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COMOVEMENTS IN AGGREGATE AND RELATIVE PRICES: SOME EVIDENCE ON NEUTRALITY

by

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ABSTRACT

This paper develops an alternative test of the neutrality of anticipated monetary policy. A multi-good equilibrium model along the lines of Barro and Hercowitz is used to derive a neutrality proposition for anticipated movements in the aggregate price level and to demonstrate econometrically its equivalence to the exogeneity of relative prices with respect to the aggregate price level. Multivariate causality tests provide a basis for testing these restrictions. The empirical results provide mixed evidence for the equilibrium models, while the variation in the findings across industries suggests a role for supply-side disturbances in explaining comovements in aggregate and relative prices.

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Introduction

Within a wide class of macroeconomic models, including both Keynesian and classical rational expectations models, the channel for monetary policy to affect real activity is through changes in actual or perceived relative prices and wages. As a result, if anticipated monetary policy is to have real effects, these should appear in the relative wage and price structure. For example, suppose anticipated monetary policy impinges on the real sector through changes in the real rate of interest. In that case, any Mundell-Tobin effects will be reflected in the cross-sectional data as changes in the relative wages and prices of capital-intensive versus labor-intensive industries. Therefore, it is appropriate, in gathering evidence on the debate over the neutrality of anticipated monetary policy, to examine directly comovements between relative prices and relative wages on the one hand, and nominal variables on the other.[1]

This paper takes one class of models in which anticipated monetary policy is neutral, equilibrium models with misperceptions, and derives a set of testable restrictions on the joint time-series behavior

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1. Similar tests of the invariance of the relative wage structure with respect to anticipated monetary policy appear in B.D. Pauls, "Relative Wages, Wage Determination, and Inflation."

of aggregate and relative prices. The reasons for concentrating on these particular models are twofold. First, it is important to see how far we can push the competitive paradigm in explaining the covariation in the data. And second, this is the class of models which generates the greatest concern over the potentially destabilizing effects of macroeconomic policies. Specifically, in a world where markets clear but information is incomplete, monetary disturbances may create distortions in relative prices and thereby decrease the allocative efficiency of relative price signals.

The paper begins with a description of a prototype multi-market equilibrium model, which follows along the lines of Hercowitz (1981). The major innovation in the model is the introduction of dynamics into the demand and supply decision rules. Using this model as an example, it is shown that the characteristic assumption of equilibrium models, that prices are flexible, implies a kind of neutrality proposition. Given the past history of a spanning set of relative prices, today's relative price structure is independent of anticipated movements in the general price level. Since, under rational expectations, these restrictions are equivalent to the econometric exogeneity of relative prices, Granger-Sims causality tests provide a natural method for testing this proposition.

The empirical methodology is similar to that used by Sargent (1976), Barro (1977), and Sims (1980). Rather than directly examine comovements between relative prices and nominal variables, these studies focus on the implications of an equilibrium model for the exogeneity of aggregate quantity variables, such as GNP and unemployment, with respect to nominal variables. Although a given equilibrium model may restrict both aggregate quantities and relative prices to be exogenous, statistical inference in the two contexts will not necessarily produce equivalent results because these tests only examine restrictions on the reduced form. Any particular set of reduced form restrictions is potentially generated by a number of structural models.[2] Since the set of models that implies the statistical exogeneity of aggregate quantities and the set of models that restricts relative prices to be statistically exogenous are not identical, the likelihood that the equilibrium misperceptions paradigm provides a useful approximation is increased if both sets of restrictions hold. In interpreting this literature, it is important to recognize that all of these tests are direct tests of the dichotomous structure of these models--that is, that a real sector representation exists that does not include lagged values of nominal variables. However, because dichotomy is more readily generated from a model in which anticipated monetary policy is neutral, the tests also provide indirect evidence on neutrality.

The empirical results provide mixed evidence in support of the equilibrium models. In roughly half of the industries examined, the exogeneity of relative prices is rejected. The pattern of rejections across industries suggests a different dynamic representation for the shocks, rather than deviations from the competitive paradigm or rational expectations as an explanation for the failure of the model. Specifically, supply-side disturbances, which are transmitted across sectors over time, may play an important role in accounting for comovements in aggregate and

2. For a general discussion of the issue of observational equivalence as it pertains to this class of empirical work see the exchange between McCallum (1979) and Sargent (1979a).

relative prices during the 1966 to 1980 period. Furthermore, the results of the exogeneity tests that include proxies for the supply-side shocks tend to support this conjecture. Viewed in this light, these findings suggest that the aggregate price level may add significant predictive power because it is a proxy for omitted real variables, and, therefore, the results do not pose any conclusive evidence leading to a rejection of the equilibrium model.

