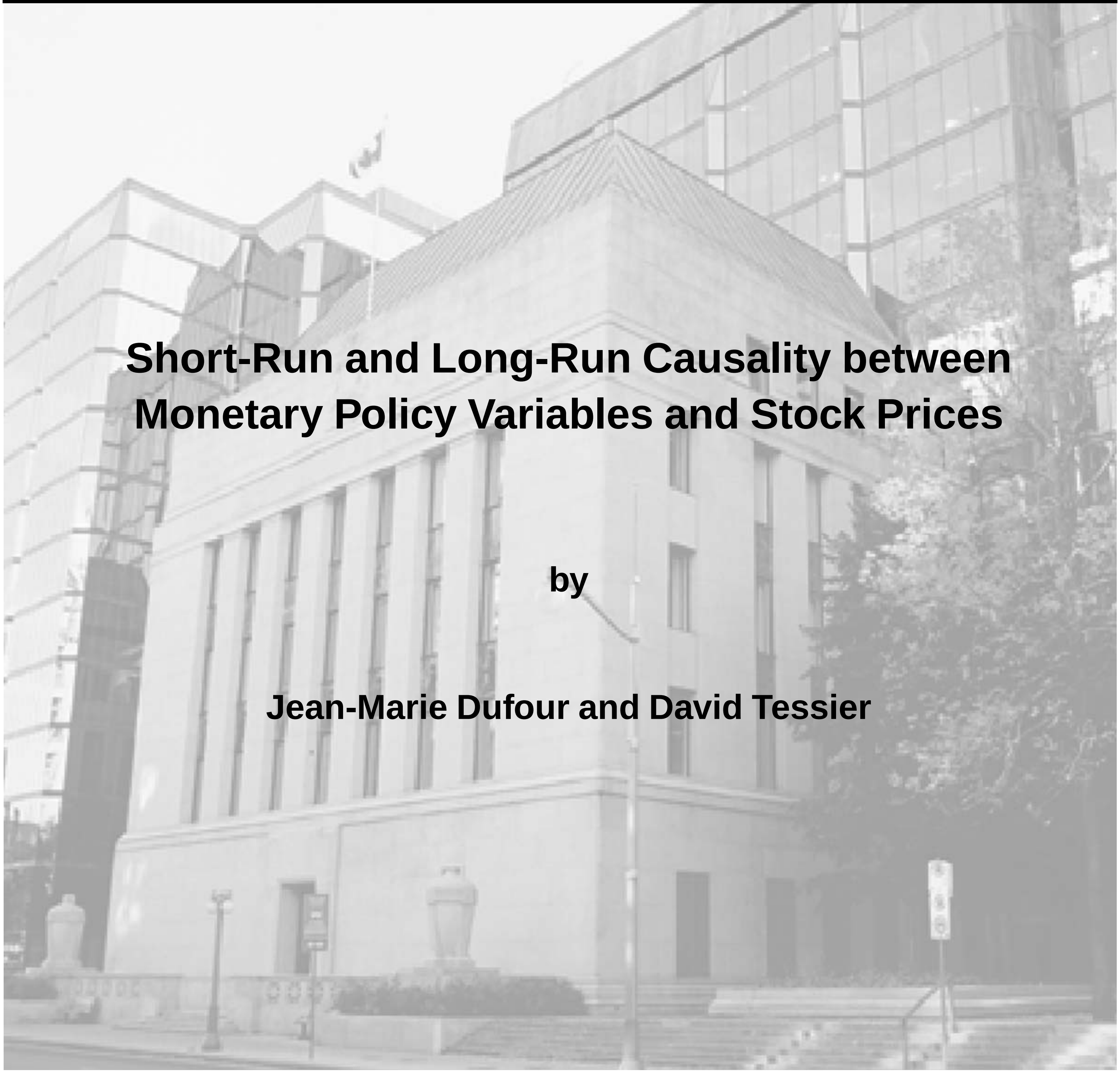
Bank of Canada Banque du Canada

Working Paper 2006-39 / Document de travail 2006-39



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ISSN 1192-5434

Printed in Canada on recycled paper

Bank of Canada Working Paper 2006-39

October 2006

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Acknowledgements

We would like to thank Pierre St-Amant and Greg Tkacz for useful comments, and Glen Keenleyside for editorial assistance. This work was supported by the Canada Research Chair Program, the Alexander von Humboldt Foundation (Germany), the Institut de Finance mathématique de Montréal, the Canadian Network of Centres of Excellence, the Canada Council for the Arts (Killam Fellowship), the Social Sciences and Humanities Research Council of Canada, and the Fonds de recherche sur la société et la culture (Quebec).

Abstract

The authors examine simultaneously the causal links connecting monetary policy variables, real activity, and stock returns. Their interest lies in the fact that the dynamics of asset prices can provide key insights—in terms of information—for the conduct of monetary policy, since asset prices constitute a class of potentially leading indicators of either economic activity or inflation. This is of particular interest in the context of an inflation-targeting regime, where the monetary policy stance is set according to inflation forecasts. While most empirical studies on causality have examined this issue using Granger's (1969) original definition, the authors examine the causality relations through the generalization proposed in Dufour and Renault (1998).

