Estimating the Output Effects of Energy Price and Real Interest Rate Shocks: A Cross-Country Study*

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1. Introduction

This paper is concerned with investigating how inflation and interest rate shocks affect the real side of the economy. To do this, a simple aggregate demand model is specified and estimated from the data of ten western countries. In particular, the model gives estimates of real interest rate and energy price effects. In addition, it can be used to examine certain general features of output, price and interest rate determination in these countries. For instance, it can be used to analyze the persistence of output behaviour, i.e. the speed of adjustment with respect to changes in different determinants of output.

The data sample in the empirical study covers the period 1964–1983. Using quarterly data with a total of 650 oberservations makes it possible to obtain very precise estimates and to evaluate the stability of the underlying behavioural equations over time, for instance, in terms of the "first oil crisis" period and the late 1970's when monetary policy rules changed in some major countries.

2. Theoretical Considerations

As stated above, the analysis concentrates on examining the behaviour of aggregate demand. The following standard Keynesian model is used as a point of reference:

$$C = C(\bar{Y}_P, r) \tag{1}$$

$$I = I(Y, r, SS) \tag{2}$$

$$M = M(Y, P_m) \tag{3}$$

$$Y = C + I + G + X - M, \tag{4}$$

* This paper draws on work conducted while I was on leave of absence in the General Economic Analysis Division of the *UN* Economic Commission for Europe, Geneva, September 1985 to December 1985. I am indebted to an anonymous referee and to Professor Ernst Baltensperger for helpful comments. Financial support from the Yrjö Jahnsson Foundation is gratefully acknowledged.

where Y denotes aggregate output, C private consumption, I private investment, G government expenditures, X exports and M imports, all variables being in real terms. The variable r, in turn, is the real interest rate, defined as $R - p^e$ where R is the nominal interest rate and p^e the expected rate of inflation. $\bar{Y}_p$ is real income, SS is the relative price of energy and P_m is the price of domestic goods relative to world market prices. The income variable is defined as follows: $\bar{Y}_p = Y_p - (A/P)p^e$, where Y_p denotes the real disposable income of the private sector, A the stock of liquid assets and P the price level. The fact that the relevant income measure also includes corporate retained earnings is discussed and analyzed in *Feldstein* (1973) and *Koskela/Virén* (1983). The inflation effect on liquid assets, and on household consumption behaviour, is analyzed in e.g. *Hendry* and von *Ungern-Stenberg* (1981)[1].

Given this definition of disposable income and the additional assumption that tax rates are constant over time, we can derive a consumption function which depends on Y, p^e and r only. In addition, we simplify the analysis by dropping the relative price variable P_m. This is done because the movements in this variable largely follow the movements in SS and P, which are already included in the model, and it is probable that we are not able to identify the separate effect of P_m in the subsequent empirical analysis. Obviously, when assessing the effects of SS and P (or, in fact, also p^e) we should take this simplification into account. Thus, when equations (1) and (4) are solved in terms of Y assuming that X and G are exogenous, we might end up with the following log linear approximation:

$$Y_t = a_0 + a_1 X_t + a_2 G_t + a_3 SS_t + a_4 r_t + a_5 p_t^e + u_t, \tag{5}$$

where all the variables except r and p^e are in natural logs and where u is a stochastic error term.

The problem is that (5) is a completely static specification, and as such it is hard to see that it could adequately explain both the short- and long-run movements in Y. To solve this problem we make use of the standard partial adjustment mechanism. In addition, we introduce a time trend variable, t, in (5) to capture the effects of structural and/or technical change. Thus, the final estimating specification takes the form:

$$Y_t = b_0 + b_1 Y_{t-1} + b_2 X_t + b_3 G_t + b_4 SS_t + b_5 r_t + b_6 p_t^e + b_7 t + u_t. \tag{6}$$

[1] When assessing the effect of inflation on household income and consumption it seems obvious that the effect, if it exists, is of short-term nature. This is because in the long run nominal interest rates will adjust to the expected rate of inflation compensating for the inflation losses (we do not, however, agree with the view that nominal interest rates would already in the short run move exactly according to the Fisher equation, see e.g. *Virén*, 1986). Of course, inflation may also affect private consumption via various other channels which are subsequently discussed in the text.

