the strategy tank

Economic Discussion Paper

Can monetary policy help attain stabilisation objectives?

Incomplete Nominal Adjustment & Co-ordination Failure in the Fischer Model

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Abstract

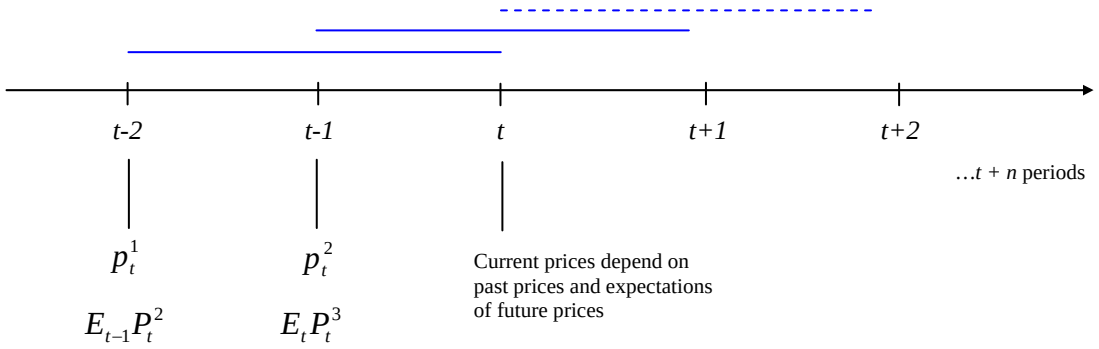
Overview

This economic discussion paper discusses the role of monetary policy within the Fischer model and examines its implications with particular attention to whether changes to the money supply can help in attaining stabilisation objectives. It is found that unlike the Lucas Imperfect-Information model, monetary policy has the ability to affect the short-run behaviour of output in the model, although the persistence of this impact is variable dependent on the length of time-periods in which periodic price-setting decisions are made. Furthermore, the role of 'real' rigidity and its ability to amplify or dampen the affects of changes in monetary supply by the policymaker is also discussed.

What is the Fisher Model & What is the Role of Monetary Policy?

Stanley Fischer's staggered price adjustment model developed in the late 1970s was one of a wave of new economic thinking that used microeconomic foundations of macroeconomics pioneered by the 'New-Keynesian'[1] economists that included himself as well as John Taylor and Edmund Phelps. The approach offered by Fischer differs to early Keynesian views and that of the Lucas Imperfect-Information model by demonstrating that business cycles occur not because of agents holding imperfect information and not specifically because of imperfectly competitive markets, but because nominal wages and prices are slow to adjust to changes in aggregate demand as a result of staggered prices and wages.

Fischer's model constructs a staggered, two-period overlapping labour contract timeline allowing agents given the opportunity to set prices at given times, *t-1* and *t-2,* such that wage rates are *pre-determined* and different prices can be set every other period, but not *fixed* as in the Lucas and Taylor Models.[2] Under each discrete time period in this model, imperfectly competitive firms produce output by using labour as their only input.[3]



For a given period *t,* it is assumed that half of the prices are set in the previous period and half are ones set two periods ago as although agents are given the option of adjusting prices at each stage, only half are expected to do so.

$$p_t = \tfrac{1}{2}(p_t^1 + p_t^2)$$

[1] A term coined by Michael Parkin in 1982
[2] Caplin-Spulber, developed Fischer's work further and allowed price changes to be determined endogenously so that the fraction of prices that changes each period can vary.
[3] Romer, D., 2006, *Advanced Macroeconomics*, (3rd Ed), New York: McGraw-Hill

