Why do prices rise faster than they fall?

Toolsema-Veldman, Linda; Jacobs, J.P.A.M.

Why do prices rise faster than they fall? With an application to mortgage rates

Linda A. Toolsema and Jan Jacobs*

June 18, 2001

Abstract

Empirical literature shows that prices respond asymmetrically to cost changes in many markets, rising faster than falling. The market for mortgages is an example; the mortgage rate follows an increase in capital market rates faster than a decrease. We examine various theoretical explanations for asymmetric price adjustments in general, and discuss their validity for the mortgage rate in particular. Also, we investigate Dutch mortgage rates and show that in The Netherlands mortgage rates indeed respond asymmetrically to changes in capital market rates.

1 Introduction

According to empirical evidence, prices respond faster to cost increases than to cost decreases. Peltzman (2000) analyses price adjustments for 77 consumer goods and 165 producer goods and concludes that this asymmetry prevails in more than two of every three markets. The market for gasoline is a well-known example. Consumers closely observe retail gasoline prices and regularly complain that they rise faster than they fall. This suspicion is generally confirmed by observed time series of gasoline and crude oil prices. Borenstein *et al.* (1997) demonstrate that gasoline prices in the US indeed

*Department of Economics, University of Groningen, P.O.Box 800, 9700 AV Groningen, The Netherlands. E-mail: L.A.Toolsema@eco.rug.nl (corresponding author). Helpful discussions with and suggestions by Robert-Paul Berben, Hans van Ees, Marco Haan, Jan Kakes, Robert Lensink, Bert Schoonbeek, Timon Verheule, and participants of the CCSO/SOM seminar are gratefully acknowledged.

rise more quickly after an increase in crude oil prices than they fall after a decrease in this input price. Brown and Yücel (2000) discuss the evidence from several empirical studies. Using a more intuitive approach, they list possible explanations for asymmetric pricing and argue whether or not they are relevant for gasoline prices. However, Godby *et al.* (2000) do not find evidence of asymmetries in price adjustments for retail gasoline in Canada.

We remark here that survey evidence by Blinder (1994) and a store-level analysis of supermarkets by Levy *et al.* (1998) suggest the existence of asymmetries in the opposite direction, i.e. prices being more rigid upward than downward (see Section 2 for an explanation). We refer to this as downward asymmetry since it favours downward adjustments. In the remainder of the paper, we focus on upward asymmetries as discussed above.

Although this paper concentrates on the response of an output price to an input price, we stress that the asymmetry phenomenon is not limited to some (or many as Peltzman, 2000, argues) specific consumer or producer good markets. For example, Shirvani and Wilbratte (1999) analyse the response of the domestic price level to import price changes in a macroeconomic context and observe a similar upward asymmetry. Perhaps even more intriguing is the war-ratchet hypothesis put forward by Rockoff (1998). This hypothesis suggests that wars produce upward ratchets in federal spending, and is partly based on the following argument: "Taxes are raised during wars, people become reconciled to them, and so afterwards governments face limited political cost if taxes are reduced only part of the way to prewar levels" (Rockoff, 1998, p. 46).

There is a wide variety of theoretical explanations of the observed upward asymmetry. Lay prejudice suggests that firms in concentrated markets collude. An alternative view believes that consumer search costs give firms some market power in the short run. At the firms' side there may be adjustment costs, causing firms to be reluctant to adjust prices. Others believe inventories and/or input supplies to play a crucial role. We will discuss these and other explanations in more detail in the next section. Of course, any microeconomic explanation of the asymmetry has a strong New Keynesian flavour. New Keynesians try to underpin price rigidities by postulating that there are real costs to price changes.

This paper focuses on mortgage rates, a topic that did not attract a lot of attention in the literature on asymmetric price adjustments. We discuss the relevancy of the theoretical explanations of asymmetries for the case of mortgage rates. Also, we present an application for The Netherlands, identifying an upward asymmetry in mortgage rate adjustments. Using a related approach, Frost and Bowden (1999) find evidence of asymmetries for the case of the New Zealand mortgage rate. However, these asymmetries are downward in the sense that they are beneficial to consumers. Another empirical analysis of asymmetric interest rate adjustments is the study by Neumark and Sharpe (1992), who present evidence of asymmetric adjustments of consumer deposit interest rates (which fall faster than they rise) and link this observation to market concentration.

