

***Mortgage Terms:***  
***A Study of***  
***Optimal Term Selection***  
***in Canada***

***1960-1994***

**Prepared for:**

**Market Analysis Centre**

**Canada Mortgage & Housing Corporation**

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## EXECUTIVE SUMMARY

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○ Canadian households who are either renewing an existing mortgage or getting a mortgage for the first time continue to be confronted with the issue of which is the optimal mortgage term choice. Indeed, the question for most mortgage borrowers remain - should they lock into a longer term rate or should they go short and roll their mortgage over continuously into short terms?

○ The objective of this technical paper is to address several key issues related to mortgage term selection. The paper first compares, on an historical basis, the relative costs of consistently choosing a short-term rollover strategy versus locking into a five-year term mortgage. The historical analysis encompasses the period from 1960 - 1994.

○ The starting point in the methodology was to establish a frame of reference for measuring an "optimal mortgage term selection" strategy. The optimal term strategy is defined as that which results in the lowest rate paid by the borrower over the duration of the mortgage term when compared to an alternate term. In other words, it is the term choice which minimizes the interest paid over the full term of the mortgage.

○ What would have been the best mortgage term strategy for mortgage borrowers in the 1960s? In Chart Two, the lock-in premium is plotted. Up until 1964, the rollover strategy would have been the least cost strategy for borrowers.

○ Mortgage borrowers consistently choosing a rollover term strategy would have faced considerable risk with regard to higher one-year mortgage rates over a five-year period, particularly in the late 1970s.

○ In contrast to the 1970s, however, even though mortgage borrowers would have faced greater volatility, the cost of locking into five-year terms in the early 1980s would have been substantially higher than rolling over into one-year term mortgages.

○ What is apparent from the above examination of the various term strategies through each of the decades from the 1960s to the 1990s is that there has been some variance with regard to when a particular term strategy is best. While the rollover strategy, was best in the 1980s and 1990s in 8.5 out of 10 periods, this was not really the case in previous decades.

○ In the regression results, the most significant explanatory variable was the five-year mortgage rate. The positive sign on the coefficient means that as interest rates increase, the lock-in premium moves in the same direction. This means that the gap between the five-year term and the rollover strategy is growing - thus, as interest rates rise, in this framework, it is better to choose a rollover strategy.

## RÉSUMÉ

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- ° Les ménages canadiens qui renouvellent leur prêt hypothécaire ou qui contractent un prêt hypothécaire pour la première sont confrontés à la question de savoir quel est le meilleur choix sur le plan de la durée du prêt. En réalité, la question pour la plupart des emprunteurs demeure : devraient-ils s'engager pour un prêt de longue durée ou devraient-ils choisir de renouveler constamment leur prêt pour de courtes durées?
- ° L'objectif de ce document technique est d'aborder certaines questions essentielles se rapportant au choix d'une durée pour un prêt hypothécaire. Le document compare d'abord, sur le plan historique, les coûts relatifs à la décision de toujours choisir de renouveler son prêt pour de courtes durées par rapport à en fixer les modalités pour une durée de cinq ans. Cette analyse historique porte sur la période de 1960 à 1994.
- ° Le point de départ de la méthodologie consistait à établir un cadre de référence pour mesurer quelle serait la stratégie de «choix de durée optimale d'un prêt hypothécaire». On entend par durée optimale celle qui permet à l'emprunteur d'obtenir le taux d'intérêt le moins élevé pour l'ensemble de la période d'amortissement du prêt. En d'autres mots, c'est le choix de durée qui permet de réduire au minimum l'intérêt payé au cours de l'ensemble de la période d'amortissement du prêt hypothécaire.
- ° Quelle aurait été la meilleure stratégie pour les emprunteurs hypothécaires au cours des années 1960? Dans le tableau 2, on trace la prime d'engagement hypothécaire. Jusqu'en 1964, la stratégie de renouvellement aurait coûtait moins cher aux emprunteurs.
- ° Les emprunteurs choisissant constamment de renouveler leur prêt pour de courtes durées auraient couru des risques considérables avec des taux hypothécaires d'un an élevés par rapport à une durée de cinq ans, particulièrement vers la fin des années 1970.
- ° Comparativement aux années 1970, même si les emprunteurs auraient dû composer avec davantage d'instabilité, le coût de fixer un prêt pour une durée de cinq ans aurait été notablement plus élevé au début des années 1980, que de renouveler le prêt pour des durées d'un an.
- ° Il ressort de l'examen des différentes stratégies relatives à la durée des prêts, que pendant chacune des décennies depuis les années 1960 jusqu'aux années 1990, il y a eu des variations concernant le meilleur moment pour appliquer une stratégie. Si la stratégie du renouvellement se révèle meilleure dans les années 1980 et 1990 dans 8,5 périodes sur dix, cela n'a pas été réellement le cas au cours des décennies précédentes.
- ° Les résultats du calcul de régression montrent que la variable la plus significative sur le plan explicatif est le taux hypothécaire pour une durée de cinq ans. Le signe plus affectant le coefficient signifie qu'à mesure que le taux d'intérêt augmente, la prime d'engagement se déplace dans la même direction. Cela signifie que l'écart entre la durée de cinq ans et la stratégie de

renouvellement croît - donc qu'à mesure que les taux d'intérêt augmentent, il est plus avisé de choisir la stratégie du renouvellement.

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## SECTION ONE: INTRODUCTION

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The issue of optimal mortgage term selection has been with Canadian mortgage borrowers since the widespread introduction of short-term mortgage instruments in the early 1980s. For most mortgage borrowers during the 1980s and 1990s, short-term mortgages usually meant terms of between six-months to two-years while "long-term" mortgages were between three to five-year terms. More recently however, the mortgage market is witnessing the resurgence of demand for even longer term mortgages. Most mortgage lenders now offer seven and ten-year mortgages and several offer twenty-five-year term mortgages.

Canadians now face a multitude of choices with regard to mortgage term selection. With the increased breadth of mortgage term selection, Canadian households who are either renewing an existing mortgage or getting a mortgage for the first time continue to be confronted with the issue of which is the optimal mortgage term choice. Indeed, the question for most mortgage borrowers remain - should they lock into a longer term rate or should they go short and roll their mortgage over continuously into short terms?

The objective of this technical paper is to address several key issues related to mortgage term selection. The paper first compares, on an historical basis, the relative costs of consistently choosing a short-term rollover strategy versus locking into a five-year term mortgage. The historical analysis encompasses the period from 1960 - 1994. The paper then addresses the issue of predictability by attempting to derive a predictive model that could be used by mortgage borrowers in helping them determine under which conditions one term selection is better than another.

It should be noted that given the historical scope of the technical paper, it does not take into account recent innovations in the mortgage market where many lenders now offer features such as a "convertible" mortgage which provide mortgage borrowers today with considerably more flexibility in rate selection than previously. In large part, these products have been developed to help address the quandary that many mortgage borrowers face in selecting a mortgage term.

Section Two provides the overall framework for the analysis. It contains a review of the evolution of the mortgage term environment in Canada by summarizing key legislative and institutional developments since the 1960s. It also outlines in detail, the hypothesis related to optimal mortgage term selection.. Section Three outlines the methodology and estimation results. By way of looking at the historical experience, certain parameters of measurement were defined. This established a consistent framework to compare term selection in each of the decades between 1960 and 1990. A series of statistical tests were conducted to determine the relationship between the optimal term selection and external factors. Finally, a series of multiple regressions were conducted to test a more comprehensive model. Section Four contains the conclusion.



