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Abstract

This price setting survey among Icelandic firms aims to make two contributions to the literature. First, it studies price setting in an advanced economy within a more turbulent macroeconomic environment than has previously been done. The results indicate that price adjustments are to a larger extent driven by exchange rate fluctuations than in most other advanced countries. The median Icelandic firm reviews its prices every four months and changes them every six months. The main sources of price rigidity and the most commonly used price setting methods are the same as in most other countries. A second contribution to the literature is our analysis of the nexus between price setting and exchange rate movements, a topic that has attracted surprisingly limited attention in this survey-based literature. A novel aspect of our approach is to base our analysis on a categorisation of firms in the domestic market by their direct exposure to exchange rate movements captured by imported input costs as a share of total production costs. More exposed firms are found to be more likely to use state-dependent pricing, to adjust their prices in response to exchange rate changes, and to rely on increasing prices rather than decreasing costs to restore profit margins after an exchange rate depreciation. They also review their prices more often but nevertheless, surprisingly, have the same price change frequency as the median firm. On the other hand, price review frequency declines and time-dependent pricing increases as domestic labour costs rise relative to total production costs. The results provide important insight into inflation dynamics due to an interaction between high and asymmetric exchange rate pass-through and price indexation. This interaction causes an exchange rate depreciation to spread to sectors less exposed to such changes through the use of price indexation. Exchange rate pass-through, price indexation and backward-looking behaviour in price setting therefore pose challenges for monetary policy in Iceland.

JEL Classification: D40, E30, L11

Keywords: price setting, price stickiness, exchange rate pass-through, inflation dynamics.

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1. Introduction

Price setting is a classic subject of economic research. This is not surprising, as it is an important determinant of consumer behaviour and allocation of resources and hence the efficiency and performance of any economy. Firms' pricing decisions are of particular importance to central banks, and several price setting studies have been launched in recent years using macro, micro and survey approaches. A clear understanding of price setting behaviour is essential for central banks, as it plays a significant role in inflation dynamics, the monetary policy transmission mechanism, and business cycles in general, in addition to being directly related to their mandate of price stability. Inflation dynamics are driven by how firms set prices, how often they change them, by how much, and how they form expectations with regard to factors such as demand, cost developments, competitors' behaviour, and economic policy. Price stickiness plays a pivotal role in the transmission mechanism, as it is an example of nominal rigidity which ensures that changes in nominal interest rates cause changes in real interest rates due to the delayed responses of nominal prices. Finally, price changes play an important adjustment role in the economy, and information on price setting behaviour is therefore important for an understanding of business cycle dynamics. The exchange rate is the most important price in small open economies, and the relation between exchange rate movements and inflation is therefore of particular interest to their monetary authorities. Nevertheless, the literature reveals surprisingly limited focus on using surveys to analyse the nexus between price setting and exchange rate movements.

This paper presents the results of a survey among Icelandic firms, which was conducted in the summer of 2008, a few months prior to the collapse of the Icelandic banking system. The paper aims to make two contributions to the price setting literature. First, it studies price setting in an advanced economy within a more turbulent macroeconomic environment than has been done in previous surveys. This allows for an interesting testing ground to see whether the perspective on price setting provided by the extensive research in recent years holds in a more extreme, yet advanced, macroeconomic environment. Second, special emphasis is placed on studying the role of the exchange rate and the interaction between prices and exchange rate fluctuations. The studies of price setting in Canada, the United Kingdom, Romania and Turkey have included this to some degree, although not as extensively as is done here. A novel aspect of our approach is to base our analysis on a categorisation of firms in the domestic market by their direct exposure to exchange rate movements captured by the costs of imported inputs as a share of total production costs. This classification provides important insight into various aspects of price setting within a small open economy. Furthermore, we ask firms about their responses to actual and hypothetical exchange rate movements, the reasons for incomplete pass-through and ways to restore profit margins following an exchange rate depreciation. The degree of asymmetry in exchange rate pass-through is also analysed. Finally, the relationship between domestic labour costs and price setting is analysed and firms are grouped according to labour costs as a share of total production costs. Hence we examine various aspects of price setting with

regard to the composition of firms' cost structure, and we contrast firms with a relatively high share of stable costs consisting of wages and firms with a relatively high share of volatile costs consisting of imported inputs.

Our emphasis is to provide information of interest for the monetary policy debate with valuable modelling and policy implications. The remainder of the paper is organised as follows: Section 2 discusses the use of surveys in price setting research and explores why the Icelandic economy provides an interesting framework for a price setting study. It also includes a description of the Icelandic survey. Section 3 discusses the main characteristics of the market, such as firm-customer relationships and competitive pressures, as well as results on firms' price setting methods. Section 4 focuses on the first step in the price adjustment process namely price reviews, including a discussion on state-dependent and time-dependent pricing strategies, information set used in price reviews and price review frequency. Section 5 moves on to discuss firms' actual price changes, both their frequency and their main determinants. The survey's evidence on theories of price stickiness is the topic of Section 6, presenting the results on firms' main reasons for keeping prices constant (or changing them only slightly), even though there are some grounds for a (larger) price change. Section 7 discusses the relationship between exchange rate fluctuations and firms' price setting behaviour. Section 8 concludes the paper and discusses modelling implications and monetary policy considerations that arise from the results. Throughout the paper the main results are compared to evidence from comparable international studies.

