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# Short-Term Forecasting of National and Provincial Employment in Canada

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**by**
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# Abstract

This report examines short-term forecasting of employment-related variables in Canada and its provinces, using monthly data. It evaluates tools for forecasting such variables both with respect to their accuracy and their ability to announce changes in the direction of the variables. For forecasting employment changes over a one- to six-month time frame, large structural models have recently proven ineffective since, in part, they are difficult to re-estimate, given that structural changes are not well identified. Thus, analysts have begun to rely on less structural methods for forecasting.

First, the report presents a survey of literature and evaluates the performances of available techniques for constructing forecasting models. Second, the issues pertaining to the adoption of a forecasting protocol are addressed. Finally, three classes of forecasting models are selected, estimated and used for forecasting the national and provincial employment levels, employment rates and unemployment rates, leading thereafter to an assessment of their performance.

The results show that it is possible to construct reasonably good models of short-term forecasting of labour market aggregate variables for Canada and its provinces. In terms of both performance and ease of programming and use, it is helpful to develop a well-structured protocol for forecasting. However, sometimes a model that dominates other ones in terms of their root mean square error may be dominated in terms of its ability to forecast the direction of changes in a variable. Furthermore, it is not always the same class of model that dominates over all short-term horizons.

# Résumé

Ce texte concerne la prévision de variables disponibles mensuellementreliées aux marchés du travail au Canada dans son ensemble, ainsi que par provinces. Il évalue divers outils de prévision de ces variables, d'une part, en terme de leur degré de précision et, d'autre part, relativement à leur habileté à annoncer qualitativement la direction des changements à venir dans ces variables. Dans le contexte de la prévision des changements dans l'emploi sur un horizon de un à six mois, les gros modèles structurels ont récemment été jugés peu fiables, en partie à cause des difficultés reliées à leur réestimation, étant donné que changements structurels ne sont pas bien identifiées. Ainsi, les praticiens et les analystes en sont venus à préférer des méthodes moins structurelles pour fins de prévision.

Premièrement, le texte présente un survol de littérature et évalue la performance des techniques disponibles pour la construction de modèles de prévision. Deuxièmement, les questions qui concernent l'adoption d'un protocole de prévision sont abordées. Finalement, trois classes de modèles de prévision sont sélectionnées, estimées et utilisées pour prévoir les niveaux d'emplois, les taux d'emplois et les taux de chômage au niveau national, ainsi que par province. Une évaluation de la performance de ces modèles est ensuite présentée.

Nos résultats montrent qu'il est possible de construire des modèles raisonnablement satisfaisant pour la prévision à court terme de variables agrégées du marché de l'emploi pour le Canada et ses provinces. En termes à la fois de performance et de facilité de programmation, nous avons trouvé utile de développer un protocole de prévision bien structuré. Bien que parfois, un modèle domine les alternatives considérées en termes de racine de l'écart quadratique moyen des erreurs de prévision, celui-ci peut être dominé si on l'évalue par rapport à son habileté à prévoir le signe de la direction du changement dans la variable d'intérêt. De plus, ce n'est pas nécessairement toujours la même classe de modèle qui est supérieure pour toutes les horizons de court terme.

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# 1. Introduction

The Canadian labour market is changing rapidly due to a combination of structural changes and ongoing market adjustment. For example, an incomplete list of structural initiatives in the past ten years includes: the implementation of the North American Free Trade Agreement, the GST, elimination of deficits at both the federal and provincial levels, large changes in the Employment Insurance system and rising employer demands for skilled workers. Similarly, the 1990s have seen large-scale movement of key economic indicators, such as the decline in the value of the Canadian dollar relative to its U.S. counterpart and the rise and decline of Canadian unemployment rates.

In this environment, interpretation of monthly labour market data could be more effective if a variety of forecasting tools were available. Forecasting changes in employment and the unemployment rates of Canada and the provinces over one-to six-month time frames are difficult. At the same time, the Occupation Projections and Macroeconomic Studies unit and their provincial partners would like an early-warning system to identify cyclical turning points.

The effects of changes noted above are not yet well understood. This implies that large structural models have recently had difficulties forecasting with the usual accuracy the various labour market aggregates. Furthermore, these models are difficult to re-estimate, given that the structural changes are not well identified. As a result, analysts have begun to rely more on less structural models to do forecasting. This is especially relevant for short-term forecasts, for which this type of model has a proven record.

In this context, we have developed a set of models for forecasting employment levels, employment rates and unemployment rates for Canada and the provinces over a maximum six-month forecast period. These models have been assessed and are recommended for use by Occupational Projections and Macroeconomic Studies staff of Applied Research Branch, Human Resources Development Canada.

The project has involved four stages. First, we reviewed the relevant literature with particular attention to assessing the techniques for modeling and forecasting regional labour market indicators. Second, we devised a forecasting protocol that set a rigorous and systematic way to assess the forecasting performance of the models. Third, the forecasting protocol was translated into a set of computer routines in Eviews 3.1. These routines automate the steps required to select among the various forecasting models and to construct the forecasts. The fourth stage included the validation, with monthly data, of a set of forecasting models of employment levels, employment rates and unemployment rates in Canada and its provinces. These models will forecast at short horizons, from one to six-months ahead.

The remainder of this report is organized in four parts. The first part surveys the literature on alternative short-term forecasting models for national and regional employment indicators. The second part is concerned with methodological issues linked to forecasting protocol, the econometrics of the chosen approaches, and the evaluation of their forecasting performance. The third part discusses both the data and the results obtained from the selected methods. Finally, two appendices provide a short description of the Eviews 3.1 routines used in the project, and tables describing the results.

# 2. A Literature Survey

## 2.1 Alternative Short-Term Forecasting Models

Several econometric approaches have been used in the forecasting literature:[1]

- Structural system of simultaneous equations (STRM);
- Univariate methods such as ARIMA models;
- Multivariate system of dynamic equations: vector autoregressive models (VAR), vector error correction models (VECM), and indicator models;
- State-space models (SSM).
- Non-linear neural network models (NNM for).

### 2.1.1 Structural System of Simultaneous Equations

The approach based on a structural system of simultaneous equations (STRM) has been used since the late 50s and early 60s. It entails the specification of structural and causal relationships between various endogenous and exogenous variables. Often these structural specifications embed restrictive, arbitrary and non-testable identification requirements. Multi-step ahead (long-horizon) forecasts based on these models also call for the strong exogeneity of the dependent variables with respect to the estimated parameters. While these models have been popular for forecasting, they often have serious problems regarding the consistency and the accuracy of their forecasts, especially in periods of high volatility, or when there have been structural changes in the economic environment. This type of modeling also is labor intensive because it must be continually re-estimated.

### 2.1.2 Univariate Methods Such as ARIMA Models

The ARIMA approach describes the evolution of a variable with its past values and with its past and current innovations. The characterization of univariate time series by some linear stochastic representation is an iterating procedure of three stages. First, discard most of the unhelpful and

[1] Paquet (1994) provides a detailed presentation of the techniques underlying the specification, the estimation, and the inference for the ARIMA, ECM, VAR, VECM, and STRM approaches. In particular, many of these techniques can be applied with pre-programmed commands in EVIEWS, but, furthermore, Paquet has already developed several batch programs for EVIEWS that complement and automate the built-in commands. Good references on SSM and on NNM are, respectively, Harvey (1989) and Trippi and Turban (1996).

inaccurate representations to restrict study to one or just a few potentially satisfactory models as early as possible. This is called identification.[2] Second, estimate the retained models. Finally, use diagnostic tests to check whether the modeler's choice is invalidated. If the model is rejected, go back to the identification stage to look for alternative set-ups. In these steps, special attention must be devoted to non-stationarity in macroeconomic time series, particularly the existence of unit roots. One can also include several types of non-linearities, for example by combining auto-regression (AR) and thresholds (Rothman, 1996).

Instead of embarking in an extensive search for relationships among macroeconomic variables, the ARIMA approach is nonetheless useful for forecasting, and can thus provide a useful benchmark to contrast its performance with that of other approaches.[3]

### 2.1.3 Multivariate System of Dynamic Equations

This approach extends the univariate approach to a system of $N$ variables, by specifying $N$ equations relating each variable to lagged values of all variables.[4] Because they do not require *a priori* structural identifying restrictions, atheoretical VAR models had been proposed as a potentially preferable method for forecasting large dynamic simultaneous equations systems. An important practical issue consists in establishing whether the VAR system contains non-stationary regressors, and if so, whether there are long-run (cointegrating) relationships among them. Indeed, this has important implications for the estimation, the inference and the forecasting abilities of this class of model.[5] Some people have advocated the use of VARs in levels (LVAR), while others have argued in favor of using VARs in first-differences (DVAR) to deal with the integrated (non-stationary) regressors.[6] However, Phillips (1998) shows that, in practice, LVAR

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[2] The procedure proposed by Hannan and Rissanen (1982) is extremely useful in identifying univariate models.

[3] For practical purposes, it is also often convenient to consider the random walk model as a special case of an ARIMA benchmark.

[4] See Sims (1980, 1986).

[5] Notice that the same issues would also need to be considered in a STRM.

[6] Sims, Stock and Watson (1990) showed that, in theory, the estimation of a VAR including either or both stationary and integrated variables in level form will yield asymptotically consistent and efficient estimates of its parameters. In effect, provided that enough lags are included in the system, any unit roots or cointegrating relationships would be implicitly accounted for and estimated. However, in a finite sample, if there were no cointegrating relationships between the I(1) variables of the system, the inclusion of their first-difference (i.e. the imposition of unit roots) would improve the precision of the coefficients' estimates. The same would be true if cointegration prevailed between some or all I(1) variables and a vector error-correction model was estimated.

forecasts beyond a 5-period horizon estimated with a finite sample are inconsistent and tend to random values. As a result, this approach does not forecast over the required time frame.

An alternative is to extend of the VAR to account for and to estimate long-run relationships among non-stationary variables. The vector error correction models (VECM) specify the short-run dynamics of each variable in the system, and in a framework that anchors the dynamics to long-run equilibrium relationships suggested by economic theory. For instance, economic theory suggests that economic activity across regions should converge. If this convergence hypothesis is true, we might observe long-run relationships between employment performance across regions.[7] The existence of such long-run conditions does not prevent the existence of stationary, though variable, short-run deviations from them. Phillips (1998) showed that forecasts based on a vector error correction model that explicitly estimates co-integrating relationships (if any) and unit roots, are consistent and asymptotically optimal. Empirically, the literature on forecasting tends to support the superiority of the VECMs for longer-horizon forecasting, although this advantage does not seem as clear for shorter horizons (see Hoffman and Rasche, 1996, as well as Christoffersen and Diebold, 1997).

Another class of multivariate systems of dynamic equations is the indicator models. They are the modern version of the indicators approach developed at the National Bureau of Economic Research. They exploit the information content of available indicators using modern econometrics to produce forecasts on variables of interest. This can be seen as an extension of AR and VAR models, namely ARX and VARX.[8] They also rely on the information theory (Theil, 1967) and on the rational expectations framework. In addition to the usual explanatory variables of AR and VAR models, exogenous cyclical indicators (past values and possibly

However, the imposition of false restrictions about the presence of unit roots and of cointegrations would produce inconsistent estimates.

[7] Note that the theoretical arguments behind the convergence hypothesis usually focus on income rather than employment. Furthermore, empirical studies for the United States (e.g. Barro and Sala-i-Martin, 1991) and Canada (Coulombe and Lee, 1995 and 1997) find that the convergence process is very slow and does not necessarily stand out in the data over decades.

[8] Some authors associate this kind of system with the concept of transfer functions because in such a system the influence of some variables only works in one direction, without any feedback from some other variables in the system.

present values) can be included in the model on the basis of their capacity to increase the predictive power of the model.[9]

One potential problem that may arise, however, is the possible instability of the estimated parameters of these multivariate systems. This issue needs to be empirically settled. It is possible to re-estimate regularly, but given the often fairly large number of parameters involved this may lead to some problems with the accuracy of the forecasts.

### 2.1.4 State-Space Models

State-space models (SSM) are parsimonious models in which state variables characterize the stochastic movements of the variable of interest. For instance, one could model employment growth rates as the sum of two components: one permanent (to account for its non-stationarity) and one transitory. The latter could be modeled as a function of its past but also conditioned on some key economic variables (e.g. the lagged values of U.S. employment growth rates, indicators of the monetary and fiscal policy stance, output growth, wage measures, help-wanted indexes, etc.). Such models need to be estimated using a Kalman filter technique. Harvey (1989) and Conrad and Kaul (1988) provide application of the SSM approach to forecasting.

While the SSM approach may be promising for forecasting, it has not yet been used much for labour variables. Future considerations of this technique might be of interest, but would, at this stage, go beyond the scope of this study.

### 2.1.5 Nonlinear Neural Network Models

The neural network approach (NNM) has created a fair amount of interest amongst analysts and forecasters, especially in the financial markets. While this technique may seem obscure because of its terminology, it essentially consists in modeling non-linear relationships among variables as inputs to a forecast. The *inputs* are first transformed through some weighted combinations that are substituted into one or more non-linear indicators. Several *"hidden" layers* of weighted combinations of the values generated by the non-linear functions can be considered. Alternative variants of the NNM differ in specification for the non-linear functions. The estimation consists

[9] A somewhat different and less used version of the indicator model relates the forecasting variables to the cyclical indicators without controlling for the impact of lagged endogenous variables.

in computing the weights, using a training sample and a testing sample, before considering the forecast sample.

Despite its novelty appeal, the recent empirical literature tends to keep a healthy skepticism about the forecasting performance of the NNM. For instance, Chatfield (1993) is very critical, while Hill *et al*. (1994) find that the NNM may sometimes perform better than more conventional econometric methods under specific conditions. Furthermore, the software to estimate and to forecast based on the NNM are not very user-friendly. Finally, these techniques seem to be more powerful for financial variables than for macroeconomics and the labor markets. Diebold (1998, p. 182) specifies the reasons for this:

> First, many of the non-linear methods require larger amounts of high-quality data for successful application, whereas in macroeconomics we typically have short samples of data contaminated by substantial measurement errors. Second, many of the nonlinearities relevant in fields such as finance simply don't appear to be important in macroeconomics, perhaps because macroeconomic data are highly aggregated over both space and time.

## 2.2 General Considerations Deemed Important to Construct Good Forecasting Models

In applied research, one should submit one's empirical model to a battery of specification tests. In many papers, estimation techniques implicitly assume at the outset that the empirical model respects conventions regarding the specification, the behaviour of the residuals, the stability of the model, and so forth. Since such problems can yield spurious inferences and invalidate the results and forecasts, one should test for possible departures from this set of conventions. Only when one is reasonably satisfied that the empirical model provides a good statistical representation of the data, should one go on with forecasting exercises.

Also, the forecasting properties of a model have to be judged on its ability to produce unbiased, accurate forecasts. It may theoretically be preferable to consider models based on larger information sets and with more structure. However, it is not uncommon to find that, empirically, the forecast performances of models embedding too many structural restrictions and too many variables are plagued by misspecification. Various indicators have been developed to evaluate and to compare the forecasting performance of models. These statistical tools are key in establishing a rigorous judgment about the options available.[10]

## 2.3 The Determination of Regional Employment: Relevant Implications of Economic Theory and Some Recent Empirical Studies for Forecasting Models

Regional economic theory teaches us that immobility (at least temporary immobility) of manpower and the absence of perfectly flexible prices and wages explain the existence of differences in labour market performance across regions.[11] Disparities in the industrial mix of various regions likely exacerbate these differences.

Traditionally, the analysis and forecasting of regional employment fluctuations have been performed with regional structural econometric models.[12] The specification of these models relies directly on economic theory and draws on numerous assumptions that have strong implications for both the analysis and the forecasts. In these models, regional employment (and many other variables) are influenced by national business cycles as well as the industrial structure or other idiosyncratic factors of the region.[13]

Moreover, problems with both the lack of availability and the poor quality of data at the regional level present serious barriers to the development of these modes. This is even more pronounced with monthly data. Also, weaknesses in the Keynesian theories upon which these regional models are built has recently led to a loss of interest in structural forecasting (Diebold, 1998). In parallel, non-structural modeling approaches (such as time-series models) have gained favour.[14]

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[10] Usual criteria include the mean squared forecast errors (MSE) and its decomposition, the mean absolute errors (MAE), and the Theil inequality coefficient. Furthermore, it is also important to assess the ability of a model to replicate the dynamics (serial correlation structures) of the data. This is likely to be important for the robustness of the out-of-sample forecasts. Recently, other tools have been developed in this regard (e.g. Granger and Jeon, 1997). Ericsson (1992) is an another relevant reference.

[11] See McNees amd Tootell (1991) for a more detailed analysis.

[12] See Bolton (1991) and Glickman (1976) for a survey of such models. See also Stevens and Moore (1980) for a critical review of "shift-share" models for forecasting.

[13] There are also multi-regional structural models, see Rietveld (1982) for a survey.

[14] See Diebold (1998) for a historical perspective and Paquet (1994) for a technical survey of the main approaches. These approaches were initially designed for economic forecasting but are more and more used as means to analyse and to quantify the relative importance of the sources of fluctuations of the studied variables.

It is mainly within this framework that the recent literature on regional employment analysis and forecasting has evolved.

As the discussion in section 1 has shown, there are several classes of time series models, including linear and non-linear models. Applications to real economic variables (like employment) almost exclusively use linear models.[15] Another distinction is that of univariate and multivariate models. In practice, univariate models of the pure autoregressive form (AR) and those mixed with moving average terms (ARIMA) are very popular and have predictive power. Indeed, they often remain difficult to beat in out-of-sample evaluations. However, in the literature, univariate models are mainly used as benchmarks to assess the predictive power of more elaborate statistical models.[16]

Many studies use multivariate models in forecasting regional employment. Several focus on a specific region. A good number refer to the indicator-model approach. Intended for short-term forecasting, indicator models try to exploit the information content of cyclical indicators. These are usually autoregressive or vector autoregressive models to which indicators are added as explanatory variables. These indicators are chosen first for the information gain they bring to the basic model, but also for their ability to improve the real time predictive power of the models.[17] The role of these indicators is to capture the influence of recent economic developments that cannot be captured by the recent evolution of the variables to be forecasted. McNees and Tootell (1991) and Dua and Miller (1994) have been the most convincing examples of this approach at the regional level. Weller (1989) shows that national indicators can prove useful for regional employment forecasting when regional indicators are not available. Moore (1985) shows that leading employment index can also be used to forecast unemployment rates.

These models perform very well in terms of in-sample predictive power. Often, there are several variables that give value-added information. However, an out-of-sample evaluation is essential to verify the stability of the forecasting model. The multiplicity of current and lagged explanatory variables decrease the number of degrees of freedom of the regression model and exacerbate

[15] Rothman (1991) suggests that there are significant non-linearities in unemployment rates.

[16] Variations to ARIMA exist. For example, Flaig (1992) estimates an ARCH-M (ARCH-in-mean) model of labor input in West-German manufacturing.

[17] This class of models is also called ARX and VARX. Some authors also refer to transfer functions.

problems of precisions arising from multi-collinearity. One should therefore avoid situations of over-parametrization (or “over-fitting”) to insure that the forecasting models performs well, in real time, outside the estimation period.[18] Still, parsimonious ARIMA models of transfer functions can still beat VARs, as Edlund and Karlsson (1993) show for Swedish unemployment rates. Also, combinations of indicators models, while not necessarily more accurate, can prevent large forecast errors. Li and Dorfman (1995) demonstrate this for U.S. employment growth when they estimate a large number of different indicator models varying the indicators and the lags. Pooled forecasts are then on average not the best model, but they never stray too far from observed realizations.

There is also an entire literature in which authors seek to model the behavior of a regional economy with vector autoregressive models. Employment constitutes just one of many variables that can be forecast with these models. McCarthy and Steindel (1997) and Coulson and Rushen (1995) use vector autoregressive models to quantify the regional (local) and national influences on the evolution of employment in Massachusetts for the last fifteen to twenty years. Here again, these models have not been used for forecasting, but it could be possible to validate them according to their out-sample predictive power. Notice that these models may also use exogenous variables, mostly representing national aggregates. For examples, see Dua and Miller (1995), and Cruben and Long (1988). On a national scale, Edlund and Karlsson (1995) show that VAR models can be more useful than others to forecast turning points (they apply this to Swedish unemployment rates). Surprisingly, they also find that taking into account cointegration (while there is actually none) in their VAR models with up to six variables yields better results.

Vector error correction models (VECM) can be more effective in forecasts because they take into account long-term relationships. For example, LeSage (1990a, 1990b) and Crane and Nourzad (1998) all show that VECM models can lead to gains in accuracy relatively to VAR models (whether in levels or differences), in their case for local manufacturing employment forecasts.

Bayesian versions of VAR models (BVAR) have also been applied to employment forecasts. For example, Partridge and Rickman (1998) forecast regional inter-industry employment and show

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18 The problems of over-parametrization have been documented empirically by Cruben and Long (1988), McNees and Tootell (1991) and, within a somewhat different framework, Estrella and Mishkin (1996).

that this approach can be quite successful, depending on the choice of priors and the degree of confidence one puts in them. At the national level, Zarnowitz and Braun (1992) argue that BVAR models are not good for unemployment rate forecasts, but Dua and Miller (1995) conclude the opposite for Connecticut. Stark (1998) extends this application to BVECM and finds this model to be superior to BVAR.

Another strain of literature using time-series approaches examines, in an integrated fashion, the various sources for employment fluctuations. These sources may be linked to shocks to the national economy, to the regional economy, to a specific industry or shocks affecting an industry in a given region. Therefore, these studies put forward the interrelations between national, regional and industrial fluctuations of employment and are interested in groups of regions. They use the approach of dynamic models with common unobservable factors to identify the fluctuations induced by the various shocks. This approach is a special case of state-space models.

Among these studies, Altonji and Ham (1990) examines Canadian patterns, and Blanchard and Katz (1992), Kuttner and Sbordone (1997) and Clark (1998), the U.S.. These studies usually show the very important role played by the national business cycle in explaining regional fluctuations in employment, and they also focus the other sources of fluctuations, particularly in regions with a poorly-diversified industrial structure. The applications of this approach need very disaggregated data, and these are neither always available, nor of sufficient quality. In addition, the number of variables exacerbates the problems of over-parametrization. Furthermore, the methodology used is still experimental and these models have no proven stability in use. For the moment, this type of modeling has mostly been used for causal analysis and does not seem yet to be mature for forecasting.

There are a few examples of non-linear models. Rothman (1991) uses bilinear and several non-linear AR models to forecast U.S. unemployment rates. He finds that several of these methods beat a benchmark AR(2) model, but the results are sensitive to the stationarity of the unemployment rate: assuming I(0) unemployment rates leads to worse forecasts. Swanson and White (1997) find that adaptative artificial neural network models do no better than VAR models for the same variable. Finally, Stock and Watson (1998), in a huge exercice of model comparison across many variables, finds that Articificial Neural Network models comprise about a sixth of all best forecasting models for employment-related variables. They find threshold models like LSTAR to perform better (one third of best perfomances), but simple AR model still make the remaining half of the best models.

## 2.4 Identification and Motivation of Potentially Preferred Approaches

On the basis of our examination of the various alternative approaches, it seems to us preferable at this stage to focus on the univariate, multivariate and indicator models. Despite their apparent simplicity, univariate models tend to do pretty well in practice for forecasting purposes. Similarly, their natural extension to a multivariate setting (i.e. VAR) may constitute an interesting approach for an integrated treatment of various labour market variables. Their forecasting performance is also usually good. Finally, by building on the previous models, indicator models that add extra regressors with predictive content can capture the influence of factors not reflected by the past history of the endogenous variables. We do not believe that the STRM or the NNM approach would deliver readily usable or superior results. The SSM may be promising but would require more extensive work.

While the models above are fairly well-known, many recent developments in the forecasting literature have focused on the process one should follow in applying them and in evaluating their performance.[19] In particular, there may be advantages to conduct simulated real time forecastings based on rolling window prediction methods. It might also be worth considering the weighted pooling of various forecasting methods.[20]

[19] For instance, see Swanson and White (1997), and Stock and Watson (1998).

[20] See Diebold and Lopez (1996).

# 3. Methodological Issues and Retained Approaches to Forecasting

## 3.1 The Forecasting Protocol

Before embarking in the actual selection, estimation and forecasting stages of the exercise, one should establish the strategy for the project. Various alternatives are possible at every stage and it is important to be as specific as possible at the outset to limit arbitrary decisions. Hence, the principles underlying a good forecasting protocol are: that it follows a systematic path, that it can easily be replicated, and that it takes into account recent developments in the forecasting literature. The rigour of a systematic approach brings the additional bonus that it can be programmed in computer routines with a software (such as Eviews 3.1). Hence, this makes it easily accessible for use with many variables and by many users.

A forecasting protocol is not unique and requires some decisions about which way to take to develop an appropriate model. Users of forecasting models should assess their performance along several dimensions.

As a result, forecasting protocol involves five steps:

**1) Gather, Construct and Characterize the Variables**

This step is fundamental for the quality of the econometric analysis. It involves not only listing relevant variables and their publication lag, but also knowing whether breaks have occurred in the collection or in the definition of the raw data. At this stage one must decide at which frequency the econometric work is going to proceed, and what transformations and conversions will be applied to the raw data. It is also important to characterize the series at hand and, in particular, to examine for the presence of unit roots. Whether some or all the series are integrated or stationary may influence the formulation of the specifications to be estimated, as we discussed in the previous section.

We postpone to the next section a detailed description of the data set and the variables that were defined. For the moment, let it suffice to say that because of data availability and changes in the definitions of some variables, we have worked with a data set spanning the 1983:01-1998:09

period. The data were either directly available on a monthly basis, or in the case of data stemming from a quarterly survey intrapolated to construct monthly observations, using a cubic spline technique with the last monthly observation of each quarter matched to the source data. Augmented Dickey-Fuller tests and the DF-GLS tests for unit roots were conducted on each series. The former is now well known. The second was developped by Elliott, Rothenberg and Stock (1996) and is more powerful when deterministic components are significant in the DGP of the series.[21] Following Stock (1996), who documented the usefulness of this unit root pretest for constructing forecasting models, Stock and Watson (1998) used of the DF-GLS test.

**2) Specify the Forecasting Horizons**

Choosing the forecasting horizons may have implications for elements of the protocol. For one, the modeling approaches may be different for short-term and longer-term forecasting. As discussed in the literature survey, VECM may be more appropriate in the context of long-term forecasts. Moreover, the next step may also be influenced by the forecasting horizons.

In this project, our purpose being the construction of short-term forecasts, we will consider one-to-six-month horizons.

**3) Partition the Data Set**

Forecasters initially have a sample of data (made up of, say, $T_3$-$T_0$ observations) that they must divide in three main segments. A first segment is called the specification sample which is used to pre-select the model that will be employed in forecasting for a given class of models. We can think of it as including ($T_1$-$T_0$) observations. A second segment with ($T_2$-$T_1$) observations is called the testing sample. Over this sub-sample, forecasting exercises are run in simulated real time. That is, at each point in time over this sub-sample, each forecast is conducted as if future information about the series were unknown. Then, the forecast can be compared to its actual

[21] This mainly stems from the fact that deterministic components (such as the intercept and the parameter associated to a linear trend) are nuisance parameters that drastically affect the statistical powers of unit root tests. Elliot, Rothenberg and Stock (1996) have proposed a way to estimate more efficiently the parameters attached to the intercept and the deterministic trend components on the basis of a quasi-difference of the original series. Then, these components are removed from the original series, prior to performing the ADF test. This allows also to specify a tighter local alternative to the unit root hypothesis that increases the power of the unit root test relative to that of the ADF test.

realized values for evaluation over this period. Finally, the last segment from $T_2$ to $T_3$ is the *real-time forecasting sample,* where each new observation is unpublished when the forecast is made.

There are no established rules to set the lengths of either the specification or the testing sample. They have to be motivated in relation with the series involved, the availability of the data and the forecasting horizon.

In this project, we have chosen to work with a 10-year specification sample of monthly data from 1983:01 to 1992:12. This period essentially spans an entire business cycle in Canada (from peak to trough).[22] A sample of 10 years is also the size of the estimation windows that will be considered below. Moreover, the testing sample covers the 1993:01-1998:09 sample. This leaves 69 observations to evaluate the one-period-ahead forecasting performance of the models, up to 64 observations in the case of the six-month-ahead forecasts.

**4) Establish the Pre-Forecasting Estimation Practice**

Another issue pertains to the pre-forecasting estimation practice. Namely, there are four main avenues:

***The Whole Sample Approach***

The first one is to select a model on the basis of the ($T_1$-$T_0$) observations of the specification sample and to use the estimates obtained over this sample as fixed values in simulated real-time forecasting. This would be appropriate provided that the underlying parameters are time-invariant and that the system has not evolved over time.

***The Recursive Approach***

This second approach consists in specifying and estimating a model using the observations from $T_0$ to $T_1$. Then, 1- to h-periods-ahead forecasts are computed as of date $T_1$+1. Next, the same model is estimated using observations from $T_0$ to $T_1$+1, before constructing the 1- to h-periods-ahead forecasts as of date $T_1$+2. The same steps are repeated until forecasts have been computed over the entire testing forecast.

[22] In their chronology of the business cycles in Canada, Bergeron, Fauvel and Paquet (1995) report the following dates: expansion from 1982:12 to 1990:03, and recession from 1990:04 to 1991:03.

This procedure was used by Diebold and Rudebusch (1991), and, as argued by Swansson and White (1995), implies that "they were not concerned with tracking a possibly evolving system."

***The Rolling-Window Approach with Invariant Specification***

In this approach, a model is specified and estimated over the specification sample from $T_0$ to $T_1$. Then, 1- to *h*-periods-ahead forecasts are computed as of date $T_1$+1. Next, the same model is estimated using observations from $T_0$+1 to $T_1$+1, before constructing the 1- to *h*-periods-ahead forecasts as of date $T_1$+2. The same steps are repeated until forecasts have been computed over the entire testing forecast. This is comparable with what Swanson and White (1997), and Stock and Watson (1998) have done.

One issue relates to the appropriate size of the rolling window one should use. In this project, we have chosen to work with a window size of 120 months for our regression models. There is no authoritative way of setting this value *a priori* as it essentially remains an empirical matter. We argue that for labour market indicators such as employment, employment rates and unemployment rates, it may be somewhat more preferable to work with a longer window due to persistence of labour market activity in Canada. Furthermore, a larger window will allow to obtain more precise estimates *ceteris paribus*. Yet, too large a window may limit the ability of the model to track the evolution of the underlying relationship. For now, we have not studied the impact of shorter window sizes on our forecasting performance, this is left for further research.

***The Rolling-Window Approach with Adaptive Specification***

This approach builds on the previous one in that in each period, within a class of models, a new specification is selected prior to the estimation and the computation of the 1- to *h*-step-ahead forecasts. Hence, this approach acknowledges the possibility that the relation between the variables and the information set being considered evolves through time not only along the underlying values of the parameters but also in the elements making up the information set.

**5) Establish the Evaluation Criteria of the Forecasting Performance**

Various indicators have been developed to evaluate and to compare the forecasting performance of alternative models. These statistical tools are key in making a rigorous judgment about the options available. Some indicators show the optimality of forecast errors, some are concerned with forecasting accuracy, while, finally, others focus on the ability of a model to forecast the direction of change in the variable of interest. Diebold and Lopez (1996) provide a fairly broad review of these tools.

In the context of this project, following Swanson and White (1997), and Stock and Watson (1998) we assess our forecasting models both with respect to accuracy and direction of change.[23]

***Evaluating forecasting accuracy***

Usual criteria to evaluate forecasting accuracy include the mean squared forecast errors (MSE) or its root squared (RMSE), the decomposition of the MSE, the mean absolute errors (MAE), the mean absolute percentage error (MAPE), and the U-Theil inequality coefficient.

The RMSE is scaled dependent and is used to compare forecasts of a given series across different models. The smaller its values, the more accurate is the forecasts. It is computed as the deviation of, say, the $h$-step-ahead forecasts of a variable, $\hat{y}_{t+h}$, from its observed time path, $y_{t+h}$:

$$RMSE(\hat{y}_{t+h}) = \sqrt{\left[ \frac{1}{T_2 - T_1 - h + 1} \sum_{t=T_1+h}^{T_2} (\hat{y}_{t+h} - y_{t+h})^2 \right]} \tag{1}$$

where $T_1+h$ is the beginning of the effective testing sample, $T_2$ is the end of the testing sample.

The MAE, that is also scaled dependent, serves as an indicator to assess how far above or below the actual series its forecasted counterpart is. It is defined as:

$$MAE(\hat{y}_{t+h}) = \left[ \frac{1}{T_2 - T_1 - h + 1} \sum_{t=T_1+h}^{T_2} \left| \hat{y}_{t+h} - y_{t+h} \right| \right] \tag{2}$$

[23] We have not systematically conducted an evaluation of each single forecasts with respect to their optimality properties, namely: (1) that they have a zero mean; (2) that the 1-step-ahead optimal forecast errors are white noise; (3) that the $k$-step-ahead forecast errors are at most MA($k$-$1$); (4) that the $k$-step-ahead optimal forecast error variance be non-increasing in $k$. These properties relate to the concepts of full optimality, and its weaker counterpart of partial optimality with respect to an information set. It is noticeable that in much recent applied work by reknown theoretical and applied econometricians, such as Swansson and White (1997), and Stock and Watson (1998), no tests of these properties are reported. We suggest that some unresolved issues remain about the appropriate testings of these properties in the context of rolling window approaches to forecasting.

The MAPE casts the magnitude of mean absolute error in percentage of the actual series, i.e.

$$MAPE(\hat{y}_{t+h}) = \left[ \frac{1}{T_2 - T_1 - h + 1} \sum_{t=T_1+h}^{T_2} \left| \frac{\hat{y}_{t+h} - y_{t+h}}{y_{t+h}} \right| \right] \tag{3}$$

The U-Theil inequality coefficient is the ratio of the RMSE of a particular forecasting model to that of a no-change model. The latter is a naive model that postulates that the forecast of a variable for *t*+*h* is given by the value of the series in *t.* Hence, if this ratio is less than unity, forecasts from a given model tend to be superior to the no-change-model forecasts over the testing sample.

The MSE can be decomposed as the sum of three components so that 100% of the MSE can be explained as the sum of the *bias proportion*, the *variance proportion*, and the *covariance proportion*. Namely,

$$\textit{Bias proportion} + \textit{Variance proportion} + \textit{Covariance proportion} = 1, \tag{4a}$$

where $$\textit{Bias proportion} = \frac{(\bar{\hat{y}} - \bar{y})^2}{MSE(y_{t+h})} \tag{4b}$$

$$\textit{Variance proportion} = \frac{(\sigma_{\hat{y}} - \sigma_y)^2}{MSE(y_{t+h})} \tag{4c}$$

$$\textit{Covariance proportion} = \frac{2\sigma_{\hat{y}}\sigma_y [1 - \rho(\hat{y}_{t+h}, y_{t+h})]}{MSE(y_{t+h})} \tag{4d}$$

with $\bar{\hat{y}}, \bar{y}, \sigma_{\hat{y}}$, and $\sigma_y$ are respectively the sample means and standard deviations of the forecasts and the observed series over the testing sample, while $\rho$ is the correlation coefficient between these two series.

The bias proportion suggests part of the systematic error in the forecasts by measuring how far the average value of the forecasted path is from the mean of the actual observed path of the variable. For instance, Pindyck and Rubinfeld (1998) argue that a large value (above 0.1 or 0.2) is quite troubling. The variance proportion is an indicator of how different is the variability of the forecasted interest rates from that of the observed series over the testing sample. Too large a value is also troubling. The covariance proportion is a measure of the unsystematic error in the forecasts. The larger this component, the better.

***Evaluating Direction-of-Change Forecasts***

On this account, the idea is assess the ability of a model to forecast the direction of the changes of a variable, regardless of whether the value of the change is closely approximated. The *confusion index* (CI) computes the proportion of times the model gives incorrect directional predictions of the variable over the testing sample. One way to look at this is to think of a 2-by-2 confusion matrix. Its upper (lower) diagonal element would record the number of actual moves in the series that were up (down) while the predicted changes were up (down). Its lower-left (upper-right) off-diagonal element would record the number of actual moves in the series that were up (down) while the predicted changes were down (up). Hence, the CI is the sum of the off-diagonal elements, or number of incorrect directional predictions to the total number of predictions. A better model would therefore exhibit a smaller CI.

One way to formalize the assessment of directional predictions of a model is to perform the test proposed by Pesaran and Timmermann (1992). This tests whether the sign of the change in the observed series is independent of the sign of the change in the forecasts, it is based on the proportion of times that the direction of change in the former is correctly predicted by the latter. Notice that this tests requires only information on the signs of the changes in the realizations and the forecasts; it does not use any quantitative information about these series. To summarize, a model is said to be useful as a predictor of the direction of change of a variable provided that the null hypothesis of independence is rejected.

## 3.2 Retained Approaches and Adopted Forecasting Protocol

Following our review of the literature, we have chosen to consider three classes of forecasting models for each type of variables (i.e. the employment level, the employment rate and the unemployment rate). These define three approaches to forecasting and they are: univariate ARMA models, multivariate VAR models, and indicator ARX models. We now discuss in turn some specific methodological issues pertaining to each class.

**1) The Invariant Univariate ARIMA Specifications with a Rolling Window**

A model for a variable $y_t$ is this class has the following representation:

$$(1-L)^d\left(y_t-\mu_y\right)=\phi_1(1-L)^d\left(y_{t-1}-\mu_y\right)+\ldots+\phi_p(1-L)^d\left(y_{t-p}-\mu_y\right)+ \\ \varepsilon_t+\theta_1\varepsilon_{t-1}+\ldots+\theta_q\varepsilon_{t-q} \tag{5}$$

where $p$ and $q$ are the orders of the AR and MA polynomials, respectively, $d$ is the order of integration of the variable.

First, unit root tests were applied on each series over the 1983:01-1998:09 period. Provided that the null hypothesis was not statistically rejected at conventional significance levels, we set appropriately the order of diffencing. Then, an ARMA model was identified on either the level or the first-difference of the series depending on the series being either I(0) or I(1). As it will be presented later, the existing evidence suggests that the series under consideration were I(1).

The Hannan and Rissanen procedure was conducted to identify an ARIMA model over the 1983:01 - 1992:12 sample, i.e. the specification sample. Essentially, this amounts for a given I(1) variable to select an ARMA model for its first-difference on the basis of the minimization of the Schwarz (Bayesian) information criterion (SC or BIC). Notice that this criterion has the property to select fairly parsimonious models that may still be afflicted by serial correlation in (small) estimation sample, even though it is a consistent criterion. That is, in large enough samples, the SC will lead to the correct model choice, provided it belonged to the set of models considered.

It should be pointed out that, in the context of forecasting exercises, we have not conducted in-sample misspecification tests. While left-out serial correlation or missing dynamics (if any) may induce some biases (especially in sample), the forecasting literature has often found that forecasting models selected on the basis of the SC showed better out-of-sample forecasting performance in terms of root mean-squared error (RMSE). (E.g. Swanson and White, 1997, Engle and Brown, 1986). This illustrates the trade-off there may be between unbiasedness and precision (or variance) of the forecasts. It therefore a common practice to use SC as the basis of the model selection criterion (e. g. Stock et Watson, 1998).

Once a model was identified over the specification sample, out-of-sample forecasts were constructed both with the ARIMA model and with the no-change (random walk) model as in simulated real time over the testing sample from 1993:01 to 1998:09. Basically information up to date t were used to forecast from 1-month-ahead (t+1), up to 6-month-ahead (t+6). We followed the rolling-window approach with invariant specification. That is, in order to allow for the possibility that the underlying stochastic process is evolving through time, parameters of the ARIMA model were estimated using a finite 120-month window of past data. Namely, in order to forecast as of date T for T+s (with s= 1 to 6), a model was previously estimated with data from T-120 up to T. Notice that we have not gone through a reassessment of the specification after moving the window. The specification selected over the specification sample was maintained.

After having gathered 6 series of forecasts for each interest rate variable (1-, 2-, 3-, 4-, 5-, and 6-month ahead), we proceeded to a comparative evaluations of the performance of the no-change versus the ARIMA model. Various criteria were computed and are discussed in the next section.

**2) The Invariant Multivariate VAR Specifications with A Rolling Window**

To illustrate the algebraic set-up of a VAR typically used in forecasting, consider $y_{1,t}$, $y_{2,t}$, ..., and $y_{N,t}$ a set of N variables whose past values contain information useful to predict the future paths of one another. A VAR model involving these N variables can be set up as:

$$\mathrm{Y}_t = \delta + \Phi \mathrm{Y}_{t-1} + \ldots + \Phi_p \mathrm{Y}_{t-p} + \varepsilon_t = \delta + \Phi(L)\mathrm{Y}_{t-1} + \varepsilon_t \qquad (6)$$

where $\mathrm{Y}_t = [y_{1,t}, y_{2,t}, ..., y_{N,t}]'$ , $\Phi(L)$ is a $p$-order matrix polynomial in the lag operator $L$, for which each matrix of coefficients $\Phi_i$ is $N \times N$.

In this project, we used a VAR model with four variables. For each case, the first variable was the primary variable of interest (e.g. either the employment level, the employment rate, or the unemployment rate of a particular geographic entity). Also, we added the following two national indicators: Statistics Canada's composite leading indicator and the slope of the yield curve. This variable was defined as the difference between the 3-month Treasury Bill rate and the yield on the 10-year-and-over Federal government bond. Finally, the fourth variable was the help-wanted index of the geographic entity.[24]

Given that this project focuses on short-term forecasts, we have restricted ourselves to VAR models with the variables being expressed in levels. The lag-length was determined by

[24] The national help-wanted index is included in the calculation of the Statistics Canada’s composite leading indicator, which introduces a small amount of multi-collinearity.

minimizing the Schwarz information criterion after considering 1 to 15 lags over the specification sample (1983:01 - 1992:12). Then, the rolling-window approach with invariant specification was also followed to cover the entire testing sample, prior to the assessment of the forecasts of the primary variables of interest.

**3) The Adaptive Specifications of Indicator ARX Models with a Rolling Window**

The indicator models that are considered are linear regression models, which often include an autoregressive component and additional explanatory variables that have been chosen for their potential information content. Hence, a key first step is identifying which variables could contain useful predictive content, while a second, is to build an appropriate indicator model.

In their study on New England employment growth, McNees and Tootell (1991) used bivariate Granger non-causality tests of various potential regional and national indicators with the employment growth. Then, as they explain it:

> The potential indicators having the strongest bivariate relationship with regional employment growth were first combined to form a base model. All the remaining variables were then added to the base equation, one at a time. The most significant added variable was then included in the fundamental equation next round. This procedure was then repeated with the new base model. This process continued until no more variables could be added to the base equation, and all the included variables were significant. One drawback of this methodology is that the final model may be dependent on both the original base equation used and the order of acceptance of the added variables. For this reason, several different routes to arrive at the final equation were taken; the final equation in each information set turned out to be fairly robust to different routes. (pp. 18-19).

As can be inferred from this quote and experience in econometric work, there always is some arbitrariness that may affect the route one follows to construct an indicator model. The purpose is not to build structural models but statistical ones. Nonetheless, it is important to limit the unsystematic arbitrariness by first specifying a systematic path that will be followed. Furthermore, we subscribe to Hendry's (1979) general-to-specific approach. Starting from a general model, variables that are not significant can be dropped on statistical grounds to obtain a trimmed down model since omitting statistically significant variables at the outset causes biases. On the other hand, including too many irrelevant regressors does not induce biases in the parameters estimates, even though it decreases the precision of the estimates. Hendry's approach is now dominant in econometric practice, and we believe that our search of indicator models should reflect it.[25]

We have therefore proceeded in two stages. First, we have tested a set of potential indicators for their ability to predict future movements in the variables to be forecast using the whole sample from 1983:01 to 1998:09. These variables will be listed in the next section of this report. Notice however that we always included the lagged values of the variable to be forecast among them. For instance, let $y_t$ be the variable to be forecasted, and let $x_{it}$ a variable that may contain information regarding the future path of $y_t$. We therefore estimate the following equation,[26]

$$\Delta y_t = \gamma_{i,0} + \gamma_{i,d_i} \Delta x_{i,t-d_i} + \ldots + \gamma_{i,S_{\max}} \Delta x_{i,t-S_{\max}} + u_{i,t} \tag{7}$$

where $d_i$ is the maximum of 1 and the lag with which this variable is available as of date $t$, and $S_{\max}$ is the maximum lag-length that we have considered.

For instance, for a variable that was available with a 4-month lag, the starting lag $d_i$ was set to 4. In this project, we have set the maximum lag-length to 24 months. Then, the optimal lag-length, $S_i$, was selected on the basis of Schwarz information criterion, before applying a F-test of the joint statistical significance of the slopes in the bi-variate information regression. Namely, the null hypothesis that was tested was $H_0$: $\gamma_{i,di} = \gamma_{i,di+1} = \ldots = \gamma_{i,Si}$. The same procedure was followed for each variable $i$ included in the information set that we had at our disposal, say for $i$= 1 to $N$.

The next stage was to construct a general indicator or ARX model for $y_t$. Here, we referred to the results obtained from the previous stage, by including all variables with lags $d_i$ to 12 among the $N$ variables for which the above F-test had a significance level smaller than or equal to 10 per cent. For instance, this general ARX could be generally represented as,

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25 The converse specific-to-general approach is inappropriate for many reasons. Tests conducted first on a more specific model maintain zero coefficient restrictions on additional regressors without haveng tested them. If these maitained restrictions are false, it is likely that the inference conducted on the coefficients of the included regressors will be biased. Also because the sequence of hypothesis testing is conducted in some unstructured manner, the significance levels of this testing procedure are unknown.

26 Here we will report the results from the bi-variate information regression with both the dependent variables and the regressor being expressed in first difference. This is compatible with the evidence of unit roots of the series under study. We also have estimated bi-variate information regressions with all variables in levels, as well as with the dependent variables in levels and the regressors in first difference. The results of this stage were essentially the same.

$$\Delta y^{t} = \alpha_0 + \sum_{i=1}^{12} \alpha_{1,i} \Delta y_{t-i} + \sum_{i=d_2}^{12} \alpha_{2,i} x_{2t-i} + \ldots + \sum_{i=d_Q}^{12} \alpha_{Q,i} x_{Qt-i} + \varepsilon_t^{G} \tag{8}$$

where *Q+1* indicator variables were retained, including the lagged values of $\Delta y_t$.

