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This paper is intended to make the results of Bank research available in preliminary form to other economists to encourage discussion and suggestions for revision. The views expressed are those of the authors. No responsibility for them should be attributed to the Bank of Canada.

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Abstract

This paper examines the ability of a number of financial variables to predict Canadian recessions. Regarding methodology, we follow closely the technique employed by Estrella and Mishkin (1998), who use a probit model to predict U.S. recessions up to eight quarters in advance. Our main finding is that the spread between the yield on Canadian long bonds and the 90-day commercial paper rate is particularly useful in predicting Canadian recessions. This result is consistent with those of Estrella and Mishkin (1998).

Résumé

Les auteurs étudient la faculté de certaines variables financières d'aider à prévoir les récessions au Canada. Sur le plan méthodologique, ils s'inspirent étroitement d'Estrella et Mishkin (1998), qui utilisent un modèle probit pour prédire les récessions de l'économie américaine jusqu'à huit trimestres à l'avance. Leur principale conclusion est que l'écart entre le rendement des obligations à long terme canadiennes et le taux du papier commercial à 90 jours est une variable très utile pour la prévision des récessions au Canada. Ce résultat est conforme à ceux qui ont été obtenus par Estrella et Mishkin (1998).

CONTENTS

1.0 Introduction and Summary

The term structure of interest rates has been observed by researchers at central banks and the academic world to be a very useful indicator for macroeconomic variables such as output and inflation. For instance Estrella and Hardouvelis (1991), Hu (1993), Cozier and Tkacz (1994), Atta-Mensah (1997) and Harvey (1991 and 1997) find a strong relationship between the term structure and future economic growth. Fama (1990), Mishkin (1988, 1990 and 1991), Lowe (1992), Frenkel and Lown (1994) and Day and Lange (1997) also find the slope of the yield curve to be a good predictor of future changes in inflation.

Recently, Estrella and Mishkin (1998) have shown that the term structure is an excellent indicator of the likelihood of United States recessions. They also demonstrate that the term spread dominates other macroeconomic variables, such as the index of leading indicators, as predictor of real economic activity.

From a policy perspective, having advance knowledge of future movements in economic activity is of crucial importance, given the lags with which policy affects the economy. Thus, if recessions can be successfully predicted a number of quarters in advance, this would represent a signal for a future rise in the output gap and a possible fall in inflation. Monetary policy could then respond accordingly.

The focus of this paper is to examine the ability of a number of financial variables to predict Canadian recessions. Estrella and Mishkin suggest that this type of financial-indicator model should be of particular interest to policy-makers for the following reasons. First, by providing a qualitative assessment of the economy, it sidesteps the spurious accuracy associated with quantitative point estimates provided by other indicator models. Second, this indicator model may provide cross-checks on other macroeconometric models. For instance, if this model and alternative models agree, then more confidence is placed in the quantitative results from the alternative models. On the other hand, if the models do not agree then it may be worthwhile to re-assess the assumptions and relationships behind the alternative models. Third, the data on financial variables are readily available and are not subject to the revisions a number of other macroeconomic variables have to undergo.

Regarding methodology, we follow closely the technique employed by Estrella and Mishkin (1998), who use a probit model to predict U.S. recessions up to eight quarters in advance, both in- and out-of-sample. As such, our dependent variable is the probability of being in a recession, with the value of 1 being assigned to a recession date and 0 to other dates. Our model generates probabilities of being in a recession up to k quarters in advance, with k taking the values of 1 to 8 and 12.

Our main finding is that the spread between the yield on Canadian long bonds and the 90-day commercial paper rate is particularly useful in predicting Canadian recessions. This result is consistent with those of Estrella and Mishkin (1998) for the United States.

It must be noted that this paper does not address the question why the term structure predicts recessions or economic activity in general. There are two explanations for this relationship in the literature. The first explanation can be illustrated with this example. Consider a situation in which a country is currently enjoying strong economic growth and there is a general agreement among investors that the country is heading for a slow-down or a recession in the future. The desire by consumers to hedge against the recession would lead them to purchase financial instruments, such as long-term bonds, that will deliver pay-offs in the slowdown. The rush for the long-term bonds will cause the price of the bonds to rise and the corresponding yields to fall. In an attempt to finance the purchase of the long-term bonds, consumers may sell off their shorter-term assets. Thus, the price of shorter-term assets will fall while their yields will rise. The scenario presented here shows that if a recession is expected, we should expect to see long rates to decrease and short rates to rise. Consequently, prior to a recession, the slope of term structure (difference between long and short rates) will become flat or inverted.

The second interpretation of the spread is that it is a better measure of the “liquidity effect” of monetary policy than a short rate alone. To explain this view, let us assume that a central bank tightens monetary policy by raising short-term rates. The rise in current short rates will lead economic agents to expect future short term rates to rise by less than the current change in rates. Based on the expectations hypothesis of the term structure, long-term rates will rise by less than the current short rate. (This could lead to the inversion of the term structure.) Since monetary policy affects economic activity with a lag of one to two years, the tightening of policy will cause a reduction of future economic activity and an increase in the probability of a recession.

The paper is organised as follows. A background is presented in the next section. Section 3 presents a discussion on the methodology of the paper. The results of the paper are presented in Section 4 and concluding remarks are made in Section 5.

2.0 Background

The NBER pioneered the practice of identifying leading economic indicators. Mitchell and Burns (1938) examined 487 series, identified 21 to be reliable indicators of business expansion (with stock prices being on this short list). This study was remarkable not only because it was undertaken prior to the advent of modern statistical and computing techniques, but also because quarterly GNP figures were not yet available. A major finding of their paper was that business cycles were highly irregular in both timing and magnitude.

Burns and Mitchell helped define what eventually became known as the “NBER method” for selecting economic indicators. They defined an original list of criteria for selecting indicators, which were updated over the years. Among their criteria, an indicator should span a long period, show no erratic movements and lead recessions or expansions by an invariable interval.

Moore (1950) was the second major study of business cycle indicators at the NBER. In it the author examines a greater number of series (801) and searches for indicators of business contractions in addition to indicators of expansions. With a sample ending in 1938, he constructs a new list of indicators. Interestingly, interest rates are not included on the list (interest rates varied little in the 1930s and 1940s). Moore (1961) and Moore and Shiskin (1966) continued the NBER's search for reliable leading indicators, using more powerful statistical techniques and revising the criteria used for selecting indicators.

Beckett (1961) applies the NBER method for selecting indicators on Canadian data. From 1947 to 1957, a period covering only two business cycles, the author finds that stock prices lead peaks by as much as 21 months, and troughs by as much as 8 months. The interest rate on day-to-day loans, available since only 1954, was found to lag the 1954 trough by 8 months.

