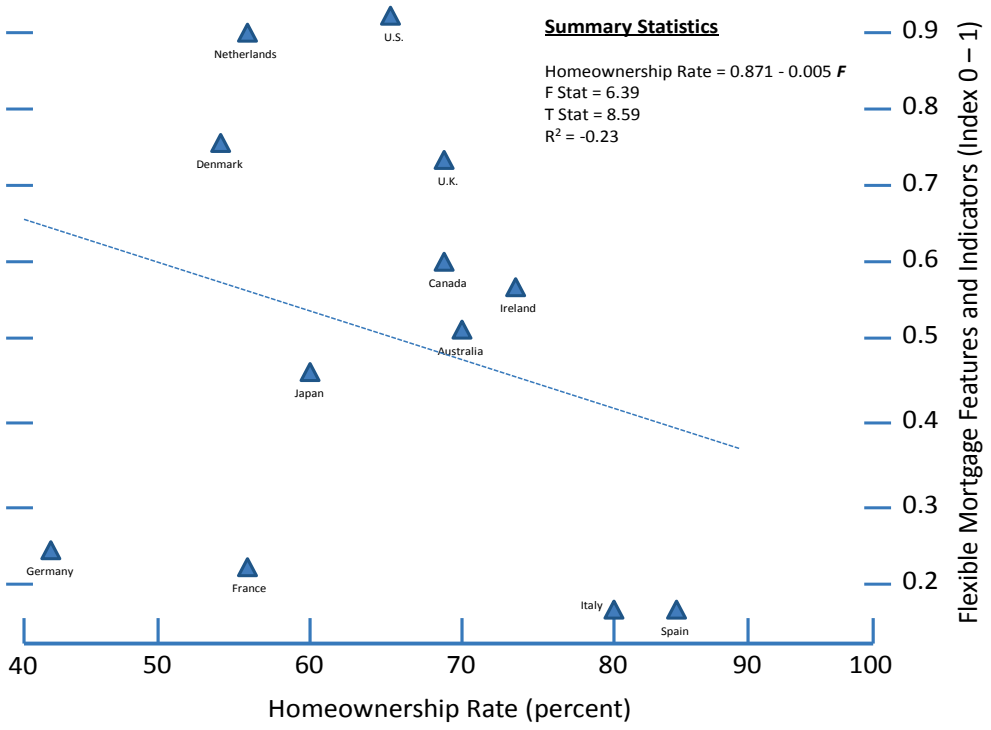
Panel A : Index of Liberal Mortgage Features and Indicators and Homeownership Rate



Sources: most recent available data based on report publication date from European Mortgage Federation; Australian Bureau of Statistics; Japan, Ministry of Internal Affairs and Communications, Statistics Bureau; Statistics Canada; U.S. Census Bureau; and Internal Monetary Fund.

Sources for the data include the European Mortgage Federation for the European nations; Bond Market Association and Federal Reserve for the U.S.; Bank of Australia and the Australian Bureau of Statistics; Bank of Japan and the Japan Ministry of Internal Affairs and Communications; Statistics Canada and Canada Mortgage and Housing Corporation; and the Organization for Economic Co-operation and Development and International Monetary Fund to obtain other data and for general data verification.