The remainder of this paper is structured as follows. Section 2 summarises several theoretical explanations for the observed asymmetry between output price and input price changes as put forward in the (mainly empirical) literature. Furthermore, we discuss which of these are relevant for mortgage rates. Section 3 presents an empirical analysis of the Dutch mortgage interest rate. We show evidence of upward asymmetries in the dynamic behaviour of the mortgage rate. Section 4 concludes.

2 Explaining the asymmetry

Several explanations for asymmetries in price adjustments have been advanced in the literature. This section starts with an overview of explanations and proceeds with a discussion of the relevancy of the explanations for the case of mortgage rates.

Explanations for asymmetric price adjustments

Let us start with what is perhaps the most intuitive explanation. If concentration in a market is high—for example due to entry barriers or because the market is geographically limited—there may be scope for co-ordination on prices. Even if firms cannot explicitly co-ordinate on a certain price level (which is commonly forbidden by law) there may be room for tacit collusion. Suppose there is asymmetric information about input prices, and that firms are engaged in an unspoken collusive agreement. If a firm's input price rises—which is not observed by the other firms—it will be quick to increase its output price to signal that it adheres to the agreement. However, if the firm's input price falls, it will be reluctant to decrease output price, since the other firms may interpret this as a deviation from the collusive agreement and punish the presumed deviator by competing more aggressively. But even if input prices are common knowledge, there is a possibility for tacit collusion after a decrease in input prices. In this situation, the old price serves as a 'focal' or trigger price. As long as no firm decreases its price, all firms can earn supernormal profits. However, as soon as one firm reduces its price, the others will follow in order not to loose their market share. Thus, a firm hurts itself by being the first to decrease its output price. Therefore, every firm has an incentive not to adjust the output price after a decrease in the input price. With respect to empirical evidence, in Peltzman's (2000) analysis the effect of more competition is statistically indistinguishable from zero. Nevertheless, in their analysis of consumer deposit interest rates, Neumark and Sharpe (1992) conclude that their results indicate that the observed asymmetry is a consequence of market concentration (which acts as a proxy for market power).

A second explanation based on market power builds on consumer search costs. It is assumed that searching for a low(er) price is costly, for example because it is time-consuming. In the case of local monopolies (think of a gasoline station at a specific location) firms have some market power in the short run, since they are only forced to lower prices to (more or less) the competitive level after consumers have been engaged in a search process. This implies that they can pass on input price decreases to the output price slowly, and temporarily have high profit margins. This is particularly relevant in markets in which demand is relatively inelastic, such as the market for retail gasoline. A similar argument holds when consumers believe input prices to be volatile. In this situation, consumers face a signal-extraction problem: it is not clear whether a higher output price reflects a higher input price, or a higher relative output price. The expected gain from search to the consumer is therefore decreased. Consumers will search less, and firms' market power is temporarily higher. This argument tends to be empirically relevant (Peltzman, 2000).

Although the standard kinked demand curve model does not explain asymmetric price adjustments but predicts price stickiness in either direction, the third explanation adopts the kinked demand concept. Roufagalas (1994) assumes that there is a 're-optimisation' cost to consumers' financial planning. If a price rises after consumers have decided on their optimal consumption bundle, the consumers must re-optimise and incur the cost because otherwise their budget constraint is violated. However, a price reduction leads them to re-optimise only when the decrease is large enough. If not, they simply consume the planned bundle and have some unexpected savings. This implies that the inverse demand curve has a completely inelastic (vertical) segment below the current price. So, a firm facing this demand curve has no incentive to reduce output price after a decrease in input price because such a reduction will not imply higher sales. For the case of gasoline, Brown and Yücel (2000) suggest another variety of the kinked demand concept. They argue that, when gasoline prices rise, consumers may accelerate purchases in order to beat further price increases, thereby causing the price to rise even faster. On the other hand, as prices fall, they may not slow down their purchases as much, out of fear to run out of gasoline.