Next, for each block of regressors, a sequence of likelihood-ratio tests was conducted to check statistically the significance, at a 5 per cent level, of the 12th lag, of the 11th and 12th lag, then of the 10th, 11th and 12th lag, and so on. When the null joint hypothesis was rejected, it was decided that the block of variables in the specification would be trimmed so that it included the regressors only up to the last lag before the rejection. At this stage, the indicator model could look like this:

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{s_1} \alpha_{1,i} \Delta y_{t-i} + \sum_{i=d_2}^{s_2} a_{2,i} x_{2t-i} + \ldots + \sum_{i=d_Q}^{s_Q} \alpha_{Q,i} x_{Qt-i} + \varepsilon_t^{T} \tag{9}$$

where $s_i$ is the lag-length that was selected specifically for block *i*.

Finally, for each block, a test of statistical significance of the entire set of lags within a block was assessed at a 15 per cent level. This stage sometimes leads to dropping an indicator from the previous stage specification. For instance, this might have lead to excluding the block associated with the second indicator, so that the final specification would become:

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{s_1} \alpha_{1,i} \Delta y_{t-i} + \sum_{i=d_3}^{s_3} \alpha_{2,i} x_{2t-i} + \ldots + \sum_{i=d_Q}^{s_Q} \alpha_{Q,i} x_{Qt-i} + \varepsilon_t \tag{10}$$

For this class of model, we have a followed the rolling-window approach with adaptive specification. This means that our selection practice was applied each time that the window of observations was rolled over prior to the construction of the forecasts. Accordingly, the indicator model that was estimated over a given sample, say from $T_0$' to $T_0$'+120, to forecast a variable as of date $T_0$'+120, for $T_0$'+121 up to $T_0$'+126, was not necessarily the same when the window was moved one month up.

Finally, this approach was applied over the entire testing forecast, so that we could next proceed with the assessment of the forecasting performance.

# 4. The Results

## 4.1 The Data and their Characteristics

### 4.1.1 Data Description

The original data set at our disposal for this project was mostly collected by Human Resources Development Canada. The data spanned a range that varies from the early 60s for some variables, 1976 for others, or even 1981 for the rest, up to September 1998. As mentioned earlier, we chose to work with a sample that started in 1983:01. From this date, all the data were available in a consistent manner, and this followed the end of the 1982 recession. Table 1 gives a summary presentation of the data used in this project, with their effective availability (in months) for use in date t, because the delay of publication. For instance, this month's unemployment rate is available in the first two weeks of the next month.

The three sets of variables under consideration for forecasting were:[27] the employment level (*empsa*), the employment rate (*ersa*), and the unemployment rate (*ursa*). All are seasonally adjusted at the source by Statistics Canada. Each set included these variables for each following geographical entities: Canada (*c*); Newfoundland (*nf*); Nova Scotia (*ns*); New Brunswick (*nb*); Prince Edward Island (*p*); Quebec (*q*); Ontario (*o*); Manitoba (*m*); Saskatchewan (*s*); Alberta (*a*); and British Columbia (*b*). In the analysis below, the name of a particular variable is formed by combining the regional prefix and the variable name's mnemonics as a suffix, the two being separated by the underscore "_". Hence, for instance, *c_empsa*, *c_ersa* and *c_ursa* are respectively the employment level, the employment rate and the unemployment rate in Canada.

The other variables in the data set were of use as potential indicator variables in the ARX models or in the VARs. The data set included both the Canadian and the U.S. composite leading indicators, which we expressed in logs as *lcan_ind* and *lus_ind*. The help-wanted indexes (*hwi*) for Canada and all 10 provinces were also available at least from 1981.[28]

[27] The mnemonics associated with each set of variable or with each geographical entity is listed between parentheses.

[28] Data for Canada and the usual five regions were available prior to 1981. However, there was a break in these series in 1981, when the method of determining the index changed.

Another set of series was taken from a quarterly survey of employers conducted by Manpower Inc., a temporary employment agency. The agency contacts each quarter about 1500 to 1700 employers to find out what their hiring intentions are for the next quarter. Then, it compiles counts of how many respondents expect to increase staff levels in the coming quarter, how many intend to decrease staff levels, and the number who do not plan to change it. These data were initially available from the first quarter of 1978 for 10 industries.[29] They were seasonally adjusted by HRDC using the additive-adjustment X-11 routine in Eviews. We chose to work with the Manpower survey ratio of the share of respondants with increased-staff intentions to that of respondents with decreased-staff intentions (*z_ratioc*, where *z* is the industry grouping).

One conjecture is that the Manpower survey ratios (*MSR*) are more forward-looking than the help-wanted index. Moreover, as employers will increasingly use other methods than help-wanted postings (such as temporary agencies, or the internet), the help-wanted indexes may be expected to lose their effectiveness for forecasting through time. On this account, the *MSR* might maintain better its effectiveness as a leading indicator of labour market variables. On the other hand, the actual data on *MSR* are not yet available by province, contrary to the help-wanted indexes. Still, the *MSR* by industry may provide some useful information for some provinces. In the end, the issue of these series' informational content of any of these series can only be resolved empirically. This is what are forecasting protocol is set to do.

We also added to the data set the yield on the 90-day Treasury bills and the yield on the 10-year-and-over return on Federal government bonds. The difference between the former and the latter interest rate defines a measure of slope of the yield curve. This variable has often been found in other literature to be a leading indicator of economic activity. Finally, the monthly data on Canadian real GDP were also included in the data set.

### 4.1.2 Data Transformation

While many series did not require any special transformation (except for that of differencing in some instances), other variables needed to be computed from the raw data.

[29] The different industries or grouping of industries are reported in Table 1. A series also existed for the education sector in the public school system (at primary, secondary and post-secondary levels), excluding the administrators attached to provincial governments. However, there seemed to be some inconsistent observations for this series. Hence, we decided to exclude it from consideration.

### *Conversion of the Survey Data from Quarterly to Monthly Frequency*

For use in monthly forecasting models, the Manpower survey series needed to be converted from the quarterly to the monthly frequency. Intrapolation to monthly observations were computed by a cubic spline technique, with last monthly observation of each quarter matched to the source quarterly data, as programmed in Eviews 3.1. As explained in Eviews manual:

> This method assigns each value in the low frequency series to the last high frequency observation associated with the low frequency period, then places all intermediate points on a natural cubic spline connecting all the points. [...] Each segment of the curve is represented by a cubic polynomial. Adjacent segments of the curve have the same level, first derivative and second derivative at the point where they meet. The second derivative of the curve at the two global end points is equal to zero.

### *Construction of Business Cycles Indicators*

In forecasting short-term employment, it seems also worthwhile to look for predictive information content in some business cycles indicators. Using the monthly figures on Canadian real GDP, a natural one is to compute its growth rate.

In government departments or in some central banks, analysts frequently use an output gap measure obtained from the Hodrick-Prescott (HP) filter of log real GDP. This is however unsatisfactory on econometric ground in forecasting. Despite its ease of computation, for a given value at time $t$, the HP filter amounts to taking a moving average of past, current and future values of the original series. So that future information of a series would thus be used *de facto* to forecast itself.

Instead, we have considered two other alternative measures or indicators of "business cycles."[30] The first one is obtained as the transitory component from the Beveridge and Nelson (1981) (BN) decomposition of log real GDP, and was computed using Newbold's (1990) algorithm. Because this decomposition assumes that the innovations in the permanent and the transitory components are perfectly correlated, the transitory component may be also interpreted as shocks to the stochastic trend. In any case, since our objective is not that of providing a good measure of

[30] Notice that the term business cycle indicator is used loosely here, as our constructed series can be seen more as a transitory or irregular component of real GDP.

business cycles, our goal will be to assess whether there is some information content in this measure of business cycle impetus for predicting labour market variables.

From Beveridge and Nelson (1981), the monthly series for log real GDP, $lny_t$, is decomposed in a way such that:

$$\text{In } y_t^{BNtransitory} = \text{In } y_t - \text{In } y_t^{BNtrend} \tag{11}$$

In order to apply the *BN* decomposition, it is first necessary to identify an ARIMA process of $lny_t$. Having found it to be integrated of order 1, Hannan and Rissanen procedure lead us to the following univariate representation for the 1978:01-1998:10 period:

$$\begin{aligned}\Delta \text{In } y_t &= \underset{(0.0003)}{0.002045} - \underset{(0.0592)}{0.1386}\,\Delta \text{In } y_{t-1} + \underset{(0.0587)}{0.1769}\,\Delta \text{In } y_{t-2} \\ &+ \underset{(0.0588)}{0.3494}\,\Delta \text{In } y_{t-3} - \underset{(0.0591)}{0.1505}\,\Delta \text{In } y_{t-12} - \underset{0.0597}{0.1451}\,\Delta \text{In } y_{t-24} + e_t\end{aligned} \tag{12}$$

where $\overline{R}^2 = 0.1767$, and the estimated standard errors of the estimated coefficients are shown in parentheses.

Notice that all coefficients are statistically significant at the 1% level. As shown by Beveridge and Nelson (1981), from an ARIMA representation like equation (11) the trend component can be computed as:

$$\text{In } y_t^{BNtrend} = \text{In } y_t + \lim_{k\to\infty} E_t\left[\sum_{j=1}^{k} \Delta\text{In } y_{t+j} - k\mu_{\Delta \text{ In } y_t}\right] \tag{12}$$

where $\mu_{\Delta \ln yt}$ is the unconditional expectation of $\Delta \ln y_t$.

Newbold's (1990) contribution was to find a way to compute exactly the above expression without having to truncate the infinite sum. In the rest of the report, we name $\ln y_t^{BNtransitory}$ as *bncycle.*

A second measure of "business cycle" impetus was obtained from estimating a simple trend plus noise model of monthly real GDP over the 1978:01-1998:10 sample. In this context one of the major difference with the previous decomposition, is that we imposed a zero correlation between the innovations in the permanent and the transitory components. Namely, this decomposition can be represented as follows:

$$\text{In } y_t^{transitory} = \text{In } y_t - \text{In } y_t^{trend} \tag{13a}$$

$$\text{In } y_t^{trend} = a_0 + \text{In } y_{t-1}^{trend} + \upsilon_t \tag{13b}$$

where $E\left[\upsilon_t \text{ In } y_t^{transitory}\right] = 0$.

This model was estimated as a state-space model by Kalman filter estimation. We denote this ln $y_t^{transitory}$, as *stspcycle*.

### 4.1.3 Order of Integration of the Variables

All series in the data set were subjected to ADF and DF-GLS unit root tests over the 1983:01-1998:09 period. The lag length of the first difference of the series that were included in the ADF-type equations to account for the time-dependency in the innovations were determined using the Campbell and Perron (1991) recursive t-statistic procedure. The evidence from both tests were consistent with all the variables being integrated of order one, the unit root hypothesis often not being rejected even at the 10% significance level.[31]

Having gone through the steps preliminary to forecasting, we now turn to the presentation and discussion of our results for each set of labour market aggregates. Notice that even when the model used the first-difference of a series in the model, the analysis of forecasting performance was carried out with respect to its level.

## 4.2 Forecasting the Employment Level and Discussion on Forecast Accuracy

Tables 2a, 3a, 4a, 5a, 6.1 to 6.11, 7.1, 8.1, and 9a report various results regarding the forecasting of employment levels in Canada, as a whole, and in each of its provinces.

As shown in table 2a, the Schwarz information criterion has lead to the identification of ARMA processes for the change in the employment level that vary across the geographical entities over the 1983:01-1992:12 sample. While Canada's change in employment is characterized by an

31 While we have not included a table with the details of all these tests, these are available upon request.

MA(2), in Newfoundland, P.E.I. and Saskatchewan, the series is better captured by an AR(1). New Brunswick's and Manitoba's change in employment is modelled as a MA(1). Quebec's and Ontario's processes are respectively an ARMA(2,1), and an ARMA(1,1). Finally, in Nova Scotia, Alberta and British Columbia, the preferred model is an ARMA(0,0), i.e. a no-change model. Notice that while an ARMA specification was identified and estimated for the first-difference of employment, these models were used to forecast the level of employment in each region.

Table 4a reports the specification of the VAR models with variables being expressed in levels. Typically, each VAR was made up of a region's employment level, its help-wanted index, the log of Statistics Canada's leading indicator of the Canadian economy, and the slope of the yield curve (defined as the 3-month Treasury bill yield minus the 10-year-and-over Federal government bond yield). In all cases, the Schwarz information criterion selected a VAR(2) model.

Tables 6.1 to 6.11 show the results for the bivariate analysis of the information content of the various potential indicators that were considered, over the 1983:01-1998:10 sample. These results reveal that in all provinces except Nova Scotia, Alberta and British Columbia, the lagged values of the change in employment contained statistically significant information (at least at the 10% level) to forecast itself. The Canadian leading indicator was also significant in 5 instances: Canada, Nova Scotia, Quebec, Ontario and Manitoba. The U.S. leading indicator had predictive information content in Canada, Nova Scotia and Ontario. A region's help-wanted index mattered in P.E.I., Quebec, Ontario and Alberta. The slope of the yield curve was significant only in British Columbia. Except for Newfoundland, with past Canadian real growth in GDP, and P.E.I. with the Beveridge-Nelson measure of transitory component of Canadian real GDP, there does not seem to be systematic predictive content for changes in employment coming from past values of GDP-based measures of business cycle stance. Also, the past values of Manpower survey ratios do not generally have much of a significant information content for most provinces. The noteworthy exceptions are: the MSR for the non-durable goods industry in P.E.I.,[32] Manitoba and Saskatchewan; and the MSE for the durable goods industry in Ontario.

[32] These results reflect the importance of agriculture and food processing in P.E.I. and the prairies, and of the auto industry in Ontario's economy.

As we have explained earlier, the indicator or ARX models were specified prior to the estimation and the forecasting stages of the protocol. To illustrate whether this specification changed much over the testing sample, we have reported the estimates for the employment levels for the 1983:01-1992:12 sample and the 1989:10-1998:09 sample respectively, in Tables 7.1 and 8.1.[33] For the employment levels, we report the adjusted-$R^2$ for the first-difference of the series and the variable(s) with their corresponding optimal lag-length. For the employment levels, the variables being included in the indicator models did not change much over our testing sample. This seems especially true for Newfoundland, Nova Scotia, New Brunswick, P.E.I., Quebec and British Columbia. However, the indicator model applicable to Canadian employment levels changed quite a bit between the two samples. The specifications for Ontario and Saskatchewan have each dropped one variable, while Alberta's ARX model added one.

**Forecast Accuracy**

Referring to Tables 3a, 5a, and 9a, we compare the relative performance of the three classes of models in terms of their root mean squared error (RMSE), which can be summarized by comparing their respective U-Theil. We find that the VAR model's forecasting performance dominates the other models at each horizon from 1- to 6-month ahead for Canada, Nova Scotia, Quebec, Ontario, Saskatchewan, Alberta and British Columbia. For P.E.I., the ARMA model performs slightly better than the VAR. For Newfoundland and New Brunswick, the first place goes to the ARMA model. Only for Manitoba, at horizons 1 and 3, the VAR model has a smaller RMSE than the ARMA representation, while it is the converse at other horizons. Yet, in this case, the VAR model shows somewhat higher value of the bias proportion.

The covariance bias is generally pretty high (above 0.90 or 0.95) at all horizons for most provinces. This is a sign that our models mainly exhibit unsystematic errors in forecasting. The covariance bias also tends to decrease with the forecasting horizon.

Finally, in terms of the sign of directions of change, the forecasting performance is not systematically related to the horizon or to the model that dominates in terms of RMSE. The confusion indexes take values that range from 0.35 to 0.60. These are smaller for some provinces

[33] Of course, since there is an overlap between the two samples, the evidence we will find on this account may be less strong.

than others. Hence, Canada, Quebec, Ontario, Manitoba, Alberta and British Columbia tend to exhibit confusion indexes that are smaller than 0.50.

### 4.3 Forecasting the Employment Rate and Discussion on Forecast Accuracy

The selected univariate ARMA models for the changes in the employment rate are shown in Table 2b. For each province, they are generally of the same order as those selected for the employment levels. One might conclude from this that even though the level of employment and the ratio of employment to the working-age population are distinct, their respective univariate dynamic patterns share some similarities. Notice however that while for Canada, an ARMA(2,3) is selected by the Schwarz information criterion over other specifications, compared to an ARMA(0,2) for the employment levels. The second best model that would be selected by this information criterion would have been an ARMA(0,2).

As shown in Table 4b, VAR(2) models were selected for systems that include a region's employment rate, its help-wanted index, the Canadian leading indicator (in logs) and the slope of the yield curve.

According to bivariate regressions, except for Nova Scotia, Alberta and British Columbia, the lagged values of the change in employment rates contained statistically significant predictive information content for their future paths. Basically, the same variables ranked at the top in terms of information content both for the employment levels and the employment rates. Only, in some cases, variables that were not significant at 10% in the specifications for the change in employment levels, fall in the 10% significant range in the specifications pertaining to the the change in the employment rates.

When comparing the selected specification of the indicator models over the 1983:01-1992:12 and the 1989:10-1998:09 periods, the sets of variables that are retained change somewhat for Canada, Quebec, Ontario, Manitoba, Saskatchewan, and Alberta. We also notice that the adjusted $R^2$ between the forecasts and the actual values of the series tend also to be higher for the employment levels than for the employment rates. Moreover, the employment rates may be more difficult to forecast accurately with the indicator models for New Brunswick, P.E.I., Manitoba, Saskatchewan and British Columbia over the first subperiod. Over the later subperiod, the adjusted $R^2$ for the employment rates are smaller than 0.85 for P.E.I., Manitoba and Saskatchewan.

**Forecast Accuracy**

With respect to forecast RMSE, over the testing sample, the VAR model is superior to the other specifications at all horizons for Canada, Newfoundland, Nova Scotia, P.E.I., Quebec, Ontario, Saskatchewan and Alberta. In this last province, a no-change model does better than the VAR, except one-month ahead. In New Brunswick, the ARMA representation leads to a lower RMSE at all horizons. In British Columbia, the no-change model dominates, followed by the indicator model. Finally, while the ARX model performs better at the one-month-ahead horizon for Manitoba, the VAR representation dominates at other horizons.

Looking at the confusion index, the ARX model may be better at times to forecasts the direction of change. Quebec provides such an example. Here too, the confusion indexes are systematically smaller for some regions than others.

## 4.4 Forecasting the Unemployment Rate and Discussion on Forecast Accuracy

Selected ARMA specifications for the change in unemployment rates, over the 1983:01 - 1992:12 sample, are generally of low orders. In Canada, Nova Scotia, and Alberta, the no-change model is selected. In Newfoundland, New Brunswick, Quebec and Saskatchewan, it is a MA(1), while British Columbia's retained specification is an AR(1). ARMA(1,1) specifications were picked out for P.E.I. and Manitoba. Ontario's unemployment rate has more implied dynamics as an ARMA(5,2) was chosen by Schwarz information criterion.[34]

In the case of the unemployment rate as well, a lag-length of 2 was found optimal by Schwarz information criterion for a VAR that contained a region's unemployment rate, its help-wanted index, the Canadian leading indicator (in logs) and the slope of the yield curve.

Bivariate dynamic regression analyses of the information content of various indicators are reported in Tables 6.23 to 6.33. In Newfoudland, Nova Scotia, New Brunswick, P.E.I., Quebec,

[34] The Schwarz information criterion (SIC) was 0.460305 for the ARMA(5,2), followed by a value of 0.465024 for an ARMA(6,2), and of 0.518078 for an ARMA(5,7).

Manitoba, Saskatchewan, Alberta and British Columbia, past values of the change in unemployment rates have some predictive content for their future values. The geographical entity's help-wanted index is also useful in Canada, Quebec, Ontario and Alberta. The Canadian leading indicator is significant in the regressions for Canada, Nova Scotia, and Ontario, while its U.S. counterpart has some value for Canada and Ontario at the 10% significance level. Real-GDP-based indicators have information content for Ontario and British Columbia (with *dlny*), P.E.I. (with *stspcycle* and *dlny*), as well as Alberta (with *bncycle*). The slope of the yield curve is also significant for Ontario. Our results show also that the Manpower survey ratios tend to have more predictive information content for the unemployment rate than for the employment levels and rates. Indeed, the ratio associated with the nondurable goods industry was significant for Canada, P.E.I., Quebec, Ontario and Alberta. The MSR for durable goods had content for Canada and Ontario. That of the totality of industries could not be rejected for Canada, Quebec and Ontario. Other industry's ratio were also found to be informative in only a few provinces: construction (in Nova Scotia); trade (in New Brunswick and Alberta); transportation (in Alberta). Subsequently, as shown in Tables 7.3 and 8.3, the Manpower survey ratios played a more significant part in forecasting the unemployment rate than the previous variables. This seems especially the case from 1989:10 to 1998:09, and particularly in Canada, Ontario, and Alberta, followed, to a lesser extent, by New Brunswick, P.E.I. and Quebec.

**Forecast Accuracy**

Referring to Tables 3c, 5c, and 9c, the RMSE performance of the various forecasting models of unemployment rates differ at times depending on the horizon being considered. For Canada, the no-change model does better at horizons 1 to 4, while the ARX model dominates in 5-month and 6-month-ahead forecasts. In Newfoundland, the ARX model ranks first for $h$=1, the VAR model dominates at horizon 2 to 5, and the ARMA model has a slight hedge at the 6-month horizon. In Nova Scotia, the performance of the ARMA and VAR models do not differ much, but the latter does a bit better only at the 6-month horizon. The ARX model does not do well in this case. In New Brunswick, the indicator model dominates for $h$=1 and the ARMA specification is more accurate for $h$=2 and 3. The VAR representation is superior for horizons 4, 5, and 6. In Quebec and in Ontario, the ARMA representations dominate. Yet, the no-change model is even better for forecasting Ontario's unemployment rate. This is true as well for Alberta. The ARMA models lead also to smaller RMSE in Manitoba and Saskatchewan. Finally, British Columbia's unemployment rate is more accurately forecasted 2- to 6-month ahead by the ARMA model, while the 1-month-ahead forecasts based on the ARX model are more accurate.

# 5. Conclusion

This report provides a non-exhaustive treatment of short-term forecasting of employment-related variables in Canada and its provinces. First, a survey of literature described the different routes one may take in constructing forecasting models and in evaluating their performance. Second, the issues pertaining to the adoption of a forecasting protocol were addressed. Finally, three classes of forecasting models were selected, estimated and used for forecasting the national and provincial employment levels, employment rates and unemployment rates, leading thereafter to an assessment of their performance.

In summary, we find that it is possible to construct reasonably good models of short-term forecasting of labour market aggregate variables for Canada and its provinces. In terms of both performance and ease to program and to use, it is useful to develop a well-structured protocol for forecasting. In particular, the VAR model tends to do pretty well. The results suggest however that sometimes, a model that dominates other ones in terms of RMSE, may be dominated in terms of its ability to forecast the direction of changes in a variable. Furthermore, it is not always the same class of model that dominates over all short-term horizons.

Further work may consider the forecasting performance derived from pooling or combining forecasts from the three classes of models. This will require the estimation of weights that may vary over time. Other avenues that are left for further research is the robustness of the forecasting performance to a window width smaller than 10 years, or to the bivariate analysis of predictive information content with a rolling window. We judge these avenues to go beyond the scope of the current project.

# Appendix A

## List of Main Eviews 3.1 Routines Used In This Project

*adfur.prg* Program to perform ADF unit root test with Campbell-Perron data dependant selection of lag-length

*erstest.prg* Program to perform Elliot-Rothenberg-Stock (1986) DF-GLS unit root test

*ersvc.prg* Program to perform Monte Carlo simulations to generate critical values for Elliot-Rothenberg-Stock (1986) DF-GLS unit root test

*quickbn,prg* Program applying Newbold's (1990) quick computation of Beveridge-Nelson decomposition of time series

*idarmasc.prg* Program using Hannan and Rissanen (1982) algorithm to select the orders of an ARMA (*p,q*) specification

*arma.prg* Program to construct forecasts based on invariant ARIMA models and rolling windows

*armasubrout.prg* Program containing a set of subroutines to compute various statistics used in evaluating the forecasting performance of ARIMA models; to be used with *arma.prg*

*nochange.prg* Program to construct forecasts based on no change model; used as a subroutine for *arma.prg*, *var.prg*, and *arx.prg* to use as a benchmark for comparison with other models

*idvar.prg* Program using Schwarz criterion to select the order of a VAR specification

*var.prg* Program to construct forecasts based on invariant VAR models in levels and rolling windows

*varsubrout.prg* Program containing a set of subroutines to compute various statistics used in evaluating the forecasting performance of VAR models; to be used with var.prg

*indicatorll.prg* program to assess the information content of various indicators (in levels) for a variable (in level) to be forecasted

*indicatotdl.prg* program to assess the information content of various indicators (in levels) for a variable (in-first difference) to be forecasted

*indicatordd.prg* program to assess the information content of various indicators (in-first difference) for a variable (in-first difference) to be forecasted

*allindicator.prg* Super-program to run *indicatorll.prg*, *indicatordl.prg*, and *indicatordd.prg*

*shuffle.prg* Program to sort the results obtained from *allindicator.prg*

*arxselect.prg* Program to select the specification of an ARX model using results from *indicatordd.prg*

*arx.prg* Program to construct forecasts based on adaptive ARX models and rolling windows

*arxsubrout.prg* Program containing a set of subroutines to compute various statistics used in evaluating the forecasting performance of ARX models; to be used with *arx.prg*

# Appendix B

## Selected Tables

**Table 1. The variables and their effective availability (in months) because of publication delay.**

| Mnemonics | Description | Effective availability |
|---|---|---|
| *x_empsa* | Employment level in geographic entity *x*[1] | 0 |
| *x_erpsa* | Employment rate in geographic entity *x*[1] | 0 |
| *x_urpsa* | Unemployment rate in geographic entity *x*[1] | 0 |
| *x_hwi* | Help-wanted index in geographic entity *x*[1] | 0 |
| *lcan_ind* | Log of Canadian composite leading indicator | 0 |
| *lus_ind* | Log of US composite leading indicator | 0 |
| *dlny* | Growth rate of real Canadian monthly GDP | 3 |
| *bncycle* | Beveridge-Nelson based business cycle indicator from real Canadian monthly GDP | 3 |
| *stspcycle* | State-space decomposition-based business cycle indicator (from removing a stochastic trend) from real Canadian monthly GDP | 3 |
| *total_ratioc* | Manpower survey ratio (*MSR*) for all industries [2] | 4 |
| *construc_ratioc* | *MSR* in the construction industry[2] | 4 |
| *durgood_ratioc* | *MSR* in the durable goods manufacturing industry [2,3] | 4 |
| *finance_ratioc* | *MSR* in the finance industry [2,4] | 4 |
| *mining_ratioc* | *MSR* in the mining industry [2,5] | 4 |
| *nondur_ratioc* | *MSR* in the non-durable goods manufacturing industry [2,6] | 4 |
| *publicad_ratioc* | *MSR* public administration [2,7] | 4 |
| *services_ratioc* | *MSR* in the services industry [2,8] | 4 |
| *trade_ratioc* | *MSR* in the trade industry [2,9] | 4 |
| *transpo_ratioc* | *MSR* in the broadly-defined transportation industry [2,10] | 4 |

1 *x = c, nf, ns, nb, p, q, o, m, s, a, b.*

2 Ratio of the % of respondents with increased-staff intentions to that of respondents with decreased-staff intentions.

3 This includes motor vehicles, machinery, electrical appliances, iron, steel and metal products, furniture and wood products.

4 This includes finance, insurance and real estate.

5 Metal mining, oil extraction, natural gas, and coal mining.

6 Clothing, leather, paper, printers, drugs and chemicals, food, beverage, publishers, petroleum, refining.

7 At the local, provincial and federal level, and at social services agencies.

8 Business and personal services, private schools, and religion.

9 Wholesale and retail trade, and restaurants.

10 Transportation, storage, public utilities, and communications.

**Table 2. Identification of ARMA specification for the first difference of the labour market aggregates from Hannan and Rissanen's algorithm.**

| a) Employment levels | | | b) Employment rates | | | c) Unemployment rates | | |
|---|---|---|---|---|---|---|---|---|
| ARMA | *p* | *q* | ARMA | *p* | *q* | ARMA | *p* | *q* |
| △c_empsa | 0 | 2 | △c_ersa | 2 | 3 | △c_ursa | 0 | 0 |
| △nf_empsa | 1 | 0 | △nf_ersa | 1 | 0 | △nf_ursa | 0 | 1 |
| △ns_empsa | 0 | 0 | △ns_ersa | 0 | 0 | △ns_ursa | 0 | 0 |
| △nb_empsa | 0 | 1 | △nb_ersa | 0 | 1 | △nb_ursa | 0 | 1 |
| △p_empsa | 1 | 0 | △p_ersa | 1 | 0 | △p_ursa | 1 | 1 |
| △q_empsa | 2 | 1 | △q_ersa | 2 | 1 | △q_ursa | 0 | 1 |
| △o_empsa | 1 | 1 | △o_ersa | 1 | 1 | △o_ursa | 5 | 2 |
| △m_empsa | 0 | 1 | △m_ersa | 0 | 1 | △m_ursa | 1 | 1 |
| △s_empsa | 1 | 0 | △s_ersa | 1 | 0 | △s_ursa | 0 | 1 |
| △a_empsa | 0 | 0 | △a_ersa | 0 | 0 | △a_ursa | 0 | 0 |
| △b_empsa | 0 | 0 | △b_ersa | 0 | 0 | △b_ursa | 1 | 0 |

**Table 3. Evaluation of the forecasting performance of the rolling-windows-based invariant ARIMA models in simulated real time.**

| Variable | ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a) Employment levels | | | | | | | | | | | | |
| c_empsa | (0,1,2) | 1 | 1993:01 1998:09 | 37.7525 | 31.3801 | 0.0023 | 0.0242 | 0.0162 | 0.945 | 0.9142 | 0.4412 | * |
| | (0,1,0) | | 69 obs. | 41.2947 | 34.0353 | 0.0025 | 0.2639 | 0.0087 | 0.7129 | | 0.5 | * |
| | (0,1,2) | 2 | 1993:02 1998:09 | 48.8021 | 39.6875 | 0.0029 | 0.0463 | 0.0258 | 0.9132 | 0.8123 | 0.4478 | * |
| | (0,1,0) | | 68 obs. | 60.0804 | 49.0119 | 0.0036 | 0.4808 | 0.0115 | 0.493 | | 0.4478 | * |
| | (0,1,2) | 3 | 1993:03 1998:09 | 56.944 | 46.6046 | 0.0034 | 0.0825 | 0.0338 | 0.8688 | 0.7085 | 0.4242 | -- |
| | (0,1,0) | | 67 obs. | 80.3747 | 66.9348 | 0.0049 | 0.5979 | 0.0105 | 0.3766 | | 0.3939 | -- |
| | (0,1,2) | 4 | 1993:04 1998:09 | 65.7288 | 53.2962 | 0.0039 | 0.1096 | 0.0410 | 0.8342 | 0.6506 | 0.4308 | -- |
| | (0,1,0) | | 66 obs. | 101.0302 | 86.2523 | 0.0063 | 0.6638 | 0.0105 | 0.3105 | | 0.3692 | -- |
| | (0,1,2) | 5 | 1993:05 1998:09 | 74.4587 | 59.853 | 0.0044 | 0.1508 | 0.0568 | 0.7771 | 0.6051 | 0.4844 | * |
| | (0,1,0) | | 65 obs. | 123.0509 | 107.2453 | 0.0078 | 0.7128 | 0.0119 | 0.2599 | | 0.4531 | * |
| | (0,1,2) | 6 | 1993:06 1998:09 | 83.7988 | 69.1341 | 0.005 | 0.1907 | 0.0776 | 0.716 | 0.577 | 0.3333 | -- |
| | (0,1,0) | | 64 obs. | 145.2371 | 128.0508 | 0.0094 | 0.7526 | 0.0145 | 0.2173 | | 0.4286 | * |
| nf_empsa | (1,1,0) | 1 | 1993:01 1998:09 | 3.0259 | 2.3570 | 0.0122 | 0.0015 | 0.0032 | 0.9808 | 0.9933 | 0.5 | * |
| | (0,1,0) | | 69 obs. | 3.0462 | 2.3382 | 0.0121 | 0.0000 | 0.0000 | 0.9855 | | 0.5735 | * |
| | (1,1,0) | 2 | 1993:02 1998:09 | 3.7929 | 3.0883 | 0.016 | 0.0029 | 0.0008 | 0.9816 | 0.9865 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 3.8447 | 3.0970 | 0.016 | 0.0000 | 0.0000 | 0.9853 | | 0.4925 | * |
| | (1,1,0) | 3 | 1993:03 1998:09 | 4.1269 | 3.4568 | 0.0178 | 0.0013 | 0.0002 | 0.9836 | 0.9847 | 0.5606 | * |
| | (0,1,0) | | 67 obs. | 4.1909 | 3.5076 | 0.0181 | 0.0008 | 0.0000 | 0.9842 | | 0.5758 | * |
| | (1,1,0) | 4 | 1993:04 1998:09 | 4.3692 | 3.6806 | 0.019 | 0.0006 | 0.0011 | 0.9831 | 0.9904 | 0.5385 | * |
| | (0,1,0) | | 66 obs. | 4.4115 | 3.6662 | 0.0189 | 0.0036 | 0.0008 | 0.9805 | | 0.5077 | * |
| | (1,1,0) | 5 | 1993:05 1998:09 | 4.6017 | 3.9189 | 0.0202 | 0.0004 | 0.0012 | 0.9831 | 0.9976 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 4.6129 | 3.9078 | 0.0201 | 0.0071 | 0.0017 | 0.9758 | | 0.4844 | * |
| | (1,1,0) | 6 | 1993:06 1998:09 | 4.8496 | 4.1853 | 0.0216 | 0.0008 | 0.0009 | 0.9827 | 1.0052 | 0.5079 | * |
| | (0,1,0) | | 64 obs. | 4.8243 | 4.2222 | 0.0217 | 0.0091 | 0.0025 | 0.9728 | | 0.4921 | * |
| ns_empsa | (0,1,0) | 1 | 1993:01 1998:09 | 3.1947 | 2.4926 | 0.0065 | 0.0234 | 0.0002 | 0.9619 | 1.0000 | 0.5735 | * |
| | (0,1,0) | | 69 obs. | 3.1947 | 2.4926 | 0.0065 | 0.0234 | 0.0002 | 0.9619 | | 0.5735 | * |
| | (0,1,0) | 2 | 1993:02 1998:09 | 4.2475 | 3.3343 | 0.0087 | 0.0548 | 0.0000 | 0.9305 | 1.0000 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 4.2475 | 3.3343 | 0.0087 | 0.0548 | 0.0000 | 0.9305 | | 0.4925 | * |
| | (0,1,0) | 3 | 1993:03 1998:09 | 5.3041 | 4.0242 | 0.0104 | 0.077 | 0.0001 | 0.9080 | 1.0000 | 0.5606 | * |
| | (0,1,0) | | 67 obs. | 5.3041 | 4.0242 | 0.0104 | 0.077 | 0.0001 | 0.9080 | | 0.5606 | * |
| | (0,1,0) | 4 | 1993:04 1998:09 | 5.8675 | 4.5631 | 0.0118 | 0.1194 | 0.0004 | 0.8651 | 1.0000 | 0.4154 | -- |
| | (0,1,0) | | 66 obs. | 5.8675 | 4.5631 | 0.0118 | 0.1194 | 0.0004 | 0.8651 | | 0.4154 | -- |
| | (0,1,0) | 5 | 1993:05 1998:09 | 6.6202 | 5.1562 | 0.0133 | 0.168 | 0.0014 | 0.8151 | 1.0000 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 6.6202 | 5.1562 | 0.0133 | 0.168 | 0.0014 | 0.8151 | | 0.5156 | * |
| | (0,1,0) | 6 | 1993:06 1998:09 | 7.1898 | 5.6619 | 0.0146 | 0.2214 | 0.0028 | 0.7602 | 1.0000 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 7.1898 | 5.6619 | 0.0146 | 0.2214 | 0.0028 | 0.7602 | | 0.5238 | * |

**Table 3. Evaluation of the forecasting performance of the rolling-windows-based invariant ARIMA models in simulated real time. (cont.)**

| Variable | ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a) Employment levels (Continued) | | | | | | | | | | | | |
| nb_empsa | (0,1,1) | 1 | 1993:01 1998:09 | 3.2756 | 2.7005 | 0.0087 | 0.0008 | 0.0106 | 0.9741 | 0.9697 | 0.5735 | * |
| | (0,1,0) | | 69 obs. | 3.3780 | 2.7603 | 0.0089 | 0.008 | 0.0006 | 0.9769 | | 0.5294 | * |
| | (0,1,1) | 2 | 1993:02 1998:09 | 4.0168 | 3.2363 | 0.0104 | 0.0039 | 0.0108 | 0.9706 | 0.9731 | 0.5224 | * |
| | (0,1,0) | | 68 obs. | 4.1281 | 3.4866 | 0.0112 | 0.0161 | 0.0012 | 0.9680 | | 0.597 | * |
| | (0,1,1) | 3 | 1993:03 1998:09 | 4.5122 | 3.5715 | 0.0115 | 0.0101 | 0.0119 | 0.9631 | 1.0053 | 0.4545 | -- |
| | (0,1,0) | | 67 obs. | 4.4886 | 3.6000 | 0.0116 | 0.023 | 0.0015 | 0.9605 | | 0.4091 | -- |
| | (0,1,1) | 4 | 1993:04 1998:09 | 5.2822 | 4.1525 | 0.0134 | 0.016 | 0.0132 | 0.9557 | 1.0089 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 5.2357 | 4.2277 | 0.0136 | 0.0253 | 0.0024 | 0.9571 | | 0.5538 | * |
| | (0,1,1) | 5 | 1993:05 1998:09 | 5.9445 | 4.8077 | 0.0155 | 0.0214 | 0.0157 | 0.9475 | 1.0157 | 0.5312 | * |
| | (0,1,0) | | 65 obs. | 5.8526 | 4.7812 | 0.0154 | 0.0294 | 0.0039 | 0.9513 | | 0.5469 | * |
| | (0,1,1) | 6 | 1993:06 1998:09 | 6.5315 | 5.3323 | 0.0172 | 0.0264 | 0.0190 | 0.9390 | 1.0137 | 0.5556 | * |
| | (0,1,0) | | 64 obs. | 6.4434 | 5.1873 | 0.0166 | 0.0354 | 0.0071 | 0.9419 | | 0.5079 | * |
| p_empsa | (0,1,1) | 1 | 1993:01 1998:09 | 0.6987 | 0.5461 | 0.0094 | 0.0069 | 0.0020 | 0.9766 | 0.9646 | 0.6029 | * |
| | (0,1,0) | | 69 obs. | 0.7244 | 0.5735 | 0.0098 | 0.0196 | 0.0024 | 0.9635 | | 0.6176 | * |
| | (0,1,1) | 2 | 1993:02 1998:09 | 0.8768 | 0.716 | 0.0122 | 0.0103 | 0.0030 | 0.9720 | 0.9318 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 0.941 | 0.7806 | 0.0133 | 0.0382 | 0.0026 | 0.9445 | | 0.5075 | * |
| | (0,1,1) | 3 | 1993:03 1998:09 | 0.9255 | 0.7633 | 0.013 | 0.0249 | 0.0035 | 0.9567 | 0.944 | 0.3636 | -- |
| | (0,1,0) | | 67 obs. | 0.9804 | 0.8121 | 0.0139 | 0.0927 | 0.0019 | 0.8904 | | 0.3636 | -- |
| | (0,1,1) | 4 | 1993:04 1998:09 | 1.036 | 0.8543 | 0.0145 | 0.0365 | 0.0034 | 0.9449 | 0.9446 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 1.0968 | 0.8815 | 0.015 | 0.1381 | 0.0012 | 0.8455 | | 0.5077 | * |
| | (0,1,1) | 5 | 1993:05 1998:09 | 1.157 | 0.9358 | 0.0159 | 0.0532 | 0.0075 | 0.9240 | 0.9187 | 0.5312 | * |
| | (0,1,0) | | 65 obs. | 1.2594 | 1.0109 | 0.0171 | 0.1818 | 0.0024 | 0.8005 | | 0.5312 | * |
| | (0,1,1) | 6 | 1993:06 1998:09 | 1.2016 | 0.9696 | 0.0165 | 0.0749 | 0.018 | 0.8915 | 0.904 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 1.3292 | 1.0841 | 0.0184 | 0.2426 | 0.0071 | 0.7347 | | 0.4921 | * |
| q_empsa | (2,1,1) | 1 | 1993:01 1998:09 | 17.5513 | 13.8598 | 0.0043 | 0.0385 | 0.0009 | 0.9461 | 0.9847 | 0.5 | * |
| | (0,1,0) | | 69 obs. | 17.8245 | 13.75 | 0.0043 | 0.0431 | 0.0025 | 0.9399 | | 0.4559 | * |
| | (2,1,1) | 2 | 1993:02 1998:09 | 21.8655 | 17.8263 | 0.0056 | 0.0682 | 0.0041 | 0.9129 | 0.9706 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 22.529 | 18.3254 | 0.0057 | 0.1208 | 0.0029 | 0.8616 | | 0.5373 | * |
| | (2,1,1) | 3 | 1993:03 1998:09 | 23.9318 | 19.3865 | 0.0061 | 0.1187 | 0.0254 | 0.841 | 0.9656 | 0.4242 | -- |
| | (0,1,0) | | 67 obs. | 24.7848 | 20.3303 | 0.0063 | 0.2224 | 0.0005 | 0.7621 | | 0.4848 | * |
| | (2,1,1) | 4 | 1993:04 1998:09 | 26.8176 | 21.131 | 0.0066 | 0.1547 | 0.0486 | 0.7816 | 0.9974 | 0.4462 | ** |
| | (0,1,0) | | 66 obs. | 26.8868 | 22.3677 | 0.007 | 0.3203 | 0.0001 | 0.6644 | | 0.4154 | -- |
| | (2,1,1) | 5 | 1993:05 1998:09 | 32.0171 | 25.9513 | 0.0081 | 0.165 | 0.0643 | 0.7553 | 1.0149 | 0.4375 | -- |
| | (0,1,0) | | 65 obs. | 31.5485 | 26.7125 | 0.0083 | 0.3592 | 0.0007 | 0.6247 | | 0.4688 | * |
| | (2,1,1) | 6 | 1993:06 1998:09 | 37.1399 | 30.7055 | 0.0096 | 0.1823 | 0.0703 | 0.7318 | 1.0164 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 36.5392 | 31.4016 | 0.0098 | 0.3919 | 0.0007 | 0.5918 | | 0.5397 | * |

**Table 3. Evaluation of the forecasting performance of the rolling-windows-based invariant ARIMA models in simulated real time. (cont.)**

| Variable | ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a) Employment levels (Continued) | | | | | | | | | | | | |
| o_empsa | (1,1,1) | 1 | 1993:01 1998:09 | 23.2282 | 18.6096 | 0.0035 | 0.0273 | 0.0043 | 0.9539 | 0.9797 | 0.3971 | -- |
| | (0,1,0) | | 69 obs. | 23.7088 | 19.4956 | 0.0037 | 0.1389 | 0.0131 | 0.8335 | | 0.4118 | * |
| | (1,1,1) | 2 | 1993:02 1998:09 | 30.6553 | 26.6701 | 0.005 | 0.0444 | 0.0057 | 0.9352 | 0.9338 | 0.4328 | * |
| | (0,1,0) | | 68 obs. | 32.8268 | 27.7493 | 0.0052 | 0.245 | 0.0221 | 0.7181 | | 0.4328 | * |
| | (1,1,1) | 3 | 1993:03 1998:09 | 39.0646 | 32.2013 | 0.0061 | 0.0607 | 0.0108 | 0.9135 | 0.9194 | 0.4545 | * |
| | (0,1,0) | | 67 obs. | 42.4881 | 34.5136 | 0.0065 | 0.3221 | 0.0339 | 0.629 | | 0.4242 | * |
| | (1,1,1) | 4 | 1993:04 1998:09 | 45.8083 | 38.1881 | 0.0072 | 0.0785 | 0.0193 | 0.8871 | 0.8937 | 0.4308 | * |
| | (0,1,0) | | 66 obs. | 51.2541 | 41.9708 | 0.0079 | 0.3878 | 0.0513 | 0.5457 | | 0.4 | * |
| | (1,1,1) | 5 | 1993:05 1998:09 | 52.9449 | 43.7243 | 0.0082 | 0.1067 | 0.0373 | 0.8406 | 0.876 | 0.4062 | -- |
| | (0,1,0) | | 65 obs. | 60.4421 | 48.8922 | 0.0092 | 0.4486 | 0.0692 | 0.4668 | | 0.4062 | * |
| | (1,1,1) | 6 | 1993:06 1998:09 | 61.7027 | 50.2176 | 0.0095 | 0.1281 | 0.0556 | 0.8006 | 0.8772 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 70.3431 | 58.0032 | 0.0108 | 0.4862 | 0.0827 | 0.4155 | | 0.4444 | * |
| m_empsa | (0,1,1) | 1 | 1993:01 1998:09 | 4.0059 | 3.2464 | 0.0062 | 0.0176 | 0.0031 | 0.9648 | 0.9736 | 0.5441 | * |
| | (0,1,0) | | 69 obs. | 4.1144 | 3.2941 | 0.0063 | 0.0253 | 0.0001 | 0.96 | | 0.5147 | * |
| | (0,1,1) | 2 | 1993:02 1998:09 | 5.0642 | 4.0913 | 0.0078 | 0.0324 | 0.0074 | 0.9455 | 0.9691 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 5.2259 | 4.2284 | 0.0081 | 0.0615 | 0.0027 | 0.9211 | | 0.4925 | * |
| | (0,1,1) | 3 | 1993:03 1998:09 | 5.8206 | 4.854 | 0.0093 | 0.0456 | 0.011 | 0.9285 | 0.943 | 0.5152 | * |
| | (0,1,0) | | 67 obs. | 6.1721 | 5.2318 | 0.01 | 0.0942 | 0.0057 | 0.8852 | | 0.5152 | * |
| | (0,1,1) | 4 | 1993:04 1998:09 | 6.1258 | 4.881 | 0.0093 | 0.062 | 0.0108 | 0.912 | 0.9325 | 0.5231 | * |
| | (0,1,0) | | 66 obs. | 6.5694 | 5.3569 | 0.0102 | 0.1352 | 0.0052 | 0.8445 | | 0.5231 | * |
| | (0,1,1) | 5 | 1993:05 1998:09 | 6.4111 | 5.1721 | 0.0099 | 0.0933 | 0.0092 | 0.8821 | 0.9232 | 0.5000 | * |
| | (0,1,0) | | 65 obs. | 6.9444 | 5.7438 | 0.0109 | 0.1979 | 0.0038 | 0.7830 | | 0.4688 | -- |
| | (0,1,1) | 6 | 1993:06 1998:09 | 6.8135 | 5.7118 | 0.0109 | 0.1318 | 0.0073 | 0.8453 | 0.8999 | 0.5397 | * |
| | (0,1,0) | | 64 obs. | 7.5710 | 6.5714 | 0.0125 | 0.2586 | 0.0025 | 0.7233 | | 0.5714 | * |
| s_empsa | (1,1,0) | 1 | 1993:01 1998:09 | 2.7060 | 1.9065 | 0.0041 | 0.0195 | 0.0007 | 0.9653 | 0.9995 | 0.5588 | * |
| | (0,1,0) | | 69 obs. | 2.7073 | 1.9382 | 0.0042 | 0.0171 | 0.0001 | 0.9683 | | 0.5882 | * |
| | (1,1,0) | 2 | 1993:02 1998:09 | 3.6302 | 2.7911 | 0.0060 | 0.0400 | 0.0007 | 0.9446 | 1.0035 | 0.6119 | * |
| | (0,1,0) | | 68 obs. | 3.6175 | 2.7403 | 0.0059 | 0.0443 | 0.0004 | 0.9405 | | 0.6119 | * |
| | (1,1,0) | 3 | 1993:03 1998:09 | 4.4325 | 3.4303 | 0.0074 | 0.0596 | 0.0003 | 0.9252 | 0.9999 | 0.5606 | * |
| | (0,1,0) | | 67 obs. | 4.4329 | 3.4500 | 0.0074 | 0.0684 | 0.0002 | 0.9164 | | 0.5303 | * |
| | (1,1,0) | 4 | 1993:04 1998:09 | 5.0515 | 4.0180 | 0.0086 | 0.0795 | 0.0001 | 0.9053 | 1.0051 | 0.5385 | * |
| | (0,1,0) | | 66 obs. | 5.0256 | 3.9708 | 0.0085 | 0.0936 | 0.0001 | 0.8911 | | 0.5538 | * |
| | (1,1,0) | 5 | 1993:05 1998:09 | 5.7012 | 4.7106 | 0.0101 | 0.0948 | 0.0006 | 0.8892 | 1.0075 | 0.375 | -- |
| | (0,1,0) | | 65 obs. | 5.6588 | 4.6438 | 0.0100 | 0.1129 | 0.0006 | 0.8711 | | 0.4219 | -- |
| | (1,1,0) | 6 | 1993:06 1998:09 | 6.1674 | 5.1599 | 0.0111 | 0.1100 | 0.0040 | 0.8704 | 1.0097 | 0.5079 | * |
| | (0,1,0) | | 64 obs. | 6.1085 | 5.0905 | 0.0109 | 0.1325 | 0.0038 | 0.8481 | | 0.4286 | -- |

