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Overnight Rate Innovations as a Measure of Monetary Policy Shocks in Vector Autoregressions

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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

The authors examine the Bank of Canada's overnight rate as a measure of monetary policy in vector autoregression (VAR) models. Since the time series of the Bank's current measure of the overnight rate begins only in 1971, the authors splice it to day loan rate observations to obtain a sufficiently long period of data. The resulting series, called Ron, extends back to the 1950s.

The authors' analysis yields four findings of interest: First, Ron innovations and innovations of the Bank's current overnight rate measure appear to incorporate virtually identical information about monetary policy shocks. Second, the path of Ron innovations provides a reasonable account of the evolution of monetary policy actions over the past 35 years. Third, shocking Ron in VAR systems has consequences for output, prices and the exchange rate that might be expected from a monetary policy shock. Finally, as a monetary policy variable in these VAR systems, Ron performs at least as well as either the 90-day paper rate or the term spread.

The main conclusions are that Ron, the overnight rate variable developed by the authors, provides a good basis for measuring monetary policy actions in VAR-based analysis and that Ron innovations can provide a good measure of monetary policy shocks.

Résumé

Les auteurs exploitent des modèles à vecteur autorégressif pour examiner la pertinence du taux du financement à un jour de la Banque du Canada comme variable de politique monétaire. Puisque la série de taux du financement à un jour que la Banque utilise à l'heure actuelle ne commence qu'en 1971, les auteurs y greffent des taux des prêts au jour le jour de manière à obtenir une période d'observation d'une durée suffisante. La série chronologique ainsi créée, à laquelle ils ont donné le nom de Ron, remonte aux années 50.

Dans leur analyse, les auteurs font quatre constatations intéressantes. Premièrement, les chocs effectués sur Ron et sur la mesure du taux du financement à un jour utilisée par la Banque semblent fournir des renseignements presque identiques au sujet des chocs de politique monétaire. Deuxièmement, le sentier des variations non anticipées de Ron rend assez bien compte de l'évolution des mesures de politique monétaire depuis 35 ans. Troisièmement, lorsque des chocs sont appliqués à Ron dans les modèles autorégressifs, la production, les prix et le taux de change subissent des effets analogues à ceux qu'un choc de politique monétaire est susceptible de produire. Finalement, en tant que variable représentant l'évolution de la politique monétaire dans

les modèles autorégressifs, Ron donne des résultats au moins aussi probants que le taux du papier à 90 jours ou que l'écart de taux.

La principale conclusion qui se dégage est que Ron, la mesure du taux du financement à un jour mise au point, constitue une base solide pour la représentation des mesures de politique monétaire dans les analyses autorégressives et que ses chocs non anticipés peuvent fournir une bonne mesure des chocs de politique monétaire.

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1. Introduction

In the last several years, there has been a substantial amount of work on identifying "monetary policy shocks" and examining their effects on the economy with vector autoregression (VAR) models. In this context, monetary policy shocks refer to an unexpected monetary policy action, one not explained by the endogenous influences accounted for in the model. As well, there has been considerable interest in representing monetary policy actions with operational measures. These measures are believed to be subject to significant central bank influence, and subject to relatively less influence from other, non-central bank disturbances. Thus, inferences in VAR-based analysis about the effects of monetary policy actions might be more consistently reliable if such operational measures are used to represent monetary policy actions in a VAR. As well, to the extent that VAR models are used to provide advice with respect to the appropriate setting of policy instruments, it seems sensible and convenient to rely on operational measures of monetary policy actions.[1]

As a result of this kind of thinking, VAR-based analysis for the United States has focussed increasingly on operational measures of Federal Reserve behaviour, that is, on non-borrowed reserves and the federal funds rate. Operational measures relevant to the Bank of Canada are excess settlement cash and the overnight interest rate. However, an important drawback of excess settlement cash and the overnight rate as measures of monetary policy action is a paucity of data. For example, data on the Bank's current measure of the overnight rate (Rcall) are available only from June 1971. Data on excess settlement cash are available only from 1970. In 1991, the Bank began to phase out reserve requirements, and there was a change in the way that the Bank calculates settlement balances. Obviously, these data limitations prohibit us from estimating systems over a long span of time, and can readily lead to degrees of freedom problems in larger and more complicated systems, such as those exploiting cointegrating relationships.[2]

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[1] It has been traditional, especially at the Bank of Canada, to identify monetary *policy* with the objective of the central bank, such as price stability. Monetary policy actions are the actions taken to achieve the monetary conditions that would lead to achieving the policy objective.

Accordingly, in this paper, we examine a measure of monetary policy action that is closely related to the Bank's current measure of the overnight rate, but which is available over a much longer period. In the next section, we discuss why operational measures of monetary policy are appealing. In Section 3, the nature of the Bank's operational framework for policy implementation over the last 35 years is considered. We suggest that the basic operational framework of monetary policy has been reasonably constant since the late 1950s, and that the overnight cost of dealer financing has been a reasonable operational measure for the last 35 years or so. The development of the overnight market in Canada is then reviewed. We suggest creating a long time series for the overnight rate by extending the Bank's current overnight rate measure back from mid-1971 by combining it with the measure of the overnight cost of dealer financing relevant for that earlier period, that is, the day-loan rate.

In Section 4, the identification of "monetary policy shocks" with VAR-based techniques is discussed. Sections 5, 6, 7 and 8 then examine in different ways whether the spliced overnight rate series (called "Ron") appears to be a good measure of monetary policy actions. That analysis examines the behaviour of (orthogonalized) Ron innovations and the responses of key macro variables to these Ron shocks.[3] We conclude that Ron provides a good basis for measuring monetary policy for the following five reasons.

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[2] Hendry (1986), Perron (1989) and Siklos (1993) argue that when estimating cointegrating relationships among economic time series, increasing the sample size by increasing the sampling frequency is inadequate, especially when the equilibrating process is a slow one. Instead, it is preferable to use lower frequency data over a longer period of time.

(i) The overnight rate is an operational measure of monetary policy action, over which the Bank of Canada has considerable influence, and the Bank has for many years implemented monetary policy by steering the overnight rate. Thus, monetary policy action should be reflected well in the overnight rate.

(ii) Ron innovations provide virtually identical information about monetary policy shocks since the early 1970s, as do innovations of the Bank's current operational target, Rcall, even though the Ron innovations are based on a VAR estimated over a much longer period. That is, splicing the Bank's current overnight rate measure with the day-loan rate to extend the series back to 1956 (and creating Ron), does not seem to have altered the information content of the overnight rate as a measure of monetary policy action. Since we know that Rcall is a good operational measure of monetary policy action, the implication of this result is that Ron seems to be a good operational measure as well.

(iii) The path of Ron innovations provides a reasonable account of the evolution of monetary policy shocks over the last 35 years, an account that is generally consistent with the record provided by the Bank of Canada's annual reports. As well, these Ron innovations are positively correlated with disturbances to the spread between Ron and short-term market rates, suggesting that Ron innovations do not simply reflect endogenous market behaviour that moves all short rates together. Instead, this seems to suggest that disturbances to the relationship between the overnight rate and short-term market rates arise from monetary policy shocks that are reflected by Ron innovations.

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[3] VAR-based analyses of policy shocks depend on two joint hypotheses: first, that the monetary policy variable used is an appropriate measure of policy; and second, that the specific VAR estimated and the approach used to identify the orthogonalized innovations are adequate to identify policy shocks. The orthogonalized Ron innovations considered in this paper are identified through contemporaneous restrictions and a Wold causal interpretation of the data.

Identification through long-run restrictions is arguably preferable, and it would be useful as well to distinguish among different policy regimes in the data. However, the relatively simple approach followed in this paper seems to be adequate to reveal major policy shocks, and to allow one to make some judgments about Ron as a monetary policy variable. In subsequent work with Ron as the monetary policy variable, policy shocks and their effects on the economy will be identified by relying on cointegrating relationships in the data and on long-run restrictions.

(iv) Ron innovations in the context of VAR models provide conventional representations of monetary policy shocks. That is, shocking Ron in these systems leads to impulse responses of output, prices and the exchange rate that one might expect from a monetary policy shock.

(v) Ron performs at least as well as the 90-day paper rate or the term spread to represent monetary policy actions in these quarterly VAR systems. That is, the Ron-based impulse responses seem to be more sensible than are those based on these other measures of monetary policy actions, and the results are more consistent across different orderings of the variables in the VAR.

In sum, we conclude that the overnight rate measure developed in this paper, Ron, provides a good basis for measuring monetary policy actions and that Ron innovations can provide a good measure of monetary policy shocks.

2. Operational Measures of Monetary Policy Actions: The Overnight Rate and Excess Settlement Cash

2.1 Why operational measures of monetary policy actions make sense

As noted above, in the last several years, there has been considerable interest in the appropriate representation of monetary policy for empirical analysis. One might suppose that, ideally, a good measure of monetary policy action ought to be strictly exogenous and not react to any of the other variables in the economy. However, in practice, any potential measure of monetary policy has some endogenous component. At a minimum, any measure of monetary policy will reflect the central bank’s reaction function; that is, its (more-

or-less) systematic and predictable reaction to economic developments. As well, an endogenous component could arise from influences unrelated to monetary policy, such as demand or supply shocks elsewhere in the economy. A good monetary policy measure should also reflect the central bank's unsystematic behaviour, that is, exogenous monetary policy shocks.

As is well known, the Bank of Canada implements monetary policy by adjusting the availability of settlement balances to influence the very shortest-term interest rate, that is, the overnight cost of investment dealer financing.[4] Since settlement balance shortfalls or excesses are costly to the direct clearers in the payment system, they react promptly and fairly predictably to the Bank's interventions in the overnight market. Thus, according to Thiessen (1995), the Bank's influence in this market is considerable and fairly precise. (For instance, the Bank targets the overnight rate within a range of 50 basis points.) Nevertheless, the Bank is faced with some uncertainty with respect to obtaining the level of the overnight rate that it wants, since the desired settlement balances of direct clearers cannot be forecast with precision.

In contrast to the considerable influence that the Bank of Canada has on the overnight rate, its direct influence on interest rates rapidly diminishes as one moves out along the term structure (Thiessen 1995). Interest rates further along the term structure are less subject to the Bank's direct control, and are more subject to a greater variety and frequency of endogenous shocks owing to risk premia, portfolio balance

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4. More precisely, the overnight rate that the Bank aims to influence is a weighted average of all of the dealer costs of overnight financing. For a discussion of the Bank of Canada's operating framework (and its views on subsequent stages of the transmission mechanism), see Clinton (1991), Clinton and Howard (1994) and Thiessen (1995). Some of the institutional features of the overnight market in Canada are discussed further in Section 3.

effects and inflation expectations.[5] The term spread, which has also been used to represent monetary policy, can be expressed as the difference between the rates on short- and long-dated market rates. Assuming that the relative impact of monetary policy action on long-dated interest rates is small, then the term spread can be considered to reflect monetary policy action, the expected change in inflation, the relative default risk premium across the two markets, and the relative difference in other portfolio balance effects across the two markets.

It follows that, at a minimum, measuring monetary policy with an operational measure for VAR-based work is sensible and intuitively appealing: moving the overnight rate is exactly what the Bank of Canada does to implement policy. As well, inferences in VAR-based analyses about the effects of monetary policy actions might be more consistently reliable if monetary policy is represented by an operational measure, like the overnight rate, instead of other variables that are less subject to the Bank's direct control, such as a short-term market rate, or possibly the term spread as well.[6]

2.2 Excess settlement cash and the overnight rate

As noted above, analysis of the effects of monetary policy in the literature has increasingly focussed on operational measures and targets of policy. For example, recent U.S. work in this area considers non-borrowed reserves and the federal funds rate to measure monetary policy.[7] In work done recently at the Bank of Canada, Fung and Gupta (1994) consider the Bank's operational targets and identify monetary policy shocks in two ways: as innovations to various measures of excess settlement cash and as innovations to the overnight rate. An important component of the overnight rate is the call loan rate, so this measure of monetary policy is termed Rcall.

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[5] Thiessen (1995, 46-47) describes a scenario in which the Bank of Canada might act to bring about a decline in the overnight rate in the face of a market that saw such policy action as taking excessive inflationary risks. In this case, the Bank could force a decline in interest rates at the very short-term end of the money market, perhaps even out to 30 days. However, such action could result in a *rise* in rates further along the yield curve because of expectations of inflation and a declining currency.

The distinction between the overnight rate and short-term market rates is probably most evident in the context of high-frequency data, such as daily or monthly observations. At lower frequencies, such as annually or quarterly, one would expect the overnight rate and short-term market rates to move together much more, although the spread between these rates would not be constant. We consider this further in subsequent sections.

[6] This is not to say, however, that VAR-based work using the 90-day paper rate or the term spread will be misleading, especially in the context of lower-frequency data. Section 8 compares impulse responses of (quarterly) VAR systems that account for monetary policy with the overnight rate, the 90-day paper rate, or the term spread.

One curiosity often found in VAR estimations of the effects of monetary policy is the "price puzzle," whereby the price level rises (falls) after an unanticipated contractionary (expansionary) monetary policy shock. Sims (1992) studies the effects of monetary policy shocks in five countries, including France, Germany, Japan, the United States, and the United Kingdom. He finds that when innovations in a short-term market interest rate are used to measure monetary policy shocks, all five countries display the price puzzle. Similar results are found in Strongin (1992) and Christiano, Eichenbaum and Evans (1994) for the United States, regardless of whether innovations in the federal funds rate or non-borrowed reserves are used to measure monetary policy shocks. Dale and Haldane (1994) find similar results for the United Kingdom using the official interest rate as the monetary policy instrument.

Sims suggests that the price puzzle may reflect the omission of a variable from the VAR that is relevant to the central bank's reaction function. Therefore, he includes a measure of commodity prices in his VAR as a proxy for inflationary pressure, and finds that the price responses are somewhat improved. Christiano, Eichenbaum and Evans also find that by including commodity prices in their VAR, the responses of prices are no longer anomalous when either innovations in *the federal funds* rate or *non-borrowed reserves* are used as a measure of monetary policy shocks.

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[7] For recent examples of U.S. work focussing on the operational targets of monetary policy, see Christiano and Eichenbaum (1992), Strongin (1992), Bernanke and Blinder (1992), Leeper and Gordon (1992), Christiano, Eichenbaum and Evans (1994) and Brunner (1994). These papers also provide criticisms of using intermediate targets of monetary policy as measures of policy.

We have found that in VARs based on monthly Canadian data, it is straightforward to rectify the price puzzle when the overnight rate (Rcall) accounts for monetary policy by including *the federal funds rate* (FF) in the VAR.[8] However, in monthly systems that identify monetary policy shocks as innovations to excess settlement cash instead of Rcall, adding *FF*, the terms of trade, commodity prices or the exchange rate does not eliminate the price puzzle. This suggests that *the excess cash variables* that were developed for these estimations might not be good measures of monetary policy, despite the fact that monetary policy is implemented by changing the supply of *excess cash* to the direct clearers. (Excess settlement cash is a very high-frequency, highly volatile, stationary series; see Fung and Gupta 1994 for more details.) As well, time series of (cumulated) excess cash are not consistent with movements in prices.

In sum, of the two operational measures of monetary policy, excess cash and Rcall, Rcall seems to be a more promising measure.[9] One drawback of Rcall as a monetary policy measure is that data on Rcall are available only from June 1971.[10] Obviously, this data limitation prohibits the estimating of VAR systems over a long span of time, and can readily lead to degrees of freedom problems in larger, more complicated systems. In the rest of this paper, we examine the usefulness of an alternative measure of monetary policy that is closely related to Rcall but is available over a much longer period.

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[8] In this case, the basic VAR system is (excess settlement cash, Rcall, output and CPI). Notably, including the terms of trade, commodity prices or the exchange rate does not eliminate the price puzzle in these systems where monetary policy shocks are identified as innovations to Rcall.

[9] As well, Sims (1986, 1992) and Bernanke and Blinder (1992) argue that unanticipated monetary policy shocks are best represented by innovations to interest rate measures as opposed to financial quantities.

[10] The market on which Rcall is based was formed only in 1967. (Section 3 provides more information on the development of the call loan market in Canada.) The CANSIM data base has observations on Rcall from 1975. The Bank of Canada data base includes observations of the daily high and low Rcall from June 1971, from which a daily average can be computed to extend the CANSIM series back to mid-1971.

Month-end data on excess settlement cash are available from 1970, and daily data, which allow for intra-month cumulations of excess cash, are available from August 1977. In 1991, the Bank began to phase out reserve requirements and there was a change in the way that the Bank calculates settlement balances. See Fung and Gupta (1994) for more details.

3. The Operational Framework of Monetary Policy and the Overnight Interest Rate

In this section, we begin with a brief discussion of the nature of the Bank of Canada's operating framework, which seems to have been relatively constant since the late 1950s. Then, we consider the evolution of the overnight market in Canada, and suggest how we could extend a measure of monetary policy back to the 1950s.

3.1 The monetary policy operating framework from the 1950s to the present

As noted above, the Bank of Canada implements monetary policy by manipulating the supply of settlement cash that influences the shortest-term interest rate, that is, the overnight cost of financing for investment dealers. Certainly, this has been the Bank of Canada's operating framework for policy implementation since at least the mid-1970s. (See, for example, Bank of Canada 1975, 1983.) As well, based on anecdotal evidence, it appears that this basically has been the Bank's operating framework for a number of years prior to this, say from the late 1950s.

In other words, for many years, the Bank has transmitted its policy to the economy, in the first instance, by manipulating the cash reserves of the direct clearers and influencing the overnight rate.[11] Therefore, developing a long time series for an operational measure of monetary policy based on the overnight rate requires extending the currently available Rcall data back to cover those earlier years. Thus, extending a measure of the overnight rate beyond the earliest data on

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11. In the 1960s, the Bank paid attention to the "excess cash ratio" of the banks, according to a rule of thumb, whereby a ratio over a given level indicated a loose stance for policy, and conversely, a ratio under this level indicated a tight stance. Nevertheless, it seems to have been recognized that the mechanism was as described above: the monetary policy impulse went from excess cash to overnight rates to the economy.