The role of the right-hand side variables of (6) should be fairly straightforward[2]. The autonomous components of aggregate real demand, Y and G, should have a positive effect on Y while real energy prices, SS, the real interest rate, r, and the expected rate of inflation should have a negative effect on Y. Only the time trend variable, t, cannot be unambiguously signed, given our definition of this variable. Things become even more complicated if one takes into account the fact that this variable may also serve as a proxy for real wealth, not to speak of any other interpretations we may care to give it.

3. Estimation Procedure

As mentioned earlier, (6) is estimated using data from ten western countries from the period 1961.1–1983.4. Even though the number of observations for each country is about ten times the number of estimated parameters, the existence of small-sample bias cannot be ruled out. On the other hand, individual country results are not so easily summarized. The data have therefore been pooled, and because they are mainly used in level form, individual country intercepts are always introduced in this case (possible contemporaneous correlation between country residuals has not, however, been taken into account for computational reasons). Pooling is carried out using both equal weights for all countries (i.e. the data are unweighted, this case being denoted by the abbreviation UW) and using GDP weights (i.e. the value of gross domestic product in purchasers' values – billions of constant US dollars at 1975 exchange rates and prices).

Besides various data problems there are two major problems relating to the empirical analysis. First, how to obtain data for the (unobservable) expected rate of inflation, which is such an important variable in evaluating the role and impact of the real interest rate on output. Secondly, how to take into account the fact that r is presumably endogenous[3, 4].

[2] Obviously, one could arrive at the reduced form (6) by using a structural model which differs from that given by equations (1)–(4). Even so, we still think that the structural model we use takes into account the most important elements of output determination.

[3] If we use a conventional IS/LM framework with an exogenous money supply as a starting point, Y and r are in fact simultaneously determined. Obviously, if interest rates are regulated, or pegged by adjusting monetary aggregates, we might treat r as exogenous. Yet another case is the one implied by the simple form of the Fisher hypothesis, which says that real rate is approximately constant and that the nominal rate will move one-for-one with the anticipated rate of inflation. Clearly, this hypothesis does not produce any real interest rate effects. (p.t.o.)

As far as the expected rate of inflation is concerned, two alternative ways of constructing a proxy variable for this unobservable are used. Obviously, all proxy variables include measurement errors, which, in turn, tend to bias the estimates. There is no way of finding out how much the estimates are in fact biased: the variance of the measurement error (as well as the true variance of u) is simply not known. Anyway, the present analysis makes use of, on the one hand, the actual rate of inflation (denoted by A) and, on the other hand, the predictions of an autoregressive model ($AR(k)$) and a vector autoregressive model ($VAR(k)$, where k indicates the lag length). The use of the actual rate of inflation as a proxy for p^e is, of course, at variance with the rational expectations hypothesis, whereas the use of the $AR(k)$ and $VAR(k)$ models is consistent with the weak and semi-strong forms of this hypothesis.

The simultaneity problem caused by the presence of the real interest rate variable in the output equation is solved in a standard way by using the instrumental variable method (IV), and by including the (current and lagged) growth rate of the money stock – in addition to the current and lagged values of the exogenous variables – as instruments[5]. However, the three-stage least squares method is also applied so that equation (6) is estimated together with a demand for money schedule (which, in turn, is solved with respect to the nominal interest rate). In fact, it turns out that these two sets of results are in essence very similar. So as to avoid a detailed discussion of the specification of the demand for money (real balances) equation, this paper concentrates on the estimation results with the IV method. Obviously, it is not only the real rate of interest which may be endogenous, but also exports and the rate of inflation. The rate of inflation, in turn, is used directly as a proxy for p^e or as an instrument in forming p^e. Thus p^e may not strictly speaking be exogenous, which may give arise to some estimation problems, see e.g. *Cumby* et al. (1983) for a more thorough analysis.

still [3] If, however, r is assumed to be endogenous, then it would be correlated with the error term, u, and the ordinary least squares estimates of the parameters of (6) would be inconsistent and thus give incorrect inference about the impact of interest rates on aggregate demand. This problem can, however, be solved by using the IV method. It should be emphasized that, even if interest rates were not directly market-determined but were instead an object of various sorts of regulatory measures, this would not necessarily eleminate the simultaneity problem. If, in fact, interest rates are systematically adjusted in response to current values of, say, total output, then the orthogonality between r and u would be violated. It is only in the case where policy reacts only to lagged values of Y that a similar simultaneity problem would not arise and the use of OLS would be appropriate.