Fourth, even for competitive firms, there may be short-run costs to unexpected changes in firms' inventories. Because of finite inventories and production lags, positive demand shocks cannot be accommodated as quickly as negative demand shocks (see Reagan and Weitzman, 1982). According to Borenstein *et al.* (1997), this partly explains the asymmetries in gasoline price adjustments. However, Peltzman's (2000) analysis does not suggest that this effect is very important.

Fifth, adjustment or small menu costs that a firm incurs when adjusting its price or output may cause asymmetries. Levy *et al.* (1997) show that for their sample of supermarkets, menu costs may indeed form a barrier to price changes. They find that approximately 20 to 35% of cost-based price adjustments are not implemented because the costs of these adjustments are higher than the corresponding benefits. However, both Blinder (1994) and Levy *et al.* (1998) suggest that the presence of asymmetric adjustment costs deters price increases more often than price decreases, implying a downward asymmetry in price adjustments. An explanation for this type of asymmetry in adjustment costs may be the fear of loss of sales in competitive markets if rivals do not match the price increase (see Blinder, 1994, p. 128). But adjustment costs need not be asymmetric themselves to explain (upward) asymmetries in price adjustments. Alternatively, consider supply shocks with symmetric adjustment costs. A negative input supply shock must imply a decrease in output, despite the adjustment costs. A positive supply shock however does not necessarily imply an increase in output precisely because of the adjustment costs, which may outweigh the benefits of increasing output. This suggests that price rises following a negative input supply shock, but it does not necessarily fall following a positive shock. Nevertheless, Peltzman's (2000) results indicate that inflation-related asymmetric menu costs are irrelevant in explaining asymmetric price dynamics.

Finally, there are some more sketchy explanations. Peltzman (2000) suggests vertical market linkages, since these tend be positively correlated with the asymmetry in his empirical results. Brown and Yücel (2000) mention varying mark-ups over the business cycle.

Explanations for asymmetric mortgage rate adjustments

With respect to downward stickiness of mortgage (or other lending) rates, some of the above explanations can be skipped. For example, tacit collusion due to asymmetric information with respect to input prices is not relevant, since the main 'input price' for mortgages is the capital market rate which is common knowledge to all banks. Theories based on inventories and supply shocks do not hold for mortgages either, since banks can always turn to the capital market where they face an 'infinite' supply of funds at the current interest rate. Also, the explanations based on menu costs and vertical market linkages do not seem particularly relevant here.

To explain asymmetries in mortgage rate changes, we can exploit the mortgage offer practice. In The Netherlands, most mortgages are fixed rate. Fixed rate mortgages are also offered in other countries, for example in the UK, Germany, Sweden, Belgium, Italy, Spain, Portugal and Greece. If a person wants to buy a house with a fixed rate mortgage, he (or she) can invite mortgage offers from one or more banks[1]. The bank makes an offer to the client, stating that he can borrow at most this or that amount at some fixed rate. In general, this rate depends on the number of years for which the rate is fixed (in The Netherlands, say, 2, 5, 10, 15 or 20 years for a 30-year mortgage). For simplicity, we assume below that an offer consists of a single interest rate that corresponds to some given term (say, five years, as in the data used in Section 3). The offer is valid for a fixed period of, say, one month. The client can accept it at any time during this period and get a mortgage at the given rate; if the client wants a mortgage after the offer has expired, he has to solicit for a new offer.

The crucial idea in the reasoning below is that whenever the mortgage rate moves up, clients with an outstanding offer can still get the mortgage at the low rate of the offer. If clients accept their offer after the increase, they pay the low rate of the offer even though the current mortgage rate is higher. When the mortgage rate falls, the bank cannot charge the old, high rate to clients that have a non-expired offer (they would simply ask for a new offer at the current, lower rate if the bank would do so). So, a mortgage rate increase does not affect outstanding offers, whereas a decrease does. Note

[1] The procedure for mortgage offers described here is based on the Dutch case. For at least some of the other countries mentioned, the procedure is similar.

the analogy of the offer policy with an option: the offer is a contract that gives the owner the right to obtain a mortgage at a fixed, specified rate at any time on or before a given date.

