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Nault, Barrie R; Dexter, Albert S.; Levi, Maurice D.

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Author(s): Albert S. Dexter, Maurice D. Levi and Barrie R. Nault

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ALBERT S. DEXTER  
MAURICE D. LEVI  
BARRIE R. NAULT

## Freely Determined versus Regulated Prices: Implications for the Measured Link between Money and Inflation

THIS PAPER EXPLORES the importance for the measured link between money and inflation of measuring inflation from indices that include prices that, by virtue of being regulated, are unlikely to respond systematically to the forces of supply and demand.<sup>1</sup> The inclusion of regulated prices for such items as property taxes, telephone and postal charges, vehicle registration, and public transportation means that even if supply and demand are systematically related to money, the measured overall rate of inflation may not be. Certainly, it would seem reasonable to believe that the nature of the setting and subsequent maintenance of regulated prices would result in them responding *differently* to market forces that might themselves be affected by money, than would relatively unfettered prices such as those of many food items, furniture, insurance, household repairs, and automobile servicing. Indeed, it would seem reasonable to believe that the link between money and freely determined market prices would be *more systematic* than that between money and regulated prices, a belief that our results strongly confirm.<sup>2</sup>

As well as investigating the extent to which freely determined prices respond more systematically than regulated prices, we also consider the relative *speeds* of

The authors are indebted to James Forbes, Michael Goldberg, Trevor Heaver, and William Stanbury for their advice, and to Milton Friedman, Brendan McCabe, and two anonymous referees of this journal for their helpful comments.

<sup>1</sup>The importance of regulated prices for economic *theory* has received some recent attention, but surprisingly, the connection to price stickiness has not been made. See, for example, DeAlessi (1987).

<sup>2</sup>If the measurement errors were in the money supply, traditionally taken as the independent variable, this would introduce bias as well as noise in the money-inflation relationship (Levi 1973, 1977). However, our concern is with the measurement of inflation, traditionally the dependent variable.

ALBERT S. DEXTER is associate professor and MAURICE D. LEVI is professor in the Faculty of Commerce and Business Administration at the University of British Columbia. BARRIE R. NAULT is assistant professor, Faculty of Business, University of Alberta.

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response of the two categories of inflation to changes in the money supply. Even though regulated prices are likely to be changed less frequently than freely determined prices, if the bodies responsible for setting and/or approving price changes are forward looking and employ rational expectations of future supply and demand conditions, we would expect that on average, regulated inflation would show the same lag vis à vis money as freely determined inflation.<sup>3</sup> However, if the bodies that set or approve price changes choose to or are forced to wait for evidence in support of a price change before approving or implementing new prices, we would expect regulated prices to respond more slowly to changes in monetary policy. Indeed, because price changes in the regulated sector typically require approval, not only from the individual organization's management, but from an additional tier of bureaucracy representing a government department or a regulator, we might expect a longer delay before implementation. This additional tier of bureaucracy might, for example, require evidence of actual rather than projected cost increases, or of inflation elsewhere in the country, before permitting rate or tax increases. Our evidence provides distinct support for the view that regulated prices respond relatively slowly, with a substantially longer lag in the effect of money on regulated than on freely determined inflation.

Of course, we are not suggesting that delay in changing prices occurs only in the regulated sector. Numerous reasons for stickiness of prices have been identified at the level of the unregulated firm, including those found in survey work by Blinder (1991). Rather, we are suggesting an additional reason for stickiness in overall indices of inflation, making the difference in stickiness one of degree. Because price stickiness has such important implications for new-Keynesian economics, the consideration of regulated prices as a cause of this stickiness is particularly relevant.<sup>4</sup> Surprisingly, none of the previous work in the area of price inertia has identified regulation as a possible factor.

Our results show that the measured link between money and overall inflation is closer than the link between money and freely determined price inflation as well as, less surprisingly, the link between money and regulated price inflation. We argue that this is what we might expect if the real balance effect dominates the substitution effect.

