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The New Classical vs. the New Keynesian Debate on the Output-Inflation Tradeoff: Evidence from Four Industrialized Countries.*

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Abstract: Based on quarterly data for Canada, Germany, the United Kingdom, and the United States, this paper tests the New Classical view against the extended New Keynesian view about the factors underlying the output-inflation tradeoff. The simple Lucas is amended to reflect the presence of serial correlation in nominal aggregate demand shocks. We find that the mean rate of inflation has a statistically significant negative effect on the coefficient of the anticipated component of nominal aggregate demand shocks in all four countries and a statistically significant negative effect on the coefficient of the unanticipated component in every country but Germany. Aggregate volatility affects the output-inflation tradeoff in two of the four countries. These findings are in line with the New Keynesian view but cast serious doubts on the New Classical view.

I. Introduction.

In a recent contribution, Ball, Mankiw and Romer(BMR,1988) advance the view that the output-inflation tradeoff responds to changes in average inflation. As inflation rises prices are adjusted upward more frequently so that nominal price rigidity decreases. The increase in nominal price flexibility in turn lessens the impact of nominal aggregate demand shocks on real output. BMR refer to their empirical finding that increases in the mean rate of inflation cause the slope of the Phillips Curve to steepen as the New Keynesian interpretation of the output-inflation tradeoff. This New Keynesian interpretation stands in sharp contrast to the New Classical view(Lucas,1973) according to which the variability of aggregate demand disturbances is the decisive element in the determination of the output-inflation tradeoff. As the New Classical economics attributes sole importance to the variance as opposed to the mean of random variables in shaping the output-inflation tradeoff, this view predicts that the mean rate of inflation does not affect the response of real output to nominal aggregate demand shocks.

The objective of this paper is to offer a somewhat broader New Keynesian interpretation of the output-inflation tradeoff. Previous empirical examinations(BMR, DeFina) model nominal aggregate demand shocks as changes in nominal GNP which in turn follow a white noise process. Unfortunately, the assumption of a stochastic white noise process for changes in nominal GNP is at odds with the actual data generating process according to which aggregate demand shocks exhibit a high

degree of serial correlation. While recognizing that nominal aggregate demand shocks are highly correlated over time, BMR find that the distinction between anticipated and unanticipated aggregate demand shocks is not crucial in their examination of the output-inflation tradeoff. This paper takes a different view. We deem it important to differentiate between anticipated and unanticipated demand disturbances since this distinction allows for a much broader interpretation of the New Keynesian view of the output-inflation tradeoff. Conventional Keynesian economics stresses the short-run effects on real output of movements in nominal aggregate demand. In the present context, with agents being aware of the serial correlation pattern of nominal aggregate demand shocks, a broader New Keynesian interpretation of the output-inflation tradeoff would encompass the effect of mean inflation on the anticipated component of a nominal aggregate demand shock. Hence the extended interpretation of the New Keynesian view would suggest that average inflation affects the response of real output to both anticipated and unanticipated nominal aggregate demand shocks. Our specification of the demand side disturbances has the further advantage that it allows measuring separately the strength of the effect of mean inflation on the coefficient of the anticipated as opposed to the coefficient of the unanticipated demand shock. The empirical results show that there is indeed ample evidence pointing to the significance of the extended New Keynesian interpretation.

A second major difference relates to the type of data used and the scope of the study. While the earlier contributions used exclusively annual data spanning the 1948-86 period and a large sample of countries, the empirical findings reported in this paper are based on quarterly time series data for Canada, Germany, the United Kingdom, and the United States and cover the 1960:1-1992:4 period.[1] The choice of quarterly data derives from the assumed short-run nature of the output-inflation tradeoff. Given the short-run nature of this tradeoff, quarterly data should yield more conclusive evidence than annual data on the relationship between the factors involved in the output-inflation tradeoff.

Third, in contrast to previous studies this paper employs a different measure of aggregate volatility. The results reported in this paper are based on Kalman filtering. Underlying the choice of a different proxy for aggregate volatility is the intent to show that the distinction between aggregate variability and aggregate uncertainty matters in assessing the output-inflation tradeoff along New Classical and New Keynesian lines.