**Table 3. Evaluation of the forecasting performance of the rolling-windows-based invariant ARIMA models in simulated real time. (cont.)**

| Variable | ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a) Employment levels | | | | | | | | | | | | |
| a_empsa | (0,1,0) | 1 | 1993:01 1998:09 | 8.5814 | 6.7779 | 0.0048 | 0.1716 | 0.0028 | 0.8111 | 1.0000 | 0.4853 | * |
| | (0,1,0) | | 69 obs. | 8.5814 | 6.7779 | 0.0048 | 0.1716 | 0.0028 | 0.8111 | | 0.4853 | * |
| | (0,1,0) | 2 | 1993:02 1998:09 | 11.9696 | 9.7806 | 0.007 | 0.3685 | 0.0086 | 0.6082 | 1.0000 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 11.9696 | 9.7806 | 0.007 | 0.3685 | 0.0086 | 0.6082 | | 0.4925 | * |
| | (0,1,0) | 3 | 1993:03 1998:09 | 14.5392 | 12.0621 | 0.0086 | 0.5584 | 0.0098 | 0.4169 | 1.0000 | 0.3939 | -- |
| | (0,1,0) | | 67 obs. | 14.5392 | 12.0621 | 0.0086 | 0.5584 | 0.0098 | 0.4169 | | 0.3939 | -- |
| | (0,1,0) | 4 | 1993:04 1998:09 | 18.4315 | 15.6354 | 0.0111 | 0.6268 | 0.0057 | 0.3523 | 1.0000 | 0.4769 | * |
| | (0,1,0) | | 66 obs. | 18.4315 | 15.6354 | 0.0111 | 0.6268 | 0.0057 | 0.3523 | | 0.4769 | * |
| | (0,1,0) | 5 | 1993:05 1998:09 | 22.2615 | 19.1609 | 0.0136 | 0.686 | 0.0055 | 0.2931 | 1.00001 | 0.4375 | -- |
| | (0,1,0) | | 65 obs. | 22.2615 | 19.1609 | 0.0136 | 0.686 | 0.0055 | 0.2931 | | 0.4375 | -- |
| | (0,1,0) | 6 | 1993:06 1998:09 | 25.8228 | 23.0349 | 0.0163 | 0.7437 | 0.01 | 0.2307 | 1.0000 | 0.4127 | -- |
| | (0,1,0) | | 64 obs. | 25.8228 | 23.0349 | 0.0163 | 0.7437 | 0.01 | 0.2307 | | 0.4127 | -- |
| b_empsa | (0,1,0) | 1 | 1993:01 1998:09 | 11.5412 | 9.2809 | 0.0053 | 0.0779 | 0.0007 | 0.9069 | 1.0000 | 0.4559 | -- |
| | (0,1,0) | | 69 obs. | 11.5412 | 9.2809 | 0.0053 | 0.0779 | 0.0007 | 0.9069 | | 0.4559 | -- |
| | (0,1,0) | 2 | 1993:02 1998:09 | 16.1114 | 13.5612 | 0.0077 | 0.1662 | 0.0066 | 0.8125 | 1.0000 | 0.5821 | * |
| | (0,1,0) | | 68 obs. | 16.1114 | 13.5612 | 0.0077 | 0.1662 | 0.0066 | 0.8125 | | 0.5821 | * |
| | (0,1,0) | 3 | 1993:03 1998:09 | 18.2228 | 15.0455 | 0.0085 | 0.292 | 0.0205 | 0.6725 | 1.0000 | 0.5000 | * |
| | (0,1,0) | | 67 obs. | 18.2228 | 15.0455 | 0.0085 | 0.292 | 0.0205 | 0.6725 | | 0.5000 | * |
| | (0,1,0) | 4 | 1993:04 1998:09 | 21.3349 | 17.6292 | 0.0099 | 0.3764 | 0.0345 | 0.5739 | 1.0000 | 0.4923 | * |
| | (0,1,0) | | 66 obs. | 21.3349 | 17.6292 | 0.0099 | 0.3764 | 0.0345 | 0.5739 | | 0.4923 | * |
| | (0,1,0) | 5 | 1993:05 1998:09 | 24.9016 | 20.9859 | 0.0118 | 0.4345 | 0.0467 | 0.5034 | 1.0000 | 0.5781 | * |
| | (0,1,0) | | 65 obs. | 24.9016 | 20.9859 | 0.0118 | 0.4345 | 0.0467 | 0.5034 | | 0.5781 | * |
| | (0,1,0) | 6 | 1993:06 1998:09 | 27.0486 | 22.9492 | 0.0129 | 0.5474 | 0.0784 | 0.3586 | 1.0000 | 0.3968 | -- |
| | (0,1,0) | | 64 obs. | 27.0486 | 22.9492 | 0.0129 | 0.5474 | 0.0784 | 0.3586 | | 0.3968 | -- |

**Table 3. Evaluation of the forecasting performance of the rolling-windows-based invariant ARIMA models in simulated real time. (cont.)**

| Variable | ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b) Employment rates | | | | | | | | | | | | |
| c_ersa | (2,1,3) | 1 | 1993:01 1998:09 | 0.1718 | 0.1399 | 0.0024 | 0.0254 | 0.0007 | 0.9593 | 1.0768 | 0.5 | * |
| | (0,1,0) | | 69 obs. | 0.1595 | 0.1279 | 0.0022 | 0.0186 | 0.0154 | 0.9515 | | 0.5294 | * |
| | (2,1,3) | 2 | 1993:02 1998:09 | 0.2257 | 0.1816 | 0.0031 | 0.0525 | 0.0011 | 0.9317 | 1.1391 | 0.4478 | * |
| | (0,1,0) | | 68 obs. | 0.1981 | 0.1627 | 0.0028 | 0.0402 | 0.024 | 0.9211 | | 0.403 | * |
| | (2,1,3) | 3 | 1993:03 1998:09 | 0.2644 | 0.2133 | 0.0036 | 0.0898 | 0.0035 | 0.8919 | 1.1242 | 0.3939 | * |
| | (0,1,0) | | 67 obs. | 0.2352 | 0.1894 | 0.0032 | 0.0613 | 0.026 | 0.8978 | | 0.4394 | * |
| | (2,1,3) | 4 | 1993:04 1998:09 | 0.3136 | 0.2579 | 0.0044 | 0.125 | 0.0094 | 0.8504 | 1.1714 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 0.2678 | 0.2215 | 0.0038 | 0.0801 | 0.0312 | 0.8736 | | 0.4154 | * |
| | (2,1,3) | 5 | 1993:05 1998:09 | 0.3538 | 0.2901 | 0.0049 | 0.1699 | 0.0122 | 0.8024 | 1.1722 | 0.5625 | * |
| | (0,1,0) | | 65 obs. | 0.3018 | 0.2422 | 0.0041 | 0.1098 | 0.0412 | 0.8336 | | 0.4688 | * |
| | (2,1,3) | 6 | 1993:06 1998:09 | 0.3959 | 0.3331 | 0.0057 | 0.2415 | 0.0055 | 0.7374 | 1.1851 | 0.4603 | * |
| | (0,1,0) | | 64 obs. | 0.334 | 0.2778 | 0.0047 | 0.1435 | 0.0598 | 0.7811 | | 0.381 | * |
| nf_ersa | (1,1,0) | 1 | 1993:01 1998:09 | 0.6772 | 0.5302 | 0.0124 | 0.0006 | 0.0052 | 0.9798 | 0.9894 | 0.5147 | * |
| | (0,1,0) | | 69 obs. | 0.6844 | 0.5309 | 0.0124 | 0.0002 | 0.0001 | 0.9852 | | 0.6029 | * |
| | (1,1,0) | 2 | 1993:02 1998:09 | 0.843 | 0.6873 | 0.0161 | 0.0012 | 0.0018 | 0.9823 | 0.9851 | 0.4627 | * |
| | (0,1,0) | | 68 obs. | 0.8557 | 0.6896 | 0.0161 | 0.0004 | 0.0000 | 0.9848 | | 0.4627 | * |
| | (1,1,0) | 3 | 1993:03 1998:09 | 0.9178 | 0.7708 | 0.0179 | 0.0072 | 0.0024 | 0.9755 | 0.9862 | 0.5758 | * |
| | (0,1,0) | | 67 obs. | 0.9306 | 0.7758 | 0.0181 | 0.0041 | 0.0001 | 0.9808 | | 0.5455 | * |
| | (1,1,0) | 4 | 1993:04 1998:09 | 0.9761 | 0.8196 | 0.0191 | 0.0156 | 0.0099 | 0.9593 | 0.994 | 0.5692 | * |
| | (0,1,0) | | 66 obs. | 0.982 | 0.8215 | 0.0191 | 0.011 | 0.0055 | 0.9684 | | 0.5077 | * |
| | (1,1,0) | 5 | 1993:05 1998:09 | 1.0334 | 0.8721 | 0.0203 | 0.0245 | 0.0143 | 0.9458 | 1.0031 | 0.5000 | * |
| | (0,1,0) | | 65 obs. | 1.0302 | 0.8688 | 0.0202 | 0.0189 | 0.0111 | 0.9547 | | 0.5156 | * |
| | (1,1,0) | 6 | 1993:06 1998:09 | 1.0922 | 0.9453 | 0.022 | 0.0291 | 0.0157 | 0.9396 | 1.0103 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 1.0811 | 0.9444 | 0.022 | 0.0239 | 0.0156 | 0.9448 | | 0.5238 | * |
| ns_ersa | (0,1,0) | 1 | 1993:01 1998:09 | 0.4251 | 0.3309 | 0.0063 | 0.0061 | 0.0000 | 0.9793 | 1.0000 | 0.6029 | * |
| | (0,1,0) | | 69 obs. | 0.4251 | 0.3309 | 0.0063 | 0.0061 | 0.0000 | 0.9793 | | 0.6029 | * |
| | (0,1,0) | 2 | 1993:02 1998:09 | 0.5637 | 0.4433 | 0.0084 | 0.015 | 0.0001 | 0.9701 | 1.0000 | 0.5522 | * |
| | (0,1,0) | | 68 obs. | 0.5637 | 0.4433 | 0.0084 | 0.015 | 0.0001 | 0.9701 | | 0.5522 | * |
| | (0,1,0) | 3 | 1993:03 1998:09 | 0.6957 | 0.5273 | 0.01 | 0.0213 | 0.0005 | 0.9633 | 1.0000 | 0.5303 | * |
| | (0,1,0) | | 67 obs. | 0.6957 | 0.5273 | 0.01 | 0.0213 | 0.0005 | 0.9633 | | 0.5303 | * |
| | (0,1,0) | 4 | 1993:04 1998:09 | 0.7618 | 0.5877 | 0.0111 | 0.035 | 0.0011 | 0.9488 | 1.0000 | 0.4154 | -- |
| | (0,1,0) | | 66 obs. | 0.7618 | 0.5877 | 0.0111 | 0.035 | 0.0011 | 0.9488 | | 0.4154 | -- |
| | (0,1,0) | 5 | 1993:05 1998:09 | 0.8452 | 0.6531 | 0.0124 | 0.0577 | 0.0033 | 0.9235 | 1.0000 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 0.8452 | 0.6531 | 0.0124 | 0.0577 | 0.0033 | 0.9235 | | 0.5156 | * |
| | (0,1,0) | 6 | 1993:06 1998:09 | 0.8964 | 0.7143 | 0.0135 | 0.0837 | 0.0065 | 0.8941 | 1.0000 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 0.8964 | 0.7143 | 0.0135 | 0.0837 | 0.0065 | 0.8941 | | 0.5238 | * |

**Table 3. Evaluation of the forecasting performance of the rolling-windows-based invariant ARIMA models in simulated real time. (cont.)**

| Variable | ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias Proportion | Variance proportion | Covariance Proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b) Employment rates | | | | | | | | | | | | |
| nb_ersa | (0,1,1) | 1 | 1993:01 1998:09 | 0.5512 | 0.4473 | 0.0086 | 0.0000 | 0.0125 | 0.973 | 0.9733 | 0.5735 | * |
| | (0,1,0) | | 69 obs. | 0.5663 | 0.4574 | 0.0088 | 0.0019 | 0.0005 | 0.9831 | | 0.5294 | * |
| | (0,1,1) | 2 | 1993:02 1998:09 | 0.6767 | 0.5474 | 0.0105 | 0.0008 | 0.0096 | 0.9749 | 0.9797 | 0.5224 | * |
| | (0,1,0) | | 68 obs. | 0.6907 | 0.5731 | 0.011 | 0.0026 | 0.0008 | 0.9819 | | 0.597 | * |
| | (0,1,1) | 3 | 1993:03 1998:09 | 0.7586 | 0.5991 | 0.0115 | 0.0033 | 0.0078 | 0.9739 | 1.0126 | 0.4545 | * |
| | (0,1,0) | | 67 obs. | 0.7491 | 0.5909 | 0.0113 | 0.0023 | 0.0007 | 0.9821 | | 0.4091 | -- |
| | (0,1,1) | 4 | 1993:04 1998:09 | 0.8868 | 0.7006 | 0.0135 | 0.0061 | 0.0058 | 0.9730 | 1.017 | 0.4923 | * |
| | (0,1,0) | | 66 obs. | 0.8720 | 0.6954 | 0.0134 | 0.0017 | 0.0005 | 0.9826 | | 0.5538 | * |
| | (0,1,1) | 5 | 1993:05 1998:09 | 0.9990 | 0.8076 | 0.0155 | 0.0088 | 0.0047 | 0.9711 | 1.0249 | 0.5469 | * |
| | (0,1,0) | | 65 obs. | 0.9748 | 0.7953 | 0.0153 | 0.0016 | 0.0005 | 0.9825 | | 0.5469 | * |
| | (0,1,1) | 6 | 1993:06 1998:09 | 1.0973 | 0.8816 | 0.0170 | 0.0114 | 0.0042 | 0.9688 | 1.024 | 0.5397 | * |
| | (0,1,0) | | 64 obs. | 1.0716 | 0.8571 | 0.0165 | 0.0019 | 0.001 | 0.9815 | | 0.5079 | * |
| p_ersa | (1,1,0) | 1 | 1993:01 1998:09 | 0.6862 | 0.5418 | 0.0097 | 0.0045 | 0.0001 | 0.9810 | 0.981 | 0.6029 | * |
| | (0,1,0) | | 69 obs. | 0.6995 | 0.5544 | 0.0100 | 0.0059 | 0.0004 | 0.9793 | | 0.6176 | * |
| | (1,1,0) | 2 | 1993:02 1998:09 | 0.8455 | 0.6710 | 0.0120 | 0.0065 | 0.0000 | 0.9788 | 0.9603 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 0.8804 | 0.7090 | 0.0127 | 0.0097 | 0.0002 | 0.9754 | | 0.5075 | * |
| | (1,1,0) | 3 | 1993:03 1998:09 | 0.8823 | 0.7317 | 0.0131 | 0.0184 | 0.0004 | 0.9663 | 0.9813 | 0.3636 | -- |
| | (0,1,0) | | 67 obs. | 0.8992 | 0.7364 | 0.0132 | 0.0287 | 0.0003 | 0.9561 | | 0.3333 | -- |
| | (1,1,0) | 4 | 1993:04 1998:09 | 0.9909 | 0.8189 | 0.0147 | 0.0274 | 0.0012 | 0.9563 | 1.0001 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 0.9908 | 0.7954 | 0.0142 | 0.0452 | 0.0018 | 0.9379 | | 0.5385 | * |
| | (1,1,0) | 5 | 1993:05 1998:09 | 1.1057 | 0.8991 | 0.0161 | 0.0412 | 0.0004 | 0.9430 | 0.9899 | 0.5625 | * |
| | (0,1,0) | | 65 obs. | 1.1170 | 0.9047 | 0.0162 | 0.0663 | 0.0014 | 0.9168 | | 0.5312 | * |
| | (1,1,0) | 6 | 1993:06 1998:09 | 1.1479 | 0.9293 | 0.0166 | 0.0572 | 0.0002 | 0.9270 | 0.9877 | 0.5079 | * |
| | (0,1,0) | | 64 obs. | 1.1622 | 0.9286 | 0.0166 | 0.0915 | 0.0002 | 0.8927 | | 0.5079 | * |
| q_ersa | (2,1,1) | 1 | 1993:01 1998:09 | 0.3132 | 0.2494 | 0.0045 | 0.0450 | 0.0023 | 0.9382 | 1.0107 | 0.5441 | * |
| | (0,1,0) | | 69 obs. | 0.3099 | 0.2309 | 0.0042 | 0.0037 | 0.0020 | 0.9798 | | 0.4853 | * |
| | (2,1,1) | 2 | 1993:02 1998:09 | 0.383 | 0.3114 | 0.0057 | 0.0831 | 0.0124 | 0.8898 | 1.0438 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 0.3669 | 0.2836 | 0.0052 | 0.0145 | 0.0041 | 0.9667 | | 0.5075 | * |
| | (2,1,1) | 3 | 1993:03 1998:09 | 0.4306 | 0.3531 | 0.0064 | 0.1393 | 0.0443 | 0.8015 | 1.1175 | 0.4091 | * |
| | (0,1,0) | | 67 obs. | 0.3853 | 0.3000 | 0.0055 | 0.029 | 0.0019 | 0.9542 | | 0.4848 | * |
| | (2,1,1) | 4 | 1993:04 1998:09 | 0.4913 | 0.3893 | 0.0071 | 0.1769 | 0.0740 | 0.7340 | 1.227 | 0.4769 | * |
| | (0,1,0) | | 66 obs. | 0.4004 | 0.3138 | 0.0057 | 0.0418 | 0.0008 | 0.9423 | | 0.4462 | * |
| | (2,1,1) | 5 | 1993:05 1998:09 | 0.5895 | 0.4815 | 0.0088 | 0.1891 | 0.0913 | 0.7042 | 1.2879 | 0.4375 | * |
| | (0,1,0) | | 65 obs. | 0.4577 | 0.3609 | 0.0066 | 0.0477 | 0.0002 | 0.9367 | | 0.4062 | * |
| | (2,1,1) | 6 | 1993:06 1998:09 | 0.6896 | 0.5668 | 0.0103 | 0.2057 | 0.1009 | 0.6778 | 1.3381 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 0.5153 | 0.4111 | 0.0075 | 0.0574 | 0.0003 | 0.9267 | | 0.5397 | * |

**Table 3. Evaluation of the forecasting performance of the rolling-windows-based invariant ARIMA models in simulated real time. (cont.)**

| Variable | ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b) Employment rates | | | | | | | | | | | | |
| o_ersa | (1,1,1) | 1 | 1993:01 1998:09 | 0.2675 | 0.2191 | 0.0036 | 0.0481 | 0.0006 | 0.9368 | 1.0775 | 0.4118 | * |
| | (0,1,0) | | 69 obs. | 0.2482 | 0.1985 | 0.0033 | 0.0077 | 0.0091 | 0.9687 | | 0.3824 | * |
| | (1,1,1) | 2 | 1993:02 1998:09 | 0.3605 | 0.3041 | 0.005 | 0.0839 | 0.0000 | 0.9014 | 1.1082 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 0.3253 | 0.2821 | 0.0047 | 0.0074 | 0.0087 | 0.9692 | | 0.4627 | * |
| | (1,1,1) | 3 | 1993:03 1998:09 | 0.4576 | 0.3777 | 0.0063 | 0.1135 | 0.0005 | 0.8711 | 1.1549 | 0.4545 | * |
| | (0,1,0) | | 67 obs. | 0.3962 | 0.3333 | 0.0055 | 0.0096 | 0.0132 | 0.9623 | | 0.4848 | * |
| | (1,1,1) | 4 | 1993:04 1998:09 | 0.5468 | 0.4507 | 0.0075 | 0.1441 | 0.0005 | 0.8402 | 1.1949 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 0.4576 | 0.3769 | 0.0063 | 0.0119 | 0.0197 | 0.9532 | | 0.4615 | * |
| | (1,1,1) | 5 | 1993:05 1998:09 | 0.6422 | 0.5238 | 0.0087 | 0.1828 | 0.0001 | 0.8017 | 1.2392 | 0.5469 | * |
| | (0,1,0) | | 65 obs. | 0.5183 | 0.4359 | 0.0072 | 0.0178 | 0.0342 | 0.9325 | | 0.5312 | * |
| | (1,1,1) | 6 | 1993:06 1998:09 | 0.7357 | 0.5880 | 0.0097 | 0.211 | 0.0002 | 0.7732 | 1.2671 | 0.5556 | * |
| | (0,1,0) | | 64 obs. | 0.5806 | 0.4825 | 0.008 | 0.0227 | 0.0475 | 0.9142 | | 0.5079 | * |
| m_ersa | (0,1,1) | 1 | 1993:01 1998:09 | 0.4706 | 0.3786 | 0.0062 | 0.0168 | 0.0064 | 0.9624 | 0.9832 | 0.5294 | * |
| | (0,1,0) | | 69 obs. | 0.4787 | 0.3765 | 0.0061 | 0.0106 | 0.0004 | 0.9745 | | 0.5147 | * |
| | (0,1,1) | 2 | 1993:02 1998:09 | 0.5975 | 0.4831 | 0.0079 | 0.0305 | 0.0111 | 0.9438 | 0.9825 | 0.5075 | * |
| | (0,1,0) | | 68 obs. | 0.6082 | 0.4836 | 0.0079 | 0.0255 | 0.0041 | 0.9557 | | 0.4627 | * |
| | (0,1,1) | 3 | 1993:03 1998:09 | 0.6823 | 0.5709 | 0.0093 | 0.0427 | 0.0145 | 0.9279 | 0.965 | 0.5000 | * |
| | (0,1,0) | | 67 obs. | 0.7070 | 0.5894 | 0.0096 | 0.0385 | 0.0081 | 0.9385 | | 0.5152 | * |
| | (0,1,1) | 4 | 1993:04 1998:09 | 0.7183 | 0.5792 | 0.0094 | 0.0581 | 0.0141 | 0.9127 | 0.967 | 0.5385 | * |
| | (0,1,0) | | 66 obs. | 0.7428 | 0.6000 | 0.0098 | 0.0541 | 0.0082 | 0.9226 | | 0.5231 | * |
| | (0,1,1) | 5 | 1993:05 1998:09 | 0.7493 | 0.6055 | 0.0098 | 0.0887 | 0.0125 | 0.8834 | 0.9781 | 0.4844 | * |
| | (0,1,0) | | 65 obs. | 0.7661 | 0.6188 | 0.0101 | 0.086 | 0.0073 | 0.8913 | | 0.4688 | * |
| | (0,1,1) | 6 | 1993:06 1998:09 | 0.7937 | 0.6681 | 0.0108 | 0.1276 | 0.0104 | 0.8463 | 0.97 | 0.5556 | * |
| | (0,1,0) | | 64 obs. | 0.8182 | 0.6825 | 0.0111 | 0.1235 | 0.0061 | 0.8549 | | 0.5714 | * |
| s_ersa | (1,1,0) | 1 | 1993:01 1998:09 | 0.3603 | 0.2575 | 0.0042 | 0.0017 | 0.0011 | 0.9827 | 1.0028 | 0.5441 | * |
| | (0,1,0) | | 69 obs. | 0.3593 | 0.2559 | 0.0041 | 0.0016 | 0.0000 | 0.9838 | | 0.5294 | * |
| | (1,1,0) | 2 | 1993:02 1998:09 | 0.4809 | 0.3781 | 0.0061 | 0.0046 | 0.0006 | 0.9801 | 1.0014 | 0.5970 | * |
| | (0,1,0) | | 68 obs. | 0.4802 | 0.3716 | 0.006 | 0.0059 | 0.0002 | 0.9792 | | 0.5821 | * |
| | (1,1,0) | 3 | 1993:03 1998:09 | 0.5697 | 0.4454 | 0.0072 | 0.0083 | 0.0002 | 0.9766 | 0.9978 | 0.5455 | * |
| | (0,1,0) | | 67 obs. | 0.5710 | 0.4485 | 0.0073 | 0.0109 | 0.0001 | 0.974 | | 0.5303 | * |
| | (1,1,0) | 4 | 1993:04 1998:09 | 0.6299 | 0.5052 | 0.0082 | 0.0117 | 0.0000 | 0.9731 | 1.0065 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 0.6259 | 0.4954 | 0.0080 | 0.0158 | 0.0000 | 0.969 | | 0.4923 | * |
| | (1,1,0) | 5 | 1993:05 1998:09 | 0.7001 | 0.5710 | 0.0092 | 0.0138 | 0.0001 | 0.9707 | 1.0119 | 0.4375 | * |
| | (0,1,0) | | 65 obs. | 0.6919 | 0.5656 | 0.0091 | 0.019 | 0.0003 | 0.9654 | | 0.4219 | * |
| | (1,1,0) | 6 | 1993:06 1998:09 | 0.7498 | 0.6081 | 0.0098 | 0.0146 | 0.0006 | 0.9692 | 1.0150 | 0.4127 | * |
| | (0,1,0) | | 64 obs. | 0.7387 | 0.6032 | 0.0098 | 0.0207 | 0.0011 | 0.9626 | | 0.4286 | * |

**Table 3. Evaluation of the forecasting performance of the rolling-windows-based invariant ARIMA models in simulated real time. (cont.)**

| Variable | ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b) Employment rates | | | | | | | | | | | | |
| a_ersa | (0,1,0) | 1 | 1993:01 1998:09 | 0.3748 | 0.2926 | 0.0044 | 0.0205 | 0.0020 | 0.9631 | 1.0000 | 0.5735 | * |
| | (0,1,0) | | 69 obs. | 0.3748 | 0.2926 | 0.0044 | 0.0205 | 0.0020 | 0.9631 | | 0.5735 | * |
| | (0,1,0) | 2 | 1993:02 1998:09 | 0.4678 | 0.3612 | 0.0054 | 0.0601 | 0.0033 | 0.9219 | 1.0000 | 0.5672 | * |
| | (0,1,0) | | 68 obs. | 0.4678 | 0.3612 | 0.0054 | 0.0601 | 0.0033 | 0.9219 | | 0.5672 | * |
| | (0,1,0) | 3 | 1993:03 1998:09 | 0.4852 | 0.3818 | 0.0057 | 0.1273 | 0.0102 | 0.8476 | 1.0000 | 0.4091 | * |
| | (0,1,0) | | 67 obs. | 0.4852 | 0.3818 | 0.0057 | 0.1273 | 0.0102 | 0.8476 | | 0.4091 | * |
| | (0,1,0) | 4 | 1993:04 1998:09 | 0.5853 | 0.4538 | 0.0068 | 0.1652 | 0.0230 | 0.7967 | 1.0000 | 0.5538 | * |
| | (0,1,0) | | 66 obs. | 0.5853 | 0.4538 | 0.0068 | 0.1652 | 0.0230 | 0.7967 | | 0.5538 | * |
| | (0,1,0) | 5 | 1993:05 1998:09 | 0.6603 | 0.5250 | 0.0079 | 0.2215 | 0.0321 | 0.7310 | 1.0000 | 0.4219 | * |
| | (0,1,0) | | 65 obs. | 0.6603 | 0.5250 | 0.0079 | 0.2215 | 0.0321 | 0.7310 | | 0.4219 | * |
| | (0,1,0) | 6 | 1993:06 1998:09 | 0.7009 | 0.5571 | 0.0084 | 0.2983 | 0.0253 | 0.6608 | 1.0000 | 0.4286 | * |
| | (0,1,0) | | 64 obs. | 0.7009 | 0.5571 | 0.0084 | 0.2983 | 0.0253 | 0.6608 | | 0.4286 | * |
| b_ersa | (0,1,0) | 1 | 1993:01 1998:09 | 0.3823 | 0.3088 | 0.0052 | 0.0014 | 0.0002 | 0.9839 | 1.0000 | 0.4559 | * |
| | (0,1,0) | | 69 obs. | 0.3823 | 0.3088 | 0.0052 | 0.0014 | 0.0002 | 0.9839 | | 0.4559 | * |
| | (0,1,0) | 2 | 1993:02 1998:09 | 0.5059 | 0.4224 | 0.0071 | 0.0024 | 0.0000 | 0.9828 | 1.0000 | 0.6269 | * |
| | (0,1,0) | | 68 obs. | 0.5059 | 0.4224 | 0.0071 | 0.0024 | 0.0000 | 0.9828 | | 0.6269 | * |
| | (0,1,0) | 3 | 1993:03 1998:09 | 0.5266 | 0.4394 | 0.0074 | 0.0054 | 0.0002 | 0.9794 | 1.0000 | 0.5152 | * |
| | (0,1,0) | | 67 obs. | 0.5266 | 0.4394 | 0.0074 | 0.0054 | 0.0002 | 0.9794 | | 0.5152 | * |
| | (0,1,0) | 4 | 1993:04 1998:09 | 0.5668 | 0.4800 | 0.0081 | 0.0093 | 0.0012 | 0.9744 | 1.0000 | 0.5538 | * |
| | (0,1,0) | | 66 obs. | 0.5668 | 0.4800 | 0.0081 | 0.0093 | 0.0012 | 0.9744 | | 0.5538 | * |
| | (0,1,0) | 5 | 1993:05 1998:09 | 0.6245 | 0.5219 | 0.0088 | 0.0117 | 0.0024 | 0.9705 | 1.0000 | 0.5781 | * |
| | (0,1,0) | | 65 obs. | 0.6245 | 0.5219 | 0.0088 | 0.0117 | 0.0024 | 0.9705 | | 0.5781 | * |
| | (0,1,0) | 6 | 1993:06 1998:09 | 0.5946 | 0.4651 | 0.0078 | 0.0153 | 0.0044 | 0.9647 | 1.0000 | 0.4286 | * |
| | (0,1,0) | | 64 obs. | 0.5946 | 0.4651 | 0.0078 | 0.0153 | 0.0044 | 0.9647 | | 0.4286 | * |

**Table 3. Evaluation of the forecasting performance of the rolling-windows-based invariant ARIMA models in simulated real time. (cont.)**

| Variable | ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c) Unemployment rates | | | | | | | | | | | | |
| c_ursa | (0,1,0) | 1 | 1993:01 1998:09 | 0.2419 | 0.1853 | 0.0187 | 0.0367 | 0.0002 | 0.9485 | 1.0000 | 0.5441 | * |
| | (0,1,0) | | 69 obs. | 0.2419 | 0.1853 | 0.0187 | 0.0367 | 0.0002 | 0.9485 | | 0.5441 | * |
| | (0,1,0) | 2 | 1993:02 1998:09 | 0.3052 | 0.2269 | 0.023 | 0.0781 | 0.0004 | 0.9067 | 1.0000 | 0.5522 | * |
| | (0,1,0) | | 68 obs. | 0.3052 | 0.2269 | 0.023 | 0.0781 | 0.0004 | 0.9067 | | 0.5522 | * |
| | (0,1,0) | 3 | 1993:03 1998:09 | 0.3330 | 0.2697 | 0.0276 | 0.1351 | 0.0024 | 0.8476 | 1.0000 | 0.5606 | * |
| | (0,1,0) | | 67 obs. | 0.3330 | 0.2697 | 0.0276 | 0.1351 | 0.0024 | 0.8476 | | 0.5606 | * |
| | (0,1,0) | 4 | 1993:04 1998:09 | 0.3748 | 0.3123 | 0.0321 | 0.1942 | 0.0032 | 0.7875 | 1.0000 | 0.4462 | * |
| | (0,1,0) | | 66 obs. | 0.3748 | 0.3123 | 0.0321 | 0.1942 | 0.0032 | 0.7875 | | 0.4462 | * |
| | (0,1,0) | 5 | 1993:05 1998:09 | 0.4332 | 0.3578 | 0.0370 | 0.2437 | 0.0018 | 0.7391 | 1.0000 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 0.4332 | 0.3578 | 0.0370 | 0.2437 | 0.0018 | 0.7391 | | 0.5156 | * |
| | (0,1,0) | 6 | 1993:06 1998:09 | 0.5032 | 0.4206 | 0.0437 | 0.2754 | 0.0009 | 0.7080 | 1.0000 | 0.5714 | * |
| | (0,1,0) | | 64 obs. | 0.5032 | 0.4206 | 0.0437 | 0.2754 | 0.0009 | 0.7080 | | 0.5714 | * |
| nf_ursa | (0,1,1) | 1 | 1993:01 1998:09 | 0.8751 | 0.6870 | 0.0359 | 0.0022 | 0.0059 | 0.9774 | 0.9971 | 0.6176 | * |
| | (0,1,0) | | 69 obs. | 0.8777 | 0.7088 | 0.0369 | 0.0005 | 0.0000 | 0.9850 | | 0.6176 | * |
| | (0,1,1) | 2 | 1993:02 1998:09 | 1.1165 | 0.8533 | 0.0448 | 0.0028 | 0.0033 | 0.9792 | 0.9472 | 0.5672 | * |
| | (0,1,0) | | 68 obs. | 1.1788 | 0.8896 | 0.0466 | 0.0008 | 0.0000 | 0.9845 | | 0.5373 | * |
| | (0,1,1) | 3 | 1993:03 1998:09 | 1.1767 | 0.9589 | 0.0507 | 0.0079 | 0.0040 | 0.9732 | 0.9416 | 0.6212 | * |
| | (0,1,0) | | 67 obs. | 1.2497 | 1.0152 | 0.0534 | 0.0036 | 0.0000 | 0.9815 | | 0.6364 | * |
| | (0,1,1) | 4 | 1993:04 1998:09 | 1.1757 | 0.9168 | 0.0488 | 0.0203 | 0.0065 | 0.9580 | 0.9696 | 0.3538 | -- |
| | (0,1,0) | | 66 obs. | 1.2126 | 0.9292 | 0.0494 | 0.0132 | 0.0006 | 0.9710 | | 0.4000 | -- |
| | (0,1,1) | 5 | 1993:05 1998:09 | 1.2640 | 1.0739 | 0.0570 | 0.0310 | 0.0083 | 0.9453 | 0.9795 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 1.2905 | 1.0750 | 0.0569 | 0.0233 | 0.0021 | 0.9592 | | 0.5312 | * |
| | (0,1,1) | 6 | 1993:06 1998:09 | 1.3292 | 1.0863 | 0.0578 | 0.036 | 0.0104 | 0.9380 | 0.9678 | 0.5079 | * |
| | (0,1,0) | | 64 obs. | 1.3733 | 1.1238 | 0.0596 | 0.0276 | 0.0040 | 0.9528 | | 0.4921 | * |
| ns_ursa | (0,1,0) | 1 | 1993:01 1998:09 | 0.5230 | 0.4206 | 0.0336 | 0.0069 | 0.0001 | 0.9785 | 1.0000 | 0.4559 | * |
| | (0,1,0) | | 69 obs. | 0.5230 | 0.4206 | 0.0336 | 0.0069 | 0.0001 | 0.9785 | | 0.4559 | * |
| | (0,1,0) | 2 | 1993:02 1998:09 | 0.6820 | 0.5493 | 0.0440 | 0.0167 | 0.0005 | 0.9681 | 1.0000 | 0.5821 | * |
| | (0,1,0) | | 68 obs. | 0.6820 | 0.5493 | 0.0440 | 0.0167 | 0.0005 | 0.9681 | | 0.5821 | * |
| | (0,1,0) | 3 | 1993:03 1998:09 | 0.8083 | 0.6121 | 0.0490 | 0.0314 | 0.0013 | 0.9524 | 1.0000 | 0.5303 | * |
| | (0,1,0) | | 67 obs. | 0.8083 | 0.6121 | 0.0490 | 0.0314 | 0.0013 | 0.9524 | | 0.5303 | * |
| | (0,1,0) | 4 | 1993:04 1998:09 | 0.9218 | 0.7246 | 0.0582 | 0.0478 | 0.0026 | 0.9345 | 1.0000 | 0.5385 | * |
| | (0,1,0) | | 66 obs. | 0.9218 | 0.7246 | 0.0582 | 0.0478 | 0.0026 | 0.9345 | | 0.5385 | * |
| | (0,1,0) | 5 | 1993:05 1998:09 | 0.9973 | 0.7969 | 0.0646 | 0.0704 | 0.0045 | 0.9097 | 1.0000 | 0.5000 | * |
| | (0,1,0) | | 65 obs. | 0.9973 | 0.7969 | 0.0646 | 0.0704 | 0.0045 | 0.9097 | | 0.5000 | * |
| | (0,1,0) | 6 | 1993:06 1998:09 | 1.1070 | 0.9206 | 0.0747 | 0.0895 | 0.0036 | 0.8913 | 1.0000 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 1.1070 | 0.9206 | 0.0747 | 0.0895 | 0.0036 | 0.8913 | | 0.5238 | * |

**Table 3. Evaluation of the forecasting performance of the rolling-windows-based invariant ARIMA models in simulated real time. (cont.)**

| Variable | ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c) Unemployment rates (Continued) | | | | | | | | | | | | |
| nb_ursa | (0,1,1) | 1 | 1993:01 1998:09 | 0.5937 | 0.4869 | 0.0400 | 0.0012 | 0.0252 | 0.9591 | 1.0052 | 0.5735 | * |
| | (0,1,0) | | 69 obs. | 0.5906 | 0.4912 | 0.0404 | 0.0001 | 0.0000 | 0.9854 | | 0.6765 | * |
| | (0,1,1) | 2 | 1993:02 1998:09 | 0.722 | 0.6017 | 0.0494 | 0.0030 | 0.0135 | 0.9688 | 1.0424 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 0.6926 | 0.5701 | 0.0470 | 0.0000 | 0.0000 | 0.9853 | | 0.4627 | * |
| | (0,1,1) | 3 | 1993:03 1998:09 | 0.8418 | 0.6936 | 0.0568 | 0.0055 | 0.0067 | 0.9728 | 1.0067 | 0.5152 | * |
| | (0,1,0) | | 67 obs. | 0.8362 | 0.7045 | 0.0583 | 0.0000 | 0.0000 | 0.9850 | | 0.4848 | * |
| | (0,1,1) | 4 | 1993:04 1998:09 | 0.9349 | 0.7638 | 0.0620 | 0.0076 | 0.0041 | 0.9731 | 1.0181 | 0.4923 | * |
| | (0,1,0) | | 66 obs. | 0.9183 | 0.7708 | 0.0632 | 0.0001 | 0.0000 | 0.9848 | | 0.5846 | * |
| | (0,1,1) | 5 | 1993:05 1998:09 | 1.0147 | 0.8164 | 0.0658 | 0.0135 | 0.0029 | 0.9681 | 1.0356 | 0.4844 | * |
| | (0,1,0) | | 65 obs. | 0.9798 | 0.8063 | 0.0657 | 0.0000 | 0.0000 | 0.9846 | | 0.3594 | -- |
| | (0,1,1) | 6 | 1993:06 1998:09 | 1.0959 | 0.8820 | 0.0710 | 0.0196 | 0.0029 | 0.9620 | 1.0205 | 0.5079 | * |
| | (0,1,0) | | 64 obs. | 1.0739 | 0.8857 | 0.0716 | 0.0005 | 0.0003 | 0.9836 | | 0.5714 | * |
| p_ursa | (1,1,1) | 1 | 1993:01 1998:09 | 0.8460 | 0.7001 | 0.0457 | 0.0479 | 0.0001 | 0.9374 | 0.9645 | 0.6029 | * |
| | (0,1,0) | | 69 obs. | 0.8772 | 0.7088 | 0.0458 | 0.0058 | 0.0011 | 0.9786 | | 0.6029 | * |
| | (1,1,1) | 2 | 1993:02 1998:09 | 1.0045 | 0.8170 | 0.0540 | 0.0919 | 0.0003 | 0.8931 | 1.0204 | 0.4179 | -- |
| | (0,1,0) | | 68 obs. | 0.9844 | 0.8239 | 0.0541 | 0.0150 | 0.0003 | 0.9700 | | 0.4030 | -- |
| | (1,1,1) | 3 | 1993:03 1998:09 | 1.1582 | 0.9157 | 0.0609 | 0.1289 | 0.0002 | 0.8560 | 1.0787 | 0.4848 | * |
| | (0,1,0) | | 67 obs. | 1.0737 | 0.8576 | 0.0570 | 0.0327 | 0.0002 | 0.9522 | | 0.4848 | * |
| | (1,1,1) | 4 | 1993:04 1998:09 | 1.3158 | 1.0708 | 0.0709 | 0.1589 | 0.0009 | 0.8251 | 1.0635 | 0.5692 | * |
| | (0,1,0) | | 66 obs. | 1.2373 | 1.0015 | 0.0660 | 0.0480 | 0.0002 | 0.9366 | | 0.5538 | * |
| | (1,1,1) | 5 | 1993:05 1998:09 | 1.4437 | 1.1418 | 0.0760 | 0.1773 | 0.0010 | 0.8063 | 1.1287 | 0.4844 | * |
| | (0,1,0) | | 65 obs. | 1.2790 | 1.0219 | 0.0678 | 0.0650 | 0.0007 | 0.9189 | | 0.5156 | * |
| | (1,1,1) | 6 | 1993:06 1998:09 | 1.5923 | 1.3264 | 0.0887 | 0.2028 | 0.0044 | 0.7773 | 1.1392 | 0.5397 | * |
| | (0,1,0) | | 64 obs. | 1.3978 | 1.1603 | 0.0775 | 0.0813 | 0.0001 | 0.9030 | | 0.4762 | ** |
| q_ursa | (0,1,1) | 1 | 1993:01 1998:09 | 0.4318 | 0.3597 | 0.0308 | 0.0210 | 0.0063 | 0.9582 | 0.9547 | 0.5735 | * |
| | (0,1,0) | | 69 obs. | 0.4523 | 0.3691 | 0.0317 | 0.0086 | 0.0002 | 0.9767 | | 0.5588 | * |
| | (0,1,1) | 2 | 1993:02 1998:09 | 0.5127 | 0.4155 | 0.0356 | 0.0375 | 0.0054 | 0.9423 | 0.9202 | 0.5373 | * |
| | (0,1,0) | | 68 obs. | 0.5572 | 0.4448 | 0.0382 | 0.0203 | 0.0002 | 0.9648 | | 0.5821 | * |
| | (0,1,1) | 3 | 1993:03 1998:09 | 0.5143 | 0.4195 | 0.0361 | 0.0680 | 0.0052 | 0.9119 | 0.9764 | 0.4242 | -- |
| | (0,1,0) | | 67 obs. | 0.5267 | 0.4227 | 0.0363 | 0.0452 | 0.0000 | 0.9399 | | 0.4394 | * |
| | (0,1,1) | 4 | 1993:04 1998:09 | 0.5932 | 0.4928 | 0.0425 | 0.0865 | 0.0042 | 0.8942 | 1.0012 | 0.4923 | * |
| | (0,1,0) | | 66 obs. | 0.5925 | 0.4769 | 0.0409 | 0.0654 | 0.0000 | 0.9195 | | 0.4154 | * |
| | (0,1,1) | 5 | 1993:05 1998:09 | 0.6906 | 0.5837 | 0.0504 | 0.1032 | 0.0022 | 0.8792 | 0.9924 | 0.5625 | * |
| | (0,1,0) | | 65 obs. | 0.6959 | 0.5984 | 0.0515 | 0.0813 | 0.0002 | 0.9031 | | 0.6719 | * |
| | (0,1,1) | 6 | 1993:06 1998:09 | 0.7496 | 0.6173 | 0.0536 | 0.1322 | 0.0010 | 0.8511 | 0.9965 | 0.5079 | * |
| | (0,1,0) | | 64 obs. | 0.7522 | 0.6111 | 0.0528 | 0.1091 | 0.0010 | 0.8743 | | 0.4603 | * |

