

# Inflation-output trade-offs and the implications for monetary policy

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# Summary and Suggestions for Further Research

## 8.1 Summary and conclusions

This thesis investigates two main kinds of explanations for the existence of a short-run trade-off between inflation and output growth: the price-misperception theories and the price stickiness theories; in the long run the trade-off is absent in both theories (see chapter 2). According to the price-misperception theories, there is a short-run trade-off between inflation and output growth because suppliers have imperfect information about the nature of the shock in the demand for their products; they are uncertain whether the relative demand for their products has risen or whether the average price level has risen. The more a shock is thought to be real, the more suppliers will adjust output. According to the price stickiness theories, there is a short-run trade-off between inflation and output growth because the competition in goods market is imperfect and there are costs associated to changing prices or other nominal rigidities like strategic complementarity or staggered wages. In this case a higher aggregate demand will cause an increase in output as prices and wages are not adjusted immediately.

The price-misperception theories contain predictions for two types of aggregate demand policies: unsystematic and systematic policy. Unsystematic policy is defined as the occurrence of shocks in, for example, government expenditures, the money stock or the exchange rate, whereas systematic policy refers to changes in the rules for these variables. In the price-misperception theories only unsystematic policy can affect real output growth; systematic policy is neutral because an expected change in policy is already taken into account by economic agents. In the price stickiness theories unsystematic as well as systematic policy can affect output growth; then systematic policy can influence real economic growth due to the fact that it takes time for firms to adjust their pricing strategy.

### *Theoretical output effects of unsystematic and systematic policy*

The theoretical effects on output growth of unsystematic as well as systematic policy which the price-misperception theories and the price stickiness theories imply have been summarized in Table 8.1. It shows that the effect of both an expansionary unsystematic and a systematic policy change on output growth is positive in the short run, but zero in the long run. Second, the type of aggregate demand policy and the theoretical explanations underlying the trade-off affect the

shape of the short-run trade-off, and determine whether expected policy does affect output growth or not and whether the output effects are persistent or not. A symmetric short-run trade-off implies that an expansionary policy has the same effect on economic growth as a contractionary policy whereas they are different in case of an asymmetric short-run trade-off; a persistent effect on output growth implies that a policy change influences output growth not only in the period of the policy change, but also in later periods.

Now Table 8.1 shows that the price-misperception models and the price stickiness models have exactly the opposite predictions for unsystematic policy with respect to the shape of the short-run trade-off, the output effect of expected policy changes, and the length of the output effect. Whereas the price-misperception theories state that an aggregate demand shock has symmetric effects on output growth, the price stickiness models predict that they are asymmetric. The main explanation for this asymmetric trade-off is the existence of price adjustment costs (see Caballero and Engel, 1993; Tsiddon, 1993; and Ball and Mankiw, 1994). Given a positive rate of inflation, the price adjustment cost theories imply that a firm will adjust a price more frequently in the case of a demand increase than in the case of a demand decrease. Consequently, the output effect will be larger with a decrease in demand than with an increase in demand. Second, the price-misperception theories imply that an expected change in aggregate demand is neutral whereas it is not neutral in the price stickiness theories. If prices are sticky, it takes time to accommodate prices to a new level given an expected change in demand; therefore, expected policy changes do affect output growth. If prices are flexible, as in the price-misperception model, prices can be adjusted immediately and thus an expected change in demand is neutral. Third, shocks in aggregate demand are not persistent in the price-misperception model whereas they are persistent in the price stickiness models. In the price-misperception models a shock disappears one period after its initiation because the publication of the general price level eliminates the uncertainty about the relative prices; in the price stickiness models persistence is due to strategic complementarity, staggered wages, replenishment of the inventory of produced goods, or lags in the acquisition of information (see section 3.3.3).

Furthermore Table 8.1 shows that the output effects with respect to systematic policy are the same in the price-misperception model of chapter 6 and the price stickiness model of chapter 5: the shape of the short-run trade-off is symmetric, expected policy changes do affect output growth, and policy changes are persistent. Note that in chapter 6 expected policy changes do influence output because the nominal interest rate affects the real demand for money, the money supply responds with a lag to inflation changes, and the real exchange rate slowly reverts to purchasing power parity. In the price stickiness models of chapter 5 the last two causes are absent, but instead price adjustment costs or staggered wages are assumed.