The mortgage offer policy implies a loss to the bank because increases in the mortgage rate are not immediately passed on to all clients. In this case, to the banks, the asymmetry is downward: an increase in the mortgage rate stated by the bank does not immediately imply an equal increase in the mortgage rate charged because of outstanding offers whereas decreases are passed on to all clients immediately. The banks may choose to 'compensate' for this loss by adjusting the mortgage rate upward faster than downward, implying an upward asymmetry in mortgage rate adjustments.

This type of offer is strikingly similar to the most-favoured-customer clause (see Cooper, 1986, or Tirole, 1988, pp. 330-332). With such a clause, a firm guarantees its current customers that if it charges a lower price in the future (up to some specified date), they will be reimbursed the difference. Mortgage offers as described above can be interpreted as a most-favoured-customer policy. Consider the clients who obtain a mortgage under the conditions of the offer (i.e. who accept their offer). For them, it is as if they already decided to accept when they invited (or received) the offer, combined with a most-favoured-customer clause. This clause guarantees them the lowest mortgage interest rate offered by the bank in the 'future', i.e. the month in between the receipt and the expiration of the offer. As Cooper (1986) argues, the most-favoured-customer clause allows firms (banks) to commit to a higher price (mortgage rate) by penalising price cuts, which softens price competition. Therefore, banks may precisely engage in mortgage offers because this facilitates tacit collusion. And as we mentioned above tacit collusion may imply asymmetric price adjustments.

3 An application to mortgage rates[2]

As we discussed in the previous section, some theoretical explanations of asymmetric price adjustments as well as the mortgage offer policy of Dutch banks suggest an upward asymmetry in mortgage rate adjustments. At first sight, movements of the Dutch mortgage rate and long-run interest rates lend credence to this story.[3] Figure 1 shows the mortgage rate r_m and the

[2] This section draws on Jacobs and Toolsema (2001).

[3] We have used the following monthly data in the empirical analysis. For the mortgage rate r_m: nominal mortgage rate with rate fixed for five years (monthly average), published

ten-year capital market rate r_l for the period April 1978 - December 2000. The mortgage rate used here represents the rate charged for a period of five years. The long-run rate r_l refers to a ten-year term. Thus, a term structure effect may blur the comparison of the two series. Dutch banks claim that they nowadays base the mortgage rate on an alternative capital market rate, the so-called swap rate, an interest rate that banks charge each other. Figure 2 shows the movements of the mortgage rate and the five-year swap rate r_{sw} for the period June 1991 - December 2000. In both Figure 1 and Figure 2 the gap between the mortgage rate and the capital market rate widens in times of downward interest rate movements, suggesting that the mortgage rate rises faster than it falls.

We test this hypothesis of asymmetric mortgage rate adjustments by estimating the following error correction model (ECM):

$$\begin{aligned} \Delta r_{m,t} &= a_1\left(r_{m,t-1} - a_2 r_{t-1} - a_3\right) \\ &\quad + a_4 \Delta r_t^+ + a_5 \Delta r_t^- + a_6 \Delta r_{t-1}^+ + a_7 \Delta r_{t-1}^- + \varepsilon_t \end{aligned} \tag{1}$$

where $r_{m,t}$ denotes the mortgage rate and r_t denotes the capital market rate in month t, and Δ is the first difference operator. Δr_t^+ and Δr_t^- refer to increases and decreases, respectively, of the capital market rate in month t. For the capital market rate we take the ten-year rate r_l and the five-year swap rate r_{sw}. The a's are the parameters to be estimated and ε is an error term. The first term on the right-hand side expresses the deviation from the long-run equilibrium relationship between the mortgage rate and the capital market rate, which is represented by $r_{m,t} = a_2 r_t + a_3$. According to Equation (1) the change in the mortgage rate is explained by the deviation from the long-run equilibrium in the previous month and (current and lagged) increases and decreases in the capital market rate. Using a Wald test, we can test for equality of the coefficients of the variables referring to increases and decreases, respectively, of r in order to determine whether or not there is evidence of asymmetries in mortgage rate adjustments.

The ECM of Equation (1) is the result of a specification search. First, we estimated a bivariate vector autoregression model in levels for the mortgage rate r_m and the capital market rate (either r_l or r_{sw}). This model explains the two variables from their lagged values. Based on two statistical criteria, the Akaike Information Criterion and the Schwarz Bayesian Criterion, we

in Statistisch Bulletin, The Netherlands Bank. For the long-run rate r_l: NLBRYLD: NL benchmark bond 10 yrs (DS) (monthly average) as published in Thomson Financial Datastream. Finally, for the swap rate r_{sw} we used ICNLG5Y: Netherlands (NLG) IR Swap 5 year - middle rate from Thomson Financial Datastream.