For the United States, the authors find no support for stock returns as a leading indicator of the macroeconomic variables considered, or for stock returns being influenced by those macroeconomic variables, except for one case: fluctuations in M1 tend to anticipate fluctuations in stock returns. Furthermore, the authors' empirical methodology allows them to infer that monetary aggregates may have significant predictive power for income and prices at longer horizons. It is therefore incorrect to dismiss the importance of monetary aggregates based on the usual Granger causality criteria. The causality pattern inferred by the authors' procedure is consistent with the Phillips curve (for the inflation dynamics) and with the Taylor rule in the case of the interest rate.

For Canada, the results are much different. The authors show that there is a potential role for asset prices as a predictor of some important macroeconomic variables, namely interest rates, inflation, and output at policy-relevant horizons. Furthermore, some measures of monetary aggregates tend to dominate the interest rate as robust causal variables for output growth and inflation. However, the authors do not find strong evidence in favour of the Phillips curve and the Taylor rule. Finally, for both Canada and the United States, the authors show that seasonal adjustments can highly distort the inferred causality structure.

JEL classification: C1, C12, C15, C32, C51, C53, E52
Bank classification: Monetary and financial indicators

Résumé

Les auteurs examinent les liens de causalité entre les variables de la politique monétaire, l'activité réelle et les rendements boursiers. Comme les prix d'actifs constituent une catégorie d'indicateurs avancés potentiels de l'activité économique ou de l'inflation, il se pourrait que la prise en compte de leur dynamique apporte une information utile pour la conduite de la politique monétaire. Cette question présente un intérêt tout particulier dans un régime de cibles d'inflation, où l'orientation de la politique monétaire est établie en fonction de l'inflation anticipée. La majorité des études empiriques sur la causalité ont pris pour point de départ la définition initiale de Granger (1969), mais les auteurs examinent ici les relations de causalité en partant de la définition plus générale proposée par Dufour et Renault (1998).

En ce qui concerne les États-Unis, les auteurs ne trouvent pas d'élément à l'appui de la thèse selon laquelle les rendements boursiers sont un indicateur avancé des variables macroéconomiques considérées ou sont influencées par celles-ci, sauf dans un cas : les fluctuations de M1 tendent en effet à précéder celles des rendements boursiers. Qui plus est, la méthodologie des auteurs les amène à penser que les agrégats monétaires pourraient permettre de prévoir assez bien l'évolution du revenu et des prix aux horizons éloignés. On aurait par conséquent tort de nier l'importance des agrégats monétaires en se fondant sur le test usuel de causalité de Granger. Le schéma de causalité que dégagent les auteurs est compatible avec l'existence d'une courbe de Phillips (pour la dynamique de l'inflation) et d'une règle de Taylor dans le cas du taux d'intérêt.

Les résultats sont très différents dans le cas du Canada. Les auteurs montrent que les prix d'actifs pourraient servir à prévoir l'évolution d'importantes variables macroéconomiques, à savoir les taux d'intérêt, l'inflation et la production, aux horizons pertinents pour la conduite de la politique monétaire. En outre, certains agrégats monétaires s'avèrent des variables causales plus robustes que le taux d'intérêt pour ce qui est de la croissance de la production et de l'inflation. Toutefois, les résultats des auteurs ne corroborent pas la validité de la courbe de Phillips et de la règle de Taylor. Enfin, il semble bien que l'emploi de données désaisonnalisées puisse grandement fausser les conclusions tirées au sujet des liens de causalité, aussi bien dans le cas du Canada que dans celui des États-Unis.

Classification JEL : C1, C12, C15, C32, C51, C53, E52
Classification de la Banque : Indicateurs monétaires et financiers

1. Introduction

In financial economics, there is an increasing interest in the relation between monetary policy and stock prices (Hunter, Kaufman, and Pomerleano (2005); White (2006)). While a part of the literature has investigated the potential response of asset prices to a change in monetary policy, a growing number of papers have debated the extent to which monetary policy should respond (Cecchetti, Genberg, and Wadhwani (2005)) or not (Goodfriend (2005)) to asset-price movements. Indeed, a developing bubble in stock prices can impair the functioning of the economy by promoting a misallocation of resources, and could provoke severe dislocations when it bursts. In that context, central banks should raise interest rates to deflate these potential bubbles. The latter point is, however, highly debatable: many would argue that bubbles probably do not exist, since rational market pressure always prices assets at their fundamental value.

Even if monetary policy and asset prices are not causally related, the dynamics of stock prices could still provide key insights—in terms of information— for the conduct of monetary policy (Stock and Watson (2003)). Indeed, asset prices tend to incorporate a forward-looking component and may provide leading indicators of economic activity or inflation. This could be attractive in the context of an inflation-targeting regime, where the monetary policy stance is set according to inflation forecasts.