As not everyone in the economy[4] sets new wages and prices every period, staggering makes the overall level of wages and prices adjust slowly and provides an explanation for incomplete nominal adjustment. As Fischer shows, the use of longer-term nominal contracts which are attributed to the costs of frequent price setting and wage negotiation,[5] places an element of wage-stickiness into the nominal wage which creates a nominal price rigidity, which itself is responsible for the effectiveness of monetary policy.[6] The equation assumes that agents can only forecast one period ahead, but not two periods, and thus Fischer suggests that the role of a monetary authority could be to intervene and react to new information about recent economic disturbances. This is further demonstrated by solving the model, which generates the following equations for price *p* and output *y*:

$$p_t = E_{t-2}m_t + \frac{\phi}{1+\phi}(E_{t-1}m_t - E_{t-2}m_t)$$

$$y_t = \frac{1}{1+\phi}(\underbrace{E_{t-1}m_t - E_{t-2}m_t}_{\textit{Anticipated portion}}) + (\underbrace{m_t - E_{t-1}m_t}_{\textit{Unanticipated portion}})$$

Unlike the Lucas model where monetary policy can only affect output by creating a difference between actual and expected prices,[7] this model demonstrates that both the unanticipated and anticipated portions of the model affect output. As expected, unanticipated aggregate demand shifts have real effects as explained by the term $(m_t - E_{t-1}m_t)$ as it is assumed that agents do not know the term m_t when they set their prices, and thus these shocks are passed one-for-one unto output.[8] The first portion of the equation demonstrates that aggregate demand shifts that become anticipated after the first prices in the model are set do in fact affect output. Information that becomes available between the periods *t-2* and *t-1* is passed into output and the remainder goes into prices, as not all prices are flexible in the short run.[9] The proportion of the change that affects output is not half-and-half, but instead is

[4] This staggered effect is often observed in the US, where ~20% of workers in the economy are unionised, and will have wage-changes made at discrete points during the year.
[5] Interestingly, the welfare effects of the implied output movements are likely to be much larger than the costs of changing prices.
[6] Fischer , S. 1977, Long-Term Contracts, Rational Expectations, and the Optimal Money Supply Rule, Journal of Political Economy 85, pp. 191-205
[7] Ibid
[8] Romer, D., 2006, *Advanced Macroeconomics*, (3rd Ed), New York: McGraw-Hill
[9] Ibid

determined by the term $1/(1+\phi)$, which has the ability to either amplify or dampen the degree of effect onto output.

Can monetary policy help in attaining stabilisation objectives?

Monetary policy *can* help attain stabilisation objectives

If we let $m_t^* = m_t + v_t$, where m_t^* is controlled by the policy maker, and assume they are under the same information constraints as price-setters, the policymaker must choose m_t^* before the exact value of v_t is known. However, as the policymaker can choose m_t^* in response to information learnt between *t-1* and *t-2* then there is a role for stabilisation policy. Clearly this model demonstrates that output can be influenced by responses of the monetary authority, and Fischer further demonstrates that indeed the policymaker *should* do so. If nominal wage contracts are set for more than one period in advance, and are not indexed to inflation then even under rational expectations, monetary policy can and should be used to stabilise the economy. Although the policymaker is unable to control the unanticipated portion, they do have control over the anticipated component,[10] and thus the role of the monetary authority should be to reduce the asymptotic variance of output and thus reduce loss of economic welfare.[11]

$$y_t = m_t - p_t + v_t$$

Where a variable either u_t or v_t for anther time period are non-policy shocks to aggregate demand;

$$u_t = p_1 u_{t-1} + \varepsilon_t \qquad |p_1| < 1,$$
$$v_t = p_2 v_{t-1} + \eta_t \qquad |p_2| < 1$$

[12]

The money stock at time *t* will be dependent on all demand shocks up to *t-1*

$$m_t = a_1\varepsilon_{t-1} + a_2\varepsilon_{t-2} + \ldots + a_n\varepsilon_{t-n} + \ldots$$

and solving output for out put is therefore;

$$y_t = \varepsilon_t + \frac{1}{2}(1+b)(1+a_1)\varepsilon_{t-1}$$ [13]