Table 8.1 Theoretical output effects of unsystematic and systematic policy

	Price-misperception models		Price stickiness models	
	Unsystematic policy (chapter 3)	Systematic policy (chapter 6)	Unsystematic policy (chapter 3)	Systematic policy (chapter 5)
Short-run output effect of expansionary policy	positive	positive	positive	positive
Long-run output effect of expansionary policy	zero	zero	zero	zero
Shape of the short-run trade-off	symmetric	symmetric	asymmetric	symmetric <sup>1</sup>
Output effect of expected expansionary policy	zero	positive	positive	positive
Length of output effect	not persistent	persistent	persistent	persistent

### *Empirical output effects of unsystematic policy*

Table 8.1 shows that the shape of the short-run trade-off, the output effect of expected expansionary policy, and the length of the output effect are different for unsystematic policy between the price-misperception models and the price stickiness models. This allows one to test whether the empirical evidence favours the price-misperception models or the price stickiness models. For that purpose the symmetry-hypothesis, the structural neutrality hypothesis and the non-persistence hypothesis have been tested against the alternatives of asymmetry, non-neutrality and persistence respectively in chapter 3. It is found for the United States and Germany over the period 1973:1-1992:4 that the evidence with respect to the asymmetry hypothesis is mixed; the structural neutrality hypothesis and the non-persistence

<sup>1</sup> The symmetric response of systematic policy in the price stickiness models results from the fact that the Alogoskoufis models in chapter 5 have been stated in first differences instead of in levels; if they are stated in levels, these models imply an asymmetric short-run trade-off.

hypothesis, however, could not be rejected against the alternatives of non-neutrality and persistence respectively. So, it is hard to reject the price-misperception model.

From a policy point of view, however, it is hard to interpret the actual shocks in, for example, nominal demand growth as changes in policy. These may have resulted not only from changes in policy, but also from change in, for example, the behaviour of consumers and producers, and financial institutions. In order to analyse policy changes these must be separated from other changes.

### *Theoretical effects of unsystematic policy on the short-run trade-off*

If unsystematic policy is used more frequently, the price-misperception theories and the price stickiness theories predict that this has a detrimental effect on the short-run trade-off between inflation and output growth; the more it is applied, the lower the real effect of a shock becomes. Table 8.2 summarizes the theoretical effects of unsystematic policy on the short-run trade-off. It shows that according to the price-misperception theories a higher variance of inflation or a higher variance of aggregate demand shocks lowers the output response of an aggregate demand shock. These effects are known as the Lucas variability hypotheses. The price stickiness model of Ball, Mankiw and Romer (1988) implies the same relations. Thus, these two relations cannot be used to discriminate between the price-misperception theories and the price stickiness theories.

Nevertheless, a different response does appear with respect to inflation. Whereas the price-misperception theories do not predict a relation between the slope of the short-run trade-off and the rate of inflation, it is negative in the price stickiness theories because prices are adjusted more frequently if inflation is higher, and thus the output response to a demand shock is smaller. Normally, however, there is a strong correlation between the rate of inflation and the variance of inflation; consequently, a negative relation between the slope of the short-run trade-off and inflation does not provide evidence for the price stickiness theories.

Finally, Table 8.2 shows that both inflation-output theories predict a different response to changes in the variance of relative prices. Whereas there is a positive relation between the variance of relative price and the slope of the short-run trade-off in the price-misperception theories, it is negative in the price-stickiness theories. The relation is positive in the price-misperception theories because a higher variance of relative prices increases the proportion of shocks that are misperceived as real shocks; according to the price stickiness theories it is negative because a higher variance of relative prices increases the frequency of price adjustment and thus decreases the output effect of an aggregate demand shock. However, it is difficult to distinguish the variance of relative prices from the variance of absolute prices; consequently, it is hard to verify whether empirical evidence provides support for the price-misperception theories or for the price stickiness theories.

Table 8.2 Theoretical effects of unsystematic policy on the slope of the short-run inflation-output trade-off

	Price-misperception theories	Price stickiness theories
Increase in the variance of inflation ( $\sigma^2$ )	negative	negative
Increase in the variance of aggregate demand shocks ( $\sigma_{\Delta r}^2$ )	negative	negative
Increase in inflation ( $\Delta p$ )	absent	negative
Increase in the variance of relative prices ( $\tau^2$ )	positive	negative

*Empirical effects of the variance of inflation and the variance of aggregate demand shocks on the short-run trade-off*

While chapter 3 tested the symmetry hypothesis, the structural neutrality hypothesis, and the non-persistence hypothesis empirically, chapter 4 tested the effect of unsystematic policy on the slope of the short-run trade-off by investigating the Lucas variability hypotheses. Because the evidence in previously published Lucas variability studies is mixed concerning the question whether these cross-country predictions differ between developed and developing countries, a meta-study of ten of those studies has been performed. If a correction is made for differences in supply response, it is found that the hypothesis that a higher variance of demand shocks leads to a steeper short-run trade-off must be rejected for the group of developed countries. Thus, the price-misperception theories fail in some respects to explain empirical results. This may be also due to endogeneity in demand shocks as these are measured as changes in nominal income.

