

# **Inflationary Surprises and Real Economic Activity in Germany: Some Tests Based on ‘Efficient Market’ Expectations**

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## **I. Introduction**

The combination of the natural rate supply theory and the rational expectations assumptions in macroeconomic models lead to the now famous argument that systematic, or anticipated, government policy is not capable of influencing real economic activity. These propositions with the implied policy neutrality have been commonly named the Expectations-Adjusted Supply Function (EASF) hypothesis. Put differently, the EASF hypothesis states that only the unanticipated (surprise) component of inflation can be transmitted to the real side of the economy, and that anticipated inflation will not exert any significant impact upon real economic activity.

In view of the profound policy implication of the EASF hypothesis, numerous studies have sought to test its empirical validity [see, for example, *Lucas (1973), Arak (1977), Barro (1977, 1978), Small (1979), Makin (1982), Mishkin (1982a, b) and Sheehey (1984)*]. However, all these studies, and many more, have been focused upon the United States’ experience. Moreover, these tests have produced, thus far, conflicting empirical results. A possible reason for such inconclusive evidence, as pointed out by *Fair (1979)*, may lie in the difficulty of developing a measure of anticipated inflation that does in fact reflect the public’s actual expectations. Because the public’s inflationary expectations are not directly observable, researchers usually sought to generate anticipated inflation series by means of some assumed econometric models. Since different model specifications could lead to different measures of anticipated (and unanticipated) inflation, it is not surprising that previous test results have been inconclusive.

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\* I am grateful for insights and helpful suggestions from *James Fackler*. The usual disclaimer applies.

The purpose of this paper is to empirically test the validity of the EASF hypothesis in the case of West Germany.<sup>1</sup> Importantly, in measuring the public's inflationary expectations, we follow *Fama's* (1975), *Mishkin's* (1981) and *Amihud's* (1982) suggestion and employ the market interest rates as efficient and rational estimates of anticipated inflation. Unlike other studies, such measures of anticipated (and unanticipated) inflation are derived from actual market-based expectations. It is shown that, for Germany over the period 1960:1 to 1983:3, the empirical results are favorable to the EASF hypothesis. The rest of the paper is set up as follows. Section II briefly outlines the process of generating the anticipated and unanticipated components of inflation and reports the regression estimates. The EASF test results for Germany are discussed in Section III. Concluding remarks are provided in Section IV.

## II. Efficient Market Estimates of Anticipated Inflation

It should be clear that a crucial problem in testing the validity of the EASF hypothesis lies in developing an appropriate decomposition of actual inflation into its anticipated and unanticipated elements. *Fama* (1975) and *Fama* and *Schwert* (1979) have showed that efficient and rational estimates of anticipated inflation can be obtained from the market short-term interest rates, and that the deviation of actual inflation from this implied measure represents unanticipated inflation. Unanticipated inflation at time  $t$ ,  $\pi_t^u$ , can be expressed as:

$$(1) \quad \pi_t^u = \pi_t - (\pi_t^e | \theta_{t-1})$$

where  $\pi_t$  is actual inflation at time  $t$ , and  $\pi_t^e$  is anticipated inflation at time  $t$  based on the information set  $\theta$  available at time  $(t - 1)$ .

The familiar Fisherian equation applied to time  $(t - 1)$  states

$$(2) \quad i_{t-1} = \pi_t^e | \theta_{t-1} + r_{t-1}^e | \theta_{t-1}$$

where  $i_{t-1}$  is the nominal (short term) interest rate observed at time  $(t - 1)$ , and  $r_{t-1}^e$  is the corresponding ex-ante real interest rate. Thus, equation (1) can be re-written as:

<sup>1</sup> *Fitzgerald* and *Pollio* (1982, 1983) and *Hoffman* and *Schlagenhauf* (1982) have also tested the policy neutrality proposition for Germany reporting results that are at odds with the EASF hypothesis. This paper suggests that the use of assumed econometric models to generate the anticipated and unanticipated components of the policy variable in the above studies appears to be a prime reason for their conclusion.

$$(3) \quad \pi_t^u = \pi_t - [i_{t-1} - r_{t-1}^e \mid \theta_{t-1}]$$

If we assume that the real interest rate is constant over time as in *Fama*, then the last term in (3) can be ignored. However, as *Mishkin* (1981) noted, such an assumption appears unduly restrictive. Alternatively, the ex-ante real interest rate can be made a function of some variables,  $X_{t-1}$ , that are based on the information set  $\theta_{t-1}$ . That is