2. About the study

Price setting has taken centre stage in economic research in the last decade and numerous studies have been launched (for a survey, see Klenow and Malin, 2010). The recent literature focuses on analysing micro price data, both data underlying consumer and producer price indices and scanner and online data from retailers, but a wealth of microeconomic evidence has also come from conducting surveys among firms about their price setting procedures. The use of survey methods to analyse firms' price setting mechanisms was pioneered in the United States by Hall and Hitch (1939), but reintroduced into the macroeconomic literature by Blinder (1991, 1994) and Blinder *et al*. (1998). Since then, many countries have conducted similar surveys on firms' price setting behaviour: Hall *et al.* (1997, 2000) in the United Kingdom; Nakagawa *et al.* (2000) in Japan; Apel *et al.* (2001) in Sweden; Amirault *et al.* (2006) in Canada; Langbraaten *et al.* (2008) in Norway; and Keeney *et al.* (2010) in Ireland. Moreover, national studies were conducted in nine euro area countries in the context of *the Eurosystem Inflation Persistence Network* (Fabiani *et al*., 2007). Finally, a few studies have been conducted within emerging market economies, including Castanon *et al.* (2008) in Mexico; Copaciu *et al.* (2010) in Romania; Sahinöz and Saracoglu (2008) in Turkey; and Dabusinskas and Randveer (2006) in Estonia.

Published research on price setting behaviour using micro evidence in Iceland is scarce. Various studies using aggregate price series data have been conducted (see, for example, Gudmundsson, 1990; Pétursson, 1998, 2002, 2008; and Daníelsson *et al.*, 2009), but extensive structural changes in the Icelandic economy in recent years have implications for the robustness of those estimates. Choudhary *et al.* (2009) is the most related research project, as the authors use the survey method to analyse firm-customer relationship in Iceland; however, questions regarding price setting are very limited.[1]

The survey method has various advantages and allows for analysis of some parts of the spectrum of the price setting mechanism that are unobservable when using micro data. Thus the use of survey methods allows for analysis of the relative importance of different driving factors, providing valuable insight into the mechanism of the two steps of price adjustments (price reviews and price changes), distinguishing between theories of price stickiness, and focusing on special features such as the nexus between exchange rate movements and price setting behaviour. Furthermore, surveys provide qualitative evidence to compare with quantitative estimates from micro and macro data.

The Icelandic economy provides an interesting framework for analysis of price setting behaviour. It combines an advanced small open economy setting with a more turbulent macroeconomic environment reflected, for instance, in higher inflation, unanchored inflation expectations, a more volatile exchange rate, and higher exchange rate pass-through than in similar survey studies.[2] These features are likely to reduce price stickiness, but whether other aspects of the price setting mechanism are affected, and in what way, is an open question. Various other characteristics of the Icelandic economy, on the other hand, are likely to increase price stickiness, such as relatively small firms and markets, close customer relations, and a low level of competition. Conducting a study on price setting under these conditions gives insight into firms' price setting behaviour and reactions to different kinds of shocks under relatively volatile circumstances.

At the time of the survey, Iceland was the world's smallest country with a fully floating exchange rate and an inflation target. The Central Bank of Iceland adopted an inflation target of 2½ per cent in March 2001. Since then, inflation has fluctuated widely, between a low of 1.5 per cent in January 2003 and a high of 18.6 per cent in January 2009. To a large extent, these fluctuations seem to be linked to developments in the exchange rate of the domestic currency, the króna (see Figure 1). Inflation volatility is considerably higher in Iceland than in most other advanced economies, including countries with similar or even higher exchange rate volatility. Inflation persistence in Iceland is similar to the levels in, for example, the United States, Australia, New Zealand, and Israel (see Pétursson, 2008) but it remains an open question to what extent

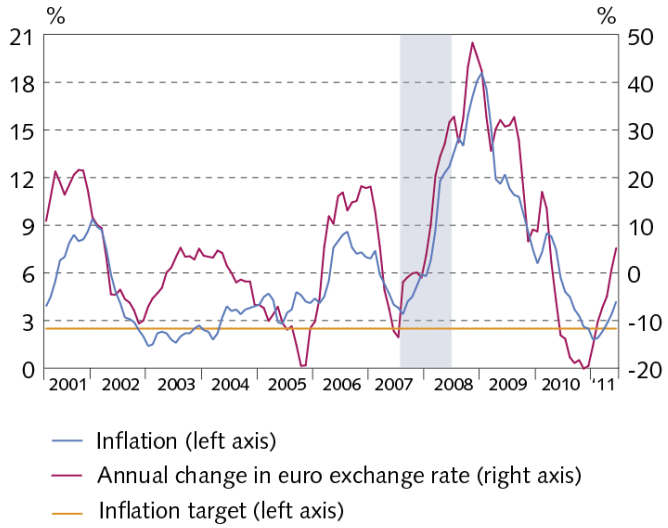
[1] Forthcoming is a paper by Gudmundsson, Ólafsson, Nakamura, Steinsson and Vignisdóttir with the results of a study on price setting in Iceland using micro data.

[2] In some cases, price setting surveys have been conducted within similarly turbulent, or even more extreme conditions in emerging market economies, but to our knowledge, none have been conducted in an advanced economy, especially not in a rich small open economy such as Iceland.

that persistence reflects persistent fluctuations in the determinants of inflation (such as marginal costs, the output gap, or the exchange rate), dependency of inflation on its own past (e.g., due to price indexation), or persistence in the formation of inflation expectations (e.g., due to learning). These three sources of inflation persistence are referred to in the literature as extrinsic, intrinsic and expectations-based persistence (see Altissimo *et al.*, 2006 and Fuhrer, 2006). It is difficult to distinguish between these sources both theoretically and in practice, as they interact with each other and are dependent on monetary policy, but our survey results could cast better light on the importance of each source, especially intrinsic persistence.

Figure 1: Inflation and exchange rate developments

March 2001-June 2011



1. Shaded area represents the twelve-month period before the survey was conducted.
Sources: Statistics Iceland, Central Bank of Iceland.

It is important to provide a short description of the economic situation in Iceland in the years preceding the period analysed in the survey. The economic upswing and build-up of macroeconomic imbalances that began in 2003 and ended abruptly with a full-blown financial crisis in October 2008 was initially triggered by extensive investments in the aluminium and power sector and intensified by structural changes in the financial system and tax reductions, which led to greatly increased household access to credit and higher real disposable income, ultimately resulting in a surge in asset prices and domestic demand. Furthermore, global interest rates were at an historical low and abundant liquidity exacerbated the credit boom. Imbalances in the domestic economy, liquidity constraints in the banking system, and changes in investors' risk assessment led to a substantial exchange rate depreciation in early 2008 in the midst of turmoil in global financial markets. These factors, among others, including the global conditions following the fall of the US investment bank Lehman Brothers, led to the

banking crisis and currency collapse a few months after the price setting survey was carried out.