*Theoretical inflation effects of systematic monetary and exchange rate policy*

Neither unsystematic nor systematic policy can be used to affect real economic growth permanently. Moreover, frequent use of unsystematic policy even deprives such a policy from its short-run real effects. Therefore, it can be questioned whether such policies are of any use. However, the theoretical models of chapters 5 and 6 show that systematic policies can be of use to decrease inflation. The theoretical effects found in both chapters have been summarized in Table 8.3. It shows that according to the price-misperception model of chapter 6 a higher degree of monetary accommodation increases the persistence of average inflation. A higher degree of exchange rate accommodation decreases the average real interest rate which in

*Empirical effects of systematic exchange rate policy*

Given reasonable parameter values, chapters 5 and 6 imply that a country can only obtain an increase in the speed of inflation convergence by maintaining a hard peg with respect to a low inflation currency. Alternatively, the borrowed credibility hypothesis suggests that it is enough to join a fixed-exchange rate regime like the Exchange Rate Mechanism (ERM) of European Monetary System (EMS). In chapter 7 it has been empirically investigated which of these two hypotheses is true for Spain and Italy over the period 1975:1-1995:1. The results show for both countries that only the hard peg to the Deutschmark increased the speed of inflation convergence; joining and leaving ERM, and changing band widths did not affect the speed of inflation convergence significantly. This provides support for the hypothesis of chapters 5 and 6, but rejects the borrowed credibility hypothesis.

*Overall conclusions*

This thesis has shown that the two explanations for a short-run trade-off between output and inflation, the price-misperception theories and the price stickiness theories, predict that the short-run output effect of both an expansionary unsystematic and a systematic policy is positive and that their long-run effects are zero. However, both theories have different predictions for unsystematic policy with respect to the shape of the short-run trade-off, the output effect of expected policy, and the length of the output effect. According to the price-misperception theories the short-run trade-off is symmetric, the output effect of an expected policy change is zero, and demand shocks are not persistent; according to the price stickiness theories, the short-run trade-off is asymmetric, the output effect of an expected policy change is not zero, and demand shocks are persistent. The empirical evidence in this thesis shows that it is hard to reject the price-misperception model. For systematic policy, both theories have the same theoretical prediction: the shape of the short-run trade-off is symmetric, the output effect of an expected expansionary policy is positive, and demand shocks are persistent.

If unsystematic policy is used frequently, this deteriorates the short-run trade-off. Whereas the new-Keynesian theories suggest two tests to distinguish between the price-misperception theories and the price-stickiness theories, these tests suffer from a measurement problem. If the average inflation is correlated with the variance of inflation, it is hard to interpret a negative relation between the slope of the short-run trade-off and the rate of inflation as resulting from price stickiness. Furthermore, if the variance of relative prices is correlated with the variance of absolute prices, it is not sure anymore whether a negative relation between the variance of relative prices results from price-misperception or price stickiness.

Finally, whereas neither unsystematic nor systematic policy can be used to increase output growth permanently, the theoretical price-misperception model of

chapter 6 and the price stickiness model of chapter 5 predict that systematic monetary and exchange rate policy can be used to reduce inflation permanently. The empirical evidence of chapter 7 shows for Spain and Italy that a hard exchange rate policy indeed increases the speed of inflation convergence as implied by the models of chapters 5 and 6; joining an exchange rate mechanism as the ERM is not enough to obtain an increase in the speed of inflation convergence as suggested by the borrowed credibility hypothesis.

## 8.2 Suggestions for further research

With respect to the new-Keynesian explanations for the trade-off, only a few empirical investigations have been performed. Improvements in this area can be achieved by constructing relative and absolute price variance in such a way that they are orthogonal based on disaggregated data. In that case, the relative price variability test of Ball, Mankiw, and Romer (1988) can be used to distinguish the price-misperception theory and the price stickiness theory. Furthermore, expected aggregate demand growth must be specified more carefully instead of assuming that it is equal to the long-run average growth. Such an assumption generates quite inefficient estimates of expected aggregate demand growth while more efficient procedures like Box-Jenkins models and Kalman filters are available. Finally, in order to investigate such trade-offs from a cross-country perspective, it is rather rigid to use all available countries without making any distinction in, for example, their stage of development. The more developed they are, the less the effect of a change in policy may be. In chapter 4 developed and developing countries were distinguished, but a more flexible classification may provide more insight into the data; such a classification can be obtained by using different non-parametric techniques.

A final suggestion for future research is to investigate the inflation convergence model with the expected inflation differentials instead of the realized differentials. This would be closer to chapter 5. Finally, as a parallel to the inflation convergence, interest convergence should be investigated. It can be investigated whether the same shifts occur in the interest rate convergence; furthermore, this analysis can be extended to more European countries.