## SECTION TWO: ANALYTICAL FRAMEWORK

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### Section 2.1 Historical Context & Review:

Up until the late 1960s, mortgage terms of 15 to 25 years were commonplace in the Canadian mortgage market. In this regard, up until that time, the Canadian mortgage market resembled the U.S. market, where longer-term fixed rate mortgages of between 25-30-years have been the most common mortgage term.<sup>1</sup> This was in contrast to Britain, for example, where the building societies - the main suppliers of mortgages funds - were allowed to change the rate of interest at any time.

There were several major reasons underlying the framework in Canada. Life insurance companies had been the largest supplier of mortgage funds to borrowers. They preferred 25-year term mortgages as a match against their long-term liabilities - life insurance policies. An additional factor was that under the National Housing Act (NHA) Canada Mortgage and Housing Corporation also played a significant role in the mortgage market. Under the *Term-Equals-Amortization* plan, the term of single family mortgages was usually 25-35 years - equal to the amortization period. On some types of properties, the term was as long as 40 years.

By the late 1960s however, a number of legislative changes occurred. These changes had an impact on financial institutions, and the outcome was the emergence of the five-year term mortgage as the most predominant term.

One of the most significant changes was the emergence of chartered banks as conventional mortgage lenders, following the revisions to the Bank Act in 1967. After 1967, chartered banks, which previously could only lend on new, NHA-insured properties, were allowed to make conventional mortgage loans on both new and existing properties. In 1969, the Regulations of the NHA were revised to permit loans to be made at the lenders' option, for a minimum term of five years.

In contrast to the life insurance companies, chartered banks, as well as trust and mortgage loan companies, funded mortgages through shorter term Guaranteed Investment Certificates and debentures. Lenders practicing a term matching strategy thus funded five-year term mortgages with equivalent term deposits. This became increasingly important as mortgage rates began to rise sharply in 1969 and 1970 after many years of stability.

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<sup>1</sup>It should be noted that over the last decade, the U.S. mortgage market has become increasingly similar to that of Canada with the widespread introduction by many mortgage lenders of short-term mortgages. In addition, a major difference with the U.S. market is that there is no interest penalty for borrowers to prepay their mortgages although significant servicing "fees" can make this a costly practice for borrowers.



The five-year term was the reference term under the Canada Interest Act, and lenders have always been exposed to prepayment risk on terms longer than five years.<sup>2</sup> As early as under the Orton Act in 1880, a mortgage borrower could pay the entire principal amount of the mortgage outstanding, accompanied by three months interest in lieu of notice, if the original term of a mortgage is greater than five years.<sup>3</sup> The five-year mortgage instrument evolved as one way of limiting risk.

While the five-year mortgage term became the standard during the 1970s, the 1980s saw further development. By the early 1980s, most mortgage lenders introduced short-term mortgages of between six-months to two years. In addition to short-term mortgages, some lenders also introduced different versions of a "variable-rate" mortgage where the rate changed frequently but payments remained equal. Indeed, as mortgage rates reached their peak in 1982, some lenders (not all) even discontinued offering five-year terms.

Throughout the 1980s and early 1990s, mortgage borrowers have generally chosen from a range of terms of five years or less. Although some lenders first introduced seven-year and 10-year mortgage terms in the mid-1980s, the high and volatile direction of interest rates in the late 1980s dampened consumer demand for these longer term products. In 1989, a 25-year term mortgage was reintroduced to the Canadian mortgage borrower.

While seven, ten and 25 year mortgage terms have been available to consumers for some time now, it is only recently that some lenders are reporting an increase in demand for these longer terms.

There are several major factors underlying the recent emergence of these longer term mortgages. In 1986, the federal government through C.M.H.C. introduced the MBS program. One of the cornerstones of the program was to facilitate the re-introduction of longer term mortgages to the Canadian marketplace in the belief that Canadian homeowners would ultimately benefit from greater choice in mortgage terms as well as be protected from volatility in mortgage payments, particularly for first-time home buyers.

On the supply side, increasingly sophisticated financing techniques have been employed by mortgage lenders in order to offset risk, in particular, the risk of early prepayment by borrowers. For example, rather than funding mortgages with equal term liabilities (called term matching), some lenders have managed to mitigate risk by maintaining duration matching. Lenders are able to track prepayment patterns more precisely; with that information they are better able to assess the average duration of a mortgage and fund it with a suitable term liability.

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<sup>2</sup> Neufeld, E.P. *The Financial System of Canada: Its Growth & Development*. MacMillan of Canada, 1972. p. 196

<sup>3</sup> In general, mortgages are subject to the Interest Act unless they are issued under the National Housing Act. Under the NHA, the mortgage borrower has full right of repayment, with a three-month interest penalty, after the third year of a mortgage, regardless of term.

The biggest change however, has been on the demand side. Borrowers have been attracted by the low rates now offered on these terms as well as increasingly flexible options. Longer term mortgages are as flexible as five-year terms. They are portable (meaning if the homeowner moves - they can take the mortgage with them) and annual repayment provisions are also similar. As with the five-year term mortgage, they are subject to a three-month interest penalty, should a borrower decide to prepay their mortgage in full by the end of the fifth year (by the end of three-years for NHA-insured mortgages).

Thus, several issues of term selection have evolved. For most borrowers, the dilemma through the 1980s and early 1990s was one of selecting between very short-term mortgages and five-year mortgage terms. More recently, coincident with a much lower interest rate environment and increased interest in mortgage terms of beyond five years, mortgage borrowers can now consider a complete range of terms from six-months to 25-years.

### **Section 2.2 Analytical Framework:**

From the perspective of the mortgage borrower, deciding which term is most appropriate at any point in time is a difficult decision, given the apparent volatility exhibited in interest rates. In developing the analytical framework for this paper, the objective was to determine elements in the economic environment which borrowers could utilize as information into the mortgage term decision. Thus, the overriding consideration was to develop a framework and ultimately, a predictive model, which could be utilized to some degree by a mortgage borrower.

Preliminary analysis indicated a pattern between the mortgage yield curve and a corresponding term selection. This preliminary analysis was used as a starting point in this technical paper to more specifically determine what, if any, the relationship was and more importantly, whether or not it could be quantified in a meaningful way.

The mortgage yield curve reflects the bond yield curve. The bond yield curve, in turn, is representative of the term structure of interest rates. The most prevalent yield curve is an upward sloping curve - that is, longer term interest rates are usually higher than short-term rates reflecting the risk premium demanded and paid to investors holding longer-term debt instruments.

In theory, in this environment (assuming that an upward sloping yield curve always prevailed), the optimal mortgage term would always be short-term mortgages because they would always be lower than long-term mortgages (exclusive of upward shifts in the curve). In practice, however, the yield curve is not always necessarily upward sloping. The slope of the yield curve can vary and is determined by the complex interaction of the economy and monetary policy.

In addition to being upward sloping, the yield curve can also either be flat or inverted. A flat yield curve means short-term rates are approximately equal to long-term rates. An inverted yield curve means that short-term rates are higher than long-term rates. Generally, changes in the yield curve signal changes in the economic cycle. A movement from an upward sloping to a flat yield curve means on a relative basis, short-term rates are rising. This usually signals a tighter monetary policy. Short-term interest rates rise as monetary policy tightens. The economic environment associated with this event is usually following a period of strong economic growth with rising inflationary pressures. Monetary policy is used to slow down the economy in order to eventually moderate inflationary pressures.