In this paper, we study the causal links between monetary policy variables, real activity, and stock returns. Monetary policy operates through a large range of financial variables and, over the years, instruments used by central banks to achieve their objective have varied a lot. For example, in the 1970s, monetary policy was mainly conducted through open market operations in view of steering some reserve concept, which then affected monetary aggregates and ultimate goals. However, over the past 20 years, inflation has become the key variable as many central banks have adopted price stability and committed to keeping inflation under control at a relatively low level. Accordingly, short-term interest rates have replaced monetary aggregates as the main instrument to achieve monetary policy objectives. Given that our investigation covers a period of about 40 years, we interpret monetary policy broadly as including interest rate instruments (the federal funds rate in the United States, or the target for the overnight rate in Canada), monetary aggregates, and inflation.

We extend previous analysis in several ways. While most empirical studies on causality have examined this issue using the original definition of Granger (1969), we examine the causality relations through the generalization proposed in Dufour and Renault (1998). The concept of causality developed by Granger refers to the predictability of a variable $X(t)$, where t is an integer, from its own past, the one of another variable $Y(t)$ and possibly a vector $Z(t)$ of auxiliary variables, one period ahead. More precisely, we say that Y causes X in the sense of Granger if the observations of Y up to time t $(Y(\tau) : \tau \leq t)$ can help to predict $X(t+1)$ when the corresponding observations on X and Z are available $(Y(\tau), Z(\tau) : \tau \leq t)$. But some authors have noted that, in multivariate models, where a vector of auxiliary variables Z is used in addition to the variables of interest X and Y, it is possible that Y does not cause X in the sense of Granger—one period ahead—but can still help to predict X several periods ahead. Such a generalization allows for the possibility of distinguishing between short-run and long-run causality. This distinction is particularly relevant in view of the fact that monetary policy actions affect the economy with possibly long lags. An interest rate cut may not have its maximum impact on real output for 12 or even 18 months, and the effects on inflation may take longer. Furthermore, under inflation forecast targeting, the emphasis is on responding to forecasts of future inflation eight quarters ahead, so it would be interesting to infer which variables significantly cause inflation according to various horizons.

The statistical procedure we use for testing non-causality at various horizons was proposed by Dufour, Pelletier, and Renault (2006) in the context of finite-order vector autoregressive (VAR) models. In such models, the non-causality restrictions at horizon one take the form of relatively simple zero restrictions on the coefficients of the VAR. However, at higher horizons, non-causality restrictions are generally non-linear, taking the form of zero restrictions on multilinear forms in the coefficients of the VAR. When applying standard test statistics such as Wald-type criteria, such forms can easily lead to asymptotically singular covariance matrices, so that standard asymptotic theory would not apply to such statistics. Consequently, these authors propose simple tests that can be implemented only through linear regression methods. These tests are based on considering multiple-horizon vector autoregression (called $(p, h) - autoregressions$) where the parameters of interest can be estimated by linear methods. Restrictions of non-causality at various horizons may then be tested through simple Wald-type criteria after taking into account the fact that such autoregressions involve autocorrelated errors that are orthogonal to the regressors. The correction for the presence of autocorrelation in the errors may then be performed by using an heteroscedastic autocorrelation consistent (HAC) covariance matrix estimator. A second extension of this work is to use bootstrap methods to implement the proposed non-causality statistics. Given the presence of a large number of parameters (a typical feature within the VAR framework) that could alleviate the unreliability of asymptotic approximations, the use of finite-sample procedures turns out to be crucial.

Our main findings can be summarized as follows. For the United States, our study provides no support for stock returns as a leading indicator for the macroeconomic variables we consider, or for stock returns being influenced by those macroeconomic variables, except for one case: fluctuations in M1 tend to anticipate fluctuations in stock returns. Furthermore, our empirical methodology allows us to infer that monetary aggregates may have significant predictive power for income and prices at longer horizons, even though this conclusion is usually absent from the literature using standard Granger causality criteria. We can also mention that the causality pattern implied by our procedure is consistent with the Phillips curve (for the inflation dynamics), and with the Taylor rule in the case of the interest rate.

For Canada, the results are much different. First, we find that there is a potential role for asset prices as a predictor of some important macroeconomic variables, namely interest rates, inflation, and output at policy-relevant horizons. Furthermore, some measures of monetary aggregates tend to dominate the interest rate as robust causal variables for output growth and inflation. However, we do not find strong evidence in favour of the Phillips curve and the Taylor rule. Finally, for both Canada and the United States, we explicitly illustrate that the causality patterns can be highly distorted by the seasonal filterings.

In section 2, we present the model considered and describe the notion of autoregression at horizon h (called $(p, h) - autoregressions$), which is the basis of the statistical procedure. We then present the asymptotic distribution of the relevant non-causality tests at various horizons for stationary processes. In section 3, we describe the empirical framework and analyze our main results. Section 4 offers some conclusions.