More recently, Stock and Watson (1989) have revised the list of U.S. leading indicators, using modern econometric techniques. Their useful indicators include the risky spread (the difference between 30-day commercial paper and 30-day Treasury-bills) and the slope of the yield curve of government securities. They use their indicators to construct simple leading and coincident indexes of economic activity.

Estrella and Mishkin (1998) use a probit model to evaluate the usefulness of financial variables to predict U.S. recessions, both in- and out-of-sample. Their full sample begins in 1960:1 and ends in 1995:1, thereby covering a number of recessions. Their main findings are that stock prices are the best leading indicators of recessions at the 1- and 2-quarter horizons, while the slope of the yield curve is the best at horizons 3 to 8. The spread typically performs better by itself than in conjunction with other variables.

Following Estrella and Mishkin (1998), Bernard and Gerlach (1996) examine the ability of the term structure to predict recessions in eight countries (Belgium, Canada, France, Germany, Japan, the Netherlands, the United Kingdom and the United States) between the period 1972:1 and 1993:4. For all the countries, their study also shows that the yield curve provides information about the likelihood of future recessions up to eight-quarters ahead.

Lamy (1997) studies the capacity of a variety of macroeconomic indicators in predicting recessions in Canada using a probit model. He finds the Department of Finance index of leading indicators of economic activity and the Bank of Canada nominal monetary conditions index to be strongest at predicting recessions for a forecast horizon of one quarter. At the horizon of two to four quarters, he finds the yield curve to be the best variable to predict recessions.

3.0 Methodology

To identify useful indicators of recessions, we follow loosely the NBER methodology in that we rely on statistical criteria to rank the usefulness of each variable. This section presents the models to be estimated, as well as the measure of goodness-of-fit employed. The models are closely related to those of Estrella and Mishkin (1998).

The dependent variable (R_t) in our models takes on two possible values: 1 if the economy is in a recession in period t, and 0 otherwise. A standard linear regression model would be

$$R_t = \alpha_0 + \alpha_1 X_{t-k} + \varepsilon_t \tag{1}$$

where $X_{t\text{-}k}$ is the explanatory variable at time t-k. However, such a model would be inappropriate given a binary dependant variable[1]. A probit model, which is one of the ways to estimate a binary response model, is recommended. The form of the estimated equation becomes:

$$P(R_t = 1) = F(\alpha_0 + \alpha_1 X_{t-k}) \tag{2}$$

where the parameters are estimated using maximum likelihood, and F is the normal cumulative distribution, given as:

$$F(\alpha_0 + \alpha_1 X_{t-k}) = \int_{-\infty}^{(\alpha_0 + \alpha_1 X_{t-k})} \frac{1}{\sqrt{2\pi}} e^{(-z^2)/2} dz \quad . \tag{3}$$

The coefficients, α_0 and α_1, of the model are usually estimated by using numerical methods to maximize the log-likelihood function, which is defined as:

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1. In the words of Greene (1993:637), such a model would produce nonsense probabilities and negative variances.

$$\log(L(R, \alpha_0, \alpha_1)) = \sum_{t=1}^{N} (R_t \log((F(\alpha_0 + \alpha_1 X_{t-k})) + (1 - R_t)\log(1 - F(\alpha_0 + \alpha_1 X_{t-k})))) \quad (4)$$

A number of goodness-of-fit measures, analogous to the coefficient of determination (R^2) in linear regression models, have been proposed for probit models. One such measure, which has been developed by Estrella (1995), is the pseudo-R^2 statistic and is defined as:

$$pseudo - R^2 = 1 - \left(\frac{\log L_u}{\log L_c}\right)^{-\frac{2}{n}\log L_c} \quad (5)$$

where L_u is the value of the likelihood of the estimated model and L_c is the value of a model containing only the constant term. The particular strength of the above measure is that, according to Estrella and Mishkin (1998), it corresponds more closely to the linear R^2 when its values are away from the end-points 0 and 1. We shall employ this measure to gauge the performance of each indicator variable.

Lastly, to determine whether α_1 in (2) is statistically different from 0, we use a statistic analogous to the t-statistic in linear models. The parameter is statistically significant at the 5% level if the t-stat exceeds 1.985.

4.0 Empirical Results

4.1 The Data and their Properties

In this section we present our results for both the in-sample and out-of-sample estimates.

The variables we examine in this paper are nominal Canadian and U.S. interest rates; interest rate spreads; nominal stock indexes; real stock indexes; and seven additional variables, consisting of money and stock performance indicators. The data set spans 1957:1 to 1996:4.

The recession dates were obtained from Cross (1988) and Macklem, Paquet and Phaneuf (1995). The recession dates in our sample are: 1957:1 - 1957:4; 1960:2 - 1961:1; 1974:2 - 1975:1; 1980:1 - 1980:2; 1981:3 - 1982:4; 1990:2 - 1991:1. Thus, our dependent variable, R_t, takes the value of 1 during each of these periods, and 0 otherwise.

Before performing the econometric exercise, we visually analysed the relationship between real GDP, on one hand, and three variables: the spread between the yield on Canadian long bonds and the 90-day commercial paper rate (S10M90), the M1 and the Toronto Stock Exchange's composite-index deflated by the CPI (RTSE). Figure 1 plots the 4-quarter growth rate of Canadian real GDP against S10M90 lagged four quarters. The graph shows that there is a strong correlation between the spread and output. In figures 2 and 3 are the 4-quarter growth rate of Canadian real GDP and the 4-quarter growth of RTSE lagged two quarters and the 4-quarter growth rate of M1 lagged two quarters. Like the spread, the real TSE index and M1 are linked quite closely to economic activity in Canada. It is evident from these graphs that all three variables provide leading information for real economic activity in Canada.

4.2 In-Sample

Tables 1 to 5 present the results for the in-sample estimates. Two results are provided in the Tables: a pseudo-R^2 statistic and the p-value for the likelihood ratio test on the significance of the variable being analysed. The performance of each variable is assessed by the magnitude of the pseudo-R^2.

Table 4.1 below lists the top three indicators based on the highest pseudo-R^2 at each forecasting horizon (detailed results can be found at the back of the paper). Over all, we find that the differential between yields on ten-year-plus Government of Canada bonds and ninety-day commercial paper is best at predicting Canadian recessions up to five quarters. This is in line with earlier studies in the literature that find this variable to be a good predictor of economic activity. Beyond five quarters, we observe that the oil and gas stock-index, deflated by the CPI, is the best predictor. At the 12-quarter horizon, it is rather surprising to note that the differential between the yields on US 10-year bond and Canadian 90-day commercial paper is the best distant-early warning indicators of Canadian recessions.