In some instances, monetary policy may have to tighten to such an extent that short-term interest rates rise above longer term interest rates. This is usually achieved as the economy reaches a peak in growth and inflationary pressures are at their maximum.

A changing interest rate environment as signaled by a change in the slope of the yield curve can present problems for mortgage borrowers who may be renewing just as the interest rate environment is changing. New mortgage borrowers are also faced with the dilemma of which rate to choose upon taking out a new mortgage. On an anecdotal basis, it appears that mortgage borrowers tend to wait to see what will happen in instances of greater rate uncertainty signaled by a frequent change in mortgage rates. As a result, there tends to be a lag between the rate cycle and when borrowers act leading to instances, for example, of borrowers finally locking into long-term rates as they are on the upswing.

What information can be gleaned from the yield curve which would help to increase the probability of an appropriate selection of a mortgage term for a typical borrower? If indeed, a clear link exists between the optimal mortgage term and a corresponding yield curve, mortgage borrowers can utilize this information to guide them in their own selection of term.

Changes in the slope of the yield curve are coincident with developments in the economic cycle. In turn, changes in the economic cycle - for example, as the economy moves from peak growth to contraction to recession and finally, to recovery - are evident in a number of key economic indicators. Information on indicators is broadly available.

For example, suppose a period of strong economic growth exists. As inflation pressures begin to mount in this environment, the yield curve begins to flatten as monetary policy starts to tighten. If the rate of inflation is still accelerating, the yield curve will eventually invert, with short-term rates higher. A prolonged inversion will produce slower economic growth and eventually recession. As this occurs, the yield curve will adjust accordingly. Eventually, a period of interest rate "normality" will emerge as the economy shifts from recession to recovery.

At issue for mortgage borrowers is the duration of each phase of the economic cycle. What is known is that shifts in the economic are inevitable - thus, locking into a

long-term interest rate when interest rates have reached their peak - is probably not the best strategy for mortgage borrowers. By monitoring changes in the economic environment as evident in the yield curve, mortgage borrowers can begin to fine-tune their term selection strategy.

The procedure to test the link between optimal mortgage term selection and the yield curve is outlined below.

## **SECTION THREE: METHODOLOGY & ESTIMATION**

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### **Section 3.1 Methodology:**

#### **i) Defining the Parameters**

The starting point in the methodology was to establish a frame of reference for measuring an "optimal mortgage term selection" strategy. Depending upon the tolerance for risk, "optimal" can mean different things to different types of borrowers. For example, a mortgage borrower with little tolerance for the risk of fluctuating mortgage payments would define an optimal strategy as that which produced the lowest variance in monthly payments over the life of the mortgage. This would be in spite of the fact that he may have been locking into a higher interest rate, thus paying more interest over the life of the mortgage, simply to secure stability of mortgage payment.

Conversely, a mortgage borrower with a higher risk tolerance for interest rate volatility will place a lower implicit value on stability of payments. For this type of borrower, the optimal mortgage term strategy is one which will minimize the interest payments (conversely, maximize principal pay down) for a selected mortgage term.

In the first instance, the optimal term selection for a risk-averse borrower cannot be quantified easily - it is more qualitative than quantitative in that the optimal term for a risk-averse borrower is one which minimizes the volatility in mortgage payments over the life of the mortgage. It is qualitative in that the risk-averse borrower gets greater utility from payment stability, even if the rate paid is higher. The degree of utility depends upon an individual households' preference function and, to this extent, is qualitative and thus difficult to quantify. For purposes of this technical paper, we have confined the definition of optimal term selection to one which is purely quantitative - and allows for standardization of measurement.

The optimal term strategy is defined as that which results in the lowest rate paid by the borrower over the duration of the mortgage term when compared to an alternate term. In other words, it is the term choice which minimizes the interest paid over the full term of the mortgage. By minimizing the interest portion of the monthly payment, the portion of the payment going towards the principal is maximized.

The measurement of "optimal term strategy" thus became a comparison of terms over comparable periods of time which resulted in lower interest payments (and higher principal pay down) for a typical mortgage borrower. For purposes of illustrating the relative cost of various term strategies, two key measures were developed:

- **Mortgage Borrower's Lock-in Premium**
- **Volatility Gap.**

### **Mortgage Borrower's Lock-in Premium**

The lock-in premium was derived as a quantitative measure of the extent to which one mortgage term produced a higher stream of interest payments compared to another mortgage term over the duration of the term of the mortgage. At each point in time, a mortgage borrower is faced with the decision - taking a short-term mortgage with frequent renewals or taking a longer term mortgage.

For example, a mortgage borrower can choose a five-year mortgage and thus secure stable payments over the five year term or choose a one-year mortgage, up for renewal one-year hence and then renew at prevailing terms at that time. (For simplicity purposes, the comparison was based on a borrower rolling over each year into the prevailing one-year term- this was called the "rollover strategy". In reality, the decision-making process would be more complex in that each year on renewal, the borrower would be faced with a much wider range of terms to choose from).

The lock-in premium of the five-year term is the additional interest paid over the five years, compared to cumulative interest paid on one-year terms, renewing every year for five years at the prevailing one-year rate. This difference between the two streams of interest payments was one measure of the lock-in premium. A second measure was the interest rate differential between the five-year term and the average of one-year terms over a five year period.

A similar process was followed for all comparable term strategies, as outlined in sections of the report below.

### **Volatility Gap**

The lock-in premium was the key quantitative measure used to evaluate one term strategy over another for the corresponding time period. An additional parameter was developed as a proxy to measure the interest rate risk associated with short-term mortgages. The "volatility gap" was derived in order to provide a quantitative proxy for the risk mortgage borrowers faced with a one-year term strategy.

This was produced for the one-year term strategy only because for the most part, when considering the past 30-year history of mortgage terms in Canada, the period of greatest uncertainty has been coincident with the introduction of short-term mortgages in

the early 1980s. With the exception of recent years, for the most part, the mortgage term selection question has centered around going long by taking a five-year term mortgage or going short by taking a one-year term mortgage.

Thus, the volatility gap applies to only the one-year term strategy option. It is calculated as the difference between the lowest and highest one-year rates faced by mortgage borrowers who would be renewing annually every year for five years instead of selecting a five-year mortgage term. The higher the gap, the greater the volatility in one-year term rates over that five-year period.

The volatility gap serves as a proxy for illustrating the extent of the volatility in interest rates mortgage borrowers who consistently chose short-term mortgages would face. Implicitly, mortgage borrowers make a trade off between the volatility gap and the lock-in premium. The equilibrium between the two, when for a given level of risk, the costs of locking into a longer term mortgage are equalized, will vary by individual mortgage borrower. For a risk intolerant mortgage borrower, the volatility gap would have to be very low in order to cause a shift from longer term to short-term mortgages at the time of mortgage renewal or when taking out a new mortgage.

### **Section 3.2: Quantitative Results on the Historical Experience of Hypothetical Mortgage Term Selection**

A major component of the technical paper was to review on an historical basis, which mortgage terms would have been optimal for a mortgage borrower faced with a term selection decision.

The analysis extended back to the 1960s and was conducted for a number of different interest rate scenarios. The basic comparison was between the one-year and five-year mortgage terms, given that historically, the five-year mortgage term has been the predominant "long-term rate" over the past 30 years.

The rationale for extending the period under examination back to the 1960s and considering the entire period was based on several factors. Each decade - the 1960s, 70s, 80s and 90s - have been characterized by tremendous economic and financial market changes. For the most part, the 1960s was a period characterized by low and stable nominal interest rates, low inflation and sustained economic growth. This shifted rapidly during the 1970s - when the combination of a number of significant supply shocks generated an inflationary spiral.