[4] Obviously, fiscal policy rules may invalidate the assumption that the G variable is exogenous. This problem is ignored here.

[5] Notice, that equation (6) can be expressed in terms of the nominal rate of interest and the expected rate of inflation. Thus, in fact, it is the nominal rate of interest which is modelled in the instrumental variable estimation (according to the standard LM curve).

4. Empirical Results

We start with some brief comments on the data. The data cover 10 western countries: Austria, Canada, the Federal Republic of Germany, Finland, France, Italy, Sweden, Switzerland, the United Kingdom and the United States. The data are quarterly and seasonally adjusted. (A complete description of the data and the data sources as well as a printout of the data are available from the author upon request.) The data obtained from OECD sources have been derived in a seasonally adjusted form. As far as other data are concerned, seasonal adjustment has been carried out using the moving average seasonal adjustment procedure of the TSP program package. It is clear that seasonal adjustment procedures with respect to different time series differ, and this, in turn, gives rise to autocorrelation and decreases the efficiency of estimation. The interest rate series were found to be free from seasonality and thus these series were not adjusted. The data sample covers the period 1964.1–1983.4 for the large countries (Canada, the Federal Republic of Germany, France, Italy, the United Kingdom and the United States) and the period 1970.1–1983.4 for the rest of the countries (this is simply because of data reasons). Five observations were, however, lost in differencing and lagging so that final estimation made use of data samples with 75 and 50 observations, respectively. The following time series are used in the subsequent analysis: Y = Gross Domestic Product (in the case of Canada and the USA Gross National Product is used instead) at constant prices, P is the corresponding implicit deflator, X is exports at constant GDP prices, G is government final consumption at constant prices, SS = the producer price of energy (or fuel, or in some cases petroleum products) relative to P, M = the money supply including quasi-money, RL = the nominal long-term interest rate, which is derived from yields on long-term government bonds, RS = the nominal short-term interest rate, which is derived from three-month Treasury bill rates (unfortunately, the short-term interest series were available only in the case of the six "large" countries, and thus the analysis makes use mainly of the long rates), and t = a time trend with 1964.1 = .01, the increments being .01. Interest rates and inflation are expressed as annual rates. The interest rate observations represent the end of the period.

We turn now to the estimation results, which are presented in Tables 1 and 2 corresponding to pooled cross-country data and individual country data, respectively. In the case of pooled data both OLS and IV results are displayed. As far as the expected rate of inflation is concerned the results with an $AR(4)$ model are so close to those with a $VAR(4)$ model that they are not reported here. In the case of individual country data only IV results (given $AR(4)$ model predictions for p^e) are reported.

Table 1

Estimation Results with Pooled Cross-Country Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Y_{t-1}	.933	.879	.934	.879	.937	.884	.936	.882
	(57.70)	(51.67)	(57.36)	(51.60)	(58.25)	(51.83)	(57.75)	(51.60)
X	.014	.046	.046	.047	.018	.047	.016	.048
	(2.86)	(6.87)	(2.78)	(7.10)	(3.64)	(7.03)	(3.16)	(7.18)
SS	-.011	-.010	-.008	-.010	-.012	-.011	-.011	-.011
	(4.77)	(3.87)	(4.47)	(3.96)	(5.35)	(4.23)	(3.16)	(4.19)
r	-.083	-.114	-.152	-.162	-.037	-.062	-.139	-.120
	(2.78)	(3.44)	(5.17)	(4.59)	(1.15)	(1.64)	(3.80)	(2.92)
p^e	-.133	-.154	-.196	-.198	-.169	-.169	-.223	-.205
	(4.51)	(4.73)	(6.48)	(5.75)	(5.39)	(5.13)	(6.83)	(5.94)
G	.006	.043	.005	.043	.008	.042	.006	.043
	(0.60)	(3.32)	(0.53)	(3.30)	(0.79)	(3.24)	(0.62)	(3.26)
t	.040	.003	.043	.006	.033	.003	.044	.004
	(3.91)	(0.32)	(4.53)	(0.53)	(3.15)	(0.03)	(4.04)	(0.34)
SEE	.0119	.0144	.0145	.0144	.0119	.0143	.0119	.0144
h	1.721	3.268	4.011	3.297	.643	2.515	.462	2.847
Method	OLS	OLS	IV	IV	OLS	OLS	IV	IV
Weighting	W	UW	W	UW	W	UW	W	UW
Definition of p^e	A	A	A	A	VAR4	VAR4	VAR4	VAR4