I. An Illustrative Model

Previous studies have adopted the Phelps-Lucas model of informationally separate markets to a multi-good world and used it as a vehicle for explaining relative price behavior. (Parks (1977), Cuikerman (1979), and Hercowitz (1981)). A modified version of Hercowitz's (1981) multi-market model is used for illustrative purposes. The economy consists of a continuum of markets, each trading a different good. At each date t, any individual agent transacts in only one market. It is assumed that markets are competitive so that agents take their own local prices, $p_t(z)$ as given. Both consumers and producers locate across markets based on perceived relative prices. The basic tenet of the equilibrium misperceptions theory is that agents observe their own local prices more readily than they observe prices in other markets, and hence more readily than they observe the aggregate price level. Consequently, agents evaluate relative prices given current knowledge of their own market price and their conditional expectation of the aggregate price level.

Indexing markets by z, supply and demand in the various markets are represented by the following stylized set of decision rules, expressed in log-linear form:

$$y_t^s(z) = \overset{s}{\alpha}(z)[p_t(z) - E(p_t|I_t(z))] + \lambda_1^s(L)y_{t-1}(z) + \lambda_2^s(L)y_{t-1}$$

$$+ \lambda_3^s(L)(p_{t-1}(z) - p_{t-1}) + v_t + \varepsilon_t^s(z) \qquad (1)$$

$$y_t^d(z) = -\overset{d}{\alpha}(z)[p_t(z) - E(p_t|I_t(z))] + \beta[M_t - E(p_t|I_t(z))]$$

$$+ \lambda_1^d(L)y_{t-1}(z) + \lambda_2^d(L)y_{t-1} + \lambda_3^d(L)(p_{t-1}(z) - p_{t-1}) + \varepsilon_t^d(z) \qquad (2)$$

where: $y_t^s(z)$, $y_t^d(z)$ = log of supply, and demand, respectively, in market z.

$p_t(z)$ = log of price in market z.

$E(p_t|I_t(z))$ = expectation of average economy-wide log of price conditional on information available in market z-- $I_t(z)$.

$\overset{s}{\alpha}(z)$, $\overset{d}{\alpha}(z)$ = relative price elasticity of supply, and demand in market z, $\overset{s}{\alpha}(z)>0$, $\overset{d}{\alpha}(z)>0$.

v_t = economy-wide average real disturbance.

$\varepsilon_t^s(z)$, $\varepsilon_t^d(z)$ = relative disturbance to supply, and demand in market z.

β = elasticity of demand with respect to real balances, $\beta>0$.

M_t = log of the money supply.

$\lambda_1^s(L)$, $\lambda_2^s(L)$, $\lambda_3^s(L)$, and $\lambda_1^d(L)$, $\lambda_2^d(L)$, $\lambda_3^d(L)$, represent one-sided polynomials in non-negative powers of the lag operator.

According to equations (1) and (2) the distribution of demand and supply across markets depends on the perceived distribution of relative prices, together with the realizations of sector-specific shocks — $\varepsilon_t^s(z)$ and $\varepsilon_t^d(z)$. In the "islands" paradigm of Lucas(1973), a single good is traded. Perceived relative prices are the primary determinant of local supply and demand decisions because they represent arbitrage opportunities. In a multi-good context, agents' willingness to change markets in response to perceived relative prices will depend upon the substitutibility of the goods in consumption and production. Allowances for intermarket differences in the degree of substitutability are made by introducing relative price elasticities that vary across markets.

Each market is treated as a microcosm of the economy, in that market supply and demand schedules are expressed as subcomponents of the aggregate demand and aggregate supply schedules for the economy as a whole. Thus, the real balance effect enters each market demand function directly. Real shocks to aggregate supply, such as an exogenous change in productivity, are represented as a common shift in the supply function in each market --v_t.