Rcall (1971) requires a measure of the overnight rate relevant to those earlier years. So, we next consider the nature of the overnight market in those earlier years.

3.2 Ordinary call loans, day loans and special call loans

As discussed above, the first stage in the transmission of monetary policy to the economy is the Bank of Canada's influence on very short-term interest rates. Over the years, the nature of very short-term financing has evolved, and this section reviews that evolution by focussing on "ordinary" call loans, day loans and "special" call loans.[12]

Call loans are money-market instruments designed to finance the acquisition and holding of securities by investment dealers for short periods of time. Since the early years of this century, call loans have been made by banks to stockbrokers and bond dealers against approved securities as collateral. Such traditional call loans, often referred to as "ordinary" call loans, can be called by the lender at short notice, but in practice they are viewed as longer-term collateral loans.

In 1953, the Bank of Canada, as part of an effort to develop a broader and more sophisticated domestic money market, undertook to widen the market for treasury bills and other short-term paper. To this end, the Bank encouraged some investment dealers to act as jobbers, that is, to hold inventories of short-term financial assets and to stand ready to buy and sell them on demand. At the same time, the size of the Government of Canada treasury bill tender was raised, and the frequency of the auction was increased from every two weeks to weekly. To add liquidity to the inventory holdings of the jobbers and thereby to encourage their financing by the banks, the Bank of Canada also introduced purchase and resale agreements (PRAs) between itself and the jobbers. In 1954, the banks responded by providing day-to-day funding (day loans) to the jobbers on the collateral of the same type of short-term securities that were eligible for PRA, and in amounts not exceeding the jobbers' lines of credit with the Bank of Canada.[13] Day loans can be called the next day and consequently are very liquid assets. In sum, day loans are callable overnight loans (with a same-day call if they are completed before noon) made to investment dealers against certain government securities as collateral.

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[12] This discussion of the overnight market draws mainly on Bank of Canada (1983).

In 1967, the banks introduced "special" call loans in response to the needs of both the banks and the jobbers. For the latter, the increased use of short-term money-market instruments such as commercial and finance company paper and bankers' acceptances created a need for larger amounts of overnight inventory financing. For the banks, the new instrument provided a greater degree of flexibility in cash management. Special call loans differ from day loans in that the list of acceptable collateral is much broader and includes, in addition to Government of Canada treasury bills and short-term bonds, commercial and finance company paper, provincial notes and bonds, and some other short-term securities, with the list varying somewhat from lender to lender. More recently, long-dated collateral, such as long Government of Canada bonds, has become acceptable collateral as well. The more wide-ranging collateral accepted on special call loans results in the interest rate on special call loans being marginally higher than that charged for day loans. When special call loans were first introduced, the usual requirement was for 24-hour notice, but by the early 1980s, practice shifted almost completely to same-day notice.

Special call loans grew in importance rapidly after their introduction in 1967. They very quickly displaced day loans as the most important source of dealer financing, and gradually the use of the term "special" was dropped from the name. In addition, over time, as the money market in Canada grew and became more sophisticated, overnight dealers also drew on sources other than call loans, including repos, swapped foreign exchange loans and loans from non-banks and government agencies. Accordingly, today, it is the weighted-average overnight cost of dealer financing that the Bank of Canada aims to influence.

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[13] Securities that were acceptable for PRAs were Government of Canada treasury bills and bonds with a maturity of 3 years or less. Also, between June 1962 and February 1981, bankers' acceptances were acceptable for PRA as well. The fact that day loans were eligible to satisfy secondary reserve requirements also provided an incentive for the development of this market.

3.3 Extending the overnight rate series by including the day loan rate

As discussed above, the relevant measure of the overnight rate for the late 1950s to the early 1970s is the day-loan rate. Thus, a longer time series on the overnight rate of interest could be constructed by extending the current overnight rate series (Rcall) to include the day-loan rate back to the 1950s.

Figure 1 plots the day-loan rate (Rday) and the current overnight rate measure (Rcall). Note that observations on Rcall begin four years after the introduction of special call loans. As well, there is quite a sizable gap between Rcall and Rday in the mid-1970s. Anecdotal evidence indicates that, probably as a result of the increasing emphasis on Rcall, the quality of the Rday data during this period is relatively poor. However, after several years of inattention, following the Bank of Canada’s insistence, the banks began reporting more accurate observations for Rday. As well, the initial wide spread between Rday and Rcall could be related to the use of day loans to satisfy secondary reserve requirements during this period. However, as secondary reserve requirements decreased through the 1970s and as the banks held larger stocks of treasury bills, which also satisfied their secondary reserve requirements, day loans became less necessary for this purpose so that Rday moved toward Rcall.

Perhaps the most plausible explanation of the initial wide spread between Rday and Rcall shown in Figure 1 concerns the spread between the treasury bill rate and the commercial paper rate. As noted above, day loans are made against Government of Canada treasury bills and short-term bonds, while call loans are made against a much broader set of acceptable collateral, such as commercial paper. The sharp narrowing of the spread between Rday and Rcall in the mid-1970s coincides with a significant narrowing of the spread between the treasury bill rate and the commercial paper rate, when the supply of treasury bills became large enough to exceed secondary reserve requirements.

In any event, for most of the period of their overlap, Rday and Rcall are virtually identical, with Rcall marginally higher, as one would expect.

Given the preceding, a time series of the overnight rate from 1956 to 1994 was created by splicing Rday with the first observation of Rcall at June 1971; we call this longer overnight rate series, “Ron”. The rest of this paper provides an examination of the performance of Ron as a measure of monetary policy.

4. Measures of Monetary Policy Action, Identification and Innovations

Any monetary policy variable can be decomposed into a systematic and an unsystematic component. The systematic component of the variable can be estimated in a VAR. This VAR equation of the policy variable can be thought of as reflecting a central bank reaction function and any other endogenous non-policy influences on the variable. What is left over, the (orthogonalized) residuals of this equation, can be thought of as monetary policy shocks – the unsystematic component of monetary policy. The recent literature on the effects of monetary policy focusses on policy shocks, that is, the orthogonalized residuals or innovations.

The motivation for the focus on the policy shocks is that the macroeconomic responses to monetary policy ought to be most clear when policy behaves in an unanticipated way, that is, deviates from its usual systematic behaviour. Not separating the systematic, reaction-function component of monetary policy from the policy shocks could lead to misleading inferences about the effects of monetary policy. For instance, suppose that following a tightening of monetary conditions due to an endogenous appreciation of the exchange rate, the central bank decided to respond by acting to lower interest rates. If the tightening of monetary conditions through the exchange-rate channel was just offset by the decline in interest rates brought about by policy action, there would be no significant consequence for output and prices from the monetary policy action. Similarly, suppose that in response to a demand shock that threatened to raise prices, the central bank tightened policy. That is, in this case, suppose that the central bank's systematic reaction was to offset the shock so that inflation would be unaffected. Again, simple correlations in the data could suggest that this policy action had no consequence for prices. As well, to the extent that the policy variable is affected by non-policy influences, it would be appropriate to account for them in the estimation.[14]

In sum then, the consequences of monetary policy shocks in a VAR-based analysis are based on two joint hypotheses: first, that the monetary policy variable used is an appropriate measure of policy; and second, that the specific VAR estimated and the approach used to identify the orthogonalized innovations are adequate to identify policy shocks.

In what follows, we consider whether Ron is a good measure of monetary policy by examining the behaviour of Ron innovations, and the responses of key macro variables to these Ron shocks. The VARs are estimated over a relatively long period, the late 1950s to 1994. The orthogonalized Ron innovations that are considered as policy shocks and the impulse responses are identified through contemporaneous restrictions and a Wold causal interpretation of the data.[15] It is important to note that this identification strategy, like any other, relies

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14. Thus, if a relevant variable were omitted from the VAR, the innovations identified as policy shocks would be misleading to some extent; that is, the innovation would more properly be seen as a mix of policy shock and the (endogenous) influence of the omitted variable on the measure of policy action.

15. For a review of identification through contemporaneous restrictions, see Watson (1993) or Fung and Gupta (1994). For some applications of this technique, see Christiano, Eichenbaum and Evans (1994), and Fung and Gupta (1994).

on prior knowledge or assumptions about the relationships among the variables in the system, which are imposed on the data. In this case, such assumptions are used to establish restrictions on the *contemporaneous relationships* among the variables in the system.[16]

An alternative methodology for identifying policy shocks, the long-run restrictions approach, relies on prior views about the *long-run relationships* among the variables of interest to establish the restrictions needed to identify the policy innovations, following Blanchard and Quah (1989) or King et al. (1991), for example.[17] One could reasonably argue that the long-run restrictions approach is more appealing than contemporaneous restrictions, since economic theory and evidence is generally more informative about the nature of longer-run relationships in the data than about contemporaneous relationships. That is, long-run restrictions might be more clearly based on well-accepted economic principles and evidence than are contemporaneous restrictions.

As another qualification, the estimations in this paper span periods in which the central bank had somewhat different reaction functions. For instance, the reaction function of the Bank of Canada in the late 1960s was probably different from that in the late 1970s when the Bank was targeting M1 growth. Also, by the late 1980s, the Bank began to weigh price stability more heavily than, say, in the early 1970s, when there was a greater preoccupation with fine-tuning

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16. Identifying the structural representation accurately is important: if the identifying restrictions are not appropriate or correct, then the parameters of the structural representation would be a mixture of both structural and reduced-form parameters. In that case, impulse responses to simulated demand shocks, for example, would reflect the economy's reaction to both demand and supply shocks (instead of just the response to demand shocks), which complicates and possibly invalidates the interpretation of impulse responses, especially over longer horizons. Thus, Balke and Emery (1994) point out that the recursive chain of causality usually assumed under the contemporaneous restrictions approach, the commonplace Choleski decomposition, is controversial. They argue that if the VAR is used to draw economic inferences, then the recursive identifying restrictions imposed on the system should be supported by theory.

17. For a discussion of identification through long-run restrictions, see Watson (1993).

aggregate demand and output.[18] As a result, not accounting for policy-regime shifts in the data could lead to some estimation error. (However, adjusting for such regime shifts in the data is controversial, and it is costly in terms of degrees of freedom, leaving relatively few observations over which to estimate and simulate the VAR.)

Notwithstanding these qualifications, the purpose of the present work is to provide a fairly straightforward assessment of Ron as a monetary policy variable, in the context of a relatively simple and widely used approach to identification.

5. Do Rcall and Ron Innovations Provide Similar Information?

As discussed above, it is clear that the overnight rate, that is, Rcall, has been an operational target for monetary policy since (at least) the mid-1970s. Therefore, the orthogonalized innovations of Rcall ought to provide reasonable indications of monetary policy shocks since the 1970s. In this section, the orthogonalized Rcall innovations from a VAR estimated from mid-1971 to 1994 are compared to the orthogonalized Ron innovations from a VAR estimated from 1961 to 1994. In this way, we consider whether the Ron innovations provide the same information about monetary policy shocks as do the Rcall innovations. In other words, we consider whether splicing the day-loan rate series with Rcall has affected the information content about monetary policy shocks in Rcall.[19]

The first VAR system that we estimate is (FF, Rcall, industrial production, the consumer price index, and the Canadian dollar price of the U.S. dollar), that is, (FF, Rcall, Y, P, PFX), estimated on monthly data from June 1971 to November 1994.[20] The second VAR system measures monetary policy with the spliced overnight rate series, Ron, instead of Rcall. Accordingly, the second VAR is estimated over a longer period, from January 1961 to November 1994. That is, this system comprises (FF, Ron, Y, P, PFX), estimated from January 1961 to November 1994. (The measure of Y in these monthly VARs, industrial production, is available only from 1961.) Both VARs are estimated on monthly data with six lags in the VAR; Y, P and PFX are in log-levels. As noted above, the orthogonalized Rcall and Ron innovations are identified through contemporaneous restrictions.

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[18] These characterizations seem uncontroversial and are supported by a reading of the Bank of Canada's annual reports over the years.

[19] More precisely, we are considering a joint hypothesis here concerning both the information content of Ron and the estimated reaction functions over the two estimation periods. In particular, similarity of Ron and Rcall innovations implies that Ron and Rcall incorporate similar information about monetary policy and that the estimated reaction functions over these two periods is similar. As noted above, the VARs are estimated on data that run through various policy regimes, so the estimated reaction functions reflect an average across the various regimes.

Figure 2 plots the 3-month moving averages of the innovations from the Rcall and Ron systems over their period of overlap, 1972 to 1994. The two series are highly correlated, with a contemporaneous correlation coefficient of 0.99 (before passing the data through the moving-average filter). Rcall and Ron innovations appear to incorporate virtually identical information about monetary policy shocks from the early 1970s on, although the Ron innovations are based on a VAR estimated over a much longer period. That is, splicing the Rcall data with Rday to extend the overnight rate series from the middle of 1971 back to 1961 (and thereby creating Ron) does not seem to have altered the information content of the overnight rate as a measure of monetary policy. Since we know that Rcall is a good operational measure of monetary policy, an implication of this result is that Ron seems to be a good operational measure as well.

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20. We use monthly data for the estimations in this section (only) instead of quarterly data to have more observations available for the Rcall system, which starts in mid-1971.

6. Do Ron Innovations Provide a Reasonable Account of the Evolution of Monetary Policy Actions?

6.1 Ron innovations and monetary policy actions over the last 35 years

If Ron is a good measure of monetary policy, and if our identification strategy is adequate, then the Ron innovations ought to provide a reasonable characterization or account of the evolution of monetary policy over time. In particular, there ought to be significant Ron innovations in those periods in which we believe that there was significant or unusual policy behaviour, that is, a policy shock.

Figure 3 presents orthogonalized Ron innovations derived from a simple VAR system of (Ron, M1, Y, P, PFX), estimated on quarterly data with six lags, from 1956 to 1994. In this quarterly estimation, we include the monetary aggregate M1, and Y is GDP instead of industrial production, which was used in the monthly estimations discussed in Section 5. Also, prices are represented by the GDP deflator instead of the CPI, which was used in the monthly estimations.[21] M1, Y, P and PFX are in log-levels. To help focus attention on what might be important shocks in Figure 3, there are horizontal lines drawn at one standard deviation. Positive Ron innovations indicate tight policy; negative ones indicate loose policy. Table 1 (page 30) presents a chronology of major monetary policy episodes that stand out in the record from 1961 to 1994, based mainly on Bank of Canada annual reports.

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[21] In contrast to the monthly VARs considered in Section 5, FF is not included in the quarterly VARs discussed in this section. For the monthly VARs, which included the CPI instead of the deflator, the inclusion of FF eliminated the price puzzle. (On this point, see pp. 7-8 above.) However, the price puzzle does not arise in the quarterly VARs considered here. Indeed, the impulse responses with and without FF are very similar. Moreover, if FF is included in the VAR, it should be exogenized for impulse-response analysis (so that FF does not react to Canadian monetary policy shocks), and this leads to very large confidence intervals around the impulse responses. (Impulse response are discussed in the next section.) Accordingly, with no loss of generality and to maintain a simpler model, we omitted FF from the quarterly VARs.

Comparing the chronology of major monetary policy episodes (summarized in Table 1) to the path of the Ron innovations in Figure 3, we see that, in general, these Ron innovations signal major policy episodes over the last 35 years reasonably well. For example, Figure 3 shows the Bank of Canada’s tightening during the foreign exchange crises in 1962 and 1967 and the tight stance of policy in 1969 in response to the Bank’s concerns about the rapid expansion of aggregate demand. The Ron innovations also reflect the generally expansionary stance of policy in the first half of the 1970s.

As well, one sees the shift to a tight policy stance in late 1975 as the Bank became increasingly concerned about inflation and began to target M1 growth. The Bank’s effort in 1977 to fine-tune aggregate demand, as spending subsequently weakened, is also shown. From 1979 to 1982, the conduct of policy was complicated by shocks to M1 demand, erratic U.S. monetary policy and volatility of the exchange rate. The volatility of policy – sharp tightening punctuated by episodes of significant loosening – is also illustrated in Figure 3. The subsequent shift to an expansionary stance of policy in 1983 is also shown. However, while monetary policy provided some resistance to the declining trend of interest rates in the second half of 1984 (see Table 1), the size of the positive Ron innovation in the second half of 1984 in Figure 3 is surprising.

The Ron innovations reflect the tightening of policy in response to the downward pressure on the dollar at the end of 1985 and the beginning of 1986, as well as the subsequent easing later in 1986 and through 1987 – partly motivated by the Bank of Canada’s accommodation of the increased demand for liquidity following the stock market crash in October 1987. Finally, the Ron innovations illustrate the prolonged tight stance of policy from 1988 or 1989 through 1990, and the looser policy stance after 1991, briefly interrupted by exchange rate pressures in late 1992.

In sum, these Ron innovations provide a reasonable account of the evolution of monetary policy over the last 35 years.

6.2 Ron innovations and the relationship between Ron and short-term market rates

In the preceding, we showed that significant Ron innovations generally correspond to major monetary policy episodes. However, it is also plausible that the Ron innovations generally reflect, not monetary policy action, but endogenous market behaviour that moves all short rates together, like Ron, the 90-day commercial paper rate (R90) and the 90-day treasury bill rate (RTB90).

To examine this possibility, first consider the relationship between the Ron innovations and the (Ron–R90) spread. Ron and R90 are highly correlated at the quarterly frequency (Figure 4). This high correlation is not surprising; on the contrary, it would be surprising if they were not correlated. Both rates are affected by market influences and both rates are influenced by monetary policy action. As a result, these rates ought to generally move together, particularly at lower frequencies (such as annually or quarterly, as opposed to monthly or daily). However, the spread between Ron and R90 is not constant, and monetary policy action can be seen as an important source of disturbances to this spread. That is, monetary policy innovations might disturb the relationship between these variables. Accordingly, Ron innovations, representing monetary policy shocks, could be positively correlated with changes to the (Ron–R90) spread and with changes to the (Ron–RTB90) spread, even at the quarterly frequency.