#### THE SELECTION OF PRICE INDICES

The list of prices that are regulated depends essentially on the country being considered, with the list far longer for some countries than others. With its many marketing boards, its relatively heavy provincial and federal taxes, and its public provision of health, education, and other services, Canada offers an excellent oppor-

<sup>3</sup>Of course, by acting sometimes too early and sometimes too late, as well as by too much and too little, the link between money and regulated inflation will be less systematic, as we have already said.

<sup>4</sup>Many of these implications, which relate primarily to the effects of money on real magnitudes, are discussed by Parkin (1984), Ball, Mankiw, and Romer (1988), and Gordon (1990).

tunity for studying the effect of regulated prices. Furthermore, the Statistics Canada database means easy access to the separate, detailed statistics for the vast number of categories of items used to measure inflation. Of course, despite the easy access to data, huge problems remain, such as the need to determine which prices are regulated, and how to re-weight the baskets required to obtain the price indices for regulated and freely determined prices. The details of the approaches taken to deal with these problems are available from the authors by request, but are summarized below.

Rather than make decisions ourselves or attempt to contact a large number of ordinary consumers or producers who would be unlikely to know much about price determination over a broad range of products, it was decided to use a panel of experts to determine which items in the CPI were regulated and which were freely determined. A questionnaire was given to four experts whose combined knowledge covered a wide range of items in the CPI including housing, food, consumer goods, and transportation. These experts were given the entire CPI index, some ten pages of detailed categories of goods and services, and instructed to identify prices of these items as freely determined only if, in their opinion, prices could respond readily to market forces. "Readily" was defined to be within a calendar quarter, the period over which inflation and money were to be measured. The experts were asked to identify an item as regulated if its price could not respond to market forces within a calendar quarter or if its final price included a tax component of 50 percent or more. A mixed category was included for those items which might have switched between being freely determined and regulated during the period studied, 1968–89, or which might be regulated in some provinces but not in others. Finally, the experts were told that they were not obligated to categorize every item, and to use a "don't know" category whenever they were unsure. The inter-expert agreement on categorized items was remarkably consistent. The expert with the most experience in a given price domain was never in the minority, and close to 90 percent of the categorizations were unanimous.

Employing this approach, it was determined that prices of most food items, household repairs and insurance, furniture, clothing, automobiles, auto maintenance, pharmaceuticals, reading materials, personal care items, and recreation were all freely determined. Together, the freely determined items constituted from 48 percent to 59 percent of the CPI.<sup>5</sup> It was also determined that prices of most types of public transportation, communications such as telephone and postal services, dairy and poultry products, licensing and registration of vehicles, water rates, property taxes, liquor and tobacco with their large "sin" tax components, and education were all regulated.<sup>6</sup> Together, the regulated prices constituted from 18 percent to 20 percent of the CPI. The mixed category, which included oil, was responsible for 17 percent to 20 percent of the CPI.

<sup>5</sup>The variation is due to the basket changes over time.

<sup>6</sup>This list roughly corresponds with what we would expect to find using Statistics Canada's definition of administered prices for which there are four categories: prices of government owned goods and services, prices approved by government agencies, prices fixed by legislation or an agency, and taxes.

