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ON THE POLITICAL ECONOMY OF SEASONAL ADJUSTMENT AND THE USE OF UNIVARIATE TIME–SERIES METHODS

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Seasonal adjustment of policy related variables requires joint consideration of seasonality in prices and quantities, yet monetary aggregates are routinely adjusted with univariate statistical methods. The approach can be nevertheless correct if the univariate model for the relevant interest rates does not require seasonal differencing. This could provide a pre–test for the validity of standard univariate seasonal adjustment methods.

Seasonal adjustment of economic time series, which removes a large proportion of their short-run variation has been traditionally based on methods developed from empirical experimentation. Over the last ten years research has been directed towards a model-based approach, mostly centered on signal extraction techniques applied to univariate time-series models. In fact, work by Bell, Box, Burman, Cleveland, Dagum, Hillmer, Pierce and Tiao -among others- has allowed statistical modeling considerations to be incorporated into seasonal adjustment. Yet, when adjusting "economic" series, care should be taken if univariate time-series techniques are to be used. There are also "economic" modeling considerations which can be relevant. They are implied by the implicit demand-supply equilibrium associated with observed quantities and by the existence of economic policy (or control). From the point of view of economic analysis and policy making, it may be convenient to distinguish between seasonality in demand and supply, as well as between seasonality exogenous to the policy maker and the endogenous one induced by policy. Furthermore, for a given market, seasonality in the quantity series and in the associated price series are interrelated.

Although the interest in distinguishing among those different types of seasonality has been occasionally pointed out[(1)], zero attention however has been paid to it in practice[(2)]. Very likely, sophisticated and flexible enough estimation methods that permit identification of these seasonal effects are still far from being available to practical adjusters; hence, seasonal adjustment will probably continue to be based on statistical univariate filtering. Yet elementary economic modeling considerations may have relevant practical applications that can complement statistical analysis. In this note we shall discuss one such consideration in the context of monetary control. It is well known that seasonal adjustment plays a crucial role

in monetary policy where targets are set in seasonally adjusted terms and therefore have to be multiplied by their corresponding seasonal factors in order to set the instrument's path. Thus errors in seasonal adjustment strongly affect the accuracy of monetary control[(3)].

Monetary policy is mainly a supply-type control, and exogenous seasonal swings are more likely to come from the demand side. To simplify the discussion, assume there are only two periods in a year. Consider the market of figure 1, where D and S are money demand and supply, respectively, x the rate of growth of the money supply (a monetary aggregate series) and i the interest rate[(4)]. Assume that the monetary authority controls S, shifting it at will in parallel, and that there is an exogenous seasonal shift in D. If D and D' represent money demand in the first and second semester, respectively, the seasonal variation in money will be x_s and the one in interest rate i_s[(5)].

Assume a monetary authority whose priority is to avoid interest rate variability. We shall refer to it as a K-type authority. It shall seek a constant i, for which it shall shift S to S'. Obviously, seasonality in i disappears, while the seasonal move in x increases by Δx_s.

On the contrary, assume the monetary authority to be a very strict monetarist, for which the first priority is to maintain a constant money rate-of-growth. We shall refer to it as an F-type authority. It will shift S to S''; seasonality in x disappears while the one in i increases by Δi_s.

Finally, assume that, at a given time, the monetary authority is changed. The new authority, in order to enforce whatever monetary policy in mind, requests from its staff an estimation of seasonality in the monetary aggregate. The staff,

unconcerned about previous monetary policies, simply looks at the univariate information in the x series[(6)]. Depending upon whether the previous authority was K or F, the conclusion would be: "we are dealing with a very seasonal series" or "no need to worry: there is no seasonality". Obviously the new monetary authority could be in for a surprise.

In general, the correct answer to the monetary authority request must take into account more information than the one contained in x alone. But there is an interesting case in which the univariate information supplies the correct answer:

Asume a K-type authority. Its interest is to get an answer to the question: by how much does S have to shift (seasonally) so that i remains constant? The answer is: by an amount equal to x_S^T. Further assume that the previous years were characterized by K-type policies. Then the univariate information in the x series would display a seasonal swing equal to x_S^T, providing thus the right answer.