[10] Further research, by Chadha, 1989 on this topic related the asymptotic variance in output to the contract length, and determined this to be 3.73 quarters for the US economy. As these contracts act as 'shock absorbers' for the economy, one could argue that part of the role of the policy maker would be to enforce a contract period duration of this optimal length.
[11] Heijdra, B. J., and F. van der Ploeg, 2000, *The Foundations of Modern Macroeconomics*, Oxford University Press.
[12] Fischer , S. 1977, Long-Term Contracts, Rational Expectations, and the Optimal Money Supply Rule, Journal of Political Economy 85, pp. 191-205
[13] Blanchard, O. and Fischer, S. 1989, *Lectures in Macroeconomics*, The MIT Press, Cambridge MA and London

Ultimately, the aim of monetary policy will be to minimise the variance of output by optimally setting the monetary rule to $a_1 = -1$ as this offsets the anticipated non-policy shock in the next period.[14] However, movements in aggregate demand (whether they are non-policy shocks or in money) that are more than two periods in advance have no effect on output. Harris and Holstrom note that the role of monetary policy is simply to act as a substitute for contract indexation, and that one role of aggregate policy is to convey information that would otherwise be more costly to obtain. If the monetary authority could set the money stock each period after the velocity shock becomes known, it could prevent all divergences of output from a given constant level.[15]

Persistence in the Model

Although persistence is observed in the Fischer model, it is limited. In the absence of other sources of persistence the effect of aggregate demand on output lasts only for a period equal to the period for which prices are predetermined.[16] This arises as a result of the fact that the value of an aggregate demand shift that becomes known after the first prices are set; $E_{t-2}m_t$ does not have any effect on output, as price setters have had a chance to respond to output, and this change and will not lead to changes in output.[17]

We can compare this result to other models; the Lucas model, that utilises only one time period does not consider persistence, although the Taylor model with more than one time period observes lengthy persistence in changes in output. In the Taylor model which more realistically reflects the economy, both wages and price levels adjust slowly to a permanent increase in money, ε_t, and as a result, the effects of a nominal disturbance on output are long lived, dying exponentially at a rate λ [18] and persistence in this productivity disturbance generates continued output persistence.[19]

[14] Blanchard, O. and Fischer, S. 1989, *Lectures in Macroeconomics*, The MIT Press, Cambridge MA and London
[15] Ibid
[16] Ibid
[17] Romer, D., 2006, *Advanced Macroeconomics*, (3rd Ed), New York: McGraw-Hill
[18] Where lambda = [1-sqrt(1-b2)]/b ; and 0< lambda <1 further details are given in the appendix of this paper.
[19] Walsh, C., 2003, *Monetary Theory and Policy*, (2nd Ed), The MIT Press, Cambridge MA and London Press.

What is the role of real rigidity?

Real rigidity refers to the models that explain why real wages or prices are unresponsive to changes in economic activity. Although for symmetry, the Fischer model assume that at time *t*, only half of the prices setters have updated their prices so that $p = \frac{1}{2}(p_t^1 + p_t^2)$, the true proportion is in fact determined by the fraction;

$$\frac{1}{1+\phi}$$

The parameter ϕ measures the degree of real rigidity, such that a smaller value of ϕ corresponds to a greater real rigidity. As Romer notes, when real rigidity is large $(\phi < 1)$, price setters are reluctant to allow variations in their relative prices and thus do not allow their prices to differ greatly from the level that they are initially set, leading to a large real affect from a monetary shock. Conversely, if the value of ϕ is large, then the real effects of changes in *m* are small,[20] and furthermore an undesired inflationary effect may be observed if ϕ is too large.