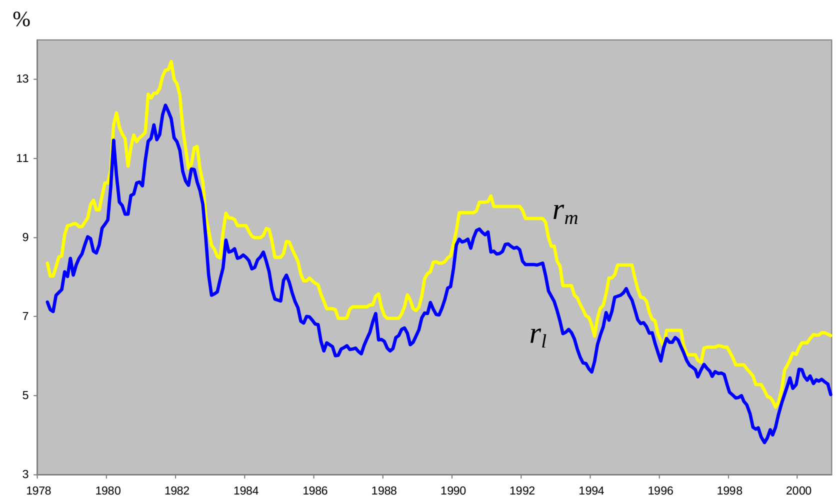

Figure 1: Mortgage rate (r_m) and ten-year capital market rate (r_l) for The Netherlands; April 1978 - December 2000.

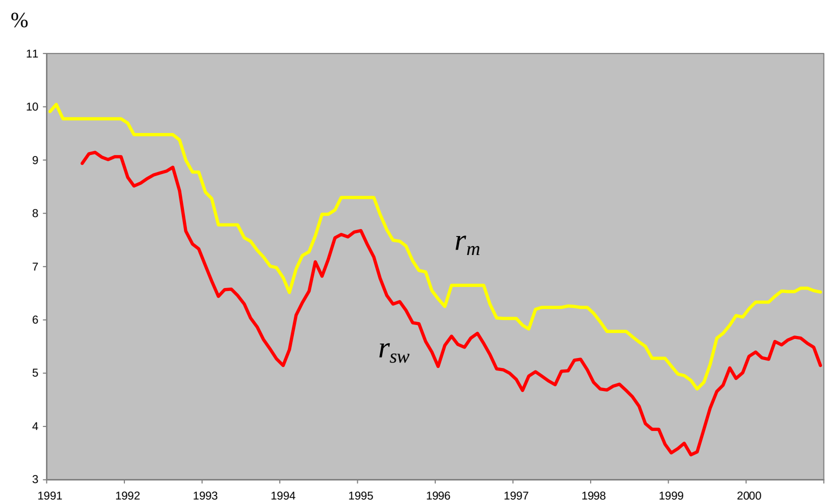

Figure 2: Mortgage rate (r_m) and five-year swap rate (r_{sw}) for The Netherlands; June 1991 - December 2000.

Capital market rate Sample period	r_l 1978:4-2000:12	r_{sw} 1991:6-2000:12
Coefficients		
a_1	-0.12	-0.23
a_2	1	0.90
a_3	0.64	1.51
a_4	0.42	0.25
a_5	0.34	0.24
a_6	0.53	0.45
a_7	0.28	0.19
Wald tests (p-value)		
$a_4 = a_5$	0.446	0.894
$a_6 = a_7$	0.019	0.042
$a_4 = a_5$, $a_6 = a_7$	0.014	0.100
$a_4 + a_6 = a_5 + a_7$	0.006	0.074

Table 1: Estimation results. (Note that a_2 is set to 1 for r_l, because the hypothesis that $a_2 = 1$ cannot be rejected.)