2. Causality Testing at Different Horizons

In this section, we describe the statistical procedure proposed to test causality relationships at different horizons. To that end, we closely follow Dufour, Pelletier, and Renault (2006). Let us first describe the notion of "autoregression at horizon h" and the relevant notations. Consider a VAR (p) process of the form:

$$W(t) = \mu(t) + \sum_{k=1}^{p} \pi_k W(t-k) + a(t) \ , \quad t = 1, \ldots, T, \tag{1}$$

where $W(t) = \left(w_{1t}, w_{2t}, \ldots, w_{mt}\right)'$ is a random vector, $\mu(t)$ is a deterministic trend, and $a(t)$ is a white-noise process of order two with a non-singular variance-covariance matrix Ω.

The most common specification for $\mu(t)$ consists in assuming that $\mu(t)$ is a constant vector, although other deterministic trends—such as seasonal dummies—could also be considered.

The VAR (p) is an autoregression at horizon 1. This autoregressive form can be generalized to allow for projection at any horizon h given the information available at time t. Hence, the observation at time $t+h$ can be computed recursively from equation (1) and is given by:

$$W(t+h) = \mu^{(h)}(t) + \sum_{k=1}^{p} \pi_k^{(h)} W(t+1-k) + \sum_{j=0}^{h-1} \psi_j a(t+h-j) \,, \tag{2}$$

where $\psi_0 = I_m$ and $h < T$. The appropriate formulas for the coefficients $\pi_k^{(h)}$ and $\mu^{(h)}(t)$ are given in Dufour and Renault (1998), and the ψ_j matrices are the impulse-response coefficients of the process.

The above equation is called an "autoregression of order p at horizon h" or a "$(p,\, h)$-autoregression."

Let us consider equation (2) written under a more useful matrix form[1]:

$$W(t+h) = \overline{W}_p(h)\, \Pi^{(h)} + U(t+h) \,. \tag{3}$$

We can estimate this equation by ordinary least-squares (OLS), which yields the estimator:

$$\hat{\Pi}^{(h)} = \left[\overline{W}_p(h)' \, \overline{W}_p(h)\right]^{-1} \overline{W}_p(h)' \, W(t+h) \,, \tag{4}$$

hence

$$\sqrt{T}\,[\hat{\Pi}^{(h)} - \Pi^{(h)}] = \left[\frac{1}{T}\overline{W}_p(h)' \, \overline{W}_p(h)\right]^{-1} \frac{1}{\sqrt{T}} \overline{W}_p(h)' \, U(t+h) \,. \tag{5}$$

Under usual regularity conditions, we can show that $\sqrt{T}\, vec\left[\hat{\Pi}^{(h)} - \Pi^{(h)}\right]$ converges to a normal distribution with a non-singular covariance matrix.

In this paper, we are interested in the hypothesis that a variable w_{jt} does not cause another one, w_{it}, at horizon h, and the restrictions related to that hypothesis take the form:

$$H_0^{(h)} : \pi_{ijk}^{(h)} = 0 \,,\ k = 1, \ldots, p \,, \tag{6}$$

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[1] For a more detailed description of these expressions, the reader should consult Dufour, Pelletier, and Renault (2006).

where $\pi_k^{(h)} = \left[\pi_{ijk}^{(h)}\right]_{i,\, j=1, \ldots, m}$ comes from the "$(p,\, h)$-autoregression" defined in equation (2). In other words, the null hypothesis takes the form of a set of zero restrictions on the coefficients of the matrix $\hat{\Pi}^{(h)}$.

Under the hypothesis $H_0^{(h)}$ of non-causality at horizon h from w_{jt} to w_{it}, the asymptotic distribution of the Wald statistic $\mathcal{W}[H_0^{(h)}]$ is $\chi^2\,(p)$. In order to get an appropriate distribution, we have to take into account that the prediction error $\hat{u}\,(t+h)$ follows an MA$(h-1)$ process. To that end, we use the Newey-West procedure, which gives an automatically positive-semidefinite variance-covariance matrix.

The Gaussian asymptotic distribution provided may not be very reliable in finite samples, especially if we consider a VAR system with a large number of variables and/or lags. Due to autocorrelation, a larger horizon may also affect the size and the power of the test. An alternative to using the asymptotic chi-square distribution of $\mathcal{W}[H_0^{(h)}]$ consists in using Monte Carlo test techniques (see Dufour (2006)) or bootstrap methods. In view of the fact that the asymptotic distribution of $\mathcal{W}[H_0^{(h)}]$ is nuisance-parameter free, such methods yield asymptotically valid tests when applied to $\mathcal{W}[H_0^{(h)}]$, and typically provide a much better control of the test level in finite samples.