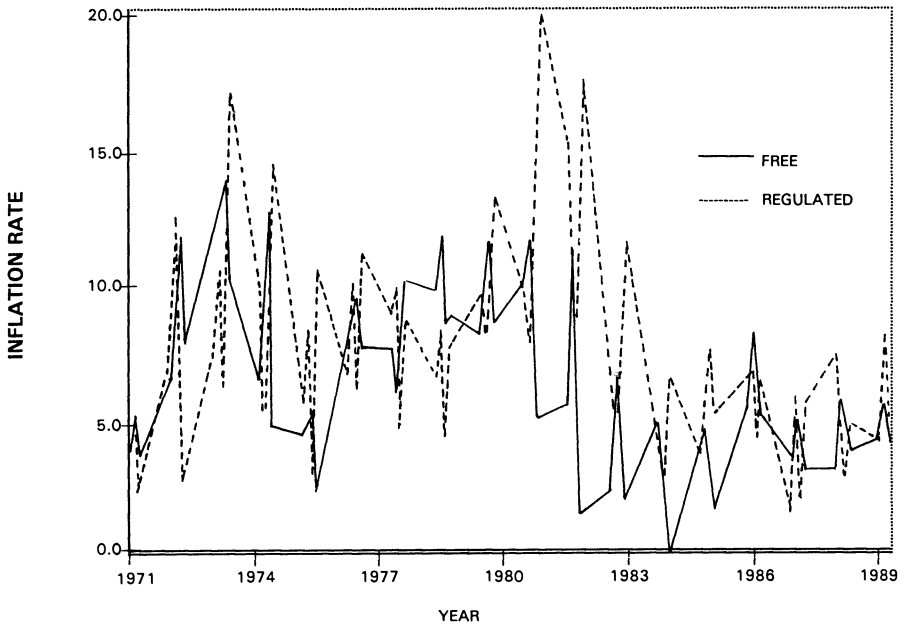


FIG. 1. Inflation Subindices for 1972.I to 1989.III

Of course, forcing items into categories suggests there is a dichotomy between regulated and unregulated prices when, as mentioned, the distinction is one of degree. In reality, the costs of changing prices vary along a spectrum in which the approval hearings often required to adjust regulated prices constitute particularly high “menu costs” at one end of the spectrum, while the absence of hearings or of price lists may mean zero menu costs at the other end. By forcing items into two or three categories we lump ranges of menu costs together, clouding the distinctions that exist for specific items. To the extent, however, that the regulated-unregulated distinction is correlated with the differences in menu costs in the different categories, finding different responses of regulated and unregulated prices suggests the possibility of building a general equilibrium model with high and low menu costs; the regulated-unregulated distinction may be proxying for a difference in menu costs.<sup>7</sup> Such a model should be capable of predicting the results we find, and perhaps also real effects of money and other policy variables.

The procedure for reweighting to form the different inflation indices does not suffer from what is inevitably an artificial dichotomy, but does suffer from a major organizational difficulty. That is, it is no mean feat to take detailed price series over a long time period and reform indices.<sup>8</sup> Indeed, we believe that the data management difficulty may be a principal reason why there has not been previous research on this

<sup>7</sup>We are indebted to an anonymous referee for clarifying this.

<sup>8</sup>An appendix with the details is available on request from the authors.

issue. The inflation rates computed from the subindices calculated by our approach for the period studied are shown in Figure 1. We see immediately that they are very different.<sup>9</sup> For example, we can note the different paths of inflation during and subsequent to the 1980–82 recession.

#### THE APPROACH

Since our purpose is not to provide econometric novelty, but rather to check the consequences of regulated prices for the relationship between money and inflation, we have chosen the simplest reasonable estimation equation and have omitted other potential influences on inflation, such as fiscal policy, capacity pressures, and so on. What we have done is estimate

$$\dot{P}_{jt} = \sum_{i=0}^n \beta_i \dot{M}_{t-i} + \mu_t$$

where  $\dot{P}_{jt}$  is the quarterly, seasonally adjusted rate of inflation in index  $j$  during quarter  $t$ ,  $\dot{M}_{t-i}$  is the percent change in the seasonally adjusted money supply, M2, during quarter  $t - i$ , and where the coefficients  $\beta_i$  are allowed to follow an Almon (1965) polynomial.<sup>10</sup> Following the practice of Anderson and Carlson (1970) we have adopted a fourth degree polynomial with sixteen quarters of lag, and no end point constraints.<sup>11</sup> A dummy variable taking on the value unity during 1975.IV–1978.I, the period of price controls of the Anti Inflation Board, was also included.<sup>12</sup>

The systematic nature of the relationships between the different measures of inflation and money can be judged both from the relative values of adjusted  $R^2/SEE$  for the different inflation indices used, as shown in Theil (1966), and from the significance levels of the regression coefficients. The results for the estimation of the inflation-money relationships over the period 1972–1989 are shown in Table 1. The results convincingly demonstrate that money has a more systematic link to prices that are freely determined than to those that are regulated. In particular, we find the fraction of variation in freely determined price inflation that is explained by money being more than twice that for regulated prices. Correspondingly, we find that the  $t$ -statistics on lagged money are more than twice as large at their peak for freely deter-