$$(4) \quad r_{t-1}^e \mid \theta_{t-1} = \alpha X_{t-1}$$

Feeding (4) in (3) yields

$$\pi_t^u = \pi_t - i_{t-1} + \alpha X_{t-1}$$

or,

$$(5) \quad (\pi_t - i_{t-1}) = -\alpha X_{t-1} + \varepsilon_t$$

where  $\varepsilon_t$  is the vector of residuals reflecting the unanticipated component of inflation, ( $\varepsilon_t \equiv \pi_t^u$ ). Hence, efficient market estimates of anticipated inflation can be represented by the fitted values from regressing the dependent variable  $(\pi_t - i_{t-1})$  on the set of variables  $X_{t-1}$ . Following *Mishkin* (1981), *Singleton* (1981), and *Amihud* (1982), the variables set  $X_{t-1}$  is defined as: the time trend  $T$  in a fourth-degree polynomial form, lagged inflation  $\pi_{t-1}$ , and the lagged dependent variable  $(\pi_{t-1} - i_{t-2})$ . The anticipated inflation equation can thus be re-written in the following final form:

$$(6) \quad (\pi_t - i_{t-1}) = \beta_0 + \beta_1 T + \beta_2 T^2 + \beta_3 T^3 \\ \beta_4 T^4 + \beta_5 \pi_{t-1} + \beta_6 (\pi_{t-1} - i_{t-2}) + \varepsilon_t$$

The parameter estimates of equation (6) are displayed in Table 1. These estimates are generated using the German quarterly data over the period 1960: 1 through 1983: 3 (95 observations).<sup>2</sup> Because preliminary tests using ordinary least-squares (OLS) indicated significant first-order serial correlation, a maximum-likelihood correction procedure was employed to estimate the equation. According to the *Durbin-h* statistic, first-order serial correlation is no longer present, an inference that is supported by the score of the

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<sup>2</sup> Data on real GNP and GNP price deflator (and the corresponding inflation rate) were compiled from the International Economic Conditions published by the Federal Reserve Bank of St. Louis. Data on short-term interest rates and the unemployment rate were derived from OECD Main Economic Indicators (various issues).

**Table 1: The Anticipated Inflation Equation for Germany (Equation 6)**  
**Quarterly Data: 1960:1 - 1983:3**  
 Dependent Variable:  $(\pi_t - i_{t-1})$

Constant	Coefficient on					Summary Statistics						
	T	T <sup>2</sup>	T <sup>3</sup>	T <sup>4</sup>	$\pi_{t-1}$	$(\pi_{t-1} - i_{t-2})$	$\bar{R}^2$	S.E.	Rho	D.W.	h	$\tau$
2.149 (2.02)	-0.253 (1.86)	0.010 (1.83)	-0.0001 (1.75)	0.0000007 (1.63)	-1.324 (8.38)	0.757 (11.26)	0.729	1.104	0.23	1.99	0.08	38

Notes: The numbers in parentheses beneath the coefficient estimates are the absolute values of the *t*-statistics.  $\bar{R}^2$  is the coefficient of multiple determination adjusted for degrees of freedom. S.E. is the standard-error of the regression. Rho is the estimate of the first-order serial correlation adjustment coefficient. D.W. is the Durbin-Watson statistic. *h* is the Durbin-*h* statistic.  $\tau$  is the Geary nonparametric sign-changes statistic to test for general serial correlation.

*Geary* nonparametric tau statistic. To further check for serial correlation, autoregressions of the residuals were tested for first-through fourth-order serial correlation. None of the coefficients on the lagged residuals were significantly different from zero. It can thus be argued that the regression estimates of Table 1 are statistically efficient with correct test statistics. These regression estimates suggest further a close fit as about 73% of the total variation in the dependent variable is explained by the equation. All the explanatory variables in equation (6) are statistically significant which seems an evidence for the unconstancy of real interest rate in the German economy. Our main objective for estimating equation (6), however, is to obtain the market measures of anticipated and unanticipated inflation rates. These measures are given, respectively, by the fitted and residual values from equation (6).

### III. The EASF Test Results

To test the validity of the EASF hypothesis for Germany, we estimate the following equation of unemployment and test for the statistical significance of the coefficients on the anticipated and unanticipated inflation measures:<sup>3</sup>

$$(7) \quad U_t = U_t^* + \sum_{j=0}^{n_1} b_{1,j} \pi_{t-j}^e + \sum_{j=0}^{n_2} b_{2,j} \pi_{t-j}^u + \xi_t$$

where  $U$ ,  $U^*$  denote the natural logs of actual and natural rates of unemployment respectively,<sup>4</sup>  $\pi^e$  refers to the measure of anticipated inflation,  $\pi^u$  refers to the measure of unanticipated inflation; and  $\xi$  is a white noise disturbance term.

Equation (7) is estimated following *Mishkin* (1982 a, b) using polynomial distributed lags. However, contrary to *Mishkin*, we did not impose any of the endpoint restrictions – as recommended by *Schmidt* and *Waud* (1973) – in order to avoid possible bias arising from these restrictions. Following *Schmidt* and *Waud*, the degree of polynomial and the length of the lags on both the anticipated and unanticipated inflation variables were determined using *Theil's* residual-variance criterion.