The Icelandic survey was conducted during a two-week period in June and July 2008. Hence it was conducted following the large depreciation of the exchange rate in H1/2008 but prior to the collapse of the banking system in October 2008. In the twelve months prior to the survey period, inflation increased from 4.0 per cent to 12.7 per cent, with the largest share of the rise occurring in the last few months before the survey was conducted (see Figure 1). An international comparison shows that other price setting surveys within advanced economies were done in periods characterised by low and stable inflation (see Table 1).[3]

Table 1: International comparison of the macroeconomic environment for price setting

	IS	*US*	*UK*	*CA*	*JA*	*SW*	*NO*	*EU*	*BE*	*LU*	*NL*
Average inflation 12 months prior to survey	6.9	4.7	2.3	2.5	-0.5	0.7	1.8	2.1	1.5	2.8	1.8
Peak of inflation 12 months prior to survey	12.7	6.3	3.0	4.7	0.3	1.3	2.7	2.5	1.8	4.1	2.3
Inflation persistence[1]	0.36	0.34	0.63	0.01	0.45	0.47	0.44	-	0.46	0.58	0.8
Inflation volatility[1]	8.3	1.4	1.9	2.0	1.8	3.2	2.8	-	1.3	1.6	1.4
Exchange rate volatility[1]	11.0	11.0	10.4	9.2	18.6	11.6	7.5	-	4.7	3.6	4.2
Exchange rate pass-through[1]	0.43	0.02	0.04	0.03	0.21	0.07	0.18	-	0.2	0.37	0.41
Output volatility[1]	2.7	0.9	1.1	1.3	1.2	1.3	1.0	-	1.0	1.9	1.1
Output persistence[1]	0.43	0.87	0.92	0.91	0.79	0.78	0.36	-	0.81	-	0.79

1. During the period 1985-2005 for most countries according to Pétursson (2008). Inflation and output persistence is obtained from an AR(k) model where in the former case a mean break of unknown date is allowed. Inflation and output volatility is given by the standard deviation of inflation and the output gap, respectively. Exchange rate volatility is given by the standard deviation of annualised quarterly changes of effective exchange rates. Exchange rate pass-through is estimated as the cumulative effect of a 1% exchange rate shock after 8 quarters in a VAR model using the generalised impulse response approach.

Sources: Pétursson (2008), Statistics Offices in individual countries.

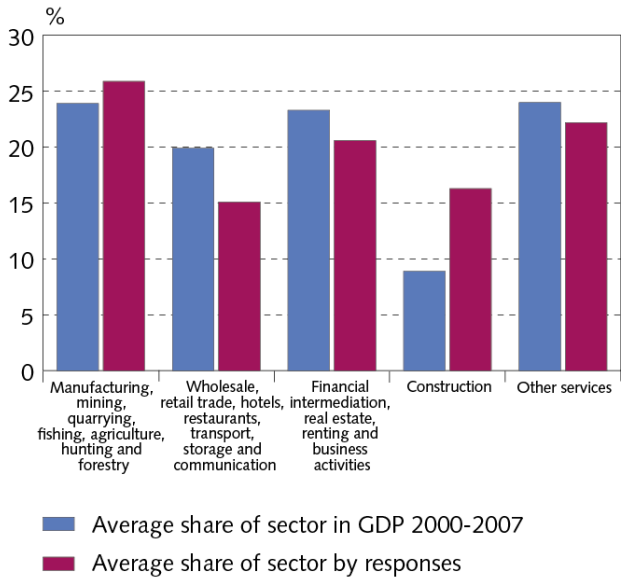
The interviews were conducted by Capacent Gallup, a firm specialising in carrying out surveys and research. The interviews took place either via the internet or by telephone, depending on the respondents' preference. A random sample of 600 firms was drawn from the business directory. In order to eliminate holding companies that exist mainly for tax purposes rather than being price setting firms, the sample was limited to firms with four or more employees. The population was weighed according to sector division to ensure that the sample broadly reflected the composition of different sectors in the Icelandic economy (see Figure 2). The analysis is based on five sectoral categories, reflecting manufacturing, the financial sector, construction, and the services sector, which was split into two categories.[4] Large firms, based on the number of employees, are over-represented to a certain extent as is most often the case in similar studies. The final sample consists of 580 firms. The response rate was 45.2 per cent which is similar to the 47 percent average response rate in comparable international studies. The response rate for countries in the euro area varied between 30 and 70 per

[3] The following country abbreviations are used in the tables in this paper which include an international comparison: AT: Austria, BE: Belgium, CA: Canada, EU: the euro area, FR: France, GE: Germany, IR: Ireland, IT: Italy, JA: Japan, LU: Luxembourg, NL: Netherlands, NO: Norway, PT: Portugal, SP: Spain, SW: Sweden, UK: United Kingdom, USA: United States.

[4] The former services category represents wholesale, retail trade, hotels, restaurants, transport, storage and communication while the latter category represents other services.

cent, whereas it was below 20 per cent in the Romanian survey and 27.7 per cent in the Turkish survey, which focused to some extent on price setters' reaction to exchange rate movements (Fabiani *et al.*, 2007, Copaciu *et al.*, 2010, Sahinöz and Saracoglu, 2008).

Figure 2: Sectoral composition in survey compared to GDP



Sources: Capacent Gallup, Statistics Iceland.

