REFERENCES


INTRODUCTION

In a recent paper in this journal, Makiinen and Woodward ([15]; MW hereafter) consider the direction of statistical causality between money and prices following several twentieth century hyperinflations. Because the successful end of a hyperinflation signals the advent of a new monetary régime consistent with price stability, fiscal responsibility, and renationalization, the strong correlation between monetary and price movements, evident during every recorded hyperinflation (e.g., see Cagan [5]), disappears immediately in its aftermath. In other words, a change in monetary régime takes place.

MW used Granger causality tests and found no relationship from money to prices or vice-versa with one notable exception, the Hungarian hyperinflation of 1945-46. According to MW the second Hungarian hyperinflation did not appear to fit the above scenario because once the transition to price stability was achieved inflation appears to Granger cause money. This result is unexpected since it is believed that a return to price stability signals the end of a policy based on seigniorage and the return to a régime in which the government meets its financial obligations through conventional means (e.g., borrowing from the public). Hence, a stabilization should produce a levelling of any significant money-price link of the kind which existed during the hyperinflation. Put differently, causality tests reported by MW for the Hungarian case seem to reject the hypothesis, found in all the other episodes they considered, of a significant change in the monetary régime in place.

Any statistical test of post-hyperinflation money-price relationships must, however, recognize that if a true régime change takes place any link between these variables may also be a function of the path of government debt. The reason, following the framework developed by Sargent and Wallace ([11]; SW hereafter), is that a successful stabilization can only be achieved when a government intends to satisfy its intertemporal budget constraint instead of relying on seigniorage to generate the bulk of its revenues. More difficult, however, is a definitive explanation of those factors which influence inflationary expecta-
tions and which facilitate a rapid transition to price stability (see [16] for a survey).

Finally, it should also be pointed out that the theory linking debt growth and inflation is not without its critics (see [14] and references therein). Nevertheless, as this note will show, once the money-price relationship is conditioned on government debt, the hypothesis of a significant régime change following the termination of the Hungarian hyperinflation of 1945-1946 is no longer rejected, contrary to the findings of MW. In fact, following the successful termination of hyperinflation in Hungary, the note issue was largely geared to fluctuations in the deficit ([11]).

Weekly data on currency in circulation (money), the cost of living index (price), and Treasury Bills outstanding (debt), are used in tests whose results are reported in the following section.1 The results support the hypothesis of a régime change.

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This paper was written while the author was on sabatical leave at the Institute of Economics and Statistics, St. Antony's College, both in Oxford, and the University of California at San Diego. Comments on a previous draft from the Editors Ingrid Rima, Gail Makinen, and an anonymous referee substantively improved the exposition and content of this paper.

The Transition from Hyperinflation to Price Stability: Further Evidence

Pierre L. Siklos*
By contrast, MW used monthly data resulting in considerably fewer degrees of freedom. However, when monthly data are used, applying the suggested testing procedure, the results are consistent with those found for other twentieth century hyperinflations, unlike the conclusions reached by MW. However, this result is not robust to the addition of the government debt growth variable.

**METHODOLOGY AND RESULTS**

MW apply Granger causality tests to a post-stabilization sample of quasi-differenced monthly rates of change in money and prices, thereby following the methodology outlined by SW [11] in their study of hyperinflations. The Granger-Sims causality tests require that the time series be stationary, yet MW do not provide evidence to suggest that quasi-differencing, required for data from a hyperinflation, is also appropriate for post-hyperinflation data.1 Alternatively, since the quasi-differences are used to correct for possible serial correlation in the regressions specified to detect Granger causality between money and prices, there is the presumption that a problem exists with the rate of change formulation requiring correction.

Hendry and Mitton [17] have shown that the imposition of a restriction of the type used by MW is not generally supported by the data. The implication then is that the regressions estimated by MW may have been misspecified.

Table 1 displays results of some tests conducted on the weekly series of money and prices for the period following the end of the Hungarian hyperinflation of 1945–1946 for which data are available. Autocorrelation estimates of the logarithm (log) of the money and price series reveal the kind of pattern which led Nelson and Plosser [9] to suggest that most macroeconomic series need to be differenced once to isolate their stationary component. Indeed, autocorrelations of the first log difference (log ch) of money and prices suggest that both series are stationary. Further indications of a such result are also available.

Table 1 also shows results of some unit root tests on the data.Dickey and Fuller [5] have produced a test to determine whether a particular series follows a trend or, rather, whether it possesses a unit root which prevents first differencing to remove it. Not surprisingly, the unit root (null) hypothesis is accepted for the logarithm of money and prices series (not shown). However, additional tests reveal that further differencing is not required since the hypothesis of a unit root in money growth is rejected at the 0.05 p.c. level while the unit root hypothesis in inflation is rejected at the 2.5 p.c. level of significance.2 It would appear, therefore, that quasi-differencing may be unnecessary.