In the empirical study presented below, p-values are computed using a parametric bootstrap (i.e., an asymptotic Monte Carlo test based on a consistent point estimate). The number of replications is $N = 999$. The procedure can be described as follows:

(i) an unrestricted VAR(p) model is fitted for the horizon one, yielding the estimates $\hat{\Pi}^{(1)}$ and $\hat{\Omega}$ for $\Pi^{(1)}$ and $\Omega\,$;

(ii) an unrestricted (p, h)-autoregression is fitted by least squares, yielding the estimate $\hat{\Pi}^{(h)}$ of $\Pi^{(h)}$;

(iii) the test statistic $\mathcal{W}$ for testing non-causality at the horizon h is computed;

(iv) N simulated samples are drawn by Monte Carlo methods, using $\Pi^{(h)} = \hat{\Pi}^{(h)}$ and $\Omega = \hat{\Omega}$ (and the hypothesis that $a(t)$ is Gaussian); we then impose to $\hat{\Pi}^{(h)}$ the constraints of non-causality;

(v) the simulated p-value is obtained by calculating the rejection frequency.

3. Empirical Results

In order to examine the causality relationship between monetary policy and stock prices, the following variables are utilized: the logarithm of real GDP (Y); the logarithm of the monetary base (B); the logarithm of the M1 multiplier, M1/B ($MM1$); the logarithm of the consumer price index (P); the logarithm of the stock price index—Dow Jones for the United States, TSX for Canada (S)—and a short-term interest rate—federal funds rate in the United States, 3-month treasury bills in Canada (r). In the case of Canada, as a small open economy, we also add the log of the exchange rate. These series are quarterly and in order to get apparently stationary time series, they were all transformed by taking first differences. Consequently, with the exception of interest rates, the causality relations will have to be interpreted in terms of the growth rate of variables.

According to likelihood-ratio tests of K lags versus $K + 1$, a VAR(6) seems to be the most appropriate specification. The sample goes from 1968Q1 to 2005Q3 for both countries. As seasonal variations account for a large part of the variation in many macroeconomic time series, the dynamic structure of the series is likely to be altered by the way the seasonality pattern is specified. Official statistical agencies tend to produce seasonally adjusted series by applying the $X - 11$ filter, which uses information from both the past and future to filter out seasonal patterns. Therefore, these adjusted series may not properly reflect the true information structure, since they incorporate data not available when assessing projections. Given that Granger causality tests are essentially based on projections, such a filtering could distort the inferred causality structure. It will then be important to examine the robustness of our results to seasonality adjustments. The VAR models specified with unadjusted data include seasonal dummy variables, to remove the deterministic seasonal component. However, if the seasonal pattern is changing rather than constant over time, the inclusion of seasonal dummies may be insufficient and the VAR specification will have to be rich enough to include lags at the seasonal frequency.

We summarize the significant results by presenting horizons, from 1 to 8, that turn out to be significant at the 5 per cent and 10 per cent level.[2]

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[2] The entire set of p-values for all the non-causality tests is available from the authors.

3.1 United States

Consistent with the weakest form of market efficiency,[3] we cannot reject the hypothesis that stock returns are exogenous with respect to the rest of the system, in the sense that they do not cause and are not caused by the other variables (see Tables 1 and 2). The only robust exception appears to be the causality relation from the M1 multiplier, although this result is somewhat sensitive to the seasonal adjustment, since only horizons 4 (5 per cent) and 5 (10 per cent) turn out to be significant with unadjusted data. This example is particularly interesting because it explicitly exposes the effects of seasonal filtering on the dynamic properties of the series. Hence, in that specific case, the non-vanishing causality relations for horizons 1 to 3 might result from additional future information that is incorporated in the series through the seasonal filtering. A rationale for this significant causality relation could be that a money multiplier is directly linked to the liquidity in the economy and, when more liquidity is available, a part of it might flow into financial assets. This conjecture is often referred to as the *easy money channel*.

For real activity (output growth), the interest rate has strong statistically predictive power under both specifications. These results are consistent with the classical conclusion of Sims (1980), who shows that monetary aggregates have a lesser role once we include a measure of interest rates in the system.[4] For the longer horizons, our results also confirm the conclusion of Dufour, Pelletier, and Renault (2006) with monthly data on the strong influence of interest for almost every horizon. On the other hand, our results seem to contradict Lee (1992), who finds that stock returns are Granger causal to real activity. However, it is interesting to note that this result would have held if we had used the asymptotically critical value, with a p-value of 1.3 per cent. This example highlights the potential distortion implied by the use of asymptotic approximation. Since the Monte Carlo test procedure provides more conservative test results, we can be more confident that a significant causality relationship is in fact really significant.

For inflation, output growth appears to have the strongest influence over all the horizons, and thus provides support for Phillips curve dynamics. Furthermore, at horizon one, interest rates are highly statistically significant for inflation dynamics (similar to the result in Lee (1992)) with a p-value of 0.1 per cent.

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[3] Under that hypothesis, stock prices contain very little information and tend to follow a random walk.