As a matter of fact, real world monetary authorities tend to be of the K-type. In the U.S. case, for example, the objective of accomodating seasonal fluctuations in the demand for credit was specifically stated in the 1913 Federal Reserve Act. However, interest rate series often exhibit some residual seasonality, which seems to have been mostly induced by policy reactions to errors in the estimation of the seasonal component of the money supply[(7)]. In fact, policy formulation uses seasonal factor forecasts for the year ahead while monitoring relies on preliminary factors. All of these factors contain the so-called revision errors which can be quite seasonal[(8)]. Insofar as these errors affect control, they are likely to induce some

seasonality in the i-series. Moreover, even if all future values of x were to be known (so that no filter truncation, hence no revision, was needed), it is known that optimal extraction would produce (small) dips in the autocorrelation function of the seasonally adjusted x-series for seasonal lags, which could also have a (small) seasonal reflection in the i-series. But ignoring this small interest rate seasonality, as long as the monetary authority intends to remain K, the use of univariate time-series analysis seems valid. Yet, aside from the fact that it simplifies estimation of seasonality, is there a reason to always prefer a K-type of policy?

Seasonal fluctuations are often associated with innefficiencies which are mostly the result of imperfections in the ability to reallocate resources(9). But, on the one hand, these imperfections do not characterize financial and money markets. On the other hand, even in the presence of some rigidities, the fact that a particular seasonal profile is inefficient does not imply that the optimal profile is the one associated with no seasonality in prices.

Consider, for example, a (partial equilibrium) market, where seasonal moves in demand and supply induce seasonality in the price series (p) and in the quantity series (x). In general, different seasonal patterns imply different sequences of welfare measures associated with the equilibrium points (p,x). Thus, different seasonal patterns have different welfare properties. Basically, the comparison among them can be done in a manner similar to the analysis of welfare properties associated with price instability(10). Then it can be easily seen that a K-type policy (i.e., removing price variability) may very well be less preferable than a policy which produces a different seasonal profile. In fact, for a particular market and a well-defined optimality

criterion, there may be an optimal seasonal path[11].

Naturally, for policies aimed at altering seasonality in non-K ways, seasonal adjustment based on the information of an x series only would be inappropriate. Thus an easy-to-enforce check that could, in some way, indicate to us whether, in order to adjust a quantity series, a univariate method is appropriate would be quite hepful. Back to the monetary example, we concluded before that univariate seasonal adjustment of the quantity series was appropriate when the interest rate series showed no seasonality. This can provide therefore the easy-to-enforce pre-test. If the i series has no seasonality, univariate statistical techniques can be used. If, on the contrary, there is seasonality in i, then possibly a more sophisticated analysis would be required. Notice, however, that the test would provide a sufficient (though by no means necessary) condition for the validity of univariate time-series seasonal adjustment.

Thus, before seasonally adjusting a monetary aggregate series, it would be convenient to check for seasonality in the appropiate interest rate series. This can be done by estimating its spectrum or its autocorrelation function. In fact, the check could be simplified even further:

In Hillmer-Bell-Tiao (1981) it is suggested that if the autoregresive operator of the univariate model for a series does not contain the factor

$$U(B) = 1 + B + \dots + B^{11} \quad ,$$

then the series should not be adjusted for seasonality. Since

$$\nabla_{12} = 1-B^{12} = (1-B)\ U(B) \quad ,$$

this amounts to not adjusting series which do not require seasonal differencing. If, for example, the autoregresive operator were to be of the form $(1-\phi B^{12})$ with ϕ relatively small, the seasonality implied by the eleven roots of

$$1 + \alpha z^{-1} + \ldots + \alpha^{11} z^{-11} = 0 \quad ,$$

where α in the real positive 12th root of ϕ, would damp out rapidly from year to year. Thus the series would present, for all practical purposes, a small seasonal component of short duration.

Since, as we mentioned before, even under a K-type of policy, some seasonality is likely to remain in the interest rate series, the same pre-test could be used to determine the appropriateness of univariate time series adjustment of the money supply series: If the univariate model for the i-series does not require the factor ∇_{12}, then univariate time series methods could be used (under a K-type of policy) to seasonally adjust the money supply series, and vice-versa. The check is thus trivial to compute. Figure 2 displays the autocorrelation function of the rates of change of M_3 and the interbank rate for the Spanish case, both series computed as monthly averages of daily values. Obviously, no ∇_{12} is needed for the i-series, thus validating univariate adjustment of the monetary aggregate.

Similar examples can be constructed for different types of markets. In general, for the case of economic variables, when seasonally adjusting a quantity series, information on its dual variable, the price series, should also be considered, and vice-versa. As we saw before, one of the things the "dual" information might tell us is whether univariate statistical adjustment is appropriate, or whether a more complete analysis is required.

FOOTNOTES

(1) See Poole-Lieberman (1972), Bach *et al* (1976) and Sims (1981).