Finally, recent evidence suggests the presence of a unit root in real GNP data. As the modelling strategy of the earlier contributions is limited to estimating the Lucas model in its original form we expand it by taking proper account of the presence of a unit root. This is undertaken with a view towards ensuring that the outcome of the test of the New Classical vs. New Keynesian view is not tainted by the misspecification of the trend component of real output.

The remainder of the paper is organized as follows. Section II contains a succinct overview of the relevant literature. In Section III we explain the relevant measure of aggregate volatility used in the paper, while in Section IV we discuss the results of the test for a unit root and serial correlation, respectively. The amended version of the Lucas model appears in Section V. Section VI discusses the empirical results. A brief summary of the relevant points appears in Section VII.

II. Background.

Following the original idea developed by Lucas(1973), BMR first estimate the output response coefficient to nominal aggregate demand shocks for 43 countries over the 1948-1985 period. Then they run a cross-section regression of the estimated values of the output response coefficient on the mean rate of inflation, the square of the mean rate of inflation, the standard deviation of nominal GNP growth, and the variance of nominal GNP growth. BMR's empirical findings reveal that the average rate of inflation is a statistically significant determinant of the output-inflation tradeoff whereas aggregate variability, modelled by the standard deviation and variance of nominal GNP shocks, is not. Moreover, the estimated effect of the standard deviation of nominal GNP growth on the output-inflation tradeoff is found to be positive and not negative as predicted by the Lucas hypothesis. In summary, the evidence which BMR present casts doubt on the validity of the New Classical hypothesis about

the output-inflation tradeoff.

In a follow-up study using the same annual data as BMR, DeFina(1991) introduces a few desirable changes. Most important, he dispenses with the assumption that the coefficient which measures the response of real output to nominal aggregate demand shocks remained constant over the whole sample period. Instead the size of this coefficient is assumed to vary inversely with the level of average inflation. Furthermore, besides adding a supply shock to the standard Lucas model, DeFina also models aggregate variability by means of a moving standard deviation of the rate of inflation and not by the growth rate of nominal GNP. The results reported by DeFina lend further support to the New Keynesian notion that the output-inflation tradeoff is sensitive to the average rate of inflation rather than aggregate variability.

III. Aggregate Variability vs. Uncertainty About Inflation.

In previous work(DeFina(1991)) the standard deviation of the rate of inflation served as a proxy for aggregate variability. While this construct has been employed frequently in the literature, its use as a measure of volatility has been criticized on several grounds. Perhaps the most serious drawback associated with a moving variance or standard deviation of the inflation rate as a proxy for volatility is its failure to distinguish between expected and unexpected changes in the rate of inflation. Certainly, there may be a great deal of variability in the rate of inflation without there being much uncertainty. Such would be the case if agents

anticipated wide swings in the rate of inflation. Thus volatility in the observed rate of inflation may be extreme in the face of contemporaneous low uncertainty about inflation. Conversely, there may be a great deal of uncertainty about inflation although the observed volatility of the inflation rate may be extremely low. The simple moving standard deviation has the further drawback that it shares a close positive correlation with the mean rate of inflation over the sample period. The empirical assessment of the impact on the output-inflation tradeoff of aggregate variability - represented by a moving standard deviation - relative to the mean rate of inflation would thus be tainted by imprecise coefficient estimates.

In view of the desirability to distinguish between measures of volatility based on expected and unexpected inflation, an alternative measure of the volatility inherent in the rate of inflation is suggested. This measure is derived from a simple equation modelling the inflation process and is based on the unanticipated part of inflation. The measure of uncertainty is determined by application of the Kalman Filter routine.[2] The absolute value of the one-step Kalman Filter forecast error is taken to capture the short-term unpredictability of the inflation process which in turn is viewed as the extent of uncertainty faced by agents. It is this type of short-term uncertainty which should play a central role in the temporal decision making process in the Lucas model.

IV. Estimation Strategy.

IV.A. Unit Root Tests.