The Icelandic survey is based upon a structured questionnaire allowing for statistical analysis. The questionnaire builds on similar international surveys but also includes questions found exclusively in the Icelandic survey. The respondents were asked to use their "main product" - that is, the product that generates the most turnover - as a reference for their answers and to focus their answers on the domestic market. The main product's turnover is, on average, 60-80 per cent of firms' total turnover. Participants were also asked whether the firm itself set the price of the main product or if prices were set by outside regulation or a parent company. Firms falling into the latter category did not participate further in the survey. A translation of the questionnaire is included in Appendix 1.

3. Main characteristics of the market and firms' price setting method

In order to understand the decisions driving firms' price setting, it is important to know the structure and main characteristics of the market in which they operate. This section focuses on these aspects as well as firms' price setting method; i.e., whether they base their pricing mainly on costs, competitors' prices, or other variables.

3.1 Market structure

In the survey firms were asked about their type of customers, that is if they primarily sell their main product to other firms or to consumers. The results show an almost equal division between business-to-business sales and business-to-consumer sales (see Table 2). Hence the findings of the survey refer to both producer and consumer prices.

Table 2: Market and competition characteristics (share of firms in %)

	Total	*Manufacturing and fishing*	*Wholesale, retail, hotels, restaurants, transport, and communication*	*Financial intermediation, real estate, renting and business activities*	*Construction*	*Other services*
Main customer						
Consumers	40.8	37	63	56	30	19
Other firms	43.6	54	21	23	44	71
Equal share of consumers and other firms	15.6	9	16	21	26	10
Firm-customer relationships						
Long-term	72.8	83	46	69	60	100
Occasional	27.2	18	54	31	40	0
Number of competitors						
0 to 3	23.9	35	33	9	17	30
4 to 15	27.6	38	22	31	17	23
16 or more	48.5	27	44	60	67	47
Leaders in domestic market						
Own firm	26.8	33	39	23	5	32
Other firm	20.8	19	30	23	23	11
No leading company	52.3	47	30	55	73	57

Sources: Capacent Gallup, Central Bank of Iceland.

As for the relationship with customers, 73 per cent of the firms surveyed indicate that they have a long-term relationship with their customers. In all sectoral categories except one (wholesale, retail, transport and various services), long-term relationships with customers are dominant. The close customer relationships conduce to stickier prices due to so-called implicit and explicit contracts, which are discussed in more detail in Section 6. These results are very similar to those found in other studies where on average almost 70 per cent of firms have claimed to have a long-term relationship with their customers (see Table 3).

The competitive environment is of great importance for price setting behaviour. In highly competitive markets, companies are likely to change their prices more often in response to changing market conditions or price revisions by main competitors. The survey uses various proxies to estimate the degree of competition but this is a complex task as is well known from the literature (see e.g., Breshnahan, 1989). First, firms were asked how many other firms operate in the market for their main product. Almost 50 per cent of the firms face 16 or more competitors in the market for their main product. Just below 28 per cent have 4-15 rivals and 24 per cent operate in monopoly or oligopoly markets with 0-3 competitors. The share of firms facing the highest number of competitors (16 or more) is highest in construction and the financial sector, but lowest in manufacturing (see Table 2). The number of firms operating in the market indicates a

high degree of competition in comparison to some other European countries (see Table 3). This indicator has the disadvantages that firms with a large number of competitors may still maintain local market power and even in oligopolistic markets with a small number of firms, competition may still be strong.

Table 3: International comparison of survey results for market and competition characteristics (share of firms in %)

	IS	*NO*	*EU*	*AT*	*BE*	*FR*	*GE*	*IT*	*PT*	*SP*
Main customer										
Consumers	40.8	40	21	9	40	30	7	25	13	39
Other firms	43.6	40	75	84	56	66	89	79	84	58
Equal share of consumers and other firms	15.6									
Firm-customer relationships										
Long-term	72.8	75	70	81	41	54	57	70	83	86
Occasional	27.2	20	30	19	56	46	43	30	17	14
Number of competitors										
0 to 3	23.9			18	30	20		18		
4 to 15	27.6			40	43	63		39		
16 or more	48.5			42	29	11		28		
Degree of perceived competition[1]	48.0		61	62	61	63	58	66	71	54

1. For the euro area countries, it reflects the share of firms attaching high or very high importance to competitors' prices when considering to reduce prices. For Iceland, it reflects the share of firms which refer to competirors' prices as one of the two most important factors when considering a price reduction.

Sources: Capacent Gallup, Fabiani et al. (2007), Langbraaten et al. (2008), Central Bank of Iceland.

Second, firms were asked whether a market leader existed in the market for their main product. Similar results are attained from this indicator for competition pressures, as roughly half of firms state that no market leader operates within their market. Nevertheless, 27 per cent of firms claim to be market leaders themselves (see Table 2), which is very close to the findings in the Canadian survey (28 per cent) but higher than in the Italian survey (12 per cent), but these two surveys included this question (see Amirault *et al.*, 2006, and Fabiani *et al.*, 2004).

The third indicator for competitive pressure in the economy, and the one that has been emphasised by *the Eurosystem Inflation Persistence Network*, is the importance firms attach to changes in competitors' prices in explaining their own price decreases.[5] Thus Fabiani *et al.* (2007) assess competition pressures in the euro area by considering the share of firms that report competitors' prices as important factors in determining a reduction in their own prices. The argument for using this proxy is that it can be expected that the more competitive environment firms face, the more their pricing is likely to be affected by the behaviour of their competitors. In addition, it has been shown that this indicator has a high correlation with firms' perceived competition (Hoeberichts and Stokman, 2006). The question regarding the driving forces of price decreases does not have exactly the same format in our survey as commonly used in the euro area, and we can only identify the share of firms that report competitors' prices as

[5] See Álvarez and Hernando (2007) for further discussion of the relation between competition and price adjustment in the euro area and the advantages and disadvantages related to the use of different proxies for competition pressures.

the most and second most important driving factor of price decreases.[6] Close to half of firms in our sample refer to competitors' prices as one of the two most important factors in their own decision to decrease prices. This indicates that competitive pressures are less in Iceland than in the countries surveyed by *the Eurosystem Inflation Persistence Network.*[7]

A fourth measure of the divergence from the simple model of perfect competition, and at the same time one of the main features of price setting behaviour, is the extent of price discrimination. Only around a fifth of Icelandic firms charge the same price to all customers, which is roughly in line with evidence from France, Italy and Portugal (see Table 4). Roughly 47 per cent of Icelandic firms set their prices on a case-by-case basis, and 30 per cent of firms set their prices according to quantity sold. These results indicate that firms are able to price discriminate among customers, an indication of monopolistic competition. Uniform pricing is, as expected, most common in the category for wholesale, retail, transport, and various services, where a third of firms charge the same price to all customers. On the other hand, two-thirds of firms in the financial sector set their prices on a case-by-case basis.