[4] With unadjusted series, in addition to interest rates, the monetary base appears to have some explanatory power at longer horizons. We will see in a subsequent section the robustness of this result to alternative monetary aggregates.

For the interest rate, we find significant relationships running from output growth for the first two horizons. But with unadjusted series, in addition to output growth, inflation becomes significant for the first two horizons. These results seem to be consistent with a Taylor rule specification, in which interest rates are taken as determined by a measure of real activity (output gap) and inflation.

3.2 Canada

The results for Canada present a much different picture (see Tables 3 and 4). While for the U.S. case stock returns do not seem to contain much information, stock price returns in Canada appear to present some leading-indicator properties and thus reflect the forward-looking features of stock prices. Indeed, stock returns tend to include significant predictive power for inflation at longer horizons (from six to eight quarters), and this is robust to seasonal adjustments. Such a result is particularly interesting when we know the importance of inflation expectations around eight quarters ahead for the conduct of monetary policy. We also find significant causality relations running from stock prices into output growth at short horizons, although the evidence is weaker when we adjust for seasonal factors, with a significance level of 15 per cent. On the other hand, none of the variables that we consider provides any significant evidence that it can be useful for predicting stock returns.

Interest rate changes in Canada are much less predictable than they seem to be in the United States, where inflation and output growth are considered as important determinants at short-run horizons. Therefore, for Canada, at horizons 3 and 4, only stock returns seem to incorporate some predictive power. Though not really robust to seasonal adjustment, we can add that the monetary base appears to cause interest rate changes at horizons 2 and 3 (10 per cent level) with adjusted data.

The most striking result for Canada is the strong statistically causal relationship from the monetary base to output growth at many horizons under both specifications, whereas the causality relation running from the interest rate is significant only with unadjusted data. This conclusion somewhat contradicts the usual findings on the unimportance of monetary aggregates once we include a measure of interest rates in the system. However, it is interesting to note that, although interest rates do not cause output directly, they remain significantly causal for both the monetary base and the money multiplier, which in turn cause output. Therefore, interest rates may still have an indirect impact on output growth.

For inflation dynamics, in addition to stock returns, as noted earlier, the monetary base emerges as the most important determinant. Hence, we observe significant causal relations for horizons 6 to 8, and this suggests that monetary base growth could be useful in the monitoring of inflation at policy-relevant horizons. Notice that the Phillips curve dynamics for inflation, that appear to be so strong for U.S. inflation, are significant only when we use adjusted data.

Except for output growth at longer horizons (10 per cent level), nothing is causing exchange rates. On the other hand, as a causal variable, our results provide no clear evidence in terms of robust relations that could be meaningful.

3.3 Sensitivity analysis

This section verifies the robustness of our results for a different set of variables. It is nowadays generally agreed that the term spread is a relevant measure of the monetary policy stance and thus an important leading indicator for output growth. Therefore, we have included it in the specification, with the conclusion that the yield-curve evidence is very weak with our methodology. This result can be explained by the fact that the term spread incorporates an important time-varying risk premia that has been particularly volatile over our sample (especially during the 1970s), and renders this variable uninformative in terms of its marginal predictive content.[5] Consequently, we maintain the short-term interest rate in the specification, since it is likely less contaminated by the effects of the largely time-varying term premia.[6] The importance of some measures of monetary aggregates motivates asking whether our results would still be robust to alternative monetary measures and how they can affect the conclusions. Accordingly, we maintain a six-variable specification in which we replace the monetary base and the M1 multiplier by M1 and M2.

For the United States (see Tables 5 and 6), this new specification brings almost the same causality patterns and highlights the importance of M1 in the dynamics of output growth, whereas the role of M2 is somewhat negligible. For the interest rate, we notice that seasonal filterings tend to increase its importance to the detriment of monetary aggregates. Therefore, the usual conclusion in the literature about the dominance of the interest rate over money in the dynamics of output growth appears to be sensitive to seasonal filtering.[7] Furthermore, it is also worth noting that, under the usual Granger causality test (i.e., only the horizon one),

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[5] We have obtained the same uninformative conclusion with the inclusion of longer-term interest rates.

[6] It is quite obvious from our previous results that this measure of interest rates turns out to be very informative for both countries.

[7] The question about the most appropriate strategy to adopt in terms of seasonal filtering in the specification of a macroeconomic model is still an open question, but is beyond the scope of this paper.

monetary aggregates under both specifications are never significant. Therefore, focusing only on horizon one can dismiss important dynamic relationships that are evident in the real causality structure. Finally, this new specification is also consistent with the *easy money channel*, since M1 turns out to be very significant in the dynamics of stock returns. Although robust to filtering, working with raw data tends to push ahead the significant horizons.