Figure 5 shows the time series of the Ron innovations that we discussed above along with a time series of the first difference of the spread between Ron and R90, that is, Δ(Ron–R90). The quarterly Ron innovations are positively correlated with Δ(Ron–R90), particularly in the second part of Figure 5, 1978 to 1994:3. The correlation coefficient is 0.52 for the whole sample, 1957:3 to 1994:3, and 0.65 from 1978 to 1994:3. Perhaps more relevant is the relationship between the Ron innovations and the (Ron–RTB90) spread, which would be less affected by variation in credit risk over time. From 1962:3 to 1994:3 the correlation coefficient between the Ron innovations and Δ(Ron–RTB90) is 0.61; from 1978 to 1994:3 it is 0.67.

In sum, these results suggest that Ron innovations do not simply reflect endogenous market behaviour that moves all short rates together. Taken together, the evidence considered in this section suggests that significant Ron innovations correspond to major monetary policy developments, and that disturbances to the relationships between the overnight rate and short-term market rates at the quarterly frequency arise from monetary policy shocks, which are reflected by these Ron innovations.[22]

7. Do Ron Innovations Lead to Conventional Macroeconomic Responses?

In this section, we examine the impulse responses to Ron innovations in our VAR systems. Figure 6 shows impulse responses to a one-standard deviation shock to Ron in the system considered in Section 6, that is, (Ron, M1, Y, P, PFX), estimated on quarterly data with six lags, from 1956 to 1994. The confidence bands shown are two standard deviations wide (95 per cent bands). Figure 7 shows impulse responses in a system with a different ordering; one that allows Ron to react contemporaneously to Y, P and PFX, that is, (Y, P, PFX, Ron, M1).

The two sets of impulse-response diagrams are very similar. Following a monetary policy shock, there is an immediate decline in M1, and an immediate, temporary appreciation of the exchange rate. As well, there is a significant output decline beginning about six months after the shock, and output appears to return to its preshock level about four years after the Ron shock. Prices begin to fall about 18 months after the shock, and the decline becomes statistically significant about three years after the shock.

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[22] Note in Figure 5 that Δ(Ron–R90) moves with the Ron innovations during periods of exchange rate crises and during the 1979-82 period, which suggests that the Ron innovations in these periods are not simply reflecting endogenous market reactions.

However, it is not necessarily the case that all monetary policy shocks need to be reflected in disturbances to Δ(Ron–R90). For example, the significant Ron innovations from 1988 to 1990 are not all accompanied by increases in Δ(Ron–R90): We interpret this as an indication that the market clearly understood the direction that the Bank of Canada was taking at that time, so that the policy shocks were relatively quick to find their way through from the overnight market to short-term market rates.

The results shown in Figures 6 and 7 are conventional for impulse responses based on contemporaneous restrictions. However, while output is not significantly different from zero after about four years, the impulse response itself does not converge to zero.[23] Figure 8 presents impulse responses based on a system that includes a measure of potential output: (Y^p, Ron, M1, Y, P, PFX), where Y^p is the log of potential output, which is determined from a regression of the log of actual output against a linear and a quadratic time trend. Figure 9 presents the alternative ordering (Y^p, Y, P, PFX, Ron, M1). In these systems, again, output falls about six months following the Ron shock. However, now, output more clearly converges back to the preshock level, returning after three years. As well, in these figures, prices respond more quickly; that is, prices begin to decline about one year after the shock, which becomes significant about two years after the Ron innovation.[24]

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23. The identification strategy used here may not be adequate to fully disentangle demand and supply shocks in the data; see footnote 16.

24. Including a measure of potential output in the VAR has the effect of separating or filtering the output data into stationary and nonstationary components. As a result, it is not surprising that the Ron shock has a clearer transitory effect on Y and no effect on Y^p in the impulse response functions; this occurs virtually by construction. Figures 8 and 9 are included only to illustrate that in the context of a model including a (simple) measure of potential output, a Ron shock has conventional results.

In sum, these systems seem to capture relationships in the data that provide conventional representations of a monetary policy shock, given by a Ron innovation.[25]

8. Impulse Response Functions with Ron, the 90-Day Paper Rate and the Term Spread

In Section 2 we suggested that the distinction between operational measures like the overnight rate and more traditional measures of monetary policy, like the 90-day commercial paper rate, is probably most evident in the context of high-frequency data, such as daily or monthly observations. However, an important drawback of using high-frequency data in a VAR is that such data tends to be noisy, leading to larger standard errors and confidence intervals, which makes it more difficult to draw meaningful conclusions from the work. In addition, macroeconomic time series (like GDP) are frequently measured on a quarterly basis. As a result of these considerations, VAR analysis is frequently conducted in the quarterly frequency domain, on long time series, if possible.

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25. Raynauld and Sigouin (1993) report the results of impulse response functions based on a *weekly* VAR estimated over the period 1981:11 to 1991:11. They conclude that the overnight rate cannot be used to measure monetary policy because a positive overnight rate shock leads to a decline in the other interest rates in their model. Their model includes five balance sheet quantities from the banking sector as well as four associated short-term interest rates such as the overnight rate and the 90-day treasury bill rate.

However, we have found that their results are sensitive to the ordering of the variables in the VAR: when the overnight rate appears before the treasury bill rate in their model, a positive overnight rate shock results in an increase in the bill rate and in all other interest rates. Moreover, these effects are larger and more persistent when the federal funds rate is also included in the model. As well, extending the monthly systems considered in Fung and Gupta (1994) by including the 90-day treasury bill rate also leads to the same conclusion: a positive overnight rate shock leads to an increase of the bill rate.

One possible explanation for the sensitivity of the results of Raynauld and Sigouin to the ordering of the variables may have to do with the nature of the Bank of Canada’s reaction function. For example, if the Bank were targeting R90, an exogenous overnight rate shock would lead to a rise in R90. On the other hand, an exogenous R90 shock might lead the Bank to try to counteract or smooth the effect by moving the overnight rate in the opposite direction.

Therefore, although Ron appears to have attractive properties as a monetary policy variable, one question that naturally arises is how Ron compares to more traditional measures of monetary policy, like the 90-day paper rate and the term spread, at the conventional quarterly frequency. So, in this section we compare the (quarterly) impulse responses discussed above, where Ron is used to account for monetary policy, with those based on VARs in which the monetary policy variable is the 90-day paper rate (R90). We also consider impulse responses based on VARs in which the monetary policy variable is the term spread. (The term spread is defined as R90 less the yield on 10-year-and-over Government of Canada bonds.)

However, first, consider the Ron innovations, R90 innovations and term-spread innovations. Figures 10 and 11 show the Ron, R90 and term-spread innovations based on a VAR system of (MP, M1, Y, P, PFX). MP denotes the measure of monetary policy, that is, Ron, R90 or the term spread; prices, P, are again represented by the GDP deflator; and all variables are in log-levels except for MP. Clearly, the two series shown in Figure 10, the Ron and R90 innovations, are highly correlated. Similarly, Figure 11 shows that the Ron innovations and the term-spread innovations are also highly correlated.

Figures 12 to 15 present impulse responses to a one standard deviation shock to the monetary policy variable (either R90 or the term spread) in the VAR systems, for two different orderings of each system. In one ordering, the monetary policy variable appears first, and in the other, the monetary policy variable appears later in the ordering. That is, we consider (MP, M1, Y, P, PFX), and (Y, P, PFX, MP, M1), where MP is represented by R90 (Figures 12 and 13), or by the term spread (Figures 14 and 15). In the next subsection, we compare these impulse responses to those of the comparable Ron-based systems, shown in Figures 6 and 7.

8.1 Impulse responses based on Ron and R90

First, we consider the effect of the two different orderings of the variables on the results. The impulse responses of the Ron-based VARs appear to be less sensitive to the change in ordering than are the R90-based systems. For example, in the Ron-based systems (Figures 6 and 7), output returns to its preshock level after 17 or 18 quarters; that is, we have very similar results across the two orderings. In the R90-based VARs, output returns to its preshock level after 16 quarters in Figure 12, while in Figure 13, it takes 20 quarters for output to return to its preshock level, a year longer. As well, in Figure 12, following the policy tightening, there is an immediate increase in output, before output begins to fall.

With respect to prices, there is again greater variation across the two R90-based impulse responses compared with the Ron-based systems. The price response to a policy shock is also somewhat quicker in the Ron systems; for example, in the Ron systems, prices start to fall after 7 quarters, while in the R90 system shown in Figure 12, prices start to fall after 10 quarters. As well, in this R90 system, prices initially rise notably following a monetary policy tightening, although the increase is not statistically significant.

Turning to the responses of the exchange rate, that is, PFX, the conclusion from the Ron-based VARs is that a positive monetary policy shock, that is, a tightening, would lead to an appreciation of the exchange rate, as one would expect – although the evidence of this in Figure 6 is weak. However, in the case of the R90-based systems, Figure 12 suggests that a monetary policy tightening would lead to a statistically significant *depreciation* of the exchange rate lasting one quarter. Moreover, there is no sign of any exchange rate appreciation until 8 quarters after the R90 innovation.

8.2 Impulse responses based on Ron and the term spread

As regards the term-spread systems, again, the Ron-based systems appear to be less sensitive to the change in ordering. Also, it takes longer for output to return to its preshock level in the term-spread systems compared with the Ron-based systems. For example, in Figure 14, it takes 21 quarters for output to return to its preshock level. In Figure 15, output still has not returned to its preshock level six years after the term-spread innovation.

Again, it also takes longer for the policy shock to affect prices in the term-spread systems as compared with the Ron-based systems; for example, prices start to fall after 10 quarters in the term-spread system shown in Figure 14. As well, following the monetary policy tightening in this term-spread system, prices rise before they decline, and the increase appears to be significant. Finally, unlike the R90 system in Figure 12, neither of the term-spread systems suggest that a monetary policy tightening would lead to a depreciation of the exchange rate; however, the evidence of an appreciation in Figure 14 is even weaker than that in the corresponding Ron system, Figure 6.

8.3 Summary

In the context of these quarterly VARs, the Ron-based systems provide more consistent results across the different orderings of the variables in the VAR. That is, inferences about the effects of monetary policy shocks are less sensitive to the (identifying) assumptions about the nature of the contemporaneous relationships among the variables in the VAR system.

In addition, the impulse responses for the Ron-based systems seem to be more appealing and sensible than those based on R90 or on the term spread. That is, consistent with our conventional priors, Ron behaves more like a monetary policy variable than does R90 or the term spread. For example, in the Ron-based systems there is less persistence of output effects, the price effects are more consistent with prior views, and there is clearer evidence of an exchange rate appreciation following a positive monetary policy shock.

While there are evident distinctions among the impulse responses depending on whether Ron, R90 or the term spread is the monetary policy variable, they should not be overstated: these differences do not appear to be statistically significant. In sum, one might best conclude that Ron performs at least as well as R90 or the term spread as a monetary policy variable in these quarterly VARs, given the identification strategy followed here.

9. Conclusions

In the last several years, there has been a substantial amount of work on identifying “monetary policy shocks” and examining their effects on the economy in the context of VAR models. As well, there has been considerable interest in representing monetary policy actions with operational measures of policy, which are believed to be subject to significant central bank influence and relatively less influence from other, non-central bank disturbances. Thus, inferences in VAR-based analysis about the effects of monetary policy might be more consistently reliable if such operational measures are used to represent monetary policy in a VAR. As well, to the extent that VAR models are used to provide advice with respect to the appropriate setting of policy instruments, it seems sensible and convenient to rely on operational measures of monetary policy action.

In this paper, we suggested that an operational measure of monetary policy action, the overnight rate, would be a good way to account for monetary policy in VAR-based analysis. However, one important drawback to using the overnight rate to measure monetary policy action is that data are available only from mid-1971. This data limitation prohibits the estimating of VAR systems over a long span of time, and can readily lead to degrees of freedom problems in larger, more complicated systems.

We argued that the operational framework of monetary policy has been reasonably constant since the late 1950s, and that an operational measure of monetary policy action relevant for the last 35 years is the overnight rate. Thus, we proposed splicing two measures of the overnight rate, that is, the day-loan rate, relevant from the late

1950s up to 1971, and the Bank's current measure of the overnight rate, Rcall, available from mid-1971 to the present.

We then examined the performance of this variable, Ron, as a measure of monetary policy action. We found that Ron innovations and innovations of the Bank's current operational target, Rcall, appear to incorporate virtually identical information about monetary policy shocks since the early 1970s, even though the Ron innovations are based on a VAR estimated over a much longer period. Since we know that Rcall is a good operational measure of monetary policy, the implication of this result is that Ron seems to be a good operational measure as well.

We then found that Ron innovations can provide reasonable representations of monetary policy shocks. That is, the path of Ron innovations provides a reasonable account of the evolution of monetary policy actions over the last 35 years. As well, these Ron innovations are positively correlated with disturbances to the spread between Ron and short-term market rates, suggesting that Ron innovations do not simply reflect endogenous market behaviour that moves all short rates together. Instead, this seems to suggest that disturbances to the relationship between the overnight rate and short-term market rates arise from monetary policy shocks, which are reflected by Ron innovations.

Also, we found that shocking Ron in VAR systems has consequences for output, prices and the exchange rate that one might expect from a monetary policy shock. Finally, Ron performs at least as well as either the 90-day paper rate or the term spread as a monetary policy variable in our (quarterly) VAR systems. That is, the impulse responses seem more sensible than those based on these other measures of monetary policy actions, and the results are more consistent across different orderings of the variables in the VAR.

In sum, we conclude that the overnight rate measure developed in this paper, Ron, provides a good basis for measuring monetary policy actions for VAR-based analysis, and that Ron innovations can provide a good measure of monetary policy shocks. Accordingly, we intend to represent monetary policy action with Ron in subsequent structural VAR analysis, which will rely on cointegrating relationships in the data and long-run restrictions for identifying policy shocks and their effects on the economy (following King et. al. 1991).

Table 1: A Chronology of Major Monetary Policy Episodes from 1961 to 1994[a]

Date and general policy stance	Remarks
1961-62 An easing of policy, followed by a sharp tightening	In mid-1961, concerned about idle capacity in the economy, the Bank of Canada pursued an easing of monetary policy. However, following a sharp decline in foreign exchange reserves in the first part of 1962, in mid-year the Bank of Canada acted to protect the exchange value of the dollar. By September the Bank was again acting to ease its policy stance.
1967 Began with loose policy, moved to a tight stance, closed with an easing.	From the middle of 1966 and into 1967, the Bank aimed at providing considerable resistance to a tightening of monetary conditions. Then in the fall of 1967, the Bank actively aimed for tighter conditions, putting significant pressure on bank liquidity and raising the Bank Rate in September, in November (following the devaluation of the pound), and again in January 1968. For most of the first half of 1968, the Bank continued to defend the dollar by aiming for tight conditions. However, by September, the Bank of Canada was again encouraging an easing of conditions.
1969 Tight policy	Beginning in late 1968, the Bank of Canada became increasingly concerned that inflationary pressures were not moderating as anticipated. Therefore, through 1969 and into the first few months of 1970, monetary policy was “directed towards restraint.” The Bank acted to sharply reduce bank liquidity, and the Bank Rate was raised twice in the middle of 1968.

Table 1: (Cont'd) A Chronology of Major Monetary Policy Episodes from 1961 to 1994[a]

Date and general policy stance	Remarks
Early 1970s Loose policy	In first few years of the 1970s, the Bank generally pursued an expansionary policy. For instance, in 1970, monetary policy was "relaxed substantially," and in 1972, the Bank actively pursued an "expansionary stance." Between early 1973 to the late summer of 1974, there was some resistance to the rapid growth of aggregate spending. However, from late summer 1974 onwards, policy was again aiming at achieving easy conditions.
1975-76 Sharp tightening followed by a substantial easing	Over the course of the summer of 1975, the Bank of Canada came to the view that underlying inflation was rapidly building up to a critical level. Thus, short-term interest rates were allowed to move higher and in early September the Bank Rate was increased substantially. The Bank continued to push up short-term interest rates in the first part of 1976. However, in the second quarter of 1976, M1 growth slowed abruptly, and in the third quarter, it became apparent that M1 growth was running beneath the lower limit of the target range and the Bank decided that "some corrective action was needed." Thus, the Bank worked to lower rates through the last two months of 1976 and into 1977. The loose stance of monetary policy generally continued through 1977.

Table 1: (Cont'd) A Chronology of Major Monetary Policy Episodes from 1961 to 1994[a]

Date and general policy stance	Remarks
1979-82 Tight policy punctuated by episodes of easing. Very volatile policy behaviour.	Following an increase in the Bank Rate in January 1979, in the first half of the year the Bank resisted downward pressure on interest rates. In the second half of the year, the Bank encouraged increases in interest rates and raised the Bank Rate in July, September and twice in October. In the early months of 1980, there was upward pressure on rates, which the Bank resisted initially. However, as the dollar weakened, the Bank allowed short-term interest rates to rise. As well, a tight policy stance was actively pursued through the spring and early summer. However, through the summer and fall, policy eased substantially. In the last months of the year, however, the Bank again tightened. Through the first half of 1981 economic conditions put continuing upward pressure on short-term interest rates, which the Bank felt was appropriate, and its operations were directed toward smoothing fluctuations in the upward trend of rates. In July and August of 1981, as the dollar came under downward pressure, the Bank accepted a sharp increase in interest rates. However, from August on, the Bank acted to lower rates. In early 1982, there was downward pressure on the dollar and the Bank let the market take rates up. After mid-year, there was strong downward pressure on interest rates; in response, due to concerns about renewed weakness of the dollar, the Bank acted to moderate the decline in short-term interest rates.