Hence the different proxies provide contrasting evidence on the degree of competition in Iceland. Different indicators even provide mixed results regarding the extent of competition pressures for different sectors. In the following analysis, we refer to different indicators of competition when we discuss its influence on price setting behaviour.

Table 4: International comparison of survey results for extent of price discrimination (share of firms in %)

The price of the main product is:	*IS*	*EU*	*FR*	*GE*	*IT*	*LU*	*PT*	*SP*
The same for all customers	22.2	18	23	8	19	29	24	35
Different depending on quantity	30.4	42	35	51	41	29	41	29
Decided case by case	47.4	40	42	41	40	42	35	36

Sources: Capacent Gallup, Fabiani et al. (2007), Central Bank of Iceland.

3.2 Price setting method

The survey addresses the issue of how firms set their prices. In models with imperfect competition, firms generally charge a price that represents a mark-up over marginal cost, which can induce price stickiness since firms can keep prices unchanged through

[6] Hence we cannot take into account those firms that would have answered that competitors' prices are an important factor in determining a reduction in their own prices while identifying two other factors as more or equally important. It can be argued that this share is probably small, especially in light of our results that changes in demand and competitors' prices are the main determinants of price decreases whereas exchange rate changes play a more prominent role in price increases (as discussed in Section 5.2).

[7] This is in line with other evidence, e.g. from comparisons using the so-called Herfindahl-Hirschman Index, which measures concentration in individual markets and reflects extensive concentration in many of the most important markets in Iceland (see Pálsson, 2006).

adjustments in price mark-ups, even though their costs might change.[8] Hence market power is a prerequisite for price stickiness to be an equilibrium phenomenon. In the simple model of perfect competition, firms have no market power and prices are continuously set at the market-clearing level equal to marginal costs with no price rigidity in place (Gaspar *et al.*, 2007). Any inflation persistence in such a model is therefore mainly due to extrinsic persistence in the determinants of inflation; e.g., marginal costs.

Cost-based pricing with variable or constant mark-up is found to be the most common price setting method, as 45 per cent of firms claim to use this method of price setting. Almost 35 per cent of firms set their prices with reference to competitors' prices, and a fifth of firms index their prices to the consumer price index (see Table 5). Price indexation is especially common in the financial, construction, and other services sectors. In wholesale, retail, transport, and various services, 60 per cent of firms set prices using a constant or variable mark-up on costs.

Table 5: Type of price setting by sectors (share of firms in %)

	Total	*Manufacturing and fishing*	*Wholesale, retail, hotels, restaurants, transport, and communication*	*Financial intermediation, real estate, renting and business activities*	*Construction*	*Other services*
Constant or variable mark-up on costs	45.1	51	60	34	37	45
Taking the price of the main competitor as reference	34.9	39	30	37	36	29
Price tied to the evolution of the CPI index	21.4	9	10	30	27	26

Sources: Capacent Gallup, Central Bank of Iceland.

Mark-up pricing is evidence of monopolistic competition and is commonly used in the New Keynesian literature. As expected, this type of price setting is more common for firms with few competitors, whereas the main competitors' price plays a more important role for firms facing a higher number of competitors. Some 60 per cent of firms that have 0-3 competitors use mark-up pricing, as opposed to 36 per cent of firms with 16 or more competitors (See Table 6).

Table 6: Type of price setting and number of competitors (share of firms in %)

	Total	*0-3 competitors*	*4-15 competitors*	*16 or more competitors*
Constant or variable mark-up on costs	45.1	60	50	36
Taking the price of the main competitor as reference	34.9	25	35	38
Price tied to the evolution of the CPI index	21.4	16	15	27

Sources: Capacent Gallup, Central Bank of Iceland.

Icelandic firms seem to base their price setting on methods similar to those used by firms in other countries (see Table 7). Mark-up pricing is the dominant price setting practice adopted by firms in the euro area and Norway (Fabiani *et al.*, 2007 and

[8] We follow a common procedure within the literature and do not use the term "marginal cost" in our questionnaire as it has generally been found that it is hard to question firms about their marginal costs. The concept is both complicated to explain in layman's words and hard for firms to compute.

Langbraaten *et al.*, 2008). In the euro area there are also indications of a negative relationship between the share of firms that follow a mark-up rule and the degree of competition, supporting the idea that firms are closer to being price takers in a competitive environment. A distinctive feature of firms' pricing strategies in Iceland is the use of indexation, which is more common than in other advanced economies and reflects the legacy of high and volatile inflation in Iceland.[9]

Table 7: International comparison of survey results for type of price setting (share of firms in %)

	IS	*EU*	*UK*	*BE*	*FR*	*GE*	*IT*	*NL*	*PT*	*SP*	*IR*
Mark-up	45.1	54	37	46	40	73	42	56	65	52	44
- Constant mark-up on costs	15,0		17	13		4		27			
- Varying mark-up on costs	30.1		20	33		69		30			
Competitors' price	34.6	27	25	36	38	17	32	22	13	27	33
Other	20.3	19	38	18	22	10	26	21	23	21	23

Sources: Capacent Gallup, Fabiani et al. (2007), Hall et al. (1997), Keeney et al. (2010), Central Bank of Iceland.