**Table 3. Evaluation of the forecasting performance of the rolling-windows-based invariant ARIMA models in simulated real time. (cont.)**

| Variable | ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c) Unemployment rates (Continued) | | | | | | | | | | | | |
| o_ursa | (5,1,2) | 1 | 1993:01 1998:09 | 0.3287 | 0.2600 | 0.0285 | 0.0129 | 0.0007 | 0.9720 | 1.0967 | 0.6176 | * |
| | (0,1,0) | | 69 obs. | 0.2998 | 0.2368 | 0.0261 | 0.0356 | 0.0000 | 0.9499 | | 0.6176 | * |
| | (5,1,2) | 2 | 1993:02 1998:09 | 0.4277 | 0.3396 | 0.0377 | 0.0232 | 0.0003 | 0.9618 | 1.1189 | 0.5224 | * |
| | (0,1,0) | | 68 obs. | 0.3823 | 0.2970 | 0.0332 | 0.0705 | 0.0019 | 0.9129 | | 0.4627 | * |
| | (5,1,2) | 3 | 1993:03 1998:09 | 0.4972 | 0.4081 | 0.0455 | 0.0430 | 0.0002 | 0.9419 | 1.1308 | 0.5 | * |
| | (0,1,0) | | 67 obs. | 0.4397 | 0.3727 | 0.0417 | 0.1062 | 0.0077 | 0.8712 | | 0.5303 | * |
| | (5,1,2) | 4 | 1993:04 1998:09 | 0.5655 | 0.4519 | 0.0506 | 0.0706 | 0.0000 | 0.9142 | 1.1091 | 0.5231 | * |
| | (0,1,0) | | 66 obs. | 0.5099 | 0.4185 | 0.0474 | 0.1447 | 0.0133 | 0.8269 | | 0.5385 | * |
| | (5,1,2) | 5 | 1993:05 1998:09 | 0.6421 | 0.5022 | 0.0565 | 0.1076 | 0.0002 | 0.8769 | 1.1237 | 0.375 | ** |
| | (0,1,0) | | 65 obs. | 0.5715 | 0.4719 | 0.0539 | 0.1949 | 0.0158 | 0.7739 | | 0.3906 | * |
| | (5,1,2) | 6 | 1993:06 1998:09 | 0.7551 | 0.6115 | 0.0693 | 0.1268 | 0.0007 | 0.8569 | 1.1498 | 0.5079 | * |
| | (0,1,0) | | 64 obs. | 0.6567 | 0.5508 | 0.0632 | 0.2197 | 0.0179 | 0.7468 | | 0.5079 | * |
| m_ursa | (1,1,1) | 1 | 1993:01 1998:09 | 0.4999 | 0.3948 | 0.0513 | 0.0669 | 0.0021 | 0.9165 | 0.9977 | 0.5588 | * |
| | (0,1,0) | | 69 obs. | 0.5010 | 0.3809 | 0.0492 | 0.0141 | 0.0013 | 0.9702 | | 0.5735 | * |
| | (1,1,1) | 2 | 1993:02 1998:09 | 0.6258 | 0.4979 | 0.0650 | 0.1025 | 0.0076 | 0.8751 | 0.9518 | 0.5373 | * |
| | (0,1,0) | | 68 obs. | 0.6574 | 0.5134 | 0.0651 | 0.0245 | 0.0000 | 0.9607 | | 0.5672 | * |
| | (1,1,1) | 3 | 1993:03 1998:09 | 0.6851 | 0.5506 | 0.0730 | 0.1417 | 0.0157 | 0.8277 | 0.9505 | 0.5152 | * |
| | (0,1,0) | | 67 obs. | 0.7208 | 0.5894 | 0.0760 | 0.0437 | 0.0024 | 0.9390 | | 0.5303 | * |
| | (1,1,1) | 4 | 1993:04 1998:09 | 0.7367 | 0.5895 | 0.0790 | 0.1838 | 0.0206 | 0.7804 | 0.986 | 0.4923 | * |
| | (0,1,0) | | 66 obs. | 0.7472 | 0.5708 | 0.0745 | 0.0727 | 0.0050 | 0.9071 | | 0.5077 | * |
| | (1,1,1) | 5 | 1993:05 1998:09 | 0.8068 | 0.6553 | 0.0890 | 0.2280 | 0.0227 | 0.7340 | 0.9955 | 0.4531 | *** |
| | (0,1,0) | | 65 obs. | 0.8104 | 0.6078 | 0.0808 | 0.1104 | 0.0081 | 0.8661 | | 0.5 | * |
| | (1,1,1) | 6 | 1993:06 1998:09 | 0.8644 | 0.7172 | 0.0987 | 0.2775 | 0.0234 | 0.6834 | 1.0552 | 0.4286 | -- |
| | (0,1,0) | | 64 obs. | 0.8192 | 0.6413 | 0.0872 | 0.1697 | 0.0111 | 0.8035 | | 0.4444 | -- |
| s_ursa | (0,1,1) | 1 | 1993:01 1998:09 | 0.4132 | 0.3401 | 0.0507 | 0.0192 | 0.0082 | 0.9581 | 0.9848 | 0.5441 | * |
| | (0,1,0) | | 69 obs. | 0.4196 | 0.3485 | 0.0523 | 0.0087 | 0.0068 | 0.9700 | | 0.5 | * |
| | (0,1,1) | 2 | 1993:02 1998:09 | 0.5094 | 0.4125 | 0.0617 | 0.0288 | 0.0221 | 0.9343 | 0.9401 | 0.6269 | * |
| | (0,1,0) | | 68 obs. | 0.5418 | 0.4373 | 0.0654 | 0.0177 | 0.0154 | 0.9522 | | 0.6418 | * |
| | (0,1,1) | 3 | 1993:03 1998:09 | 0.5452 | 0.4404 | 0.0666 | 0.0456 | 0.0333 | 0.9062 | 0.9561 | 0.4394 | * |
| | (0,1,0) | | 67 obs. | 0.5702 | 0.4576 | 0.0694 | 0.0355 | 0.0222 | 0.9274 | | 0.4545 | * |
| | (0,1,1) | 4 | 1993:04 1998:09 | 0.5822 | 0.4780 | 0.0726 | 0.0644 | 0.0423 | 0.8782 | 0.9954 | 0.4308 | -- |
| | (0,1,0) | | 66 obs. | 0.5849 | 0.4800 | 0.0734 | 0.0593 | 0.0299 | 0.8957 | | 0.4769 | * |
| | (0,1,1) | 5 | 1993:05 1998:09 | 0.6404 | 0.5281 | 0.0799 | 0.0825 | 0.0421 | 0.8600 | 0.9974 | 0.5625 | * |
| | (0,1,0) | | 65 obs. | 0.6421 | 0.5297 | 0.0808 | 0.0840 | 0.0263 | 0.8743 | | 0.5781 | * |
| | (0,1,1) | 6 | 1993:06 1998:09 | 0.6852 | 0.5563 | 0.0845 | 0.0979 | 0.0416 | 0.8449 | 1.0053 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 0.6816 | 0.5571 | 0.0849 | 0.1045 | 0.0253 | 0.8546 | | 0.5079 | * |

**Table 3. Evaluation of the forecasting performance of the rolling-windows-based invariant ARIMA models in simulated real time. (cont.)**

| Variable | ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c) Unemployment rates (Continued) | | | | | | | | | | | | |
| a_ursa | (0,1,0) | 1 | 1993:01 1998:09 | 0.3515 | 0.2765 | 0.0379 | 0.0220 | 0.0021 | 0.9614 | 1.0000 | 0.6029 | * |
| | (0,1,0) | | 69 obs. | 0.3515 | 0.2765 | 0.0379 | 0.0220 | 0.0021 | 0.9614 | | 0.6029 | * |
| | (0,1,0) | 2 | 1993:02 1998:09 | 0.4655 | 0.3910 | 0.0529 | 0.0546 | 0.0005 | 0.9301 | 1.0000 | 0.5821 | * |
| | (0,1,0) | | 68 obs. | 0.4655 | 0.3910 | 0.0529 | 0.0546 | 0.0005 | 0.9301 | | 0.5821 | * |
| | (0,1,0) | 3 | 1993:03 1998:09 | 0.4640 | 0.3682 | 0.0499 | 0.1321 | 0.0000 | 0.8529 | 1.0000 | 0.4848 | * |
| | (0,1,0) | | 67 obs. | 0.4640 | 0.3682 | 0.0499 | 0.1321 | 0.0000 | 0.8529 | | 0.4848 | * |
| | (0,1,0) | 4 | 1993:04 1998:09 | 0.4882 | 0.3769 | 0.0523 | 0.2435 | 0.0010 | 0.7403 | 1.0000 | 0.3846 | * |
| | (0,1,0) | | 66 obs. | 0.4882 | 0.3769 | 0.0523 | 0.2435 | 0.0010 | 0.7403 | | 0.3846 | * |
| | (0,1,0) | 5 | 1993:05 1998:09 | 0.5942 | 0.4656 | 0.0652 | 0.2789 | 0.0038 | 0.7019 | 1.0000 | 0.6562 | * |
| | (0,1,0) | | 65 obs. | 0.5942 | 0.4656 | 0.0652 | 0.2789 | 0.0038 | 0.7019 | | 0.6562 | * |
| | (0,1,0) | 6 | 1993:06 1998:09 | 0.6557 | 0.5381 | 0.0749 | 0.3520 | 0.0025 | 0.6298 | 1.0000 | 0.4444 | * |
| | (0,1,0) | | 64 obs. | 0.6557 | 0.5381 | 0.0749 | 0.3520 | 0.0025 | 0.6298 | | 0.4444 | * |
| b_ursa | (1,1,0) | 1 | 1993:01 1998:09 | 0.4518 | 0.3675 | 0.0400 | 0.0009 | 0.0083 | 0.9763 | 0.9454 | 0.5294 | * |
| | (0,1,0) | | 69 obs. | 0.4779 | 0.3691 | 0.0402 | 0.0021 | 0.0001 | 0.9834 | | 0.6176 | * |
| | (1,1,0) | 2 | 1993:02 1998:09 | 0.5265 | 0.4237 | 0.0463 | 0.0037 | 0.0032 | 0.9784 | 0.9800 | 0.4478 | * |
| | (0,1,0) | | 68 obs. | 0.5373 | 0.4239 | 0.0465 | 0.0051 | 0.0001 | 0.9802 | | 0.403 | * |
| | (1,1,0) | 3 | 1993:03 1998:09 | 0.6067 | 0.5044 | 0.0550 | 0.0089 | 0.0015 | 0.9747 | 0.9573 | 0.6364 | * |
| | (0,1,0) | | 67 obs. | 0.6338 | 0.4985 | 0.0547 | 0.0060 | 0.0000 | 0.9790 | | 0.5606 | * |
| | (1,1,0) | 4 | 1993:04 1998:09 | 0.6209 | 0.5251 | 0.0572 | 0.0215 | 0.0010 | 0.9623 | 0.9709 | 0.4615 | -- |
| | (0,1,0) | | 66 obs. | 0.6395 | 0.5323 | 0.0585 | 0.0065 | 0.0000 | 0.9783 | | 0.4615 | * |
| | (1,1,0) | 5 | 1993:05 1998:09 | 0.6429 | 0.5075 | 0.0551 | 0.0353 | 0.0003 | 0.9491 | 0.9721 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 0.6613 | 0.5109 | 0.0559 | 0.0074 | 0.0003 | 0.9769 | | 0.4688 | * |
| | (1,1,0) | 6 | 1993:06 1998:09 | 0.6379 | 0.4780 | 0.0522 | 0.0455 | 0.0027 | 0.9362 | 0.9711 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 0.6568 | 0.5016 | 0.0553 | 0.0153 | 0.0069 | 0.9621 | | 0.5397 | * |

**Table 4. Identification of VAR specifications in levels. Specification sample: 1983:01 1992:12**

| Variables | Schwarz IC | Variables | Schwarz IC | Variables | Schwarz IC |
|---|---|---|---|---|---|
| a) Employment levels | | b) Employment rates | | c) Unemployment levels | |
| c_empsa, lcan_ind, yldslope, c_hwi | 2 | c_ ersa, lcan_ind, yldslope, c_hwi | 2 | c_ursa, lcan_ind, yldslope, c_hwi | |
| nf_empsa, lcan_ind, yldslope, nf_hwi | 2 | nf_ ersa, lcan_ind, yldslope, nf_hwi | 2 | nf_ ursa, lcan_ind, yldslope, nf_hwi | 2 |
| ns_empsa, lcan_ind, yldslope, ns_hwi | 2 | ns_ ersa, lcan_ind, yldslope, ns_hwi | 2 | ns_ ursa, lcan_ind, yldslope, ns_hwi | 2 |
| nb_empsa, lcan_ind, yldslope, nb_hwi | 2 | nb_ ersa, lcan_ind, yldslope, nb_hwi | 2 | nb_ ursa, lcan_ind, yldslope, nb_hwi | 2 |
| p_empsa, lcan_ind, yldslope, p_hwi | 2 | p_ ersa, lcan_ind, yldslope, p_hwi | 2 | p_ ursa, lcan_ind, yldslope, p_hwi | 2 |
| q_empsa, lcan_ind, yldslope, q_hwi | 2 | q_ ersa, lcan_ind, yldslope, q_hwi | 2 | q_ ursa, lcan_ind, yldslope, q_hwi | 2 |
| o_empsa, lcan_ind, yldslope, o_hwi | 2 | o_ ersa, lcan_ind, yldslope, o_hwi | 2 | o_ ursa, lcan_ind, yldslope, o_hwi | 2 |
| m_empsa, lcan_ind, yldslope, m_hwi | 2 | m_ ersa, lcan_ind, yldslope, m_hwi | 2 | m_ursa, lcan_ind, yldslope, m_hwi | 2 |
| s_empsa, lcan_ind, yldslope, s_hwi | 2 | s_ ersa, lcan_ind, yldslope, s_hwi | 2 | s_ ursa, lcan_ind, yldslope, s_hwi | 2 |
| a_empsa, lcan_ind, yldslope, a_hwi | 2 | a_ ersa, lcan_ind, yldslope, a_hwi | 2 | a_ ursa, lcan_ind, yldslope, a_hwi | 2 |
| b_empsa, lcan_ind, yldslope, b_hwi | 2 | b_ersa, lcan_ind, yldslope, b_hwi | 2 | b_ ursa, lcan_ind, yldslope, b_hwi | 2 |

**Table 5. Evaluation of the forecasting performance of the rolling-windows-based invariant VAR models in simulated real time.**

| Variable | VAR ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | y | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a) Employment levels | | | | | | | | | | | | |
| c_empsa | (2) | 1 | 1993:01 1998:09 | 34.7033 | 28.4919 | 0.0021 | 0.0011 | 0.0019 | 0.9825 | 0.8404 | 0.4853 | * |
| | (0,1,0) | | 69 obs. | 41.2947 | 34.0353 | 0.0025 | 0.2639 | 0.0087 | 0.7129 | | 0.5000 | * |
| | (2) | 2 | 1993:02 1998:09 | 41.7373 | 33.6570 | 0.0025 | 0.0032 | 0.0051 | 0.9770 | 0.6947 | 0.4627 | * |
| | (0,1,0) | | 68 obs. | 60.0804 | 49.0119 | 0.0036 | 0.4808 | 0.0115 | 0.4930 | | 0.4478 | * |
| | (2) | 3 | 1993:03 1998:09 | 47.5151 | 39.6979 | 0.0029 | 0.0047 | 0.0088 | 0.9715 | 0.5912 | 0.3939 | -- |
| | (0,1,0) | | 67 obs. | 80.3747 | 66.9348 | 0.0049 | 0.5979 | 0.0105 | 0.3766 | | 0.3939 | -- |
| | (2) | 4 | 1993:04 1998:09 | 52.6396 | 44.0898 | 0.0032 | 0.0060 | 0.0086 | 0.9703 | 0.5210 | 0.3538 | -- |
| | (0,1,0) | | 66 obs. | 101.0302 | 86.2523 | 0.0063 | 0.6638 | 0.0105 | 0.3105 | | 0.3692 | -- |
| | (2) | 5 | 1993:05 1998:09 | 56.0335 | 46.5157 | 0.0034 | 0.0032 | 0.0047 | 0.9767 | 0.4554 | 0.5000 | * |
| | (0,1,0) | | 65 obs. | 123.0509 | 107.2453 | 0.0078 | 0.7128 | 0.0119 | 0.2599 | | 0.4531 | * |
| | (2) | 6 | 1993:06 1998:09 | 57.0247 | 46.4708 | 0.0034 | 0.0002 | 0.0000 | 0.9842 | 0.3926 | 0.3810 | -- |
| | (0,1,0) | | 64 obs. | 145.2371 | 128.0508 | 0.0094 | 0.7526 | 0.0145 | 0.2173 | | 0.4286 | * |
| nf_empsa | (2) | 1 | 1993:01 1998:09 | 3.1254 | 2.4883 | 0.0129 | 0.0505 | 0.0457 | 0.8894 | 1.0260 | 0.4853 | * |
| | (0,1,0) | | 69 obs. | 3.0462 | 2.3382 | 0.0121 | 0.0000 | 0.0000 | 0.9855 | | 0.5735 | * |
| | (2) | 2 | 1993:02 1998:09 | 3.8302 | 2.9246 | 0.0152 | 0.0915 | 0.0442 | 0.8496 | 0.9962 | 0.4179 | -- |
| | (0,1,0) | | 68 obs. | 3.8447 | 3.0970 | 0.0160 | 0.0000 | 0.0000 | 0.9853 | | 0.4925 | * |
| | (2) | 3 | 1993:03 1998:09 | 4.2817 | 3.3965 | 0.0176 | 0.1317 | 0.0431 | 0.8102 | 1.0217 | 0.5152 | * |
| | (0,1,0) | | 67 obs. | 4.1909 | 3.5076 | 0.0181 | 0.0008 | 0.0000 | 0.9842 | | 0.5758 | * |
| | (2) | 4 | 1993:04 1998:09 | 4.6313 | 3.7661 | 0.0195 | 0.1746 | 0.0517 | 0.7585 | 1.0498 | 0.5385 | * |
| | (0,1,0) | | 66 obs. | 4.4115 | 3.6662 | 0.0189 | 0.0036 | 0.0008 | 0.9805 | | 0.5077 | * |
| | (2) | 5 | 1993:05 1998:09 | 4.9620 | 4.0743 | 0.0211 | 0.2292 | 0.0477 | 0.7078 | 1.0757 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 4.6129 | 3.9078 | 0.0201 | 0.0071 | 0.0017 | 0.9758 | | 0.4844 | * |
| | (2) | 6 | 1993:06 1998:09 | 5.2250 | 4.4402 | 0.0231 | 0.2843 | 0.0475 | 0.6526 | 1.0830 | 0.4762 | -- |
| | (0,1,0) | | 64 obs. | 4.8243 | 4.2222 | 0.0217 | 0.0091 | 0.0025 | 0.9728 | | 0.4921 | * |
| ns_empsa | (2) | 1 | 1993:01 1998:09 | 3.1145 | 2.4054 | 0.0063 | 0.0002 | 0.0019 | 0.9834 | 0.9749 | 0.5294 | * |
| | (0,1,0) | | 69 obs. | 3.1947 | 2.4926 | 0.0065 | 0.0234 | 0.0002 | 0.9619 | | 0.5735 | * |
| | (2) | 2 | 1993:02 1998:09 | 4.0637 | 3.2885 | 0.0086 | 0.0002 | 0.0034 | 0.9816 | 0.9567 | 0.5224 | * |
| | (0,1,0) | | 68 obs. | 4.2475 | 3.3343 | 0.0087 | 0.0548 | 0.0000 | 0.9305 | | 0.4925 | * |
| | (2) | 3 | 1993:03 1998:09 | 4.8730 | 3.7249 | 0.0097 | 0.0004 | 0.0063 | 0.9784 | 0.9187 | 0.5000 | * |
| | (0,1,0) | | 67 obs. | 5.3041 | 4.0242 | 0.0104 | 0.0770 | 0.0001 | 0.9080 | | 0.5606 | * |
| | (2) | 4 | 1993:04 1998:09 | 5.2086 | 4.0760 | 0.0106 | 0.0003 | 0.0089 | 0.9757 | 0.8877 | 0.4462 | -- |
| | (0,1,0) | | 66 obs. | 5.8675 | 4.5631 | 0.0118 | 0.1194 | 0.0004 | 0.8651 | | 0.4154 | -- |
| | (2) | 5 | 1993:05 1998:09 | 5.6242 | 4.4148 | 0.0115 | 0.0000 | 0.0107 | 0.9739 | 0.8496 | 0.5781 | * |
| | (0,1,0) | | 65 obs. | 6.6202 | 5.1562 | 0.0133 | 0.1680 | 0.0014 | 0.8151 | | 0.5156 | * |
| | (2) | 6 | 1993:06 1998:09 | 5.7517 | 4.7242 | 0.0123 | 0.0004 | 0.0133 | 0.9707 | 0.8000 | 0.5714 | * |
| | (0,1,0) | | 64 obs. | 7.1898 | 5.6619 | 0.0146 | 0.2214 | 0.0028 | 0.7602 | | 0.5238 | * |

**Table 5. Evaluation of the forecasting performance of the rolling-windows-based invariant VAR models in simulated real time. (cont.)**

| Variable | VAR ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a) Employment levels (Continued) | | | | | | | | | | | | |
| nb_empsa | (2) | 1 | 1993:01 1998:09 | 3.4897 | 2.8260 | 0.0091 | 0.0402 | 0.0491 | 0.8962 | 1.0331 | 0.5588 | * |
| | (0,1,0) | | 69 obs. | 3.378 | 2.7603 | 0.0089 | 0.0080 | 0.0006 | 0.9769 | | 0.5294 | * |
| | (2) | 2 | 1993:02 1998:09 | 4.4223 | 3.3527 | 0.0108 | 0.0861 | 0.0715 | 0.8277 | 1.0713 | 0.5672 | * |
| | (0,1,0) | | 68 obs. | 4.1281 | 3.4866 | 0.0112 | 0.0161 | 0.0012 | 0.9680 | | 0.597 | * |
| | (2) | 3 | 1993:03 1998:09 | 5.1013 | 4.0728 | 0.0132 | 0.1367 | 0.0917 | 0.7568 | 1.1365 | 0.4697 | * |
| | (0,1,0) | | 67 obs. | 4.4886 | 3.6000 | 0.0116 | 0.0230 | 0.0015 | 0.9605 | | 0.4091 | -- |
| | (2) | 4 | 1993:04 1998:09 | 5.9651 | 4.6748 | 0.0152 | 0.1663 | 0.1014 | 0.7171 | 1.1393 | 0.4923 | * |
| | (0,1,0) | | 66 obs. | 5.2357 | 4.2277 | 0.0136 | 0.0253 | 0.0024 | 0.9571 | | 0.5538 | * |
| | (2) | 5 | 1993:05 1998:09 | 6.6591 | 5.1956 | 0.0169 | 0.1936 | 0.1132 | 0.6778 | 1.1378 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 5.8526 | 4.7812 | 0.0154 | 0.0294 | 0.0039 | 0.9513 | | 0.5469 | * |
| | (2) | 6 | 1993:06 1998:09 | 7.1868 | 5.5310 | 0.0180 | 0.2224 | 0.1271 | 0.6348 | 1.1154 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 6.4434 | 5.1873 | 0.0166 | 0.0354 | 0.0071 | 0.9419 | | 0.5079 | * |
| p_empsa | (2) | 1 | 1993:01 1998:09 | 0.7934 | 0.6447 | 0.0110 | 0.0060 | 0.0028 | 0.9767 | 1.0954 | 0.6176 | * |
| | (0,1,0) | | 69 obs. | 0.7244 | 0.5735 | 0.0098 | 0.0196 | 0.0024 | 0.9635 | | 0.6176 | * |
| | (2) | 2 | 1993:02 1998:09 | 1.0239 | 0.8473 | 0.0144 | 0.0081 | 0.0063 | 0.9709 | 1.0880 | 0.5075 | * |
| | (0,1,0) | | 68 obs. | 0.9410 | 0.7806 | 0.0133 | 0.0382 | 0.0026 | 0.9445 | | 0.5075 | * |
| | (2) | 3 | 1993:03 1998:09 | 1.1340 | 0.9091 | 0.0155 | 0.0152 | 0.0115 | 0.9584 | 1.1566 | 0.3939 | -- |
| | (0,1,0) | | 67 obs. | 0.9804 | 0.8121 | 0.0139 | 0.0927 | 0.0019 | 0.8904 | | 0.3636 | -- |
| | (2) | 4 | 1993:04 1998:09 | 1.2799 | 1.0280 | 0.0174 | 0.0188 | 0.0163 | 0.9497 | 1.1669 | 0.4308 | -- |
| | (0,1,0) | | 66 obs. | 1.0968 | 0.8815 | 0.0150 | 0.1381 | 0.0012 | 0.8455 | | 0.5077 | * |
| | (2) | 5 | 1993:05 1998:09 | 1.4168 | 1.1612 | 0.0196 | 0.0251 | 0.0276 | 0.9319 | 1.1249 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 1.2594 | 1.0109 | 0.0171 | 0.1818 | 0.0024 | 0.8005 | | 0.5312 | * |
| | (2) | 6 | 1993:06 1998:09 | 1.4906 | 1.1900 | 0.0201 | 0.0334 | 0.0448 | 0.9061 | 1.1214 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 1.3292 | 1.0841 | 0.0184 | 0.2426 | 0.0071 | 0.7347 | | 0.4921 | * |
| q_empsa | (2) | 1 | 1993:01 1998:09 | 16.2324 | 12.0874 | 0.0038 | 0.0001 | 0.0005 | 0.9849 | 0.9107 | 0.4265 | -- |
| | (0,1,0) | | 69 obs. | 17.8245 | 13.7500 | 0.0043 | 0.0431 | 0.0025 | 0.9399 | | 0.4559 | * |
| | (2) | 2 | 1993:02 1998:09 | 18.4668 | 14.5247 | 0.0045 | 0.0002 | 0.0000 | 0.9851 | 0.8197 | 0.5075 | * |
| | (0,1,0) | | 68 obs. | 22.5290 | 18.3254 | 0.0057 | 0.1208 | 0.0029 | 0.8616 | | 0.5373 | * |
| | (2) | 3 | 1993:03 1998:09 | 18.6490 | 14.8798 | 0.0046 | 0.0007 | 0.0036 | 0.9808 | 0.7524 | 0.3939 | -- |
| | (0,1,0) | | 67 obs. | 24.7848 | 20.3303 | 0.0063 | 0.2224 | 0.0005 | 0.7621 | | 0.4848 | * |
| | (2) | 4 | 1993:04 1998:09 | 18.6630 | 14.8461 | 0.0046 | 0.0012 | 0.0117 | 0.9720 | 0.6941 | 0.3538 | -- |
| | (0,1,0) | | 66 obs. | 26.8868 | 22.3677 | 0.0070 | 0.3203 | 0.0001 | 0.6644 | | 0.4154 | -- |
| | (2) | 5 | 1993:05 1998:09 | 20.8524 | 15.5485 | 0.0048 | 0.0031 | 0.0145 | 0.967 | 0.6610 | 0.4531 | * |
| | (0,1,0) | | 65 obs. | 31.5485 | 26.7125 | 0.0083 | 0.3592 | 0.0007 | 0.6247 | | 0.4688 | * |
| | (2) | 6 | 1993:06 1998:09 | 22.8415 | 17.7326 | 0.0055 | 0.0080 | 0.0124 | 0.9639 | 0.6251 | 0.4444 | * |
| | (0,1,0) | | 64 obs. | 36.5392 | 31.4016 | 0.0098 | 0.3919 | 0.0007 | 0.5918 | | 0.5397 | * |

**Table 5. Evaluation of the forecasting performance of the rolling-windows-based invariant VAR models in simulated real time. (cont.)**

| Variable | VAR ARIMA | Forecast horizon | Forecast sample Sample size | y | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a) Employment levels | | | | | | | | | | | | |
| o_empsa | (2) | 1 | 1993:01 1998:09 | 22.4795 | 18.2256 | 0.0035 | 0.0134 | 0.0156 | 0.9565 | 0.9482 | 0.4118 | * |
| | (0,1,0) | | 69 obs. | 23.7088 | 19.4956 | 0.0037 | 0.1389 | 0.0131 | 0.8335 | | 0.4118 | * |
| | (2) | 2 | 1993:02 1998:09 | 29.8173 | 25.2822 | 0.0048 | 0.0353 | 0.0265 | 0.9234 | 0.9083 | 0.4776 | * |
| | (0,1,0) | | 68 obs. | 32.8268 | 27.7493 | 0.0052 | 0.2450 | 0.0221 | 0.7181 | | 0.4328 | * |
| | (2) | 3 | 1993:03 1998:09 | 36.7854 | 30.7518 | 0.0058 | 0.0471 | 0.0472 | 0.8908 | 0.8658 | 0.3485 | -- |
| | (0,1,0) | | 67 obs. | 42.4881 | 34.5136 | 0.0065 | 0.3221 | 0.0339 | 0.6290 | | 0.4242 | * |
| | (2) | 4 | 1993:04 1998:09 | 42.9742 | 35.4960 | 0.0067 | 0.0548 | 0.0804 | 0.8496 | 0.8385 | 0.4 | -- |
| | (0,1,0) | | 66 obs. | 51.2541 | 41.9708 | 0.0079 | 0.3878 | 0.0513 | 0.5457 | | 0.4 | * |
| | (2) | 5 | 1993:05 1998:09 | 48.0607 | 40.1916 | 0.0076 | 0.0581 | 0.1081 | 0.8185 | 0.7952 | 0.4062 | -- |
| | (0,1,0) | | 65 obs. | 60.4421 | 48.8922 | 0.0092 | 0.4486 | 0.0692 | 0.4668 | | 0.4062 | * |
| | (2) | 6 | 1993:06 1998:09 | 53.1987 | 43.9483 | 0.0083 | 0.0512 | 0.1597 | 0.7734 | 0.7563 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 70.3431 | 58.0032 | 0.0108 | 0.4862 | 0.0827 | 0.4155 | | 0.4444 | * |
| m_empsa | (2) | 1 | 1993:01 1998:09 | 3.9983 | 3.3033 | 0.0063 | 0.0516 | 0.0180 | 0.9159 | 0.9718 | 0.5 | * |
| | (0,1,0) | | 69 obs. | 4.1144 | 3.2941 | 0.0063 | 0.0253 | 0.0001 | 0.9600 | | 0.5147 | * |
| | (2) | 2 | 1993:02 1998:09 | 5.0741 | 4.2600 | 0.0082 | 0.0898 | 0.0270 | 0.8685 | 0.971 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 5.2259 | 4.2284 | 0.0081 | 0.0615 | 0.0027 | 0.9211 | | 0.4925 | * |
| | (2) | 3 | 1993:03 1998:09 | 5.7573 | 4.7315 | 0.0090 | 0.1187 | 0.0320 | 0.8344 | 0.9328 | 0.4545 | ** |
| | (0,1,0) | | 67 obs. | 6.1721 | 5.2318 | 0.0100 | 0.0942 | 0.0057 | 0.8852 | | 0.5152 | * |
| | (2) | 4 | 1993:04 1998:09 | 6.1650 | 5.0281 | 0.0096 | 0.1440 | 0.0416 | 0.7993 | 0.9384 | 0.5385 | * |
| | (0,1,0) | | 66 obs. | 6.5694 | 5.3569 | 0.0102 | 0.1352 | 0.0052 | 0.8445 | | 0.5231 | * |
| | (2) | 5 | 1993:05 1998:09 | 6.5151 | 5.3630 | 0.0102 | 0.1806 | 0.0533 | 0.7508 | 0.9382 | 0.4062 | -- |
| | (0,1,0) | | 65 obs. | 6.9444 | 5.7438 | 0.0109 | 0.1979 | 0.0038 | 0.7830 | | 0.4688 | -- |
| | (2) | 6 | 1993:06 1998:09 | 6.9526 | 5.7343 | 0.0109 | 0.2154 | 0.0640 | 0.7050 | 0.9183 | 0.4603 | *** |
| | (0,1,0) | | 64 obs. | 7.5710 | 6.5714 | 0.0125 | 0.2586 | 0.0025 | 0.7233 | | 0.5714 | * |
| s_empsa | (2) | 1 | 1993:01 1998:09 | 2.6569 | 1.9849 | 0.0043 | 0.0661 | 0.0056 | 0.9138 | 0.9814 | 0.5882 | * |
| | (0,1,0) | | 69 obs. | 2.7073 | 1.9382 | 0.0042 | 0.0171 | 0.0001 | 0.9683 | | 0.5882 | * |
| | (2) | 2 | 1993:02 1998:09 | 3.3924 | 2.6568 | 0.0057 | 0.1294 | 0.0099 | 0.8460 | 0.9378 | 0.6119 | * |
| | (0,1,0) | | 68 obs. | 3.6175 | 2.7403 | 0.0059 | 0.0443 | 0.0004 | 0.9405 | | 0.6119 | * |
| | (2) | 3 | 1993:03 1998:09 | 4.0504 | 3.2520 | 0.0070 | 0.1875 | 0.0218 | 0.7757 | 0.9137 | 0.4848 | -- |
| | (0,1,0) | | 67 obs. | 4.4329 | 3.4500 | 0.0074 | 0.0684 | 0.0002 | 0.9164 | | 0.5303 | * |
| | (2) | 4 | 1993:04 1998:09 | 4.6135 | 3.8107 | 0.0082 | 0.2427 | 0.0353 | 0.7069 | 0.918 | 0.4615 | -- |
| | (0,1,0) | | 66 obs. | 5.0256 | 3.9708 | 0.0085 | 0.0936 | 0.0001 | 0.8911 | | 0.5538 | * |
| | (2) | 5 | 1993:05 1998:09 | 5.2685 | 4.4172 | 0.0095 | 0.2759 | 0.0386 | 0.6702 | 0.931 | 0.4844 | -- |
| | (0,1,0) | | 65 obs. | 5.6588 | 4.6438 | 0.0100 | 0.1129 | 0.0006 | 0.8711 | | 0.4219 | -- |
| | (2) | 6 | 1993:06 1998:09 | 5.7543 | 4.8835 | 0.0105 | 0.3091 | 0.0361 | 0.6391 | 0.942 | 0.4603 | -- |
| | (0,1,0) | | 64 obs. | 6.1085 | 5.0905 | 0.0109 | 0.1325 | 0.0038 | 0.8481 | | 0.4286 | -- |

**Table 5. Evaluation of the forecasting performance of the rolling-windows-based invariant VAR models in simulated real time. (cont.)**

| Variable | VAR ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a) Employment levels (Continued) | | | | | | | | | | | | |
| a_empsa | (2) | 1 | 1993:01 1998:09 | 7.7470 | 6.2343 | 0.0045 | 0.0481 | 0.0125 | 0.9249 | 0.9028 | 0.5294 | * |
| | (0,1,0) | | 69 obs. | 8.5814 | 6.7779 | 0.0048 | 0.1716 | 0.0028 | 0.8111 | | 0.4853 | * |
| | (2) | 2 | 1993:02 1998:09 | 9.6342 | 7.3606 | 0.0053 | 0.1159 | 0.0283 | 0.8411 | 0.8049 | 0.4478 | * |
| | (0,1,0) | | 68 obs. | 11.9696 | 9.7806 | 0.0070 | 0.3685 | 0.0086 | 0.6082 | | 0.4925 | * |
| | (2) | 3 | 1993:03 1998:09 | 10.7599 | 7.9676 | 0.0058 | 0.1979 | 0.0557 | 0.7315 | 0.7401 | 0.3939 | -- |
| | (0,1,0) | | 67 obs. | 14.5392 | 12.0621 | 0.0086 | 0.5584 | 0.0098 | 0.4169 | | 0.3939 | -- |
| | (2) | 4 | 1993:04 1998:09 | 13.2017 | 10.6398 | 0.0077 | 0.2372 | 0.0782 | 0.6694 | 0.7163 | 0.4462 | * |
| | (0,1,0) | | 66 obs. | 18.4315 | 15.6354 | 0.0111 | 0.6268 | 0.0057 | 0.3523 | | 0.4769 | * |
| | (2) | 5 | 1993:05 1998:09 | 15.2960 | 12.1263 | 0.0087 | 0.2876 | 0.0825 | 0.6145 | 0.6871 | 0.3906 | -- |
| | (0,1,0) | | 65 obs. | 22.2615 | 19.1609 | 0.0136 | 0.6860 | 0.0055 | 0.2931 | | 0.4375 | -- |
| | (2) | 6 | 1993:06 1998:09 | 16.8658 | 13.3255 | 0.0096 | 0.3396 | 0.0734 | 0.5714 | 0.6531 | 0.4603 | * |
| | (0,1,0) | | 64 obs. | 25.8228 | 23.0349 | 0.0163 | 0.7437 | 0.0100 | 0.2307 | | 0.4127 | -- |
| b_empsa | (2) | 1 | 1993:01 1998:09 | 11.4504 | 9.4960 | 0.0054 | 0.0092 | 0.0009 | 0.9754 | 0.9921 | 0.4265 | -- |
| | (0,1,0) | | 69 obs. | 11.5412 | 9.2809 | 0.0053 | 0.0779 | 0.0007 | 0.9069 | | 0.4559 | -- |
| | (2) | 2 | 1993:02 1998:09 | 15.6161 | 13.1917 | 0.0074 | 0.0135 | 0.0005 | 0.9713 | 0.9693 | 0.5970 | * |
| | (0,1,0) | | 68 obs. | 16.1114 | 13.5612 | 0.0077 | 0.1662 | 0.0066 | 0.8125 | | 0.5821 | * |
| | (2) | 3 | 1993:03 1998:09 | 17.1272 | 14.3705 | 0.0081 | 0.0260 | 0.0067 | 0.9524 | 0.9399 | 0.5152 | * |
| | (0,1,0) | | 67 obs. | 18.2228 | 15.0455 | 0.0085 | 0.2920 | 0.0205 | 0.6725 | | 0.5000 | * |
| | (2) | 4 | 1993:04 1998:09 | 19.2652 | 16.4186 | 0.0092 | 0.0419 | 0.0177 | 0.9252 | 0.9030 | 0.4462 | -- |
| | (0,1,0) | | 66 obs. | 21.3349 | 17.6292 | 0.0099 | 0.3764 | 0.0345 | 0.5739 | | 0.4923 | * |
| | (2) | 5 | 1993:05 1998:09 | 21.6528 | 17.7565 | 0.0100 | 0.0584 | 0.0314 | 0.8948 | 0.8695 | 0.5625 | * |
| | (0,1,0) | | 65 obs. | 24.9016 | 20.9859 | 0.0118 | 0.4345 | 0.0467 | 0.5034 | | 0.5781 | * |
| | (2) | 6 | 1993:06 1998:09 | 22.4320 | 17.9338 | 0.0101 | 0.0812 | 0.0692 | 0.834 | 0.8293 | 0.4127 | -- |
| | (0,1,0) | | 64 obs. | 27.04860 | 22.9492 | 0.0129 | 0.5474 | 0.0784 | 0.3586 | | 0.3968 | -- |

**Table 5. Evaluation of the forecasting performance of the rolling-windows-based invariant VAR models in simulated real time. (cont.)**

| Variable | VAR ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b) Employment rates | | | | | | | | | | | | |
| c_ersa | (2) | 1 | 1993:01 1998:09 | 0.1504 | 0.1216 | 0.0021 | 0.0002 | 0.0000 | 0.9853 | 0.9431 | 0.5588 | * |
| | (0,1,0) | | 69 obs. | 0.1595 | 0.1279 | 0.0022 | 0.0186 | 0.0154 | 0.9515 | | 0.5294 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.1807 | 0.1463 | 0.0025 | 0.0005 | 0.0020 | 0.9828 | 0.9118 | 0.4478 | * |
| | (0,1,0) | | 68 obs. | 0.1981 | 0.1627 | 0.0028 | 0.0402 | 0.0240 | 0.9211 | | 0.4030 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.2029 | 0.1668 | 0.0028 | 0.0001 | 0.0047 | 0.9802 | 0.8627 | 0.4242 | * |
| | (0,1,0) | | 67 obs. | 0.2352 | 0.1894 | 0.0032 | 0.0613 | 0.0260 | 0.8978 | | 0.4394 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.2172 | 0.1769 | 0.0030 | 0.0000 | 0.0043 | 0.9805 | 0.8110 | 0.4615 | * |
| | (0,1,0) | | 66 obs. | 0.2678 | 0.2215 | 0.0038 | 0.0801 | 0.0312 | 0.8736 | | 0.4154 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.2202 | 0.1835 | 0.0031 | 0.0037 | 0.0011 | 0.9798 | 0.7295 | 0.4844 | * |
| | (0,1,0) | | 65 obs. | 0.3018 | 0.2422 | 0.0041 | 0.1098 | 0.0412 | 0.8336 | | 0.4688 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.2117 | 0.1677 | 0.0029 | 0.0232 | 0.0056 | 0.9556 | 0.6337 | 0.3810 | * |
| | (0,1,0) | | 64 obs. | 0.3340 | 0.2778 | 0.0047 | 0.1435 | 0.0598 | 0.7811 | | 0.3810 | * |
| nf_ersa | (2) | 1 | 1993:01 1998:09 | 0.6751 | 0.5513 | 0.0129 | 0.0009 | 0.0569 | 0.9277 | 0.9865 | 0.5000 | * |
| | (0,1,0) | | 69 obs. | 0.6844 | 0.5309 | 0.0124 | 0.0002 | 0.0001 | 0.9852 | | 0.6029 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.7930 | 0.6112 | 0.0143 | 0.0018 | 0.0844 | 0.8990 | 0.9268 | 0.4179 | -- |
| | (0,1,0) | | 68 obs. | 0.8557 | 0.6896 | 0.0161 | 0.0004 | 0.0000 | 0.9848 | | 0.4627 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.8384 | 0.6571 | 0.0153 | 0.0009 | 0.1344 | 0.8498 | 0.9009 | 0.5909 | * |
| | (0,1,0) | | 67 obs. | 0.9306 | 0.7758 | 0.0181 | 0.0041 | 0.0001 | 0.9808 | | 0.5455 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.8581 | 0.6831 | 0.0159 | 0.0010 | 0.2537 | 0.7301 | 0.8739 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 0.9820 | 0.8215 | 0.0191 | 0.0110 | 0.0055 | 0.9684 | | 0.5077 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.8612 | 0.6954 | 0.0162 | 0.0028 | 0.3177 | 0.6642 | 0.8360 | 0.5625 | * |
| | (0,1,0) | | 65 obs. | 1.0302 | 0.8688 | 0.0202 | 0.0189 | 0.0111 | 0.9547 | | 0.5156 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.8517 | 0.7024 | 0.0164 | 0.0060 | 0.4037 | 0.5747 | 0.7878 | 0.3968 | -- |
| | (0,1,0) | | 64 obs. | 1.0811 | 0.9444 | 0.022 | 0.0239 | 0.0156 | 0.9448 | | 0.5238 | * |
| ns_ersa | (2) | 1 | 1993:01 1998:09 | 0.4187 | 0.3207 | 0.0061 | 0.0002 | 0.0007 | 0.9846 | 0.9849 | 0.5588 | * |
| | (0,1,0) | | 69 obs. | 0.4251 | 0.3309 | 0.0063 | 0.0061 | 0.0000 | 0.9793 | | 0.6029 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.5537 | 0.4439 | 0.0085 | 0.0007 | 0.0012 | 0.9834 | 0.9822 | 0.5970 | * |
| | (0,1,0) | | 68 obs. | 0.5637 | 0.4433 | 0.0084 | 0.0150 | 0.0001 | 0.9701 | | 0.5522 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.6659 | 0.5026 | 0.0096 | 0.0010 | 0.0019 | 0.9822 | 0.9572 | 0.5000 | * |
| | (0,1,0) | | 67 obs. | 0.6957 | 0.5273 | 0.0100 | 0.0213 | 0.0005 | 0.9633 | | 0.5303 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.7200 | 0.5515 | 0.0105 | 0.0021 | 0.0023 | 0.9804 | 0.9452 | 0.4308 | -- |
| | (0,1,0) | | 66 obs. | 0.7618 | 0.5877 | 0.0111 | 0.0350 | 0.0011 | 0.9488 | | 0.4154 | -- |
| | (2) | 5 | 1993:05 1998:09 | 0.7811 | 0.5979 | 0.0114 | 0.0059 | 0.0027 | 0.9760 | 0.9242 | 0.5312 | * |
| | (0,1,0) | | 65 obs. | 0.8452 | 0.6531 | 0.0124 | 0.0577 | 0.0033 | 0.9235 | | 0.5156 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.8090 | 0.6307 | 0.0120 | 0.0104 | 0.0028 | 0.9712 | 0.9026 | 0.5556 | * |
| | (0,1,0) | | 64 obs. | 0.8964 | 0.7143 | 0.0135 | 0.0837 | 0.0065 | 0.8941 | | 0.5238 | * |