found that for each capital market rate we had to include two lags in this model. Then, we tested for cointegration in the model with two lags. The results show that the mortgage rate is cointegrated both with r_l and r_{sw}. In the cointegrating equation, we normalised the coefficient of the mortgage rate to one, and we tested whether the coefficient of the capital market rate used was significantly different from zero. If this is not the case, in the long run the mortgage rate equals the capital market rate plus a constant. Here, the constant refers to the interest rate margin. Using a 5% confidence level, we reject the hypothesis of a unit coefficient for the swap rate. Therefore, we estimate the coefficient a_2 for the swap rate; for the ten-year capital market we set $a_2 = 1$. Finally, we assume that the capital market rate is exogenous for the determination of the mortgage rate. Thus, we estimate a single regression equation with the change in the mortgage rate as dependent variable instead of a system of two equations. Two lags in a model in levels correspond to one lag in the ECM of Equation (1) which runs in first differences. For both capital market rates we find that the lagged change in the mortgage rate is not significantly different from zero. Therefore we do not include this variable as an explanatory variable.

Table 1 summarises the main estimation results for the model (1). The table presents estimates for the coefficients, all significant at the 5% level, and the

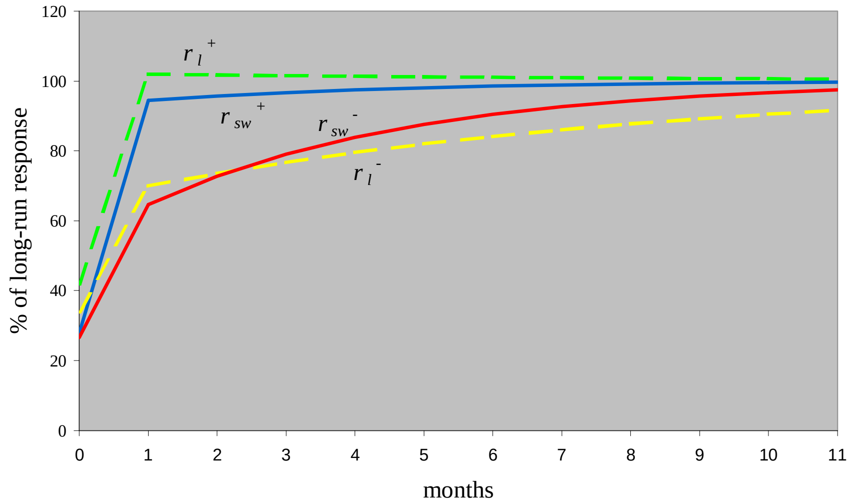

Figure 3: Responses of the mortgage rate to an impulse of capital market rates, as a percentage of the long-run response.

p-values corresponding to the Wald tests. From the results we conclude that the sum of the direct and lagged effect of an increase in the capital market rate r_l is significantly larger than the sum of the effects of a decrease in that rate. This means that the (total) effect of a positive change in r_l exceeds the effect of a negative change in r_l (in absolute value). For the swap rate, where the term structure does not blur the relationship, the result is less convincing, but still we can reject equality of the effects at the 10% significance level.

Figure 3 presents the estimation results in another way. It shows the responses of the mortgage rate to permanent positive and negative impulses to the capital market rates r_l and r_{sw}. The outcomes are in terms of the percentage of the long-run responses measured by parameter a_2 in Equation (1). We computed the figure with permanent 1%-point impulses. Because the model is linear, the size of the impulses does not affect the percentual results. We observe that positive impulses in both capital market rates are (more or less) completely passed on to the mortgage rate within one month. However, negative shocks are transmitted with longer lags.

The econometric analysis allows us to conclude that Dutch banks adjust the mortgage rate asymmetrically after changes in their cost structure. Our results show that the mortgage rate responds stronger to an increase in the capital market rate than to a decrease.

4 Concluding remarks

Empirical literature presents evidence for prices responding asymmetrically to cost changes, rising faster than falling in many markets. One example is the market for mortgages, where the mortgage rate follows an increase in capital market rates faster than a decrease. We summarised possible theoretical explanations for such asymmetric price adjustments as advanced in the literature. Also, we discussed their relevance for the mortgage market, concluding that most of the explanations suggested in the literature do not apply to the case of mortgages rates or interest rates in general.