For Canada (see Tables 7 and 8), this new specification including M1 and M2 strengthens the previous conclusion on the potential role of asset prices as a predictor of some important macroeconomic variables at policy-relevant horizons; i.e., six to eight quarters. Hence, this new set of results still provides strong evidence that stock returns may contain useful predictive information for the interest rate and inflation. We also confirm that the predictive ability of stock returns for output growth is highly sensitive to filtering, since it is significant only with unadjusted data. We also maintain the conclusion that monetary aggregates (namely M1) tend to dominate the interest rate as a robust predictor of output growth. But as the interest rate is significantly causal for M1, there may be an indirect causal link between the interest rate and output growth.[8] However, new results emerge on the predominance of monetary aggregates in the dynamics of inflation. Indeed, both M1 and M2 present significant predictive power for inflation, and this evidence is much stronger for M2, since causality relations turn out to be significant over all considered horizons. We further note that these results are highly robust to seasonal adjustments. Finally, as in the previous set of results, the exchange rate appears to be exogenous to the system, although we can find a more robust relation running from the exchange rate into inflation at horizon 6.

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[8] A direct causality relation running from interest rates into output growth exists only with unadjusted data.

4. Conclusion

In this paper, we have examined the short-run and long-run causality relationships between monetary policy variables, real activity, and stock returns. The first basic finding is that, although we find no significant role for monetary aggregates in the dynamics of output growth at horizon one—a recurrent conclusion in the literature based on the usual Granger causality criteria—our empirical methodology allows us to infer that monetary aggregates may have significant predictive power for income and prices at longer horizons. Therefore, the restrictive nature of the usual Granger causality test might dismiss important causal relationships that would appear in a richer dynamic framework. For the United States, the authors find no support for stock returns as a leading indicator of the macroeconomic variables considered, or for stock returns being influenced by those macroeconomic variables, except for one case: fluctuations in M1 tend to anticipate fluctuations in stock returns. However, for Canada, we find that there is a potential role for asset prices as a predictor of some important macroeconomic variables, namely interest rates and inflation, at policy-relevant horizons. Furthermore, for Canada, some measures of monetary aggregates tend to dominate interest rates as robust causal variables for output growth and inflation. Finally, we explicitly illustrate that the causality patterns can be highly distorted by the seasonal filterings.

An important issue concerns the best strategy to adopt in order to infer the real causality structure of a set of macroeconomic variables. The concept of causality tests used in our paper is essentially based on the in-sample fit of the model, while we know that in-sample tests tend to reject the null hypothesis of no predictability more often than out-of-sample tests. This would suggest that we should examine the robustness of our results by exploring the predictability of stock returns in an out-of-sample framework, obtained from a sequence of recursive regressions.

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Table 1: Causal relations at different horizons: U.S., base–M1 multiplier model, seasonally adjusted data

(A) Significance level: 0.05

Predictor	B	r	$MM1$	P	Y	S
Predicted B		1, 2	4			
r					1, 2	
$MM1$		3		5, 6, 7		6
P	6	1			3, 4, 5, 7, 8	
Y		1, 2, 3, 5				
S			1, 2, 3, 4			

(B) Significance level: 0.10

Predictor	B	r	$MM1$	P	Y	S
Predicted B		1, 2, 5	3, 4, 5		5, 6	
r	2				1, 2, 5	
$MM1$		3, 6		5, 6, 7, 8	3	6
P	3, 6	1, 8			3, 4, 5, 7, 8	
Y		1, 2, 3, 5				
S	1	8	1, 2, 3, 4			

Table 2: Causal relations at different horizons: U.S., base–M1 multiplier model, seasonally unadjusted data

(A) Significance level: 0.05

Predictor	B	r	$MM1$	P	Y	S
Predicted						
B		5	5, 6, 7		6	
r				1, 2	1, 2	
$MM1$		3, 4, 5, 7		2, 3, 5, 6, 7	3	
P		1			1, 2, 3, 4, 8	
Y	5, 6, 7	1, 2, 5, 6		5		
S		8	4			

(B) Significance level: 0.10

Predictor	B	r	$MM1$	P	Y	S
Predicted						
B		1, 2, 5	3, 5, 6, 7, 8		5, 6	
r				1, 2	1, 2, 3	
$MM1$	1	1, 3, 4, 5, 6, 7		2, 3, 5, 6, 7, 8	3	
P	3	1, 8	1		1, 2, 3, 4, 7, 8	
Y	1, 5, 6, 7	1, 2, 4, 5, 6		2, 4, 5		5
S		8	4, 5			

Table 3: Causal relations at different horizons: Canada, base–M1 multiplier model, seasonally adjusted data

(A) Significance level: 0.05

Predictor	B	r	$MM1$	P	Y	S	E
Predicted							
B		1, 7			2		
r						4	
$MM1$	4	1					
P	6, 8				1, 7	8	
Y	1, 2, 3		1				
S							
E							

(B) Significance level: 0.10

Predictor	B	r	$MM1$	P	Y	S	E
Predicted							
B		1, 7		6	2, 4		
r	2, 3					4	
$MM1$	4	1					
P	6, 7, 8				1, 7, 8	8	
Y	1, 2, 3, 4		1				
S							
E	4, 5				5, 6		