Table 4.1 : In-sample results of three best models that predict Canadian recessions at various horizons (based on pseudo-R^2)[a]

Rank / Horizon (k)	1st	2nd	3rd
1	US 10-year less Cdn CP90, MA(4) 0.397	10-year + less CP90, MA(4) 0.358	US 10-year less Cdn CP90 0.213
2	10-year + less CP90, MA(4) 0.349	US 10-year less Cdn CP90, MA(4) 0.340	10-year + less CP90 0.305
3	10-year + less CP90 0.326	10-year + less CP30 0.304	US 10-year less CP90 0.276
4	10-year + less CP90 0.235	10-year + less CP30 0.217	US 10-year less Cdn CP90 0.190
5	10-year + less CP90 0.167	10-year + less CP30 0.148	us 10-year less CP90 0.123
6	Real Oil & Gas 0.139	US Fed Funds 0.085	10-year + less CP90 0.068
7	Real Oil & Gas 0.128	P/E Ratio 0.059	US Fed Funds 0.044
8	Real Oil & Gas 0.112	P/E Ratio 0.071	US Fed Funds 0.018
12	US 10-year less Cdn CP90 0.065	P/E Ratio 0.045	Real Metals & Minerals 0.032

a. (Pseudo-R^2 in each cell)

Although the term spread clearly dominates all other variables examined up to five quarters, it is worth mentioning that the one-quarter growth of real M1 performs reasonably well in predicting Canadian recessions in the short run. (See Table 5.) This result also supports the view that, in the short run, real M1 growth is a good predictor of economic activity. The view that the stock market is a good predictor of economic activity is not supported by our results.

Figure 4 plots the in-sample probability of a recession occurring at time *t*, with forecasts having been made a year ago (four quarters before), based on the term spread. The graph depicts that the term structure is good at predicting recessions in Canada.

4.3 Out-of-Sample Results

To generate the out-of-sample results we initially estimate each model from 1957:1+*k* to 1969:4. Using the estimated parameters α_0 and α_1 we forecast the probability of a recession occurring at time *t*. We then augment the sample by 1 quarter, re-estimate the model, and use the new parameter estimates to generate a forecast of a recession at time *t*+1. We continue this process until we reach 1996:4. In this way, the procedure mimics what a statistical model would have predicted with the information available at any point in the past. The sequences of *k*-quarter forecasts of the probability of a recession are then used to compute pseudo-R^2 statistics, and the performance of each variable is gauged by the strength of the pseudo-R^2. Detailed results are reported in the Tables at the back of the paper.

It must be noted that this process of assessing the out-of-sample performance of models suffers from a number of drawbacks. First, the pseudo-R^2 may not lie between 0 and 1. Second, statistical tests of significance of the variables no longer exist. As explained by Estrella and Mishkin, these problems are not the consequence of the probit form, for they apply to the predictions based on other linear regressions. In the table of results, we only report non-negative pseudo-R^2s.

Based on the pseudo-R^2, the three indicator models that performed best at each horizon are reported in Table 4.2, below. The results, which confirmed the in-sample results, suggest that the spread is the best predictor of Canadian recessions up to five quarters. Beyond the five-quarter horizon none of the models could be recommended since their computed pseudo-R^2 were negative. The results for the term spread again reinforce the findings in the literature that it is a good predictor of economic activity. We must mention that our results corroborate those of Estrella and Mishkin who find the US spread (10-year Treasury bond less 3-month bill) to be a good predictor of U.S. recessions.

Table 4.2 : Out-of-sample results of three best models that predict Canadian recessions at various horizons (based on pseudo-R^2)[a]

Rank / Horizon (k)	1st	2nd	3rd
1	10-year + less CP90, MA(4) 0.490	US 10-year less Cdn CP90 0.412	10-year + less CP90 0.289
2	10-year + less CP90, MA(4) 0.443	10-year + less CP90 0.404	10-year + less CP30 0.382
3	10-year + less CP90 0.412	10-year + less CP30 0.382	US 10-year less Cdn CP90 0.303
4	10-year + less CP90 0.261	10-year + less CP30 0.236	US 10-year less Cdn CP90 0.173
5	10-year + less CP90 0.164	10-year + less CP30 0.138	US 10-year less Cdn CP90 0.091

a. (Pseudo-R^2 in each cell)

Besides the spread, we note that the one-quarter growth of real M1 performs well in predicting recessions up to four quarters; (see Table 8) again supporting the view that this aggregate is a good predictor of real output in the short run.

Based on the spread, Figure 5 plots the out-of-sample probability of a recession occurring at time *t*, with forecasts having been made a year ago (four quarters before). The graph clearly shows that the slope of the yield curve provides good information on the likelihood of a recession in Canada.

5.0 Conclusion

This paper examines the performance of selected financial variables in predicting recessions in Canada. Results in the paper show that, in comparison to other financial variables, the spread between Canadian long bonds and the 90-day commercial paper rate is best at predicting recessions in Canada. Our results support the findings of Estrella and Mishkin (1998) for the U.S., who find the interest rate spread to be a good predictor of U.S. recessions. We note that the TSE-index was not observed to provide any useful information for recessions.

One drawback of the model used here is the lack of a dynamic structure. The model fail to tell us how the probabilities of recession may be influenced by the current state of the business cycle. For example, if the economy is currently in a recessionary state then the probability of future recession or recovery may be influenced by the fact that the economy is in a recession. To address this drawback, one might want to include a lag dependent variable in the probit model. A richer analysis may be conducted that uses of the probit model within a framework of regime switching.