The existing literature on the New Keynesian interpretation of the output-inflation tradeoff has largely ignored the debate on whether real output contains a unit root or follows a stationary autoregressive process. The empirical modelling strategy of both BMR and DeFina is confined to estimating the reduced form equation of the Lucas model which views real output as following a stationary process. Since this property of the output process is based on an assumption rather than fact, we propose to conduct unit root tests of the real output data.

Table 1 presents the results of the unit root tests. The hypothesis that the real output process in the four countries contains a unit root cannot be rejected at the 10 percent level. This finding is taken as evidence in favor of the view that the real output series follows a stochastic trend and necessitates taking first differences of the real output series.

IV.B. Evidence of Serial Correlation in Nominal Aggregate Demand Disturbances.

The presence of serial correlation in nominal aggregate demand shocks is clearly evident in Table 2. In all four countries the nominal aggregate demand disturbance follows an autoregressive process. This suggests in turn that agents can use the past history of aggregate demand disturbances to compute the anticipated component of the present nominal

aggregate demand disturbance. We take account of the agents' ability to form forecasts of the nominal aggregate demand shocks by postulating the following scheme: Anticipated nominal aggregate demand shocks are formed via a rolling regression technique whereby the previous eight observations are used to produce an AR(3) forecast of the current nominal aggregate demand shock. The unanticipated component of the nominal aggregate demand shock is then obtained by subtracting the anticipated from the actual nominal aggregate demand shock.

V. The Model.

In line with previous approaches, we adopt a version of the Lucas model as the basic framework for the empirical analysis of the output-inflation tradeoff.

The serial correlation of nominal aggregate demand shocks calls for distinguishing between anticipated and unanticipated nominal aggregate demand disturbances as agents can form rough estimates of the anticipated nominal aggregate demand disturbance based solely on the previous history of these disturbances. The fact that nominal aggregate demand shocks are serially correlated also gives rise to a more fundamental test of the output-inflation tradeoff along Keynesian vs. New Classical lines. A more scrutinizing test of the competing views involves examining the effect of the mean rate of inflation on not only the response coefficient of real output to unanticipated nominal aggregate demand shocks but would also consider the effect of the mean rate of inflation on the

coefficient of anticipated nominal aggregate demand shocks.[3] The presence of the predicted negative effect in either case will cast serious doubts on the validity of the New Classical view. As in the original New Classical framework aggregate variability impacts on the coefficient of the unanticipated nominal aggregate disturbance only. Proceeding in this way permits measuring the impact of average inflation on the response coefficient of real output to unanticipated nominal aggregate demand shocks <u>after</u> accounting for the impact of aggregate variability.

The broader New Keynesian hypothesis about the output-inflation tradeoff can be easily incorporated into the extended Lucas model. Let

$$\Delta y_t = b_0 + b_1 adx_t + b_2 uadx_t + b_3 \mu_t \qquad (1)$$
$$uadx_t \sim N(0, \sigma_x^2) \qquad \mu_t \sim N(0, \sigma_\mu^2)$$

where Δy_t = the change in the level of real output

adx_t = anticipated shock to nominal aggregate demand

$uadx_t$ = unanticipated shock to nominal aggregate demand

μ_t = real aggregate supply shock

represent the Lucas model. According to the broader New Keynesian view there exists an inverse link between the coefficients of both the anticipated and the unanticipated nominal demand shock and average inflation. Specifically, the size of b_1 and b_2 decreases, ceteris paribus, as the mean rate of inflation increases. In contrast, the new Classical view hypothesizes that there exists an inverse link between b_2 and

aggregate variability, proxied by the variability of the rate of inflation. In algebraic form:

$$(2) \qquad b_1 = c(ai_t) \qquad \frac{\partial c}{\partial ai_t} < 0$$

$$b_2 = f(ai_t, vi_t) \qquad \frac{\partial f}{\partial ai_t} < 0 \qquad \frac{\partial f}{\partial vi_t} < 0$$

where ai_t = average rate of inflation[4]

vi_t = variability of the rate of inflation.