(2) An exception is the work by Plosser (1978 and 1979).

(3) See Pierce et al (1981).

(4) We assume that bank demand for excess reserves is a function of interest rate.

(5) The seasonal shift in D could be caused, for example, by a seasonal shift in income.

(6) Although simplified, it is nevertheless a fairly accurate description of reality.

(7) See, for example, Lawler (1979) and Maravall (1981).

(8) See Pierce (1980).

(9) See Kuznets (1933).

(10) See, for example, Turnovsky, Shalit and Schmitz (1980).

(11) In some instances the point may not be purely academic. When at the Spanish Ministry of Agriculture (in 1967), the author used some estimates of consumer surplus, as a measure of welfare, in a cost-benefit analysis of policies aimed at smoothing seasonal fluctuations in the availability of fruits to the Madrid market.

Figure 1.

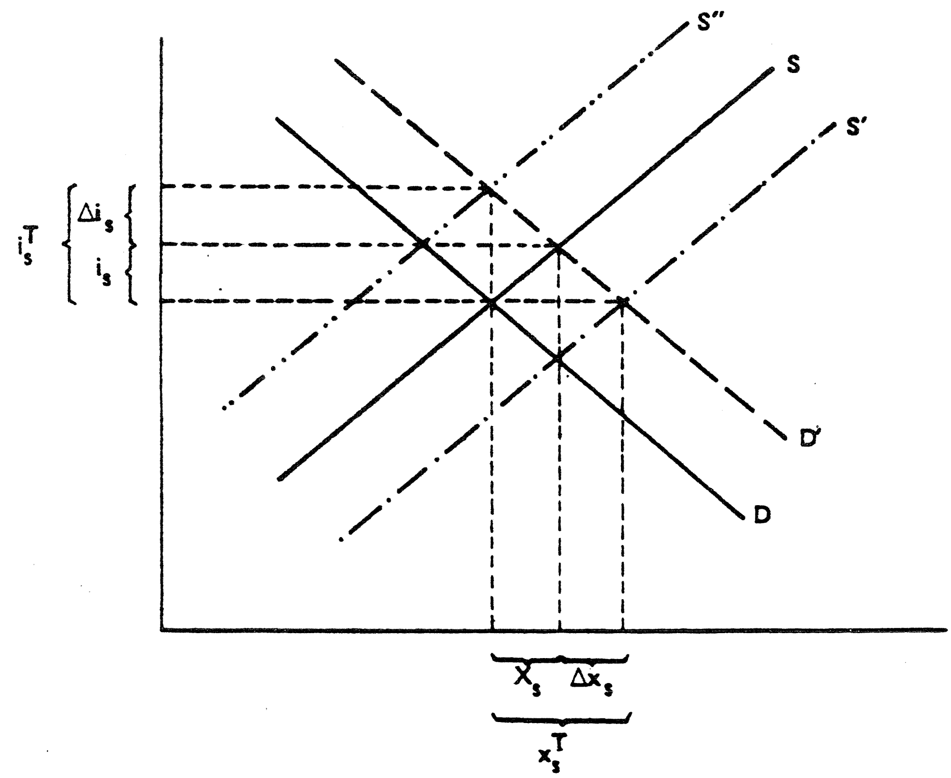
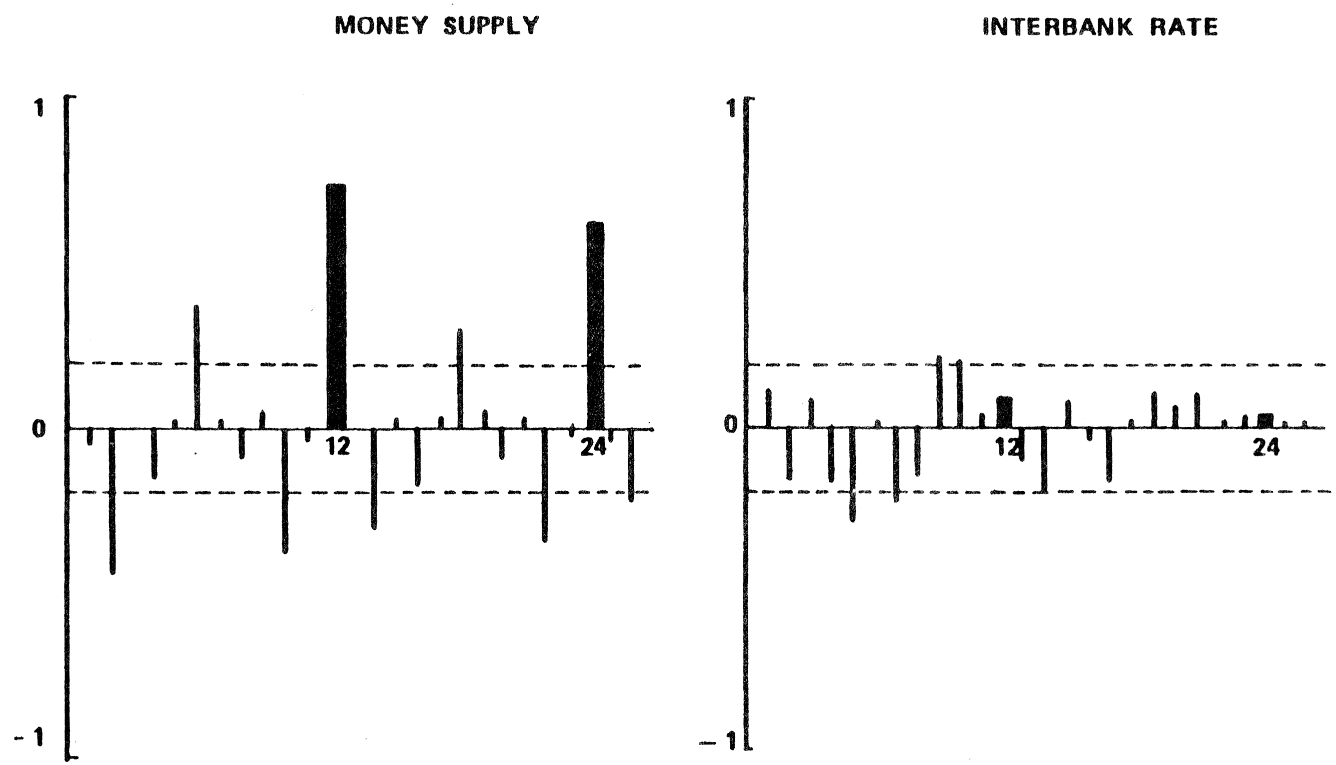