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Figure 1: Four-quarter growth of GDP and S10M90 (lagged four quarters)

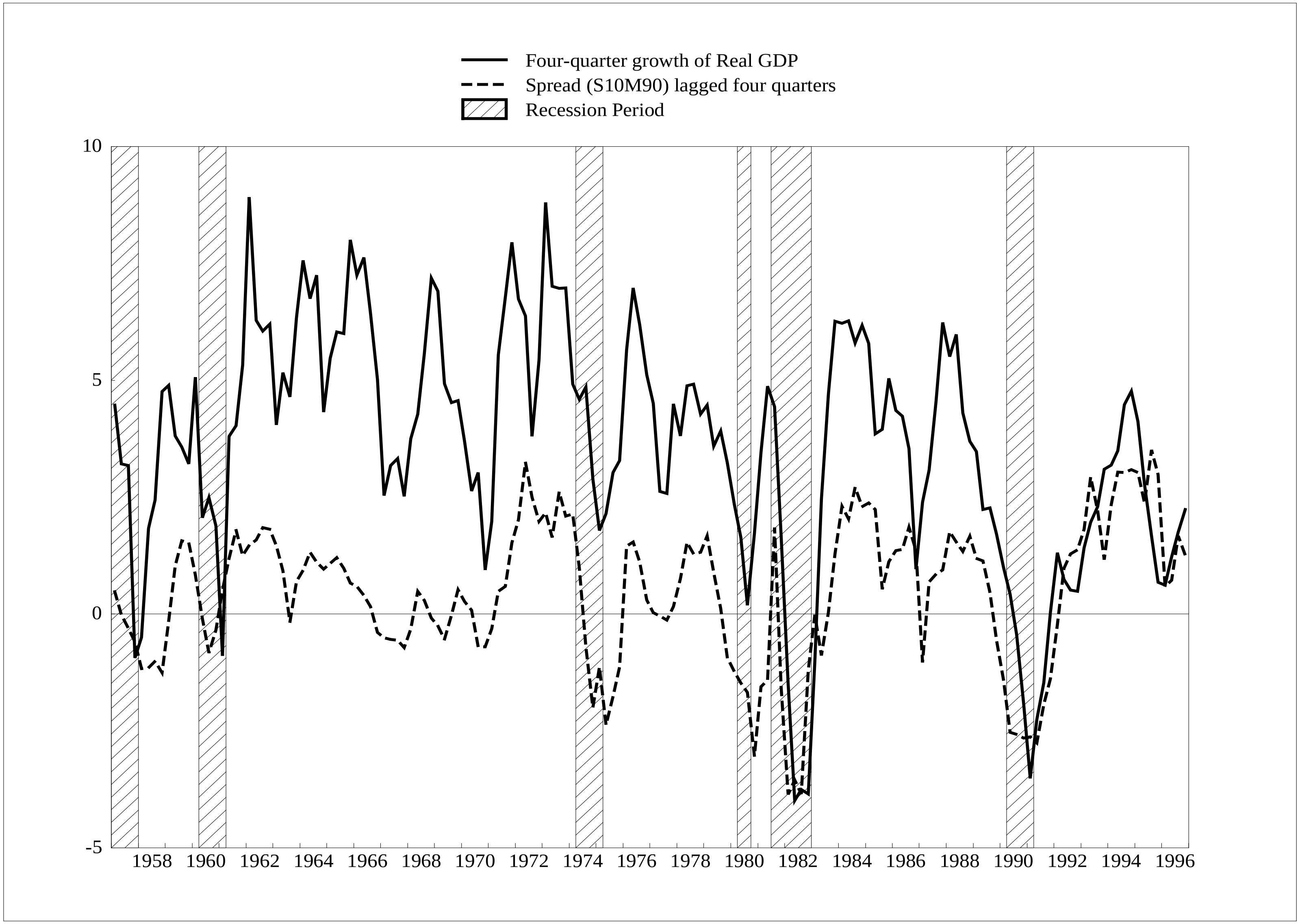

Figure 2: Four-quarter growth of GDP and four-quarter growth of real TSE-composite-index (lagged two quarters)

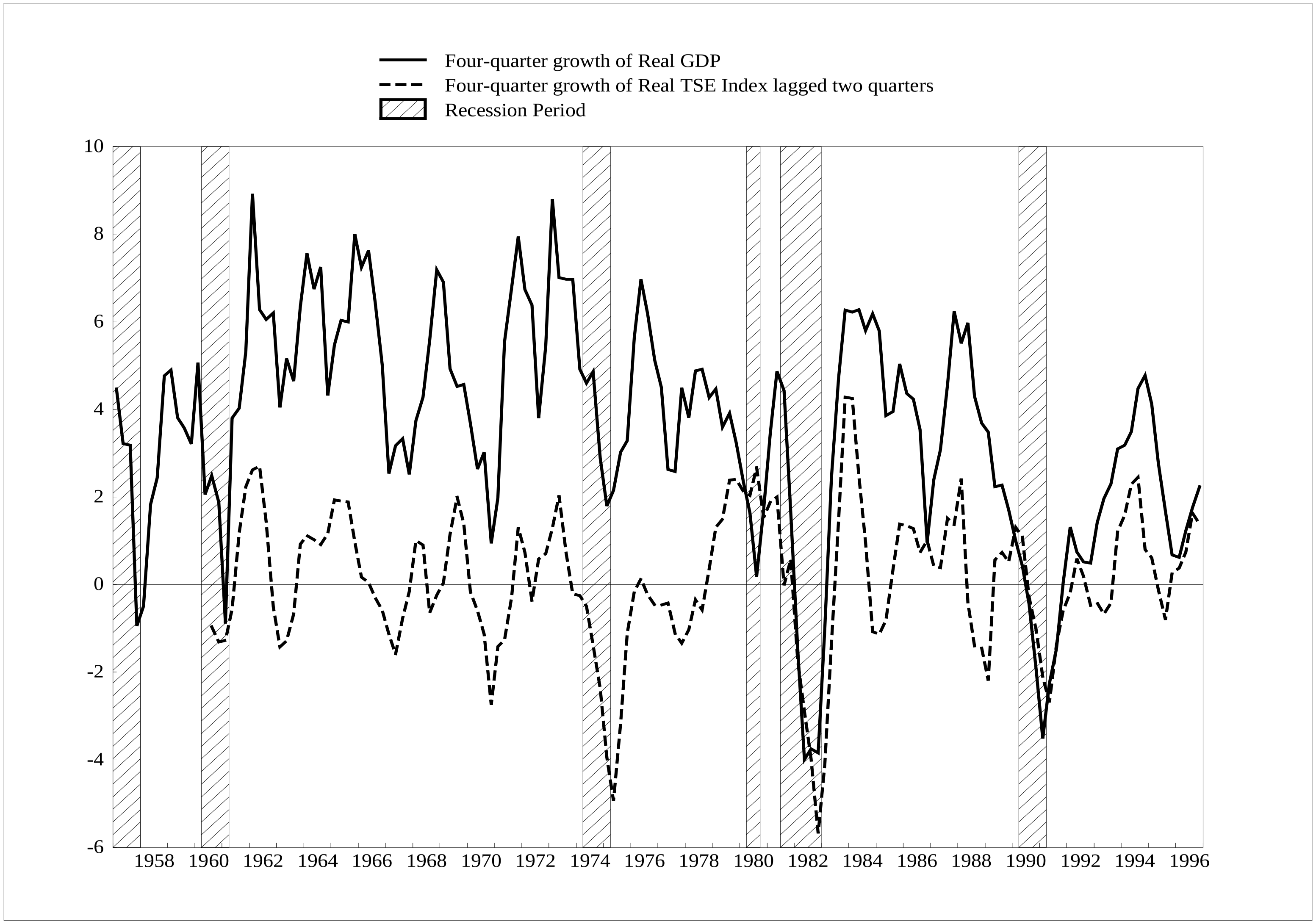

Figure 3: Four-quarter growth of GDP and four-quarter growth of M1 (lagged two quarters)