Table 4: Causal relations at different horizons: Canada, base–M1 multiplier model, seasonally unadjusted data

(A) Significance level: 0.05

Predictor	B	r	$MM1$	P	Y	S	E
Predicted B		1			5, 6		
r							
$MM1$				3	3, 4, 5, 6, 7, 8		4
P	6						
Y	1, 2, 3, 4, 5, 6, 7	1, 3, 4, 6	1, 2			1, 2, 3	1, 4
S							
E							

(B) Significance level: 0.10

Predictor	B	r	$MM1$	P	Y	S	E
Predicted B		1, 7		6	1, 2, 5, 6	7	
r						3	
$MM1$		1, 8		3	1, 3, 4, 5, 6, 7, 8		4, 5, 7
P	6, 7					6, 8	
Y	1, 2, 3, 4, 5, 6, 7	1, 2, 3, 4, 6	1, 2, 5			1, 2, 3, 4	1, 3, 4, 5
S							
E					8	2	

Table 5: Causal relations at different horizons: U.S., M1–M2 model, seasonally adjusted data

(A) Significance level: 0.05

Predictor	r	$M1$	$M2$	P	Y	S
Predicted						
r					1	
$M1$	1, 2, 4, 5			4, 5, 6, 7		
$M2$	1	1, 2, 3, 4		2, 3, 4		
P	1	3	4			
Y	1	5		4		
S		1, 2, 3, 4				

(B) Significance level: 0.10

Predictor	r	$M1$	$M2$	P	Y	S
Predicted						
r					1, 2	
$M1$	1, 2, 3, 4, 5			4, 5, 6, 7		
$M2$	1	1, 2, 3, 4, 8		2, 3, 4		
P	1	1, 2, 3, 4	4			8
Y	1, 2, 5	5, 6		1, 2, 4		
S		1, 2, 3, 4	5			

Table 6: Causal relations at different horizons: U.S., M1–M2 model, seasonally unadjusted data

(A) Significance level: 0.05

Predictor	r	$M1$	$M2$	P	Y	S
Predicted						
r						
$M1$	$1, 2, 3, 4, 5, 7$			$3, 4, 5, 6, 7$	$2, 6$	
$M2$		$1, 2, 3, 4$		$2, 3$		
P		2				
Y		$5, 6, 7$				
S		$4, 5, 6$				

(B) Significance level: 0.10

Predictor	r	$M1$	$M2$	P	Y	S
Predicted						
r				$1, 2$		
$M1$	$1, 2, 3, 4, 5, 6, 7$		1	$2, 3, 4, 5, 6, 7$	$2, 3, 4, 5, 6$	
$M2$	$1, 2, 7$	$1, 2, 3, 4, 7, 8$		$2, 3, 4, 5, 6$		
P	1	2			1	
Y	2	$1, 2, 3, 5, 6, 7, 8$	$5, 6, 7$	8		
S		$2, 4, 5, 6$				

Table 7: Causal relations at different horizons: Canada, M1–M2 model, seasonally adjusted data

(A) Significance level: 0.05

Predictor	r	$M1$	$M2$	P	Y	S	E
Predicted							
r						3, 4	
$M1$	1			1, 3	1	4, 5	
$M2$		1		5	1, 5		
P		7, 8	1, 2, 3, 4, 5, 6, 7			7, 8	
Y		1					
S							
E					4, 5, 6		

(B) Significance level: 0.10

Predictor	r	$M1$	$M2$	P	Y	S	E
Predicted							
r		3, 4				3, 4	
$M1$	1			1, 3, 4	1	1, 4, 5	
$M2$		1, 3		4, 5	1, 2, 4, 5		
P	6	6, 7, 8	1, 2, 3, 4, 5, 6, 7, 8		6	7, 8	6
Y		1	1				
S							
E			4		4, 5, 6		

Table 8: Causal relations at different horizons: Canada, M1–M2 model, seasonally unadjusted data

(A) Significance level: 0.05

Predictor	r	$M1$	$M2$	P	Y	S	E
Predicted							
r		3				3, 4	
$M1$	1			3	4	1, 4	
$M2$		1			1		
P	5, 6	7	1, 2, 3, 4, 5, 6, 7			7	6
Y	1, 2, 3, 4, 5	1, 5				1, 2, 3	1
S							
E							

(B) Significance level: 0.10

Predictor	r	$M1$	$M2$	P	Y	S	E
Predicted							
r		3, 4				2, 3, 4	
$M1$	1			1, 3	3, 4	1, 4, 5, 6	
$M2$		1			1, 3, 4, 6		
P	5, 6	4, 7	1, 2, 3, 4, 5, 6, 7			6, 7, 8	6
Y	1, 2, 3, 4, 5, 6	1, 2, 5				1, 2, 3	1, 5, 6
S							
E			1			1, 4	

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