Inflation reached a peak in the early 1980s but remained at high levels through the balance of the decade. High inflation contributed to a significant upward shift in nominal interest rates. Institutional and financial market changes - beginning with a change in the exchange rate regime in Canada - contributed to a much more volatile interest rate environment. Frequent changes in money market and bond yields were mirrored in administered rates such as mortgage rates and the prime rate.

In contrast to the 1980s, the 1990s have so far been characterized by considerably lower nominal interest rates. While it is difficult to conclude at this point that interest rate volatility has also lessened, it would appear that mortgage borrowers are not exposed to the same degree of risk and payment shocks as was the case in the 1980s.

Given the secular changes that have occurred since the 1960s, it was evident that in addition to testing for the impact of the yield curve on mortgage term selection, the absolute level of interest rates also had to be considered. For this reason, rate strategies spanning to 1960 were considered.

In order to actually measure the historical experience, the following process was undertaken. For purposes of simplification, it was assumed that for each discrete period of time, in this case, on a monthly basis, the mortgage borrower makes the following choice - either locking into a five-year term mortgage available in that month or choosing a one-year term and rolling over into one year terms every year for five years. While this is a simplification, in that borrowers do not necessarily choose one year terms consistently and have a range of mortgage term choices at the end of the one-year term, it was selected as the basis for a framework because of the ease of estimation.

The cumulative interest paid on a five-year term mortgage was compared to the cumulative interest paid on one-year terms over a five year period. The difference in interest paid between the two scenarios was the actual quantitative measure of the lock-in premium. In addition, a second measure was developed based on the difference between the five-year mortgage rate and average of one-year mortgage rates over a five year period.

In addition to a comparison of nominal one and five-year rates for the period 1960 - 1994, the following comparisons were also examined:

- 1) Real 5 and 1-year mortgage terms 1980- 1994
- 2) 3 and 1-year mortgage terms 1980-1994
- 3) 7, 10 and 25-year terms where available
- 4) Term strategies compared on a NPV basis.

### **Data Issues**

A major data issue in testing the various hypothesis was the discontinuity in the time series for mortgage rates of varying terms. One and three-year mortgage terms were only introduced in the 1980s. Data on longer term mortgages - 7, 10 and 25-year terms - was available in a time-series format only since 1990.

A one-year mortgage rate series was created for the 1960s and 1970s to compare to the five-year term. A proxy was developed based on the bond yield curve by taking a portion (two-thirds) of the differential between short-term treasury bills and longer term bonds and subtracting that from the five-year mortgage rate. There are a number of



considerations however in this methodology which introduce estimation bias into the results. While there is some relationship between the bond yield curve differential, administered rates such as mortgage rates do not fully reflect either the differential and the timing.

This technique was limited to the hypothetical one-year mortgage series. Given that the process represents a "best-guess" approach only, generating other proxy series, such as a three-year rate series for the 1960s and 1970s was not considered.

In comparing the various mortgage term strategies on an historical basis, the results were disaggregated by each decade due to factors previously mentioned. Each decade over the 1960 - 1994 period has been characterized by different cyclical and secular factors which would affect mortgage term selection. Both the volatility index and the lock-in premium have been used in the comparative analysis.

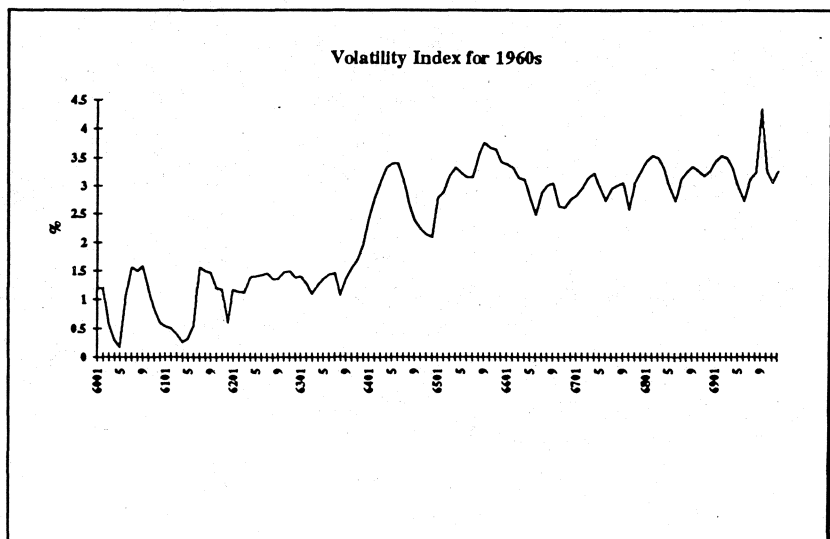
To recap, the lock-in premium is a measure of the interest rate differential between choosing a longer term mortgage rate (in the following examples, the five-year mortgage rate) over the alternative of a rollover strategy, where a borrower would choose a one-year term every year for five years.

In the following charts, observations above the horizontal axis mean that the five-year strategy was more costly; below the axis means that the one-year term was more costly.

### **SUMMARY: 1960s**

As noted in previous sections, mortgage terms of less than five-years were not offered by mortgage lenders through the 1960s. For purposes of analysis for this decade, a hypothetical one-year mortgage rate was constructed in order to compare it to the five-year term strategy.

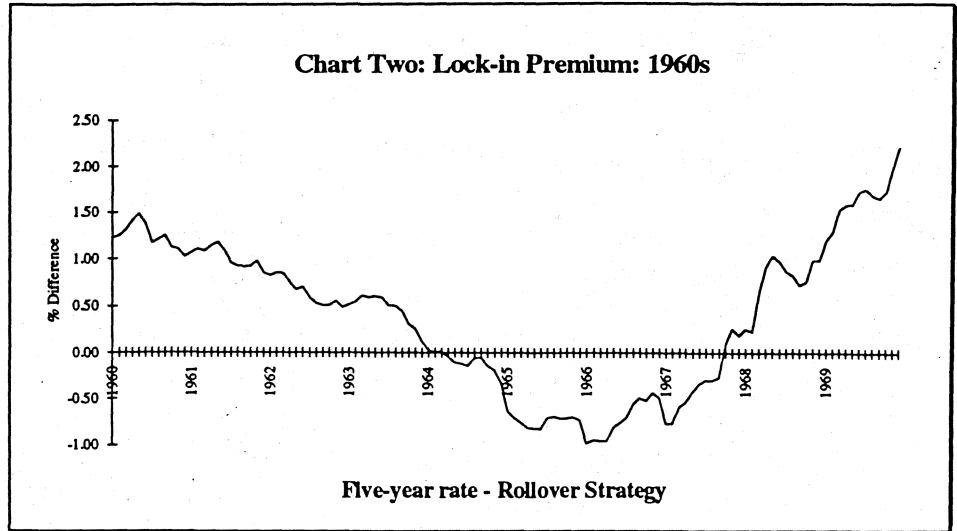
The Volatility Index created for the 1960s - reflects the relative stability of mortgage rates through most of this decade. The one-year rate used in this series is a proxy, based on the T-bill and bond-yield curve. If the one-year rate had been available to mortgage borrowers in this decade, they would have been exposed to very little interest rate risk, particularly in the first half of the 1960s.



Interest rate volatility did start to increase in the latter part of the decade, however. Nominal interest rates rose in response to higher inflation. Administered rates such as mortgage rates also fluctuated more as legislative controls previously limiting rate levels were gradually removed.