The same conclusions can be drawn for monthly data (Table 3) since a unit root exists in both the log of money and price series while differencing largely eliminates the high autocorrelations present in the log levels.

As noted in the introduction, the regime change bringing about price stability, in the SW framework, signals the end of the influence of money growth on inflation and the beginning of a role for government debt discounted at the central bank in explaining a subsequent inflation, assuming that the regime change is a credible one.3 It would be more appropriate, therefore, to determine the existence of a Granger type causal relationship between money growth and inflation, conditional on debt growth.4 The results of such a test are presented in Table 2. Inflation is regressed jointly on a distributed lag of past current, and future money and debt growth. Growth rates are proxyed by the log change in the levels of each the series considered. One way of analyzing the link between inflation and money growth, conditional on debt growth, or inflation on debt growth, conditional on money growth, is by testing whether the null hypothesis, that all the log or lag coefficients are jointly zero, can be accepted. The resulting statistic is distributed as an F, and the estimated values for the post-Hungarian hyperinflation sample are the ones given in Table 2, along with their corresponding significance levels.

The reason for estimating a two-sided distributed lag is to avoid imposing, a priori, zero restrictions on either the lag and/or lag terms in a regression. Raj and Skitka [10] discuss at greater length other advantages of such an approach for a different application.

The smallest result of Table 2 is that neither lag nor lagged money growth terms jointly influence current inflation at any conventional level of statistical significance. Since such a result is clearly at variance with those obtained for hyperinflationary samples (see e.g., [11, 15]) there is evidence of a significant regime shift even in the Hungarian case. More importantly, perhaps, the results in Table 2 are consistent with the test outcome for the other countries considered by MW. Hence, the Hungarian

## Table 1

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2. Note: Notes — Currency in Circulation, Price — Cost of Living Index.


## Table 2

| Tests on Post-Hyperinflation Hungarian Data: August 1946–June 1948 (Monthly) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | s.e. |
| Notes—log | 551 | 954 | 946 | 951 | 951 | 208 |
| —log ch | 517 | 353 | 110 | 240 | 254 | 213 |
| Price—log | 474 | 962 | 929 | 924 | 832 | 216 |
| —log ch | 302 | 368 | 018 | 081 | 601 | 627 | 213 |

## Table 3

| Tests on Post-Hyperinflation Hungarian Data: August 1946–June 1948 (Monthly) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | s.e. |
| Log of Money |       |       |       |       |       |       |       |       |       |       |       |
| Log of Price |       |       |       |       |       |       |       |       |       |       |       |
| Dickey-Fuller Statistic | 679 |       |       |       |       |       |       |       |       |       |       |

Note: See Dickey and Fuller [5] for calculation and Tables of critical values.

4. Note: To that the results may be compared with those of MW a wholesale price index was used as the proxy for price. Conclusions are unaffected when a cost of living index is used. See [15]. Data is from [17].
transition from hyperinflation to price stability

footeNotes

1. A copy of the data and other results not presented in this paper are available upon request. Further details about the data and potential problems with them can be found in [13] and [15]. Note, however, that adding observations through an increase in sampling frequency tends not necessarily produce more robust results.

2. Evidence suggests that annual differences in the log of money and price in a sample from a hyperinflation are stationary. See [6] and [15]. This result is not uncontroversial in light of the debates about the existence of inflationary bubbles.

3. Critical values are approximately 4.41 (90%) and 4.17 (50%) for a sample of 43 observations.

4. See [12], pp. 5–10. For a recent description of the asymmetric credibility of the August 1946 event, unlike previous attempts at ending the Hungarian hyperinflation, see [13] and [14]. For an earlier analysis, see [2].

5. Measured as the rate of change in the amount of Treasury bills discounted at the central bank. The resulting series was also found to be stationary.

6. See [13]. Any description of causal relationships is, however, subject to the criticism of such tests, levied by [4].

7. I have estimated regressions of the kind reported in Table 3 using monthly data. Unlike the weekly data set (Table 2), or the monthly data set considered in Table 4, the results were found to be highly sensitive to lag selection. It was felt, therefore, that there was no basis for bringing confidence in making inferences based on such a regression.

References


Conclusion

This paper has reconsidered the evidence presented by MW [8] about the apparent absence of a regime shift, as measured by Granger-Sims type causality tests, after the end of the Hungarian hyperinflation of 1945–1946. By estimating a two-sided distributed lag model in which inflation is a function of money growth and debt growth, the latter variable included to comply with the requirements of SW [11] about the determinants of inflation across monetary regimes, estimates based on weekly data are consistent with the conclusions drawn by MW. Hence, after the hyperinflation ended, no statistical link appears to exist between inflation and money growth. A significant relationship, however, was found between inflation and debt growth. When monthly data are considered the money-prices relationship is also found to be consistent with the hypothesis of a regime change unlike what MW concluded. It was suggested that their econometric approach may have been improper under the circumstances.

An understanding of the economic policies implemented by the Hungarian government at the time is also shown to be helpful in interpreting the econometric estimates.