<sup>9</sup>The variances of regulated and flexible inflation are respectively 0.00140 and 0.00096. While it might be believed that price stickiness in regulated *prices* would reduce volatility, the idiosyncrasies in delays from the unsystematic response of regulators could add noise to regulated *inflation*. For example, instead of equal changes of prices in successive periods, there could be no change and then a large catch-up change. This would increase the volatility of inflation. Of course, stickiness would also be manifest in the speed of response, as we have explained.

<sup>10</sup>Regression results using M1, which, because this aggregate is available from an earlier date, cover a longer time period, are very similar to those using M2, and are available from the authors by request. Other less restrictive procedures also generate similar conclusions.

<sup>11</sup>The absence of end point constraints is to reduce the chance of bias. See Dhrymes (1971), Schmidt and Waud (1973), and Trivedi (1970).

<sup>12</sup>Price controls were imposed during the period 15 October 1975 and 30 April 1978.

TABLE 1

RELATIONSHIP BETWEEN MONEY (M2) AND INFLATION IN CPI COMPONENTS AND THE OVERALL CPI, 1972.III–1989.III

	Freely Determined	Regulated	Mixed	Total CPI
$R^2$	.6464	.3093	.4476	.7572
$R^2(\text{adj})$	.6192	.2562	.4051	.7385
$SEE$	.0192	.0323	.0443	.0157
Constant	-0.0265 (-2.450)	-0.1710 (-0.094)	-0.0710 (-2.848)	-0.0342 (-3.882)
Dummy	-0.0202 (-2.631)	-0.0117 (-0.903)	-0.0370 (-2.092)	-0.0241 (-3.844)
Mean Lag	4.234	8.171	6.693	5.456
Coef Sum	0.828 (8.660)	0.669 (4.168)	1.256 (5.703)	0.952 (12.240)
D-W	1.438	1.902	1.452	1.702

Coefficients on Lagged Money (M2)				
0	0.1682 (4.857)	-0.0687 (-1.180)	0.0406 (0.508)	0.1067 (3.830)
1	0.1400 (7.650)	-0.0028 (-0.092)	0.0479 (1.136)	0.1051 (7.055)
2	0.1135 (9.158)	0.0434 (2.084)	0.0597 (2.089)	0.1004 (9.948)
3	0.0892 (6.422)	0.0727 (3.113)	0.0744 (2.322)	0.0933 (8.246)
4	0.0673 (4.373)	0.0876 (3.389)	0.0904 (2.550)	0.0844 (6.731)
5	0.4800 (3.209)	0.0910 (3.617)	0.1064 (3.085)	0.0742 (6.089)
6	0.3170 (2.398)	0.0854 (3.843)	0.1208 (3.965)	0.0636 (5.097)
7	0.1860 (1.606)	0.0735 (3.778)	0.1320 (4.950)	0.0531 (5.632)
8	0.0089 (0.772)	0.0580 (2.976)	0.1386 (5.188)	0.0433 (4.589)
9	0.0031 (0.229)	0.0415 (1.855)	0.1390 (4.527)	0.0350 (3.222)
10	0.0012 (0.078)	0.0268 (1.045)	0.1317 (3.746)	0.0286 (2.305)
11	0.0036 (0.226)	0.0165 (0.614)	0.1152 (3.128)	0.0250 (1.920)
12	0.0106 (0.711)	0.0132 (0.528)	0.0880 (2.560)	0.0247 (2.030)
13	0.0224 (1.641)	0.0197 (0.859)	0.0486 (1.542)	0.0283 (2.542)
14	0.0394 (2.103)	0.0387 (1.229)	-0.0046 (-0.107)	0.0365 (2.397)
15	0.0617 (1.816)	0.0726 (1.272)	-0.0731 (-0.933)	0.0500 (1.808)

NOTE: *t*-statistics in parentheses.

mined prices as for regulated prices. While, as Johnston (1984, pp. 509–10) has argued, it is difficult to test for significance in this difference of association, in this case all indicators are in the same direction. We also see that the sum of lag coefficients is slightly larger with freely determined prices as well as more significant; a 1 percent increase in the money supply eventually causes a 0.83 percent increase in freely determined prices versus a 0.67 percent increase in regulated prices. Thus,



not only is the association between money and inflation looser for regulated prices, but the effect also appears to be smaller.