What would have been the best mortgage term strategy for mortgage borrowers in the 1960s? In Chart Two, the lock-in premium is plotted. Up until 1964, the rollover strategy would have been

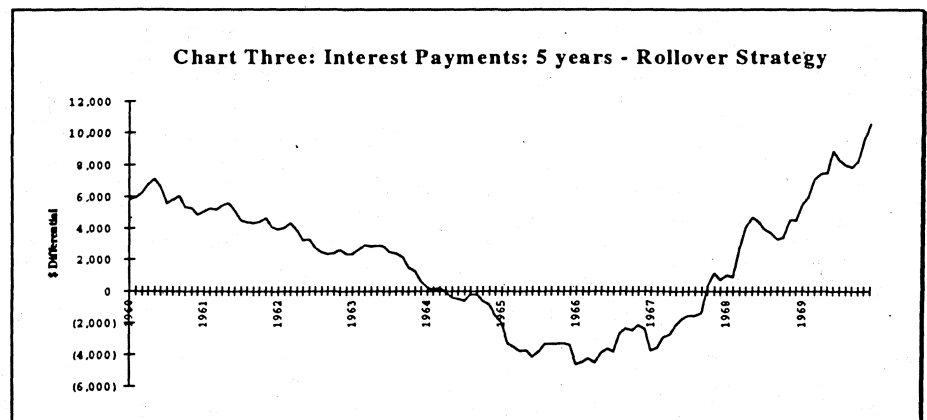
the least cost strategy for borrowers. On average, between 1960 - 1963, the five-year mortgage rate would have exceeded the five-year average of one year terms (the rollover average rate) by an average of .84%.



Through the mid-1960s, the lock-in premium shifted in favour of the five-year term. The one-year strategy proved to be more costly in an environment when mortgage rates were changing more frequently. Borrowers who had safely locked into the prevailing five-year rates through the mid-1960s would have been better off. Once again, the balance shifted in favour of the rollover strategy by the late 1960s. This reflects the fact that the early 1970s was characterized by lower and more stable nominal rates.

From the perspective of relative interest costs, Chart 3 shows in nominal dollars how much more (or less) borrowers would have

paid, depending on the strategy. Between 1969 - 1963, mortgage borrowers would, on average, have paid \$4,000 more by locking into the prevailing five year rate. In the mid-1960s, mortgage borrowers on average would have paid \$2,600 more if they had chosen the rollover strategy. To put this in context, in 1967, average family income of NHA-insured borrowers was less than \$9,000 and the average NHA loan amount was less than \$18,000. It should be noted that these are nominal dollars.



## SUMMARY: 1970s:

The nominal interest rate environment of the 1970s was characterized by considerable change as reflected in the volatility index. The first half of the 1970s mirrored the previous decade in that volatility, while increasing slightly from the 1960s, was still relatively moderate. By the second half of the 1970s, this had changed considerably. The oil price shock of the mid-1970s set the stage through the balance of the decade for a sharp, upward inflationary spiral. Double-digit inflation rates were the consequence and these became entrenched through cost-of-living clauses introduced in labour settlements.

The inflation cycle of the late 1970s set in motion a number of economic events which had a major impact on financial markets as was evident in interest rate levels and volatility. Administered interest rates such as mortgage rates, which had previously lagged changes in money market and bond yields, began to adjust with increasing frequency. Further, the overall rate level shifted upward reflecting underlying inflation trends.

Mortgage borrowers consistently choosing a rollover term strategy would have faced considerable risk with regard to higher one-year mortgage rates over a five-year period, particularly in the late 1970s.

In the environment of the late 1970s, the rollover strategy would have proved more costly, as borrowers would have faced higher and higher interest rates upon renewal. This is in contrast to borrowers who would have locked into five-year rates prevailing at that time. It was evident from the 1970s that the absolute level of nominal interest rates, as well

Chart Four: Volatility Index for 1970s

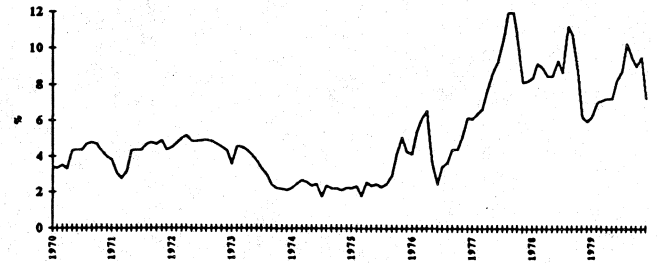
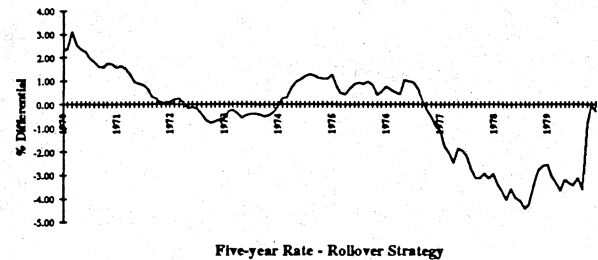
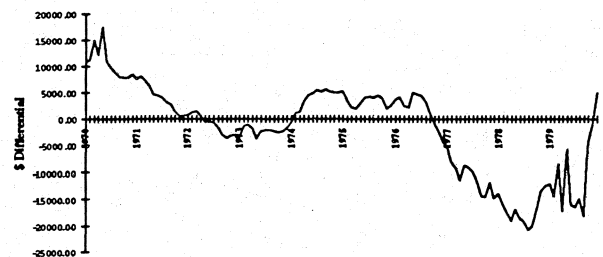


Chart Five: Lock-in Premium for the 1970s



Five-year Rate - Rollover Strategy

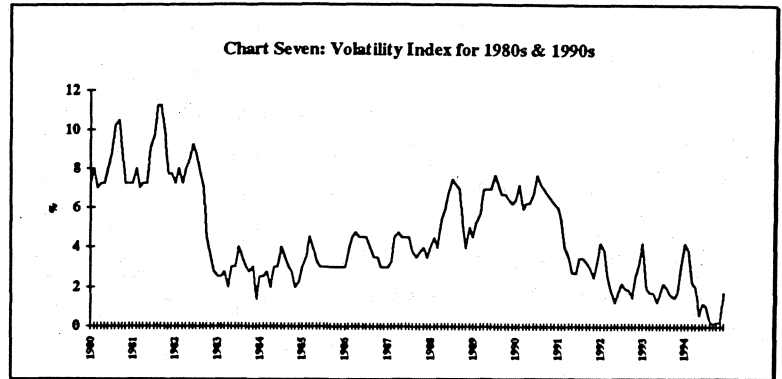
Chart Six: Interest payments: 5-year - Rollover Strategy



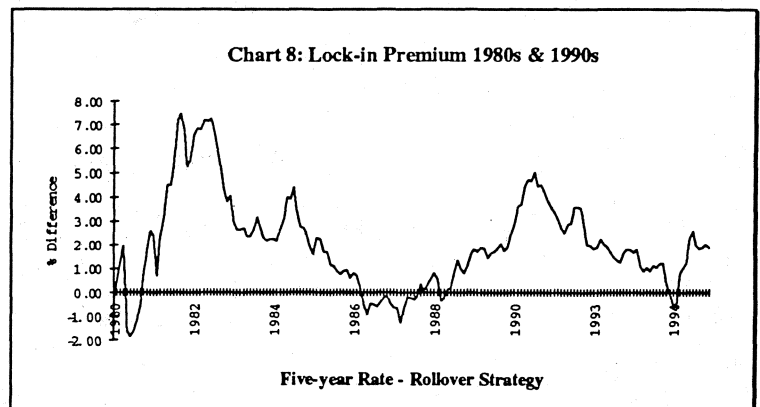
as the rate of change in rates had a significant impact on determining the appropriate term selection.

