Why do Prices Rise Faster Than They Fall?
With an Application to Mortgage Rates

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Empirical literature shows that prices respond asymmetrically to cost changes in many markets, rising faster than falling. An example is the mortgage rate, which 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. We show that in The Netherlands mortgage rates indeed respond asymmetrically to changes in capital market rates and consider the relevance of theoretical explanations for this particular market. Copyright © 2007 John Wiley & Sons, Ltd.

INTRODUCTION

According to empirical evidence, prices respond faster to cost increases than to cost decreases. Peltzman (2000) analyzes 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 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 informal approach, they list possible explanations for asymmetric pricing and discuss their relevance for gasoline prices. However, Godby et al. (2000) do not find evidence of asymmetries in price adjustments for retail gasoline in Canada.

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 favors 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) analyze 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 or switching 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 flavor. New Keynesians try to underpin price rigidities by postulating that there exist 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 relevance of various theoretical explanations of asymmetries for the case of mortgage rates. Also, we present an application for The Netherlands, which indicates that positive impulses are passed through significantly faster than negative impulses. We argue that the observed asymmetry is probably due to collusion or price coordination, search or switching costs, and perhaps the mortgage offer policy.

There are some related empirical studies of asymmetric interest rate adjustments. Frost and Bowden (1999), who use an approach comparable to ours, find evidence of asymmetries for the case of the New Zealand mortgage rate. However, these asymmetries are downward and in that sense they are beneficial to consumers. Hannan and Berger (1991) and Neumark and Sharpe (1992) present evidence of asymmetric adjustments of US consumer deposit interest rates (which fall faster than they rise). Neumark and Sharpe link this observation to market concentration.

The remainder of this paper is structured as follows. The following section summarizes several theoretical explanations for the observed asymmetry between output price and input price changes as put forward in the (mainly empirical) literature. We discuss which of these may be relevant for mortgage rates and present additional explanations for asymmetric mortgage rate adjustments, based on prepayment and on the mortgage offer practice. The third section begins with a brief description of the mortgage market in The Netherlands and presents an empirical analysis of the Dutch mortgage interest rate. We show evidence of upward asymmetries in the dynamic behavior of the mortgage rate. We also discuss the relevance of theoretical explanations for this particular market. The final section concludes.

EXPLAINING THE ASYMMETRY

Several theoretical explanations for asymmetries in price adjustments have been advanced in the literature. This section starts with an overview of general explanations and proceeds with a discussion of the relevance 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 bounded—there may be scope for coordination on prices. Even if firms cannot explicitly coordinate 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 (see Damania and Yang, 1998).

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. Suppose that initially firms charge the equilibrium oligopoly price, i.e. there is no collusion. If input prices rise, the equilibrium oligopoly price rises as well. Now suppose that input prices fall. The equilibrium oligopoly price will fall as well, but the old price can now work as a focal price for collusion. This price is higher than the new oligopoly price.
and thus collusive. 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 lose 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 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 or, equivalently, switching costs. It is assumed that searching for a lower 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-optimization’ cost to consumers’ financial planning. If a price rises after consumers have decided on their optimal consumption bundle, the consumers must re-optimize and incur the cost because otherwise their budget constraint is violated. However, a price reduction leads them to re-optimize 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. Hannan and Berger (1991) have shown formally that if the slope of the demand curve (or menu cost) differs between price increases and price decreases, price adjustments will be asymmetric.

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 20–35% 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 (as they are in Hannan and Berger, 1991) to explain (upward) asymmetries in price adjustments. Alternatively, consider input supply shocks.
with symmetric adjustment costs. A negative input supply shock must imply a decrease in output, despite the adjustment costs. A positive input 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 do not apply. For example, tacit collusion due to asymmetric information with respect to input prices does not seem very 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 input supply shocks do not seem very important 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. Thus, asymmetric mortgage rate adjustments might be due to tacit collusion with symmetric information; consumer search or switching costs; or varying markups over the business cycle.