Numbers in parentheses are t-ratios, which in the case of IV estimation are, of course, only asymptotic. The equations include country intercepts which are not displayed. *SEE* denotes the standard error of the estimate and h Durbin's h autocorrelations statistic (which has been computed by taking account of the gap in the sequence in movements from one country to the next; its distribution under the null hypothesis is $N(0, 1)$. *UW* indicates that the observations are unweighted and *W* that the observations have been weighted by the *GDP* weights. *A*, in turn, indicates that the actual rate of inflation is used as a proxy for p^e and *VAR*4 that the predicted values of a *VAR*(4) model are used a proxy for p^e. In the case of the IV estimation, the instruments include lagged values of exogenous variables and the growth rate of the money stock and its lagged value.

Table 2

Estimation Results with Individual Country Data

Country	Austria	Canada	FRG	Finland	France	Italy	Sweden	Switzerland	UK	USA
C	-1.414	-.095	-1.123	-1.533	-1.121	.871	-.225	-.517	1.552	.369
	(0.84)	(0.20)	(2.13)	(0.90)	(3.23)	(1.49)	(0.24)	(0.50)	(2.05)	(1.14)
Y_{t-1}	.537	.856	.796	.549	.407	.846	.469	.740	.341	.943
	(4.25)	(13.78)	(11.10)	(4.00)	(6.10)	(15.03)	(4.24)	(7.12)	(3.39)	(14.84)
X	.137	.087	.034	.022	.152	.070	.121	.180	.120	-.004
	(3.53)	(3.28)	(1.21)	(0.43)	(8.10)	(3.20)	(3.69)	(2.98)	(5.04)	(0.16)
SS	-.014	.033	-.026	.074	-.089	-.038	-.009	.020	-.155	.002
	(3.53)	(1.12)	(3.42)	(1.23)	(4.04)	(1.67)	(0.60)	(0.70)	(4.51)	(0.16)
r	-.450	-.587	-.051	-2.454	-.054	-.135	-.042	-.617	-.377	-.327
	(1.93)	(3.86)	(0.33)	(1.93)	(0.42)	(0.82)	(0.11)	(1.54)	(2.66)	(1.73)
p^e	-.503	-.660	-.240	-2.546	.031	-.160	.196	.064	-.461	-.497
	(2.07)	(4.15)	(1.54)	(2.07)	(0.23)	(0.89)	(0.53)	(0.16)	(3.47)	(2.97)
G	.170	.052	.147	.210	.279	-.014	.270	.182	.194	-.023
	(1.19)	(0.91)	(2.58)	(0.93)	(4.23)	(0.16)	(2.45)	(1.39)	(2.57)	(0.53)
t	.044	-.030	.044	.130	.087	.057	-.086	-.142	.136	.009
	(0.46)	(0.35)	(0.94)	(0.52)	(1.41)	(0.77)	(0.93)	(2.10)	(2.68)	(2.00)
SEE	.0115	.0101	.0110	.0260	.0091	.0139	.0097	.0161	.0126	.0105
h	1.197	2.651	.387	6.513	.465	1.056	.885	1.548	1.896	1.157

Numbers in parentheses are (asymptotic) t-ratios. C is the constant term. Estimates are IV estimates, the instruments include lagged values of exogenous variables and the growth rate of the money stock and its lagged value. The predicted values of an $AR(4)$ model are used as a proxy for p^e.