If we consider how a firm might change its real price in response to a change in aggregate real output, its optimal price setter *i* is demonstrated by;

$$p_{it}^* - p_t = c + \phi y_t$$

A lower value of ϕ corresponds to greater real rigidity since firms are unwilling to adjust their real prices when aggregate output changes.[21] Real rigidity alone does not cause monetary disturbances to have real effects: if prices can adjust freely, money is neutral regardless of the value of ϕ. But real rigidity magnifies the effect of nominal rigidity: a low value of ϕ implies that price-setters are unwilling to allow variations in their relative prices. As a result,

[20] Romer, D., 2006, *Advanced Macroeconomics*, (3rd Ed), New York: McGraw-Hill

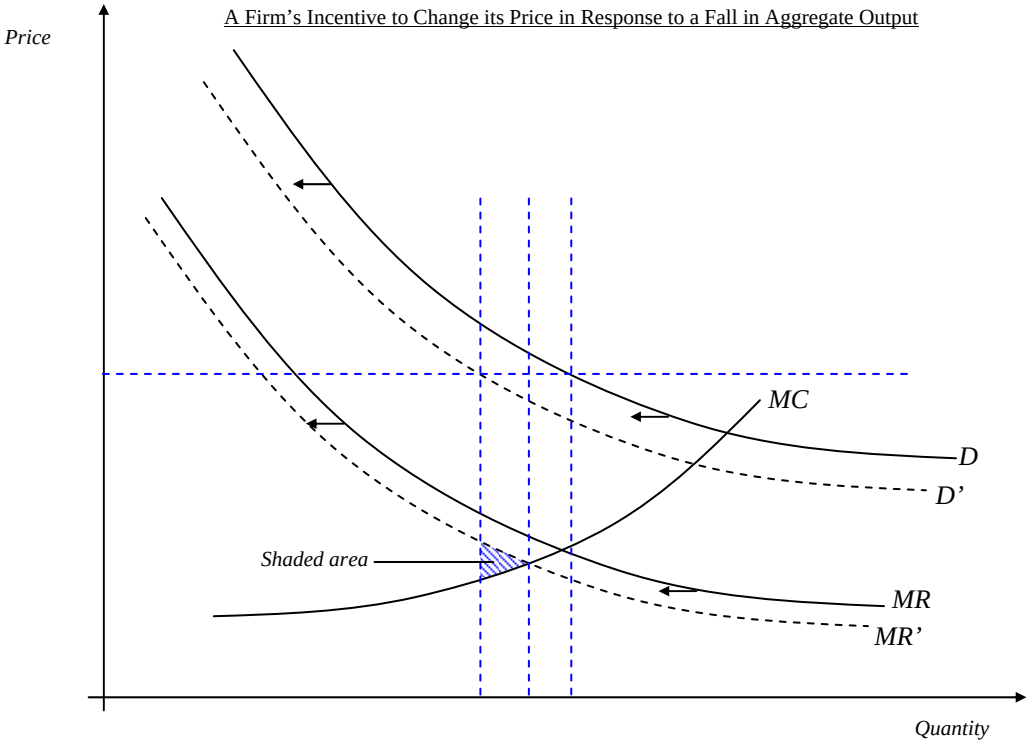
[21] If ϕ = 0 then there is complete real rigidity.

the price-setters that are free to adjust their prices do not allow their prices to differ greatly from those already set.[22]

Ultimately, real rigidity alone does not cause monetary non-neutrality if prices are completely flexible but in conjunction with nominal rigidity it increases the real effect of monetary shocks, and a greater degree of real rigidity increases persistence of the effects of changes in the money supply.

The Importance of Real Rigidity & Potential Sources

Although in a given economic system figures are often denominated in nominal terms, they are not of great importance to agents in that economy. Individuals clearly care more about the real level of wages, prices and consumption levels and will use these figures in their economic activities. According to New Keynesian Economics, if nominal imperfections are important to fluctuations in aggregate activity, it must be that small nominal frictions at the microeconomic level have a large effect of the macroeconomy.