We examined an additional explanation based on mortgage offers as they exist for example in The Netherlands. A mortgage offer is valid for a limited period of time and states an interest rate at which the client can obtain a mortgage from a bank. If the mortgage rate charged by the bank moves up during this period, the outstanding offers keep the old, lower rate. If clients accept an offer after the increase, they will pay the lower rate even though the current mortgage rate is higher. However, when the mortgage rate falls, the bank evidently cannot charge the old, higher rate to these clients. This shows that decreases in the mortgage rate are immediately passed on to all clients, whereas increases are not. Banks might thus be inclined to decrease mortgage rates at a slower pace in order to compensate for this loss, causing an upward asymmetry in mortgage rate adjustments.

Finally, we analysed Dutch mortgage interest rates and found evidence that mortgage rates indeed respond asymmetrically to changes in capital market rates. Should banks be forced to adjust mortgage rates downwards faster? This sounds like a good idea, but it will be hard to implement. Our theoretical discussion brings another drawback to the fore. As mentioned above, an explanation for upward asymmetry of mortgage rate adjustments may be that banks compensate for the loss caused by the offer policy. Should banks be forced to follow increases and decreases in the capital market rate equally fast, they could decide to diminish the offer loss by passing on mortgage rate increases for outstanding offers too. This remedy might be worse than the disease.

References

Blinder, Alan S. (1994), "On sticky prices: Theories meet the real world", in N. Gregory Mankiw, editor, *Monetary Policy*, Chicago, National Bureau of Economic Research, University of Chicago Press, 117–150.

Borenstein, Severin, A. Colin Cameron, and Richard Gilbert (1997), "Do gasoline prices respond asymmetrically to crude oil price changes?", *Quarterly Journal of Economics*, **112**, 305–339.

Brown, Stephen A. and Mine K. Yücel (2000), "Gasoline and crude oil prices: Why the asymmetry?", *Federal Reserve Bank of Dallas Economic and Financial Review*, 23–29.

Cooper, T. (1986), "Most-favored-customer pricing and tacit collusion", *Rand Journal of Economics*, **17**, 377–388.

Frost, Denise and Roger Bowden (1999), "An asymmetry generator for error-correction mechanisms, with application to bank mortgage rate dynamics", *Journal of Business and Economic Statistics*, **17**(2), 253–263.

Godby, Rob, Anastasia M. Lintner, Thanasis Stengos, and Bo Wandschneider (2000), "Testing for asymmetric pricing in the Canadian retail gasoline market", *Energy Economics*, **22**, 349–368.

Jacobs, Jan and Linda A. Toolsema (2001), "Rekenen banken zich rijk?", *Economisch Statistische Berichten*, **86**(4300), 250–252.

Levy, Daniel, Mark Bergen, Shantanu Dutta, and Robert Venable (1997), "The magnitude of menu costs: Direct evidence from large U.S. supermarket chains", *Quarterly Journal of Economics*, **112**(3), 791–825.

Levy, Daniel, Shantanu Dutta, Mark Bergen, and Robert Venable (1998), "Price adjustment at multiproduct retailers", *Managerial and Decision Economics*, **19**, 81–120.

Neumark, David and Steven A. Sharpe (1992), "Market structure and the nature of price rigidity: Evidence from the market for consumer deposits", *Quarterly Journal of Economics*, **107**(2), 657–680.

Peltzman, Sam (2000), "Prices rise faster than they fall", *Journal of Political Economy*, **108**(3), 466–502.

Reagan, Patricia B. and Martin L. Weitzman (1982), "Asymmetries in price and quantity adjustments by the competitive firm", *Journal of Economic Theory*, **27**, 410–420.

Rockoff, Hugh (1998), "The peace dividend in historical perspective", *American Economic Review*, **88**(2), 46–50.

Roufagalas, John (1994), "Price rigidity: An exploration of the demand side", *Managerial and Decision Economics*, **15**, 87–94.

Shirvani, Hassan and Barry Wilbratte (1999), "The asymmetric response of domestic prices to changes in import prices: A cointegration test of the ratchet effect", *Journal of Macroeconomics*, **21**(23), 381–396.

Tirole, Jean (1988), *The Theory of Industrial Organization*, MIT Press, Cambridge.