**Table 5. Evaluation of the forecasting performance of the rolling-windows-based invariant VAR models in simulated real time. (cont.)**

| Variable | VAR ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b) Employment rates (Continued) | | | | | | | | | | | | |
| nb_ersa | (2) | 1 | 1993:01 1998:09 | 0.5762 | 0.4575 | 0.0088 | 0.0470 | 0.0822 | 0.8563 | 1.0175 | 0.5735 | * |
| | (0,1,0) | | 69 obs. | 0.5663 | 0.4574 | 0.0088 | 0.0019 | 0.0005 | 0.9831 | | 0.5294 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.7203 | 0.5367 | 0.0104 | 0.1022 | 0.1224 | 0.7606 | 1.0429 | 0.5522 | * |
| | (0,1,0) | | 68 obs. | 0.6907 | 0.5731 | 0.0110 | 0.0026 | 0.0008 | 0.9819 | | 0.5970 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.8179 | 0.6273 | 0.0121 | 0.1574 | 0.1534 | 0.6742 | 1.0917 | 0.4242 | -- |
| | (0,1,0) | | 67 obs. | 0.7491 | 0.5909 | 0.0113 | 0.0023 | 0.0007 | 0.9821 | | 0.4091 | -- |
| | (2) | 4 | 1993:04 1998:09 | 0.9357 | 0.7085 | 0.0137 | 0.1930 | 0.1588 | 0.6330 | 1.0731 | 0.4769 | * |
| | (0,1,0) | | 66 obs. | 0.8720 | 0.6954 | 0.0134 | 0.0017 | 0.0005 | 0.9826 | | 0.5538 | * |
| | (2) | 5 | 1993:05 1998:09 | 1.0313 | 0.7898 | 0.0153 | 0.2236 | 0.1649 | 0.5961 | 1.0580 | 0.5312 | * |
| | (0,1,0) | | 65 obs. | 0.9748 | 0.7953 | 0.0153 | 0.0016 | 0.0005 | 0.9825 | | 0.5469 | * |
| | (2) | 6 | 1993:06 1998:09 | 1.1047 | 0.8335 | 0.0162 | 0.2596 | 0.1670 | 0.5578 | 1.0309 | 0.5873 | * |
| | (0,1,0) | | 64 obs. | 1.0716 | 0.8571 | 0.0165 | 0.0019 | 0.0010 | 0.9815 | | 0.5079 | * |
| p_ersa | (2) | 1 | 1993:01 1998:09 | 0.6923 | 0.5534 | 0.0100 | 0.0005 | 0.0196 | 0.9654 | 0.9898 | 0.6029 | * |
| | (0,1,0) | | 69 obs. | 0.6995 | 0.5544 | 0.0100 | 0.0059 | 0.0004 | 0.9793 | | 0.6176 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.8322 | 0.7014 | 0.0126 | 0.0013 | 0.0263 | 0.9577 | 0.9452 | 0.5373 | * |
| | (0,1,0) | | 68 obs. | 0.8804 | 0.7090 | 0.0127 | 0.0097 | 0.0002 | 0.9754 | | 0.5075 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.8611 | 0.7138 | 0.0128 | 0.0012 | 0.0366 | 0.9473 | 0.9577 | 0.3939 | -- |
| | (0,1,0) | | 67 obs. | 0.8992 | 0.7364 | 0.0132 | 0.0287 | 0.0003 | 0.9561 | | 0.3333 | -- |
| | (2) | 4 | 1993:04 1998:09 | 0.9111 | 0.7735 | 0.0139 | 0.0013 | 0.0414 | 0.9422 | 0.9196 | 0.4308 | -- |
| | (0,1,0) | | 66 obs. | 0.9908 | 0.7954 | 0.0142 | 0.0452 | 0.0018 | 0.9379 | | 0.5385 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.9442 | 0.8082 | 0.0145 | 0.0005 | 0.0323 | 0.9519 | 0.8453 | 0.5781 | * |
| | (0,1,0) | | 65 obs. | 1.1170 | 0.9047 | 0.0162 | 0.0663 | 0.0014 | 0.9168 | | 0.5312 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.9478 | 0.8084 | 0.0145 | 0.0000 | 0.0227 | 0.9616 | 0.8155 | 0.4286 | -- |
| | (0,1,0) | | 64 obs. | 1.1622 | 0.9286 | 0.0166 | 0.0915 | 0.0002 | 0.8927 | | 0.5079 | * |
| q_ersa | (2) | 1 | 1993:01 1998:09 | 0.2904 | 0.2174 | 0.0040 | 0.0184 | 0.0181 | 0.9489 | 0.9371 | 0.5147 | * |
| | (0,1,0) | | 69 obs. | 0.3099 | 0.2309 | 0.0042 | 0.0037 | 0.0020 | 0.9798 | | 0.4853 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.3283 | 0.2619 | 0.0048 | 0.0348 | 0.0172 | 0.9333 | 0.8947 | 0.5522 | * |
| | (0,1,0) | | 68 obs. | 0.3669 | 0.2836 | 0.0052 | 0.0145 | 0.0041 | 0.9667 | | 0.5075 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.3485 | 0.2781 | 0.0051 | 0.0682 | 0.0114 | 0.9055 | 0.9045 | 0.4697 | * |
| | (0,1,0) | | 67 obs. | 0.3853 | 0.3000 | 0.0055 | 0.0290 | 0.0019 | 0.9542 | | 0.4848 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.3626 | 0.2993 | 0.0055 | 0.1004 | 0.0079 | 0.8765 | 0.9055 | 0.4154 | * |
| | (0,1,0) | | 66 obs. | 0.4004 | 0.3138 | 0.0057 | 0.0418 | 0.0008 | 0.9423 | | 0.4462 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.4095 | 0.3418 | 0.0062 | 0.1283 | 0.0082 | 0.8482 | 0.8945 | 0.4688 | * |
| | (0,1,0) | | 65 obs. | 0.4577 | 0.3609 | 0.0066 | 0.0477 | 0.0002 | 0.9367 | | 0.4062 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.4459 | 0.3788 | 0.0069 | 0.1734 | 0.0180 | 0.7930 | 0.8654 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 0.5153 | 0.4111 | 0.0075 | 0.0574 | 0.0003 | 0.9267 | | 0.5397 | * |

**Table 5. Evaluation of the forecasting performance of the rolling-windows-based invariant VAR models in simulated real time. (cont.)**

| Variable | VAR ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b) Employment rates (Continued) | | | | | | | | | | | | |
| o_ersa | (2) | 1 | 1993:01 1998:09 | 0.2539 | 0.2111 | 0.0035 | 0.0006 | 0.0071 | 0.9777 | 1.0227 | 0.3824 | ** |
| | (0,1,0) | | 69 obs. | 0.2482 | 0.1985 | 0.0033 | 0.0077 | 0.0091 | 0.9687 | | 0.3824 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.3379 | 0.2837 | 0.0047 | 0.0027 | 0.0009 | 0.9817 | 1.0388 | 0.5224 | * |
| | (0,1,0) | | 68 obs. | 0.3253 | 0.2821 | 0.0047 | 0.0074 | 0.0087 | 0.9692 | | 0.4627 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.4034 | 0.3346 | 0.0056 | 0.0017 | 0.0007 | 0.9827 | 1.0183 | 0.4697 | * |
| | (0,1,0) | | 67 obs. | 0.3962 | 0.3333 | 0.0055 | 0.0096 | 0.0132 | 0.9623 | | 0.4848 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.4583 | 0.3744 | 0.0062 | 0.0004 | 0.0021 | 0.9824 | 1.0016 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 0.4576 | 0.3769 | 0.0063 | 0.0119 | 0.0197 | 0.9532 | | 0.4615 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.4971 | 0.4038 | 0.0067 | 0.0002 | 0.0049 | 0.9795 | 0.9593 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 0.5183 | 0.4359 | 0.0072 | 0.0178 | 0.0342 | 0.9325 | | 0.5312 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.5211 | 0.4281 | 0.0071 | 0.0047 | 0.0232 | 0.9565 | 0.8974 | 0.5397 | * |
| | (0,1,0) | | 64 obs. | 0.5806 | 0.4825 | 0.0080 | 0.0227 | 0.0475 | 0.9142 | | 0.5079 | * |
| m_ersa | (2) | 1 | 1993:01 1998:09 | 0.4696 | 0.3845 | 0.0063 | 0.0436 | 0.0180 | 0.9239 | 0.9812 | 0.5000 | * |
| | (0,1,0) | | 69 obs. | 0.4787 | 0.3765 | 0.0061 | 0.0106 | 0.0004 | 0.9745 | | 0.5147 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.5939 | 0.5076 | 0.0083 | 0.0750 | 0.0338 | 0.8765 | 0.9766 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 0.6082 | 0.4836 | 0.0079 | 0.0255 | 0.0041 | 0.9557 | | 0.4627 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.6649 | 0.5616 | 0.0091 | 0.0980 | 0.0454 | 0.8417 | 0.9404 | 0.5000 | * |
| | (0,1,0) | | 67 obs. | 0.7070 | 0.5894 | 0.0096 | 0.0385 | 0.0081 | 0.9385 | | 0.5152 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.7055 | 0.5834 | 0.0095 | 0.1184 | 0.0609 | 0.8055 | 0.9499 | 0.5385 | * |
| | (0,1,0) | | 66 obs. | 0.7428 | 0.6000 | 0.0098 | 0.0541 | 0.0082 | 0.9226 | | 0.5231 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.7345 | 0.5944 | 0.0096 | 0.1524 | 0.0797 | 0.7525 | 0.9587 | 0.3906 | -- |
| | (0,1,0) | | 65 obs. | 0.7661 | 0.6188 | 0.0101 | 0.0860 | 0.0073 | 0.8913 | | 0.4688 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.7682 | 0.6316 | 0.0102 | 0.1914 | 0.0994 | 0.6936 | 0.9388 | 0.4921 | * |
| | (0,1,0) | | 64 obs. | 0.8182 | 0.6825 | 0.0111 | 0.1235 | 0.0061 | 0.8549 | | 0.5714 | * |
| s_ersa | (2) | 1 | 1993:01 1998:09 | 0.3507 | 0.2502 | 0.0041 | 0.0069 | 0.0201 | 0.9585 | 0.9760 | 0.5882 | * |
| | (0,1,0) | | 69 obs. | 0.3593 | 0.2559 | 0.0041 | 0.0016 | 0.0000 | 0.9838 | | 0.5294 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.4457 | 0.3465 | 0.0056 | 0.0116 | 0.0466 | 0.9271 | 0.9281 | 0.5970 | * |
| | (0,1,0) | | 68 obs. | 0.4802 | 0.3716 | 0.0060 | 0.0059 | 0.0002 | 0.9792 | | 0.5821 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.5113 | 0.4021 | 0.0065 | 0.0171 | 0.0562 | 0.9118 | 0.8954 | 0.4848 | * |
| | (0,1,0) | | 67 obs. | 0.5710 | 0.4485 | 0.0073 | 0.0109 | 0.0001 | 0.9740 | | 0.5303 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.5533 | 0.4348 | 0.0070 | 0.0220 | 0.0628 | 0.9001 | 0.8841 | 0.4923 | * |
| | (0,1,0) | | 66 obs. | 0.6259 | 0.4954 | 0.0080 | 0.0158 | 0.0000 | 0.9690 | | 0.4923 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.5996 | 0.4846 | 0.0078 | 0.0234 | 0.0710 | 0.8901 | 0.8666 | 0.4531 | * |
| | (0,1,0) | | 65 obs. | 0.6919 | 0.5656 | 0.0091 | 0.0190 | 0.0003 | 0.9654 | | 0.4219 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.6283 | 0.5135 | 0.0083 | 0.0223 | 0.0844 | 0.8777 | 0.8506 | 0.4444 | * |
| | (0,1,0) | | 64 obs. | 0.7387 | 0.6032 | 0.0098 | 0.0207 | 0.0011 | 0.9626 | | 0.4286 | * |

**Table 5. Evaluation of the forecasting performance of the rolling-windows-based invariant VAR models in simulated real time. (cont.)**

| Variable | VAR ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b) Employment rates (Continued) | | | | | | | | | | | | |
| a_ersa | (2) | 1 | 1993:01 1998:09 | 0.3700 | 0.2931 | 0.0044 | 0.0112 | 0.0092 | 0.9651 | 0.9873 | 0.6029 | * |
| | (0,1,0) | | 69 obs. | 0.3748 | 0.2926 | 0.0044 | 0.0205 | 0.0020 | 0.9631 | | 0.5735 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.4679 | 0.3761 | 0.0056 | 0.0340 | 0.0245 | 0.9268 | 1.0002 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 0.4678 | 0.3612 | 0.0054 | 0.0601 | 0.0033 | 0.9219 | | 0.5672 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.5250 | 0.4068 | 0.0061 | 0.0578 | 0.0606 | 0.8667 | 1.0820 | 0.3333 | -- |
| | (0,1,0) | | 67 obs. | 0.4852 | 0.3818 | 0.0057 | 0.1273 | 0.0102 | 0.8476 | | 0.4091 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.6253 | 0.4919 | 0.0074 | 0.0753 | 0.1032 | 0.8064 | 1.0683 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 0.5853 | 0.4538 | 0.0068 | 0.1652 | 0.0230 | 0.7967 | | 0.5538 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.6914 | 0.5238 | 0.0078 | 0.1007 | 0.1438 | 0.7402 | 1.0472 | 0.3906 | -- |
| | (0,1,0) | | 65 obs. | 0.6603 | 0.5250 | 0.0079 | 0.2215 | 0.0321 | 0.7310 | | 0.4219 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.7321 | 0.5781 | 0.0087 | 0.1249 | 0.1598 | 0.6997 | 1.0445 | 0.4127 | * |
| | (0,1,0) | | 64 obs. | 0.7009 | 0.5571 | 0.0084 | 0.2983 | 0.0253 | 0.6608 | | 0.4286 | * |
| b_ersa | (2) | 1 | 1993:01 1998:09 | 0.4043 | 0.3286 | 0.0055 | 0.1741 | 0.0003 | 0.8111 | 1.0575 | 0.4265 | -- |
| | (0,1,0) | | 69 obs. | 0.3823 | 0.3088 | 0.0052 | 0.0014 | 0.0002 | 0.9839 | | 0.4559 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.5657 | 0.4558 | 0.0077 | 0.2906 | 0.0004 | 0.6943 | 1.1180 | 0.5970 | * |
| | (0,1,0) | | 68 obs. | 0.5059 | 0.4224 | 0.0071 | 0.0024 | 0.0000 | 0.9828 | | 0.6269 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.6568 | 0.5343 | 0.0090 | 0.4230 | 0.0008 | 0.5613 | 1.2473 | 0.5758 | * |
| | (0,1,0) | | 67 obs. | 0.5266 | 0.4394 | 0.0074 | 0.0054 | 0.0002 | 0.9794 | | 0.5152 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.7505 | 0.6172 | 0.0104 | 0.5175 | 0.0015 | 0.4659 | 1.3242 | 0.5385 | * |
| | (0,1,0) | | 66 obs. | 0.5668 | 0.4800 | 0.0081 | 0.0093 | 0.0012 | 0.9744 | | 0.5538 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.8538 | 0.6964 | 0.0117 | 0.5662 | 0.0028 | 0.4156 | 1.3671 | 0.5938 | * |
| | (0,1,0) | | 65 obs. | 0.6245 | 0.5219 | 0.0088 | 0.0117 | 0.0024 | 0.9705 | | 0.5781 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.9272 | 0.7860 | 0.0132 | 0.6189 | 0.0058 | 0.3596 | 1.5595 | 0.4127 | -- |
| | (0,1,0) | | 64 obs. | 0.5946 | 0.4651 | 0.0078 | 0.0153 | 0.0044 | 0.9647 | | 0.4286 | * |

**Table 5. Evaluation of the forecasting performance of the rolling-windows-based invariant VAR models in simulated real time. (cont.)**

| Variable | VAR ARIMA | Forecast Horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c) Unemployment rates | | | | | | | | | | | | |
| c_ursa | (2) | 1 | 1993:01 1998:09 | 0.2591 | 0.2083 | 0.0212 | 0.0232 | 0.0460 | 0.9163 | 1.0709 | 0.6471 | * |
| | (0,1,0) | | 69 obs. | 0.2419 | 0.1853 | 0.0187 | 0.0367 | 0.0002 | 0.9485 | | 0.5441 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.3483 | 0.2777 | 0.0286 | 0.0443 | 0.0708 | 0.8702 | 1.1412 | 0.5373 | * |
| | (0,1,0) | | 68 obs. | 0.3052 | 0.2269 | 0.0230 | 0.0781 | 0.0004 | 0.9067 | | 0.5522 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.4095 | 0.3244 | 0.0336 | 0.0649 | 0.0882 | 0.8320 | 1.2297 | 0.5455 | * |
| | (0,1,0) | | 67 obs. | 0.3330 | 0.2697 | 0.0276 | 0.1351 | 0.0024 | 0.8476 | | 0.5606 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.4698 | 0.3788 | 0.0394 | 0.0922 | 0.0997 | 0.7930 | 1.2535 | 0.4462 | * |
| | (0,1,0) | | 66 obs. | 0.3748 | 0.3123 | 0.0321 | 0.1942 | 0.0032 | 0.7875 | | 0.4462 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.5264 | 0.4288 | 0.0448 | 0.1302 | 0.1138 | 0.7406 | 1.2152 | 0.4531 | * |
| | (0,1,0) | | 65 obs. | 0.4332 | 0.3578 | 0.0370 | 0.2437 | 0.0018 | 0.7391 | | 0.5156 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.5809 | 0.4816 | 0.0503 | 0.1765 | 0.1195 | 0.6884 | 1.1544 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 0.5032 | 0.4206 | 0.0437 | 0.2754 | 0.0009 | 0.7080 | | 0.5714 | * |
| nf_ursa | (2) | 1 | 1993:01 1998:09 | 0.8627 | 0.7183 | 0.0376 | 0.0004 | 0.0709 | 0.9141 | 0.9829 | 0.5882 | * |
| | (0,1,0) | | 69 obs. | 0.8777 | 0.7088 | 0.0369 | 0.0005 | 0.0000 | 0.9850 | | 0.6176 | * |
| | (2) | 2 | 1993:02 1998:09 | 1.0746 | 0.8846 | 0.0465 | 0.0007 | 0.0817 | 0.9029 | 0.9116 | 0.5373 | * |
| | (0,1,0) | | 68 obs. | 1.1788 | 0.8896 | 0.0466 | 0.0008 | 0.0000 | 0.9845 | | 0.5373 | * |
| | (2) | 3 | 1993:03 1998:09 | 1.1266 | 0.9200 | 0.0487 | 0.0021 | 0.0893 | 0.8937 | 0.9015 | 0.5303 | * |
| | (0,1,0) | | 67 obs. | 1.2497 | 1.0152 | 0.0534 | 0.0036 | 0.0000 | 0.9815 | | 0.6364 | * |
| | (2) | 4 | 1993:04 1998:09 | 1.1313 | 0.9123 | 0.0484 | 0.0060 | 0.1014 | 0.8774 | 0.9329 | 0.3692 | -- |
| | (0,1,0) | | 66 obs. | 1.2126 | 0.9292 | 0.0494 | 0.0132 | 0.0006 | 0.9710 | | 0.4000 | -- |
| | (2) | 5 | 1993:05 1998:09 | 1.1594 | 0.9478 | 0.0502 | 0.0108 | 0.1119 | 0.8619 | 0.8984 | 0.5625 | * |
| | (0,1,0) | | 65 obs. | 1.2905 | 1.0750 | 0.0569 | 0.0233 | 0.0021 | 0.9592 | | 0.5312 | * |
| | (2) | 6 | 1993:06 1998:09 | 1.1506 | 0.9296 | 0.0492 | 0.0125 | 0.1196 | 0.8523 | 0.8378 | 0.5556 | * |
| | (0,1,0) | | 64 obs. | 1.3733 | 1.1238 | 0.0596 | 0.0276 | 0.0040 | 0.9528 | | 0.4921 | * |
| ns_ursa | (2) | 1 | 1993:01 1998:09 | 0.5213 | 0.4218 | 0.0336 | 0.0047 | 0.0135 | 0.9673 | 0.9968 | 0.5000 | * |
| | (0,1,0) | | 69 obs. | 0.5230 | 0.4206 | 0.0336 | 0.0069 | 0.0001 | 0.9785 | | 0.4559 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.6847 | 0.5562 | 0.0441 | 0.0070 | 0.0234 | 0.9549 | 1.0040 | 0.5522 | * |
| | (0,1,0) | | 68 obs. | 0.6820 | 0.5493 | 0.0440 | 0.0167 | 0.0005 | 0.9681 | | 0.5821 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.8171 | 0.6388 | 0.0504 | 0.0101 | 0.0259 | 0.9490 | 1.0109 | 0.4697 | * |
| | (0,1,0) | | 67 obs. | 0.8083 | 0.6121 | 0.0490 | 0.0314 | 0.0013 | 0.9524 | | 0.5303 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.9244 | 0.7550 | 0.0596 | 0.0135 | 0.0271 | 0.9443 | 1.0028 | 0.4462 | -- |
| | (0,1,0) | | 66 obs. | 0.9218 | 0.7246 | 0.0582 | 0.0478 | 0.0026 | 0.9345 | | 0.5385 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.9991 | 0.8338 | 0.0658 | 0.0184 | 0.0273 | 0.9389 | 1.0017 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 0.9973 | 0.7969 | 0.0646 | 0.0704 | 0.0045 | 0.9097 | | 0.5000 | * |
| | (2) | 6 | 1993:06 1998:09 | 1.0799 | 0.9008 | 0.0713 | 0.0236 | 0.0183 | 0.9425 | 0.9755 | 0.5873 | * |
| | (0,1,0) | | 64 obs. | 1.1070 | 0.9206 | 0.0747 | 0.0895 | 0.0036 | 0.8913 | | 0.5238 | * |

**Table 5. Evaluation of the forecasting performance of the rolling-windows-based invariant VAR models in simulated real time. (cont.)**

| Variable | VAR ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c) Unemployment rates (Continued) | | | | | | | | | | | | |
| nb_ursa | (2) | 1 | 1993:01 1998:09 | 0.6087 | 0.5087 | 0.0413 | 0.0744 | 0.1616 | 0.7495 | 1.0307 | 0.5588 | * |
| | (0,1,0) | | 69 obs. | 0.5906 | 0.4912 | 0.0404 | 0.0001 | 0.0000 | 0.9854 | | 0.6765 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.7209 | 0.6148 | 0.0497 | 0.1247 | 0.1857 | 0.6749 | 1.0408 | 0.4328 | -- |
| | (0,1,0) | | 68 obs. | 0.6926 | 0.5701 | 0.0470 | 0.0000 | 0.0000 | 0.9853 | | 0.4627 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.8465 | 0.6978 | 0.0560 | 0.1679 | 0.2195 | 0.5976 | 1.0124 | 0.5303 | * |
| | (0,1,0) | | 67 obs. | 0.8362 | 0.7045 | 0.0583 | 0.0000 | 0.0000 | 0.9850 | | 0.4848 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.9150 | 0.7357 | 0.0586 | 0.2078 | 0.2373 | 0.5398 | 0.9964 | 0.5385 | * |
| | (0,1,0) | | 66 obs. | 0.9183 | 0.7708 | 0.0632 | 0.0001 | 0.0000 | 0.9848 | | 0.5846 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.9774 | 0.7878 | 0.0625 | 0.2564 | 0.2465 | 0.4817 | 0.9976 | 0.4219 | -- |
| | (0,1,0) | | 65 obs. | 0.9798 | 0.8063 | 0.0657 | 0.0000 | 0.0000 | 0.9846 | | 0.3594 | -- |
| | (2) | 6 | 1993:06 1998:09 | 1.0110 | 0.8098 | 0.0639 | 0.3204 | 0.2995 | 0.3645 | 0.9414 | 0.5556 | * |
| | (0,1,0) | | 64 obs. | 1.0739 | 0.8857 | 0.0716 | 0.0005 | 0.0003 | 0.9836 | | 0.5714 | * |
| p_ursa | (2) | 1 | 1993:01 1998:09 | 0.9163 | 0.7322 | 0.0473 | 0.0312 | 0.0083 | 0.9460 | 1.0446 | 0.6176 | * |
| | (0,1,0) | | 69 obs. | 0.8772 | 0.7088 | 0.0458 | 0.0058 | 0.0011 | 0.9786 | | 0.6029 | * |
| | (2) | 2 | 1993:02 1998:09 | 1.1351 | 0.9433 | 0.0615 | 0.0569 | 0.0159 | 0.9125 | 1.1532 | 0.3582 | -- |
| | (0,1,0) | | 68 obs. | 0.9844 | 0.8239 | 0.0541 | 0.0150 | 0.0003 | 0.9700 | | 0.4030 | -- |
| | (2) | 3 | 1993:03 1998:09 | 1.3494 | 1.0654 | 0.0696 | 0.0763 | 0.0222 | 0.8866 | 1.2568 | 0.4848 | * |
| | (0,1,0) | | 67 obs. | 1.0737 | 0.8576 | 0.0570 | 0.0327 | 0.0002 | 0.9522 | | 0.4848 | * |
| | (2) | 4 | 1993:04 1998:09 | 1.5194 | 1.2042 | 0.0785 | 0.0944 | 0.0339 | 0.8566 | 1.2280 | 0.5385 | * |
| | (0,1,0) | | 66 obs. | 1.2373 | 1.0015 | 0.0660 | 0.0480 | 0.0002 | 0.9366 | | 0.5538 | * |
| | (2) | 5 | 1993:05 1998:09 | 1.6877 | 1.3489 | 0.0882 | 0.1002 | 0.0384 | 0.8460 | 1.3195 | 0.4688 | -- |
| | (0,1,0) | | 65 obs. | 1.2790 | 1.0219 | 0.0678 | 0.0650 | 0.0007 | 0.9189 | | 0.5156 | * |
| | (2) | 6 | 1993:06 1998:09 | 1.8332 | 1.4580 | 0.0959 | 0.1202 | 0.0494 | 0.8148 | 1.3115 | 0.5714 | * |
| | (0,1,0) | | 64 obs. | 1.3978 | 1.1603 | 0.0775 | 0.0813 | 0.0001 | 0.903 | | 0.4762 | ** |
| q_ursa | (2) | 1 | 1993:01 1998:09 | 0.4463 | 0.3798 | 0.0326 | 0.0282 | 0.0038 | 0.9536 | 0.9868 | 0.5588 | * |
| | (0,1,0) | | 69 obs. | 0.4523 | 0.3691 | 0.0317 | 0.0086 | 0.0002 | 0.9767 | | 0.5588 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.5693 | 0.4785 | 0.0414 | 0.0591 | 0.0006 | 0.9256 | 1.0218 | 0.5672 | * |
| | (0,1,0) | | 68 obs. | 0.5572 | 0.4448 | 0.0382 | 0.0203 | 0.0002 | 0.9648 | | 0.5821 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.6258 | 0.5214 | 0.0452 | 0.0933 | 0.0000 | 0.8918 | 1.1880 | 0.4242 | * |
| | (0,1,0) | | 67 obs. | 0.5267 | 0.4227 | 0.0363 | 0.0452 | 0.0000 | 0.9399 | | 0.4394 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.6929 | 0.5814 | 0.0505 | 0.1254 | 0.0000 | 0.8595 | 1.1694 | 0.3692 | -- |
| | (0,1,0) | | 66 obs. | 0.5925 | 0.4769 | 0.0409 | 0.0654 | 0.0000 | 0.9195 | | 0.4154 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.7487 | 0.6423 | 0.0558 | 0.1681 | 0.0000 | 0.8165 | 1.0760 | 0.5469 | * |
| | (0,1,0) | | 65 obs. | 0.6959 | 0.5984 | 0.0515 | 0.0813 | 0.0002 | 0.9031 | | 0.6719 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.7779 | 0.6491 | 0.0566 | 0.2337 | 0.0007 | 0.7500 | 1.0341 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 0.7522 | 0.6111 | 0.0528 | 0.1091 | 0.0010 | 0.8743 | | 0.4603 | * |

**Table 5. Evaluation of the forecasting performance of the rolling-windows-based invariant VAR models in simulated real time. (cont.)**

| Variable | VAR ARIMA | Forecast Horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias Proportion | Variance Proportion | Covariance Proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c) Unemployment rates (Continued) | | | | | | | | | | | | |
| o_ursa | (2) | 1 | 1993:01 1998:09 | 0.3393 | 0.2740 | 0.0302 | 0.0599 | 0.0996 | 0.8260 | 1.1320 | 0.5441 | * |
| | (0,1,0) | | 69 obs. | 0.2998 | 0.2368 | 0.0261 | 0.0356 | 0.0000 | 0.9499 | | 0.6176 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.4575 | 0.3465 | 0.0384 | 0.0827 | 0.1341 | 0.7684 | 1.1967 | 0.4627 | * |
| | (0,1,0) | | 68 obs. | 0.3823 | 0.2970 | 0.0332 | 0.0705 | 0.0019 | 0.9129 | | 0.4627 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.5459 | 0.4090 | 0.0458 | 0.1034 | 0.1458 | 0.7358 | 1.2415 | 0.4545 | * |
| | (0,1,0) | | 67 obs. | 0.4397 | 0.3727 | 0.0417 | 0.1062 | 0.0077 | 0.8712 | | 0.5303 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.6239 | 0.4581 | 0.0514 | 0.1318 | 0.1474 | 0.7057 | 1.2235 | 0.5385 | * |
| | (0,1,0) | | 66 obs. | 0.5099 | 0.4185 | 0.0474 | 0.1447 | 0.0133 | 0.8269 | | 0.5385 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.6908 | 0.5123 | 0.0575 | 0.1694 | 0.1564 | 0.6588 | 1.2088 | 0.4219 | * |
| | (0,1,0) | | 65 obs. | 0.5715 | 0.4719 | 0.0539 | 0.1949 | 0.0158 | 0.7739 | | 0.3906 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.7539 | 0.5608 | 0.0630 | 0.2065 | 0.1532 | 0.6247 | 1.1480 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 0.6567 | 0.5508 | 0.0632 | 0.2197 | 0.0179 | 0.7468 | | 0.5079 | * |
| m_ursa | (2) | 1 | 1993:01 1998:09 | 0.5795 | 0.4571 | 0.0599 | 0.0927 | 0.0551 | 0.8377 | 1.1567 | 0.5294 | * |
| | (0,1,0) | | 69 obs. | 0.5010 | 0.3809 | 0.0492 | 0.0141 | 0.0013 | 0.9702 | | 0.5735 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.7657 | 0.6000 | 0.0795 | 0.1365 | 0.0764 | 0.7723 | 1.1647 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 0.6574 | 0.5134 | 0.0651 | 0.0245 | 0.0000 | 0.9607 | | 0.5672 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.8494 | 0.6676 | 0.0889 | 0.1709 | 0.0800 | 0.7342 | 1.1784 | 0.5303 | * |
| | (0,1,0) | | 67 obs. | 0.7208 | 0.5894 | 0.0760 | 0.0437 | 0.0024 | 0.9390 | | 0.5303 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.9134 | 0.7272 | 0.0974 | 0.2007 | 0.0816 | 0.7025 | 1.2224 | 0.5538 | * |
| | (0,1,0) | | 66 obs. | 0.7472 | 0.5708 | 0.0745 | 0.0727 | 0.0050 | 0.9071 | | 0.5077 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.9714 | 0.7898 | 0.1060 | 0.2366 | 0.0848 | 0.6632 | 1.1987 | 0.4375 | * |
| | (0,1,0) | | 65 obs. | 0.8104 | 0.6078 | 0.0808 | 0.1104 | 0.0081 | 0.8661 | | 0.5000 | * |
| | (2) | 6 | 1993:06 1998:09 | 1.0254 | 0.8345 | 0.1126 | 0.2730 | 0.0893 | 0.6221 | 1.2517 | 0.4603 | * |
| | (0,1,0) | | 64 obs. | 0.8192 | 0.6413 | 0.0872 | 0.1697 | 0.0111 | 0.8035 | | 0.4444 | -- |
| s_ursa | (2) | 1 | 1993:01 1998:09 | 0.4237 | 0.3534 | 0.0531 | 0.0103 | 0.0524 | 0.9228 | 1.0098 | 0.5588 | * |
| | (0,1,0) | | 69 obs. | 0.4196 | 0.3485 | 0.0523 | 0.0087 | 0.0068 | 0.9700 | | 0.5000 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.5113 | 0.4256 | 0.0645 | 0.0140 | 0.0942 | 0.8771 | 0.9436 | 0.6119 | * |
| | (0,1,0) | | 68 obs. | 0.5418 | 0.4373 | 0.0654 | 0.0177 | 0.0154 | 0.9522 | | 0.6418 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.5431 | 0.4428 | 0.0679 | 0.0298 | 0.1549 | 0.8004 | 0.9524 | 0.4697 | * |
| | (0,1,0) | | 67 obs. | 0.5702 | 0.4576 | 0.0694 | 0.0355 | 0.0222 | 0.9274 | | 0.4545 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.5857 | 0.4947 | 0.0758 | 0.0445 | 0.1990 | 0.7414 | 1.0013 | 0.4000 | -- |
| | (0,1,0) | | 66 obs. | 0.5849 | 0.4800 | 0.0734 | 0.0593 | 0.0299 | 0.8957 | | 0.4769 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.6453 | 0.5435 | 0.0838 | 0.0603 | 0.2178 | 0.7064 | 1.0049 | 0.5469 | * |
| | (0,1,0) | | 65 obs. | 0.6421 | 0.5297 | 0.0808 | 0.0840 | 0.0263 | 0.8743 | | 0.5781 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.6909 | 0.5821 | 0.0902 | 0.0735 | 0.2362 | 0.6747 | 1.0136 | 0.5079 | * |
| | (0,1,0) | | 64 obs. | 0.6816 | 0.5571 | 0.0849 | 0.1045 | 0.0253 | 0.8546 | | 0.5079 | * |

**Table 5. Evaluation of the forecasting performance of the rolling-windows-based invariant VAR models in simulated real time. (cont.)**

| Variable | VAR ARIMA | Forecast Horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias Proportion | Variance Proportion | Covariance Proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c) Unemployment rates (Continued) | | | | | | | | | | | | |
| a_ursa | (2) | 1 | 1993:01 1998:09 | 0.3572 | 0.2929 | 0.0403 | 0.0050 | 0.0165 | 0.9640 | 1.0163 | 0.5882 | * |
| | (0,1,0) | | 69 obs. | 0.3515 | 0.2765 | 0.0379 | 0.0220 | 0.0021 | 0.9614 | | 0.6029 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.4692 | 0.3904 | 0.0539 | 0.0192 | 0.0215 | 0.9446 | 1.0080 | 0.5522 | * |
| | (0,1,0) | | 68 obs. | 0.4655 | 0.3910 | 0.0529 | 0.0546 | 0.0005 | 0.9301 | | 0.5821 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.5017 | 0.4200 | 0.0587 | 0.0384 | 0.0358 | 0.9109 | 1.0812 | 0.5000 | * |
| | (0,1,0) | | 67 obs. | 0.4640 | 0.3682 | 0.0499 | 0.1321 | 0.0000 | 0.8529 | | 0.4848 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.5569 | 0.4783 | 0.0680 | 0.0608 | 0.0619 | 0.8622 | 1.1409 | 0.4154 | * |
| | (0,1,0) | | 66 obs. | 0.4882 | 0.3769 | 0.0523 | 0.2435 | 0.0010 | 0.7403 | | 0.3846 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.6302 | 0.5340 | 0.0764 | 0.0739 | 0.0883 | 0.8224 | 1.0605 | 0.5625 | * |
| | (0,1,0) | | 65 obs. | 0.5942 | 0.4656 | 0.0652 | 0.2789 | 0.0038 | 0.7019 | | 0.6562 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.6700 | 0.5869 | 0.0842 | 0.0912 | 0.0968 | 0.7964 | 1.0217 | 0.4286 | * |
| | (0,1,0) | | 64 obs. | 0.6557 | 0.5381 | 0.0749 | 0.3520 | 0.0025 | 0.6298 | | 0.4444 | * |
| b_ursa | (2) | 1 | 1993:01 1998:09 | 0.4825 | 0.3922 | 0.0425 | 0.1016 | 0.0139 | 0.8701 | 1.0096 | 0.5294 | * |
| | (0,1,0) | | 69 obs. | 0.4779 | 0.3691 | 0.0402 | 0.0021 | 0.0001 | 0.9834 | | 0.6176 | * |
| | (2) | 2 | 1993:02 1998:09 | 0.5807 | 0.4660 | 0.0507 | 0.1713 | 0.0065 | 0.8075 | 1.0808 | 0.4776 | * |
| | (0,1,0) | | 68 obs. | 0.5373 | 0.4239 | 0.0465 | 0.0051 | 0.0001 | 0.9802 | | 0.4030 | * |
| | (2) | 3 | 1993:03 1998:09 | 0.6863 | 0.5610 | 0.0608 | 0.2233 | 0.0018 | 0.7600 | 1.0829 | 0.6212 | * |
| | (0,1,0) | | 67 obs. | 0.6338 | 0.4985 | 0.0547 | 0.0060 | 0.0000 | 0.9790 | | 0.5606 | * |
| | (2) | 4 | 1993:04 1998:09 | 0.7408 | 0.6069 | 0.0657 | 0.2895 | 0.0004 | 0.6949 | 1.1585 | 0.4615 | -- |
| | (0,1,0) | | 66 obs. | 0.6395 | 0.5323 | 0.0585 | 0.0065 | 0.0000 | 0.9783 | | 0.4615 | * |
| | (2) | 5 | 1993:05 1998:09 | 0.7984 | 0.6420 | 0.0694 | 0.3263 | 0.0001 | 0.6582 | 1.2073 | 0.5312 | * |
| | (0,1,0) | | 65 obs. | 0.6613 | 0.5109 | 0.0559 | 0.0074 | 0.0003 | 0.9769 | | 0.4688 | * |
| | (2) | 6 | 1993:06 1998:09 | 0.8453 | 0.6753 | 0.0735 | 0.3377 | 0.0056 | 0.6411 | 1.2869 | 0.4444 | *** |
| | (0,1,0) | | 64 obs. | 0.6568 | 0.5016 | 0.0553 | 0.0153 | 0.0069 | 0.9621 | | 0.5397 | * |

**Table 6.1 Bivariate analysis of the information content of various indicators for: c_empsa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | c_hwi | 1 to 1 | 35.0096 | 9.9938 | 0.0000 |
| 2 | lcan_ind | 1 to 1 | 36.9953 | 10.1041 | 0.0004 |
| 3 | lusa_ind | 1 to 1 | 37.3494 | 10.1232 | 0.0028 |
| 4 | c_empsa | 1 to 2 | 37.1110 | 10.1326 | 0.0021 |
| 5 | nondur_ratioc | 4 to 4 | 37.9940 | 10.1574 | 0.1138 |
| 6 | durgood_ratioc | 4 to 4 | 38.0356 | 10.1596 | 0.1482 |
| 7 | yldslope | 1 to 1 | 38.0683 | 10.1613 | 0.1836 |
| 8 | total_ratioc | 4 to 4 | 38.1457 | 10.1654 | 0.3158 |
| 9 | trade_ratioc | 4 to 4 | 38.1555 | 10.1659 | 0.3401 |
| 10 | finance_ratioc | 4 to 4 | 38.1851 | 10.1674 | 0.4313 |
| 11 | bncycle | 3 to 3 | 38.2078 | 10.1686 | 0.5288 |
| 12 | services_ratioc | 4 to 4 | 38.2182 | 10.1691 | 0.5872 |
| 13 | publicad_ratioc | 4 to 4 | 38.2183 | 10.1692 | 0.5882 |
| 14 | dlny | 3 to 3 | 38.2377 | 10.1702 | 0.7480 |
| 15 | stspcycle | 3 to 3 | 38.2400 | 10.1703 | 0.7762 |
| 16 | mining_ratioc | 4 to 4 | 38.2428 | 10.1704 | 0.8186 |
| 17 | construc_ratioc | 4 to 4 | 38.2433 | 10.1705 | 0.8269 |
| 18 | transpo_ratioc | 4 to 4 | 38.2466 | 10.1706 | 0.9004 |

**Table 6.2 Bivariate analysis of the information content of various indicators for: nf_empsa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | nf_empsa | 1 to 1 | 3.0802 | 5.1325 | 0.0049 |
| 2 | dlny | 3 to 3 | 3.1232 | 5.1603 | 0.0991 |
| 3 | bncycle | 3 to 3 | 3.1272 | 5.1628 | 0.1346 |
| 4 | yldslope | 1 to 1 | 3.1331 | 5.1666 | 0.2150 |
| 5 | construc_ratioc | 4 to 4 | 3.1355 | 5.1681 | 0.2638 |
| 6 | lcan_ind | 1 to 1 | 3.1362 | 5.1686 | 0.2806 |
| 7 | stspcycle | 3 to 3 | 3.1384 | 5.1700 | 0.3424 |
| 8 | finance_ratioc | 4 to 4 | 3.1384 | 5.1700 | 0.3425 |
| 9 | nf_hwi | 1 to 1 | 3.1397 | 5.1708 | 0.3879 |
| 10 | mining_ratioc | 4 to 4 | 3.1407 | 5.1714 | 0.4292 |
| 11 | services_ratioc | 4 to 4 | 3.1424 | 5.1725 | 0.5137 |
| 12 | lusa_ind | 1 to 1 | 3.1426 | 5.1726 | 0.5252 |
| 13 | durgood_ratioc | 4 to 4 | 3.1434 | 5.1731 | 0.5792 |
| 14 | transpo_ratioc | 4 to 4 | 3.1451 | 5.1742 | 0.7504 |
| 15 | publicad_ratioc | 4 to 4 | 3.1453 | 5.1744 | 0.7825 |
| 16 | total_ratioc | 4 to 4 | 3.1458 | 5.1747 | 0.9067 |
| 17 | trade_ratioc | 4 to 4 | 3.1459 | 5.1747 | 0.9497 |
| 18 | nondur_ratioc | 4 to 4 | 3.1460 | 5.1748 | 0.9952 |

**Table 6.3 Bivariate analysis of the information content of various indicators for: ns_empsa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | lusa_ind | 1 to 1 | 3.0363 | 5.1038 | 0.0273 |
| 2 | lcan_ind | 1 to 1 | 3.0389 | 5.1055 | 0.0329 |
| 3 | yldslope | 1 to 1 | 3.0543 | 5.1156 | 0.1033 |
| 4 | ns_empsa | 1 to 1 | 3.058 | 5.1181 | 0.1382 |
| 5 | ns_hwi | 1 to 1 | 3.0598 | 5.1193 | 0.1598 |
| 6 | bncycle | 3 to 3 | 3.0603 | 5.1196 | 0.1659 |
| 7 | construc_ratioc | 4 to 4 | 3.0656 | 5.1230 | 0.2606 |
| 8 | nondur_ratioc | 4 to 4 | 3.0663 | 5.1235 | 0.276 |
| 9 | durgood_ratioc | 4 to 4 | 3.0667 | 5.1237 | 0.2853 |
| 10 | finance_ratioc | 4 to 4 | 3.068 | 5.1246 | 0.3229 |
| 11 | total_ratioc | 4 to 4 | 3.0716 | 5.1269 | 0.4608 |
| 12 | stspcycle | 3 to 3 | 3.072 | 5.1272 | 0.4846 |
| 13 | dlny | 3 to 3 | 3.0724 | 5.1274 | 0.5058 |
| 14 | services_ratioc | 4 to 4 | 3.0736 | 5.1282 | 0.587 |
| 15 | publicad_ratioc | 4 to 4 | 3.0750 | 5.1291 | 0.7216 |
| 16 | transpo_ratioc | 4 to 4 | 3.0751 | 5.1292 | 0.7327 |
| 17 | mining_ratioc | 4 to 4 | 3.0759 | 5.1297 | 0.9009 |
| 18 | trade_ratioc | 4 to 4 | 3.0759 | 5.1297 | 0.9192 |

**Table 6.4 Bivariate analysis of the information content of various indicators for: nb_empsa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | nb_empsa | 1 to 1 | 2.6925 | 4.8635 | 0.0002 |
| 2 | nb_hwi | 1 to 1 | 2.7724 | 4.9219 | 0.0775 |
| 3 | construc_ratioc | 4 to 4 | 2.7771 | 4.9253 | 0.1154 |
| 4 | total_ratioc | 4 to 4 | 2.7859 | 4.9317 | 0.2561 |
| 5 | publicad_ratioc | 4 to 4 | 2.7877 | 4.9329 | 0.3052 |
| 6 | yldslope | 1 to 1 | 2.7879 | 4.9331 | 0.3128 |
| 7 | lusa_ind | 1 to 1 | 2.7897 | 4.9344 | 0.3776 |
| 8 | lcan_ind | 1 to 1 | 2.7928 | 4.9366 | 0.5456 |
| 9 | stspcycle | 3 to 3 | 2.7928 | 4.9366 | 0.5476 |
| 10 | finance_ratioc | 4 to 4 | 2.7934 | 4.9371 | 0.5969 |
| 11 | trade_ratioc | 4 to 4 | 2.7937 | 4.9373 | 0.623 |
| 12 | services_ratioc | 4 to 4 | 2.7941 | 4.9375 | 0.6599 |
| 13 | bncycle | 3 to 3 | 2.7947 | 4.9380 | 0.7463 |
| 14 | mining_ratioc | 4 to 4 | 2.7951 | 4.9383 | 0.8182 |
| 15 | transpo_ratioc | 4 to 4 | 2.7954 | 4.9384 | 0.8883 |
| 16 | dlny | 3 to 3 | 2.7954 | 4.9385 | 0.9077 |
| 17 | durgood_ratioc | 4 to 4 | 2.7955 | 4.9385 | 0.9779 |
| 18 | nondur_ratioc | 4 to 4 | 2.7955 | 4.9386 | 0.9992 |

**Table 6.5 Bivariate analysis of the information content of various indicators for: p_empsa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | p_empsa | 1 to 1 | 0.7763 | 2.7610 | 0.0008 |
| 2 | bncycle | 3 to 3 | 0.7875 | 2.4047 | 0.0152 |
| 3 | nondur_ratioc | 4 to 4 | 0.7934 | 2.4196 | 0.0779 |
| 4 | lusa_ind | 1 to 1 | 0.7971 | 2.4289 | 0.245 |
| 5 | durgood_ratioc | 4 to 4 | 0.7972 | 2.4292 | 0.2552 |
| 6 | trade_ratioc | 4 to 4 | 0.7974 | 2.4297 | 0.2731 |
| 7 | publicad_ratioc | 4 to 4 | 0.7982 | 2.4316 | 0.359 |
| 8 | dlny | 3 to 3 | 0.7989 | 2.4335 | 0.4817 |
| 9 | lcan_ind | 1 to 1 | 0.7991 | 2.4340 | 0.5247 |
| 10 | p_hwi | 1 to 2 | 0.7902 | 2.4340 | 0.0618 |
| 11 | stspcycle | 3 to 3 | 0.7994 | 2.4347 | 0.604 |
| 12 | transpo_ratioc | 4 to 4 | 0.7994 | 2.4347 | 0.6052 |
| 13 | construc_ratioc | 4 to 4 | 0.7994 | 2.4348 | 0.6144 |
| 14 | finance_ratioc | 4 to 4 | 0.7994 | 2.4348 | 0.6173 |
| 15 | services_ratioc | 4 to 4 | 0.7997 | 2.4355 | 0.7248 |
| 16 | yldslope | 1 to 1 | 0.7997 | 2.4355 | 0.7281 |
| 17 | mining_ratioc | 4 to 4 | 0.7999 | 2.4361 | 0.9162 |
| 18 | total_ratioc | 4 to 4 | 0.8000 | 2.4361 | 0.9534 |

**Table 6.6 Bivariate analysis of the information content of various indicators for: q_empsa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | q-empsa | 1 to 1 | 17.1043 | 8.5612 | 0.0000 |
| 2 | q_hwi | 1 to 1 | 17.8916 | 8.6512 | 0.0223 |
| 3 | lcan_ind | 1 to 1 | 17.9811 | 8.6612 | 0.0672 |
| 4 | stspcycle | 3 to 3 | 18.0199 | 8.6655 | 0.1108 |
| 5 | lusa_ind | 1 to 1 | 18.0329 | 8.6669 | 0.1317 |
| 6 | yldslope | 1 to 1 | 18.0513 | 8.6690 | 0.1693 |
| 7 | durgood_ratioc | 4 to 4 | 18.1073 | 8.6752 | 0.3933 |
| 8 | dlny | 3 to 3 | 18.1083 | 8.6753 | 0.4002 |
| 9 | nondur_ratioc | 4 to 4 | 18.1184 | 8.6764 | 0.4801 |
| 10 | services_ratioc | 4 to 4 | 18.1238 | 8.6770 | 0.5342 |
| 11 | mining_ratioc | 4 to 4 | 18.1295 | 8.6776 | 0.6045 |
| 12 | trade_ratioc | 4 to 4 | 18.1304 | 8.6777 | 0.6176 |
| 13 | finance_ratioc | 4 to 4 | 18.1336 | 8.6781 | 0.6684 |
| 14 | total_ratioc | 4 to 4 | 18.1350 | 8.6782 | 0.6942 |
| 15 | construc_ratioc | 4 to 4 | 18.1386 | 8.6786 | 0.7763 |
| 16 | transpo_ratioc | 4 to 4 | 18.1397 | 8.6787 | 0.8118 |
| 17 | bncycle | 3 to 3 | 18.1405 | 8.6788 | 0.8421 |
| 18 | publicad_ratioc | 4 to 4 | 18.1416 | 8.6789 | 0.8946 |