Source: Romer, D., 2006, (Fig. 6.2, pg 291), Advanced Macroeconomics, (3rd Ed), New York: McGraw-Hill

[22] Cameron, G., *Macroeconomic Theory IV: New Keynesian Economics*, Lady Margaret Hall, Nuffield College, University of Oxford

The shaded area of the graph above shows the additional profits to be gained from reducing price and increasing quantity produced,[23] though the firm has an incentive not to adjust its price if the size of this area is smaller than the menu costs it has to pay in order to adjust.[24] The importance of real rigidity in the Fischer model is therefore clear; the incentive for firms to reduce price may be small, even though there may be a large change in demand, and if many firms behave this way, then a recessionary situation - with no firm adjusting- becomes an equilibrium.[25] Robert Gordon reaffirms this finding suggesting that in a response to a nominal demand change, no single private agent has an incentive to move its price unless it believes that all other agents will do likewise, and will do so without delay.[26]

However, if firms have a strong incentive to cut prices, then a recession can be avoided.[27] The two factors that will influence a firm's incentive to cut prices are marginal cost and marginal revenue, and how they respond to a fall in demand. The more marginal cost falls as output drops, then the greater the incentive of the firm will be to lower its price. Conversely, the more the marginal revenue curve shifts to the left due to a decrease in demand, the smaller the firm's incentive to change price.[28] Both a small cyclical sensitivity of marginal costs and a larger cyclical sensitivity of marginal revenues increase real rigidity.

There is an important link between multiple equilibria and real rigidity, as co-ordination failure requires that real rigidity be very strong over some range and as a result since there are many potential sources of real rigidity, there are many potential sources of co-ordination failure.[29] Generally, sources of real rigidity in the market can be classified under three or four topics, namely; customer markets, the independence of costs and demand and the role of the input-output table. Although the insensitivity of the profit function is recognised as an important factor of real rigidity, the labour market is often viewed as an equally important, if not even

[23] Romer, D., The New Keynesian Synthesis, *The Journal of Economic Perspectives*, Vol. 7, No. 1. (Winter, 1993) pp.5-22
[24] Professor Mitra, K. *Lectures in Advanced Macroeconomics, Handout 3*, 2006, University of St Andrews
[25] Professor Mitra, K. *Lectures in Advanced Macroeconomics, Handout 3*, 2006, University of St Andrews
[26] Gordon, R. J., *Journal of Economic Literature*, Vol. 28, No. .3. (Sep., 1990), pp. 1115-1171
[27] Professor Mitra, K. *Lectures in Advanced Macroeconomics, Handout 3*, 2006, University of St Andrews
[28] Ibid
[29] Romer, D., 2006, *Advanced Macroeconomics*, (3rd Ed), New York: McGraw-Hill

more influential source,[30] particularly if labour markets clear and labour supply is inelastic, then real wages are highly procyclical.[31] Other reasons include the extent of labour mobility or differences in the goods and credit markets.[32] However, real wages may not be highly procyclical as a result of either elastic short-run labour supply under intertemporal-substitution, or some other labour market imperfection such as an efficiency wage designed to increase the productivity of workers and reduce 'shirking', as well as reducing hiring and firing costs, but which results in setting real wages above market clearing levels.[33]

Generally, the incentive to change prices in response to a change in aggregate output depends on two factors: the impact of the change on the firms' profit maximising real price and on the cost to the firm of a given departure from the profit maximising level. For the incentive of price adjustment to be small, either profit maximising real prices must respond little to changes in aggregate demand – the degree of 'real rigidity' must be large, or large departures from profit maximising prices must have small costs.

[30] Ibid
[31] Professor Mitra, K. *Lectures in Advanced Macroeconomics, Handout 3*, 2006, University of St Andrews
[32] Romer, D., 2006, *Advanced Macroeconomics*, (3rd Ed), New York: McGraw-Hill
[33] Robert Gordon discusses customer markets, inventory models and theories of mark-ups under imperfect competition, and labour market rigidities as implicit contracts, efficiency wages and insider–outsider models as some explanations.