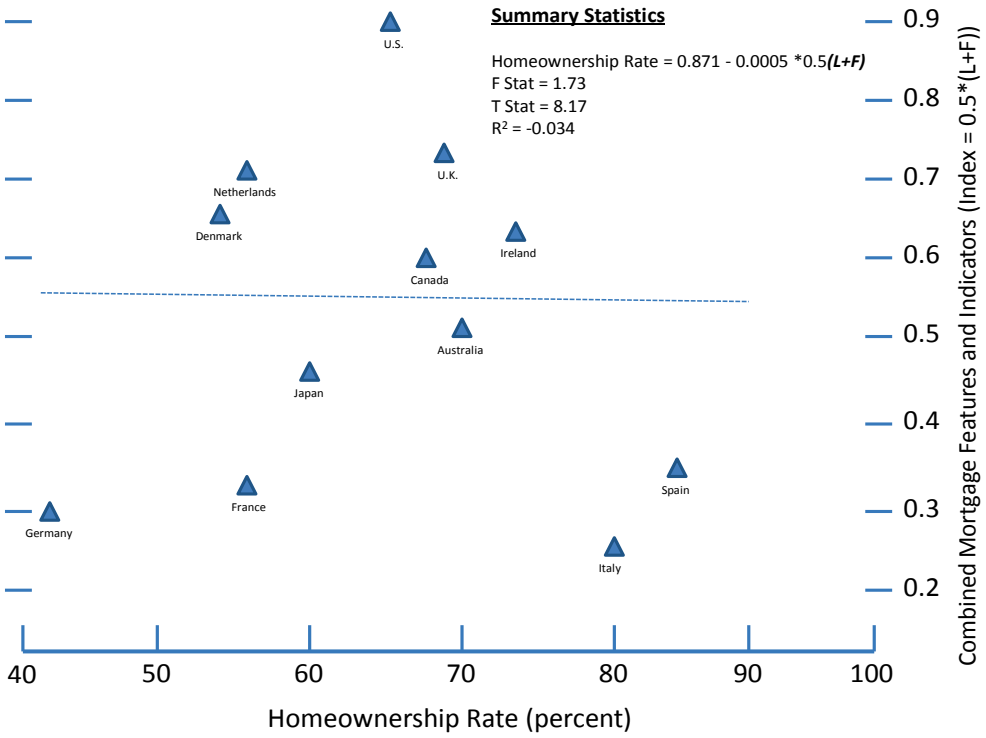
Panel B : Index of Flexible Mortgage Features and Indicators and Homeownership Rate



Sources: most recent available data based on report publication date from European Mortgage Federation; Australian Bureau of Statistics; Japan, Ministry of Internal Affairs and Communications, Statistics Bureau; Statistics Canada; U.S. Census Bureau; and Internal Monetary Fund.

Sources for the data include the European Mortgage Federation for the European nations; Bond Market Association and Federal Reserve for the U.S.; Bank of Australia and the Australian Bureau of Statistics; Bank of Japan and the Japan Ministry of Internal Affairs and Communications; Statistics Canada and Canada Mortgage and Housing Corporation; and the Organization for Economic Co-operation and Development and International Monetary Fund to obtain other data and for general data verification.

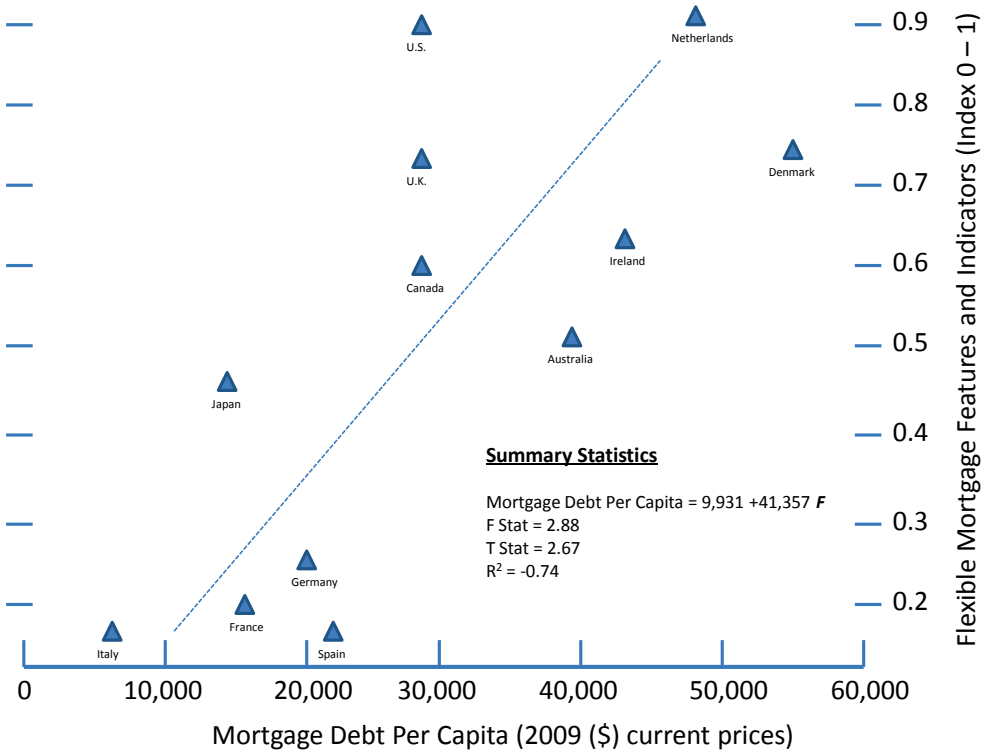
Panel C : Index of Combined Mortgage Features and Indicators and Homeownership Rate