**Table 6.7 Bivariate analysis of the information content of various indicators for: o_empsa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | o_hwi | 1 to 1 | 21.2790 | 8.9980 | 0.0000 |
| 2 | lusa_ind | 1 to 1 | 22.1538 | 9.0785 | 0.0003 |
| 3 | lcan_ind | 1 to 1 | 22.2779 | 9.0897 | 0.0008 |
| 4 | o_empsa | 1 to 2 | 22.4032 | 9.1232 | 0.0067 |
| 5 | durgood_ratioc | 4 to 4 | 22.768 | 9.1332 | 0.0838 |
| 6 | yldslope | 1 to 1 | 22.8094 | 9.1369 | 0.1286 |
| 7 | trade_ratioc | 4 to 4 | 22.8196 | 9.1378 | 0.1434 |
| 8 | nondur_ratioc | 4 to 4 | 22.8518 | 9.1406 | 0.2041 |
| 9 | total_ratioc | 4 to 4 | 22.8649 | 9.1417 | 0.2372 |
| 10 | bncycle | 3 to 3 | 22.8745 | 9.1426 | 0.2655 |
| 11 | stspcycle | 3 to 3 | 22.9003 | 9.1448 | 0.3663 |
| 12 | mining_ratioc | 4 to 4 | 22.9166 | 9.1463 | 0.4584 |
| 13 | construc_ratioc | 4 to 4 | 22.9170 | 9.1463 | 0.4612 |
| 14 | dlny | 3 to 3 | 22.9331 | 9.1477 | 0.5970 |
| 15 | transpo_ratioc | 4 to 4 | 22.9345 | 9.1478 | 0.6123 |
| 16 | finance_ratioc | 4 to 4 | 22.9347 | 9.1478 | 0.6137 |
| 17 | services_ratioc | 4 to 4 | 22.9361 | 9.1480 | 0.6310 |
| 18 | publicad_ratioc | 4 to 4 | 22.9440 | 9.1486 | 0.7487 |

**Table 6.8 Bivariate analysis of the information content of various indsicators for: m_empsa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | m_empsa | 1 to 1 | 3.9031 | 5.6061 | 0.0045 |
| 2 | lcan_ind | 1 to 1 | 3.957 | 5.6335 | 0.0875 |
| 3 | nondur_ratioc | 4 to 5 | 3.9193 | 5.6366 | 0.0236 |
| 4 | lusa_ind | 1 to 1 | 3.9668 | 5.6384 | 0.1575 |
| 5 | transpo_ratioc | 4 to 4 | 3.9685 | 5.6393 | 0.176 |
| 6 | publicad_ratioc | 4 to 4 | 3.9735 | 5.6418 | 0.2429 |
| 7 | finance_ratioc | 4 to 4 | 3.9789 | 5.6445 | 0.3551 |
| 8 | dlny | 3 to 3 | 3.981 | 5.6456 | 0.4192 |
| 9 | stspcycle | 3 to 3 | 3.9817 | 5.6460 | 0.4431 |
| 10 | bncycle | 3 to 3 | 3.9828 | 5.6465 | 0.4844 |
| 11 | services_ratioc | 4 to 4 | 3.9832 | 5.6467 | 0.5038 |
| 12 | yldslope | 1 to 1 | 3.9842 | 5.6472 | 0.5525 |
| 13 | m_hwi | 1 to 1 | 3.9844 | 5.6473 | 0.562 |
| 14 | total_ratioc | 4 to 4 | 3.9852 | 5.6477 | 0.6127 |
| 15 | mining_ratioc | 4 to 4 | 3.986 | 5.6481 | 0.6686 |
| 16 | durgood_ratioc | 4 to 4 | 3.9868 | 5.6485 | 0.7431 |
| 17 | construc_ratioc | 4 to 4 | 3.9873 | 5.6487 | 0.7987 |
| 18 | trade_ratioc | 4 to 4 | 3.9873 | 5.6488 | 0.8028 |

**Table 6.9 Bivariate analysis of the information content of various indicators for: s_empsa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | s_empsa | 1 to 1 | 2.7955 | 4.9386 | 0.0092 |
| 2 | total_ratioc | 4 to 4 | 2.8214 | 4.9570 | 0.0681 |
| 3 | nondur_ratioc | 4 to 4 | 2.8253 | 4.9598 | 0.0938 |
| 4 | s_hwi | 1 to 1 | 2.8313 | 4.9640 | 0.1552 |
| 5 | lcan_ind | 1 to 1 | 2.8313 | 4.9640 | 0.1560 |
| 6 | finance_ratioc | 4 to 4 | 2.8313 | 4.964 | 0.1563 |
| 7 | transpo_ratioc | 4 to 4 | 2.8315 | 4.9641 | 0.1583 |
| 8 | bncycle | 3 to 3 | 2.8318 | 4.9643 | 0.1625 |
| 9 | lusa_ind | 1 to 1 | 2.8377 | 4.9685 | 0.2801 |
| 10 | dlny | 3 to 3 | 2.8394 | 4.9697 | 0.3322 |
| 11 | yldslope | 1 to 1 | 2.8420 | 4.9715 | 0.4368 |
| 12 | durgood_ratioc | 4 to 4 | 2.8427 | 4.9720 | 0.4755 |
| 13 | publicad_ratioc | 4 to 4 | 2.8428 | 4.9721 | 0.4822 |
| 14 | stspcycle | 3 to 3 | 2.8432 | 4.9724 | 0.5074 |
| 15 | construc_ratioc | 4 to 4 | 2.8440 | 4.9729 | 0.5597 |
| 16 | trade_ratioc | 4 to 4 | 2.8444 | 4.9732 | 0.5931 |
| 17 | services_ratioc | 4 to 4 | 2.8464 | 4.9746 | 0.8783 |
| 18 | mining_ratioc | 4 to 4 | 2.8464 | 4.9746 | 0.8877 |

**Table 6.10 Bivariate analysis of the information content ofvarious indicators for: a_empsa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | a_hwi | 1 to 1 | 7.4671 | 6.9035 | 0.0569 |
| 2 | bncycle | 3 to 3 | 7.4872 | 6.9089 | 0.1059 |
| 3 | trade_ratioc | 4 to 4 | 7.4892 | 6.9095 | 0.1127 |
| 4 | lusa_ind | 1 to 1 | 7.4921 | 6.9102 | 0.1234 |
| 5 | a_empsa | 1 to 1 | 7.5004 | 6.9124 | 0.1618 |
| 6 | yldslope | 1 to 1 | 7.5066 | 6.9141 | 0.1996 |
| 7 | transpo_ratioc | 4 to 4 | 7.5205 | 6.9178 | 0.3290 |
| 8 | services_ratioc | 4 to 4 | 7.5342 | 6.9214 | 0.6042 |
| 9 | total_ratioc | 4 to 4 | 7.5354 | 6.9218 | 0.6464 |
| 10 | mining_ratioc | 4 to 4 | 7.5357 | 6.9218 | 0.6564 |
| 11 | stspcycle | 3 to 3 | 7.5366 | 6.9221 | 0.699 |
| 12 | construc_ratioc | 4 to 4 | 7.5370 | 6.9222 | 0.7164 |
| 13 | durgood_ratioc | 4 to 4 | 7.5384 | 6.9225 | 0.8038 |
| 14 | publicad_ratioc | 4 to 4 | 7.5393 | 6.9228 | 0.8977 |
| 15 | lcan_ind | 1 to 1 | 7.5395 | 6.9228 | 0.9241 |
| 16 | nondur_ratioc | 4 to 4 | 7.5395 | 6.9228 | 0.9446 |
| 17 | dlny | 3 to 3 | 7.5396 | 6.9229 | 0.9844 |
| 18 | finance_ratioc | 4 to 4 | 7.5396 | 6.9229 | 0.9923 |

**Table 6.11 Bivariate analysis of the information content of various indicators for: b_empsa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | yldslope | 1 to 1 | 10.2750 | 7.5420 | 0.0615 |
| 2 | mining_ratioc | 4 to 4 | 10.3091 | 7.5486 | 0.1332 |
| 3 | b_empsa | 1 to 1 | 10.3147 | 7.5497 | 0.1520 |
| 4 | publicad_ratioc | 4 to 4 | 10.3173 | 7.5502 | 0.1618 |
| 5 | transpo_ratioc | 4 to 4 | 10.3187 | 7.5504 | 0.1671 |
| 6 | construc_ratioc | 4 to 4 | 10.3327 | 7.5532 | 0.2369 |
| 7 | total_ratioc | 4 to 4 | 10.3363 | 7.5538 | 0.2600 |
| 8 | durgood_ratioc | 4 to 4 | 10.3405 | 7.5547 | 0.2910 |
| 9 | trade_ratioc | 4 to 4 | 10.3529 | 7.5571 | 0.4145 |
| 10 | bncycle | 3 to 3 | 10.3628 | 7.5590 | 0.5784 |
| 11 | lusa_ind | 1 to 1 | 10.3630 | 7.5590 | 0.5834 |
| 12 | nondur_ratioc | 4 to 4 | 10.3647 | 7.5593 | 0.6236 |
| 13 | finance_ratioc | 4 to 4 | 10.3647 | 7.5593 | 0.625 |
| 14 | b_hwi | 1 to 1 | 10.3657 | 7.5595 | 0.6531 |
| 15 | dlny | 3 to 3 | 10.3704 | 7.5604 | 0.8553 |
| 16 | stspcycle | 3 to 3 | 10.3704 | 7.5604 | 0.8567 |
| 17 | lcan_ind | 1 to 1 | 10.3712 | 7.5606 | 0.9452 |
| 18 | services_ratioc | 4 to 4 | 10.3713 | 7.5606 | 0.9625 |

**Table 6.12 Bivariate analysis of the information content of various indicators for: c_ersa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | c_hwi | 1 to 1 | 0.1739 | -0.6160 | 0.0000 |
| 2 | lcan_ind | 1 to 1 | 0.1848 | -0.4944 | 0.0002 |
| 3 | lusa_ind | 1 to 1 | 0.1862 | -0.4791 | 0.0009 |
| 4 | c_ersa | 1 to 3 | 0.1827 | -0.4733 | 0.0001 |
| 5 | nondur_ratioc | 4 to 4 | 0.1907 | -0.4312 | 0.1441 |
| 6 | durgood_ratioc | 4 to 4 | 0.1908 | -0.4303 | 0.1598 |
| 7 | total_ratioc | 4 to 4 | 0.1913 | -0.4252 | 0.3144 |
| 8 | bncycle | 3 to 3 | 0.1914 | -0.4241 | 0.3690 |
| 9 | trade_ratioc | 4 to 4 | 0.1915 | -0.4234 | 0.4103 |
| 10 | finance_ratioc | 4 to 4 | 0.1915 | -0.4234 | 0.4110 |
| 11 | yldslope | 1 to 1 | 0.1915 | -0.4233 | 0.4150 |
| 12 | services_ratioc | 4 to 4 | 0.1917 | -0.4215 | 0.5705 |
| 13 | publicad_ratioc | 4 to 4 | 0.1917 | -0.4214 | 0.5779 |
| 14 | mining_ratioc | 4 to 4 | 0.1918 | -0.4203 | 0.7551 |
| 15 | construc_ratioc | 4 to 4 | 0.1918 | -0.4201 | 0.8188 |
| 16 | stspcycle | 3 to 3 | 0.1918 | -0.4200 | 0.8377 |
| 17 | dlny | 3 to 3 | 0.1918 | -0.4198 | 0.9765 |
| 18 | transpo_ratioc | 4 to 4 | 0.1918 | -0.4198 | 0.9935 |

**Table 6.13 Bivariate analysis of the information content of various indicators for: nf_ersa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | nf_ersa | 1 to 1 | 0.7026 | 2.1767 | 0.0035 |
| 2 | dlny | 3 to 3 | 0.7129 | 2.2058 | 0.0790 |
| 3 | bncycle | 3 to 3 | 0.7134 | 2.2071 | 0.0918 |
| 4 | yldslope | 1 to 1 | 0.7159 | 2.2140 | 0.2132 |
| 5 | construc_ratioc | 4 to 4 | 0.716 | 2.2144 | 0.2257 |
| 6 | lcan_ind | 1 to 1 | 0.7166 | 2.2160 | 0.2799 |
| 7 | stspcycle | 3 to 3 | 0.7168 | 2.2165 | 0.3007 |
| 8 | finance_ratioc | 4 to 4 | 0.7169 | 2.2170 | 0.3227 |
| 9 | nf_hwi | 1 to 1 | 0.7172 | 2.2177 | 0.3544 |
| 10 | mining_ratioc | 4 to 4 | 0.7177 | 2.2191 | 0.4407 |
| 11 | durgood_ratioc | 4 to 4 | 0.7182 | 2.2204 | 0.5622 |
| 12 | services_ratioc | 4 to 4 | 0.7183 | 2.2208 | 0.6044 |
| 13 | lusa_ind | 1 to 1 | 0.7183 | 2.2209 | 0.6142 |
| 14 | transpo_ratioc | 4 to 4 | 0.7187 | 2.2218 | 0.7887 |
| 15 | publicad_ratioc | 4 to 4 | 0.7188 | 2.2221 | 0.8765 |
| 16 | nondur_ratioc | 4 to 4 | 0.7188 | 2.2222 | 0.9253 |
| 17 | total_ratioc | 4 to 4 | 0.7188 | 2.2222 | 0.9828 |
| 18 | trade_ratioc | 4 to 4 | 0.7188 | 2.2222 | 0.9917 |

**Table 6.14 Bivariate analysis of the information content of various indicators for: ns_ersa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | lusa_ind | 1 to 1 | 0.4289 | 1.1895 | 0.0279 |
| 2 | lcan_ind | 1 to 1 | 0.4293 | 1.1914 | 0.0341 |
| 3 | yldslope | 1 to 1 | 0.4312 | 1.2001 | 0.0913 |
| 4 | bncycle | 3 to 3 | 0.4317 | 1.2027 | 0.1240 |
| 5 | ns_hwi | 1 to 1 | 0.4321 | 1.2042 | 0.1488 |
| 6 | ns_ersa | 1 to 1 | 0.4325 | 1.2063 | 0.1931 |
| 7 | construc_ratioc | 4 to 4 | 0.4329 | 1.2078 | 0.2360 |
| 8 | nondur_ratioc | 4 to 4 | 0.4329 | 1.2082 | 0.2497 |
| 9 | durgood_ratioc | 4 to 4 | 0.4331 | 1.2089 | 0.2752 |
| 10 | finance_ratioc | 4 to 4 | 0.4334 | 1.2103 | 0.3340 |
| 11 | total_ratioc | 4 to 4 | 0.4338 | 1.2121 | 0.4405 |
| 12 | stspcycle | 3 to 3 | 0.4341 | 1.2135 | 0.5585 |
| 13 | services_ratioc | 4 to 4 | 0.4342 | 1.2138 | 0.6016 |
| 14 | publicad_ratioc | 4 to 4 | 0.4343 | 1.2143 | 0.6653 |
| 15 | dlny | 3 to 3 | 0.4343 | 1.2144 | 0.6854 |
| 16 | transpo_ratioc | 4 to 4 | 0.4343 | 1.2145 | 0.7034 |
| 17 | mining_ratioc | 4 to 4 | 0.4344 | 1.2149 | 0.7992 |
| 18 | trade_ratioc | 4 to 4 | 0.4345 | 1.2152 | 0.9112 |

**Table 6.15 Bivariate analysis of the information content of various indicators for: nb_ersa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | nb_ersa | 1 to 1 | 0.4669 | 1.3592 | 0.0003 |
| 2 | nb_hwi | 1 to 1 | 0.4791 | 1.4107 | 0.0554 |
| 3 | construc_ratioc | 4 to 4 | 0.4807 | 1.4176 | 0.1220 |
| 4 | total_ratioc | 4 to 4 | 0.4821 | 1.4235 | 0.2570 |
| 5 | yldslope | 1 to 1 | 0.4823 | 1.4242 | 0.2834 |
| 6 | publicad_ratioc | 4 to 4 | 0.4826 | 1.4252 | 0.3276 |
| 7 | lusa_ind | 1 to 1 | 0.4830 | 1.4270 | 0.4333 |
| 8 | lcan_ind | 1 to 1 | 0.4833 | 1.4282 | 0.5318 |
| 9 | stspcycle | 3 to 3 | 0.4833 | 1.4285 | 0.5573 |
| 10 | services_ratioc | 4 to 4 | 0.4834 | 1.4288 | 0.5949 |
| 11 | trade_ratioc | 4 to 4 | 0.4835 | 1.4289 | 0.6086 |
| 12 | finance_ratioc | 4 to 4 | 0.4835 | 1.4290 | 0.6126 |
| 13 | mining_ratioc | 4 to 4 | 0.4837 | 1.4301 | 0.8570 |
| 14 | durgood_ratioc | 4 to 4 | 0.4838 | 1.4302 | 0.8814 |
| 15 | dlny | 3 to 3 | 0.4838 | 1.4302 | 0.8869 |
| 16 | transpo_ratioc | 4 to 4 | 0.4838 | 1.4302 | 0.8894 |
| 17 | bncycle | 3 to 3 | 0.4838 | 1.4303 | 0.9589 |
| 18 | nondur_ratioc | 4 to 4 | 0.4838 | 1.4303 | 0.9914 |

**Table 6.16 Bivariate analysis of the information content of various indicators for: p_ersa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | p_ersa | 1 to 1 | 0.7853 | 2.3992 | 0.0003 |
| 2 | bncycle | 3 to 3 | 0.8001 | 2.4364 | 0.0148 |
| 3 | nondur_ratioc | 4 to 4 | 0.8063 | 2.4519 | 0.0818 |
| 4 | p_hwi | 1 to 2 | 0.7989 | 2.4558 | 0.0241 |
| 5 | durgood_ratioc | 4 to 4 | 0.8098 | 2.4606 | 0.2385 |
| 6 | lusa_ind | 1 to 1 | 0.8103 | 2.4619 | 0.2835 |
| 7 | trade_ratioc | 4 to 4 | 0.8112 | 2.4640 | 0.3844 |
| 8 | publicad_ratioc | 4 to 4 | 0.8117 | 2.4654 | 0.4789 |
| 9 | finance_ratioc | 4 to 4 | 0.812 | 2.4661 | 0.5484 |
| 10 | dlny | 3 to 3 | 0.812 | 2.4661 | 0.5489 |
| 11 | lcan_ind | 1 to 1 | 0.8123 | 2.4667 | 0.6191 |
| 12 | construc_ratioc | 4 to 4 | 0.8124 | 2.4670 | 0.6613 |
| 13 | transpo_ratioc | 4 to 4 | 0.8124 | 2.4670 | 0.6617 |
| 14 | stspcycle | 3 to 3 | 0.8124 | 2.4670 | 0.6663 |
| 15 | services_ratioc | 4 to 4 | 0.8126 | 2.4675 | 0.7562 |
| 16 | mining_ratioc | 4 to 4 | 0.8128 | 2.4679 | 0.8762 |
| 17 | yldslope | 1 to 1 | 0.8128 | 2.4679 | 0.8800 |
| 18 | total_ratioc | 4 to 4 | 0.8128 | 2.4680 | 0.9152 |

**Table 6.17 Bivariate analysis of the information content of various indicators for: q_ersa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | q_ersa | 1 to 1 | 0.3155 | 0.5754 | 0.0000 |
| 2 | q_hwi | 1 to 1 | 0.3293 | 0.661 | 0.0101 |
| 3 | lcan_ind | 1 to 1 | 0.3313 | 0.6734 | 0.0383 |
| 4 | stspcycle | 3 to 3 | 0.3323 | 0.6794 | 0.0754 |
| 5 | lusa_ind | 1 to 1 | 0.3324 | 0.6795 | 0.0760 |
| 6 | yldslope | 1 to 1 | 0.3340 | 0.6893 | 0.2542 |
| 7 | dlny | 3 to 3 | 0.3342 | 0.6902 | 0.2872 |
| 8 | durgood_ratioc | 4 to 4 | 0.3343 | 0.6912 | 0.3291 |
| 9 | nondur_ratioc | 4 to 4 | 0.3347 | 0.6932 | 0.4519 |
| 10 | services_ratioc | 4 to 4 | 0.3347 | 0.6936 | 0.4785 |
| 11 | mining_ratioc | 4 to 4 | 0.3349 | 0.6945 | 0.5647 |
| 12 | bncycle | 3 to 3 | 0.3349 | 0.6946 | 0.5781 |
| 13 | trade_ratioc | 4 to 4 | 0.3349 | 0.6948 | 0.5999 |
| 14 | finance_ratioc | 4 to 4 | 0.3349 | 0.6948 | 0.6084 |
| 15 | total_ratioc | 4 to 4 | 0.3350 | 0.695 | 0.6349 |
| 16 | transpo_ratioc | 4 to 4 | 0.3351 | 0.696 | 0.8265 |
| 17 | publicad_ratioc | 4 to 4 | 0.3351 | 0.6961 | 0.8698 |
| 18 | construc_ratioc | 4 to 4 | 0.3351 | 0.6961 | 0.8880 |

**Table 6.18 Bivariate analysis of the information content of various indicators for: o_ersa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | o_hwi | 1 to 1 | 0.2703 | 0.2664 | 0.0000 |
| 2 | lusa_ind | 1 to 1 | 0.2811 | 0.3445 | 0.0001 |
| 3 | lcan_ind | 1 to 1 | 0.2825 | 0.3546 | 0.0003 |
| 4 | o_ersa | 1 to 2 | 0.2858 | 0.3997 | 0.0076 |
| 5 | durgood_ratioc | 4 to 4 | 0.2905 | 0.4106 | 0.1090 |
| 6 | trade_ratioc | 4 to 4 | 0.2909 | 0.4130 | 0.1468 |
| 7 | nondur_ratioc | 4 to 4 | 0.2912 | 0.4147 | 0.1814 |
| 8 | total_ratioc | 4 to 4 | 0.2912 | 0.4153 | 0.1945 |
| 9 | yldslope | 1 to 1 | 0.2913 | 0.4156 | 0.2016 |
| 10 | bncycle | 3 to 3 | 0.2917 | 0.4187 | 0.3075 |
| 11 | stspcycle | 3 to 3 | 0.2918 | 0.4190 | 0.3214 |
| 12 | mining_ratioc | 4 to 4 | 0.2918 | 0.4194 | 0.3411 |
| 13 | construc_ratioc | 4 to 4 | 0.2920 | 0.4203 | 0.3915 |
| 14 | finance_ratioc | 4 to 4 | 0.2922 | 0.4221 | 0.5287 |
| 15 | services_ratioc | 4 to 4 | 0.2923 | 0.4228 | 0.6052 |
| 16 | transpo_ratioc | 4 to 4 | 0.2924 | 0.4231 | 0.6358 |
| 17 | dlny | 3 to 3 | 0.2924 | 0.4232 | 0.6537 |
| 18 | publicad_ratioc | 4 to 4 | 0.2924 | 0.4233 | 0.6667 |

**Table 6.19 Bivariate analysis of the information content of various indicators for: m_ersa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | m_ersa | 1 to 1 | 0.4684 | 1.3658 | 0.0040 |
| 2 | lcan_ind | 1 to 1 | 0.4758 | 1.3969 | 0.1183 |
| 3 | nondur_ratioc | 4 to 5 | 0.4708 | 1.3983 | 0.0256 |
| 4 | transpo_ratioc | 4 to 4 | 0.4763 | 1.3993 | 0.1584 |
| 5 | lusa_ind | 1 to 1 | 0.4768 | 1.4013 | 0.2031 |
| 6 | finance_ratioc | 4 to 4 | 0.4776 | 1.4044 | 0.3069 |
| 7 | publicad_ratioc | 4 to 4 | 0.4776 | 1.4047 | 0.3224 |
| 8 | bncycle | 3 to 3 | 0.4779 | 1.4056 | 0.3700 |
| 9 | dlny | 3 to 3 | 0.4782 | 1.4072 | 0.4767 |
| 10 | stspcycle | 3 to 3 | 0.4783 | 1.4074 | 0.4924 |
| 11 | yldslope | 1 to 1 | 0.4784 | 1.408 | 0.5497 |
| 12 | total_ratioc | 4 to 4 | 0.4784 | 1.4081 | 0.5582 |
| 13 | mining_ratioc | 4 to 4 | 0.4785 | 1.4084 | 0.5955 |
| 14 | services_ratioc | 4 to 4 | 0.4785 | 1.4084 | 0.5967 |
| 15 | m_hwi | 1 to 1 | 0.4787 | 1.4091 | 0.6999 |
| 16 | trade_ratioc | 4 to 4 | 0.4787 | 1.4093 | 0.7362 |
| 17 | durgood_ratioc | 4 to 4 | 0.4788 | 1.4094 | 0.7530 |
| 18 | construc_ratioc | 4 to 4 | 0.4788 | 1.4094 | 0.7613 |

**Table 6.20 Bivariate analysis of the information content of various indicators for: s_ersa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | s_ersa | 1 to 1 | 0.3760 | 0.9259 | 0.0077 |
| 2 | total_ratioc | 4 to 4 | 0.3806 | 0.9504 | 0.1131 |
| 3 | nondur_ratioc | 4 to 4 | 0.3808 | 0.9518 | 0.1332 |
| 4 | transpo_ratioc | 4 to 4 | 0.3815 | 0.9554 | 0.2090 |
| 5 | finance_ratioc | 4 to 4 | 0.3817 | 0.9562 | 0.2337 |
| 6 | s_hwi | 1 to 1 | 0.3819 | 0.9573 | 0.2691 |
| 7 | bncycle | 3 to 3 | 0.3819 | 0.9575 | 0.2782 |
| 8 | dlny | 3 to 3 | 0.3820 | 0.9576 | 0.2827 |
| 9 | yldslope | 1 to 1 | 0.3825 | 0.9604 | 0.4265 |
| 10 | lcan_ind | 1 to 1 | 0.3825 | 0.9607 | 0.4446 |
| 11 | publicad_ratioc | 4 to 4 | 0.3827 | 0.9617 | 0.5355 |
| 12 | lusa_ind | 1 to 1 | 0.3828 | 0.9618 | 0.5403 |
| 13 | stspcycle | 3 to 3 | 0.3828 | 0.9620 | 0.5618 |
| 14 | durgood_ratioc | 4 to 4 | 0.3830 | 0.9630 | 0.6915 |
| 15 | construc_ratioc | 4 to 4 | 0.3831 | 0.9634 | 0.7918 |
| 16 | mining_ratioc | 4 to 4 | 0.3831 | 0.9636 | 0.8617 |
| 17 | trade_ratioc | 4 to 4 | 0.3831 | 0.9636 | 0.8669 |
| 18 | services_ratioc | 4 to 4 | 0.3831 | 0.9637 | 0.9183 |

**Table 6.21 Bivariate analysis of the information content of various indicators for: a_ersa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | a_hwi | 1 to 1 | 0.3854 | 0.9758 | 0.0262 |
| 2 | trade_ratioc | 4 to 4 | 0.3874 | 0.9857 | 0.0785 |
| 3 | bncycle | 3 to 3 | 0.3880 | 0.9891 | 0.1179 |
| 4 | transpo_ratioc | 4 to 4 | 0.3887 | 0.9928 | 0.1844 |
| 5 | a_ersa | 1 to 1 | 0.3887 | 0.9928 | 0.1854 |
| 6 | yldslope | 1 to 1 | 0.3889 | 0.9935 | 0.2021 |
| 7 | lusa_ind | 1 to 1 | 0.3900 | 0.9992 | 0.4542 |
| 8 | durgood_ratioc | 4 to 4 | 0.3902 | 1.0005 | 0.5697 |
| 9 | stspcycle | 3 to 3 | 0.3902 | 1.0005 | 0.5796 |
| 10 | services_ratioc | 4 to 4 | 0.3902 | 1.0006 | 0.5815 |
| 11 | total_ratioc | 4 to 4 | 0.3903 | 1.0008 | 0.6165 |
| 12 | nondur_ratioc | 4 to 6 | 0.3817 | 1.0009 | 0.0144 |
| 13 | lcan_ind | 1 to 1 | 0.3903 | 1.0010 | 0.6357 |
| 14 | mining_ratioc | 4 to 4 | 0.3903 | 1.0011 | 0.6505 |
| 15 | construc_ratioc | 4 to 4 | 0.3904 | 1.0014 | 0.7045 |
| 16 | finance_ratioc | 4 to 4 | 0.3905 | 1.0019 | 0.8197 |
| 17 | dlny | 3 to 3 | 0.3905 | 1.0019 | 0.8310 |
| 18 | publicad_ratioc | 4 to 4 | 0.3905 | 1.0021 | 0.9133 |

**Table 6.22 Bivariate analysis of the information content of various indicators for: b_ersa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | yldslope | 1 to 1 | 0.3991 | 1.0456 | 0.0484 |
| 2 | publicad_ratioc | 4 to 4 | 0.4013 | 1.0565 | 0.1730 |
| 3 | transpo_ratioc | 4 to 4 | 0.4015 | 1.0575 | 0.1983 |
| 4 | b_ersa | 1 to 1 | 0.4017 | 1.0584 | 0.2220 |
| 5 | mining_ratioc | 4 to 4 | 0.4018 | 1.0588 | 0.2328 |
| 6 | total_ratioc | 4 to 4 | 0.4021 | 1.0602 | 0.2826 |
| 7 | construc_ratioc | 4 to 4 | 0.4023 | 1.0614 | 0.3330 |
| 8 | trade_ratioc | 4 to 4 | 0.4023 | 1.0614 | 0.3335 |
| 9 | durgood_ratioc | 4 to 4 | 0.4024 | 1.0619 | 0.3614 |
| 10 | nondur_ratioc | 4 to 4 | 0.4029 | 1.0644 | 0.5468 |
| 11 | finance_ratioc | 4 to 4 | 0.4031 | 1.0653 | 0.6535 |
| 12 | bncycle | 3 to 3 | 0.4031 | 1.0655 | 0.6827 |
| 13 | b_hwi | 1 to 1 | 0.4031 | 1.0656 | 0.7055 |
| 14 | lcan_ind | 1 to 1 | 0.4032 | 1.0658 | 0.7351 |
| 15 | dlny | 3 to 3 | 0.4032 | 1.0661 | 0.8294 |
| 16 | lusa_ind | 1 to 1 | 0.4033 | 1.0662 | 0.8463 |
| 17 | stspcycle | 3 to 3 | 0.4033 | 1.0662 | 0.8639 |
| 18 | services_ratioc | 4 to 4 | 0.4033 | 1.0663 | 0.9264 |

**Table 6.23 Bivariate analysis of the information content of various indicators for: c_ursa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | c_hwi | 1 to 2 | 0.2051 | -0.2639 | 0.0000 |
| 2 | lcan_ind | 1 to 1 | 0.2108 | -0.2316 | 0.0001 |
| 3 | lusa_ind | 1 to 1 | 0.2158 | -0.1845 | 0.0071 |
| 4 | total_ratioc | 4 to 4 | 0.2171 | -0.1724 | 0.0254 |
| 5 | durgood_ratioc | 4 to 4 | 0.2173 | -0.1706 | 0.0311 |
| 6 | nondur_ratioc | 4 to 4 | 0.2181 | -0.1630 | 0.0726 |
| 7 | transpo_ratioc | 4 to 4 | 0.2187 | -0.1580 | 0.1297 |
| 8 | finance_ratioc | 4 to 4 | 0.2189 | -0.1553 | 0.1804 |
| 9 | trade_ratioc | 4 to 4 | 0.2191 | -0.1543 | 0.2052 |
| 10 | services_ratioc | 4 to 4 | 0.2193 | -0.1519 | 0.2856 |
| 11 | dlny | 3 to 3 | 0.2194 | -0.1516 | 0.2961 |
| 12 | construc_ratioc | 4 to 4 | 0.2195 | -0.1503 | 0.3556 |
| 13 | yldslope | 1 to 1 | 0.2195 | -0.1503 | 0.3588 |
| 14 | publicad_ratioc | 4 to 4 | 0.2199 | -0.1469 | 0.6472 |
| 15 | stspcycle | 3 to 3 | 0.2199 | -0.1468 | 0.6580 |
| 16 | mining_ratioc | 4 to 4 | 0.2199 | -0.1464 | 0.7282 |
| 17 | bncycle | 3 to 3 | 0.2199 | -0.1463 | 0.7487 |
| 18 | c_ursa | 1 to 1 | 0.2200 | -0.1462 | 0.7889 |

**Table 6.24 Bivariate analysis of the information content of various indicators for: nf_ursa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | nf_ursa | 1 to 3 | 0.9288 | 2.7794 | 0.0000 |
| 2 | dlny | 3 to 3 | 0.9831 | 2.8485 | 0.0247 |
| 3 | lcan_ind | 1 to 1 | 0.9903 | 2.8630 | 0.1275 |
| 4 | stspcycle | 3 to 3 | 0.9909 | 2.8643 | 0.1479 |
| 5 | construc_ratioc | 4 to 4 | 0.9915 | 2.8655 | 0.1730 |
| 6 | finance_ratioc | 4 to 4 | 0.9924 | 2.8674 | 0.2190 |
| 7 | mining_ratioc | 4 to 4 | 0.9935 | 2.8695 | 0.2926 |
| 8 | nf_hwi | 1 to 1 | 0.9939 | 2.8703 | 0.3275 |
| 9 | services_ratioc | 4 to 4 | 0.9942 | 2.8708 | 0.3545 |
| 10 | durgood_ratioc | 4 to 4 | 0.9951 | 2.8728 | 0.4826 |
| 11 | publicad_ratioc | 4 to 4 | 0.9951 | 2.8728 | 0.4829 |
| 12 | lusa_ind | 1 to 1 | 0.9952 | 2.8729 | 0.4923 |
| 13 | yldslope | 1 to 1 | 0.9958 | 2.8740 | 0.6108 |
| 14 | trade_ratioc | 4 to 4 | 0.9963 | 2.8750 | 0.7904 |
| 15 | total_ratioc | 4 to 4 | 0.9964 | 2.8753 | 0.8706 |
| 16 | bncycle | 3 to 3 | 0.9964 | 2.8753 | 0.8907 |
| 17 | transpo_ratioc | 4 to 4 | 0.9964 | 2.8754 | 0.9314 |
| 18 | nondur_ratioc | 4 to 4 | 0.9965 | 2.8754 | 0.9816 |

**Table 6.25 Bivariate analysis of the information content of various indicators for: ns_ursa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | ns_ursa | 1 to 1 | 0.5464 | 1.6737 | 0.0116 |
| 2 | construc_ratioc | 4 to 4 | 0.5511 | 1.6908 | 0.0761 |
| 3 | lcan_ind | 1 to 1 | 0.5512 | 1.6911 | 0.0785 |
| 4 | nondur_ratioc | 4 to 4 | 0.5524 | 1.6957 | 0.1340 |
| 5 | finance_ratioc | 4 to 4 | 0.5527 | 1.6968 | 0.1546 |
| 6 | ns_hwi | 1 to 1 | 0.5530 | 1.6978 | 0.1743 |
| 7 | durgood_ratioc | 4 to 4 | 0.5533 | 1.6988 | 0.1992 |
| 8 | total_ratioc | 4 to 4 | 0.5533 | 1.6988 | 0.1992 |
| 9 | bncycle | 3 to 3 | 0.5534 | 1.6990 | 0.2039 |
| 10 | lusa_ind | 1 to 1 | 0.5535 | 1.6994 | 0.2135 |
| 11 | publicad_ratioc | 4 to 4 | 0.5535 | 1.6995 | 0.2168 |
| 12 | yldslope | 1 to 1 | 0.5537 | 1.7003 | 0.2419 |
| 13 | dlny | 3 to 3 | 0.5548 | 1.7043 | 0.4277 |
| 14 | mining_ratioc | 4 to 4 | 0.5551 | 1.7055 | 0.5235 |
| 15 | stspcycle | 3 to 3 | 0.5555 | 1.7068 | 0.6918 |
| 16 | transpo_ratioc | 4 to 4 | 0.5556 | 1.7069 | 0.7204 |
| 17 | services_ratioc | 4 to 4 | 0.5557 | 1.7074 | 0.8295 |
| 18 | trade_ratioc | 4 to 4 | 0.5557 | 1.7076 | 0.9523 |

**Table 6.26 Bivariate analysis of the information content of various indicators for: nb_ursa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | nb_ursa | 1 to 1 | 0.5691 | 1.7553 | 0.0000 |
| 2 | total_ratioc | 4 to 4 | 0.6146 | 1.9090 | 0.0871 |
| 3 | trade_ratioc | 4 to 4 | 0.6149 | 1.9099 | 0.0971 |
| 4 | nondur_ratioc | 4 to 4 | 0.6170 | 1.9168 | 0.2277 |
| 5 | mining_ratioc | 4 to 4 | 0.6173 | 1.9177 | 0.2548 |
| 6 | services_ratioc | 4 to 4 | 0.6176 | 1.9186 | 0.2885 |
| 7 | transpo_ratioc | 4 to 4 | 0.6179 | 1.9197 | 0.3394 |
| 8 | publicad_ratioc | 4 to 4 | 0.6182 | 1.9207 | 0.3938 |
| 9 | nb_hwi | 1 to 1 | 0.6182 | 1.9208 | 0.3968 |
| 10 | finance_ratioc | 4 to 4 | 0.6186 | 1.9220 | 0.4834 |
| 11 | bncycle | 3 to 3 | 0.6188 | 1.9225 | 0.5262 |
| 12 | durgood_ratioc | 4 to 4 | 0.6190 | 1.9231 | 0.5966 |
| 13 | dlny | 3 to 3 | 0.6190 | 1.9231 | 0.6005 |
| 14 | yldslope | 1 to 1 | 0.6190 | 1.9231 | 0.6027 |
| 15 | construc_ratioc | 4 to 4 | 0.6192 | 1.9238 | 0.7077 |
| 16 | lusa_ind | 1 to 1 | 0.6194 | 1.9244 | 0.8392 |
| 17 | stspcycle | 3 to 3 | 0.6194 | 1.9245 | 0.8827 |
| 18 | lcan_ind | 1 to 1 | 0.6194 | 1.9246 | 0.9941 |

**Table 6.27 Bivariate analysis of the information content of various indicators for: p_ursa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | p_ursa | 1 to 2 | 0.9024 | 2.6994 | 0.0001 |
| 2 | stspcycle | 3 to 3 | 0.9287 | 2.7346 | 0.0104 |
| 3 | dlny | 3 to 3 | 0.9323 | 2.7424 | 0.0240 |
| 4 | nondur_ratioc | 4 to 4 | 0.9345 | 2.7469 | 0.0394 |
| 5 | bncycle | 3 to 3 | 0.9391 | 2.7568 | 0.1223 |
| 6 | finance_ratioc | 4 to 4 | 0.9438 | 2.7668 | 0.4691 |
| 7 | services_ratioc | 4 to 4 | 0.9440 | 2.7673 | 0.5157 |
| 8 | lusa_ind | 1 to 1 | 0.9442 | 2.7677 | 0.5537 |
| 9 | durgood_ratioc | 4 to 4 | 0.9442 | 2.7677 | 0.5565 |
| 10 | trade_ratioc | 4 to 4 | 0.9444 | 2.7681 | 0.6027 |
| 11 | publicad_ratioc | 4 to 4 | 0.9444 | 2.7682 | 0.6074 |
| 12 | yldslope | 1 to 1 | 0.9445 | 2.7683 | 0.6235 |
| 13 | lcan_ind | 1 to 1 | 0.9448 | 2.7689 | 0.7177 |
| 14 | transpo_ratioc | 4 to 4 | 0.9448 | 2.7690 | 0.7489 |
| 15 | total_ratioc | 4 to 4 | 0.9451 | 2.7695 | 0.9004 |
| 16 | p_hwi | 1 to 1 | 0.9451 | 2.7695 | 0.9329 |
| 17 | construc_ratioc | 4 to 4 | 0.9451 | 2.7696 | 0.9441 |
| 18 | mining_ratioc | 4 to 4 | 0.9451 | 2.7696 | 0.9602 |

**Table 6.28 Bivariate analysis of the information content of various indicators for: q_ursa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | q_ursa | 1 to 2 | 0.4141 | 1.1415 | 0.0000 |
| 2 | q_hwi | 1 to 1 | 0.4295 | 1.1920 | 0.0222 |
| 3 | nondur_ratioc | 4 to 4 | 0.4301 | 1.1953 | 0.0315 |
| 4 | total_ratioc | 4 to 4 | 0.4310 | 1.1991 | 0.0483 |
| 5 | transpo_ratioc | 4 to 4 | 0.4326 | 1.2066 | 0.1136 |
| 6 | durgood_ratioc | 4 to 4 | 0.4327 | 1.2069 | 0.1178 |
| 7 | lcan_ind | 1 to 1 | 0.4334 | 1.2102 | 0.1780 |
| 8 | bncycle | 3 to 3 | 0.4334 | 1.2105 | 0.1847 |
| 9 | yldslope | 1 to 1 | 0.4336 | 1.2113 | 0.2039 |
| 10 | services_ratioc | 4 to 4 | 0.4338 | 1.2122 | 0.2283 |
| 11 | publicad_ratioc | 4 to 4 | 0.4340 | 1.2131 | 0.2581 |
| 12 | trade_ratioc | 4 to 4 | 0.4343 | 1.2147 | 0.3213 |
| 13 | lusa_ind | 1 to 1 | 0.4348 | 1.2170 | 0.4595 |
| 14 | stspcycle | 3 to 3 | 0.4349 | 1.2171 | 0.4653 |
| 15 | finance_ratioc | 4 to 4 | 0.4349 | 1.2171 | 0.4677 |
| 16 | mining_ratioc | 4 to 4 | 0.4353 | 1.2190 | 0.6720 |
| 17 | construc_ratioc | 4 to 4 | 0.4354 | 1.2196 | 0.8120 |
| 18 | dlny | 3 to 3 | 0.4354 | 1.2197 | 0.8360 |

**Table 6.29 Bivariate analysis of the information content of various indicators for: o_ursa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | lcan_ind | 1 to 1 | 0.2876 | 0.3899 | 0.0000 |
| 2 | o_hwi | 1 to 2 | 0.2846 | 0.3916 | 0.0000 |
| 3 | lusa_ind | 1 to 1 | 0.2926 | 0.4248 | 0.0001 |
| 4 | durgood_ratioc | 4 to 4 | 0.3015 | 0.4849 | 0.0427 |
| 5 | total_ratioc | 4 to 4 | 0.3021 | 0.4884 | 0.0637 |
| 6 | yldslope | 1 to 1 | 0.3026 | 0.4915 | 0.0911 |
| 7 | bncycle | 3 to 3 | 0.3035 | 0.4979 | 0.1980 |
| 8 | finance_ratioc | 4 to 4 | 0.3036 | 0.4988 | 0.2209 |
| 9 | nondur_ratioc | 4 to 4 | 0.3037 | 0.4990 | 0.2295 |
| 10 | o_ursa | 1 to 2 | 0.3004 | 0.4997 | 0.0390 |
| 11 | services_ratioc | 4 to 4 | 0.3041 | 0.5016 | 0.3240 |
| 12 | stspcycle | 3 to 3 | 0.3042 | 0.5021 | 0.3505 |
| 13 | transpo_ratioc | 4 to 4 | 0.3044 | 0.5035 | 0.4342 |
| 14 | trade_ratioc | 4 to 4 | 0.3044 | 0.5040 | 0.4716 |
| 15 | construc_ratioc | 4 to 4 | 0.3047 | 0.5056 | 0.6442 |
| 16 | mining_ratioc | 4 to 4 | 0.3048 | 0.5060 | 0.7144 |
| 17 | publicad_ratioc | 4 to 4 | 0.3048 | 0.5063 | 0.7777 |
| 18 | dlny | 3 to 3 | 0.3049 | 0.5067 | 0.9100 |

**Table 6.30 Bivariate analysis of the information content of various indicators for: m_ursa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | m_ursa | 1 to 3 | 0.4973 | 1.5301 | 0.0000 |
| 2 | lusa_ind | 1 to 1 | 0.5247 | 1.5926 | 0.1134 |
| 3 | lcan_ind | 1 to 1 | 0.5248 | 1.5932 | 0.1217 |
| 4 | durgood_ratioc | 4 to 4 | 0.5260 | 1.5975 | 0.2054 |
| 5 | nondur_ratioc | 4 to 4 | 0.5263 | 1.5988 | 0.2442 |
| 6 | m_hwi | 1 to 1 | 0.5265 | 1.5995 | 0.2696 |
| 7 | finance_ratioc | 4 to 4 | 0.5269 | 1.6011 | 0.3355 |
| 8 | yldslope | 1 to 1 | 0.5271 | 1.6017 | 0.3673 |
| 9 | publicad_ratioc | 4 to 4 | 0.5272 | 1.6022 | 0.3950 |
| 10 | services_ratioc | 4 to 4 | 0.5276 | 1.6036 | 0.5022 |
| 11 | stspcycle | 3 to 3 | 0.5276 | 1.6038 | 0.5155 |
| 12 | mining_ratioc | 4 to 4 | 0.5280 | 1.6053 | 0.7222 |
| 13 | transpo_ratioc | 4 to 4 | 0.5281 | 1.6056 | 0.7928 |
| 14 | trade_ratioc | 4 to 4 | 0.5282 | 1.6058 | 0.8585 |
| 15 | construc_ratioc | 4 to 4 | 0.5282 | 1.6060 | 0.9133 |
| 16 | total_ratioc | 4 to 4 | 0.5282 | 1.6060 | 0.9170 |
| 17 | bncycle | 3 to 3 | 0.5282 | 1.6060 | 0.9826 |
| 18 | dlny | 3 to 3 | 0.5282 | 1.6060 | 0.9971 |