The basic modification made to Hercowitz's model is the introduction of dynamics into the demand and supply decision rules. This alteration is necessary if the real variables are to display cyclical behavior. The dynamic specification represents intertemporal substitution possibilities in production and consumption, both of which depend upon expected future as well as current relative prices. Based on work by Hansen and Sargent (1979), the dynamic decision rules include lagged values of the decision variable together with any information that helps predict future relative prices. Since economic theory generally does not dictate the information set used by firms and consumers for predicting relative prices, a general specification, consisting of relative prices and market output relative to aggregate output, was adopted. In keeping with the spirit of the equilibrium model, the intramarket dynamics, which are incorporated in the λ parameters, are constrained to be the same across markets.

There are three sources of disturbances in the economy--nominal aggregate disturbances or innovations in money growth, real aggregate disturbances and relative disturbances. Assuming the rate of growth of money is serially uncorrelated, the money supply is given by:

$$M_t = M_{t-1} + u_t$$

Because equilibrium models with misperceptions provide no channel for predictable components of money growth to affect relative prices, no generality is lost by assuming this form for money growth.

Real disturbances in this model are decomposed into an economy-wide average shock to supply--v_t--and relative shocks to supply and demand in the various markets-- $\varepsilon_t^s(z)$ and $\varepsilon_t^d(z)$. Since v_t represents the aggregate real disturbance that is common to all markets, the relative disturbances include both market-specific components of aggregate real disturbances and such relative shocks as a redistribution of demand between two markets. Thus, the relative disturbances net out by construction: $\int \varepsilon_t(z)\,dz = 0$, where $\varepsilon_t(z) = \varepsilon_t^d(z) - \varepsilon_t^s(z)$ is the net excess demand disturbance in the market z.

The distributional assumptions regarding the disturbances are:

$$u_t \sim N(0, \sigma_u^2)$$
$$v_t \sim N(0, \sigma_v^2)$$
$$\varepsilon_t(z) \sim N(0, \sigma_\varepsilon^2)$$

In addition, it is assumed that each type of disturbance is serially uncorrelated and that all disturbances are mutually orthogonal for all t.[3] The

3. In terms of the model developed here, it is sufficient that the aggregate disturbances and the relative disturbances be uncorrelated at nonzero lags and leads. However, imposing the additional structure simplifies the exposition.

first condition, that aggregate disturbances be uncorrelated with all lagged relative disturbances seems plausible given relative disturbances are defined to net out in the aggregate. This property follows from the assumptions that prices are flexible and relative shocks are drawn from the same distribution with a mean of zero. Thus, there is, for instance, no basis for the policy that determines aggregate demand to respond to relative excess demand or supply in a particular sector. The second condition, that relative disturbances be uncorrelated with lagged aggregate disturbances, does not rule out any non-neutrality per se. Rather, it only limits the channel whereby lagged aggregate disturbances affect market-specific behavior, so that they impinge upon particular sectors either through lagged output--both sectoral and aggregate--or lagged prices and not through the relative disturbance term.

Assuming markets clear instantaneously, we can equate (1) and (2) and solve for the market price under partial information:

$$\begin{aligned} p_t(z) = {} & [1-\beta\gamma(z)]\ E(p_t|I_t(z)) + \beta\gamma(z)M_{t-1} - \gamma(z)\lambda_1(L)y_{t-1}(z) \\ & - \gamma(z)\lambda_2(L)\ y_{t-1} - \gamma(z)\lambda_3(L)(p_{t-1}(z) - p_{t-1}) \\ & + \beta\gamma(z)u_t - \gamma(z)v_t + \gamma(z)\varepsilon_t(z) \end{aligned} \tag{3}$$

where: $\gamma(z) = 1/(\alpha^s(z) + \alpha^d(z))$

$\lambda_i(L) = \lambda_i^s(L) - \lambda_i^d(L)$ for $i=1,2,3$, and each of these newly-defined lag distributions is assumed to be one-sided and to have a one-sided inverse.