### **SUMMARY: 1980s & 1990s:**

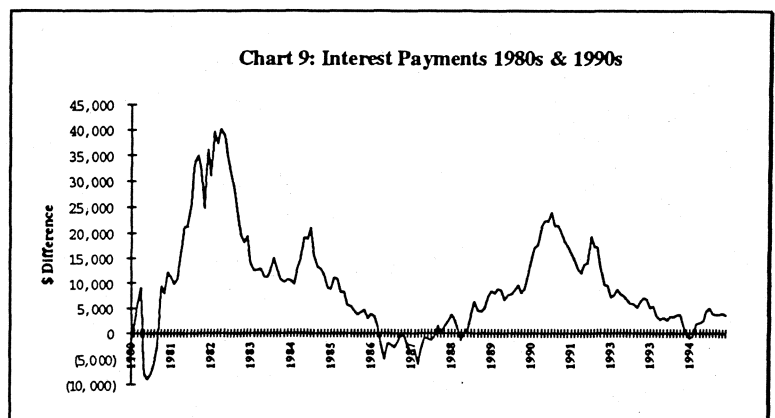
Volatility trends evident in the late 1970s were still a major factor for mortgage borrowers in the early 1980s. The volatility index for the first three years of the decade indicated that mortgage borrowers would have faced considerable payment risk by choosing a rollover strategy. Mortgage rates reached a peak of over 20% in 1981. Through this period, the volatility index also reached a peak - of up to 12% in 1981.



The inflation rate eventually declined during the mid-1980s, reflecting the long-term impact of the recession in the early 1980s. The volatility index subsided through this period. It increased again through the late 1980s, reflecting a steady increase in the inflation rate and subsequent impact on nominal interest rates. This meant that a hypothetical mortgage borrower who had consistently selected one-year terms over five year terms through this period would have been subjected to higher volatility in the one-year terms.



In contrast to the 1970s, however, even though mortgage borrowers would have faced greater volatility, the cost of locking into five-year terms in the early 1980s would have been substantially higher than rolling over into one-year term mortgages. Between 1980 - 1983, the five year mortgage rate averaged 16% before declining to an average of 12.85% between 1984 - 1985.



Mortgage borrowers who had consistently selected a one-year term in the early 1980s would have benefited later on from declining rates. The economy entered a

recession in the early 1980s and nominal interest rates declined eventually. Locking into a five-year term mortgage at the peak of the interest rate cycle through this period was not the optimal strategy. The sharp fall in nominal interest rates that preceded the recession was advantageous to borrowers selecting the rollover strategy.

The advantage of a one-year rollover strategy declined in the mid 1980s and for several months through 1985 and 1986. The best strategy for borrowers would have been to lock into a five year mortgage rate. Mortgage borrowers who choose a one-year strategy would have been faced with considerably higher rates in the late 1980s as interest rates began to rise in response to the economic cycle. These higher rates for at least a portion of the rollover period would have resulted in an average rate for the rollover strategy considerably higher than the five-year term strategy.

However, by the end of the 1980s, the rollover strategy was the better one, with the average interest paid on a five-year rate considerably higher than on the average of one-year terms. Mortgage rates reached their peak in the late 1980s; monetary policy had tightened considerably in an effort to reduce inflationary pressures in the economy and as result, mortgage borrowers who locked in at the peak of the interest rate cycle would have been penalized.

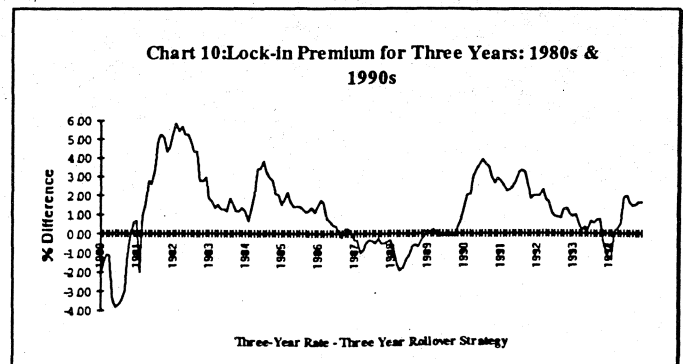
Results for the 1990s so far are preliminary in that there are not sufficient years of observations to make conclusive statements. However, based on the experience of hypothetical borrowers up to the end of 1994, several shifts have taken place.

First, in comparison to the 1980s, the overall mortgage rate environment appears to be characterized by less volatility coincident with a much more stable inflation environment. However, at the same time, an overall decline in the level of rates combined with periods of volatility indicate that while the rollover strategy is still the least costly, the five year term mortgage does not carry as high a cost.

What is apparent from the above examination of the various term strategies through each of the decades from the 1960s to the 1990s is that there has been some variance with regard to when a particular term strategy is best. While the rollover strategy, was best in the 1980s and 1990s in 8.5 out of 10 periods, this was not really the case in previous decades. The absolute level of nominal interest rates, as well as their direction, would appear to be significant factors.

### Rollover Strategy vs. Three-year Term Mortgage

The one-year rollover strategy was also compared to the three-year term mortgage for the period 1980 - 1994. As would be expected, the patterns were similar as with the five-year lock-in premium. For



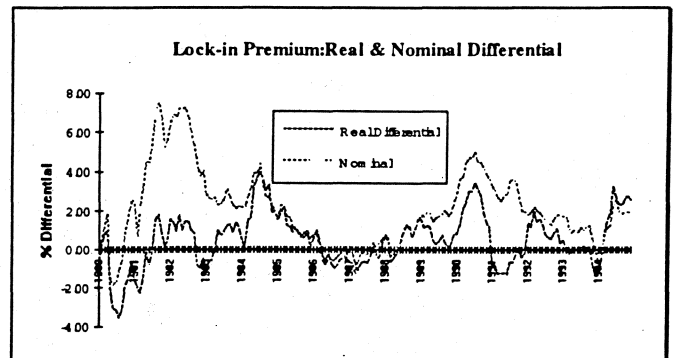
most of this period, the three year rate has been more costly. However, reflecting the narrower spread between the one and three-year mortgage rate than the one and five-year mortgage rate, the premium was lower.

As with the five-year rate scenario, it was more advantageous to mortgage borrowers to lock into three year term rates in the period 1986 - 1989 as interest rates continued to rise. However, by locking into three-year terms at the peak of the rate cycle in 1989 and 1990, mortgage borrowers selecting this term were at a cost disadvantage, relative to borrowers who took greater risk by rolling over into one-year terms.

In contrast to the one-year term mortgage, a hypothetical three-year rate series was not reconstructed for the periods prior to 1980. This was due mainly to concerns about the estimation process - the spread between the three and five-year mortgage rates can vary considerably and this variance is not always associated with corresponding changes in the bond yield curve.