The parameter estimates shown in Tables 1 and 2 indicate that autonomous expenditures do indeed have a strong positive effect on output, whereas the relative price of energy, the real interest rate and the (expected) rate of inflation have a negative impact. The coefficient of the time trend variable turns out to be more or less systematically positive. Most of the effects can be determined fairly precisely in the case of pooled cross-country data (even though there are caveats due to autocorrelation and erroneous standard erros of the generated regressors, see *Pagan* (1984) for details). Moreover, the basic results are strikingly robust in terms of additional variables, selection of sample period and the treatment of inflation rate expectations. As far as the individual country results are concerned there are very few clear exceptions from the general pattern of the results with pooled data. However, the individual country results are in general much less precise and somewhat sensitive in terms of the parameter values (thus, in fact, pooling restrictions can be rejected with most of the model specifications). We are not so much interested here in country-specific results. Thus, we concentrate on commenting on the results with pooled data.

As far as the individual coefficient estimates are concerned, the one which is perhaps of most importance is the coefficient of the real interest rate variable. The first observation one can make is that the instrumental variable method produces much higher parameter estimates for the coefficient of r_L than the ordinary least squares method. In fact, a similar result is obtained with the individual country data and with r_S. It also seems that the difference between these two sets of estimation results is particularly significant in the case of large countries (like the US and the FRG), presumably reflecting the degree of interest rate regulation. Of course, the result that the IV estimates for the coefficient of r_L (or r_S) are larger than the corresponding OLS estimates is clearly consistent with the view that the real interest rate is endogenous. This, in turn, implies that the OLS estimates are biased and inconsistent. Here, one may speculate that it is precisely this simultaneity bias which explains why some other studies have obtained rather low interest rate elasticities (see e. g. B.I.S., 1985).

By comparing the parameter estimates for different specifications and different interest rate measures, the general conclusion can be drawn that there is practically no difference between the various interest rate measures. Rather, there are minor differences between model specifications. Clearly, the implied interest rate effects are rather large: a one percentage point increase in the real rate reduces output by more than one percent in the long run. (For instance, in the case of equation (8) in Table 1 the short run semi-elasticity of r with respect to Y is –.120 and the corresponding long-run elasticity –1.017. If the short-term interest rate is used the corresponding figures are –.111 and –1.264.) Thus, if the nominal rates fail to adjust immediately and one-for-one to the expected rate of inflation – which seems to be the result of most empirical analyses – *then the resulting real interest rate shocks represent a true and significant loss to the economy* (owing to increased variability of output)[6].

If the output effects of real interest rates are large, so too are the effects of real energy prices. The corresponding negative effect is about unity in the long run (the short-run effect being roughly one tenth of this). One way of interpreting this result is to assume that energy is a strong complement with respect to capital, as indicated by the majority of empirical analyses.

[6] For empirical evidence, see e.g. *Carmichael/Stebbing* (1983) and *Summers* (1983).

The role of expected inflation also deserves some comments. As can be seen from Tables 1 and 2, the rate of expected inflation has a very strong negative effect on output. This strong negative effect is interesting, not the least because of potential simultaneity bias between inflation and output. Given the fact that the existence of a Phillips-curve type relationship would imply a positive relationship between output and inflation, one can argue that the result obtained corresponds to the effect of inflation on real balances and real income and possibly also to the "competitiveness" effect in terms of imports.

Inflation may also have a negative output effect because of the "inflation uncertainty" effect. That is, an increase in the rate of inflation also increases (or reflects) relative price uncertainty, and, given some standard assumptions about agents' risk-taking behaviour, this implies lower demand and lower output[7].

Even though the role of p^e has a meaningful interpretation or interpretations, there is a problem with the magnitude of the coefficient estimate (cf. here fn. 1). This is because the implied long-run effect typically goes up to or even exceeds two. One may suspect that the explanation lies in certain econometric problems. On the one hand, it might be due to strong multicollinearity between r and p^e, or, on the other hand, it could be due to incorrect specification of the lag structure.