The model is solved using the method of undetermined coefficients. Conjecturing the reduced form for the aggregate price level gives:

$$p_t = M_{t-1} + \Pi_1(L)y_{t-1} + \Pi_2(\beta u_t - v_t) \tag{4}$$

Given agents observe local prices more readily than they observe prices in other markets, they face an optimal filtering problem. Individuals observe a composite of the three disturbances contained in the current market price and have to infer the aggregate and relative components. The information set of agents in market z, $I_t(z)$, consists of current local prices, $p_t(z)$, lagged values of market prices and output in all markets, the parameters of the model, and the first and second moments of the probability distributions of the random disturbances. If expectations are rational then agents update their forecasts of the aggregate price level based on equation (4).

$$E(p_t|I_t(z)) = M_{t-1} + \Pi_1(L)y_{t-1} + \Pi_2 E(\beta u_t - v_t|I_t(z)) \tag{5}$$

The optimal updating procedure uses agents' knowledge of the historical sources of variability in the economy to filter the composite disturbance contained in the current market price, $\beta u_t - v_t + \varepsilon_t(z)$. Substituting the optimal linear filter into the expectation formula gives:[4]

$$E(p_t|I_t(z)) = M_{t-1} + \Pi_1(L)y_{t-1} + \Pi_2\left\{\frac{\beta^2\sigma_u^2 + \sigma_v^2}{\beta^2\sigma_u^2 + \sigma_v^2 + \sigma_\varepsilon^2}\right\}(\beta u_t - v_t + \varepsilon_t(z)) \tag{6}$$

Replacing the expectation in (3) with (6) yields the reduced form for the market price:

$$\begin{aligned} p_t(z) = {} & M_{t-1} + [(1 - \beta\gamma(z))\Pi_1(L) - \gamma(z)\lambda_2(L)]y_{t-1} \\ & - \gamma(z)\lambda_1(L)y_{t-1}(z) - \gamma(z)\lambda_3(L)(p_{t-1}(z)-p_{t-1}) \\ & + \left\{\frac{(1 - \beta\gamma(z))\Pi_2(\beta^2\sigma_u^2 + \sigma_v^2)}{\beta^2\sigma_u^2 + \sigma_v^2 + \sigma_\varepsilon^2} + \gamma(z)\right\}(\beta u_t - v_t + \varepsilon_t(z)) \end{aligned} \tag{7}$$

Integrating over markets under the assumption that $\gamma(z)$, the reciprocal

4. The coefficient on the composite disturbance is that proportion of the variance in market price innovations which has been attributed historically to aggregate price innovations.

of the elasticity of net excess demand, is distributed independently of $\varepsilon_t(z)$, and solving for the undetermined coefficients gives the following expressions for the aggregate price level and the undetermined coefficients:

$$p_t = M_{t-1} - [(\lambda_1(L) + \lambda_2(L))/\beta]y_{t-1} + [\theta/\beta + \bar{\gamma}(1 - \theta)](\beta u_t - v_t) \quad (8)$$

where: $\bar{\gamma} = \int \gamma(z)dz$ = average of the reciprocal of the relative price elasticity of excess demand across markets.

$$\theta = (\beta^3\sigma_u^2 + \beta\sigma_v^2)/(\beta^3\sigma_u^2 + \beta\sigma_v^2 + (1/\bar{\gamma})\sigma_\varepsilon^2)$$

$$\Pi_1(L) = -(\lambda_1(L) + \lambda_2(L))/\beta$$

$$\Pi_2 = \theta/\beta + \bar{\gamma}(1 - \theta)$$

Substituting these coefficients into (7), the relative price in market z is given as:

$$p_t(z) - p_t = -\gamma(z)\lambda_1(L)(y_{t-1}(z) - y_{t-1}) - \gamma(z)\lambda_3(L)(p_{t-1}(z) - p_{t-1})$$
$$+ (\gamma(z) - \bar{\gamma})(1 - \theta)(\beta u_t - v_t) + [\theta/\beta + \gamma(z)(1 - \theta)]\,\varepsilon_t(z) \quad (9)$$

In order for equation (9) to be a rational-expectations solution, the information set that was used in projecting future relative prices should be consistent with the description of the relative price process contained in equation (9). Comparing equations (1) and (2) with equation (9), the solution meets this criterion.[5]

According to equation (8), innovations in the aggregate price level are a function of $\beta u_t - v_t$. Thus, equation (9) indicates that, while innovations in relative prices and innovations in the aggregate price level are contemporaneously correlated, aggregate prices do not Granger-cause relative prices. Although this implication was derived in

5. However, the information set used is not unique in providing an internally consistent solution.

the context of a particular, highly stylized example, it embodies a kind of classical dichotomy property that is a general feature of equilibrium models. The characteristics of these models, that expectations are rational and wages and prices are flexible, imply that only the "surprise" component of the nominal variables affects the real variables of the system. While the dynamic form of the decision rule allows the effects of agents' past forecast errors to persist, in a market-clearing framework, their effects on current relative prices will be mediated through lagged relative prices and output shares. Thus, all the relevant history for predicting the future path of the real variables is embedded in the past realizations of the real variables, including, in the more general case where market dynamics vary across sectors, relative prices in other sectors of the economy.[6] As a result, these models dichotomize in expected values. Econometrically, this property implies that an appropriately defined set of relative prices and other real variables--in this case relative output shares--is jointly exogenous with respect to the aggregate price level. Thus, the causality tests directly examine the dichotomy proposition outlined above, and bear indirect evidence on the neutrality issue in the sense that dichotomy is more readily generated from the class of models in which money is neutral.