For simplicity, the functional relationship between the output response coefficients and the mean rate and the variability of inflation is modelled as a linear one:

$$(3) \qquad b_1 = c_o + c_1 ai_t \qquad c_0 > 0 \quad c_1 < 0$$

$$b_2 = f_0 + f_1 ai_t + f_2 vi_t \qquad f_0 > 0 \quad f_1 < 0 \quad f_2 < 0$$

The empirical specification of the New Keynesian and the New Classical hypotheses is obtained by substituting equation (3) into equation (1):

$$(4) \qquad \Delta y_t = b_0 + c_0 adx_t + c_1 adxai_t + f_0 uadx_t + f_1 uadxai_t + f_2 uadxvi_t + b_3 \mu_t$$

where $adxai_t = adx_t * ai_t$

$uadxai_t = uadx_t * ai_t$

$uadxvi_t = uadx_t * vi_t$

VI. Empirical Results.

Table 3 presents our statistical findings for the four countries. As is evident from the estimates of the relevant coefficients the broad New Keynesian interpretation of the output-inflation tradeoff receives unambiguous support from the data. The hypothesis that increases in the mean rate of inflation do not affect the size of the coefficient of anticipated nominal aggregate demand shocks can be rejected at the one percent level in all four countries. Moreover, the significance of the coefficient of $uadxai_t$ at the one percent level for Canada, the United Kingdom, and the United States suggests that there exists an inverse link between mean inflation and the response of output to unanticipated nominal aggregate demand shocks. This latter effect appears to be absent in Germany. On the whole, these findings imply that the New Keynesian view extends not only to the unanticipated component of nominal aggregate demand shocks but also to the anticipated component.

Given the strong support of the New Keynesian view, we examine next the possibility that the magnitude of the effect of changes in mean inflation on the two real output response coefficients is equal. The test of the restriction that the coefficient on $adxai4_t$ is equal in size to $uadxai4_t$ yields the results presented in Table 4. There is ample evidence in support of the proposition that the impact of mean inflation on the anticipated component of the nominal aggregate demand shock is statistically different from the impact of same on the unanticipated component of nominal aggregate demand shocks

in the United States and Germany and, to a lesser extent, in Canada. These findings point to the conclusion that in these countries mean inflation had a more pronounced effect on the response coefficient of anticipated aggregate demand shocks than on the response coefficient of unanticipated aggregate demand shocks. In the United Kingdom there appears to be no appreciable difference in the size of the coefficients.

The evidence pertaining to the view that aggregate volatility affects the output inflation tradeoff is mixed. While aggregate uncertainty appears to have exerted a negative effect on the magnitude of the response coefficient of unanticipated nominal aggregate demand shocks in Canada and the United Kingdom, no such effect seems to have been at work in Germany or the United States. Notice that supply shocks appear to have had a dampening effect on real output only in Germany.[5]

VII. Summary and Conclusion.

This paper provides an interesting extension of the New Keynesian vs. the New Classical debate about the factors underlying the output-inflation tradeoff. The simple Lucas model is amended to reflect the presence of serial correlation of nominal aggregate demand shocks. Using data for Canada, Germany, the United Kingdom, and the United States, we test the New Classical view against the extended New Keynesian view. We find that the mean rate of inflation had a statistically significant negative effect on the coefficient of the anticipated component of the nominal aggregate demand

shock in all four countries and a statistically significant negative effect on the unanticipated component in every country but Germany. These findings are in line with the New Keynesian view but cast serious doubt on the New Classical view. While the negative effect of the volatility of inflation on the output-inflation tradeoff is present in two of the four countries, it is accompanied by a strong inverse link between mean inflation and the size of the output response coefficients - a fact which is inconsistent with the New Classical view.

Although equally dismissive of the New Classical view as BMR's and DeFina's, our findings differ from the earlier contributions in several important respects. For one thing, unlike BMR we do not subscribe to the view that aggregate volatility plays no role in the determination of the output-inflation tradeoff. A comparison of the results reported by DeFina for the four countries with the results presented in this paper reveals significant differences, too. First, in contrast to DeFina we find that the mean rate of inflation had a significant negative impact on the output-inflation tradeoff in Canada, Germany, and the United Kingdom. This finding underscores the fact that quarterly data are more apt to uncover a short-run phenomenon such as the output-inflation tradeoff than annual data. Second, our results also show that there exists an inverse relationship between the response of real output to unanticipated nominal aggregate demand shocks and aggregate volatility in Canada and the United Kingdom.