<sup>3</sup> As recommended by *Makin*, the anticipated and unanticipated measures of inflation are simultaneously included in the unemployment testing equation. Because the inflation variables could have delayed impacts upon the real economy, lags on these variables are also included. For a supporting theoretical rationale, see *Blinder*<sup>4</sup> (1981).

<sup>4</sup> Following *Barro* (1978), *Small*, and *Mishkin* (1982 a, b), the natural level of unemployment is estimated here as a simple time trend.

The estimated equation is reported in Table 2. According to *Theil's* criterion, a fifth-degree polynomial with a lag length of ten quarters for both anticipated and unanticipated inflation measures were found appropriate.<sup>5</sup> The summary statistics suggest that the equation fits the data quite well. After correcting for first-order serial correlation, the *Durbin - Watson* statistic indicates the absence of any remaining first-order serial correlation, a result that is corroborated by the score of the *Geary* test.

**Table 2: Effects of Anticipated and Unanticipated Inflation on Unemployment in Germany\***  
(Equation 7)

Constant	Natural Unemployment	Anticipated Inflation	Unanticipated Inflation
-0.653 (2.48)	0.033 (6.36)	$b_{1,0} = 0.077 (2.07)$	$b_{2,0} = -0.083 (3.14)$
		$b_{1,1} = 0.043 (1.39)$	$b_{2,1} = -0.169 (3.76)$
		$b_{1,2} = -0.019 (0.77)$	$b_{2,2} = -0.157 (3.08)$
		$b_{1,3} = -0.051 (2.16)$	$b_{2,3} = -0.017 (1.96)$
		$b_{1,4} = -0.040 (1.70)$	$b_{2,4} = -0.061 (1.15)$
		$b_{1,5} = -0.003 (0.01)$	$b_{2,5} = -0.044 (0.90)$
$\bar{R}^2 = 0.92$		$b_{1,6} = 0.039 (1.51)$	$b_{2,6} = -0.061 (1.24)$
S.E. = 0.2295		$b_{1,7} = 0.050 (2.07)$	$b_{2,7} = -0.103 (2.02)$
Rho = 0.71		$b_{1,8} = 0.021 (0.87)$	$b_{2,8} = -0.145 (2.92)$
D.W. = 1.91		$b_{1,9} = -0.028 (0.90)$	$b_{2,9} = -0.148 (3.11)$
$\tau = 30$		$b_{1,10} = -0.032 (0.90)$	$b_{2,10} = -0.059 (1.49)$
		$\sum_{j=0}^{10} b_{1,j} = 0.060 (0.80)$	$\sum_{j=0}^{10} b_{2,j} = -1.137 (3.69)$

\* See Notes to Table 1. Absolute values of the *t*-statistics are given in parentheses after the coefficient estimates.

The empirical results reported in Table 1 lend strong support to the EASF hypothesis for Germany: only the unanticipated component of inflation exerts a significant negative impact upon unemployment. The impact of anticipated inflation upon unemployment is not significantly different from zero at the 0.05 level. In fact, the sign of some of the individual coefficients of anticipated inflation and their sum are even positive which is contrary to what might be expected a priori.<sup>6</sup> In marked contrast, all the individual

<sup>5</sup> The results, however, are robust to different lag specifications. Further, equation (7) was also estimated by unconstrained OLS to check whether the results are sensitive to the estimation procedure per se. Both estimation methods produced very similar results.

<sup>6</sup> That is, a higher rate of anticipated inflation may raise unemployment. This finding seems supportive of a positively sloped *Phillips* curve in Germany. Indeed, in view of the recent literature on the costs of inflation, such finding should not be surprising.

coefficients of unanticipated inflation are consistently negative having a negative cumulative sum that is statistically significant at better than the 0.01 level. These regression estimates imply that one percentage decrease in unanticipated inflation would eventually induce about one percentage decrease in unemployment over a period of 2<sup>1/2</sup> years. Importantly, these results further imply that a sharp reduction in inflation (if unanticipated) would induce a two year recession in the German economy starting in about the same quarter of the initial shock.

In sum, the empirical results presented in this paper for Germany support the claim of the expectations-adjusted supply function hypothesis that only unanticipated inflation can significantly induce deviations of unemployment from its trend. Unlike previous studies for Germany that are potentially sensitive to the assumed process of expectations-formation, the above empirical finding is derived from actual market-based expectations as embodied in the market interest rate.<sup>7</sup>

#### IV. Concluding Remarks

This paper explores for Germany the validity of the expectations-adjusted supply function hypothesis. In our setup, unlike that of previous studies, we have utilized “efficient market” results on the relationship between short-term interest rates and market anticipations of future inflation in order to decompose actual inflation into its anticipated and unanticipated parts.