In this connexion, a completely satisfactory explanation cannot be provided. Perhaps one "solution" would be to examine the implied effects of expected inflation *given the nominal rate of interest.* Certainty, the figures obtained make more sense. The corresponding long-run coefficients are in a majority of cases between zero and minus one so that some sort of representative value for the coefficient of the nominal interest rate is –1 and for the expected rate of inflation –1/2. As far as the lag structure is concerned, a Houthakker-Taylor type specification was fitted to the data instead of the stochastic difference equation with the Koyck lag structure, which is the basic element of equation (6). It turned out, however, that this did not make any appreciable difference in terms of the long-run elasticities[8].

[7] Cf. *Friedman* (1977) and *Evans* (1983). Obviously, increased inflation not only increases relative price uncertainty, but also increases uncertainty about real income. This effect may also tend to decrease (consumer) spending. As far as the theoretical background is concerned, one could abandon the implicit "super-neutrality" property of the underlying macro model and exploit the theories which imply permanent effects of inflation on output. The standard references for such theories are *Tobin* (1971) and *Stockman* (1981). In this connexion, it may be fair to point out that even though the effect of inflation on real balances and on real income, and possibly also a separate "real balance effect", provide a suitable explanation for the inflation effects, the asset base of these effects may be very small and the resulting effect may, in fact, be negligible; see e.g. *Patinkin* (1969).

[8] In the case of the Houthakker-Taylor specification the lagged right-hand side variables of (6), except $Y(-1)$ and t, were introduced as additional regressors. To save space, only the (p.t.o.)

As far as the other variables are concerned, the real exports variable, X behaves well according to a priori theorizing. The corresponding coefficient is positive and of expected magnitude. It is not surprising to find that the coefficient estimate is somewhat sensitive to the weighting pattern. The government final consumption variable, G, has a positive effect on output, as one might expect. However, it displays a great deal of sensitivity, particularly in terms of weighting but also in terms of the time trend variable. The sensitivity with respect to weighting is mainly due to the United States. In her case the coefficient of G is actually negative, even though the hypothesis that the coefficient equals zero cannot be rejected at standard levels of significance of the t-distribution. It is not so easy to explain why the latter result is obtained. One probable explanation is the fact that systematic fiscal policy rules make the G variable endogenous, biasing the respective OLS estimates towards zero. Thus, the fact that this coefficient equals zero may only imply that systematic counter-cyclical fiscal policy has been successful. (Recall also that equation (6) is derived and estimated assuming that the tax rate is constant.) Finally, it may be noted that the coefficient of the time trend variable, t, is positive (with a few country-specific exceptions). As indicated earlier, this may lend some support to the hypothesis that it also serves as proxy for real wealth. The estimates are, however, so unprecise that it does not make sense to assign an important role to this variable.

It is of particular interest to examine whether the estimates are stable over time. Hence the model was estimated separately for the sample periods 1965.2–1973.4 and 1974.1–1983.4. Only a few noticeable changes can be detected however. It is even difficult to say whether output has become more responsive over time with respect to energy prices, real interest rates and inflation, or not![9] Perhaps, the only thing which seems clear is the increased persistence of output behaviour; the coefficient of the lagged dependent variable increases substan-

still [8] implied long-run OLS elasticities (or semi-elasticities in the case of r and p^e) for X, SS, G, r and p^e are shown. The sample period is 1963.3–1983.4, with cross-country data being used in all cases. The $VAR(4)$ model predictions are used as a proxy for p^e.

	Stochastic difference equation		Houthakker-Taylor specifcation	
	(W)	(UW)	(W)	(UW)
X	.298	.403	.116	.294
SS	−.199	−.094	−.125	−.094
G	.130	.388	.064	.347
r	−.622	−.607	−1.046	−1.239
p^e	−2.768	−1.526	−2.961	−1.787

[9] See next page.

tially when one goes from the pre-oil crisis sample to the post-oil crisis sample. Accordingly, the implied adjustment periods more than double. An interesting question is whether this result has a more general interpretation; whether it really does reflect some increased rigidities in western economies. Unfortunately, studying this question is beyond the scope of this paper. Finally, if parameter stability is examined in terms of the period 1979.2 we find that the hypothesis of parameter instability can clearly be rejected. Thus, the results are not particularly sensitive with respect to changes in monetary policy rules. Another alternative is, of course, that there has not been a significant change in these policy rules.