6. In addition, there is the technical requirement that the relevant vector autoregressions for predicting relative prices be one-sided in lagged observations. (Geweke (1983)). This assumption of the model is tested jointly with the implications of market-clearing and rational expectations.

II. Empirical Results

Tests of the hypotheses that aggregate prices do not Granger-cause relative prices were conducted for a sample of seven four-digit industries.[7] The sample consists of monthly observations for the period 1965 to 1979. Because this period spans the wage-price controls of August 1971 to April 1974, a natural question arises concerning the stability of the reduced form equations. The hypothesis of no structural change versus the alternative of three distinct subperiods--the periods before, during, and after wage-price controls--was tested in the context of the null model. Based on equation (9), the regressors included in the null specification were: lagged relative prices, lagged relative output shares, a constant, seasonal dummies, and a time trend. All variables are in logs. To allow for the possibility of breaks in the level and trend, wage-price control dummies and additional time trends were included in the second and third subperiods. The tests reject subsample stability at the 99 percent confidence level in five out of seven industries and reject stability in the sixth industry at the 90 percent confidence level.

Having rejected the hypothesis of no structural change across all three subperiods, the wage-price control episode was omitted and a test of whether the data permit pooling the pre and post wage-price control periods was conducted. In all but one industry--glass containers--the tests fail to reject subsample stability at a marginal significance level of 0.05 percent. For the one industry where stability was rejected,

7. The number of industries in the sample is restricted by the availability of conformable price and output indices. For a description of the data, see Appendix A.

the Granger causality tests were performed separately on each portion of the sample.

The tests that relative prices are not Granger-caused by the aggregate price level entail F tests on lags of the aggregate price level in equation (9). However, in order for the computed test statistic to have an F distribution, the residuals must be independently and normally distributed. Consequently, after pretesting for the appropriate lag length for the relative prices and relative output shares for each industry, Lagrange multiplier tests were conducted to verify that there was no remaining serial correlation in the residuals. Because pretesting for the appropriate lag length for the causal variable--in this case the aggregate price level--alters the significance level of the exogeneity tests, the Granger test statistic is computed for alternative lag specifications for this variable using six- and twelve-month lags.

Tables 1 and 2 present an illustrative relative price equation based on one industry and a summary of the F statistics for the exogeneity tests for all the industries in the sample. The equation shown in Table 1 represents the null specification corresponding to equation (9). This equation is only meant to be illustrative, as the specification of the lag length in the null model varies across industries. Due to differences in lag length and data availability across industries, the estimation period varies somewhat among the different industries, although it generally covers the period 1966 to 1980, omitting the wage-price control observations.

The exogeneity test results displayed in Table 2 are mixed. The exogeneity of relative prices with respect to the aggregate price level can be rejected at the 95 percent confidence level in three out of the seven industries examined. These are cigarettes, synthetic rubber, and brick. A consistent interpretation of the results requires an explanation of the differences in the findings across industries, in addition to a rationale for the observations that are at variance with the model. On this basis, the failure of rational expectations is not a likely explanation for the rejection of the exogeneity restrictions because it is difficult to see why expectations should be formed rationally in some industries and not in others. Potential explanations do include departures from the competitive paradigm and non-market clearing. Regarding non-competitive behavior, there is no correspondence between concentration ratios and causal orderings across industries.

To determine whether deviations from market-clearing might account for the results, the industries in the sample are classified according to whether they can be primarily characterized as customer or auction markets. Among the industries examined, cigarettes, wines and brandy, and, possibly, glass containers are likely auction markets, given they are primarily final products. The remaining industries--synthetic rubber, man-made fibers, brick and aluminum--largely consist of intermediate goods and building materials. As such, they are apt to be customer markets in which there is some contractual relationship between the supplier and the industry purchasing the intermediate input. According to this framework, rejections of the model reflecting departures from market-clearing are expected to be concentrated in customer markets. However, contrary to this prediction, rejections of the exogeneity restrictions cut across both categories of markets, and in many industries characterized as customer markets, the data are consistent with an equilibrium model.