Figure 2.

AUTOCORRELATION FUNCTIONS



REFERENCES

BACH, G.L., CAGAN, P.H., FRIEDMAN, M., HILDRETH, C.G., MODIGLIANI, F. and OKUN, A., (1976), Improving the Monetary Aggregates: Report of the Advisory Committee on Monetary Statistics, Washington, D.C. Board of Governors of the Federal Reserve System.

HILLMER, S.C., BELL, W.R. and TIAO, G.C. (1981), "Modelling Considerations in the Seasonal Adjustment of Economic Time Series". Presented at the ASA-NBER-Census Conference on Applied Time Series Analysis of Economic Data, Washington, D.C., October 1981.

KUZNETS, S. (1933), Seasonal Variation in Industry and Trade, National Bureau of Economic Research.

LAWLER, A. (1979), "Federal Reserve Policy Strategy and Interest Rate Seasonality", Journal of Money, Credit and Banking, II, 4, 494-499.

MARAVALL, A. (1981), Desestacionalización y Política Monetaria, Estudios Económicos n° 19, Bank of Spain.

PIERCE, D.A. (1980) "Data Revisions with Moving Average Seasonal Adjustment Procedures", Journal of Econometrics, 14,1, 95-114.

PIERCE, D.A., PARKE, D.W., CLEVELAND, W.P. and MARAVALL, A. (1981), "Uncertainty in the Monetary Aggregates: Sources, Measurement and Policy Effects", Journal of Finance, XXXVI, 2, 507-515.

PLOSSER, C.I. (1978), "The Analysis of Seasonal Economic Models", Journal of Econometrics, 10, 147-163.

PLOSSER, C.I. (1978), "A Time Series Analysis of Seasonality in Econometric Models", in A. Zellner, Ed., Seasonal Adjustment of Economic Time Series, U.S. Department of Commerce, Bureau of the Census.

POOLE, W. and LIEBERMAN, C., (1972), "Improving Monetary Control", Brookings Papers on Economic Activity, 2, 293-335.

SIMS, C.A. (1981), "Discussion" of Pierce et al. (1981). Journal of Finance, XXXVI, 2, 515-517.

TURNOVSKY, S.J., SHALIT, H., and SCHMITZ, A., (1980), "Consumer's Surplus, Price Instability and Consumer Welfare", Econometrica, 48, 1, 135-153.

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