Table 1: (Cont'd) A Chronology of Major Monetary Policy Episodes from 1961 to 1994[a]

Date and general policy stance	Remarks
1983-84 Loose policy, then some resistance to falling rates in late 1984	The Bank of Canada pursued an expansionary policy in 1983 and in much of 1984. During 1983, monetary policy was directed towards achieving short-term interest rate levels as low as were consistent with continued progress on inflation. In the first part of 1984, U.S. interest rates moved upward and Canadian rates increased along with U.S. rates. However, through much of this period, the Bank acted to moderate the upward pressure on domestic interest rates. In the second half of 1984, as U.S. rates declined, so too did Canadian interest rates. However, the Bank acted to "smooth the rate of descent" of Canadian rates.
Late 1985, early 1986 Tight policy followed by an easing	The Canadian dollar came under downward pressure in late 1985 and early 1986, and the Bank of Canada reacted strongly to support the dollar.

Table 1: (Cont'd) A Chronology of Major Monetary Policy Episodes from 1961 to 1994[a]

Date and general policy stance	Remarks
Late 1980s to the early 1990s Prolonged tight policy followed by easing, interrupted by a tightening in late 1992.	The Bank described the stance of policy in 1988 as "demonstrating strong and consistent resistance...to the spending pressures that...threatened to provoke an...upsurge in inflation." According to Laidler and Robson (1993), however, a decisive policy shift and clear tightening in line with the drive to price stability occurred in 1989, and there was increased tightening through 1990. The stance of monetary policy became clearly expansionary in the first half of 1992, although this loosening of policy was interrupted in the last months of 1992 by the Bank's response to downward pressure on the dollar. In 1993, the Bank resumed an expansionary stance.

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[a] This table is based on Bank of Canada annual reports, but it also draws on Courchene (1981) for the 1979-82 period and on Laidler and Robson (1993) for the period from the late 1980s to the early 1990s. All quotes in the table are from the Bank's annual reports for the corresponding year.