4. Price reviews

Price adjustments take place in two steps, as firms need to consider whether a price change is optimal before actually changing prices. This section focuses on the first step of the price adjustment process, namely price reviews. Surveys are uniquely suited for obtaining information on how firms implement price reviews. The main features of price reviews include whether they are time-dependent or state-dependent, the information set firms use during price reviews, and the frequency of price reviews.

4.1 Time-dependent versus state-dependent pricing strategies

Firms' price adjustments are not continuous, as is indicated by the simple model of instantaneous market clearing. To account for this, the theoretical literature has traditionally considered two types of price setting behaviour, namely time-dependent (for instance, Taylor, 1980 and Calvo, 1983) and state-dependent price reviews (see Sheshinski and Weiss, 1977 and Caballero and Engel, 1991). Firms that follow the former pricing strategy review prices periodically, while firms that follow a state-dependent pricing strategy review prices when a large enough shock occurs. If shocks are large and frequent, time-dependent price reviews are likely to lead to more price rigidity than state-dependent strategies since the timing of the reviews is exogenous and is unaffected by the state of the economy. In contrast, state-dependent price setters are likely to conduct price reviews more frequently than price changes in such

[9] Many studies do not include the option of price indexation when firms are asked about their price setting method. Some surveys include the option that the price of their main product is linked to another price but this has received very limited support. Only roughly 10 per cent of Dutch firms and 2 per cent of German firms use this method and indexation to the consumer price index is very limited in Norway and Sweden according to survey evidence (see Hoeberichts and Stokman, 2006, Stahl, 2005, Langbraaten *et al.*, 2008, and Apel *et al.*, 2001). Many surveys include a question on the information set used in relation to price setting and one of the option firms can choose is a rule-of-thumb where price or wage indexation is one possible form of such a rule but it is not possible to interpret firms' answers to that question as evidence of the extent of price indexation as they can be referring to various other forms of rules-of-thumb.

circumstances, as they want to be able to respond to shocks and change nominal prices as soon as the benefits of doing so exceeds the cost of price adjustment. Given the different implications of state- and time-dependent price setting, surveys have been used to see which is a better approximation of reality.

In the survey, firms were asked if they conduct price reviews by using a time-dependent strategy, a state-dependent strategy, or a combination of both. The results indicate that roughly 40 per cent of Icelandic firms practice purely time-dependent price reviews, while 47 per cent use a combination of both. The results are similar to those obtained from surveys conducted in the euro area and the United Kingdom, where an average of 34 per cent and 42 per cent, respectively, of the surveyed firms follow a purely time-dependent strategy (Fabiani *et al.*, 2007 and Hall *et al*., 1997). Given the volatile macroeconomic environment for price setting in Iceland during the period leading up to the survey, it is somewhat surprising both that the results are similar to those in the euro area and the United Kingdom and that the share of firms following a purely state-dependent strategy is small (see Table 8).

Table 8: International comparison of survey results for price reviewing strategies (share of firms in %)

	IS	*EU*	*UK*	*CA*	*SW*	*NO*	*BE*	*LU*	*NL*
Time-dependent	39.3	34	42	67	18	27	26	18	36
Mainly time-dependent but also in reaction to specific events	46.7	46	44		41	44	40	32	18
State-dependent (non-regular)	14.1		14	33	34	12			
Other					7	17			

Sources: Amirault et al. (2006), Apel et al. (2001), Capacent Gallup, Fabiani et al. (2007), Hall et al. (1997), Langbraaten et al. (2008), Central Bank of Iceland.

4.2 Information set used in price reviews

An ongoing issue in economic theory is the degree of backward-looking vs. forward-looking behaviour in price setting (see Pétursson, 1998, for a study using Icelandic inflation data). Estimations of New Keynesian Phillips curves emphasise the existence of forward-looking price setters in monetary policy analysis but their empirical relevance has been questioned (for a survey, see Ólafsson, 2006). The information set on which firms base their pricing decisions is an important part of the speed of price adjustment and price reactions to various shocks. Icelandic firms seem to be considerably more backward-looking in their pricing behaviour than firms in other countries, with the exception of Norway (see Table 9). Almost 68 per cent of firms evaluate their prices mainly on the basis of current information and past developments and are therefore backward-looking. However, just under one-third of firms base their pricing decisions mainly on expectations about future conditions. These results indicate that a large share of firms might behave non-optimally by not taking the future outlook sufficiently into account, especially given that price-setters realise that prices tend to remain unchanged for many months. On the other hand, this high degree of backward-looking behaviour could reflect large uncertainty about future prospects undermining

efforts to base price setting on expectations, as well as firms regarding recent developments as the preferred indicator of future developments. To a certain extent, this could also reflect the turbulent economic conditions at the time when the survey was conducted. Larger firms tend to be more forward-looking than smaller firms, which could be due to the relatively greater availability of resources to spend on focusing on future conditions. The small size of Icelandic firms could therefore be an obstacle to more forward-looking pricing behaviour.

This extensive backward-looking behaviour and the previous results of widespread use of price indexation contribute to high intrinsic persistence in the inflation process in Iceland, posing challenges for monetary policy, as is discussed further in Section 8. Given that overall inflation persistence is relatively limited in Iceland and e.g. comparable to the level in the United States (see Table 1), these results indicate that intrinsic persistence is a larger source of inflation persistence here than in many other countries.

Table 9: International comparison of survey results for information set for pricing decisions (share of firms in %)

	IS	*EU*	*UK*	*BE*	*IT*	*LU*	*PT*	*SP*	*NO*
Future context	32.3	48	35	34	68	44	47	28	
Present/Past context	67.7	34	53	29	32	26	30	39	70
Other			12	37		30	23	33	

Sources: Amirault et al. (2006), Capacent Gallup, Fabiani et al. (2007), Hall et al. (1997), Langbraaten et al. (2008), Central Bank of Iceland.