The seeming rebuttal of the New Classical view also has

direct implications for the conduct of economic policy. If average inflation affects the output-inflation tradeoff, then attempts to reduce inflation by curtailing aggregate demand may result initially in only small output losses. As agents become aware of the pattern of nominal aggregate demand shocks, however, further reductions in inflation become possible only at the sacrifice of more output foregone. Hence a complete elimination of inflation may be possible only at extremely high cost.

Appendix:

This appendix contains a brief description of the assumptions underlying the measure of aggregate uncertainty employed in the paper. In addition it lays out the steps taken to generate this measure of volatility.

1. Expectations about the inflation process are based on the principle of weak rationality. Agents therefore base their forecasts of the rate of inflation solely on past information about the rate of inflation.

2. In practice, this assumption implies that the current rate of inflation is regressed on its lagged levels.
The number of regressors is chosen so as to remove serial correlation in the regression residuals.

3. The number of observations necessary to generate starting values of the regression coefficients is determined prior to executing the Kalman Filter routine.

4. Execution of Kalman Filter routine. This procedure updates coefficient estimates in light of new information on the current rate of inflation.

5. The recursive residuals are obtained by taking the difference between the current rate of inflation and the inflation forecast. Lastly, take the absolute value of the residual of each period to obtain the desired measure of uncertainty.

References:

Ball, L., G. Mankiw, and D. Romer(1988), The New Keynesian Economics and the Output-Inflation Tradeoff, Brookings Papers on Economic Activity, no.1, pp.1-82.

Ball, L. and Stephen Cecchetti(1990), Inflation and Uncertainty at Short and Long Horizons, Brookings Papers on Economic Activity, 1.

Brown, R., J. Durbin, and J. Evans(1975), Techniques for Testing the Constancy of Regression Relationships over Time, Journal of the Royal Statistical Society, B, pp.147-192.

Cecchetti, Stephen(1986), The Frequency of Price Adjustment: A Study of the Newsstand Prices of Magazines, Journal of Econometrics, pp.255-74.

DeFina, Robert(1991), International Evidence on a New Keynesian Theory on the Output-Inflation Tradeoff, Journal of Money, Credit and Banking, pp.410-22.

Dickey, D.A. and W.A. Fuller(1979), Distribution of the Estimators for Autoregressive Time Series with a Unit Root, Journal of the American Statistical Association, pp.427-31.

Engle, Robert. F.(1983), Estimates of the the Variances of US Inflation Based on the ARCH Model, Journal of Money, Credit and Banking, pp.286-301.

Evans, Martin(1991), Discovering the Link Between Inflation Rates and Inflation Uncertainty, Journal of Money, Credit, and Banking, pp.169-184.

Fischer, Stanley(1981), Towards an Understanding of the Costs of Inflation, Carnegie-Rochester Conference Series on Public Policy, pp. 5-41.

Foster, Edward(1978), The Variability of Inflation, Review of Economics and Statistics, pp.346-50.

Froyen, Richard and Roger Waud(1980), Further International Evidence on the Output-Inflation Tradeoffs, American Economic Review, pp.409-21.

------(1984), The Changing Relationship Between Aggregate Price and Output: the British Experience, Economica, pp.53-67.

------(1987), An Examination of Aggregate Price Uncertainty in Four Countries and Some Implications for Real Output, International Economic Review, pp.353-72.

Gauger,Jean(1989), The Generated Regressor Correction: Impacts Upon Inferences in Hypothesis Testing, Journal of Macroeconomics, pp.383-95.

Gordon, Robert(1990), What is the New-Keynesian Economics?, Journal of Economic Literature, pp. 1115-71.

Guender, Alfred V.(1993), Output, Technology, and the Output-Inflation Tradeoff, Unpublished Dissertation, University of North Carolina.