5. Concluding Remarks

This paper has produced empirical evidence which shows that the behaviour of aggregate output is very much affected by real interest rates, inflation and energy shocks. In particular, the results suggest that real interest rate shocks represent a major source of variability in terms of the growth rate of total output for the countries in the OECD area. Clearly, this fact should be taken into account when designing macroeconomic policies, and, in particular, when making choices between interest rate targeting and monetary aggregates targeting.

[9] Even though very few changes in parameters seem to take place, the computed (Chow) stability test statistics for the period 1973.4 allow us to reject the hypothesis of parameter invariance, even if this cannot be done very clearly. Thus, there is some reason for caution. If, instead, the stability of the coefficient of the real interest rate variable is tested by allowing it to change over time according to a linear trend, the resultant coefficient does not deviate from zero at any standard levels of significance. Thus, given the model, the interest rate effect appears to be rather stable. The forecasting power and structural stability of the basic equation (6) was also tested with respect to the period 1979.2 (Which roughly corresponds to the time when monetary policy rules changed in some major western countries). Thus, equations were estimated over the sample period 1965.2–1979.1, and the period 1979.2–1983.4 was used in forecasting. Forecasting was performed using dynamic simulation. Because of space restrictions only the results for two representative equations are reported (both estimated by OLS and by using a $VAR(4)$ model for p^e). It may suffice to mention that the results with the other specifications were qualitatively very similar. The following statistics could be computed to check the forecasting power of equation (6):

	(W)	(UW)
Correlation coefficient (between actual (A) and forecasted (F) values)	1.000	1.000
Root-Mean-Square Error	.0158	.0164
Mean Absolute Error	.0117	.0125
Mean Error $(A-F)$	$-.0040$	.0068
Theil's Inequality Coefficient	.0022	.0023
Janus Quotient	1.1052	1.1508
$z(190)$ stability test statistic	214.04	251.79
$(\chi^2_{190,.05} = 258.96)$ (p.t.o)		

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still [9] Clearly, the forecasting performance of these specifications is very good. Moreover, the values of the Janus Quotient and the $z(190)$ statistics indicate that equation (6) does not suffer from structural instability in terms of the period 1979.2.

Summary

Estimating the Output Effects of Energy Price and Real Interest Rate Shocks: A Cross-Country Study

This paper is concerned with investigating how inflation, interest rate and energy price shocks affect the real side of the economy. Estimating a simple aggregate demand model from the data of 10 western countries shows that the behaviour of aggregate output is very much affected by these shocks. In particular, it turns out that real interest rate shocks represent a major source of variability in terms of the growth rate of total output.

Zusammenfassung

Schätzungen der Auswirkungen von Energiepreis- und Realzinsschocks auf die Produktion: eine zwischenstaatliche Untersuchung

Der Artikel befasst sich mit der Untersuchung von Auswirkungen, die die Inflations-, Zinssatz- und Energiepreisschocks auf die Realseite der Wirtschaft ausüben. Die Schätzung eines einfachen Gesamtnachfragemodelles, die auf Informationen aus 10 westlichen Ländern basiert, zeigt, wie stark die Auswirkungen dieser Schocks auf das Verhalten der Gesamtproduktion waren. Vor allem ist festzustellen, dass die Realzinsschocks auf die Schwankungen der Wachstumsrate der Gesamtsproduktion einen wichtigen Einfluss haben.

Résumé

Estimations des conséquences des chocs des prix de l'énergie et des taux de l'intérêt sur la production: une étude entre pays

Cet article étudie comment le côté réel de l'économie est influencé par les chocs de l'inflation, des taux de l'intérêt et des prix de l'énergie. L'éstimation d'un modèle simple de la demande globale qui est basé sur des données provenant de 10 pays de l'ouest montre que la production globale est beaucoup influencée par ces chocs. Particulièrement, il est visible que les chocs des taux de l'intérêt réel représentent une source importante des fluctuations de la croissance de la production globale.