Figure 1
Rcall and Rday

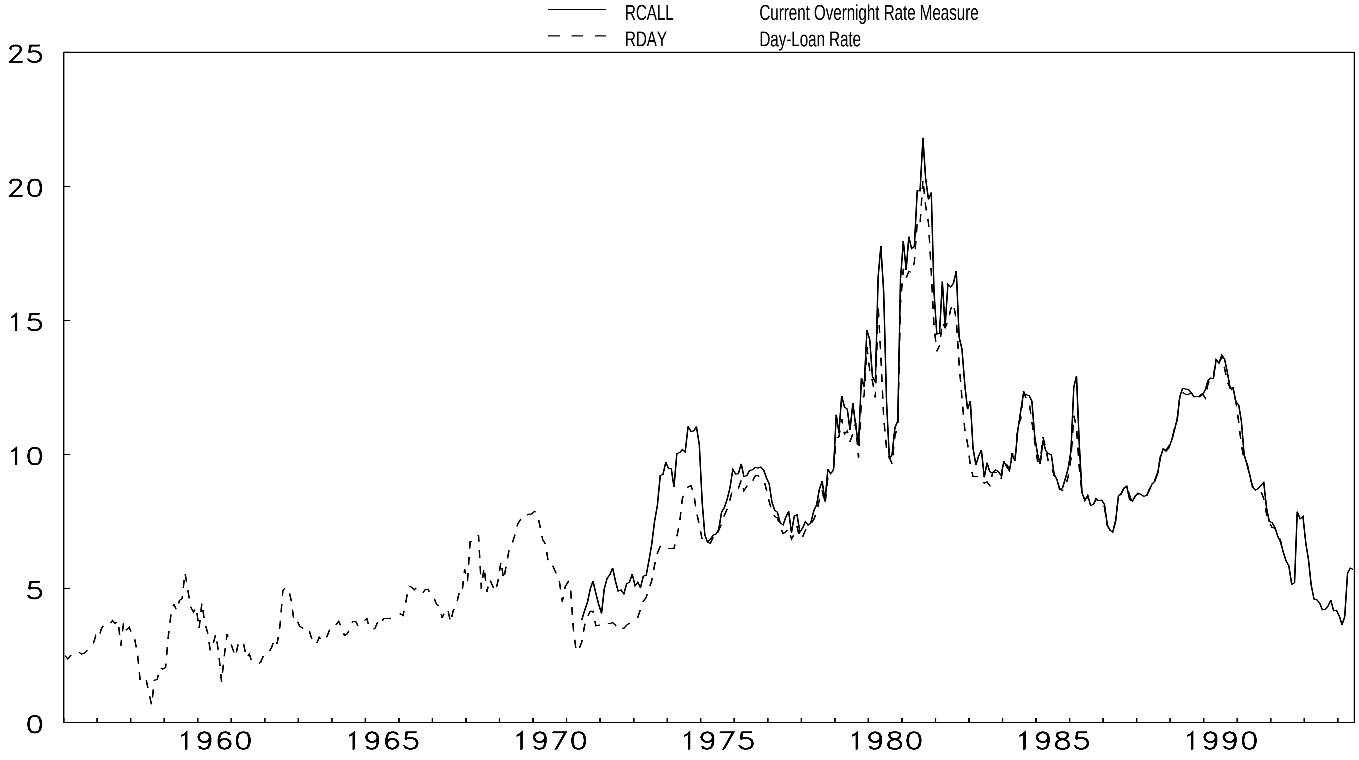


Figure 2
Rcall and Ron Innovations

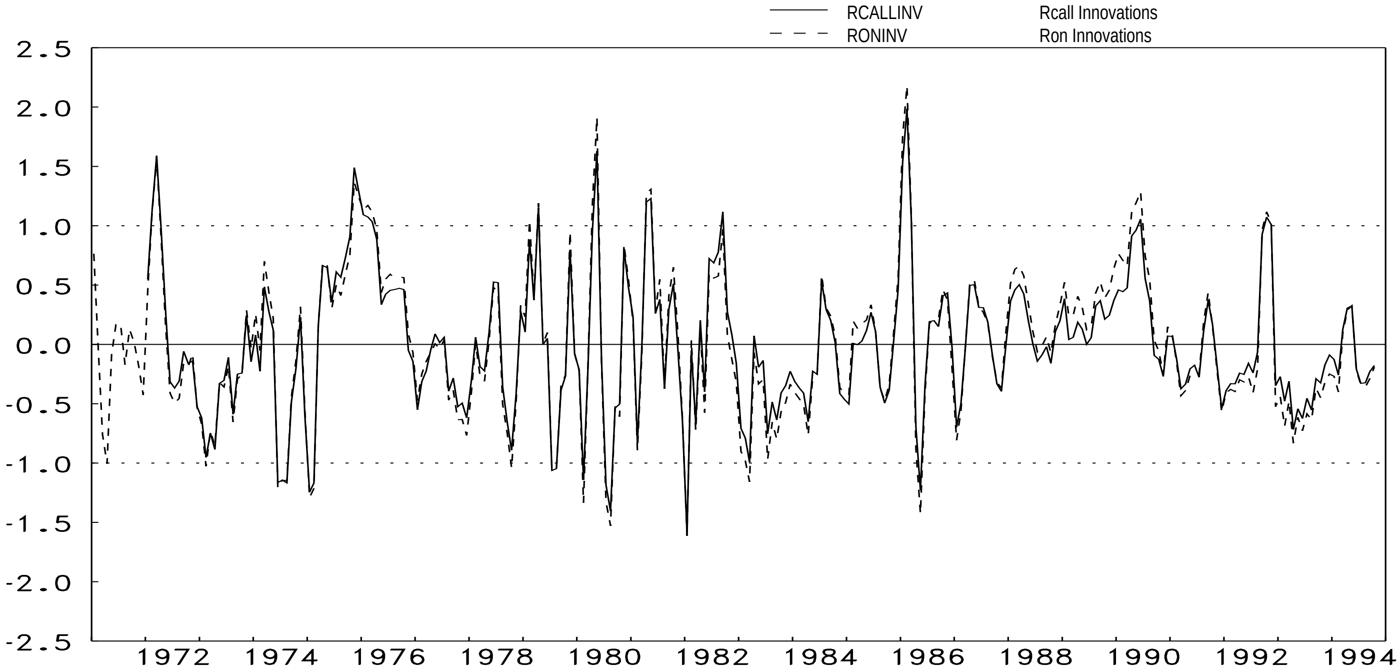


Figure 3
Ron Innovations

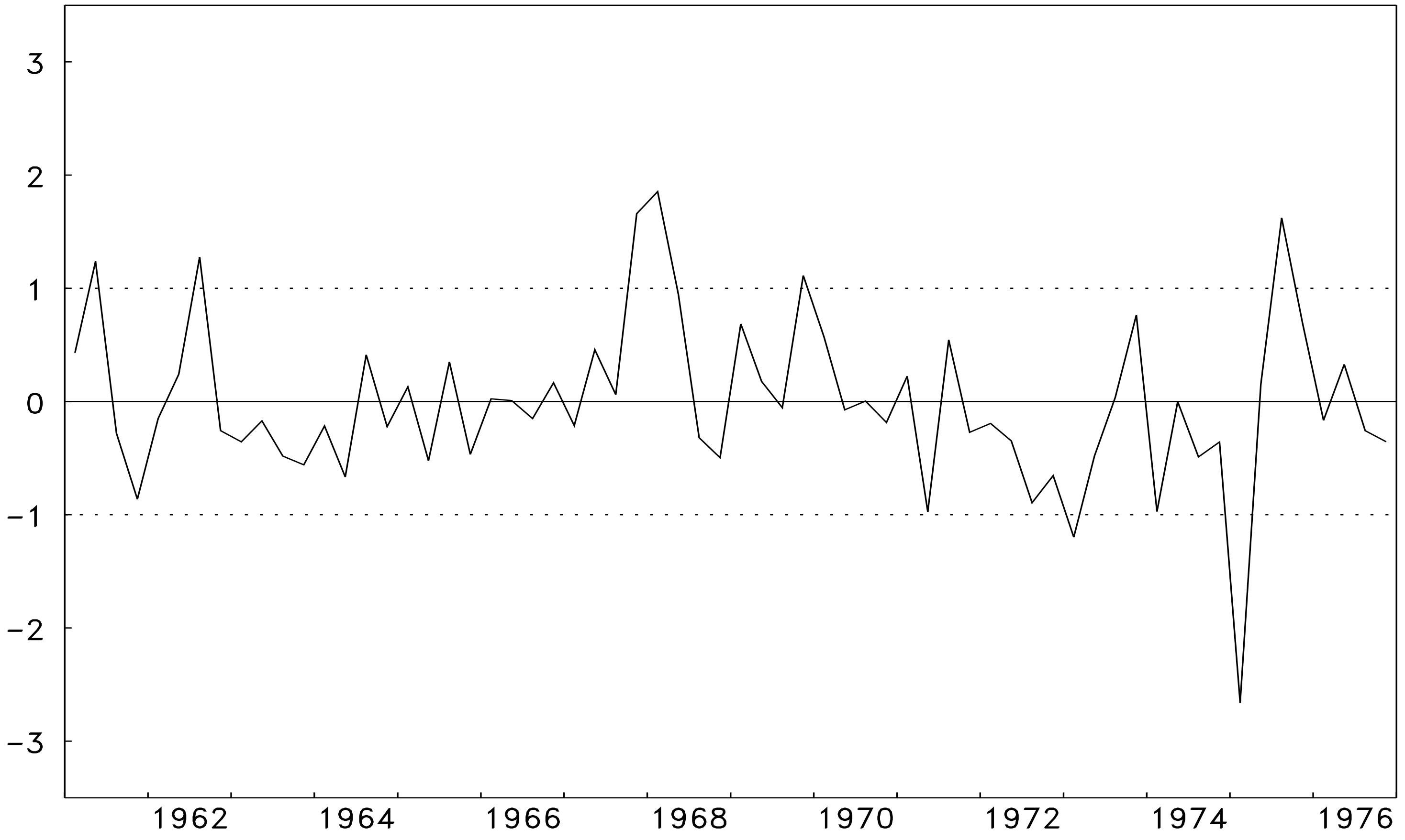


Figure 3 (cont'd)
Ron Innovations

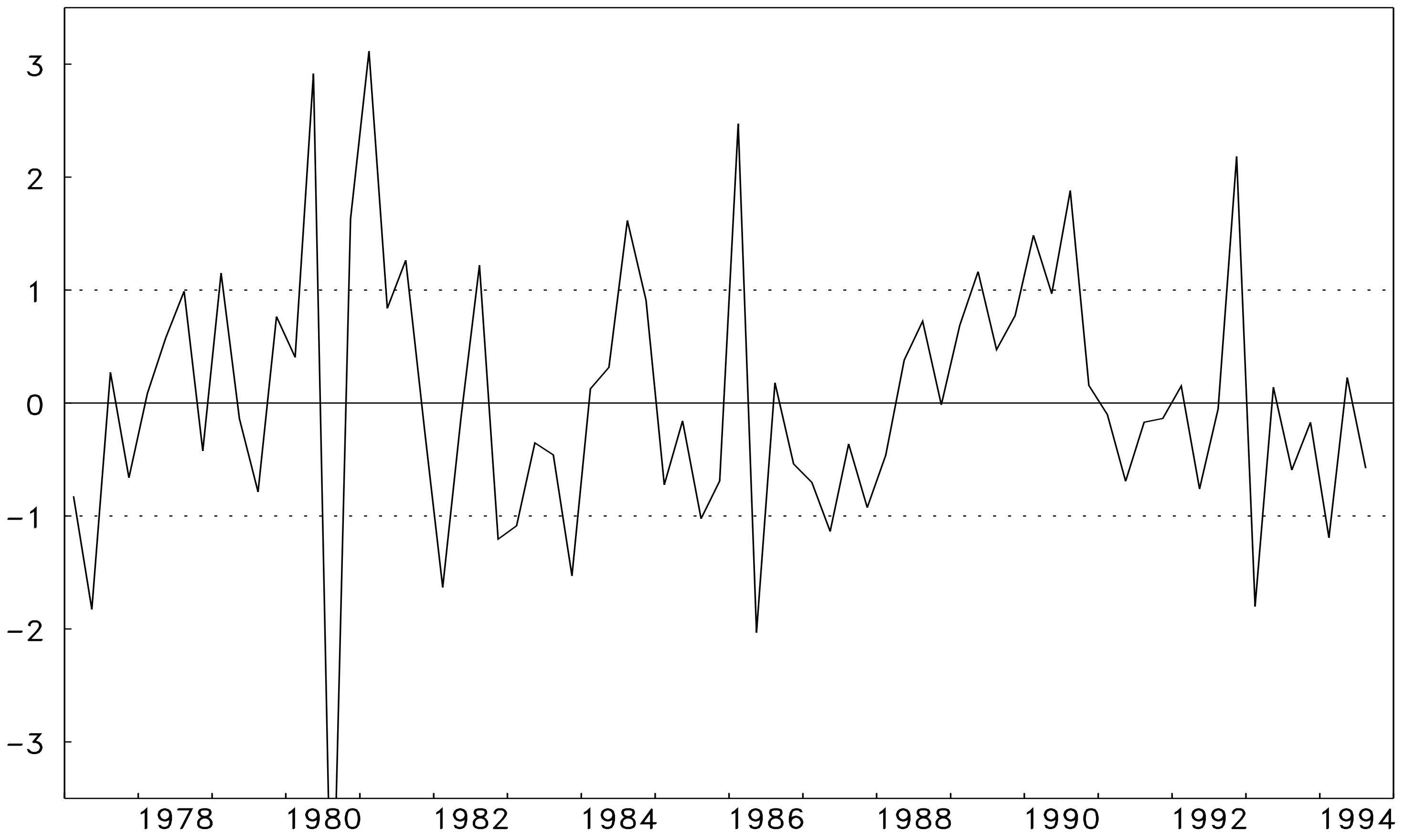


Figure 3
Ron Innovations

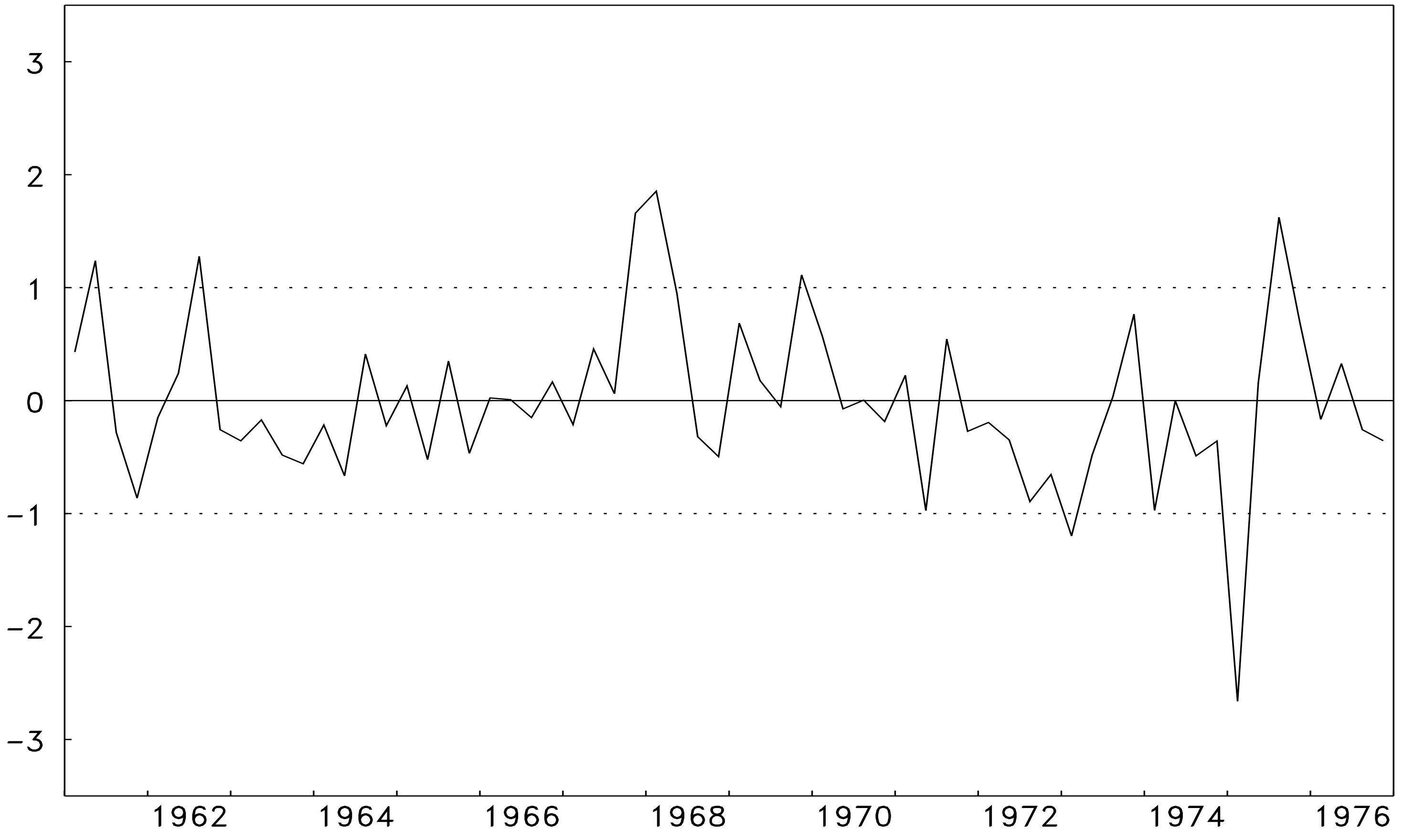


Figure 3
Ron Innovations

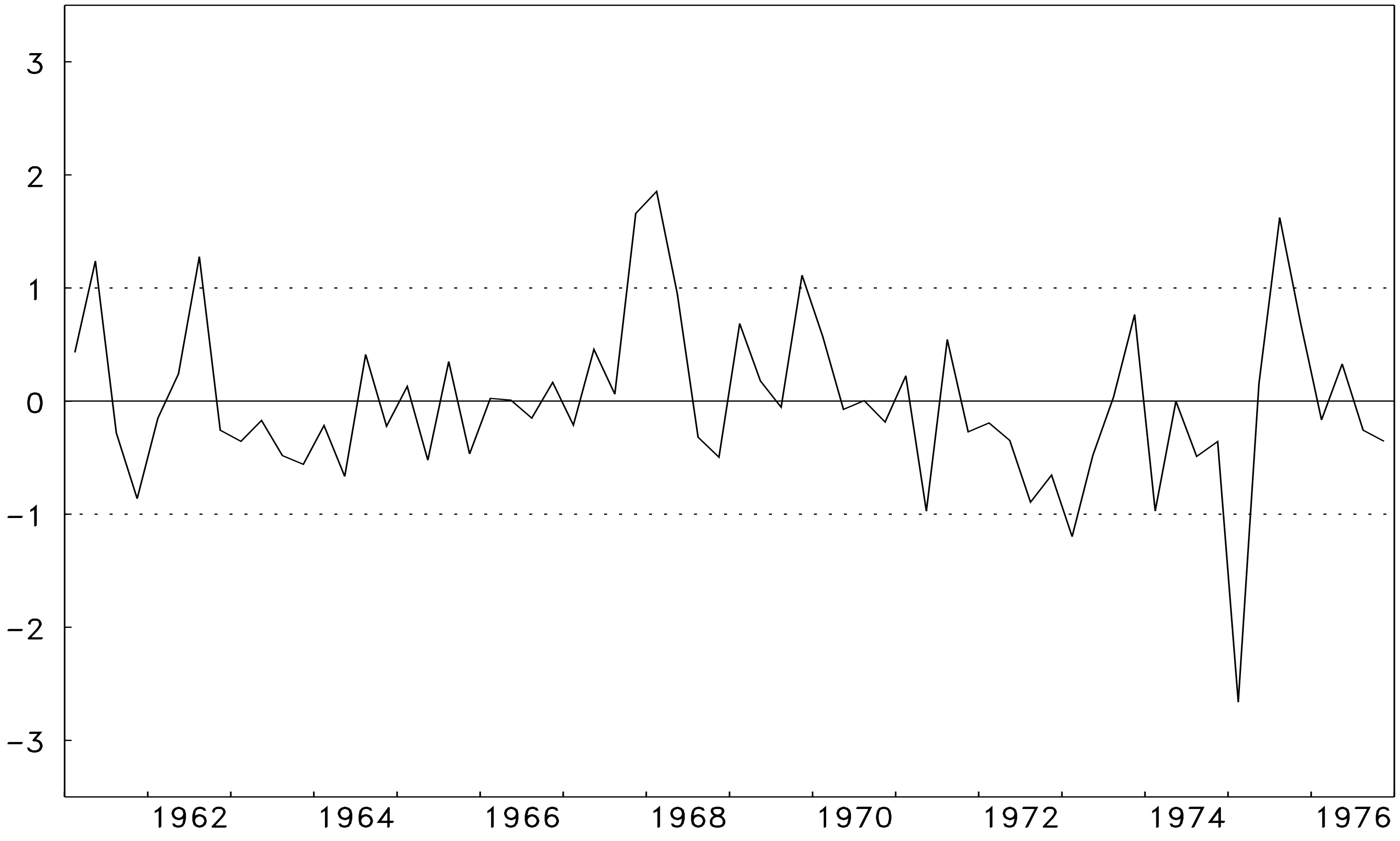


Figure 4
Ron and R90

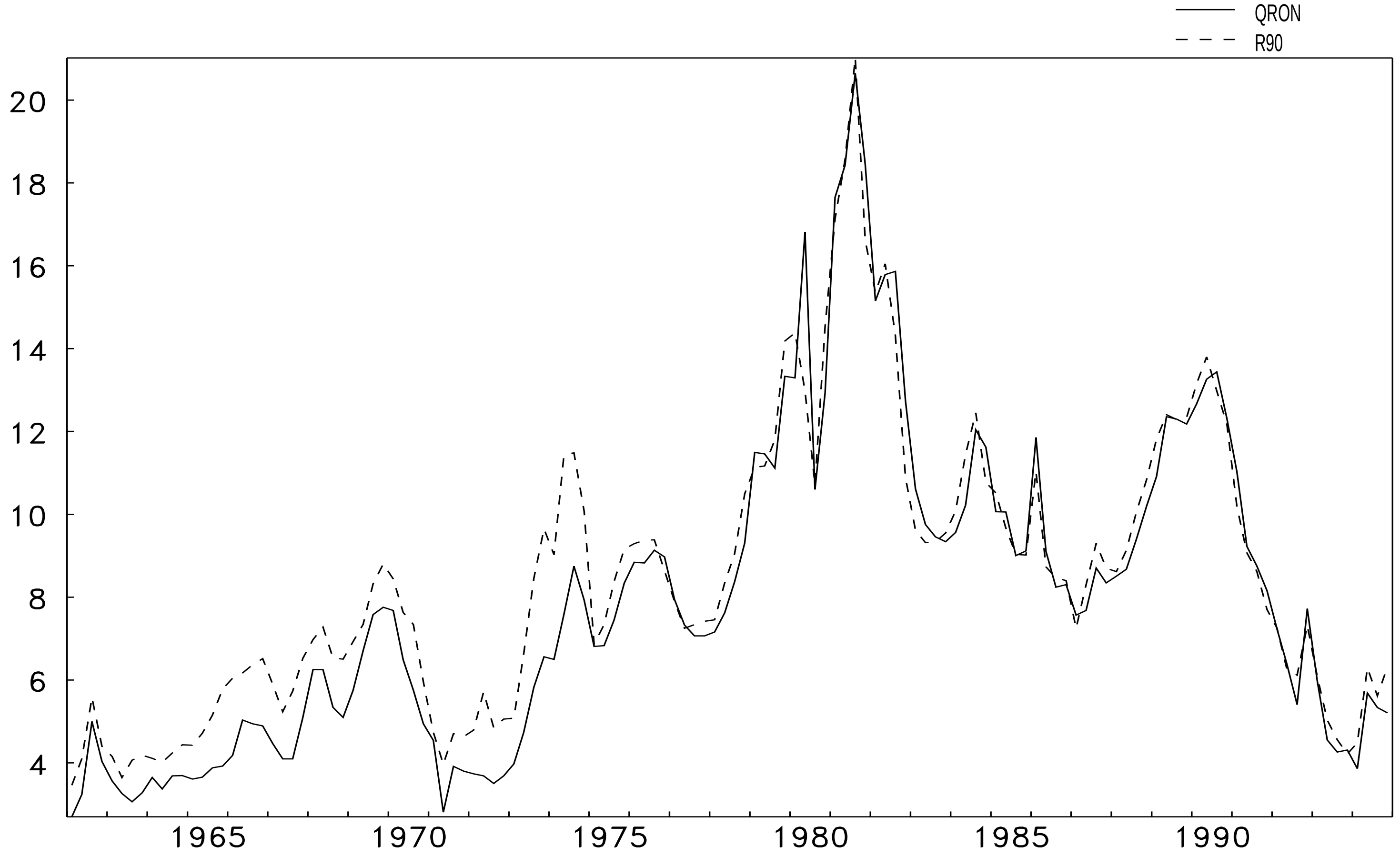


Figure 5
Ron Innovations and Change in (Ron-R90)

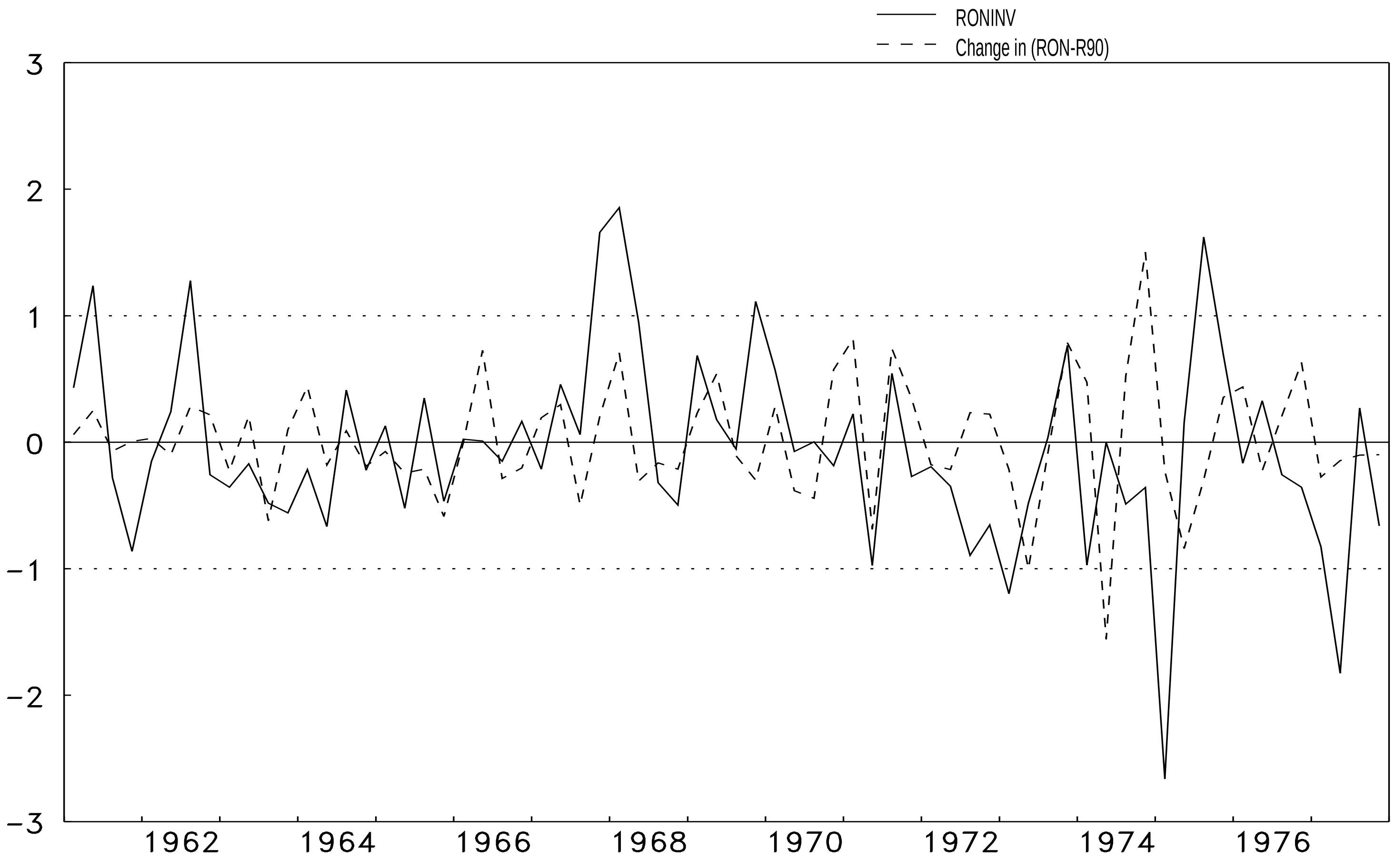


Figure 5 (cont'd)
Ron Innovations and Change in (Ron-R90)