Guilkey, David and Peter Schmidt(1989), Extended Tabulations for Dickey-Fuller Tests, Economics Letters, pp.355-57.

Hatanaka, M.(1974), An Efficient Two-Step Estimator for the Dynamic Adjustment Model with Autoregressive Errors, Journal of Econometrics, pp.189-204.

Jansen, Dennis(1989), Does Inflation Uncertainty Affect Output Growth? Further Evidence, Economic Review(St. Louis), pp.43-54.

Kim, Chang-Jin and Charles Nelson(1989), The Time-Varying Parameter Model for Modelling Changing Conditional Variance: The Case of the Lucas Hypothesis, Journal of Business and Economic Statistics, pp.433-440.

Logue, Dennis and Thomas Willett(1976), A Note on the Relation Between the Rate and Variability of Inflation, Economica, pp.151-58.

Lucas, Robert(1973), Some International Evidence on Output-Inflation Tradeoffs, American Economic Review, pp.326-34.

Mankiw, Gregory(1985), Small Menu Costs and Large Business Cycles: A Macroeconomic Model, Quarterly Journal of Economics, pp.529-38.

Murphy, Kevin and Robert Topel(1985), Estimation and Inference in Two-Step Econometric Models, Journal of Business and Economic Statistics, pp.370-79.

Nelson, C.R., and C.I. Plosser(1982), Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications, Journal of Monetary Economics, pp.139-62.

Okun, Arthur(1971), The Mirage of Steady Inflation, Brookings Papers on Economic Activity, 2, pp.485-98.

Pagan, Adrian(1984), Econometric Issues in the Analysis of Regressions with Generated Regressors, International Economic Review, pp.221-47.

Pagan, A., A.D. Hall, and P.K. Trivedi(1983), Assessing the Variability of Inflation, Review of Economic Studies, pp.585-96.

Taylor, John B.(1981), On the Relation Between the Variability of Inflation and the Average Inflation Rate, Carnegie-Rochester Conference Series on Public Policy, pp.57-86.

Table 1: Unit Root Test[a]: Real Output.
Augmented Dickey-Fuller Test.

	Canada 57:4-92:4	Germany 60:4-92:4	UK 57:4-92:4	USA 57:4-92:4
Test Statistic[b]	.095	-4.54	-7.29	-9.05

Note:
[a] The real output series is taken from the International Financial Statistics(IFS) diskette. Real output is defined as real GNP or real GDP, respectively.
[b] The test statistic is $\rho=T(\beta-1)$ where β is the least squares estimate of the lagged dependent variable in the Dickey-Fuller test equation.

1. Two lagged differences are included in the Augmented Dickey-Fuller test equation.
2. The test equation includes a stationary time trend.
3. The critical value for 125 observations at a significance level of 10 percent is -17.57(Taken from Guilkey and Schmidt(1989)).

Table 2:

Equation estimated:[a] dx_t = constant + $a_1 dx_{t-1}$ + $a_2 dx_{t-2}$ + $a_3 dx_{t-3}$ + $a_4 dx_{t-4}$

	Canada 60:1-92:4	Germany 67:1-92:4	UK 60:1-92:4	USA 60:1-92:4
constant	.0067** (.0022)	.0077** (.0030)	.0088** (.0034)	.0098** (.0025)
dx_{t-1}	.4000** (.0833)	-.1283 (.0922)	.0387 (.0882)	.2623** (.0882)
dx_{t-2}	.1930* (.0935)	.0795 (.0912)	.2048** (.0850)	.1033 (.0900)
dx_{t-3}	.1997* (.0937)	.2193** (.0909)	.2761** (.0848)	.0290 (.0898)
dx_{t-4}	-.0982 (.0890)	.3683** (.0928)	.1042 (.0878)	.0874 (.0866)
Q(33)[b]	33.57	11.07	34.66	43.17
Signif. Level	.44	.99	.39	.11

Note:
[a] Nominal aggregate demand shocks are modelled as first differences in nominal GNP(GDP). The nominal GNP(GDP) series were taken from International Financial Statistics(IFS).
[b] Except in the case of Germany where the Q statistic is computed for 26 lags.