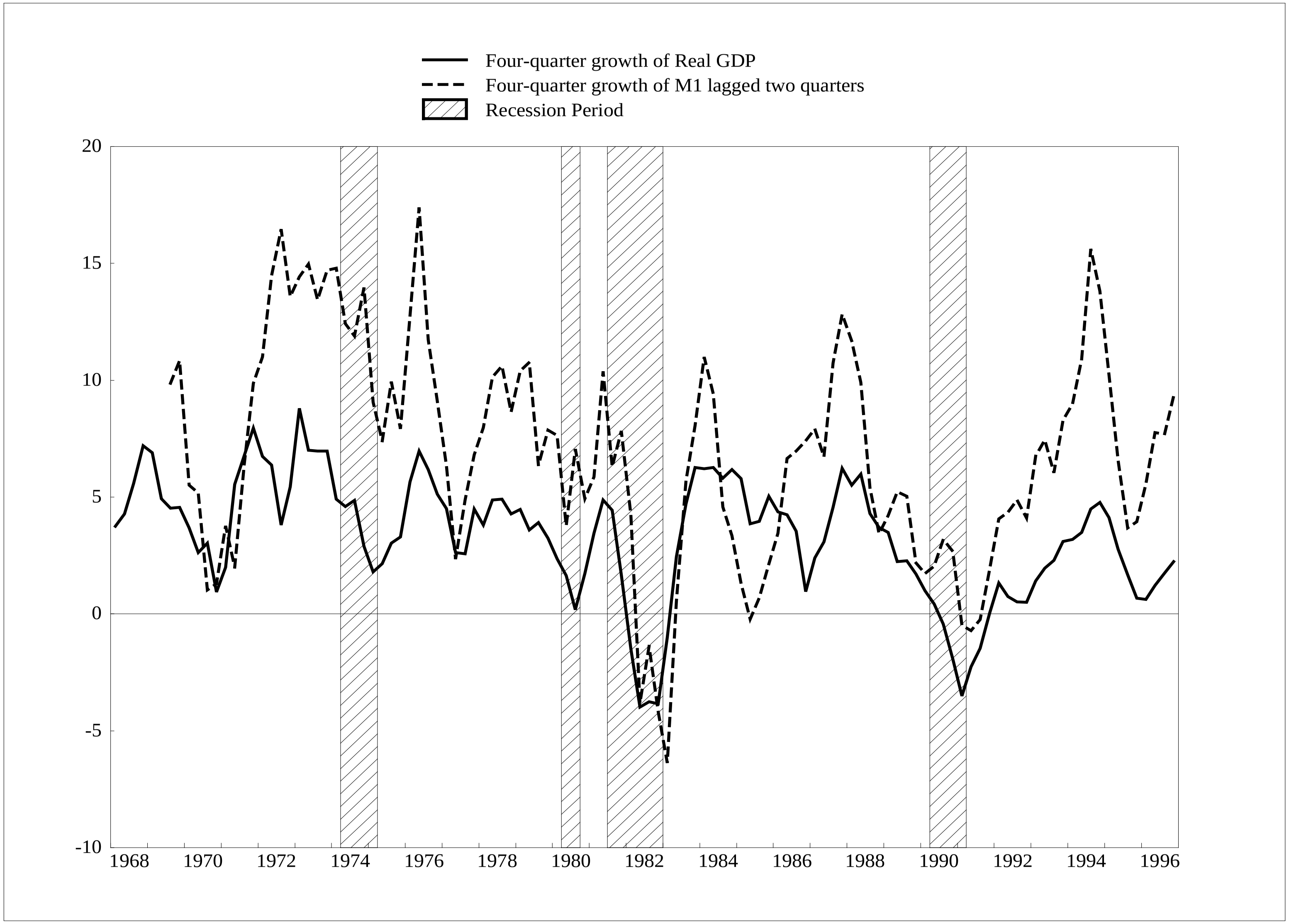

Figure 4: 4-Quarter In-Sample Forecast of the Probability of a Recession, Using 10-year + Less 90-day CP Spread (S10M90)