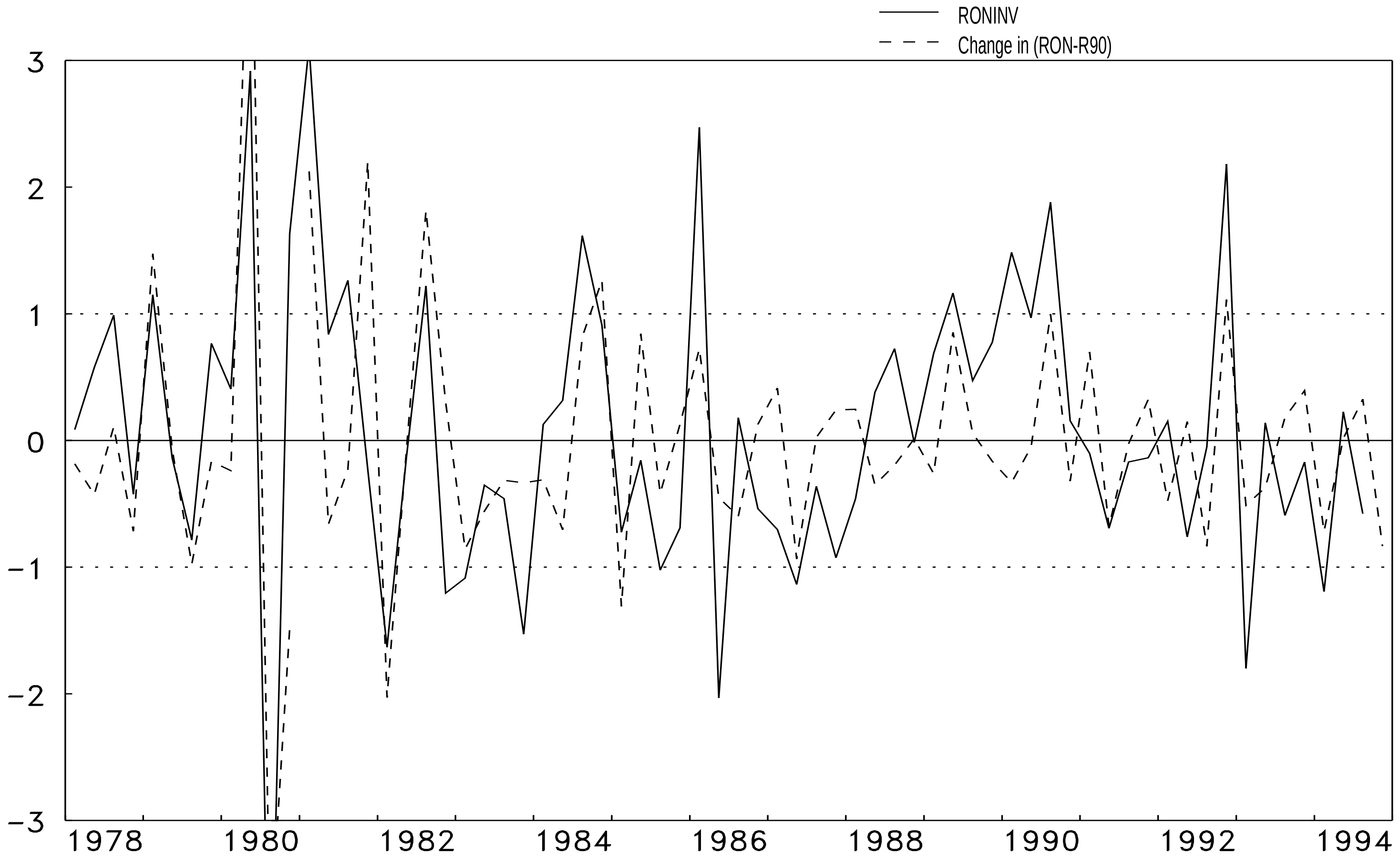


Figure 3
Ron Innovations

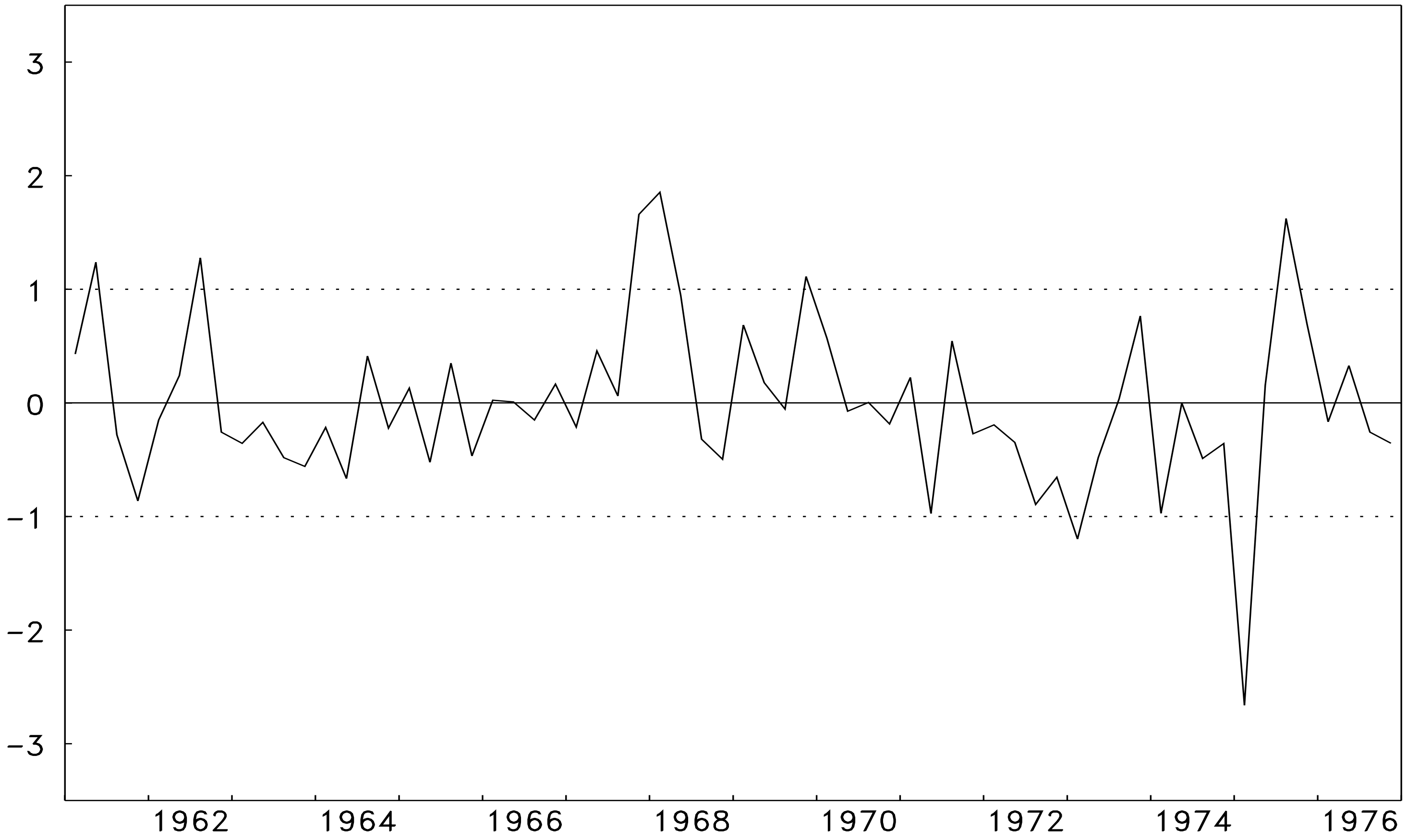


Figure 5 (cont'd)
Ron Innovations and Change in (Ron-R90)

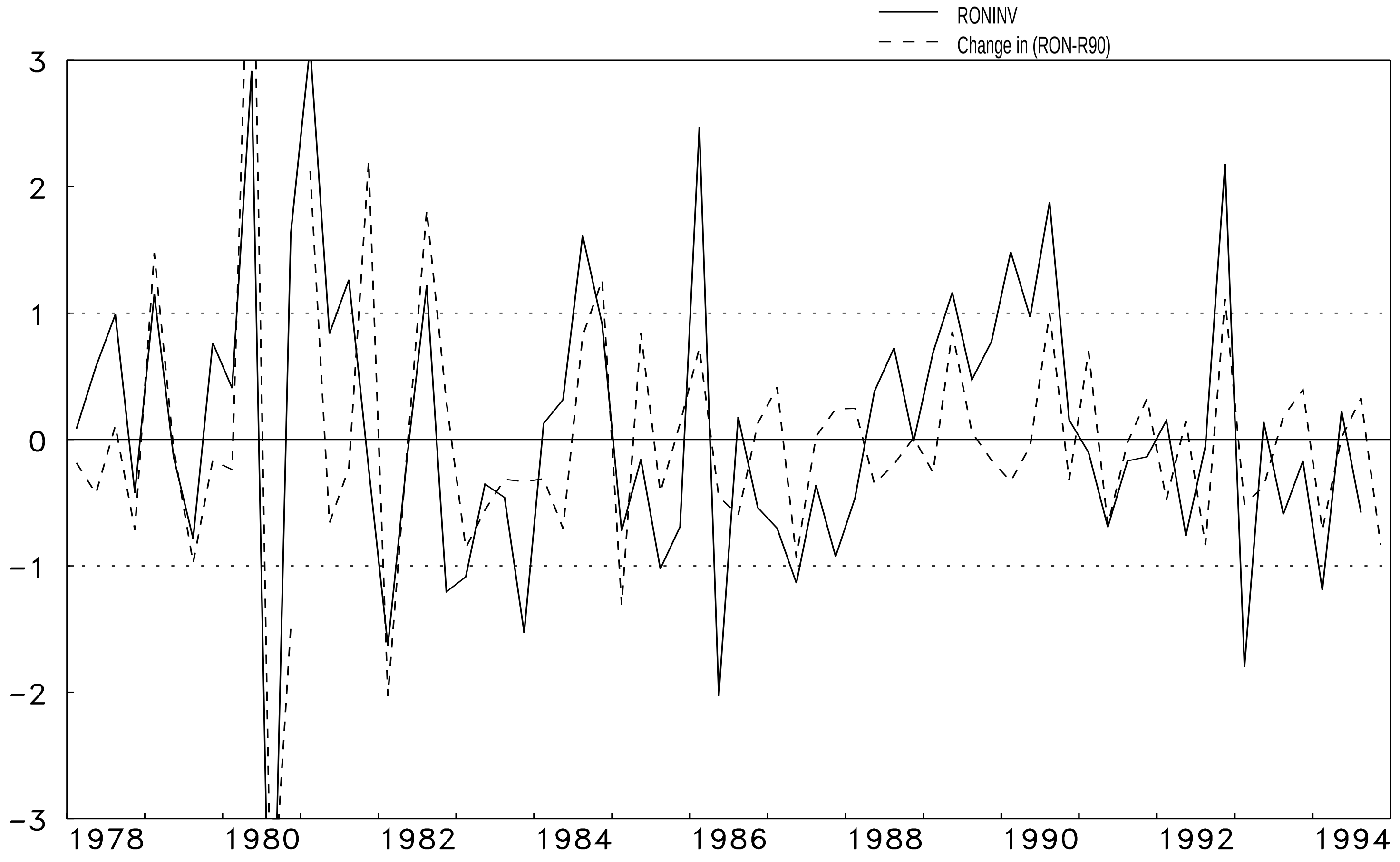


Figure 9
Effect of a Ron Innovation: (Yp, Y, P, PFX, RON, M1)