Table 3:

Equation estimated:[a,b] $\Delta y_t = b_0 + c_0 adxt_t + c_1 adxai4_t + f_0 uadx_t + f_1 uadxai4_t\ f_2 uadxvi_t + b_3 \mu_t$

	Canada 60:1-92:4	Germany 67:1-92:4	UK 60:1-92:4	USA 60:1-92:4
constant	-.0066** (.0012)	.0011 (.0020)	-.0066** (.0020)	.0065** (.0012)
adx_t	1.1013** (.0699)	.3142** (.1547)	.8289** (.0913)	1.2322** (.0710)
$adxai4_t$	-.2482** (.0245)	-.2484** (.0862)	-.1116** (.0228)	-.3772** (.0309)
$uadx_t$	1.1971** (.0758)	.1183 (.1480)	.9572** (.0780)	1.0184** (.0824)
$uadxai4_t$	-.1819** (.0449)	-.0349 (.0997)	-.1188** (.0206)	-.1126** (.0372)
$uadxvi_t$	-.3242** (.0795)	.0404 (.0685)	-.1703** (.0363)	-.1257 (.0898)
μ_t	.0004 (.0014)	-.0064** (.0017)	.0073 (.0067)	.0015 (.0011)
Summary Measures				
DW	1.69	1.92	1.89	1.85
standard error	.0050	.0093	.0092	.0036
adj. R^2	.78	.14	.55	.85

Note:
[a] The supply shock is modelled as the difference of the log of an energy index and the log of the implicit GDP deflator. The energy price index for each country was obtained from the OECD database.

[b] As the regression equation contains several generated regressors, we followed the procedure suggested by Murphy and Topel(1988) to obtain consistent estimates of the standard errors of the regression coefficients. A subsequent comparison of the estimates of standard errors generated by OLS and the ones produced by the Murphy-Topel procedure revealed that there was virtually no difference between the two types of estimates.

Table 4: Test of Restriction: Coefficient of $\dot{adxai4}_t$ equals coefficient of $uadxai4_t$.

	Canada	Germany	UK	USA
F(1,125)[a]	3.52	5.89	.08	47.40
Significance Level	.063	.017	.78	.00

Note:
[a] Except in the case of Germany where the degrees of freedom are 96 instead of 125.

Footnotes:

1. The data period for Germany extends from 1967:1 to 1992:4

2. See the Appendix for further details on how this measure of aggregate uncertainty is constructed.

3. Within the New Classical framework anticipated nominal aggregate demand shocks should not have any effect on real output. While the discussion of anticipated vs. unanticipated policy effects is of importance, it does not concern us here. Moreover, we do not bother do distinguish between Keynesian and New Keynesian interpretations of the output-inflation tradeoff. One could argue that the New Keynesian view predicts that only the coefficient of the unanticipated component of nominal aggregate demand shocks reacts to changes in average inflation while the more traditional Keynesian view could be interpreted as suggesting that it is the coefficient of the anticipated nominal aggregate demand shocks which responds to changes in mean inflation. The emphasis of the paper is squarely on determining whether the real output response coefficients move in concert with mean inflation.

4. Throughout the paper the mean rate of inflation is defined as follows:

$$ai4_t = (lp_{t-1}+lp_{t-2}+lp_{t-3}+lp_{t-4})/4$$

where lp_{t-j} is the log of the rate of inflation at time t-j.

5. Similar results are obtained if the original reduced form equation containing a lagged dependent variable and a deterministic time trend is retained. These results are available upon request from the author.

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No. 9101 Bounds on the Effect of Heteroscedasticity on the Chow Test for Structural Change, by David Giles and Offer Lieberman.

No. 9102 The Optimal Size of a Preliminary Test for Linear Restrictions when Estimating the Regression Scale Parameter, by Judith A. Giles and Offer Lieberman.

No. 9103 Some Properties of the Durbin-Watson Test After a Preliminary t-Test, by David Giles and Offer Lieberman.

No. 9104 Preliminary-Test Estimation of the Regression Scale Parameter when the Loss Function is Asymmetric, by Judith A. Giles and David E. A. Giles.

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