Conclusion

The Fischer model demonstrates how the early Keynesian view that the monetary policy can have no significant role in determining the behaviour is not necessarily true, and that in fact there is a very real ability for policymakers to impact the economy. As the money stock is changed by monetary authorities more frequently than labour contracts are renegotiated, monetary policy has the ability to affect the short-run behaviour of output, though it has no effects on long-run output behaviour. The model builds on the work of Lucas to create a model that more accurately describes the economy and the opportunities for policymakers to intervene, although the Taylor model provides a further development that more accurately describes the economy.

In conclusion, Fischer draws our attention to the fact that both anticipated and unanticipated changes in the money supply have an effect on output, and it is clear that staggered price decisions can generate long-lasting effects of money on output, though limited to the time periods set by the model. Furthermore, in the presence of non-policy shocks, policy can decrease the amplitude of output fluctuations, although the ability to do so is regulated by the real rigidity of the economy. Taylor's model provides a further development of this widely debated topic in macroeconomics.

Bibliography and Appendix

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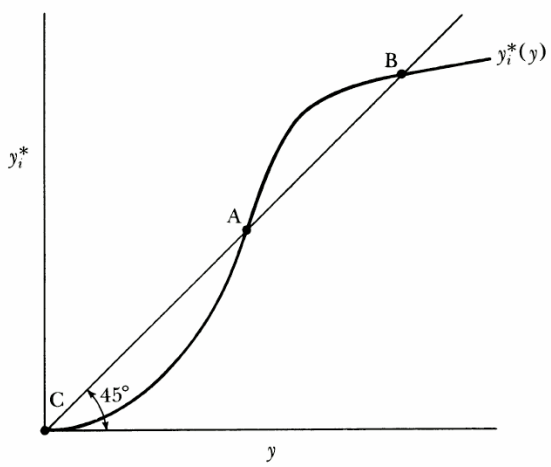
Appendix

Co-ordination Failure

Co-ordination failure demonstrates how more than one 'normal' level of output may exist:



Source: Romer, D., The New Keynesian Synthesis, The Journal of Economic Perspectives, Vol. 7, No. 1. (Winter, 1993) pp.5-22

Persistence in the Taylor Model

Solving the model generates the following equations for price *p* and output *y* gives;[34]

$$p_t = \lambda p_{t-1} + \frac{1}{2}(1-\lambda)(m_{t-1} + m_{t-2})$$

$$y_t = \lambda y_{t-1} + [m_t - \frac{1}{2}(1+\lambda)m_{t-1} - \frac{1}{2}(1-\lambda)m_{t-2}]$$

If λ is close to one, then the effects of money on output are large for periods of time much longer than the length of time during which each price is pre-determined on the timeline. Fischer demonstrates therefore that under time-dependent rules, for fixed and staggered price decisions, nominal money can have long-lasting effects on output as a result of the interdependence between price decisions.[35] Similarly, if lambda, or the *degree of inertia* is close to one then there will be little incentive for price-setters – whose turn it is to change

[34] Blanchard, O. and Fischer, S. 1989, *Lectures in Macroeconomics*, The MIT Press, Cambridge MA and London
[35] Ibid

prices – to do so, as they will not want to increase their relative price much vis-à-vis other price-setters.

The Fischer and Taylor model was developed further in 1987 by Caplin & Spulber

The Fischer and Taylor models assume that the timing of price changes is determined by the passage of time. However, since all contracts are, in principle, renegotiable, perhaps it is better to think of the timing as being endogenous. In the Caplin-Spulber model a situation with an Ss rule: whenever a price-setter adjusts her price, she sets it so that the difference between the actual and the optimal price is some target level S. The nominal price is then fixed until the optimal level has changed such that the trigger level s is reached. This is optimal when inflation is steady. In contrast to the Fischer model, money is neutral in the Caplin-Spulber model since the number of price-setters changing their prices at any one time is an increasing function of the money supply growth rate. Caplin-Spulber shows that state-dependent price changes are important and that even when prices are fixed for most price-setters, the actions of other price-setters can be offsetting.