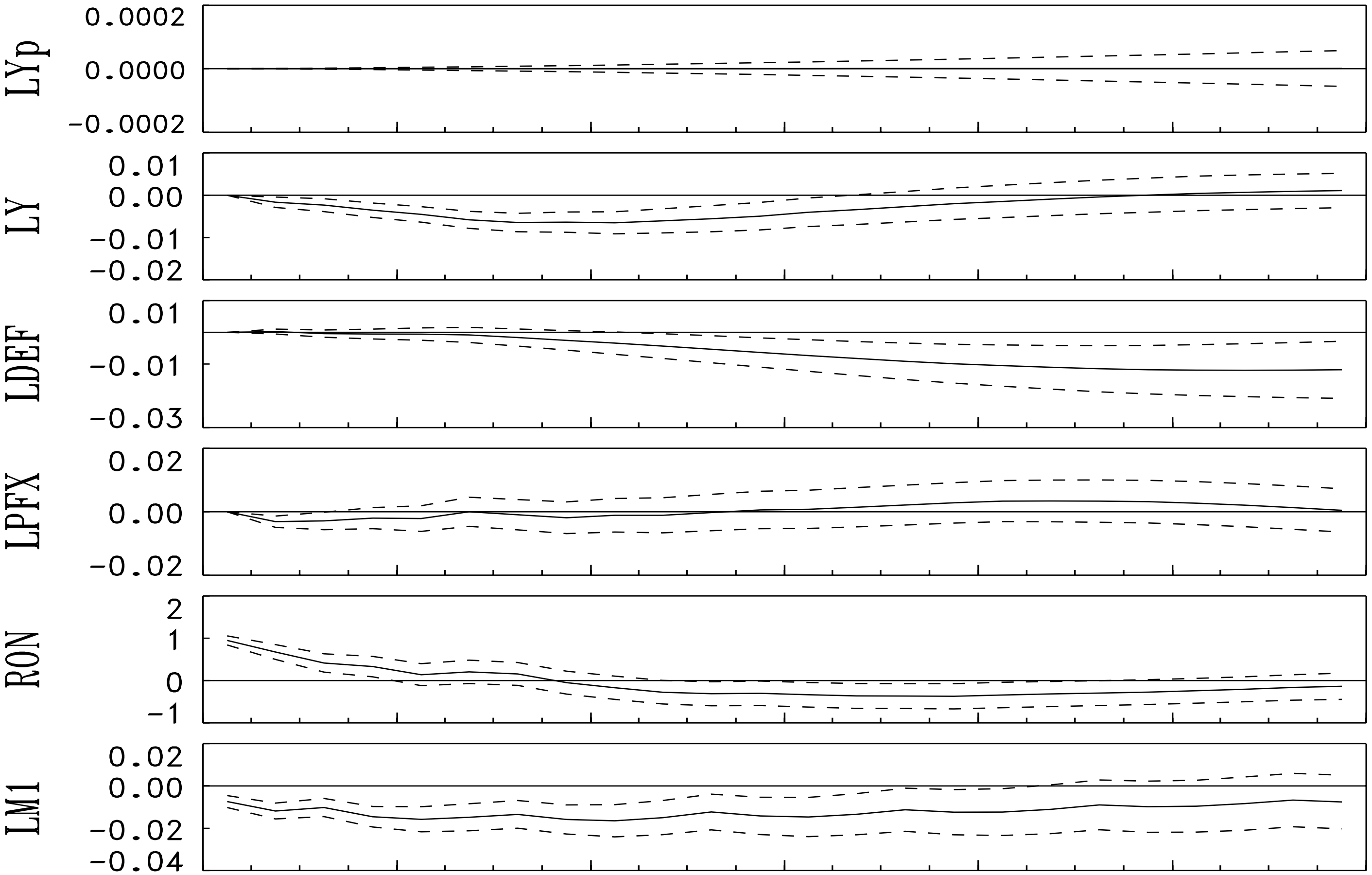


Figure 10
Ron Innovations and R90 Innovations

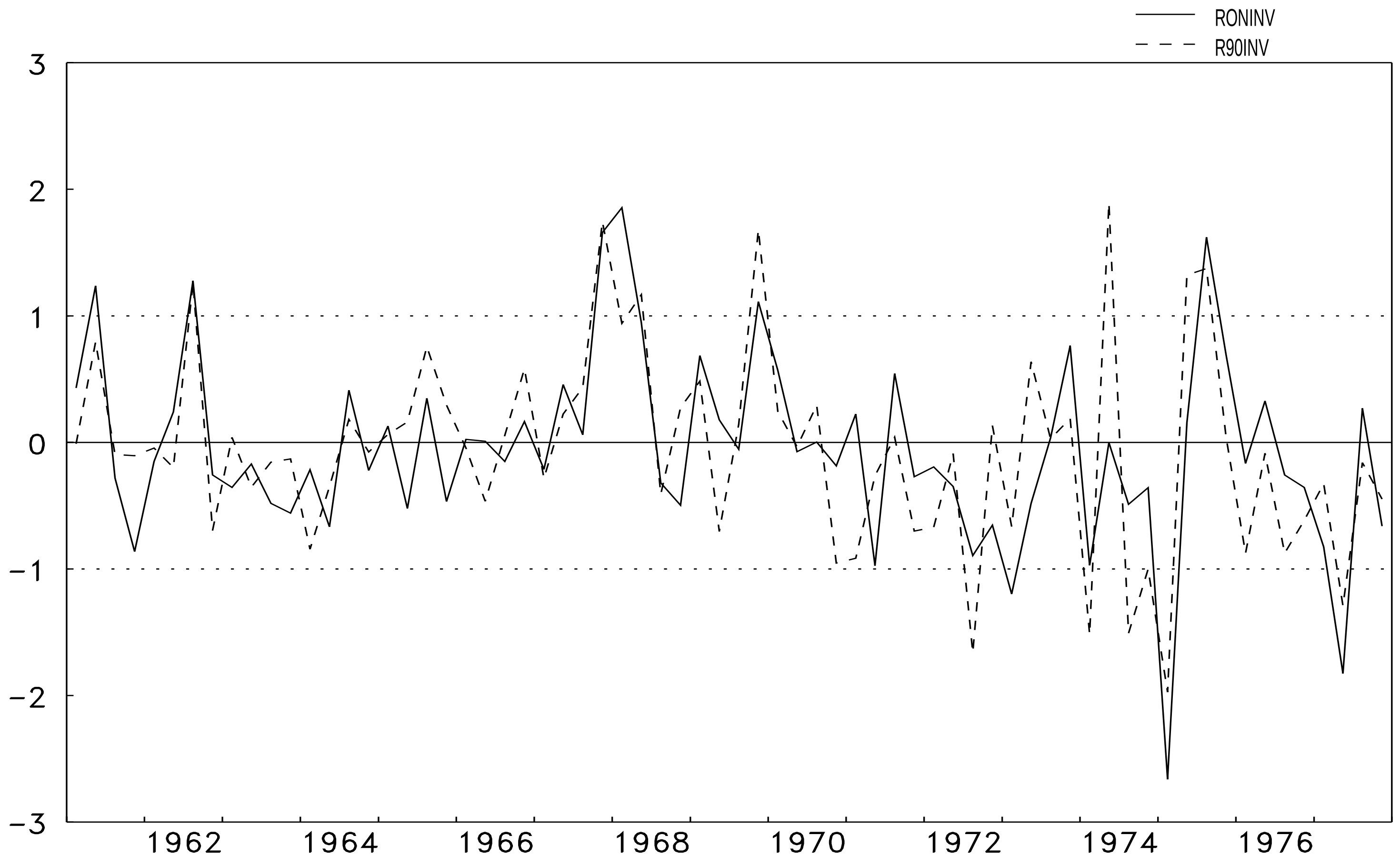


Figure 10 (cont'd)
Ron Innovations and R90 Innovations

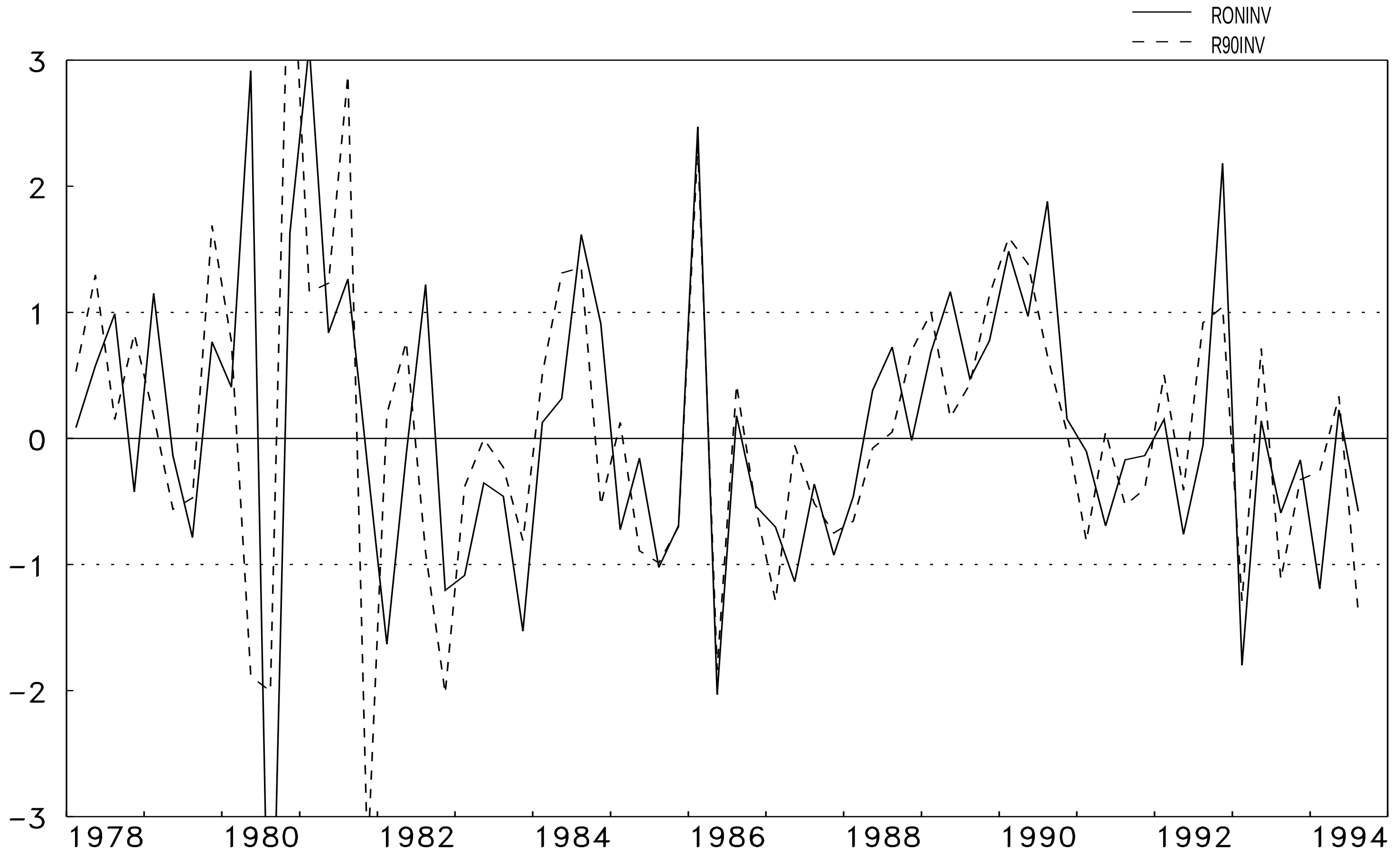


Figure 11
Ron Innovations and Term Spread Innovations

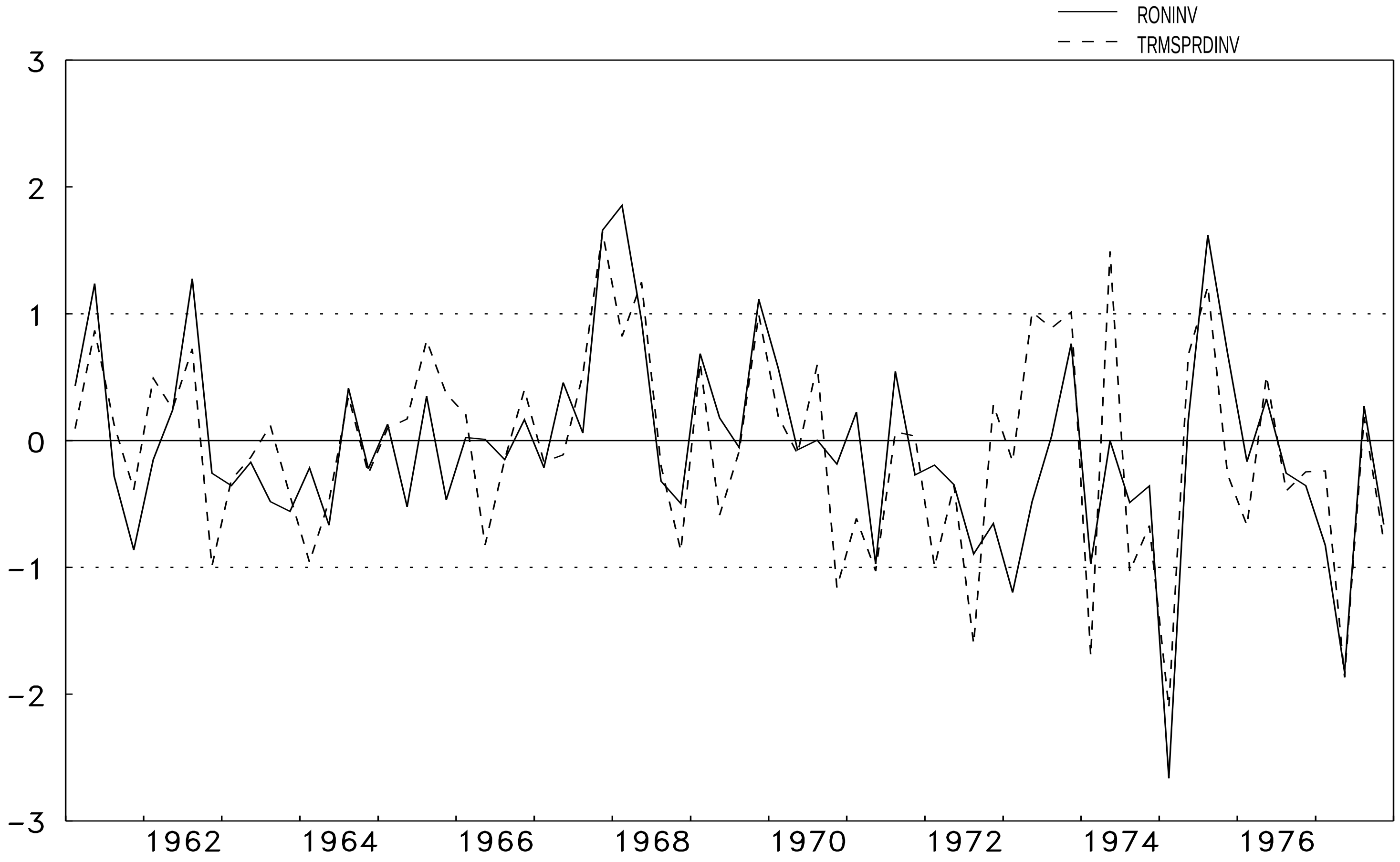


Figure 11 (cont'd)
Ron Innovations and Term Spread Innovations

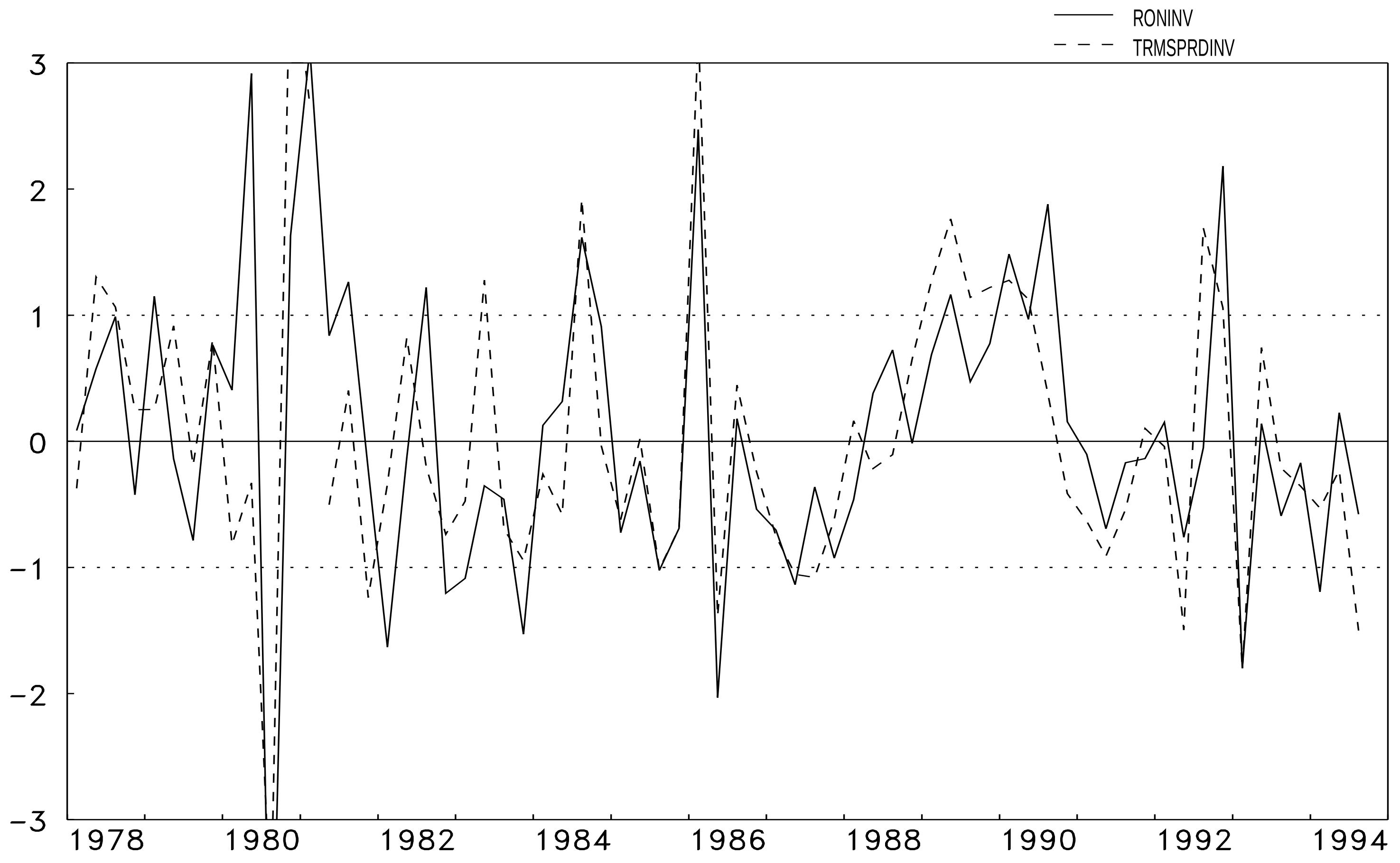
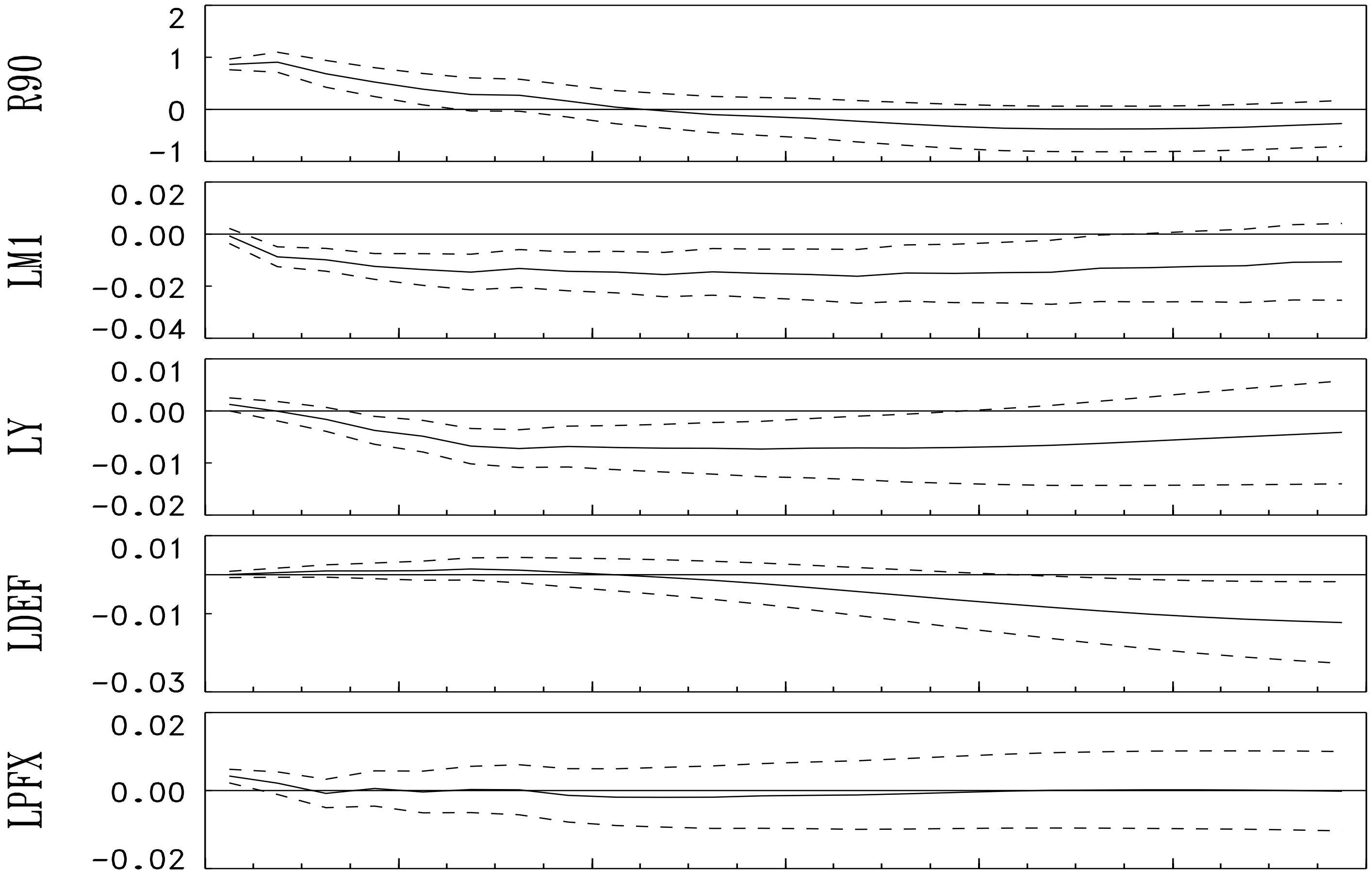


Figure 12
Effect of an R90 Innovation: (R90, M1, Y, P, PFX)



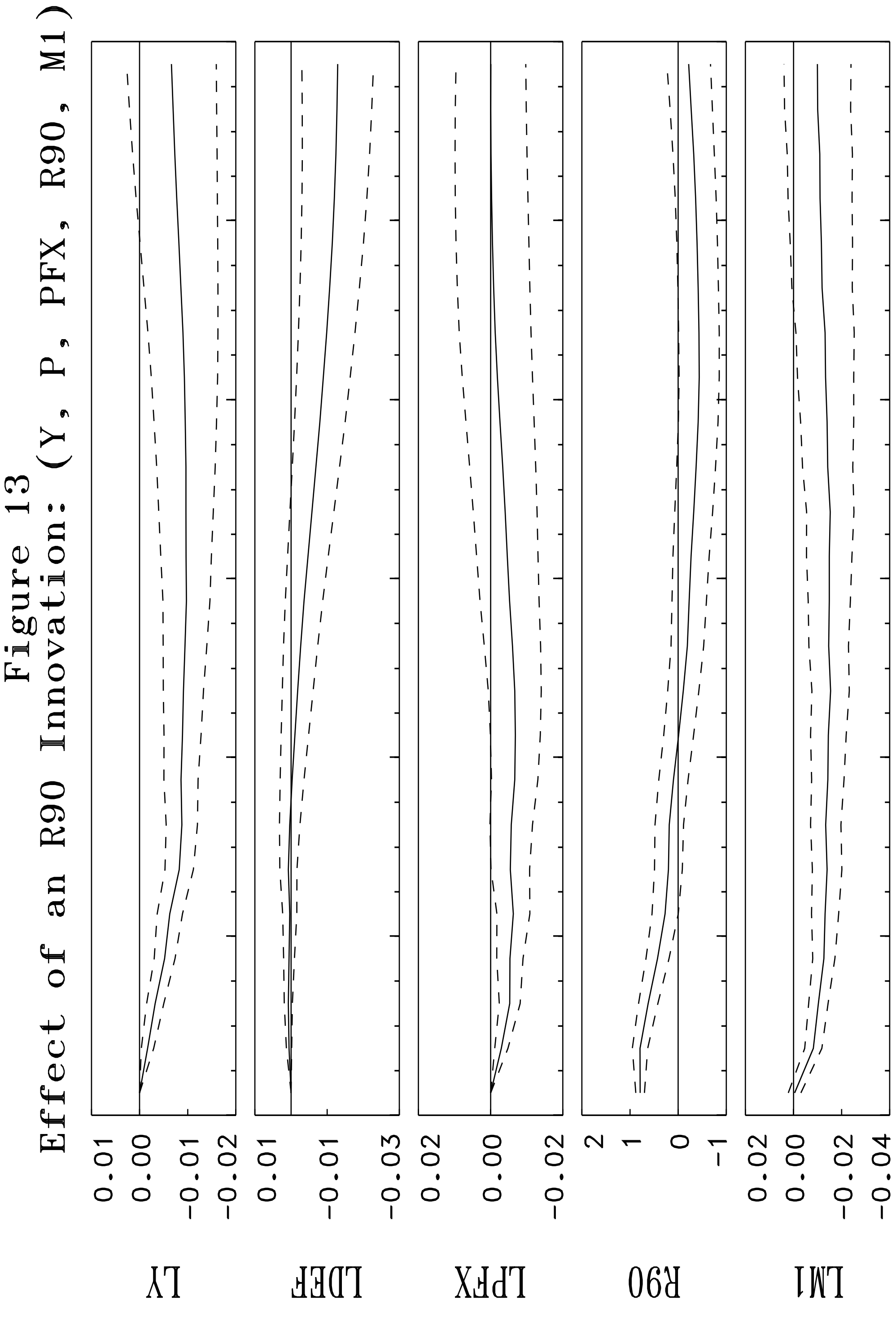


Figure 13
Effect of an R90 Innovation: (Y, P, PFX, R90, M1)
LY
0.01
0.00
−0.01
−0.02
LDEF
0.01
−0.01
−0.03
LPFX
0.02
0.00
−0.02
R90
2
1
0
−1
LM1
0.02
0.00
−0.02
−0.04

Figure 14
Effect of a Term Spread Innovation: (TRMSPRD, M1, Y, P, PFX)