An additional explanation for asymmetries in the dynamic behavior of mortgage rates in particular is related to the prepayment risk (Alink, 2002). This refers to the risk that current clients renew their mortgage if the bank charges a lower mortgage rate. That is, a lower rate attracts additional new clients, but it may also lead to lower interest revenues from outstanding mortgages. If the latter effect is relatively large (e.g. if it is easy for clients to renew their mortgage), banks may hesitate to lower the mortgage rate after a decrease in the capital market rate. This would imply more downward rigidity in mortgage rates.

Asymmetries in mortgage rate changes might also result from the mortgage offer practice for fixed rate mortgages. Fixed rate mortgages exist in many countries, for example, in the US, UK, France, Germany, Switzerland, The Netherlands, Belgium, Sweden, Italy, Spain, Portugal, Greece, and Israel. 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. 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 (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 (five years, say, as in the data used in Section 3). The offer itself is usually valid for a short fixed period, two weeks, say. 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). So, a mortgage rate increase does not affect the offers outstanding, whereas a decrease does. Note 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.

From the point of view of the bank the mortgage offer policy implies a ‘loss’ because increases in the mortgage rate are not immediately passed on to all clients. To the banks, this 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.

More formally, this type of offer is strikingly similar to the most-favored-customer (mfc) clause (see Cooper, 1986; 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 an mfc 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 an mfc clause. This clause guarantees them the lowest mortgage interest rate offered by the bank in the ‘future’, i.e. the weeks in between the receipt and the expiration of the offer. As Cooper (1986) argues, the mfc clause allows firms (banks) to commit to a higher price (mortgage rate) by penalizing price cuts, which softens price competition.³

Toolsema (2003, Chapter 8) presents a formal model in which asymmetric price adjustments may arise due to the mfc policy. It is a static duopoly model in which the asymmetry refers to prices responding more to cost changes in one direction than another.⁴ The model has three stages. The firms decide whether or not to offer an mfc clause at time zero. Then, they compete in prices for two periods. The focus is on the effects of a cost change after the first period on the second-period prices. Note that the mfc clause can be interpreted as a kind of self-imposed, asymmetric adjustment cost: if the firm decreases its price in the second period, it will have to pay some endogenous amount of money. Intuitively, firms using this policy will be reluctant to decrease their price because of the costs of rebates incurred. This suggests more downward rigidity.⁵ Toolsema shows that this indeed may occur in equilibrium. This model can be tested empirically using high-frequency, disaggregated price, and cost data. For the empirical application below, however, such data are not available.

AN APPLICATION TO MORTGAGE RATES IN THE NETHERLANDS

Brief Description of the Dutch Mortgage Market

The Dutch mortgage market is characterized by substantial growth. Between 1993 and 2001, the amount of mortgages outstanding rose from 119 to 316 billion euros. The amount of mortgages newly issued rose from 21 billion euros in 1993 to 73 billion euros in 2001. This strong increase is due to an increase in both average loan size and the number of newly issued mortgages. A substantial part of new mortgages refers to refinancing of existing mortgages (Charlier and van Bussel, 2003).

The market is highly concentrated. In the period 1993–2001, commercial banks had a market share of 45–50% for new mortgages, where the remaining share was accounted for by insurance companies and other lenders (Hassink and van Leuvensteijn, 2003). In terms of stocks (outstanding mortgages), the banks control a far larger share of the market. In 2002, banks supplied 278 billion euros out of a total of 350 billion euros (De Haan and Sterken, 2005). Further, four large banks control about 80% of the bank-mortgage market (De Bas et al., 2004; De Haan and Sterken, 2005).

Although floating rate mortgages do exist, only few mortgages carry variable rates. Most mortgages in The Netherlands are fixed rate, where the fixed interest term is commonly 5, 10, or 15 years. The maturity of mortgages is commonly up to 30 years. During the 1980s the most popular mortgage types were the annuity and linear redemption mortgages. In the 1990s savings and investment mortgages have become popular because of tax advantages. Mixed types of mortgages also exist.