It is also of interest to note that, judged from the mean lag, freely determined prices respond noticeably more quickly than do regulated prices. Indeed, the mean lag for freely determined prices is approximately four quarters shorter than for regulated prices. The mean lag for the total CPI is between the lag for regulated and that for freely determined prices, with the overall CPI lag roughly commensurate with the lengths of lags of its components. It is worth noting that the lag for the total CPI over the period studied here is similar to that found for the reference cycle in the United States by Friedman (1958, 1961) over an earlier period, but shorter than that found more recently in Friedman (1984); Friedman (1984) finds a lag for the total CPI in the United States similar to that for regulated prices in Canada. Table 1 also shows that the Anti-inflation Control Board was effective in suppressing overall inflation, and inflation in the freely determined and mixed categories.

An interesting feature of the results shown in the table is that the  $R^2$  for the total CPI exceeds that for any of the three inflation components, and  $SEE$  is lower for total CPI than any of the components. This suggests the regression errors for the component regressions are negatively covariable.<sup>13</sup> In economic terms this means that if, for example, regulated items are increasing in price faster than they should for the relevant recent monetary policy, then the other items are typically increasing slower than they should, given recent monetary policy. A partial equilibrium view would suggest the reverse in that via the substitution effect, faster inflation in regulated items would increase the demand for unregulated items, increasing inflation there also. However, in general equilibrium we cannot ignore the real-balance effect. In particular, relatively rapid inflation in some prices due, for example, to regulators putting upward pressure on inflation, *ceteris paribus*, causes reductions in real cash balances. This should reduce spending and cause lower inflation elsewhere, at least *vis à vis* recent monetary policy. That is, our results suggest that the real cash balance effect dominates the substitution effect.<sup>14</sup>

## CONCLUSIONS

By identifying which prices are freely determined and which are regulated we have shown that, as expected, the freely determined or unfettered prices are more closely related to the money supply. This closeness of relationship is manifest in comparisons of  $R^2/SEE$  and  $t$ -statistics. We have also shown that freely determined prices respond much more quickly to changes in the growth rate of the money supply. These conclusions are sufficiently strong that they would appear not to be the result of the specific items being placed in the particular inflation categories selected

<sup>13</sup>Demonstration of this is provided in an appendix, along with the variance-covariance matrix of regression errors, that is available from the authors by request. The alternative explanation that there are larger idiosyncrasies in subindices than the overall index would not explain the negative covariances of realized errors, and would in any case be doubtful given the sizes of the subindices.

<sup>14</sup>We are indebted to an anonymous referee for this point.

by the panel of experts. That is, if our determination of categories had used different experts or procedures for selection of categories, our conclusions are unlikely to have changed.

It might have been expected from the poor fit of regulated-price inflation and money that the fit between freely determined prices and money would have been better than that of overall inflation and money. However, we have shown that the fit between money and overall inflation is superior to that for freely determined prices, or indeed for any component. We have argued that this is indirect evidence of a real balance effect dominating a substitution effect.

Given the importance of price stickiness for the conduct of monetary policy, we believe that the demonstration that regulated prices respond relatively slowly makes the study of the reasons for stickiness in this sector worthy of further research. Certainly, studies of price stickiness which have so far exclusively emphasized firm-level decisions might be broadened to consider the regulated sector.

By necessity, we have studied the effect of regulated prices on the money-inflation relationship in the specific country context with which we are familiar and for which we could identify and persuade experts to cooperate. We believe, however, that if the required identification, sorting, and reconstructing of inflation data were performed for other countries, the results would be unlikely to contradict those shown here.

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