### Real vs. Nominal Interest Rates

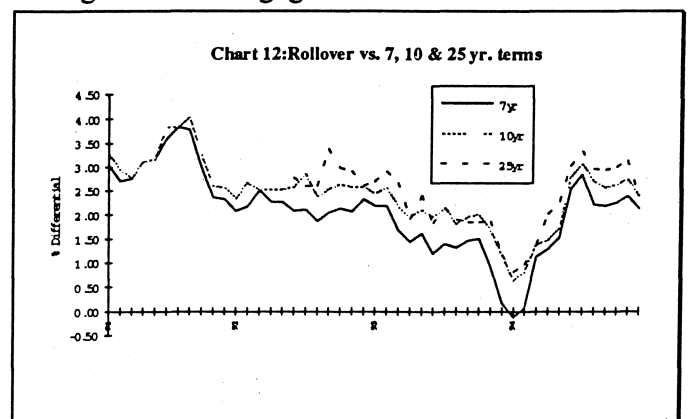
In addition to the above series, the lock-in premium for real interest rates as well as on a net present value basis were also calculated. These results for the real interest rates (where real interest rates are represented by a proxy of nominal rates minus the rate of inflation) are presented in Chart 11. What is apparent from this chart is that in real terms, the benefits of the rollover strategy were not as great as in nominal terms. Indeed, when the impact of high inflation in the early 1990s is discounted for, the strategy of locking into a longer term rate becomes more advantageous.



This would suggest that going forward, there are implications for the low-inflation environment of the 1990s on term strategy. A lower inflation environment has a different impact on the magnitude of the lock-in premium of a longer term mortgage.

### Rollover vs. Longer Term Mortgages

Historical data were also used to compare the rollover strategy with mortgage terms of more than 5-years including the 7, 10 and 25 year term mortgages. Data on these terms was available back to only the beginning of 1991. Similar to comparing the rollover strategy with the five-year term, the interest rate differential between the average of one-year terms, beginning in 1991 to the end of 1994, and the rate



on each of the longer terms was calculated. The accompanying chart displays the lock-in premium for each of these terms.

The data indicate that to date, mortgage borrowers would have been paying a premium to lock into the longer terms. However, the size of the premium varies with the interest rate cycle. The premium declined for a brief period at the beginning of 1994 as interest rates reached very low levels. This indicates that mortgage borrowers locking into terms longer than five-years may have benefited in the longer term. Given the timing, however, this cannot be fully evaluated until the 7, 10 and 25 year mortgages have run their course. Only then, can the rollover strategy be properly compared to locking into these longer terms.

### **Estimation Results:**

On a descriptive basis, it is apparent that depending upon both cyclical and secular economic trends, the optimal term strategy has varied. In the 1980s and 1990s, mortgage borrowers would have been better off with a rollover strategy approximately 85% of the occurrences. However, this was less the case in the 1960s and 1970s. The next stage from the descriptive analysis was to try to determine a predictive relationship between factors which may influence the optimal term selection.

#### **Lock-in Premium:**

The original hypothesis was that there was a link between the yield curve and the optimal term strategy. For the period between 1980 - 1994, the lock-in premium was calculated for periods when the yield curve was

<b>TimePeriod</b>	<b>Inverted/flat</b>	<b>Upward Sloping</b>
<b>1980-1984</b>	3.22%	3.29%
<b>1985-1989</b>	1.26%	.32%
<b>1990-1994</b>	3.69%	1.66%

flat or inverted and separately from when there was an upward sloping yield curve. From observation, it appeared that the lock-in premium was greatest when the mortgage yield curve was flat or inverted - in other words, that it was least advantageous to borrowers to lock-in to a five-year mortgage rate at this time. A period when the mortgage yield curve was flat or inverted usually signaled a shift to a higher nominal interest rate regime- thus, borrowers who locked in were locking into high rates at the peak of the cycle. Borrowers choosing a rollover strategy ultimately benefited as interest rates began to fall.

Conversely, the lock-in premium was lowest when the mortgage yield curve was upward sloping, although there was still a premium to going longer term. This result appeared counterintuitive; it was apparent that factors other than the yield curve were an important influence on this outcome such as the absolute level of rates as well as their rate of change.

#### **Occurrences of Yield Curve:**

The approach undertaken to determine an estimable (and predictive) relationship between the optimal term strategy and the yield curve was the following. The dependent variable was the

<b>TimePeriod</b>	<b>Inverted/Flat</b>	<b>Upward Sloping</b>
<b>1980-1984</b>	25	35
<b>1985-1989</b>	23	37
<b>1990-1994</b>	16	44



lock-in premium calculated for the one and five year rates, as well as for the one and three year rates (where both were available historically). There were two versions of the lock-in premium used in the calculations - one was the rate differential itself and the second was the differential in cumulative nominal interest payments under the various strategies.

The first test which was done was a simple correlation test. The strength of the correlation between the lock-in premium and the various types of yield curve was tested as was the correlation with the various stages of the economic cycle between 1960 - 1994. The correlation statistic used was the bivariate correlation coefficient.

The second set of statistical tests conducted was a series of regressions including a single linear regression as well as a multiple linear regressions for various time periods.

The third set of tests was to test for structural change which may have taken place in the 1960s, 1970s and 1980 - 94 compared to the period for 1970 - 1994 in its entirety. The hypothesis to be tested was that structural economic change, as reflected in the level of nominal interest rates, had occurred to such an extent that the optimal term strategy would vary accordingly.

### **Correlation Test:**

Casual observation indicated that the lock-in premium varied with different phases of the mortgage yield curve. Estimating the correlation coefficient was conducted in order to determine if a more formal (and statistical) relationship existed. The results of casual observation indicated that a period of inverse or flat yield curve favoured a rollover strategy as it tended to foreshadow changes in the overall level of interest rates.

The results of the correlation analysis were varied. The first set of tests were grouped by various economic cycles. The phases of the economic cycle were determined by real GDP growth. The correlation between the lock-in premium and the mortgage yield curve was then estimated for each cycle phase.

The results for the first set of tests where the correlation coefficient was calculated separately under various yield curve and economic cycle regimes produced inconsistent results. Both the magnitude of the coefficient as well as the sign of the coefficient showed considerable variance.

A second set of tests were run the correlation coefficient was calculated based on grouping all data together under different yield curve regimes. As a group, the strength of the correlation between all occurrences of an upward sloping yield curve and both the lock-in premium and interest differential was weak. There appeared to be a stronger relationship between all periods when the yield curve was either flat or inverted and the dependent variables. The correlation coefficient for the lock-in premium as measured by the difference in interest payments between the five-year and rollover strategy was .30; the coefficient when the rate differential was used as the dependent

variable was .38. The coefficient itself measures the degree of linear association between the two variables with a lower and upper limit of between -1 and +1.

Although this would appear to support the observation that periods of a flat or inverted yield curve produced the greatest benefit for a rollover strategy, the overall inconsistency of the results suggested that additional elements had to be considered.

### **Regression Results:**

The overall objective of the regression procedures was to test for a relationship in as simplified a format as was possible. This was determined by the overall objectives - to develop a model which was easily translatable and usable by the general public in a meaningful way. While more complex specifications could have been considered (and should be considered), the estimation procedures which follow adhered to the first principle of simplicity.

The first set of OLS regressions were similar in structure to the correlation procedure. Data were grouped by periods of varying economic growth and secondly, according to the slope of the mortgage yield curve. In the first instance, single linear regressions were estimated, where in one set, economic growth (measured by the annual percentage change in real GDP) was the explanatory variable and in a second set, the slope of the mortgage yield curve was the single explanatory variable. Under both scenarios, the dependent variable was specified as two measures of the lock-in premium.

The results of this procedure were similar to that of the first exercise in that there was considerable variability in the regression results. Re-doing the regressions by grouping the data did not improve the statistical results significantly. Again, similar to the conclusions reached in the first procedure, on the strength of simple statistical and regression testing alone, it appeared that the lock-in premium (the dependent variable) showed little relationship to various phases of the yield curve.