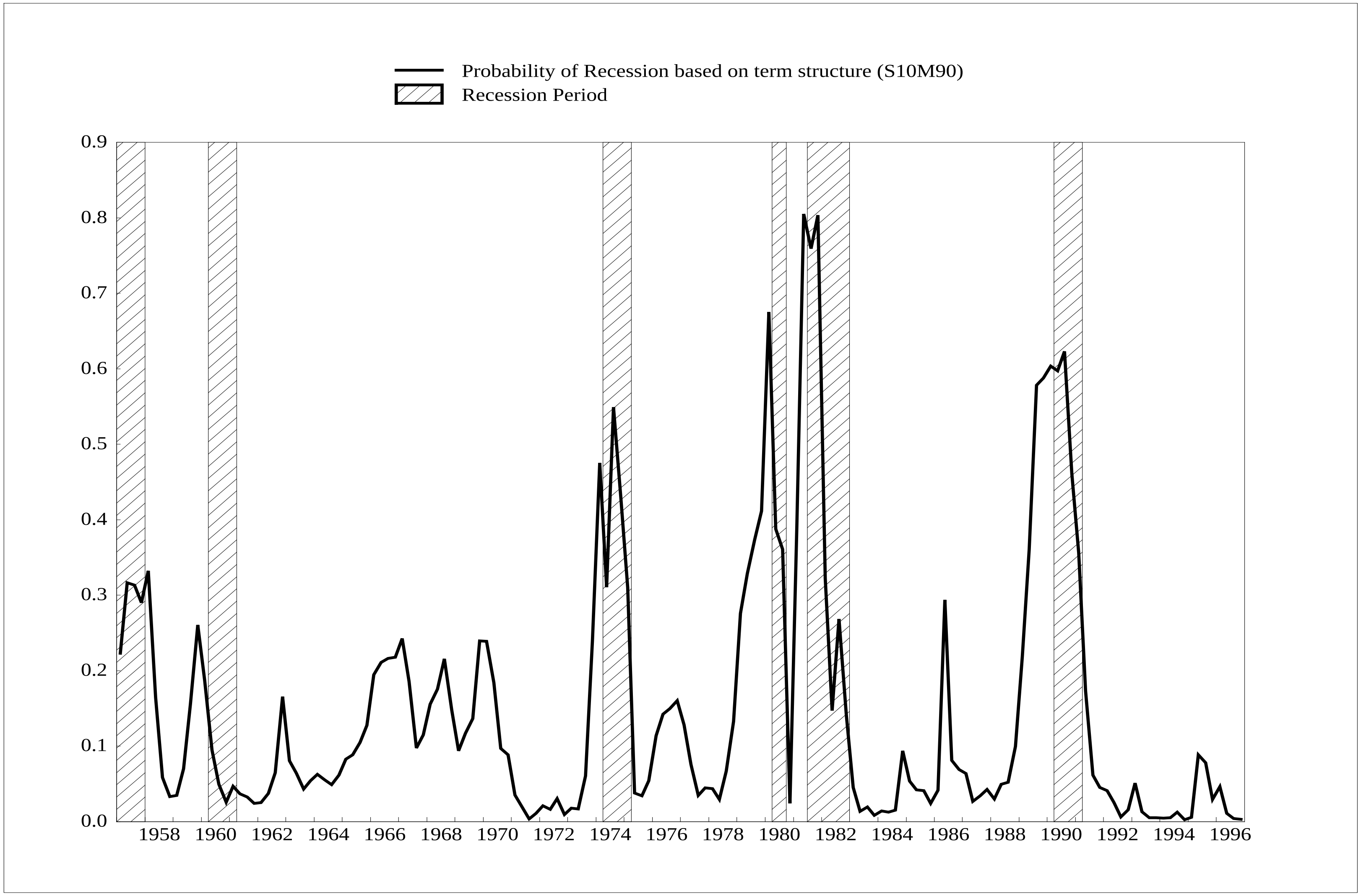

Figure 5: 4-Quarter Out-of-Sample Forecast of the Probability of a Recession, Using 10-year + Less 90-day CP Spread (S10M90)

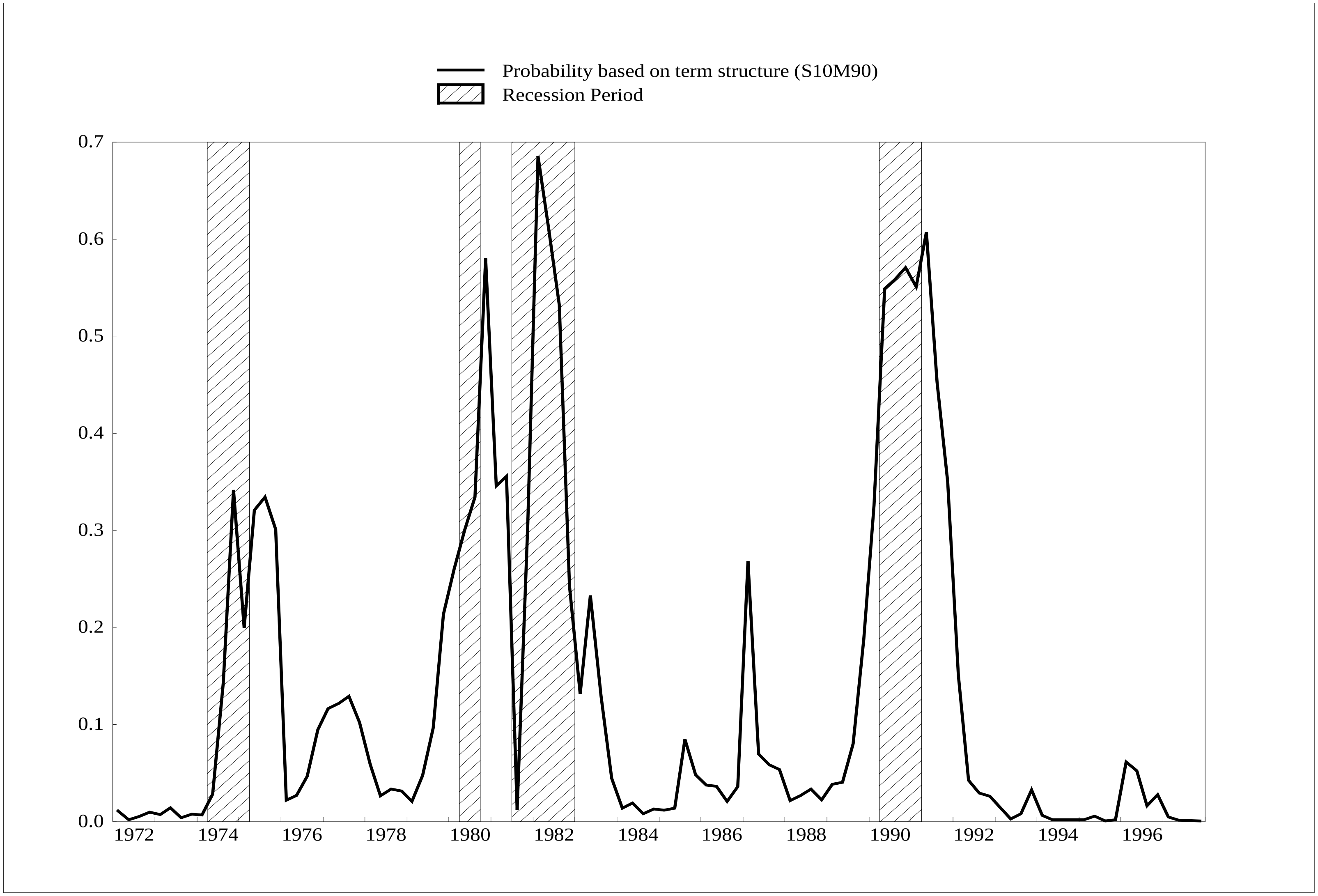

Table 1: Nominal Interest Rates
(In-Sample; 1957:1+*k* to 1996:4)