4.3 Price review frequency

Firms were asked how often during the previous twelve months they reviewed the price of their main product without necessarily having changed it. The median price review frequency indicates that firms review their prices every four months, while the most frequently cited frequency indicates they review their prices every six months.

There are interesting differences across sectors (see Table 10). Manufacturing and the sectors including wholesale, retail, transport, and various services review their prices more often than other sectors, or roughly every three months, while firms operating in sectors such as construction, financial activities, and other services review their prices only every six months. To a larger extent, manufacturing, wholesale, retail, transport, and various services are subject to exchange rate movements and therefore subject to more volatility. It is therefore unsurprising that firms in these sectors review their prices more often. This will be discussed further in Section 7.

Firm size seems to be another important factor in price review frequency. Larger firms seem to review their prices more often than smaller firms. These results are especially evident when firm size is captured by turnover but less so when it is measured by the number of employees. Here the same result might apply as to larger firms being more forward-looking than small or medium-sized firms; i.e., smaller firms do not have sufficient resources to review and adjust prices as often because of the time it takes and the costs associated with reviewing prices and obtaining new information.

The price setting method influences the frequency of price reviews. Firms which set their prices as a variable mark-up over costs or with regard to competitors' prices review their prices three times a year, which is the same frequency as for the whole sample. On the other hand, firms using price indexation review their prices every six months.

Table 10: Frequency of price reviews in the last 12 months

	Total	*Manufacturing and fishing*	*Wholesale, retail, hotels, restaurants, transport, and communication*	*Financial intermediation, real estate, renting and business activities*	*Construction*	*Other services*
Median number of price reviews	3	4	4	2	2	2
Share of firms with no price review	6.8	5.7	5.3	12.5	0.0	9.4
Share of firms with 1 price review	14.4	11.4	5.3	29.2	13.6	12.5
Share of firms with 2 to 3 price reviews	39.4	25.7	31.6	33.3	50.0	56.3
Share of firms with 4 or more price reviews	39.4	57.1	57.9	25.0	36.4	21.9

Sources: Capacent Gallup, Central Bank of Iceland.

5. Price changes

The second step of the price adjustment process is actual price changes. This section discusses the survey's results on firms' price change frequency, the variables of which are found to be the main determinants of price changes and their relationship to the frequency of price changes. The relationship between price reviews and price changes is also discussed.

5.1 Price change frequency

Firms were asked how often they had changed the price of their main product during the previous twelve months. The median frequency of price changes indicates that prices remain unchanged for six months, which is a rough measure of the degree of price stickiness in Iceland. In particular, 44 per cent of firms claimed to have changed the price of their main product two to three times during the reference time period, while 30 per cent of firms responded that they had changed their prices only once.

These results support the theory that price adjustment takes place in two steps. Price reviews seem to be performed more frequently than actual price changes, indicating that firms use resources to review their prices and determine whether it is beneficial to change them. This could be interpreted as evidence of some use of state-dependent pricing strategies. In an environment characterised by macroeconomic volatility and economic imbalances, it is natural that firms should tend to review their prices more often than they change them. This reflects that, in some cases, firms find that a price change is unnecessary, but in other cases they choose to defer a price change even though there are indeed some grounds for an adjustment. This is discussed further in Section 6.

A comparison of various sectors indicates that the wholesale, retail, transport, and various services sectors have the highest frequency of price changes, followed by

manufacturing (see Table 11). Financial intermediation, real estate, and business activities have the lowest frequency of price changes, with the median reflecting that prices stay unchanged for one year.

Table 11: Frequency of price changes in the last 12 months

	Total	*Manufacturing and fishing*	*Wholesale, retail, hotels, restaurants, transport, and communication*	*Financial intermediation, real estate, renting and business activities*	*Construction*	*Other services*
Median number of price changes	2	2	2	1	2	2
Share of firms with no price change	8.5	3.1	10.5	16.7	4.5	9.4
Share of firms with 1 price change	30.2	18.8	36.8	41.7	27.3	31.3
Share of firms with 2 to 3 price changes	44.2	59.4	26.3	33.3	50.0	43.8
Share of firms with 4 or more price changes	17.1	18.8	26.3	8.3	18.2	15.6

Sources: Capacent Gallup, Central Bank of Iceland.

A comparison between international evidence and the price adjustment process in Iceland reveals that the median frequency of price reviews and price changes among Icelandic firms is in the high-end of the results from similar studies. Given the more volatile macroeconomic conditions in Iceland, the frequency of price reviews and price changes could have been expected to be even higher. As in all other surveys, price reviews are more frequent than price changes. The median firm in most euro area countries changes its prices once a year, while in the United Kingdom, Luxembourg, and Ireland, prices remain unaltered for six months as in Iceland (see Table 12).[10] The results regarding differences between sectors in Iceland align to a certain extent with evidence from other studies. A common finding is that firms in the services sector review and change prices less frequently than firms in manufacturing. However, we obtain similar results only for those parts of the service sector that have insignificant exposure to exchange rate developments. Our result regarding the role of competition in influencing price setting in Iceland differs from evidence in other studies. Firms that follow competitors' prices to a large extent have the lowest frequency of price changes, keeping their prices unchanged for one year according to the median. In contrast, a common result in other studies is that more competition induces increased flexibility in firms' price setting. This could reflect either the use of poor proxies in our survey or the fact that competition has less influence on price setting in Iceland than in other countries. For example, there is some evidence to indicate that high and volatile inflation has blunted consumers' price awareness, making Icelandic consumers rather inattentive to price changes which could ease the extent to which competitive pressures affect firms' price setting behaviour (Sigurdsson *et al*., 2010).

[10] Klenow and Malin (2010) calculate the mean implicit duration of price stickiness based on 19 studies attaining an average of 10 months, ranging from 3 months for Turkey to 13.5 months for Germany. Using their method we find that the mean implicit duration of price stickiness in Iceland is 8 months. These calculations are based on certain assumptions as reported in Appendix 2 where an international comparison is provided.