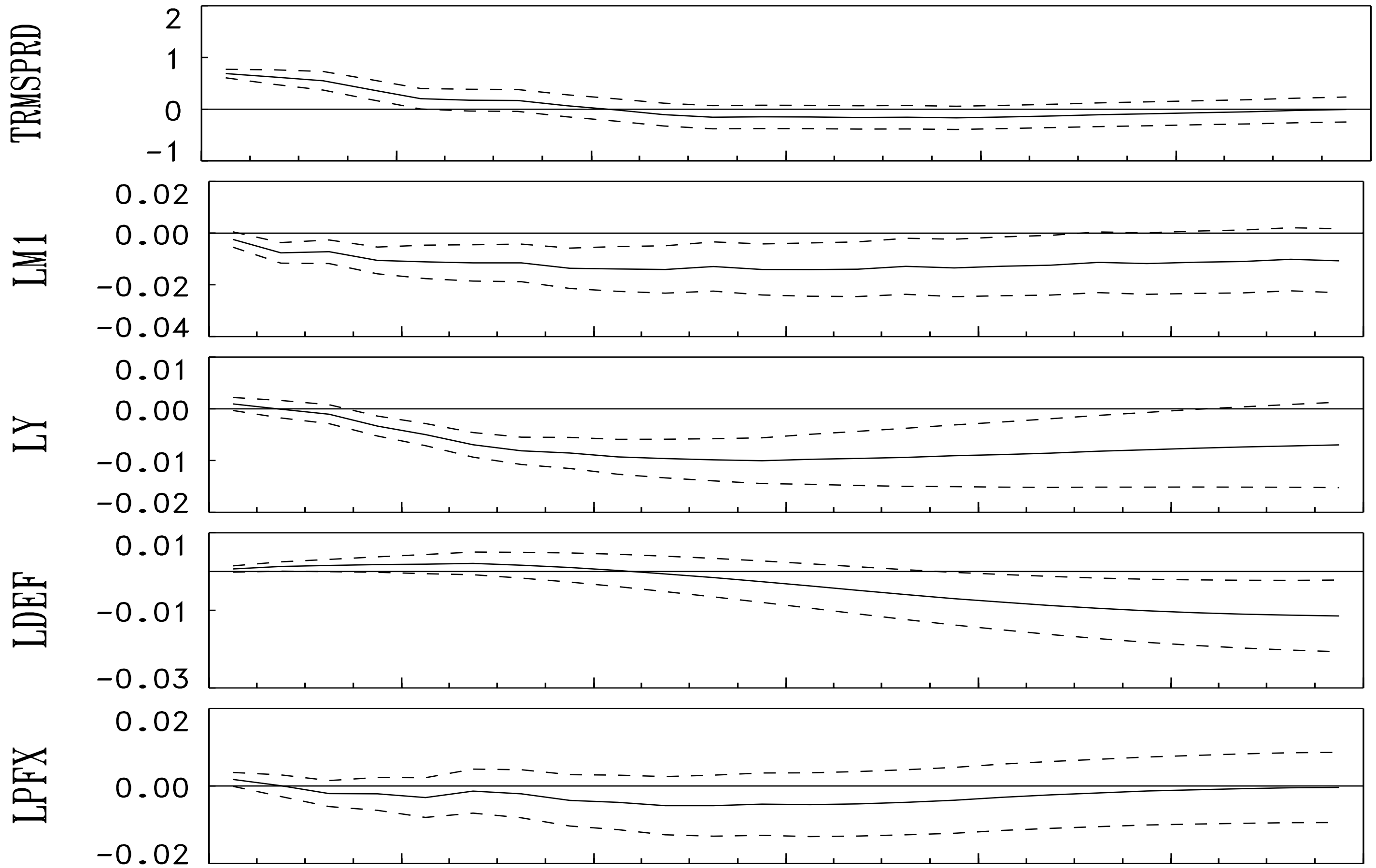


Figure 15
Effect of a Term Spread Innovation: (Y, P, PFX, TRMSPRD, M1)

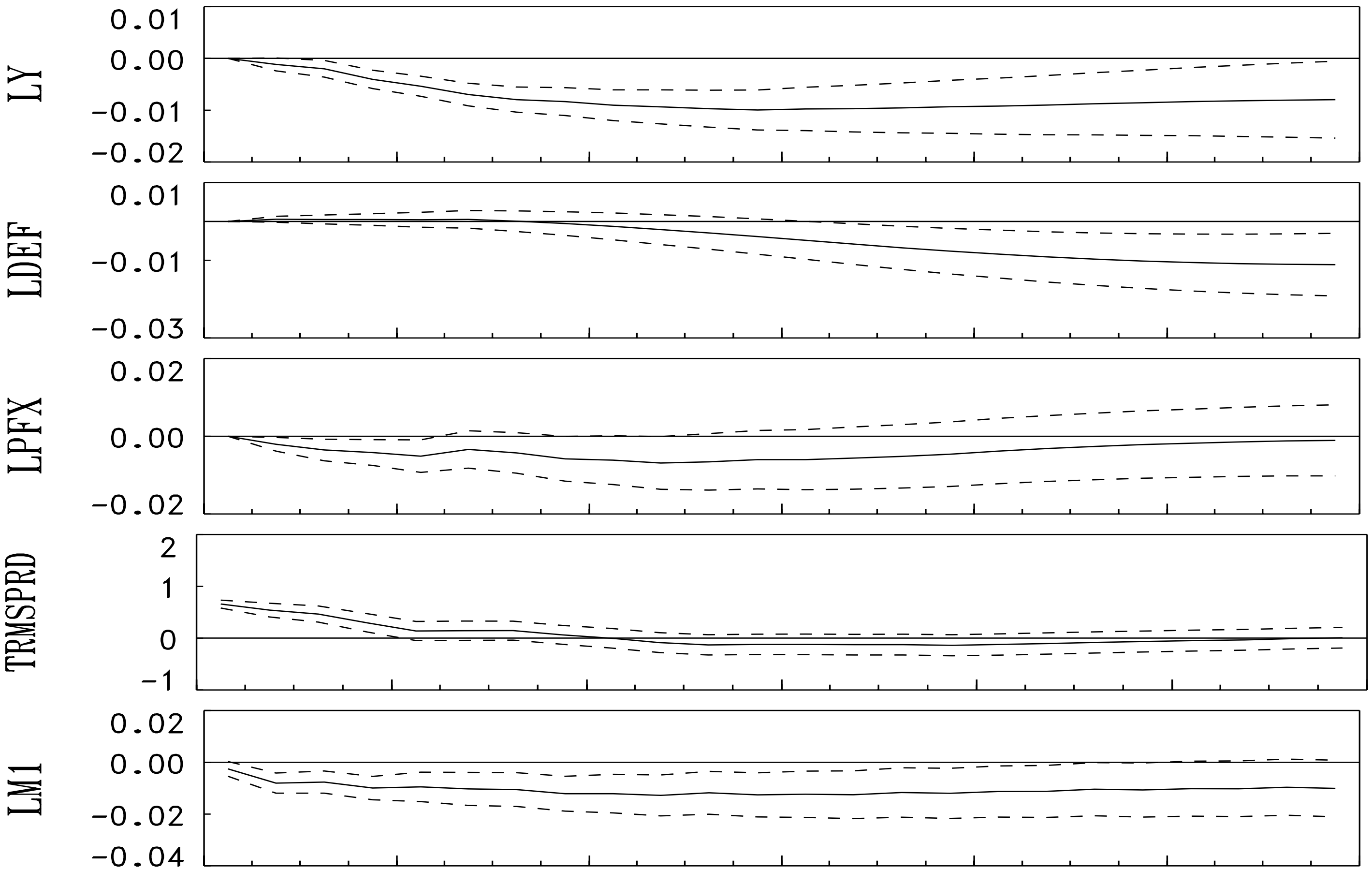


Figure 6
Effect of a Ron Innovation: (RON, M1, Y, P, PFX)

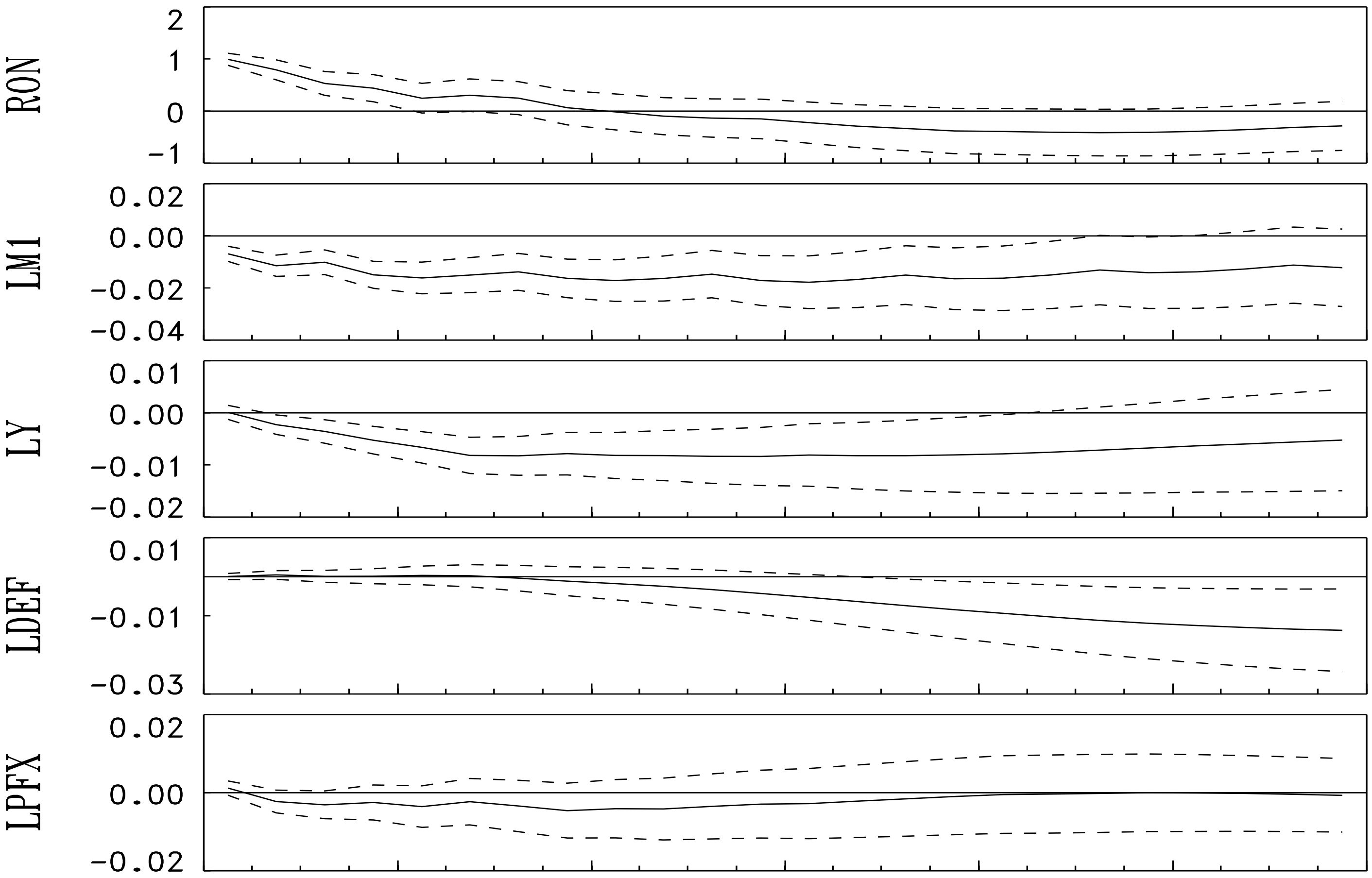


Figure 7

Effect of a Ron Innovation: (Y, P, PFX, RON, M1)

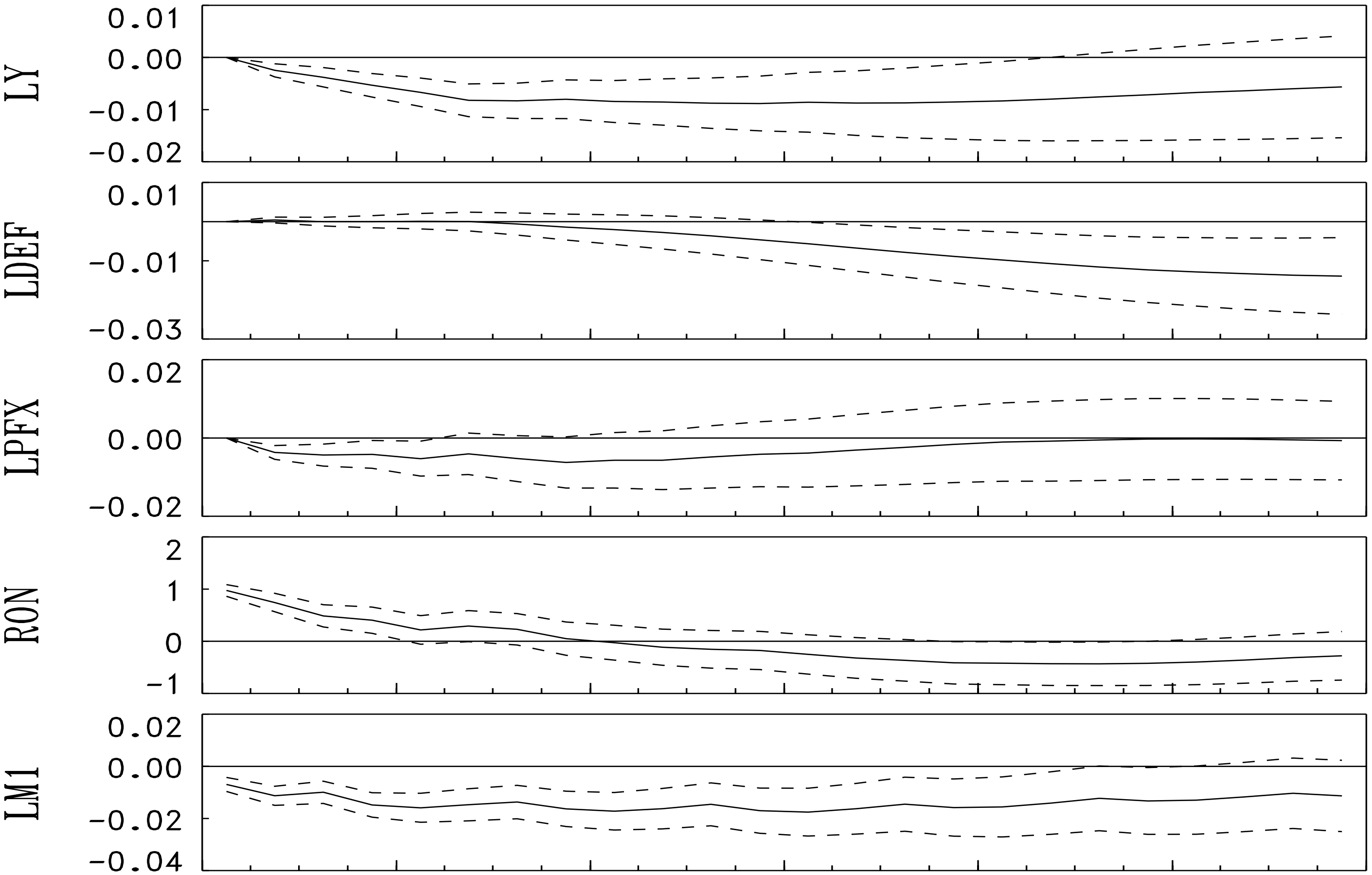
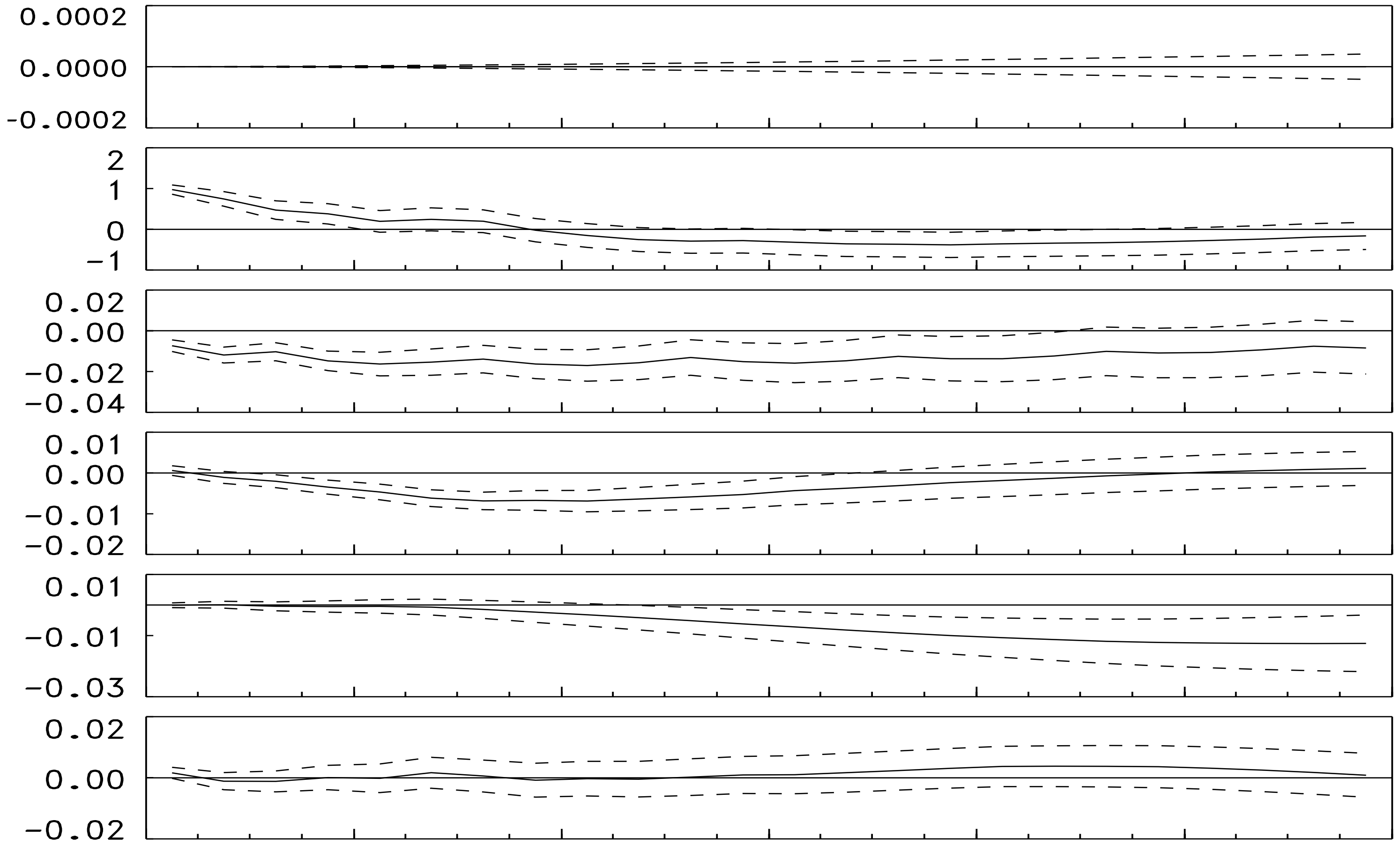


Figure 8
Effect of a Ron Innovation: (Yp, RON, M1, Y, P, PFX)



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