**Table 6.31 Bivariate analysis of the information content of various indicators for: s_ursa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | s_ursa | 1 to 2 | 0.3594 | 0.8579 | 0.0000 |
| 2 | bncycle | 3 to 3 | 0.3829 | 0.9624 | 0.1152 |
| 3 | s_hwi | 1 to 1 | 0.3831 | 0.9635 | 0.1319 |
| 4 | finance_ratioc | 4 to 4 | 0.3848 | 0.9725 | 0.4416 |
| 5 | dlny | 3 to 3 | 0.3849 | 0.9731 | 0.4874 |
| 6 | yldslope | 1 to 1 | 0.3849 | 0.9732 | 0.4987 |
| 7 | lcan_ind | 1 to 1 | 0.3850 | 0.9736 | 0.5368 |
| 8 | total_ratioc | 4 to 4 | 0.3850 | 0.9736 | 0.5414 |
| 9 | nondur_ratioc | 4 to 4 | 0.3850 | 0.9737 | 0.5481 |
| 10 | services_ratioc | 4 to 4 | 0.3850 | 0.9737 | 0.5522 |
| 11 | transpo_ratioc | 4 to 4 | 0.3851 | 0.9742 | 0.6077 |
| 12 | construc_ratioc | 4 to 4 | 0.3852 | 0.9745 | 0.6426 |
| 13 | publicad_ratioc | 4 to 4 | 0.3853 | 0.9749 | 0.7154 |
| 14 | lusa_ind | 1 to 1 | 0.3853 | 0.9751 | 0.7611 |
| 15 | mining_ratioc | 4 to 4 | 0.3853 | 0.9753 | 0.7895 |
| 16 | stspcycle | 3 to 3 | 0.3854 | 0.9755 | 0.8647 |
| 17 | trade_ratioc | 4 to 4 | 0.3854 | 0.9756 | 0.9116 |
| 18 | durgood_ratioc | 4 to 4 | 0.3854 | 0.9756 | 0.9801 |

**Table 6.32 Bivariate analysis of the information content of various indicators for: a_ursa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | a_ursa | 1 to 2 | 0.3725 | 0.9296 | 0.0006 |
| 2 | a_hwi | 1 to 1 | 0.3770 | 0.9316 | 0.0024 |
| 3 | transpo_ratioc | 4 to 4 | 0.3824 | 0.9598 | 0.0473 |
| 4 | bncycle | 3 to 3 | 0.3828 | 0.9621 | 0.0613 |
| 5 | trade_ratioc | 4 to 4 | 0.3836 | 0.9663 | 0.0994 |
| 6 | nondur_ratioc | 4 to 5 | 0.3802 | 0.9709 | 0.0301 |
| 7 | lcan_ind | 1 to 1 | 0.3851 | 0.9741 | 0.2619 |
| 8 | finance_ratioc | 4 to 4 | 0.3857 | 0.9771 | 0.4051 |
| 9 | durgood_ratioc | 4 to 4 | 0.3859 | 0.9781 | 0.4799 |
| 10 | services_ratioc | 4 to 4 | 0.3860 | 0.9787 | 0.5351 |
| 11 | total_ratioc | 4 to 4 | 0.3860 | 0.9788 | 0.5382 |
| 12 | stspcycle | 3 to 3 | 0.3860 | 0.9789 | 0.5536 |
| 13 | lusa_ind | 1 to 1 | 0.3861 | 0.9790 | 0.5581 |
| 14 | construc_ratioc | 4 to 4 | 0.3862 | 0.9796 | 0.6425 |
| 15 | yldslope | 1 to 1 | 0.3862 | 0.9798 | 0.6627 |
| 16 | publicad_ratioc | 4 to 4 | 0.3864 | 0.9807 | 0.8898 |
| 17 | mining_ratioc | 4 to 4 | 0.3864 | 0.9807 | 0.8911 |
| 18 | dlny | 3 to 3 | 0.3864 | 0.9808 | 0.9937 |

**Table 6.33 Bivariate analysis of the information content of various indicators for: b_ursa. Sample: 1983.01 1998.10 Difference/Difference**

| | Indicator | # of lags | S.E. | SC | F-test sign. |
|---|---|---|---|---|---|
| 1 | b_ursa | 1 to 1 | 0.4575 | 1.3187 | 0.0000 |
| 2 | dlny | 3 to 3 | 0.4753 | 1.3950 | 0.0689 |
| 3 | b_hwi | 1 to 1 | 0.4781 | 1.4069 | 0.2982 |
| 4 | lcan_ind | 1 to 1 | 0.4783 | 1.4074 | 0.3224 |
| 5 | stspcycle | 3 to 3 | 0.4783 | 1.4077 | 0.3356 |
| 6 | yldslope | 1 to 1 | 0.4785 | 1.4083 | 0.3698 |
| 7 | construc_ratioc | 4 to 4 | 0.4786 | 1.4090 | 0.4059 |
| 8 | bncycle | 3 to 3 | 0.4791 | 1.4108 | 0.5606 |
| 9 | trade_ratioc | 4 to 4 | 0.4792 | 1.4114 | 0.6239 |
| 10 | transpo_ratioc | 4 to 4 | 0.4793 | 1.4117 | 0.6693 |
| 11 | durgood_ratioc | 4 to 4 | 0.4793 | 1.4119 | 0.7020 |
| 12 | services_ratioc | 4 to 4 | 0.4793 | 1.4119 | 0.7038 |
| 13 | publicad_ratioc | 4 to 4 | 0.4794 | 1.4122 | 0.7663 |
| 14 | nondur_ratioc | 4 to 4 | 0.4794 | 1.4122 | 0.7777 |
| 15 | mining_ratioc | 4 to 4 | 0.4795 | 1.4126 | 0.9044 |
| 16 | total_ratioc | 4 to 4 | 0.4795 | 1.4126 | 0.9161 |
| 17 | finance_ratioc | 4 to 4 | 0.4795 | 1.4126 | 0.9841 |
| 18 | lusa_ind | 1 to 1 | 0.4795 | 1.4126 | 0.9907 |

**Table 7.1 Selected specifications of the indicators models for the employment levels in Canada and its provinces. Sample: 1983.01 1992.12 Models in first differences.**

| Variable | Rbar2 (dif./lev.) | Regressors with information content up to lag ... | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| c_empsa | 0.3390 | C_EMPSA | 8 | C_HWI | 12 | | | | |
| | 0.9979 | 0.0086 | | 0.0001 | | | | | |
| nf_empsa | 0.0501 | NF_EMPSA | 2 | | | | | | |
| | 0.9320 | 0.0165 | | | | | | | |
| ns_empsa | 0.0000 | Nothing significant | | | | | | | |
| | 0.9785 | | | | | | | | |
| nb_empsa | 0.0938 | NB_EMPSA | 2 | | | | | | |
| | 0.9847 | 0.001 | | | | | | | |
| p_empsa | 0.3615 | P_EMPSA | 12 | BNCYCLE | 8 | P_HWI | 7 | NONDUR _RATIOC | 10 |
| | 0.9037 | 0.0001 | | 0.0002 | | 0.0029 | | 0.0002 | |
| q_empsa | 0.4166 | Q_EMPSA | 12 | Q_HWI | 12 | LCAN_IND | 12 | | |
| | 0.9920 | 0.0000 | | 0.0002 | | 0.0006 | | | |
| o_empsa | 0.2765 | O_EMPSA | 12 | O_HWI | 12 | | | | |
| | 0.9962 | 0.044 | | 0.0014 | | | | | |
| m_empsa | 0.0470 | M_EMPSA | 12 | | | | | | |
| | 0.9345 | 0.1005 | | | | | | | |
| s_empsa | 0.0305 | S_EMPSA | 2 | | | | | | |
| | 0.8857 | 0.0566 | | | | | | | |
| a_empsa | 0.0000 | Nothing significant | | | | | | | |
| | 0.9828 | | | | | | | | |
| b_empsa | 0.0000 | Nothing significant | | | | | | | |
| | 0.9942 | | | | | | | | |

**Table 7.2 Selected specifications of the indicators models for the employment rates in Canada and its provinces.
Sample: 1983.01 1992.12 Models in first differences.**

| Variable | Rbar2 (dif./lev.) | Regressors with information content up to lag ... | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| c_ersa | 0.4198 | C_ERSA | 10 | C_HWI | 12 | LCAN_IND | 12 | LUSA_IND | 12 | | |
| | 0.9920 | 0.0000 | | 0.0000 | | 0.0004 | | 0.0137 | | | |
| nf_ersa | 0.0755 | NF_ERSA | 12 | | | | | | | | |
| | 0.8737 | 0.0355 | | | | | | | | | |
| ns_ersa | 0.000 | Nothing significant | | | | | | | | | |
| | 0.9457 | | | | | | | | | | |
| nb_ersa | 0.0853 | NB_ERSA | 2 | | | | | | | | |
| | 0.9593 | 0.0017 | | | | | | | | | |
| p_ersa | 0.3513 | P_ERSA | 12 | BNCYCLE | 8 | P_HWI | 7 | NONDUR _RATIOC | 10 | | |
| | 0.7619 | 0.0001 | | 0.0003 | | 0.002 | | 0.0005 | | | |
| q_ersa | 0.4512 | Q_ERSA | 12 | STSPCYCLE | 12 | Q_HWI | 11 | LCAN_IND | 12 | LUSA_IND | 12 |
| | 0.9822 | 0 | | 0.0005 | | 0.0002 | | 0.0009 | | 0.0027 | |
| o_ersa | 0.2348 | O_ERSA | 12 | O_HWI | 12 | | | | | | |
| | 0.9857 | 0.0786 | | 0.0001 | | | | | | | |
| m_ersa | 0.1138 | M_ERSA | 12 | NONDUR _RATIOC | 5 | | | | | | |
| | 0.8292 | 0.023 | | 0.0208 | | | | | | | |
| s_ersa | 0.0644 | S_ERSA | 12 | | | | | | | | |
| | 0.756 | 0.0544 | | | | | | | | | |
| a_ersa | 0.2516 | NONDUR _RATIOC | 12 | TRADE _RATIOC | 11 | | | | | | |
| | 0.9256 | 0.0015 | | 0.0002 | | | | | | | |
| b_ersa | 0.0000 | Nothing significant | | | | | | | | | |
| | 0.9663 | | | | | | | | | | |

**Table 7.3 Selected specifications of the indicators models for the unemployment rates in Canada and its provinces.
Sample: 1983.01 1992.12 Models in first differences.**

| Variable | Rbar2 (dif./lev.) | Regressors with information content up to lag... | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c_ursa | 0.4039 | C_HWI | 5 | LUSA_IND | 11 | TOTAL _RATIOC | 12 | DURGOOD _RATIOC | 9 | | | | |
| | 0.9894 | 0.0000 | | 0.0188 | | 0.0027 | | 0.0000 | | | | | |
| nf_ursa | 0.1651 | NF_URSA | 12 | | | | | | | | | | |
| | 0.7645 | 0.0006 | | | | | | | | | | | |
| ns_ursa | 0.0000 | Nothing significant | | | | | | | | | | | |
| | 0.8599 | | | | | | | | | | | | |
| nb_ursa | 0.2706 | NB_URSA | 5 | | | | | | | | | | |
| | 0.8277 | 0.0000 | | | | | | | | | | | |
| p_ursa | 0.2229 | P_URSA | 12 | NONDUR _RATIOC | 8 | | | | | | | | |
| | 0.8154 | 0.0001 | | 0.0101 | | | | | | | | | |
| q_ursa | 0.4798 | Q_URSA | 10 | Q_HWI | 12 | TOTAL _RATIOC | 12 | NONDUR _RATIOC | 12 | | | | |
| | 0.9627 | 0.0000 | | 0.0000 | | 0.0000 | | 0.0000 | | | | | |
| o_ursa | 0.3349 | O_URSA | 12 | O_HWI | 7 | LCAN_IND | 12 | DURGOOD _RATIOC | 7 | | | | |
| | 0.9859 | 0.0097 | | 0.0268 | | 0.0505 | | 0.0314 | | | | | |
| m_ursa | 0.1821 | M_URSA | 12 | | | | | | | | | | |
| | 0.7339 | 0.0002 | | | | | | | | | | | |
| s_ursa | 0.1925 | S_URSA | 12 | | | | | | | | | | |
| | 0.6042 | 0.0001 | | | | | | | | | | | |
| a_ursa | 0.5175 | A_URSA | 10 | BNCYCLE | 12 | | 12 | NONDUR _RATIOC | 12 | TRADE _RATIOC | 8 | TRANSPO _RATIOC | 6 |
| | 0.9622 | 0.0000 | | 0.001 | | 0.0000 | | 0.0000 | | 0.0145 | | 0.0000 | |
| b_ursa | 0.0910 | B_URSA | 12 | | | | | | | | | | |
| | 0.9574 | 0.0191 | | | | | | | | | | | |

**Table 8.1 Selected specifications of the indicators models for the employment levels in Canada and its provinces. Sample: 1989:10 1998:09 Models in first differences.**

| Variable | Rbar2 (dif./lev.) | Regressors with information content up to lag ... | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| c_empsa | 0.2275 | LCAN_IND | 10 | LUSA_IND | 12 | | | | |
| | 0.9944 | 0.0013 | | 0.0042 | | | | | |
| nf_empsa | 0.0941 | NF_EMPSA | 12 | | | | | | |
| | 0.7594 | 0.0237 | | | | | | | |
| ns_empsa | 0.0000 | Nothing significant | | | | | | | |
| | 0.9109 | | | | | | | | |
| nb_empsa | 0.1195 | NB_EMPSA | 12 | | | | | | |
| | 0.8669 | 0.0088 | | | | | | | |
| p_empsa | 0.1977 | P_EMPSA | 12 | BNCYCLE | 11 | P_HWI | 12 | NONDUR _RATIOC | 12 |
| | 0.9434 | 0.0006 | | 0.0012 | | 0.0312 | | 0.0293 | |
| q_empsa | 0.2442 | Q_EMPSA | 12 | Q_HWI | 9 | LCAN_IND | 10 | | |
| | 0.9593 | 0.0001 | | 0.0329 | | 0.0467 | | | |
| o_empsa | 0.0949 | LUSA_IND | 11 | | | | | | |
| | 0.9848 | 0.0072 | | | | | | | |
| m_empsa | 0.2077 | M_EMPSA | 12 | LCAN_IND | 12 | | | | |
| | 0.9317 | 0.0009 | | 0.0027 | | | | | |
| s_empsa | 0.0000 | Nothing significant | | | | | | | |
| | 0.9044 | | | | | | | | |
| a_empsa | 0.0601 | A_HWI | 7 | | | | | | |
| | 0.991 | 0.0512 | | | | | | | |
| b_empsa | 0.0000 | Nothing significant | | | | | | | |
| | 0.9899 | | | | | | | | |

**Table 8.2 Selected specifications of the indicators models for the employment rates in Canada and its provinces. Sample: 1989:10 1998:09 Models in first differences.**

| Variable | Rbar2 (dif./lev.) | Regressors with information content up to lag ... | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| c_ersa | 0.2425 | LCAN_IND | 10 | LUSA_IND | 12 | | | | |
| | 0.9853 | 0.0012 | | 0.0017 | | | | | |
| nf_ersa | 0.0841 | NF_ERSA | 12 | | | | | | |
| | 0.8566 | 0.0339 | | | | | | | |
| ns_ersa | 0.0000 | Nothing significant | | | | | | | |
| | 0.9130 | | | | | | | | |
| nb_ersa | 0.1050 | NB_ERSA | 12 | | | | | | |
| | 0.6051 | 0.0157 | | | | | | | |
| p_ersa | 0.2637 | P_ERSA | 12 | BNCYCLE | 11 | P_HWI | 9 | NONDUR _RATIOC | 12 |
| | 0.7929 | 0.0000 | | 0.0019 | | 0.0144 | | 0.0257 | |
| q_ersa | 0.2524 | Q_ERSA | 10 | Q_HWI | 12 | LCAN_IND | 10 | | |
| | 0.9500 | 0.0003 | | 0.0087 | | 0.0493 | | | |
| o_ersa | 0.1665 | O_ERSA | 12 | LUSA_IND | 12 | | | | |
| | 0.9850 | 0.0633 | | 0.0036 | | | | | |
| m_ersa | 0.0847 | M_ERSA | 12 | | | | | | |
| | 0.8241 | 0.0332 | | | | | | | |
| s_ersa | 0.0000 | Nothing significant | | | | | | | |
| | 0.7473 | | | | | | | | |
| a_ersa | 0.0771 | A_HWI | 4 | TRADE _RATIOC | 12 | | | | |
| | 0.9121 | 0.0174 | | 0.0832 | | | | | |
| b_ersa | 0.0000 | Nothing significant | | | | | | | |
| | 0.7752 | | | | | | | | |

**Table 8.3 Selected specifications of the indicators models for the unemployment rates in Canada and its provinces. Sample: 1989:10 1998:09 Models in first differences.**

| Variable | Rbar2 (dif./lev.) | Regressors with information content up to lag ... | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c_ursa | 0.3361 | C_HWI | 3 | LCAN_IND | 10 | LUSA_IND | 12 | TOTAL _RATIOC | 7 | DURGOOD _RATIOC | 12 | NONDUR _RATIOC | 11 |
| | 0.9720 | 0.0003 | | 0.0023 | | 0.0001 | | 0.0038 | | 0.075 | | 0.0073 | |
| nf_ursa | 0.0998 | NF_URSA | 4 | | | | | | | | | | |
| | 0.6418 | 0.0038 | | | | | | | | | | | |
| ns_ursa | 0.0575 | NS_URSA | 12 | | | | | | | | | | |
| | 0.8601 | 0.036 | | | | | | | | | | | |
| nb_ursa | 0.2744 | NB_URSA | 12 | TOTAL _RATIOC | 12 | | | | | | | | |
| | 0.5838 | 0.005 | | 0.0001 | | | | | | | | | |
| p_ursa | 0.2572 | P_URSA | 12 | NONDUR _RATIOC | 12 | | | | | | | | |
| | 0.795 | 0.0001 | | 0.0019 | | | | | | | | | |
| q_ursa | 0.2038 | Q_URSA | 10 | TOTAL _RATIOC | 12 | | | | | | | | |
| | 0.8571 | 0.0001 | | 0.0178 | | | | | | | | | |
| o_ursa | 0.4897 | O_URSA | 12 | O_HWI | 12 | YLDSLOPE | 12 | LUSA_IND | 12 | TOTAL _RATIOC | 10 | DURGOOD _RATIOC | 11 |
| | 0.9786 | 0.0000 | | 0 | | 0.0006 | | 0.0000 | | 0.000 | | 0.0000 | |
| m_ursa | 0.2142 | M_URSA | 12 | | | | | | | | | | |
| | 0.8741 | 0.0001 | | | | | | | | | | | |
| s_ursa | 0.1309 | S_URSA | 12 | | | | | | | | | | |
| | 0.8191 | 0.0055 | | | | | | | | | | | |
| a_ursa | 0.3394 | A_URSA | 3 | BNCYCLE | 11 | A_HWI | 3 | NONDUR _RATIOC | 11 | TRADE _RATIOC | 12 | TRANSPO _RATIOC | 6 |
| | 0.9586 | 0.0000 | | 0.0006 | | 0.0000 | | 0.0053 | | 0.0092 | | 0.0279 | |
| b_ursa | 0.1365 | B_URSA | 12 | | | | | | | | | | |
| | 0.7397 | 0.0044 | | | | | | | | | | | |

**Table 9. Evaluation of the forecasting performance of the rolling-windows-based adaptive ARX models in simulated real time.**

| Variable | ARX ARIMA | Forecast Horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias Proportion | Variance Proportion | Covariance Proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a) Employment levels | | | | | | | | | | | | |
| c_empsa | -- | 1 | 1993:01 1998:09 | 42.6496 | 33.1473 | 0.0024 | 0.0036 | 0.0001 | 0.9818 | 1.0328 | 0.5441 | * |
| | (0,1,0) | | 69 obs. | 41.2947 | 34.0353 | 0.0025 | 0.2639 | 0.0087 | 0.7129 | | 0.5000 | * |
| | -- | 2 | 1993:02 1998:09 | 55.0230 | 44.0425 | 0.0032 | 0.0069 | 0.0059 | 0.9725 | 0.9158 | 0.4179 | * |
| | (0,1,0) | | 68 obs. | 60.0804 | 49.0119 | 0.0036 | 0.4808 | 0.0115 | 0.4930 | | 0.4478 | * |
| | -- | 3 | 1993:03 1998:09 | 61.3873 | 50.4657 | 0.0037 | 0.0068 | 0.0162 | 0.9620 | 0.7638 | 0.4394 | * |
| | (0,1,0) | | 67 obs. | 80.3747 | 66.9348 | 0.0049 | 0.5979 | 0.0105 | 0.3766 | | 0.3939 | -- |
| | -- | 4 | 1993:04 1998:09 | 67.0541 | 56.0544 | 0.0041 | 0.0079 | 0.0295 | 0.9474 | 0.6637 | 0.4615 | * |
| | (0,1,0) | | 66 obs. | 101.0302 | 86.2523 | 0.0063 | 0.6638 | 0.0105 | 0.3105 | | 0.3692 | -- |
| | -- | 5 | 1993:05 1998:09 | 73.5708 | 61.7226 | 0.0045 | 0.0047 | 0.0309 | 0.9490 | 0.5979 | 0.4688 | * |
| | (0,1,0) | | 65 obs. | 123.0509 | 107.2453 | 0.0078 | 0.7128 | 0.0119 | 0.2599 | | 0.4531 | * |
| | -- | 6 | 1993:06 1998:09 | 77.0154 | 61.6109 | 0.0045 | 0.0008 | 0.0314 | 0.9522 | 0.5303 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 145.2371 | 128.0508 | 0.0094 | 0.7526 | 0.0145 | 0.2173 | | 0.4286 | * |
| nf_empsa | -- | 1 | 1993:01 1998:09 | 3.0985 | 2.3859 | 0.0123 | 0.0007 | 0.0000 | 0.9847 | 1.0172 | 0.4559 | -- |
| | (0,1,0) | | 69 obs. | 3.0462 | 2.3382 | 0.0121 | 0.0000 | 0.0000 | 0.9855 | | 0.5735 | * |
| | -- | 2 | 1993:02 1998:09 | 4.3905 | 3.6213 | 0.0187 | 0.0007 | 0.0069 | 0.9776 | 1.142 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 3.8447 | 3.0970 | 0.016 | 0.0000 | 0.0000 | 0.9853 | | 0.4925 | * |
| | -- | 3 | 1993:03 1998:09 | 4.9436 | 4.1415 | 0.0213 | 0.0000 | 0.0157 | 0.9694 | 1.1796 | 0.4697 | * |
| | (0,1,0) | | 67 obs. | 4.1909 | 3.5076 | 0.0181 | 0.0008 | 0.0000 | 0.9842 | | 0.5758 | * |
| | -- | 4 | 1993:04 1998:09 | 5.4311 | 4.5188 | 0.0233 | 0.0005 | 0.0119 | 0.9724 | 1.2311 | 0.5692 | * |
| | (0,1,0) | | 66 obs. | 4.4115 | 3.6662 | 0.0189 | 0.0036 | 0.0008 | 0.9805 | | 0.5077 | * |
| | -- | 5 | 1993:05 1998:09 | 5.7839 | 4.7601 | 0.0245 | 0.0013 | 0.0141 | 0.9692 | 1.2538 | 0.4844 | * |
| | (0,1,0) | | 65 obs. | 4.6129 | 3.9078 | 0.0201 | 0.0071 | 0.0017 | 0.9758 | | 0.4844 | * |
| | -- | 6 | 1993:06 1998:09 | 5.9393 | 4.9269 | 0.0254 | 0.0017 | 0.0164 | 0.9662 | 1.2311 | 0.5079 | * |
| | (0,1,0) | | 64 obs. | 4.8243 | 4.2222 | 0.0217 | 0.0091 | 0.0025 | 0.9728 | | 0.4921 | * |
| ns_empsa | -- | 1 | 1993:01 1998:09 | 3.1699 | 2.4609 | 0.0064 | 0.0038 | 0.0000 | 0.9817 | 0.9922 | 0.5588 | * |
| | (0,1,0) | | 69 obs. | 3.1947 | 2.4926 | 0.0065 | 0.0234 | 0.0002 | 0.9619 | | 0.5735 | * |
| | -- | 2 | 1993:02 1998:09 | 4.1761 | 3.3033 | 0.0086 | 0.0093 | 0.0001 | 0.9759 | 0.9832 | 0.5075 | * |
| | (0,1,0) | | 68 obs. | 4.2475 | 3.3343 | 0.0087 | 0.0548 | 0.0000 | 0.9305 | | 0.4925 | * |
| | -- | 3 | 1993:03 1998:09 | 5.1817 | 3.9617 | 0.0103 | 0.0125 | 0.0005 | 0.9721 | 0.9769 | 0.5455 | * |
| | (0,1,0) | | 67 obs. | 5.3041 | 4.0242 | 0.0104 | 0.0770 | 0.0001 | 0.9080 | | 0.5606 | * |
| | -- | 4 | 1993:04 1998:09 | 5.6472 | 4.406 | 0.0114 | 0.0217 | 0.0011 | 0.9620 | 0.9624 | 0.4462 | -- |
| | (0,1,0) | | 66 obs. | 5.8675 | 4.5631 | 0.0118 | 0.1194 | 0.0004 | 0.8651 | | 0.4154 | -- |
| | -- | 5 | 1993:05 1998:09 | 6.2595 | 4.9103 | 0.0127 | 0.0378 | 0.003 | 0.9438 | 0.9455 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 6.6202 | 5.1562 | 0.0133 | 0.1680 | 0.0014 | 0.8151 | | 0.5156 | * |
| | -- | 6 | 1993:06 1998:09 | 6.6537 | 5.3516 | 0.0138 | 0.0566 | 0.0055 | 0.9223 | 0.9254 | 0.5556 | * |
| | (0,1,0) | | 64 obs. | 7.1898 | 5.6619 | 0.0146 | 0.2214 | 0.0028 | 0.7602 | | 0.5238 | * |

**Table 9. Evaluation of the forecasting performance of the rolling-windows-based adaptive ARX models in simulated real time. (cont.)**

| Variable | ARX ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a) Employment levels (Continued) | | | | | | | | | | | | |
| nb_empsa | -- | 1 | 1993:01 1998:09 | 3.4536 | 2.7721 | 0.0089 | 0.0002 | 0.0037 | 0.9815 | 1.0224 | 0.5294 | * |
| | (0,1,0) | | 69 obs. | 3.3780 | 2.7603 | 0.0089 | 0.0080 | 0.0006 | 0.9769 | | 0.5294 | * |
| | -- | 2 | 1993:02 1998:09 | 4.6477 | 3.6968 | 0.0119 | 0.0022 | 0.0018 | 0.9813 | 1.1259 | 0.5821 | * |
| | (0,1,0) | | 68 obs. | 4.1281 | 3.4866 | 0.0112 | 0.0161 | 0.0012 | 0.9680 | | 0.5970 | * |
| | -- | 3 | 1993:03 1998:09 | 5.4005 | 4.0861 | 0.0132 | 0.0089 | 0.0009 | 0.9753 | 1.2032 | 0.4091 | -- |
| | (0,1,0) | | 67 obs. | 4.4886 | 3.6000 | 0.0116 | 0.0230 | 0.0015 | 0.9605 | | 0.4091 | -- |
| | -- | 4 | 1993:04 1998:09 | 6.2996 | 4.7103 | 0.0152 | 0.0159 | 0.0014 | 0.9676 | 1.2032 | 0.4769 | * |
| | (0,1,0) | | 66 obs. | 5.2357 | 4.2277 | 0.0136 | 0.0253 | 0.0024 | 0.9571 | | 0.5538 | * |
| | -- | 5 | 1993:05 1998:09 | 7.2031 | 5.5080 | 0.0178 | 0.0252 | 0.0018 | 0.9576 | 1.2308 | 0.5312 | * |
| | (0,1,0) | | 65 obs. | 5.8526 | 4.7812 | 0.0154 | 0.0294 | 0.0039 | 0.9513 | | 0.5469 | * |
| | -- | 6 | 1993:06 1998:09 | 8.0671 | 6.1273 | 0.0198 | 0.0364 | 0.0027 | 0.9453 | 1.2520 | 0.5873 | * |
| | (0,1,0) | | 64 obs. | 6.4434 | 5.1873 | 0.0166 | 0.0354 | 0.0071 | 0.9419 | | 0.5079 | * |
| p_empsa | -- | 1 | 1993:01 1998:09 | 0.9435 | 0.7125 | 0.0122 | 0.0030 | 0.0276 | 0.9549 | 1.3025 | 0.4412 | -- |
| | (0,1,0) | | 69 obs. | 0.7244 | 0.5735 | 0.0098 | 0.0196 | 0.0024 | 0.9635 | | 0.6176 | * |
| | -- | 2 | 1993:02 1998:09 | 1.2325 | 1.0008 | 0.0171 | 0.0012 | 0.0624 | 0.9217 | 1.3097 | 0.5075 | * |
| | (0,1,0) | | 68 obs. | 0.9410 | 0.7806 | 0.0133 | 0.0382 | 0.0026 | 0.9445 | | 0.5075 | * |
| | -- | 3 | 1993:03 1998:09 | 1.5120 | 1.1649 | 0.0199 | 0.0024 | 0.0987 | 0.8840 | 1.5422 | 0.4848 | * |
| | (0,1,0) | | 67 obs. | 0.9804 | 0.8121 | 0.0139 | 0.0927 | 0.0019 | 0.8904 | | 0.3636 | -- |
| | -- | 4 | 1993:04 1998:09 | 1.8419 | 1.4912 | 0.0255 | 0.0022 | 0.1396 | 0.8431 | 1.6793 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 1.0968 | 0.8815 | 0.0150 | 0.1381 | 0.0012 | 0.8455 | | 0.5077 | * |
| | -- | 5 | 1993:05 1998:09 | 2.2112 | 1.8732 | 0.0319 | 0.0015 | 0.1911 | 0.7920 | 1.7558 | 0.5469 | * |
| | (0,1,0) | | 65 obs. | 1.2594 | 1.0109 | 0.0171 | 0.1818 | 0.0024 | 0.8005 | | 0.5312 | * |
| | -- | 6 | 1993:06 1998:09 | 2.5627 | 2.2029 | 0.0374 | 0.0022 | 0.2421 | 0.7400 | 1.9280 | 0.6349 | * |
| | (0,1,0) | | 64 obs. | 1.3292 | 1.0841 | 0.0184 | 0.2426 | 0.0071 | 0.7347 | | 0.4921 | * |
| q_empsa | -- | 1 | 1993:01 1998:09 | 17.7529 | 13.665 | 0.0043 | 0.0034 | 0.0000 | 0.9821 | 0.9960 | 0.4265 | -- |
| | (0,1,0) | | 69 obs. | 17.8245 | 13.750 | 0.0043 | 0.0431 | 0.0025 | 0.9399 | | 0.4559 | * |
| | -- | 2 | 1993:02 1998:09 | 24.6044 | 19.4548 | 0.0061 | 0.0075 | 0.0045 | 0.9733 | 1.0921 | 0.5075 | * |
| | (0,1,0) | | 68 obs. | 22.5290 | 18.3254 | 0.0057 | 0.1208 | 0.0029 | 0.8616 | | 0.5373 | * |
| | -- | 3 | 1993:03 1998:09 | 26.8014 | 21.1479 | 0.0066 | 0.0085 | 0.0191 | 0.9576 | 1.0814 | 0.3939 | -- |
| | (0,1,0) | | 67 obs. | 24.7848 | 20.3303 | 0.0063 | 0.2224 | 0.0005 | 0.7621 | | 0.4848 | * |
| | -- | 4 | 1993:04 1998:09 | 29.0973 | 22.5883 | 0.0071 | 0.0163 | 0.0279 | 0.9406 | 1.0822 | 0.4000 | -- |
| | (0,1,0) | | 66 obs. | 26.8868 | 22.3677 | 0.0070 | 0.3203 | 0.0001 | 0.6644 | | 0.4154 | -- |
| | -- | 5 | 1993:05 1998:09 | 34.3329 | 26.7593 | 0.0083 | 0.0235 | 0.0289 | 0.9322 | 1.0883 | 0.4688 | -- |
| | (0,1,0) | | 65 obs. | 31.5485 | 26.7125 | 0.0083 | 0.3592 | 0.0007 | 0.6247 | | 0.4688 | * |
| | -- | 6 | 1993:06 1998:09 | 37.7235 | 30.1502 | 0.0094 | 0.0336 | 0.0259 | 0.9249 | 1.0324 | 0.3810 | -- |
| | (0,1,0) | | 64 obs. | 36.5392 | 31.4016 | 0.0098 | 0.3919 | 0.0007 | 0.5918 | | 0.5397 | * |

**Table 9. Evaluation of the forecasting performance of the rolling-windows-based adaptive ARX models in simulated real time. (cont.)**

| Variable | ARX ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a) Employment levels (Continued) | | | | | | | | | | | | |
| o_empsa | -- | 1 | 1993:01 1998:09 | 26.2804 | 22.0382 | 0.0042 | 0.0111 | 0.0044 | 0.9700 | 1.1085 | 0.4559 | * |
| | (0,1,0) | | 69 obs. | 23.7088 | 19.4956 | 0.0037 | 0.1389 | 0.0131 | 0.8335 | | 0.4118 | * |
| | -- | 2 | 1993:02 1998:09 | 33.8226 | 28.2174 | 0.0053 | 0.0295 | 0.0136 | 0.9422 | 1.0303 | 0.5224 | * |
| | (0,1,0) | | 68 obs. | 32.8268 | 27.7493 | 0.0052 | 0.2450 | 0.0221 | 0.7181 | | 0.4328 | * |
| | -- | 3 | 1993:03 1998:09 | 45.1296 | 34.0711 | 0.0064 | 0.0352 | 0.0151 | 0.9348 | 1.0622 | 0.5000 | * |
| | (0,1,0) | | 67 obs. | 42.4881 | 34.5136 | 0.0065 | 0.3221 | 0.0339 | 0.6290 | | 0.4242 | * |
| | -- | 4 | 1993:04 1998:09 | 56.9188 | 41.2119 | 0.0078 | 0.0433 | 0.0160 | 0.9255 | 1.1105 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 51.2541 | 41.9708 | 0.0079 | 0.3878 | 0.0513 | 0.5457 | | 0.4000 | * |
| | -- | 5 | 1993:05 1998:09 | 62.6183 | 44.7004 | 0.0085 | 0.0605 | 0.0114 | 0.9128 | 1.0360 | 0.4531 | -- |
| | (0,1,0) | | 65 obs. | 60.4421 | 48.8922 | 0.0092 | 0.4486 | 0.0692 | 0.4668 | | 0.4062 | * |
| | -- | 6 | 1993:06 1998:09 | 66.6132 | 48.0613 | 0.0091 | 0.0658 | 0.0095 | 0.9091 | 0.9470 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 70.3431 | 58.0032 | 0.0108 | 0.4862 | 0.0827 | 0.4155 | | 0.4444 | * |
| m_empsa | -- | 1 | 1993:01 1998:09 | 4.1031 | 3.4269 | 0.0066 | 0.0343 | 0.0001 | 0.9511 | 0.9973 | 0.5294 | * |
| | (0,1,0) | | 69 obs. | 4.1144 | 3.2941 | 0.0063 | 0.0253 | 0.0001 | 0.9600 | | 0.5147 | * |
| | -- | 2 | 1993:02 1998:09 | 5.7421 | 4.7298 | 0.0091 | 0.0748 | 0.0003 | 0.9101 | 1.0988 | 0.4776 | ** |
| | (0,1,0) | | 68 obs. | 5.2259 | 4.2284 | 0.0081 | 0.0615 | 0.0027 | 0.9211 | | 0.4925 | * |
| | -- | 3 | 1993:03 1998:09 | 7.1774 | 5.7175 | 0.0109 | 0.1031 | 0.0044 | 0.8775 | 1.1629 | 0.4394 | -- |
| | (0,1,0) | | 67 obs. | 6.1721 | 5.2318 | 0.0100 | 0.0942 | 0.0057 | 0.8852 | | 0.5152 | * |
| | -- | 4 | 1993:04 1998:09 | 8.0201 | 6.6211 | 0.0126 | 0.1422 | 0.0085 | 0.8341 | 1.2208 | 0.4462 | -- |
| | (0,1,0) | | 66 obs. | 6.5694 | 5.3569 | 0.0102 | 0.1352 | 0.0052 | 0.8445 | | 0.5231 | * |
| | -- | 5 | 1993:05 1998:09 | 8.9161 | 7.2318 | 0.0137 | 0.1995 | 0.0165 | 0.7686 | 1.2839 | 0.4219 | -- |
| | (0,1,0) | | 65 obs. | 6.9444 | 5.7438 | 0.0109 | 0.1979 | 0.0038 | 0.7830 | | 0.4688 | -- |
| | -- | 6 | 1993:06 1998:09 | 9.9131 | 7.8800 | 0.0150 | 0.2607 | 0.0225 | 0.7011 | 1.3094 | 0.3968 | -- |
| | (0,1,0) | | 64 obs. | 7.5710 | 6.5714 | 0.0125 | 0.2586 | 0.0025 | 0.7233 | | 0.5714 | * |
| s_empsa | -- | 1 | 1993:01 1998:09 | 2.9537 | 2.1606 | 0.0046 | 0.0190 | 0.0075 | 0.9590 | 1.0910 | 0.6176 | * |
| | (0,1,0) | | 69 obs. | 2.7073 | 1.9382 | 0.0042 | 0.0171 | 0.0001 | 0.9683 | | 0.5882 | * |
| | -- | 2 | 1993:02 1998:09 | 4.5372 | 3.3967 | 0.0073 | 0.0446 | 0.0063 | 0.9344 | 1.2542 | 0.5821 | * |
| | (0,1,0) | | 68 obs. | 3.6175 | 2.7403 | 0.0059 | 0.0443 | 0.0004 | 0.9405 | | 0.6119 | * |
| | -- | 3 | 1993:03 1998:09 | 5.8026 | 4.5450 | 0.0097 | 0.0705 | 0.0038 | 0.9108 | 1.3090 | 0.4394 | -- |
| | (0,1,0) | | 67 obs. | 4.4329 | 3.4500 | 0.0074 | 0.0684 | 0.0002 | 0.9164 | | 0.5303 | * |
| | -- | 4 | 1993:04 1998:09 | 6.8469 | 5.5735 | 0.0119 | 0.0967 | 0.0012 | 0.8870 | 1.3624 | 0.5692 | * |
| | (0,1,0) | | 66 obs. | 5.0256 | 3.9708 | 0.0085 | 0.0936 | 0.0001 | 0.8911 | | 0.5538 | * |
| | -- | 5 | 1993:05 1998:09 | 7.8946 | 6.5605 | 0.0140 | 0.1240 | 0.0003 | 0.8603 | 1.3951 | 0.4531 | -- |
| | (0,1,0) | | 65 obs. | 5.6588 | 4.6438 | 0.0100 | 0.1129 | 0.0006 | 0.8711 | | 0.4219 | -- |
| | -- | 6 | 1993:06 1998:09 | 8.6593 | 7.2536 | 0.0155 | 0.1565 | 0.0013 | 0.8265 | 1.4176 | 0.5556 | * |
| | (0,1,0) | | 64 obs. | 6.1085 | 5.0905 | 0.0109 | 0.1325 | 0.0038 | 0.8481 | | 0.4286 | -- |

**Table 9. Evaluation of the forecasting performance of the rolling-windows-based adaptive ARX models in simulated real time. (cont.)**

| Variable | ARX ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a) Employment levels (Continued) | | | | | | | | | | | | |
| a_empsa | -- | 1 | 1993:01 1998:09 | 8.019 | 6.2976 | 0.0045 | 0.0484 | 0.0001 | 0.937 | 0.9345 | 0.4853 | * |
| | (0,1,0) | | 69 obs. | 8.5814 | 6.7779 | 0.0048 | 0.1716 | 0.0028 | 0.8111 | | 0.4853 | * |
| | -- | 2 | 1993:02 1998:09 | 10.2007 | 8.0375 | 0.0057 | 0.1321 | 0.0012 | 0.852 | 0.8522 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 11.9696 | 9.7806 | 0.0070 | 0.3685 | 0.0086 | 0.6082 | | 0.4925 | * |
| | -- | 3 | 1993:03 1998:09 | 11.0769 | 9.1497 | 0.0066 | 0.2514 | 0.0008 | 0.7329 | 0.7619 | 0.3788 | -- |
| | (0,1,0) | | 67 obs. | 14.5392 | 12.0621 | 0.0086 | 0.5584 | 0.0098 | 0.4169 | | 0.3939 | -- |
| | -- | 4 | 1993:04 1998:09 | 13.5068 | 10.5447 | 0.0076 | 0.3118 | 0.0001 | 0.673 | 0.7328 | 0.4615 | * |
| | (0,1,0) | | 66 obs. | 18.4315 | 15.6354 | 0.0111 | 0.6268 | 0.0057 | 0.3523 | | 0.4769 | * |
| | -- | 5 | 1993:05 1998:09 | 15.7286 | 13.0425 | 0.0093 | 0.3782 | 0.0002 | 0.6063 | 0.7065 | 0.4219 | -- |
| | (0,1,0) | | 65 obs. | 22.2615 | 19.1609 | 0.0136 | 0.686 | 0.0055 | 0.2931 | | 0.4375 | -- |
| | -- | 6 | 1993:06 1998:09 | 17.4218 | 14.7171 | 0.0105 | 0.4599 | 0.0006 | 0.5239 | 0.6747 | 0.3810 | -- |
| | (0,1,0) | | 64 obs. | 25.8228 | 23.0349 | 0.0163 | 0.7437 | 0.0100 | 0.2307 | | 0.4127 | -- |
| b_empsa | -- | 1 | 1993:01 1998:09 | 11.5717 | 9.20520 | 0.0052 | 0.0018 | 0.0015 | 0.9822 | 1.0026 | 0.4265 | -- |
| | (0,1,0) | | 69 obs. | 11.5412 | 9.28090 | 0.0053 | 0.0779 | 0.0007 | 0.9069 | | 0.4559 | -- |
| | -- | 2 | 1993:02 1998:09 | 14.8523 | 12.3081 | 0.0069 | 0.0049 | 0.0081 | 0.9723 | 0.9219 | 0.5672 | * |
| | (0,1,0) | | 68 obs. | 16.1114 | 13.5612 | 0.0077 | 0.1662 | 0.0066 | 0.8125 | | 0.5821 | * |
| | -- | 3 | 1993:03 1998:09 | 15.7848 | 12.7735 | 0.0072 | 0.0136 | 0.0261 | 0.9454 | 0.8662 | 0.5152 | * |
| | (0,1,0) | | 67 obs. | 18.2228 | 15.0455 | 0.0085 | 0.292 | 0.0205 | 0.6725 | | 0.5000 | * |
| | -- | 4 | 1993:04 1998:09 | 17.7093 | 14.9037 | 0.0084 | 0.0229 | 0.0479 | 0.914 | 0.8301 | 0.4615 | -- |
| | (0,1,0) | | 66 obs. | 21.3349 | 17.6292 | 0.0099 | 0.3764 | 0.0345 | 0.5739 | | 0.4923 | * |
| | -- | 5 | 1993:05 1998:09 | 20.4375 | 16.6143 | 0.0094 | 0.0238 | 0.0745 | 0.8864 | 0.8207 | 0.5781 | * |
| | (0,1,0) | | 65 obs. | 24.9016 | 20.9859 | 0.0118 | 0.4345 | 0.0467 | 0.5034 | | 0.5781 | * |
| | -- | 6 | 1993:06 1998:09 | 20.2101 | 16.0448 | 0.0090 | 0.0313 | 0.1496 | 0.8035 | 0.7472 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 27.0486 | 22.9492 | 0.0129 | 0.5474 | 0.0784 | 0.3586 | | 0.3968 | -- |

**Table 9. Evaluation of the forecasting performance of the rolling-windows-based adaptive ARX models in simulated real time. (cont.)**

| Variable | ARX ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b) Employment rates | | | | | | | | | | | | |
| c_ersa | -- | 1 | 1993:01 1998:09 | 0.1944 | 0.1522 | 0.0026 | 0.0178 | 0.0001 | 0.9677 | 1.2187 | 0.6324 | * |
| | (0,1,0) | | 69 obs. | 0.1595 | 0.1279 | 0.0022 | 0.0186 | 0.0154 | 0.9515 | | 0.5294 | * |
| | -- | 2 | 1993:02 1998:09 | 0.2565 | 0.2115 | 0.0036 | 0.0402 | 0.0059 | 0.9392 | 1.2946 | 0.5224 | * |
| | (0,1,0) | | 68 obs. | 0.1981 | 0.1627 | 0.0028 | 0.0402 | 0.0240 | 0.9211 | | 0.4030 | * |
| | -- | 3 | 1993:03 1998:09 | 0.2899 | 0.2426 | 0.0041 | 0.0632 | 0.0107 | 0.9112 | 1.2328 | 0.5152 | * |
| | (0,1,0) | | 67 obs. | 0.2352 | 0.1894 | 0.0032 | 0.0613 | 0.0260 | 0.8978 | | 0.4394 | * |
| | -- | 4 | 1993:04 1998:09 | 0.3250 | 0.2750 | 0.0047 | 0.0739 | 0.0208 | 0.8902 | 1.2136 | 0.4308 | * |
| | (0,1,0) | | 66 obs. | 0.2678 | 0.2215 | 0.0038 | 0.0801 | 0.0312 | 0.8736 | | 0.4154 | * |
| | -- | 5 | 1993:05 1998:09 | 0.3446 | 0.2855 | 0.0049 | 0.0830 | 0.0265 | 0.8751 | 1.1416 | 0.5000 | * |
| | (0,1,0) | | 65 obs. | 0.3018 | 0.2422 | 0.0041 | 0.1098 | 0.0412 | 0.8336 | | 0.4688 | * |
| | -- | 6 | 1993:06 1998:09 | 0.3478 | 0.2781 | 0.0047 | 0.0795 | 0.0253 | 0.8795 | 1.0411 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 0.3340 | 0.2778 | 0.0047 | 0.1435 | 0.0598 | 0.7811 | | 0.3810 | * |
| nf_ersa | -- | 1 | 1993:01 1998:09 | 0.6933 | 0.5433 | 0.0127 | 0.0014 | 0.0029 | 0.9813 | 1.0131 | 0.4559 | -- |
| | (0,1,0) | | 69 obs. | 0.6844 | 0.5309 | 0.0124 | 0.0002 | 0.0001 | 0.9852 | | 0.6029 | * |
| | -- | 2 | 1993:02 1998:09 | 0.9738 | 0.7937 | 0.0185 | 0.0031 | 0.0012 | 0.9810 | 1.1380 | 0.4776 | * |
| | (0,1,0) | | 68 obs. | 0.8557 | 0.6896 | 0.0161 | 0.0004 | 0.0000 | 0.9848 | | 0.4627 | * |
| | -- | 3 | 1993:03 1998:09 | 1.0819 | 0.8837 | 0.0206 | 0.0100 | 0.0006 | 0.9745 | 1.1625 | 0.5152 | * |
| | (0,1,0) | | 67 obs. | 0.9306 | 0.7758 | 0.0181 | 0.0041 | 0.0001 | 0.9808 | | 0.5455 | * |
| | -- | 4 | 1993:04 1998:09 | 1.2096 | 1.0164 | 0.0236 | 0.0221 | 0.0000 | 0.9627 | 1.2317 | 0.5846 | * |
| | (0,1,0) | | 66 obs. | 0.9820 | 0.8215 | 0.0191 | 0.0110 | 0.0055 | 0.9684 | | 0.5077 | * |
| | -- | 5 | 1993:05 1998:09 | 1.3145 | 1.0962 | 0.0255 | 0.0312 | 0.0003 | 0.9532 | 1.2760 | 0.5469 | * |
| | (0,1,0) | | 65 obs. | 1.0302 | 0.8688 | 0.0202 | 0.0189 | 0.0111 | 0.9547 | | 0.5156 | * |
| | -- | 6 | 1993:06 1998:09 | 1.4043 | 1.1422 | 0.0266 | 0.0437 | 0.0005 | 0.9401 | 1.2990 | 0.5079 | * |
| | (0,1,0) | | 64 obs. | 1.0811 | 0.9444 | 0.0220 | 0.0239 | 0.0156 | 0.9448 | | 0.5238 | * |
| ns_ersa | -- | 1 | 1993:01 1998:09 | 0.4224 | 0.3286 | 0.0063 | 0.005 | 0.0000 | 0.9805 | 0.9935 | 0.5882 | * |
| | (0,1,0) | | 69 obs. | 0.4251 | 0.3309 | 0.0063 | 0.0061 | 0.0000 | 0.9793 | | 0.6029 | * |
| | -- | 2 | 1993:02 1998:09 | 0.5653 | 0.4413 | 0.0084 | 0.0084 | 0.0000 | 0.9769 | 1.0029 | 0.5672 | * |
| | (0,1,0) | | 68 obs. | 0.5637 | 0.4433 | 0.0084 | 0.0150 | 0.0001 | 0.9701 | | 0.5522 | * |
| | -- | 3 | 1993:03 1998:09 | 0.7030 | 0.5306 | 0.0101 | 0.0118 | 0.0001 | 0.9732 | 1.0105 | 0.5152 | * |
| | (0,1,0) | | 67 obs. | 0.6957 | 0.5273 | 0.0100 | 0.0213 | 0.0005 | 0.9633 | | 0.5303 | * |
| | -- | 4 | 1993:04 1998:09 | 0.7668 | 0.5897 | 0.0112 | 0.0233 | 0.0006 | 0.9609 | 1.0067 | 0.4308 | -- |
| | (0,1,0) | | 66 obs. | 0.7618 | 0.5877 | 0.0111 | 0.0350 | 0.0011 | 0.9488 | | 0.4154 | -- |
| | -- | 5 | 1993:05 1998:09 | 0.8588 | 0.667 | 0.0126 | 0.0397 | 0.0013 | 0.9436 | 1.0160 | 0.5312 | * |
| | (0,1,0) | | 65 obs. | 0.8452 | 0.6531 | 0.0124 | 0.0577 | 0.0033 | 0.9235 | | 0.5156 | * |
| | -- | 6 | 1993:06 1998:09 | 0.9142 | 0.7314 | 0.0138 | 0.0570 | 0.0027 | 0.9246 | 1.0199 | 0.5079 | * |
| | (0,1,0) | | 64 obs. | 0.8964 | 0.7143 | 0.0135 | 0.0837 | 0.0065 | 0.8941 | | 0.5238 | * |