It is a general property of the causality tests that differences in the dynamic properties of the shocks from those assumed in the model can lead to the failure of exogeneity. In particular, it is assumed that the market-specific shocks to demand and supply, $\varepsilon_t^d(z)$ and $\varepsilon_t^s(z)$ are serially uncorrelated. However, as these disturbances include unobserved shocks to tastes and technology, there is no reason to presume that they might not be serially correlated. In that case, as Sargent (1979a) demonstrates, provided that the real variables that are used as regressors are not sufficient to span the space containing the real shocks, lagged nominal variables can add predictive power in an equation describing the real variables because they help predict the unobserved shocks to tastes and technology.

Another possible difference in the dynamic properties of the shocks is that the aggregate real shocks may have a variable timing across sectors of the economy. Moreover, the model was developed in the context of aggregate shocks that have a coincident impact on the various sectors of the economy. Although shocks to nominal aggregate demand are apt to exhibit this behavior, supply shocks, which were prevalent in the 1970's, tend to have an uneven impact across industries, both in terms of timing and magnitude. Differences in magnitude are allowed for in the market-specific shock, but variable timing is not. In an environment where aggregate disturbances have a variable timing across sectors of the economy, information about the transmission of shocks among industries becomes relevant. As a result, the reduced form needs to be amended to capture these interdependencies between lagged sectoral prices. In terms of the above tests, the exogeneity restrictions may be rejected in a subset of the industries examined because the aggregate price level is proxying for the omitted variables, either lagged relative prices in other sectors or real shocks to tastes and technology.

At least one of these explanations, that asymmetries in the dynamic effects of supply shocks contributed to the failure of exogeneity, can be tested. Taking the lagged relative prices of food and energy as representing the supply shocks, the exogeneity tests for the industries with rejections were rerun including these variables among the regressors. It should be noted that, to the extent that the energy shock induced changes in technology, the relative price of energy may also proxy for real shocks to technology. The results based on this specification, shown in the lower portion of Table 2, fail to reject the exogeneity restrictions in all but one industry, suggesting that intersectoral differences in the timing of supply shocks and/or serially correlated real shocks to technology may have accounted for the previous evidence against the model.

III. Conclusion

This paper proposes an alternative way of addressing the question of whether anticipated monetary policy is neutral. Rather than confronting the theory with observations on aggregate quantities and nominal variables, the tests focus on comovements in relative and aggregate prices. This approach cuts to the heart of the neutrality issue because relative price changes are the mechanism for monetary policy to affect real activity in most macroeconomic models. The tests of neutrality examine a kind of classical dichotomy proposition that characterizes a major class of models in which anticipated money growth is neutral--equilibrium models with misperceptions. The proposition maintains that, given the past history of an appropriately defined set of real variables, today's relative price structure is independent of expected movements in the general price level. Under the condition that expectations are formed rationally, these restrictions are equivalent to the econometric exogeneity of relative prices with respect to the aggregate price level. Granger-Sims causality tests are then used to examine this empirical implication of the model.

The evidence from a cross-section of industries provides mixed results for the equilibrium models. The exogeneity of relative prices with respect to the aggregate price level is rejected in three out of the seven industries examined. Attempts to explain the cross-sectional variation in the results in terms of the failure of a particular assumption of the model find no correspondence between either the degree of market power or the proximity to an auction market and the exogeneity test results.

It is suggested that the dynamic representation of the shocks in the model is too restrictive to capture adequately real disturbances--either shocks to tastes and technology or commodity price disturbances. To the extent that changes in technology are induced by changes in relative factor costs, and supply-side disturbances are transmitted across sectors over time, the reduced form for relative prices needs to be amended to encompass these interdependencies. In the absence of an extensive set of lagged relative prices in other sectors, the aggregate price level may be proxying for these interindustry disturbances. The results of the exogeneity tests that include the lagged relative prices of food and energy among the regressors tend to support this conjecture. Thus, although these findings imply that the aggregate price index contains information that is relevant for predicting future relative prices in the context of a limited set of relative price information, they do not imply that an aggregate price index would add significant predictive power to forecasts based on a complete vector of relative prices, and, hence, do not present any conclusive evidence leading to a rejection of the equilibrium misperceptions model.