Rate	Number of lags (*k*)								
	1	2	3	4	5	6	7	8	12
30-day CP	0.128 (0.000)	0.149 (0.000)	0.147 (0.000)	0.124 (0.000)	0.085 (0.000)	0.039 (0.014)	0.014 (0.141)	0.003 (0.516)	0.001 (0.753)
90-day CP	0.132 (0.000)	0.153 (0.000)	0.153 (0.000)	0.130 (0.000)	0.092 (0.000)	0.045 (0.009)	0.017 (0.111)	0.004 (0.453)	0.000 (0.811)
1 to 3-year bonds	0.085 (0.000)	0.089 (0.000)	0.086 (0.000)	0.078 (0.001)	0.059 (0.003)	0.036 (0.019)	0.018 (0.099)	0.008 (0.282)	0.000 (0.881)
3 to 5-year bonds	0.074 (0.001)	0.075 (0.001)	0.071 (0.001)	0.065 (0.002)	0.047 (0.007)	0.028 (0.038)	0.014 (0.140)	0.007 (0.315)	0.000 (0.814)
5 to 10-year bonds	0.058 (0.002)	0.058 (0.002)	0.054 (0.004)	0.051 (0.005)	0.035 (0.020)	0.021 (0.075)	0.010 (0.208)	0.005 (0.405)	0.001 (0.649)
10-year + bonds	0.047 (0.006)	0.045 (0.008)	0.041 (0.011)	0.040 (0.013)	0.027 (0.040)	0.017 (0.111)	0.009 (0.232)	0.005 (0.388)	0.001 (0.644)
US Fed Funds	0.100 (0.000)	0.133 (0.000)	0.151 (0.000)	0.142 (0.000)	0.121 (0.000)	0.085 (0.000)	0.044 (0.010)	0.018 (0.100)	0.000 (0.970)
US 10-year bonds	0.039 (0.013)	0.040 (0.012)	0.043 (0.010)	0.045 (0.008)	0.035 (0.021)	0.026 (0.044)	0.017 (0.107)	0.008 (0.277)	0.000 (0.889)

The first number in each cell is the pseudo-R^2 statistic proposed by Estrella (1995); the numbers in parentheses are the p-values from likelihood ratio tests for testing the significance of each variable. The lower the p-value, the more significant the variable.

Table 2: Interest Rate Spreads and Moving Averages
(In-sample; 1957:1+k to 1996:4)

Rate	Number of lags (k)								
	1	2	3	4	5	6	7	8	12
10-year + less 30-day CP	0.205 (0.000)	0.293 (0.000)	0.304 (0.000)	0.217 (0.000)	0.148 (0.000)	0.053 (0.004)	0.011 (0.192)	0.000 (0.981)	0.000 (0.915)
10-year + less 90-day CP	0.213 (0.000)	0.305 (0.000)	0.326 (0.000)	0.235 (0.000)	0.167 (0.000)	0.068 (0.001)	0.016 (0.123)	0.000 (0.866)	0.001 (0.767)
US 10-year less Cdn 30-day CP	0.214 (0.000)	0.276 (0.000)	0.254 (0.000)	0.173 (0.000)	0.108 (0.000)	0.028 (0.038)	0.003 (0.536)	0.001 (0.716)	0.001 (0.657)
US 10-year less Cdn 90-day CP	0.227 (0.000)	0.293 (0.000)	0.276 (0.000)	0.190 (0.000)	0.123 (0.000)	0.037 (0.017)	0.004 (0.411)	0.000 (0.848)	0.001 (0.782)
US 10-year less Cdn 10-year +	0.020 (0.072)	0.008 (0.262)	0.000 (0.974)	0.002 (0.574)	0.009 (0.229)	0.036 (0.018)	0.038 (0.017)	0.010 (0.216)	0.025 (0.057)
10-year + less 90-day CP, MA(4)	0.358 (0.000)	0.349 (0.000)	0.248 (0.000)	0.131 (0.000)	0.052 (0.005)	0.012 (0.180)	0.002 (0.609)	0.000 (0.839)	0.000 (0.787)
US 10-year less Cdn 90-day CP, MA(4)	0.397 (0.000)	0.340 (0.000)	0.215 (0.000)	0.095 (0.000)	0.036 (0.020)	0.010 (0.225)	0.006 (0.354)	0.006 (0.350)	0.065 (0.002)

The first number in each cell is the pseudo-R^2 statistic proposed by Estrella (1995); the numbers in parentheses are the p-values from likelihood ratio tests for testing the significance of each variable. The lower the p-value, the more significant the variable.

Table 3: Nominal Stock Prices (TSE 300 and some Subgroups)
(In-sample; 1957:1+*k* to 1996:4)

Index	Number of lags (*k*)								
	1	2	3	4	5	6	7	8	12
TSE 300	0.009 (0.227)	0.002 (0.538)	0.000 (0.999)	0.001 (0.645)	0.002 (0.627)	0.001 (0.699)	0.000 (0.888)	0.000 (0.949)	0.002 (0.570)
Oil & Gas	0.002 (0.571)	0.007 (0.282)	0.016 (0.111)	0.029 (0.035)	0.029 (0.035)	0.027 (0.041)	0.021 (0.073)	0.016 (0.123)	0.000 (0.970)
Metals & Minerals	0.011 (0.194)	0.003 (0.509)	0.000 (0.954)	0.002 (0.566)	0.003 (0.487)	0.002 (0.548)	0.000 (0.861)	0.000 (0.866)	0.010 (0.215)
Utilities	0.027 (0.039)	0.017 (0.101)	0.008 (0.263)	0.004 (0.423)	0.004 (0.407)	0.005 (0.391)	0.007 (0.308)	0.007 (0.309)	0.004 (0.460)
Paper & Forest	0.011 (0.177)	0.003 (0.484)	0.000 (0.973)	0.001 (0.718)	0.002 (0.620)	0.001 (0.704)	0.000 (0.991)	0.000 (0.789)	0.000 (0.998)
Merchandising	0.012 (0.168)	0.004 (0.409)	0.000 (0.802)	0.000 (0.864)	0.000 (0.826)	0.000 (0.899)	0.000 (0.910)	0.001 (0.728)	0.005 (0.400)
Financial Services	0.015 (0.121)	0.005 (0.397)	0.000 (0.890)	0.001 (0.699)	0.001 (0.660)	0.001 (0.749)	0.000 (0.943)	0.000 (0.821)	0.003 (0.514)
Gold & Silver	0.005 (0.360)	0.001 (0.635)	0.001 (0.994)	0.001 (0.667)	0.001 (0.748)	0.000 (0.845)	0.000 (0.933)	0.000 (0.981)	0.000 (0.991)

The first number in each cell is the pseudo-R^2 statistic proposed by Estrella (1995); the numbers in parentheses are the p-values from likelihood ratio tests for testing the significance of each variable. The lower the p-value, the more significant the variable.