For details, see Charlier and van Bussel (2003). In The Netherlands, mortgagors are allowed to prepay 10–20% of the initial mortgage amount penalty-free each calendar year. In some other situations the full mortgage amount may be prepaid penalty-free, e.g. at the sale of one’s house and in case of bankruptcy.

The mortgage lenders increasingly sell their products via intermediaries. These intermediaries offer products of various lenders and consumers tend to regard them as independent experts who can help them select the best mortgage. To some extent, this makes the mortgage market more transparent. However, most intermediaries restrict the number of mortgage lenders considered in their advice and the payment structure of intermediaries—which is largely unclear to consumers—often does not give them the right incentives to act in the interest of the consumer. For example, intermediaries are paid more for more complex mortgage products and often receive a bonus related to the intermediary’s total turnover at a specific lender.
Empirical Analysis

As discussed in the previous section, some theoretical explanations of asymmetric price adjustments as well as prepayment risk and 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. Figure 1 shows the mortgage rate \( r_m \) and the 10-year capital market rate \( r_l \) for the period April 1978—December 2000 (for details on data and sources see the Appendix). The mortgage rate used here represents the average interest rate banks charge for a mortgage with fixed interest term of five years, so we focus on the market-average changes of the mortgage rate. The long-run rate \( r_l \) refers to a 10-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 Figures 1 and 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):

\[
\Delta r_{m,t} = a_1 (r_{m,t-1} - a_2 r_{t-1} - a_3) + a_4 \Delta r_t^+ + a_5 \Delta r_t^- + a_6 \Delta r_{t-1}^+ + a_7 \Delta r_{t-1}^- + \epsilon_t, \tag{1}
\]

where \( r_{m,t} \) denotes the mortgage rate and \( r_t \) denotes the capital market rate in month \( t \) and \( \Delta \) is the first difference operator. \( \Delta r_t^+ \) and \( \Delta r_t^- \) refer to increases and decreases, respectively, of the capital market rate in month \( t \). For the capital market rate we use the 10-year rate \( r_l \) and the five-year swap rate \( r_{sw} \). The \( a_i \)'s are the parameters to be estimated and \( \epsilon_t \) 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 (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 asymmetry in mortgage rate adjustments. Note that we do not include any control variables, like the business cycle or a measure of competition, in (1). The reason is that we want to focus on the asymmetric adjustment of the mortgage rate following a change in the capital market rate. We do not empirically analyze the causes of the

![Figure 1. Mortgage rate (\( r_m \)) and 10-year capital market rate (\( r_l \)) for The Netherlands; April 1978–December 2000.](image-url)
asymmetry, which is what including control variables would come down to (see also the next subsection).

The ECM in (1) is the result of a specification search, for details see Toolsema (2003, Section 7.2). First, we estimate 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 find that for each capital market rate we have to include two lags in this model. Then, we test 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 normalize the coefficient of the mortgage rate to one and we test whether the coefficient of the capital market rate used is significantly different from one. 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 only. Therefore, we estimate the coefficient \( a_2 \) for the swap rate; for the 10-year capital market rate 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 (1) which runs in first differences. For both capital market rates we find that the parameter corresponding to 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 summarizes the main estimation results for model (1). The table presents estimates for the coefficients (standard errors in parenthesis), some regression diagnostics and the \( \chi^2 \)-statistics and corresponding \( p \)-values for the Wald tests. The parameters are all significant at the 1% level. The fit of both equations is quite good, as can be seen from the correlation coefficient (adjusted \( R^2 \)) and the standard errors (SEs) of the regressions. The Durbin–Watson statistics indicate that there is no serial correlation. 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.