### **Multiple Linear Regressions:**

The "model" was broadened to include other variables and the format was expanded through a series of multiple regressions. Regressions were estimated for the 1960 - 1994 and 1970 - 1994 periods as well as for the 1960s, 1970s, 1980s and 1990s separately. The dependent variable was the lock-in premium; the independent variables were the actual five year mortgage rate, the mortgage yield differential and real GDP growth.

Only key statistical results are presented in Table 4. Multiple-linear regressions produce the strongest results so far. Data were grouped by decade and then by the period in its entirety. The dependent variable was the lock-in premium. Independent variables included the five-year mortgage rate, the mortgage yield curve and GDP growth. The

objective of this set of regressions was to try to discern the relationship between the lock-in premium and the overall level and direction of interest rates.

**TABLE 4: REGRESSION RESULTS**

1960's	T-STAT	COEFFICIENT	COND. INDEX
R-Square: 37.83			
FIVERATE	15.878	2085.38	1.000
MTG_YIE	4.557	2082.34	2.759
GDP	-2.033	-2101.34	5.432
CONSTANT	-12.670	-20015.32	9.224

1970's	T-STAT	COEFFICIENT	COND. INDEX
R-Square: 43.26			
FIVERATE	8.097	762.98	1.000
MTG_YIE	9.559	9326.83	2.130
GDP	-.119	- 116.20	2.612
CONSTANT	-8.5178	-91081.57	42.235

1980s	T-STAT	COEFFICIENT	COND. INDEX
R-Square: 77.80			
FIVERATE	19.183	3568.73	1.000
MTG_YIE	1.968	1075.51	1.896
GDP	-.484	-419.55	2.909
CONSTANT	-14.629	-39670.83	12.962

1990s	T-STAT	COEFFICIENT	COND. INDEX
R-Square: 91.12			
FIVERATE	11.092	2953.18	1.000
MTG_YIE	-2.329	-1333.60	1.764
GDP	-2.116	-1595.79	3.446
CONSTANT	-5.932	-20081.25	27.541

1960-1994	T-STAT	COEFFICIENT	COND. INDEX
R-Square: 55.51			
FIVERATE	18.222	3292.42	1.000
MTG_YIE	7.194	3483.59	2.818
GDP	-2.887	-2204.56	1.944
CONSTANT	-15.406	-36733.95	12.737

**Note:** The "Cond. Index" is the Multicollinearity Condition Index. It measures the degree of multicollinearity between the explanatory variables. A value in excess of 20 - 30 would suggest the presence of Multicollinearity in the equation.

In all equations, the most significant explanatory variable was the five-year mortgage rate. The positive sign on the coefficient means that as interest rates increase, the lock-in premium moves in the same direction. This means that the gap between the five-year term and the rollover strategy is growing - thus, as interest rates rise, in this framework, it is better to choose a rollover strategy. The magnitude of that benefit is

measured by the size of the coefficient. For example, in the results for the Total Period Model (1960 - 1994) , an increase of 100 basis points in the five year mortgage rate results in an increase in the lock-in premium of \$3,292.42.

The mortgage yield curve was also a significant explanatory variable in most of the estimation periods. The exception is in the 1980s when it barely meets the significance test at a 10% confidence level. There is also some variation between the decades with regard to the sign on the coefficient, indicating that a consistent relationship has not prevailed. The size of the coefficient for the Total Period Model can be interpreted as a 1 degree increase in the slope of the yield curve leads to a \$3,493.59 increase in the lock-in premium.

The third explanatory variable, the percentage change in real GDP, was not as significant as the other variables. The negative sign on the coefficient for the Total Period estimations indicates that a 1% increase in GDP would result in a \$2200.56 decrease in the lock-in premium.

The R-square statistic is a measure of goodness of fit of the estimation equation. The low R-square values for the 1960s and 1970s would suggest that there are other explanatory factors which should be incorporated into the equations. For example, no attempt was made to account for differences in the institutional and regulatory environments, particularly for the 1960s, with subsequent decades. In particular, the earlier decades were characterized by rigidity in the setting of administered interest rates. Up until the mid-1960s, mortgage rates in particular did not fully reflect money market and bond yields as there were constraints on the extent to which they could rise. (For more detail on the historical environment, refer to E.P. Neufeld, "The Financial System in Canada.")

The equations estimated separately for the 1980s and 1990s show the best fit with high R-Square values. In part, this reflects the fact that actual one-year mortgage rates are used in contrast to the 1960s and 1970s which were calculated using a proxy for the one-year rate. Overall, the multiple regressions produced the most definitive results and confirm some of the evidence based on observation. However, the variability in results between different periods of estimation would suggest that caution is required in interpreting the results, particularly as applied within the current rate environment.

The statistical results for the 1960s, the period which the current environment mirrors most closely in terms of the level of interest rates, were also the weakest. While the specification of the equations and the results for the 1980s would suggest a relationship between the lock-in premium and other factors, caution should be used in using this results on a predictive basis.

A test for structural change was conducted to determine if the 1970s varied significantly from the 1980s & 1990s as a way of understanding the relatively low R-squared value. If structural change had occurred, the slope of the regression line would be

significantly different in the 1970s than the later decades. However, test statistics confirmed that no structural change had taken place.

## **SECTION FOUR: SUMMARY**

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Mortgage term selection has been an ongoing issue with mortgage borrowers in Canada since the introduction of short-term mortgages in the early 1980s. More recently, the increased interest in very long-term mortgages, coincident with the low inflation environment, has added to the array of choices borrowers must now make.

The purpose of the technical paper was twofold:

- 1) Examine on an historical basis which mortgage term strategy borrowers should have selected in the period from 1960 -1994.
- 2) Derive a model which could statistically link optimal mortgage term selection to factors to be determined.

In order to evaluate the historical experience, several parameters were developed which would serve as quantitative measures of when one term strategy was better than another. For purposes of simplification, the five-year mortgage term was compared to a one-year rollover strategy for the 1960 -1994. Other term relationships were also examined, but data constraints prevented an examination of all term strategies over the entire period.

The historical review indicated that while for the most part, the rollover strategy proved to be the lowest cost strategy, this was not always the case. In each of the decades examined, at different points in time, the five-year rate strategy would have been better. To some extent, this was a hypothetical outcome for the 1960s and 1970s as a one-year term was not available to mortgage borrowers at that time.

The next step was to statistically link the lock-in premium to explanatory factors. Simple statistical testing of the relationship between the lock-in premium and the yield curve as well as the economic cycle showed little conclusive evidence of a relationship.

As a result, multiple linear regressions were calculated for each of the four decades as well as the period in its entirety. These results proved more conclusive in that the regression statistics were better. They also indicated that the mortgage rate itself was a more significant determinant of the optimal term strategy and that the mortgage yield curve, while significant in some periods, overall was not as strong a factor in the equation. Goodness of fit of the equations increased in later decades.

Conclusions reached from these results are that no simple and measurable relationship exists between optimal term strategy and the yield curve itself. Mortgage borrowers have to take into account other factors. In particular, the level of rates itself is

very significant. As mortgage rates rise, the benefits to mortgage borrowers of a rollover strategy increase, other things being equal.

As interest rates fall and assuming they fall far enough, borrowers can benefit by locking into longer term mortgages. There was little to suggest that these relationships will not continue to hold for the balance of the 1990s. In particular, the low inflation rate and its impact on the overall level of nominal rates will be a major factor influencing the outcome of mortgage term selection.