Table 4: Real Stock Prices (TSE 300 and some Subgroups)
(Deflated by CPI; In-sample; 1957:1+*k* to 1996:4)

Index	Number of lags (*k*)								
	1	2	3	4	5	6	7	8	12
TSE 300	0.079 (0.000)	0.021 (0.069)	0.000 (0.950)	0.010 (0.213)	0.020 (0.082)	0.021 (0.075)	0.009 (0.231)	0.002 (0.555)	0.012 (0.190)
Oil & Gas	0.013 (0.144)	0.034 (0.020)	0.065 (0.002)	0.105 (0.000)	0.124 (0.000)	0.139 (0.000)	0.128 (0.000)	0.112 (0.000)	0.013 (0.173)
Metals & Minerals	0.031 (0.027)	0.013 (0.148)	0.003 (0.502)	0.000 (0.787)	0.000 (0.961)	0.000 (0.866)	0.004 (0.442)	0.011 (0.206)	0.032 (0.030)
Utilities	0.044 (0.008)	0.041 (0.011)	0.037 (0.016)	0.038 (0.015)	0.032 (0.026)	0.027 (0.042)	0.026 (0.048)	0.023 (0.065)	0.007 (0.298)
Paper & Forest	0.026 (0.044)	0.006 (0.333)	0.000 (0.989)	0.001 (0.716)	0.004 (0.437)	0.002 (0.599)	0.001 (0.744)	0.007 (0.292)	0.009 (0.244)
Merchandising	0.090 (0.000)	0.035 (0.018)	0.005 (0.366)	0.001 (0.727)	0.006 (0.332)	0.009 (0.239)	0.005 (0.369)	0.001 (0.702)	0.014 (0.153)
Financial Services	0.113 (0.000)	0.024 (0.050)	0.000 (0.888)	0.018 (0.094)	0.033 (0.023)	0.035 (0.021)	0.021 (0.074)	0.007 (0.288)	0.002 (0.555)
Gold & Silver	0.002 (0.604)	0.000 (0.904)	0.005 (0.369)	0.017 (0.100)	0.013 (0.150)	0.011 (0.202)	0.008 (0.282)	0.005 (0.376)	0.000 (0.918)

The first number in each cell is the pseudo-R^2 statistic proposed by Estrella (1995); the numbers in parentheses are the p-values from likelihood ratio tests for testing the significance of each variable. The lower the p-value, the more significant the variable.

Table 5: Money, Prices and Stock Performance Indicators
(Real M1 deflated by CPI; In-sample; 1957:1+*k* to 1996:4)

Variable	Number of lags (*k*)								
	1	2	3	4	5	6	7	8	12
M1	0.002 (0.573)	0.000 (0.853)	0.000 (0.829)	0.002 (0.550)	0.002 (0.546)	0.002 (0.549)	0.002 (0.576)	0.002 (0.616)	0.000 (0.873)
Real M1	0.015 (0.128)	0.003 (0.484)	0.000 (0.868)	0.006 (0.343)	0.010 (0.204)	0.015 (0.123)	0.018 (0.098)	0.018 (0.095)	0.008 (0.273)
1-quarter growth of real M1	0.183 (0.000)	0.184 (0.000)	0.089 (0.000)	0.106 (0.000)	0.077 (0.001)	0.019 (0.087)	0.004 (0.434)	0.006 (0.322)	0.000 (0.828)
Stock dividend yield	0.116 (0.000)	0.047 (0.007)	0.007 (0.291)	0.000 (0.895)	0.004 (0.457)	0.007 (0.287)	0.003 (0.470)	0.000 (0.885)	0.008 (0.282)
Price / Earnings Ratio	0.099 (0.000)	0.086 (0.000)	0.069 (0.001)	0.057 (0.003)	0.051 (0.005)	0.055 (0.004)	0.064 (0.002)	0.071 (0.001)	0.045 (0.010)

The first number in each cell is the pseudo-R^2 statistic proposed by Estrella (1995); the numbers in parentheses are the p-values from likelihood ratio tests for testing the significance of each variable. The lower the p-value, the more significant the variable.

Table 6: Nominal Interest Rates
(Out-of-sample 1969:4+*k* to 1996:4; Initial sample 1957:1+*k* to 1969:4)

Rate	Number of lags (*k*)								
	1	2	3	4	5	6	7	8	12
30-day CP	0.113	0.090	0.076	0.034	--	--	--	--	--
90-day CP	0.121	0.093	0.091	0.046	0.009	--	--	--	--
1 to 3-year bonds	0.022	--	--	--	--	--	--	--	--
3 to 5-year bonds	0.014	--	--	--	--	--	--	--	--
5 to 10-year bonds	--	--	--	--	--	--	--	--	--
10-year + bonds	--	--	--	--	--	--	--	--	--
US Fed Funds	0.047	0.045	0.031	--	--	--	--	--	--
US 10-year bonds	--	--	--	--	--	--	--	--	--

The number in each cell is the pseudo-R^2 statistic proposed by Estrella (1995); (--) denotes a negative value.

Table 7: Interest Rate Spreads and Moving Averages
(Out-of-sample 1969:4+*k* to 1996:4; Initial sample 1957:1+*k* to 1969:4)

Rate	Number of lags (*k*)								
	1	2	3	4	5	6	7	8	12
10-year + less 30-day CP	0.274	0.382	0.382	0.236	0.138	--	--	--	--
10-year + less 90-day CP	0.289	0.404	0.412	0.261	0.164	--	--	--	--
US 10-year less Cdn 30-day CP	0.288	0.356	0.303	0.173	0.061	--	--	--	--
US 10-year less Cdn 90-day CP	0.311	0.384	0.337	0.199	0.091	--	--	--	--
US 10-year less Cdn 10-year +	--	--	--	--	--	--	--	--	--
10-year + less 90-day CP, MA(4)	0.490	0.443	0.279	0.086	--	--	--	--	--
US 10-year less Cdn 90-day CP, MA(4)	0.412	0.318	0.156	--	--	--	--	--	--

The number in each cell is the pseudo-R^2 statistic proposed by Estrella (1995); (--) denotes a negative value.

Table 8: Money, Prices and Stock Performance Indicators
(Real M1 deflated by CPI; Out-of-sample 1969:4+*k* to 1996:4; Initial sample 1957:1+*k* to 1969:4)

Variable	Number of lags (*k*)								
	1	2	3	4	5	6	7	8	12
M1	--	--	--	--	--	--	--	--	--
Real M1	--	--	--	--	--	--	--	--	--
1-quarter growth of real M1	0.230	0.215	0.021	0.013	--	--	--	--	--
Stock dividend yield	0.125	--	--	--	--	--	--	--	--
Price / Earnings Ratio	0.040	0.012	--	--	--	--	--	--	--

The number in each cell is the pseudo-R^2 statistic proposed by Estrella (1995); (--) denotes a negative value.

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