In the case of Germany, the empirical results presented here based on the quarterly data over the period 1960:1 to 1983:3 strongly support the EASF hypothesis that only unanticipated inflation can influence real economic variables like unemployment and real output. Anticipated inflation on the other hand is found to be neutral for unemployment and real output. These results thus seem consistent with macroeconomic models that impose rationality of expectations in conjunction with short-run policy neutrality in the case of West Germany.

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<sup>7</sup> We have also investigated the validity of the EASF hypothesis using real output (rather than unemployment) as the dependent variable in equation (7). The results from this alternative specification concur with Table 2 in support of the underlying hypothesis. That is, the results show that only unanticipated inflation have a significant positive effect on real output. The regression results are available from the author upon request.

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## Zusammenfassung

### **Inflationäre Überraschungen und reale Wirtschaftsaktivität in Westdeutschland: Einige Tests auf der Grundlage von Erwartungen „effizienter Märkte“**

Diese Untersuchung behandelt die empirische Gültigkeit der Hypothese einer um Erwartungen bereinigten Angebotsfunktion (Expectations-Adjusted Supply Function = EASF). Bekanntlich wird in dieser Hypothese behauptet, daß nur die nicht-



antizipierte (Überraschungs-)Komponente der Inflation auf den realen Wirtschaftsprozess übertragen werden kann. Da systematische Stabilisierungspolitik nur wirksam sein kann, wenn das reale Wirtschaftsgeschehen durch systematische (antizipierte) Inflation beeinflusst wird, impliziert die EASF-Hypothese, daß jede Stabilisierungspolitik wirkungslos ist. In Anlehnung an *Fama's* Behauptung, daß kurzfristige Zinssätze effiziente Schätzer der antizipierten Inflation liefern, wird die tatsächliche Inflation in Westdeutschland für den Untersuchungszeitraum 1960:1 bis 1983:3 in eine antizipierte und eine nichtantizipierte Komponente zerlegt. Diese Inflationsmaße werden dann benutzt, um die Gültigkeit der EASF-Hypothese zu testen. Die empirischen Ergebnisse bekräftigen die Hypothese insofern, als nur die nichtantizipierte Inflation einen signifikanten negativen Einfluß auf die Arbeitslosigkeit ausübt. Diese Ergebnisse lassen an der Nützlichkeit systematischer Stabilisierungspolitik für Westdeutschland zweifeln.

## Summary

### **Inflationary Surprises and Real Economic Activity in West Germany: Some Tests Based on "Efficient Market" Expectations**

This inquiry addresses the empirical validity of the Expectations-Adjusted Supply Function hypothesis (EASF) in the case of West Germany. As is well known, this hypothesis contends that only the unanticipated (surprise) component of inflation can be transmitted to the real side of the economy. Since systematic stabilization policies can work only if systematic (anticipated) inflation affects real economic activity, the EASF hypothesis implies that such policies are impotent. Drawing on *Fama's* proposition that short-term interest rates provide efficient estimates of anticipated inflation, actual inflation in West Germany over the period 1960:1 – 1983:3 are decomposed into anticipated and unanticipated elements. These inflation measures are then used to test the validity of the EASF hypothesis. The empirical results strongly support the hypothesis in that only unanticipated inflation exerts a significant negative impact upon unemployment. For West Germany, such results therefore cast doubts on the usefulness of systematic stabilization policies.

## Résumé

### **Surprises inflationnistes et activités économiques réelles en République fédérale d'Allemagne: quelques analyses basées sur des attentes de « marché efficient »**

Cette recherche aborde la validité empirique de l'hypothèse de la fonction d'offre adaptée aux attentes en République fédérale d'Allemagne. Cette hypothèse bien connue soutient que seuls les composants non-anticipés (surprise) de l'inflation peuvent être transmis au côté réel de l'économie. Comme des politiques de stabilisation systématiques ne peuvent fonctionner que si une inflation systématique (anticipée) influence les activités économiques réelles, l'hypothèse de la fonction d'offre adaptée aux attentes implique que de telles politiques n'ont aucune force. Sur base de la pro-

position de *Fama* selon laquelle des taux d'intérêt à court terme permettent d'estimer avec efficacité l'inflation anticipée, l'inflation réelle en République fédérale d'Allemagne de 1960 I à 1983 III est décomposée en éléments anticipés et non-anticipés. Ces mesures d'inflation sont ensuite utilisées pour analyser la validité de l'hypothèse de la fonction d'offre adaptée aux attentes. Les résultats empiriques soutiennent fortement l'hypothèse que seule l'inflation non-anticipée influence négativement le chômage. Pour la République fédérale d'Allemagne, de tels résultats jettent donc des doutes sur l'utilité de politiques systématiques de stabilisation.