**Table 9. Evaluation of the forecasting performance of the rolling-windows-based adaptive ARX models in simulated real time. (cont.)**

| Variable | ARX ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b) Employment rates (Continued) | | | | | | | | | | | | |
| nb_ersa | -- | 1 | 1993:01 1998:09 | 0.5720 | 0.4632 | 0.0089 | 0.0000 | 0.0037 | 0.9818 | 1.0099 | 0.5294 | * |
| | (0,1,0) | | 69 obs. | 0.5663 | 0.4574 | 0.0088 | 0.0019 | 0.0005 | 0.9831 | | 0.5294 | * |
| | -- | 2 | 1993:02 1998:09 | 0.7434 | 0.6017 | 0.0116 | 0.0000 | 0.0011 | 0.9841 | 1.0763 | 0.5970 | * |
| | (0,1,0) | | 68 obs. | 0.6907 | 0.5731 | 0.0110 | 0.0026 | 0.0008 | 0.9819 | | 0.5970 | * |
| | -- | 3 | 1993:03 1998:09 | 0.8644 | 0.6578 | 0.0126 | 0.0014 | 0.0000 | 0.9836 | 1.1539 | 0.4091 | -- |
| | (0,1,0) | | 67 obs. | 0.7491 | 0.5909 | 0.0113 | 0.0023 | 0.0007 | 0.9821 | | 0.4091 | -- |
| | -- | 4 | 1993:04 1998:09 | 1.0295 | 0.7795 | 0.0150 | 0.0046 | 0.0005 | 0.9797 | 1.1807 | 0.4462 | -- |
| | (0,1,0) | | 66 obs. | 0.8720 | 0.6954 | 0.0134 | 0.0017 | 0.0005 | 0.9826 | | 0.5538 | * |
| | -- | 5 | 1993:05 1998:09 | 1.1779 | 0.9163 | 0.0177 | 0.0097 | 0.0019 | 0.9729 | 1.2084 | 0.5000 | * |
| | (0,1,0) | | 65 obs. | 0.9748 | 0.7953 | 0.0153 | 0.0016 | 0.0005 | 0.9825 | | 0.5469 | * |
| | -- | 6 | 1993:06 1998:09 | 1.3186 | 1.0037 | 0.0193 | 0.0151 | 0.0031 | 0.9662 | 1.2306 | 0.5397 | * |
| | (0,1,0) | | 64 obs. | 1.0716 | 0.8571 | 0.0165 | 0.0019 | 0.0010 | 0.9815 | | 0.5079 | * |
| p_ersa | -- | 1 | 1993:01 1998:09 | 0.8739 | 0.6674 | 0.0120 | 0.0013 | 0.0092 | 0.9750 | 1.2493 | 0.4265 | -- |
| | (0,1,0) | | 69 obs. | 0.6995 | 0.5544 | 0.0100 | 0.0059 | 0.0004 | 0.9793 | | 0.6176 | * |
| | -- | 2 | 1993:02 1998:09 | 1.1031 | 0.8960 | 0.0161 | 0.0000 | 0.0168 | 0.9685 | 1.2530 | 0.5373 | * |
| | (0,1,0) | | 68 obs. | 0.8804 | 0.7090 | 0.0127 | 0.0097 | 0.0002 | 0.9754 | | 0.5075 | * |
| | -- | 3 | 1993:03 1998:09 | 1.3652 | 1.0729 | 0.0193 | 0.0001 | 0.0494 | 0.9355 | 1.5183 | 0.4394 | -- |
| | (0,1,0) | | 67 obs. | 0.8992 | 0.7364 | 0.0132 | 0.0287 | 0.0003 | 0.9561 | | 0.3333 | -- |
| | -- | 4 | 1993:04 1998:09 | 1.6284 | 1.3110 | 0.0236 | 0.0024 | 0.0961 | 0.8864 | 1.6435 | 0.5538 | * |
| | (0,1,0) | | 66 obs. | 0.9908 | 0.7954 | 0.0142 | 0.0452 | 0.0018 | 0.9379 | | 0.5385 | * |
| | -- | 5 | 1993:05 1998:09 | 1.9331 | 1.6082 | 0.0289 | 0.0053 | 0.1418 | 0.8375 | 1.7306 | 0.5000 | * |
| | (0,1,0) | | 65 obs. | 1.1170 | 0.9047 | 0.0162 | 0.0663 | 0.0014 | 0.9168 | | 0.5312 | * |
| | -- | 6 | 1993:06 1998:09 | 2.2025 | 1.8732 | 0.0337 | 0.0052 | 0.1898 | 0.7893 | 1.8952 | 0.6032 | * |
| | (0,1,0) | | 64 obs. | 1.1622 | 0.9286 | 0.0166 | 0.0915 | 0.0002 | 0.8927 | | 0.5079 | * |
| q_ersa | -- | 1 | 1993:01 1998:09 | 0.3587 | 0.2751 | 0.0050 | 0.0048 | 0.0039 | 0.9768 | 1.1575 | 0.4853 | * |
| | (0,1,0) | | 69 obs. | 0.3099 | 0.2309 | 0.0042 | 0.0037 | 0.0020 | 0.9798 | | 0.4853 | * |
| | -- | 2 | 1993:02 1998:09 | 0.4595 | 0.3364 | 0.0061 | 0.0094 | 0.0116 | 0.9643 | 1.2523 | 0.4627 | * |
| | (0,1,0) | | 68 obs. | 0.3669 | 0.2836 | 0.0052 | 0.0145 | 0.0041 | 0.9667 | | 0.5075 | * |
| | -- | 3 | 1993:03 1998:09 | 0.5195 | 0.3832 | 0.0070 | 0.0310 | 0.0489 | 0.9052 | 1.3481 | 0.3636 | -- |
| | (0,1,0) | | 67 obs. | 0.3853 | 0.3000 | 0.0055 | 0.0290 | 0.0019 | 0.9542 | | 0.4848 | * |
| | -- | 4 | 1993:04 1998:09 | 0.6106 | 0.4354 | 0.0079 | 0.0398 | 0.0637 | 0.8814 | 1.5250 | 0.4769 | * |
| | (0,1,0) | | 66 obs. | 0.4004 | 0.3138 | 0.0057 | 0.0418 | 0.0008 | 0.9423 | | 0.4462 | * |
| | -- | 5 | 1993:05 1998:09 | 0.7640 | 0.5398 | 0.0098 | 0.0374 | 0.1068 | 0.8404 | 1.6690 | 0.4219 | ** |
| | (0,1,0) | | 65 obs. | 0.4577 | 0.3609 | 0.0066 | 0.0477 | 0.0002 | 0.9367 | | 0.4062 | * |
| | -- | 6 | 1993:06 1998:09 | 0.8157 | 0.5990 | 0.0109 | 0.0440 | 0.1294 | 0.8111 | 1.5829 | 0.3810 | -- |
| | (0,1,0) | | 64 obs. | 0.5153 | 0.4111 | 0.0075 | 0.0574 | 0.0003 | 0.9267 | | 0.5397 | * |

**Table 9. Evaluation of the forecasting performance of the rolling-windows-based adaptive ARX models in simulated real time. (cont.)**

| Variable | ARX ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b) Employment rates (Continued) | | | | | | | | | | | | |
| o_ersa | -- | 1 | 1993:01 1998:09 | 0.2967 | 0.2369 | 0.0039 | 0.0223 | 0.0001 | 0.9631 | 1.1955 | 0.4706 | * |
| | (0,1,0) | | 69 obs. | 0.2482 | 0.1985 | 0.0033 | 0.0077 | 0.0091 | 0.9687 | | 0.3824 | * |
| | -- | 2 | 1993:02 1998:09 | 0.3445 | 0.2936 | 0.0049 | 0.0382 | 0.0012 | 0.9458 | 1.0590 | 0.5373 | * |
| | (0,1,0) | | 68 obs. | 0.3253 | 0.2821 | 0.0047 | 0.0074 | 0.0087 | 0.9692 | | 0.4627 | * |
| | -- | 3 | 1993:03 1998:09 | 0.4117 | 0.3408 | 0.0056 | 0.0488 | 0.0010 | 0.9353 | 1.0391 | 0.4697 | * |
| | (0,1,0) | | 67 obs. | 0.3962 | 0.3333 | 0.0055 | 0.0096 | 0.0132 | 0.9623 | | 0.4848 | * |
| | -- | 4 | 1993:04 1998:09 | 0.4854 | 0.3830 | 0.0064 | 0.0584 | 0.0001 | 0.9264 | 1.0608 | 0.4923 | * |
| | (0,1,0) | | 66 obs. | 0.4576 | 0.3769 | 0.0063 | 0.0119 | 0.0197 | 0.9532 | | 0.4615 | * |
| | -- | 5 | 1993:05 1998:09 | 0.5244 | 0.4234 | 0.0070 | 0.0797 | 0.0013 | 0.9037 | 1.0118 | 0.5625 | * |
| | (0,1,0) | | 65 obs. | 0.5183 | 0.4359 | 0.0072 | 0.0178 | 0.0342 | 0.9325 | | 0.5312 | * |
| | -- | 6 | 1993:06 1998:09 | 0.5921 | 0.4838 | 0.0080 | 0.0803 | 0.0077 | 0.8964 | 1.0197 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 0.5806 | 0.4825 | 0.0080 | 0.0227 | 0.0475 | 0.9142 | | 0.5079 | * |
| m_ersa | -- | 1 | 1993:01 1998:09 | 0.4648 | 0.3845 | 0.0063 | 0.0366 | 0.0149 | 0.9340 | 0.9711 | 0.5000 | * |
| | (0,1,0) | | 69 obs. | 0.4787 | 0.3765 | 0.0061 | 0.0106 | 0.0004 | 0.9745 | | 0.5147 | * |
| | -- | 2 | 1993:02 1998:09 | 0.6651 | 0.5529 | 0.0090 | 0.0750 | 0.0076 | 0.9028 | 1.0936 | 0.5373 | * |
| | (0,1,0) | | 68 obs. | 0.6082 | 0.4836 | 0.0079 | 0.0255 | 0.0041 | 0.9557 | | 0.4627 | * |
| | -- | 3 | 1993:03 1998:09 | 0.8106 | 0.6598 | 0.0107 | 0.1053 | 0.0020 | 0.8777 | 1.1466 | 0.4394 | -- |
| | (0,1,0) | | 67 obs. | 0.7070 | 0.5894 | 0.0096 | 0.0385 | 0.0081 | 0.9385 | | 0.5152 | * |
| | -- | 4 | 1993:04 1998:09 | 0.8948 | 0.7523 | 0.0122 | 0.1421 | 0.0007 | 0.8421 | 1.2047 | 0.4462 | * |
| | (0,1,0) | | 66 obs. | 0.7428 | 0.6000 | 0.0098 | 0.0541 | 0.0082 | 0.9226 | | 0.5231 | * |
| | -- | 5 | 1993:05 1998:09 | 0.9760 | 0.8234 | 0.0134 | 0.1959 | 0.0002 | 0.7885 | 1.2740 | 0.4531 | * |
| | (0,1,0) | | 65 obs. | 0.7661 | 0.6188 | 0.0101 | 0.0860 | 0.0073 | 0.8913 | | 0.4688 | * |
| | -- | 6 | 1993:06 1998:09 | 1.0633 | 0.9245 | 0.0150 | 0.2618 | 0.0000 | 0.7225 | 1.2995 | 0.4921 | * |
| | (0,1,0) | | 64 obs. | 0.8182 | 0.6825 | 0.0111 | 0.1235 | 0.0061 | 0.8549 | | 0.5714 | * |
| s_ersa | -- | 1 | 1993:01 1998:09 | 0.3808 | 0.2711 | 0.0044 | 0.0071 | 0.0120 | 0.9664 | 1.0597 | 0.5000 | * |
| | (0,1,0) | | 69 obs. | 0.3593 | 0.2559 | 0.0041 | 0.0016 | 0.0000 | 0.9838 | | 0.5294 | * |
| | -- | 2 | 1993:02 1998:09 | 0.5491 | 0.4114 | 0.0067 | 0.0197 | 0.0146 | 0.9510 | 1.1435 | 0.5373 | * |
| | (0,1,0) | | 68 obs. | 0.4802 | 0.3716 | 0.0060 | 0.0059 | 0.0002 | 0.9792 | | 0.5821 | * |
| | -- | 3 | 1993:03 1998:09 | 0.6756 | 0.5317 | 0.0086 | 0.0348 | 0.0168 | 0.9335 | 1.1831 | 0.5152 | * |
| | (0,1,0) | | 67 obs. | 0.5710 | 0.4485 | 0.0073 | 0.0109 | 0.0001 | 0.9740 | | 0.5303 | * |
| | -- | 4 | 1993:04 1998:09 | 0.7883 | 0.6258 | 0.0101 | 0.0480 | 0.0111 | 0.9258 | 1.2596 | 0.4923 | * |
| | (0,1,0) | | 66 obs. | 0.6259 | 0.4954 | 0.0080 | 0.0158 | 0.0000 | 0.9690 | | 0.4923 | * |
| | -- | 5 | 1993:05 1998:09 | 0.9122 | 0.7453 | 0.0120 | 0.0582 | 0.0052 | 0.9213 | 1.3183 | 0.4531 | * |
| | (0,1,0) | | 65 obs. | 0.6919 | 0.5656 | 0.0091 | 0.0190 | 0.0003 | 0.9654 | | 0.4219 | * |
| | -- | 6 | 1993:06 1998:09 | 1.0153 | 0.8227 | 0.0133 | 0.0631 | 0.0021 | 0.9192 | 1.3744 | 0.4286 | * |
| | (0,1,0) | | 64 obs. | 0.7387 | 0.6032 | 0.0098 | 0.0207 | 0.0011 | 0.9626 | | 0.4286 | * |

**Table 9. Evaluation of the forecasting performance of the rolling-windows-based adaptive ARX models in simulated real time. (cont.)**

| Variable | ARX ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b) Employment rates (Continued) | | | | | | | | | | | | |
| a_ersa | -- | 1 | 1993:01 1998:09 | 0.4166 | 0.3198 | 0.0048 | 0.0066 | 0.0062 | 0.9727 | 1.1116 | 0.5735 | * |
| | (0,1,0) | | 69 obs. | 0.3748 | 0.2926 | 0.0044 | 0.0205 | 0.0020 | 0.9631 | | 0.5735 | * |
| | -- | 2 | 1993:02 1998:09 | 0.5205 | 0.3931 | 0.0059 | 0.0288 | 0.0093 | 0.9472 | 1.1128 | 0.5075 | * |
| | (0,1,0) | | 68 obs. | 0.4678 | 0.3612 | 0.0054 | 0.0601 | 0.0033 | 0.9219 | | 0.5672 | * |
| | -- | 3 | 1993:03 1998:09 | 0.5625 | 0.4396 | 0.0066 | 0.0698 | 0.0165 | 0.8987 | 1.1593 | 0.4697 | * |
| | (0,1,0) | | 67 obs. | 0.4852 | 0.3818 | 0.0057 | 0.1273 | 0.0102 | 0.8476 | | 0.4091 | * |
| | -- | 4 | 1993:04 1998:09 | 0.6939 | 0.5601 | 0.0084 | 0.0998 | 0.0236 | 0.8614 | 1.1854 | 0.6000 | * |
| | (0,1,0) | | 66 obs. | 0.5853 | 0.4538 | 0.0068 | 0.1652 | 0.0230 | 0.7967 | | 0.5538 | * |
| | -- | 5 | 1993:05 1998:09 | 0.7786 | 0.6317 | 0.0095 | 0.1350 | 0.0306 | 0.8190 | 1.1793 | 0.4688 | * |
| | (0,1,0) | | 65 obs. | 0.6603 | 0.5250 | 0.0079 | 0.2215 | 0.0321 | 0.7310 | | 0.4219 | * |
| | -- | 6 | 1993:06 1998:09 | 0.8345 | 0.6642 | 0.0100 | 0.1784 | 0.0252 | 0.7807 | 1.1906 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 0.7009 | 0.5571 | 0.0084 | 0.2983 | 0.0253 | 0.6608 | | 0.4286 | * |
| b_ersa | -- | 1 | 1993:01 1998:09 | 0.4016 | 0.3168 | 0.0053 | 0.0094 | 0.0100 | 0.9661 | 1.0505 | 0.4118 | -- |
| | (0,1,0) | | 69 obs. | 0.3823 | 0.3088 | 0.0052 | 0.0014 | 0.0002 | 0.9839 | | 0.4559 | * |
| | -- | 2 | 1993:02 1998:09 | 0.5212 | 0.4298 | 0.0072 | 0.0254 | 0.0101 | 0.9497 | 1.0302 | 0.5970 | * |
| | (0,1,0) | | 68 obs. | 0.5059 | 0.4224 | 0.0071 | 0.0024 | 0.0000 | 0.9828 | | 0.6269 | * |
| | -- | 3 | 1993:03 1998:09 | 0.5704 | 0.4750 | 0.0080 | 0.0530 | 0.0152 | 0.9169 | 1.0833 | 0.5303 | * |
| | (0,1,0) | | 67 obs. | 0.5266 | 0.4394 | 0.0074 | 0.0054 | 0.0002 | 0.9794 | | 0.5152 | * |
| | -- | 4 | 1993:04 1998:09 | 0.6434 | 0.5489 | 0.0092 | 0.0813 | 0.0239 | 0.8796 | 1.1352 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 0.5668 | 0.4800 | 0.0081 | 0.0093 | 0.0012 | 0.9744 | | 0.5538 | * |
| | -- | 5 | 1993:05 1998:09 | 0.7322 | 0.5942 | 0.0100 | 0.1041 | 0.0286 | 0.8519 | 1.1724 | 0.5000 | * |
| | (0,1,0) | | 65 obs. | 0.6245 | 0.5219 | 0.0088 | 0.0117 | 0.0024 | 0.9705 | | 0.5781 | * |
| | -- | 6 | 1993:06 1998:09 | 0.7466 | 0.5880 | 0.0099 | 0.1410 | 0.0377 | 0.8057 | 1.2557 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 0.5946 | 0.4651 | 0.0078 | 0.0153 | 0.0044 | 0.9647 | | 0.4286 | * |

**Table 9. Evaluation of the forecasting performance of the rolling-windows-based adaptive ARX models in simulated real time. (cont.)**

| Variable | ARX ARIMA | Forecast horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias proportion | Variance proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c) Unemployment rates | | | | | | | | | | | | |
| c_ursa | -- | 1 | 1993:01 1998:09 | 0.2754 | 0.2127 | 0.0218 | 0.0015 | 0.0228 | 0.9612 | 1.1385 | 0.5882 | * |
| | (0,1,0) | | 69 obs. | 0.2419 | 0.1853 | 0.0187 | 0.0367 | 0.0002 | 0.9485 | | 0.5441 | * |
| | -- | 2 | 1993:02 1998:09 | 0.3472 | 0.2709 | 0.0283 | 0.0033 | 0.0283 | 0.9537 | 1.1376 | 0.5373 | * |
| | (0,1,0) | | 68 obs. | 0.3052 | 0.2269 | 0.0230 | 0.0781 | 0.0004 | 0.9067 | | 0.5522 | * |
| | -- | 3 | 1993:03 1998:09 | 0.3684 | 0.3034 | 0.0316 | 0.0057 | 0.0428 | 0.9366 | 1.1063 | 0.5909 | * |
| | (0,1,0) | | 67 obs. | 0.3330 | 0.2697 | 0.0276 | 0.1351 | 0.0024 | 0.8476 | | 0.5606 | * |
| | -- | 4 | 1993:04 1998:09 | 0.3773 | 0.3235 | 0.0337 | 0.0097 | 0.0833 | 0.8918 | 1.0067 | 0.4462 | * |
| | (0,1,0) | | 66 obs. | 0.3748 | 0.3123 | 0.0321 | 0.1942 | 0.0032 | 0.7875 | | 0.4462 | * |
| | -- | 5 | 1993:05 1998:09 | 0.4056 | 0.3398 | 0.0354 | 0.0234 | 0.1021 | 0.8591 | 0.9362 | 0.4062 | *** |
| | (0,1,0) | | 65 obs. | 0.4332 | 0.3578 | 0.0370 | 0.2437 | 0.0018 | 0.7391 | | 0.5156 | * |
| | -- | 6 | 1993:06 1998:09 | 0.4776 | 0.4040 | 0.0419 | 0.0323 | 0.1217 | 0.8304 | 0.9492 | 0.5873 | * |
| | (0,1,0) | | 64 obs. | 0.5032 | 0.4206 | 0.0437 | 0.2754 | 0.0009 | 0.7080 | | 0.5714 | * |
| nf_ursa | -- | 1 | 1993:01 1998:09 | 0.8347 | 0.6355 | 0.0334 | 0.0055 | 0.0142 | 0.9659 | 0.9510 | 0.5588 | * |
| | (0,1,0) | | 69 obs. | 0.8777 | 0.7088 | 0.0369 | 0.0005 | 0.0000 | 0.9850 | | 0.6176 | * |
| | -- | 2 | 1993:02 1998:09 | 1.1489 | 0.9032 | 0.0478 | 0.0120 | 0.0144 | 0.9589 | 0.9746 | 0.4776 | *** |
| | (0,1,0) | | 68 obs. | 1.1788 | 0.8896 | 0.0466 | 0.0008 | 0.0000 | 0.9845 | | 0.5373 | * |
| | -- | 3 | 1993:03 1998:09 | 1.3389 | 1.0722 | 0.0570 | 0.0282 | 0.0045 | 0.9524 | 1.0714 | 0.4242 | -- |
| | (0,1,0) | | 67 obs. | 1.2497 | 1.0152 | 0.0534 | 0.0036 | 0.0000 | 0.9815 | | 0.6364 | * |
| | -- | 4 | 1993:04 1998:09 | 1.4810 | 1.1579 | 0.0620 | 0.0499 | 0.0000 | 0.9349 | 1.2213 | 0.4462 | -- |
| | (0,1,0) | | 66 obs. | 1.2126 | 0.9292 | 0.0494 | 0.0132 | 0.0006 | 0.9710 | | 0.4000 | -- |
| | -- | 5 | 1993:05 1998:09 | 1.6631 | 1.3113 | 0.0704 | 0.0711 | 0.0008 | 0.9127 | 1.2888 | 0.4219 | -- |
| | (0,1,0) | | 65 obs. | 1.2905 | 1.0750 | 0.0569 | 0.0233 | 0.0021 | 0.9592 | | 0.5312 | * |
| | -- | 6 | 1993:06 1998:09 | 1.7973 | 1.3985 | 0.0752 | 0.0864 | 0.0003 | 0.8977 | 1.3087 | 0.4603 | -- |
| | (0,1,0) | | 64 obs. | 1.3733 | 1.1238 | 0.0596 | 0.0276 | 0.0040 | 0.9528 | | 0.4921 | * |
| ns_ursa | -- | 1 | 1993:01 1998:09 | 0.5395 | 0.4400 | 0.0350 | 0.0035 | 0.0019 | 0.9801 | 1.0316 | 0.5147 | * |
| | (0,1,0) | | 69 obs. | 0.5230 | 0.4206 | 0.0336 | 0.0069 | 0.0001 | 0.9785 | | 0.4559 | * |
| | -- | 2 | 1993:02 1998:09 | 0.7888 | 0.6388 | 0.0509 | 0.0101 | 0.0045 | 0.9706 | 1.1567 | 0.5522 | * |
| | (0,1,0) | | 68 obs. | 0.6820 | 0.5493 | 0.0440 | 0.0167 | 0.0005 | 0.9681 | | 0.5821 | * |
| | -- | 3 | 1993:03 1998:09 | 0.9805 | 0.7348 | 0.0586 | 0.0166 | 0.0114 | 0.9570 | 1.2131 | 0.5303 | * |
| | (0,1,0) | | 67 obs. | 0.8083 | 0.6121 | 0.0490 | 0.0314 | 0.0013 | 0.9524 | | 0.5303 | * |
| | -- | 4 | 1993:04 1998:09 | 1.1209 | 0.8529 | 0.0682 | 0.0269 | 0.0161 | 0.9419 | 1.2160 | 0.5231 | * |
| | (0,1,0) | | 66 obs. | 0.9218 | 0.7246 | 0.0582 | 0.0478 | 0.0026 | 0.9345 | | 0.5385 | * |
| | -- | 5 | 1993:05 1998:09 | 1.2483 | 0.9730 | 0.0780 | 0.0422 | 0.0223 | 0.9201 | 1.2517 | 0.4844 | * |
| | (0,1,0) | | 65 obs. | 0.9973 | 0.7969 | 0.0646 | 0.0704 | 0.0045 | 0.9097 | | 0.5000 | * |
| | -- | 6 | 1993:06 1998:09 | 1.3808 | 1.0685 | 0.0857 | 0.0611 | 0.0331 | 0.8902 | 1.2473 | 0.4762 | * |
| | (0,1,0) | | 64 obs. | 1.1070 | 0.9206 | 0.0747 | 0.0895 | 0.0036 | 0.8913 | | 0.5238 | * |

**Table 9. Evaluation of the forecasting performance of the rolling-windows-based adaptive ARX models in simulated real time. (cont.)**

| Variable | ARX ARIMA | Forecast Horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias Proportion | Variance Proportion | Covariance Proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c) Unemployment rates (Continued) | | | | | | | | | | | | |
| nb_ursa | -- | 1 | 1993:01 1998:09 | 0.5831 | 0.4831 | 0.0395 | 0.0089 | 0.0083 | 0.9683 | 0.9873 | 0.4853 | * |
| | (0,1,0) | | 69 obs. | 0.5906 | 0.4912 | 0.0404 | 0.0001 | 0.0000 | 0.9854 | | 0.6765 | * |
| | -- | 2 | 1993:02 1998:09 | 0.9240 | 0.7619 | 0.0622 | 0.0218 | 0.0073 | 0.9562 | 1.3341 | 0.3881 | -- |
| | (0,1,0) | | 68 obs. | 0.6926 | 0.5701 | 0.0470 | 0.0000 | 0.0000 | 0.9853 | | 0.4627 | * |
| | -- | 3 | 1993:03 1998:09 | 1.2327 | 0.9988 | 0.0813 | 0.0329 | 0.0345 | 0.9177 | 1.4742 | 0.5303 | * |
| | (0,1,0) | | 67 obs. | 0.8362 | 0.7045 | 0.0583 | 0.0000 | 0.0000 | 0.9850 | | 0.4848 | * |
| | -- | 4 | 1993:04 1998:09 | 1.4758 | 1.1884 | 0.0957 | 0.0443 | 0.0644 | 0.8761 | 1.6071 | 0.4615 | * |
| | (0,1,0) | | 66 obs. | 0.9183 | 0.7708 | 0.0632 | 0.0001 | 0.0000 | 0.9848 | | 0.5846 | * |
| | -- | 5 | 1993:05 1998:09 | 1.6499 | 1.2881 | 0.1027 | 0.0598 | 0.0822 | 0.8427 | 1.6840 | 0.3438 | -- |
| | (0,1,0) | | 65 obs. | 0.9798 | 0.8063 | 0.0657 | 0.0000 | 0.0000 | 0.9846 | | 0.3594 | -- |
| | -- | 6 | 1993:06 1998:09 | 1.7681 | 1.3693 | 0.1084 | 0.0800 | 0.0801 | 0.8243 | 1.6464 | 0.4286 | -- |
| | (0,1,0) | | 64 obs. | 1.0739 | 0.8857 | 0.0716 | 0.0005 | 0.0003 | 0.9836 | | 0.5714 | * |
| p_ursa | -- | 1 | 1993:01 1998:09 | 0.8771 | 0.7270 | 0.0475 | 0.0339 | 0.0131 | 0.9385 | 1.0000 | 0.5294 | * |
| | (0,1,0) | | 69 obs. | 0.8772 | 0.7088 | 0.0458 | 0.0058 | 0.0011 | 0.9786 | | 0.6029 | * |
| | -- | 2 | 1993:02 1998:09 | 1.2245 | 0.9527 | 0.0631 | 0.0690 | 0.0427 | 0.8736 | 1.2440 | 0.3731 | -- |
| | (0,1,0) | | 68 obs. | 0.9844 | 0.8239 | 0.0541 | 0.0150 | 0.0003 | 0.9700 | | 0.4030 | -- |
| | -- | 3 | 1993:03 1998:09 | 1.5387 | 1.2418 | 0.0814 | 0.1098 | 0.0708 | 0.8045 | 1.4331 | 0.4242 | -- |
| | (0,1,0) | | 67 obs. | 1.0737 | 0.8576 | 0.0570 | 0.0327 | 0.0002 | 0.9522 | | 0.4848 | * |
| | -- | 4 | 1993:04 1998:09 | 1.8143 | 1.4124 | 0.0922 | 0.1453 | 0.0979 | 0.7416 | 1.4663 | 0.4923 | * |
| | (0,1,0) | | 66 obs. | 1.2373 | 1.0015 | 0.0660 | 0.0480 | 0.0002 | 0.9366 | | 0.5538 | * |
| | -- | 5 | 1993:05 1998:09 | 2.0355 | 1.5871 | 0.1037 | 0.1746 | 0.1309 | 0.6791 | 1.5915 | 0.3594 | -- |
| | (0,1,0) | | 65 obs. | 1.2790 | 1.0219 | 0.0678 | 0.0650 | 0.0007 | 0.9189 | | 0.5156 | * |
| | -- | 6 | 1993:06 1998:09 | 2.3609 | 1.8924 | 0.1240 | 0.1946 | 0.1668 | 0.6230 | 1.6890 | 0.4921 | * |
| | (0,1,0) | | 64 obs. | 1.3978 | 1.1603 | 0.0775 | 0.0813 | 0.0001 | 0.9030 | | 0.4762 | ** |
| q_ursa | -- | 1 | 1993:01 1998:09 | 0.4562 | 0.3835 | 0.0328 | 0.0003 | 0.0001 | 0.9851 | 1.0087 | 0.5294 | * |
| | (0,1,0) | | 69 obs. | 0.4523 | 0.3691 | 0.0317 | 0.0086 | 0.0002 | 0.9767 | | 0.5588 | * |
| | -- | 2 | 1993:02 1998:09 | 0.6854 | 0.5653 | 0.0485 | 0.0004 | 0.0365 | 0.9484 | 1.2301 | 0.4030 | -- |
| | (0,1,0) | | 68 obs. | 0.5572 | 0.4448 | 0.0382 | 0.0203 | 0.0002 | 0.9648 | | 0.5821 | * |
| | -- | 3 | 1993:03 1998:09 | 0.8515 | 0.7158 | 0.0612 | 0.0013 | 0.0933 | 0.8904 | 1.6167 | 0.4545 | *** |
| | (0,1,0) | | 67 obs. | 0.5267 | 0.4227 | 0.0363 | 0.0452 | 0.0000 | 0.9399 | | 0.4394 | * |
| | -- | 4 | 1993:04 1998:09 | 0.9643 | 0.7958 | 0.0677 | 0.0042 | 0.0933 | 0.8873 | 1.6275 | 0.3692 | -- |
| | (0,1,0) | | 66 obs. | 0.5925 | 0.4769 | 0.0409 | 0.0654 | 0.0000 | 0.9195 | | 0.4154 | * |
| | -- | 5 | 1993:05 1998:09 | 1.0857 | 0.8987 | 0.0766 | 0.0084 | 0.0846 | 0.8916 | 1.5602 | 0.5469 | * |
| | (0,1,0) | | 65 obs. | 0.6959 | 0.5984 | 0.0515 | 0.0813 | 0.0002 | 0.9031 | | 0.6719 | * |
| | -- | 6 | 1993:06 1998:09 | 1.1775 | 0.9903 | 0.0845 | 0.0132 | 0.1128 | 0.8583 | 1.5653 | 0.3810 | -- |
| | (0,1,0) | | 64 obs. | 0.7522 | 0.6111 | 0.0528 | 0.1091 | 0.0010 | 0.8743 | | 0.4603 | * |

**Table 9. Evaluation of the forecasting performance of the rolling-windows-based adaptive ARX models in simulated real time. (cont.)**

| Variable | ARX ARIMA | Forecast Horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias Proportion | Variance Proportion | Covariance proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c) Unemployment rates (Continued) | | | | | | | | | | | | |
| o_ursa | (0,1,0) | | 64 obs. | 0.7522 | 0.6111 | 0.0528 | 0.1091 | 0.0010 | 0.8743 | | 0.4603 | * |
| | -- | 1 | 1993:01 1998:09 | 0.4270 | 0.3719 | 0.0421 | 0.0004 | 0.0826 | 0.9025 | 1.4244 | 0.6029 | * |
| | (0,1,0) | | 69 obs. | 0.2998 | 0.2368 | 0.0261 | 0.0356 | 0.0000 | 0.9499 | | 0.6176 | * |
| | -- | 2 | 1993:02 1998:09 | 0.7423 | 0.6088 | 0.0700 | 0.0003 | 0.1904 | 0.7946 | 1.9420 | 0.4179 | * |
| | (0,1,0) | | 68 obs. | 0.3823 | 0.2970 | 0.0332 | 0.0705 | 0.0019 | 0.9129 | | 0.4627 | * |
| | -- | 3 | 1993:03 1998:09 | 0.9822 | 0.7933 | 0.0911 | 0.0001 | 0.2377 | 0.7473 | 2.2338 | 0.5909 | * |
| | (0,1,0) | | 67 obs. | 0.4397 | 0.3727 | 0.0417 | 0.1062 | 0.0077 | 0.8712 | | 0.5303 | * |
| | -- | 4 | 1993:04 1998:09 | 1.1653 | 0.9184 | 0.1050 | 0.0014 | 0.2708 | 0.7127 | 2.2854 | 0.5077 | * |
| | (0,1,0) | | 66 obs. | 0.5099 | 0.4185 | 0.0474 | 0.1447 | 0.0133 | 0.8269 | | 0.5385 | * |
| | -- | 5 | 1993:05 1998:09 | 1.3275 | 1.0245 | 0.1170 | 0.0115 | 0.2972 | 0.6760 | 2.3230 | 0.4531 | * |
| | (0,1,0) | | 65 obs. | 0.5715 | 0.4719 | 0.0539 | 0.1949 | 0.0158 | 0.7739 | | 0.3906 | * |
| | -- | 6 | 1993:06 1998:09 | 1.5060 | 1.1334 | 0.1292 | 0.0301 | 0.3175 | 0.6368 | 2.2932 | 0.5238 | * |
| | (0,1,0) | | 64 obs. | 0.6567 | 0.5508 | 0.0632 | 0.2197 | 0.0179 | 0.7468 | | 0.5079 | * |
| m_ursa | -- | 1 | 1993:01 1998:09 | 0.4861 | 0.3815 | 0.0497 | 0.0262 | 0.0002 | 0.9591 | 0.9701 | 0.5735 | * |
| | (0,1,0) | | 69 obs. | 0.5010 | 0.3809 | 0.0492 | 0.0141 | 0.0013 | 0.9702 | | 0.5735 | * |
| | -- | 2 | 1993:02 1998:09 | 0.7472 | 0.6006 | 0.0790 | 0.0441 | 0.0037 | 0.9375 | 1.1366 | 0.4925 | * |
| | (0,1,0) | | 68 obs. | 0.6574 | 0.5134 | 0.0651 | 0.0245 | 0.0000 | 0.9607 | | 0.5672 | * |
| | -- | 3 | 1993:03 1998:09 | 0.9419 | 0.7748 | 0.1025 | 0.0626 | 0.0099 | 0.9126 | 1.3068 | 0.5000 | * |
| | (0,1,0) | | 67 obs. | 0.7208 | 0.5894 | 0.0760 | 0.0437 | 0.0024 | 0.9390 | | 0.5303 | * |
| | -- | 4 | 1993:04 1998:09 | 1.1294 | 0.9257 | 0.1223 | 0.0839 | 0.0199 | 0.8811 | 1.5115 | 0.4462 | -- |
| | (0,1,0) | | 66 obs. | 0.7472 | 0.5708 | 0.0745 | 0.0727 | 0.0050 | 0.9071 | | 0.5077 | * |
| | -- | 5 | 1993:05 1998:09 | 1.3214 | 1.0770 | 0.1439 | 0.1104 | 0.0262 | 0.8480 | 1.6306 | 0.4062 | -- |
| | (0,1,0) | | 65 obs. | 0.8104 | 0.6078 | 0.0808 | 0.1104 | 0.0081 | 0.8661 | | 0.5000 | * |
| | -- | 6 | 1993:06 1998:09 | 1.5005 | 1.2045 | 0.1629 | 0.1385 | 0.0367 | 0.8091 | 1.8316 | 0.4127 | -- |
| | (0,1,0) | | 64 obs. | 0.8192 | 0.6413 | 0.0872 | 0.1697 | 0.0111 | 0.8035 | | 0.4444 | -- |
| s_ursa | -- | 1 | 1993:01 1998:09 | 0.4263 | 0.3491 | 0.0525 | 0.0307 | 0.0083 | 0.9465 | 1.0162 | 0.5882 | * |
| | (0,1,0) | | 69 obs. | 0.4196 | 0.3485 | 0.0523 | 0.0087 | 0.0068 | 0.9700 | | 0.5000 | * |
| | -- | 2 | 1993:02 1998:09 | 0.6482 | 0.5432 | 0.0814 | 0.0548 | 0.0570 | 0.8734 | 1.1963 | 0.5224 | * |
| | (0,1,0) | | 68 obs. | 0.5418 | 0.4373 | 0.0654 | 0.0177 | 0.0154 | 0.9522 | | 0.6418 | * |
| | -- | 3 | 1993:03 1998:09 | 0.7587 | 0.6106 | 0.0919 | 0.0902 | 0.1036 | 0.7913 | 1.3305 | 0.4697 | * |
| | (0,1,0) | | 67 obs. | 0.5702 | 0.4576 | 0.0694 | 0.0355 | 0.0222 | 0.9274 | | 0.4545 | * |
| | -- | 4 | 1993:04 1998:09 | 0.8325 | 0.6684 | 0.1012 | 0.1338 | 0.1220 | 0.7291 | 1.4232 | 0.4462 | *** |
| | (0,1,0) | | 66 obs. | 0.5849 | 0.4800 | 0.0734 | 0.0593 | 0.0299 | 0.8957 | | 0.4769 | * |
| | -- | 5 | 1993:05 1998:09 | 0.9306 | 0.7515 | 0.1137 | 0.1817 | 0.1114 | 0.6914 | 1.4492 | 0.5000 | * |
| | (0,1,0) | | 65 obs. | 0.6421 | 0.5297 | 0.0808 | 0.0840 | 0.0263 | 0.8743 | | 0.5781 | * |
| | -- | 6 | 1993:06 1998:09 | 1.0576 | 0.8467 | 0.1288 | 0.2068 | 0.1199 | 0.6576 | 1.5516 | 0.5714 | * |
| | (0,1,0) | | 64 obs. | 0.6816 | 0.5571 | 0.0849 | 0.1045 | 0.0253 | 0.8546 | | 0.5079 | * |

**Table 9. Evaluation of the forecasting performance of the rolling-windows-based adaptive ARX models in simulated real time. (cont.)**

| Variable | ARX ARIMA | Forecast Horizon | Forecast sample Sample size | RMSE | MAE | MAPE | Bias Proportion | Variance Proportion | Covariance Proportion | Theil-U | CI | PT test on 1rst dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c) Unemployment rates (Continued) | | | | | | | | | | | | |
| a_ursa | -- | 1 | 1993:01 1998:09 | 0.3654 | 0.3024 | 0.0410 | 0.0022 | 0.0454 | 0.9380 | 1.0397 | 0.5294 | * |
| | (0,1,0) | | 69 obs. | 0.3515 | 0.2765 | 0.0379 | 0.0220 | 0.0021 | 0.9614 | | 0.6029 | * |
| | -- | 2 | 1993:02 1998:09 | 0.5275 | 0.4259 | 0.0582 | 0.0102 | 0.0819 | 0.8932 | 1.1331 | 0.5672 | * |
| | (0,1,0) | | 68 obs. | 0.4655 | 0.3910 | 0.0529 | 0.0546 | 0.0005 | 0.9301 | | 0.5821 | * |
| | -- | 3 | 1993:03 1998:09 | 0.6529 | 0.4914 | 0.0680 | 0.0283 | 0.1382 | 0.8187 | 1.4072 | 0.4848 | * |
| | (0,1,0) | | 67 obs. | 0.4640 | 0.3682 | 0.0499 | 0.1321 | 0.0000 | 0.8529 | | 0.4848 | * |
| | -- | 4 | 1993:04 1998:09 | 0.7790 | 0.5728 | 0.0794 | 0.0515 | 0.1991 | 0.7342 | 1.5958 | 0.4000 | * |
| | (0,1,0) | | 66 obs. | 0.4882 | 0.3769 | 0.0523 | 0.2435 | 0.0010 | 0.7403 | | 0.3846 | * |
| | -- | 5 | 1993:05 1998:09 | 0.9080 | 0.6544 | 0.0909 | 0.0728 | 0.2391 | 0.6728 | 1.5280 | 0.5156 | * |
| | (0,1,0) | | 65 obs. | 0.5942 | 0.4656 | 0.0652 | 0.2789 | 0.0038 | 0.7019 | | 0.6562 | * |
| | -- | 6 | 1993:06 1998:09 | 0.9978 | 0.7583 | 0.1052 | 0.0887 | 0.2846 | 0.6111 | 1.5216 | 0.4921 | * |
| | (0,1,0) | | 64 obs. | 0.6557 | 0.5381 | 0.0749 | 0.3520 | 0.0025 | 0.6298 | | 0.4444 | * |
| b_ursa | -- | 1 | 1993:01 1998:09 | 0.4475 | 0.3659 | 0.0399 | 0.0008 | 0.0022 | 0.9825 | 0.9364 | 0.4265 | -- |
| | (0,1,0) | | 69 obs. | 0.4779 | 0.3691 | 0.0402 | 0.0021 | 0.0001 | 0.9834 | | 0.6176 | * |
| | -- | 2 | 1993:02 1998:09 | 0.5899 | 0.4691 | 0.0514 | 0.0032 | 0.0020 | 0.9801 | 1.0980 | 0.4776 | * |
| | (0,1,0) | | 68 obs. | 0.5373 | 0.4239 | 0.0465 | 0.0051 | 0.0001 | 0.9802 | | 0.4030 | * |
| | -- | 3 | 1993:03 1998:09 | 0.6741 | 0.5606 | 0.0614 | 0.0083 | 0.0054 | 0.9713 | 1.0637 | 0.4848 | * |
| | (0,1,0) | | 67 obs. | 0.6338 | 0.4985 | 0.0547 | 0.0060 | 0.0000 | 0.9790 | | 0.5606 | * |
| | -- | 4 | 1993:04 1998:09 | 0.7149 | 0.6007 | 0.0658 | 0.0216 | 0.0133 | 0.9500 | 1.1180 | 0.4615 | -- |
| | (0,1,0) | | 66 obs. | 0.6395 | 0.5323 | 0.0585 | 0.0065 | 0.0000 | 0.9783 | | 0.4615 | * |
| | -- | 5 | 1993:05 1998:09 | 0.7075 | 0.5934 | 0.0646 | 0.0412 | 0.0062 | 0.9373 | 1.0698 | 0.3906 | -- |
| | (0,1,0) | | 65 obs. | 0.6613 | 0.5109 | 0.0559 | 0.0074 | 0.0003 | 0.9769 | | 0.4688 | * |
| | -- | 6 | 1993:06 1998:09 | 0.7071 | 0.5616 | 0.0614 | 0.0552 | 0.0236 | 0.9056 | 1.0765 | 0.3968 | -- |
| | (0,1,0) | | 64 obs. | 0.6568 | 0.5016 | 0.0553 | 0.0153 | 0.0069 | 0.9621 | | 0.5397 | * |

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