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# Trends, Random Walks and the Expectations-Augmented Phillips-Curve - A Summary

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In most macroeconomic models, variations in nominal variables, such as inflation or money growth, are considered to be important determinants of cyclical fluctuations in real activity. The major hypothesis in that respect is the so-called Phillips-curve. In its modern interpretation, it maintains that only unexpected changes in nominal magnitudes produce real effects. Reliable empirical evidence on these effects is therefore crucial for the building of macroeconomic models and the conduct of monetary policy.

Time series of output, industrial production or employment however contain growth and seasonal components in addition to cyclical elements. The empirical implementation of business cycle models therefore requires assumptions with respect to growth and seasonal parts as well, in order to isolate cyclical movements and to avoid misspecified equations. It has become general practice to assume that economic growth can be reasonably well approximated by a deterministic linear time trend. Seasonality is either captured through the explicit introduction of dummy variables or the use of seasonally adjusted data. Again, these procedures assume a deterministic seasonal structure. It is generally concluded in this literature, that unanticipated and possibly also expected changes in nominal magnitudes have non-negligible real effects.

Recent investigations into the stochastic characteristics of macroeconomic time series demonstrate that these variables most likely contain unit roots, i.e. stochastic trend or random walk elements. Two important consequences for empirical research on business cycle models follow from this finding: First, the cyclical and seasonal parts are modelled more adequately by random walks. Second, the estimation of Phillips-curves must be carried out in the appropriate stationary differences. Estimation results are badly misleading, if deterministic trends and seasonals are nevertheless introduced instead.

Given current practice in empirical research on business cycles, it must be asked whether the positive findings with respect to the Phillips-curve are an articifial result due to inappropriate measures of growth and seasonal

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components. In this paper underlying this summary, a broad approach to that problem is undertaken in several respects. First, the results using deterministic and stochastic trends are presented for the same data set, allowing a more systematic comparison. Second, relevant quarterly observations from six countries are used: The United States, France, West Germany, Great Britain, Italy and Switzerland. Third, sensitivity analysis is performed in a variety of directions. Both nominal and real variables are each proxied with two time series. Inflation and money growth are used for the former and real GNP and industrial production for the latter. In addition, the fixed and flexible exchange rate periods are analyzed separately.

The results can be summarized as follows: The distinction between deterministic and stochastic trends, used to decompose real activity into growth, cyclical and seasonal parts, strongly affects the outcome of the tests. The deterministic trend assumption for the growth component, traditionally used in the literature, is however inappropriate, given the stochastic characteristics of real activity macrovariables such as real GNP or industrial production. The result is a spuriously autocorrelated proxy for the business cycle which makes it relatively easy to obtain highly significant parameters in a distributed lag regression on proxies for unexpected inflation or monetary growth. The indicated persistence in the cyclical part is greatly reduced if differencing is applied to achieve stationarity. The empirical findings clearly show that the real effects of unforeseen movements in nominal variables are virtually reduced to zero under those circumstances. This outcome is further strengthened if the serial correlation structure of the residuals in the respective regressions is properly taken into account. An exception to this rule occurs for the United States with respect to the influence of unanticipated changes in the money stock $M_1$ on real activity. The same conclusion does rather surprisingly not hold for unexpected inflation, leaving the transmission channel for monetary policy actions on goods markets uncertain under the hypotheses used in this work.

Three rather general conclusions can be drawn: First, the stochastic characteristics of the variables entering an empirical investigation require careful consideration. Appropriate transformations for stationarity and a correct treatment of residual autocorrelation are especially important. Tests for unit roots and the large number of statistical techniques from the area of time-series analysis appear to be expecially promising procedures.

Second, sensitivity analysis in various directions contributes to a much clearer understanding of empirical regularities. «Good» results can be found for almost any proposition if one is willing to search for it long enough. It follows that policy advice based on a successful but highly special estimated relationship is likely to be a very risky undertaking.

Third, the transmission of real effects due to monetary policy actions does not seem to involve the Phillips-curve under rational expectations, at least not for the European countries investigated in this study.