Figures 3 and 4 present the estimation results in another way. They show the responses of the mortgage rate to permanent positive and negative impulses to the capital market rates \( r_l \) and \( r_{sw} \).
respectively. The outcomes are in terms of the percentage of the long-run responses measured by parameter $a_2$ in (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. The figures also show minimum

### Table 1. Estimation Results

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Capital market rate</th>
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<tr>
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<td>$r_{l}$</td>
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<table>
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<tr>
<th></th>
<th>$a_1$</th>
<th>(0.029)</th>
<th>$a_2$</th>
<th>(0.025)</th>
<th>$a_3$</th>
<th>(0.129)</th>
<th>$a_4$</th>
<th>(0.061)</th>
<th>$a_5$</th>
<th>(0.065)</th>
<th>$a_6$</th>
<th>(0.063)</th>
<th>$a_7$</th>
<th>(0.068)</th>
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<td></td>
<td>$-0.12$</td>
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<td>1</td>
<td></td>
<td>0.64</td>
<td></td>
<td>0.42</td>
<td></td>
<td>0.34</td>
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<td>0.53</td>
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<td>0.28</td>
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</tr>
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<td></td>
<td>$-0.23$</td>
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<td>0.90</td>
<td></td>
<td>1.51</td>
<td></td>
<td>0.25</td>
<td></td>
<td>0.24</td>
<td></td>
<td>0.45</td>
<td></td>
<td>0.19</td>
<td></td>
</tr>
</tbody>
</table>

| Adjusted $R^2$ | 0.63     | 0.72     |
| SE of regression| 0.138    | 0.088    |
| Durbin–Watson| 1.95     | 2.21     |

<table>
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<tr>
<th>Wald tests</th>
<th>$\chi^2$</th>
<th>$p$</th>
<th>$\chi^2$</th>
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<tr>
<td>$a_4 = a_3$</td>
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<td>0.446</td>
<td>0.02</td>
<td>0.894</td>
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<tr>
<td>$a_6 = a_7$</td>
<td>5.51</td>
<td>0.019</td>
<td>4.13</td>
<td>0.042</td>
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<td>$a_4 = a_5$, $a_6 = a_7$</td>
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<td>0.014</td>
<td>4.61</td>
<td>0.100</td>
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<td>$a_4 + a_6 = a_5 + a_7$</td>
<td>7.69</td>
<td>0.006</td>
<td>3.20</td>
<td>0.074</td>
</tr>
</tbody>
</table>

Standard errors in parenthesis. Note that $a_2$ is set to 1 for $r_l$, because the hypothesis that $a_2 = 1$ cannot be rejected.

**Figure 3.** Responses of the mortgage rate to an impulse of the 10-year capital market rate, as a percentage of the long-run response.
and maximum responses, which are calculated in the following way. For each capital market rate, we draw 300 series from a normal distribution with mean zero and variance equal to the estimated variance of the residuals of (1). Using these simulated residuals and the parameter estimates from Table 1, we calculate 300 series of $r_M$, interpreting (1) as the data-generating process. We re-estimate (1) using these new $r_M$ series and compute again impulse responses. The figures show the maximum and minimum values of the 300 responses.

For the 10-year capital market rate, we find that positive impulses are passed through within a month, whereas negative impulses take around two years to be transmitted fully. For the swap rate, positive impulses are again transmitted faster than negative ones, but here they are fully passed through only after roughly one year, whereas negative impulses take around one and a half years to be transmitted fully. The figures show that responses following a positive impulse to the capital market rate are statistically different from responses following a negative impulse. Note that the minimum and maximum values as presented in the figures are quite close together. This is probably due to the fact that the fit of the model is good, both for the 10-year rate and for the swap rate.