Sources: most recent available data based on report publication date from European Mortgage Federation; Australian Bureau of Statistics; Japan, Ministry of Internal Affairs and Communications, Statistics Bureau; Statistics Canada; U.S. Census Bureau; and Internal Monetary Fund.

Sources for the data include the European Mortgage Federation for the European nations; Bond Market Association and Federal Reserve for the U.S.; Bank of Australia and the Australian Bureau of Statistics; Bank of Japan and the Japan Ministry of Internal Affairs and Communications; Statistics Canada and Canada Mortgage and Housing Corporation; and the Organization for Economic Co-operation and Development and International Monetary Fund to obtain other data and for general data verification.

Panel D : Index of Flexible Mortgage Features and Indicators and Mortgage Debt Per Capita



Sources: Internal Monetary Fund and estimates prepared by author.

Sources for the data include the European Mortgage Federation for the European nations; Bond Market Association and Federal Reserve for the U.S.; Bank of Australia and the Australian Bureau of Statistics; Bank of Japan and the Japan Ministry of Internal Affairs and Communications; Statistics Canada and Canada Mortgage and Housing Corporation; and the Organization for Economic Co-operation and Development and International Monetary Fund to obtain other data and for general data verification.

As Figure B1 illustrates in Panel A, the Index of Liberal Mortgage Features in a nation is positively correlated with its domestic homeownership rate, with a R^2 of 0.31. If Italy is removed from the analysis the correlation increases sharply, with a R^2 of 0.59, and this may be appropriate since the homeownership rate is already one of the highest among OECD nations even without a liberal system. The other outlier is the U.S. and research by Green (2008) and Shiller (2008) among others, has concluded that the U.S. mortgage system with nonrecourse mortgage borrower may be too liberal in granting mortgage loan approvals or mortgage loan insurance, and the U.S. homeownership rate has not likely been enhanced by such a liberal system. The only exception may be among subprime borrower classes which may be dis-proportionately represented in the U.S., although this has not been confirmed. Therefore, by excluding Italy and the U.S. the correlation increases, with a R^2 of 0.75, which is a level attained by the IMF 2011 study.

Germany could also be considered an outlier with a much higher homeownership rate than would be expected given its liberal index.

In Panel B it is important to note that the Index of Flexible Mortgage Features in a nation does not correlate in any significant way with the domestic homeownership rate. Moreover, in Panel C, even when an Index of Combined Mortgage Features and Indicators is created by equally blending the liberal and flexible features and indicators in a nation, there is no significant correlation with the domestic homeownership rate.

Panel D considers whether a representative household in any nation draws upon levels of mortgage debt which are commensurate with the Index of Flexible Mortgage Features. The variable used is mortgage debt per capita in 2009 dollars, and this variable is derived from statistics published by the IMF. The reasoning is that households who borrow within a flexible mortgage market and need to use mortgage funds as a household finance tool to manage household consumption will have mortgage debt levels based on the flexibility of the system and the size of the household, and therefore per capita levels are appropriate to use. The statistical result is significant and the outcome is similar to the results expressed in Panel A, with a R^2 of 0.74. The nations which exhibit mortgage debt per capita in line with the flexible index are the Netherlands, Canada, Italy, France and Germany. Surprisingly, given the Flexible Index derived, the U.S. and the U.K. should report much higher levels of mortgage debt per capita, while Denmark, Australia, Ireland and Spain should report lower levels. For the U.S. this may be related to a high concentration of mortgage debt in particular regions and among certain borrower classes, while the general market could obtain more mortgage debt but decided not to, and this may also hold for the U.K.