Table 1: Illustrative Relative Price Equation
Null Specification

Dependent Variable: Relative price of cigarettes (S.I.C. 2111)
Period: 1965:7 - 1971:8 and 1974:10 - 1980:6

Variable	(Lag (-))	Coefficient	Standard Error
Constant		-.021	.026
Dummy (1974:10-1980:6)		.020	.020
Time (1965:7-1980:6)		.00009	.00014
Time (1974:10-1980:6)		-.00002	.00016
Relative Price	(-1)	.844	.091
	(-2)	-.072	.120
	(-3)	-.072	.122
	(-4)	.094	.121
	(-5)	-.030	.122
	(-6)	.071	.091
Relative Output	(-1)	.030	.028
	(-2)	.028	.029
	(-3)	-.013	.031
	(-4)	-.047	.030
	(-5)	.022	.030
	(-6)	-.053	.028

Note: Seasonal dummies were also included in the regression, but are not reported here.

Table 2: Exogeneity Test Results
Tests of Causality from the Aggregate Price Level to Relative Prices

Industry (S.I.C.)	Period	F-Statistic	Marginal Significance Level
2084	1966:1 - 1971:8 &	F (6, 44) = 1.327	.266
	1975:5 - 1975:12	F (12, 38) = 1.419	.200
2111	1966:1 - 1971:8 &	F (6, 96) = 5.109	.0001
	1975:5 - 1980:6	F (12, 90) = 3.433	.0004
2822	1966:1 - 1971:8 &	F (6, 90) = 2.776	.016
	1975:5 - 1980:6	F (12, 84) = 1.596	.108
2824	1969:6 - 1971:8 &	F (6, 28) = .459	.833
	1975:10 - 1980:6	F (12, 22) = .563	.848
3221	1966:1 - 1971:8	F (6, 39) = 1.160	.347
		F (12, 33) = .953	.510
	1975:5 - 1980:6	F (6, 33) = 2.169	.071
		F (12, 27) = 1.548	.168
3251	1966:1 - 1971:8 &	F (6, 88) = 3.603	.003
	1975:5 - 1980:6	F (12, 82) = 2.830	.003
3334	1968:2 - 1971:8 &	F (6, 56) = 1.235	.303
	1975:6 - 1980:6	F (12, 50) = .759	.688

ADDENDA:
Causality Tests with Relative Prices of Food and Energy Included Among the Regressors

Industry (S.I.C.)	Period	F-Statistic	Marginal Significance Level
2111	1966:1 - 1971:8 &	F (6, 84) = 3.836	.0020
	1975:5 - 1980:6	F (12, 78) = 2.324	.0134
2822	1966:1 - 1971:8 &	F (6, 72) = 1.733	.126
	1975:5 - 1980:6	F (12, 66) = .887	.564
3251	1966:1 - 1971:8 &	F (6, 68) = .716	.638
	1975:5 - 1980:6	F (12, 62) = 1.175	.321

Data Appendix

The relative price and output share data were constructed using conformable price and output indices at the four-digit industry level of disaggregation. The industries in the sample were:

SIC CODE
2084 - Wines and Brandy
2111 - Cigarettes
2822 - Synthetic Rubber
2824 - Man-made Fibers
3221 - Glass Containers
3251 - Brick
3334 - Aluminum

The market-specific prices were constructed from the Industry-Sector Price Indexes published by the Bureau of Labor Statistics. These indices are based on regroupings of the Wholesale Price Index to correspond to industries rather than the end use of the product. The sample period generally begins in 1965 with the availability of these series and ends in 1980, when the weighting procedure used to compute the indexes was substantially revised. Relative prices were calculated as the logarithmic difference of the Industry-Sector Price Index and the Wholesale Price Index for all manufacturing, which was taken to be the aggregate price level.

The industry shares of output were constructed from corresponding subcomponents of the Industrial Production Index published by the Board of Governors of the Federal Reserve System. These were computed as the logarithmic difference of industrial production for the industry and industrial production for all manufacturing.

For the supply shock variables, the relative prices of food and fuel, the logarithmic differences between the WPI for farm products, and fuels and power, and the WPI for all commodities were used. All data were seasonally unadjusted and seasonal dummies were included in the estimation.

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