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

**Possible Explanations**

The reduced form modelling approach used in the above analysis does not allow formal testing of the various theoretical explanations for asymmetric mortgage rate adjustments listed above. Formal testing requires structural models with mutually exclusive, explicit explanation channels, for which data are typically not available. For example, in order to analyze whether or not there is tacit collusion or, more generally, market power on the market and whether this could explain the observed asymmetry, data are required on mortgage quantities, cost structures, or search and switching costs. Even verification of individual explanations is hard, given the fact that identification conditions are not easily satisfied. As an example, consider the use of a business cycle indicator in our empirical model, to study whether the observed asymmetry may be due to varying markups over the business cycle. First, we face an
endogeneity problem: is the business cycle indicator really exogenous or is it partly determined by the conditions on the housing market? Second, since prepayment of mortgages is likely to be related to the business cycle, the parameter associated with the business cycle indicator may pick up (part of) the effects of prepayment as well. Third, it is not clear whether the business cycle variable affects the short run or the long run of our ECM.

Nevertheless, on the basis of additional information we can say something about which explanations are relevant. First, there is no evidence of a separate business cycle effect. Second, the offer practice discussed in the section ‘Explanations for Asymmetric Mortgage Rate Adjustments’ is common in The Netherlands. Unfortunately, available data do not allow for an empirical assessment of this explanation. However, we can conclude that the offer policy is not the only relevant explanation, since the relatively short period of the mortgage offer (even when including possible extensions and overlapping) is not consistent with the length of the lags found in our empirical analysis. For the case of Dutch mortgages, there is evidence for three explanations: tacit collusion; consumer search or switching costs; and (to some extent) prepayment risk. In our view it is not a single explanation or circumstance that drives the observed asymmetry; instead, several factors interplay, each of which induces some asymmetry.

Clearly, it is hard to track down tacit collusion. However, there is some evidence of price coordination on the Dutch mortgage market. As we mentioned before, four large banks serve a large part of the market. Empirical research shows that when it comes to price setting, one of these banks is a price leader and the others are followers (Sterken, 2004). This suggests that the former bank has a dominant position and that there is some (tacit) coordination among the main players on the market. Indeed, anecdotal evidence that the dominant bank is usually the first to lower the mortgage rate, whereas the four banks take turns in raising the mortgage rate also suggests price coordination.

More generally, (tacit) collusion is more likely if the market is more concentrated and if lenders have greater market power. Several authors present evidence for market power in the Dutch mortgage market. First, Swank (1995) finds that competition on the mortgage market has intensified during the period 1957–1990, but his results indicate that lenders had more market power than in Cournot equilibrium even at the end of the sample period. Second, a recent study on the functioning of the Dutch mortgage market by De Bas et al. (2004) concludes that there is market power on this market, mainly due to the lack of transparency in the market and consumer search and switching costs. The report also mentions that competitive pressure from outside, e.g. from potential entry and substitutes, is limited. Third, Hassink and van Leuvensteijn (2003) present evidence of mortgage rate dispersion, even when correcting for borrower characteristics, which also indicates market power.

With respect to search and switching costs we already mentioned the De Bas et al. (2004) report. Search costs (for new mortgages) are mainly related to the lack of transparency of the market, which itself is due to the complexity of the various mortgage products and the compensation structure of intermediaries (which is often not clear to consumers and does not give intermediaries the right incentives). Switching costs (i.e. when prepaying a mortgage and obtaining a new mortgage from a different lender) are also high in this market. The report identifies three types of switching costs: prepayment of the mortgage may involve a fine which usually equals the net present value of the interest rate difference; and the renewal of a mortgage with a different lender implies, first, notary fees and, second, commission for the new provider (which may include a new valuation of the property). Hassink and van Leuvensteijn (2003, p. 37) also hint at search and switching costs prevailing in this market.

Finally, prepayment risk has become an important issue in the Dutch mortgage market (Alink, 2002; Charlier and van Bussel, 2003; Hayre, 2003). Losses from prepayment have risen, in particular in 1998–1999 when mortgage rates were very low. Also, prepayment levels are now more transparent, due to developments in the secondary market for mortgages (Alink, 2002). However, if prepayment were the main force behind the observed asymmetry, this suggests that the asymmetry is stronger in more recent periods, which is not confirmed by our empirical analysis. Thus, although prepayment has become an important issue and may result in asymmetric mortgage rate adjustments, we conclude that it is
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 summarized 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 two additional explanations for the particular case of mortgages, one based on prepayment and the other on the mortgage offer practice as it exists for example in The Netherlands. Prepayment risk implies that a lower mortgage rate does not only attract new clients, but may also lead to lower revenues from current clients who decide to renew their mortgage. The mortgage offer policy implies that if the mortgage rate charged by the bank moves up, 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. So, both prepayment risk and the offer policy give lenders an incentive not to adjust mortgage rates downward.

We analyzed Dutch mortgage interest rates and found evidence that mortgage rates indeed respond asymmetrically to changes in capital market rates. We have shown that positive impulses are passed through significantly faster than negative impulses are. We argued that there is probably more than one explanation for this phenomenon, and that in our view the most likely ones are (tacit) price coordination, search or switching costs, and perhaps the offer policy.

Our discussion raises the question whether banks should be forced to adjust mortgage rates downwards faster. This sounds like a good idea, but it will be hard to implement. Our theoretical discussion showed that prepayment and the mortgage offer policy might explain upward asymmetry of mortgage rate adjustments. Banks may to some extent seek compensation for the losses caused by prepayment or the offer policy. Should banks be forced to follow increases and decreases in the capital market rate equally fast, they could decide to diminish these losses by eliminating or reducing prepayment possibilities (for example, by increasing fines) or by passing on mortgage rate increases for outstanding offers too. This remedy might be worse than the disease. If indeed collusion and search or switching costs, which are both largely due to market power, are the main causes of the asymmetry, it may be better to try to enhance underlying competitive conditions.

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APPENDIX A: DATA AND SOURCES

For the mortgage rate $r_m$ we use the nominal mortgage rate with interest rate fixed for five years (monthly average), published in Statistisch Bulletin, The Netherlands Bank. For the long-run (10-year) rate $r_l$ we use NLBRYLD: NL benchmark bond 10 years (DS) (monthly average) as published in Thomson Financial Datastream. Finally, for the swap rate $r_{sw}$ we use ICNLG5Y: Netherlands (NLG) IR Swap 5 year—middle rate from Thomson Financial Datastream. The sample period is 1978:4–2000:12 for the long-run rate $r_l$ (as well as for $r_m$) and 1991:6–2000:12 for the swap rate $r_{sw}$.

NOTES

1. The procedure for mortgage offers described here is based on the Dutch case. For other countries, e.g. Belgium and Israel, the procedure is similar.

2. Although mortgage offers are usually valid only for two weeks, the resulting lags in price adjustment may be longer for two reasons. First, offers overlap: once this week’s offers have almost expired, the bank has already written new offers for other clients. Second,
at least in The Netherlands clients benefit from a mortgage rate decreases not only during the offer period, but also during the period between accepting the offer and actually buying the house. This period can last up to three, and in some cases six, months.

3. Note that this seems to contradict the argument above that the mortgage offer policy implies a loss to the bank. Although banks may interpret the fact that a mortgage rate increase does not apply to outstanding offers as a loss, indeed the offer policy (when interpreted as an mfc policy) facilitates collusion and thereby actually increases profits.

4. In the theoretical model cost is either high or low, each with probability 1/2. With a continuous distribution, we would find the following (see e.g. Figures 8.2 and 8.3 in Toolsema, 2003); for small cost changes, price does not respond; for intermediate cost changes, price responds only in case of an increase; and for large cost changes, prices always respond. Overall, this again results in more downward rigidity.

5. The theoretical model focuses on the size, not the speed, of the adjustment. But asymmetries in size may result in asymmetries in speed. Suppose cost shocks may occur regularly, say every day as is the case for mortgages. If the cost shock is large, price may respond immediately, but if the cost shock is small, price may respond only after some period when the cumulative shock is sufficiently large.

6. Note that a similar concern holds for other explanations.

7. De Haan and Sterken (2005) find evidence for asymmetric mortgage rate adjustments for each of the four banks.

REFERENCES