Table 12: International comparison of survey results for frequency of price reviews and price changes per year

	IS	*EU*	*US*	*UK*	*CA*	*SW*	*NO*	*JA*	*BE*	*LU*	NL	*IR*
Median frequency of price reviews	3	2.7	2	2		1	2	1 to 2	1	2	4	
Most frequently cited price-review frequency	2	1	1	1		1		1 to 2				
Median frequency of price changes	2	1	1.4	2	4	1	1	1 to 2	1	2	1	2
Most frequently cited price-change frequency	2	1	1	1	1	1		1 to 2				2

Sources: Amirault et al. (2006), Apel et al. (2001), Blinder et al. (1998), Capacent Gallup, Fabiani et al. (2007), Hall et al. (1997), Keeney et al. (2010), Langbraaten et al. (2008), Central Bank of Iceland.

5.2 Determinants of price changes

The survey included questions about the principal determinants of price changes. Table 13 shows that increased costs and exchange rate depreciations are the main causes of price increases, followed by competitors' price hikes and increased demand. A large majority (almost 70 per cent) of firms responded that higher costs were the most important factor driving prices upward, while 23 per cent of firms said the same about exchange rate changes.[11] Interestingly, the converse is also true: lower costs are cited as the main reason for price decreases, while price decreases by competitors is the second most important factor.

Table 13: The importance of factors driving price changes

	Most important[1]	*Second most important*[1]	*Weighted importance (0-100)*[2]
Price increases			
Costs	68.7	27.4	80.9
Exchange rate changes	22.9	29.1	35.9
Competitors' price	1.5	28.2	14.1
Demand	6.9	15.4	13.7
Price decreases			
Costs	37.6	33.3	52.8
Exchange rate changes	20.0	18.4	28.4
Competitors' price	20.8	27.2	33.2
Demand	21.6	21.1	31.2
Asymmetries in price changes (Importance for increases/Importance for decreases)			
Costs			1.5
Exchange rate changes			1.3
Competitors' price			0.4
Demand			0.4

1. Share of firms in %. 2. The significance grade was obtained according to the following equation: (("Most important"*100) + ("Second most important"*50))/(Total number of answers in "Most important").

Sources: Capacent Gallup, Central Bank of Iceland.

There are indications of extensive asymmetries of price reactions. In line with international evidence, costs are more important for price increases than price decreases,

[11] Some care has to be taken when interpreting these results as price-setters may have problems with distinguishing between cost increases due to an exchange rate depreciation and cost increases originating in cost pressures unrelated to a depreciation.

whereas competitors' price changes and demand shocks are more relevant for price decreases than increases. Furthermore, exchange rate changes are more significant for price increases than price decreases, which is important evidence of asymmetric exchange rate pass-through (see Table 13). Viewing the results across sectors reveals that asymmetries in price changes following cost shocks are largest in the construction, the financial, and manufacturing sectors. Interestingly, those are the sectors with least confidence in the ability of monetary policy to maintain price stability, as is discussed in Section 7.3. Furthermore, it is noteworthy that asymmetries in price changes following exchange rate shocks seem to be larger for those sectors that are less exposed to exchange rate developments than the sectors where imported input costs as a share of total production costs are the highest. This is discussed further in Section 7.

When the importance of factors driving price changes is viewed in relation to the frequency of actual price changes over the previous twelve months, it is evident that firms that changed their prices most often in the given period view exchange rate changes as a very important driving factor, whereas firms with stickier prices mention competitors' prices as a significant driver (see Table 14).

Table 14: The importance of factors driving price changes (weighted importance, 0-100) and actual price changes in the last 12 months[1]

	Total	*0*	*1*	*2 to 3*	*4 or more*
Price increases					
Costs	80.9	72.2	90.8	86.0	57.5
Exchange rate changes	35.9	16.7	25.0	31.6	80.0
Competitors' price	14.1	27.8	19.7	13.2	0.0
Demand	13.7	22.2	7.9	14.9	12.5
Price decreases					
Costs	52.8	50.0	65.3	55.6	42.1
Exchange rate changes	28.4	16.7	18.1	24.1	63.2
Competitors' price	33.2	22.2	40.3	33.3	23.7
Demand	31.2	55.6	22.2	31.5	21.1

1. The significance grade was obtained according to the following equation: (("Most important"*100) + ("Second most important"*50)/Total number of answers in "Most important").

Sources: Capacent Gallup, Central Bank of Iceland.

The findings on the importance of various factors driving price changes are broadly similar to results from other international studies (see Table 15). In most other studies, increased costs are found to be the most important factor driving prices upward such as in Iceland. Cost shocks are also often found to be more relevant in driving prices upward than downward, which is also the case in the Icelandic survey. A third common finding is that changes in demand and competitors' prices seem to matter more for price decreases than increases. However, cost reductions seem to be the most important determinant of price decreases in Iceland, which is different from other studies. Another important difference with regard to other studies is the role of exchange rate movements, which is discussed below and in Section 7.

Table 15: International comparison of survey results for the importance of factors driving price changes[1]

	EU	*AT*	*BE*	*LU*	*NL*
Price increases					
Labour costs	3.0	3.4	2.9	3.5	2.7
Costs of raw materials	3.1	3.1	2.9		2.5
Financial costs	2.2	1.9	2.2	3.0	2.1
Demand	2.2	1.9	2.2	2.3	2.3
Competitors' price	2.4	2.0	2.5	2.4	2.5
Price decreases					
Labour costs	2.1	1.3	2.1	2.6	2.1
Costs of raw materials	2.6	2.2	2.3		2.0
Financial costs	1.9	1.6	1.8	2.5	1.8
Demand	2.5	2.0	2.5	2.7	2.5
Competitors' price	2.8	2.6	2.9	2.8	2.7

1. Ranked on the scale from 1 to 4 with regard to importance ("4 = very important")

Source: Fabiani et al. (2007).

Exchange rate fluctuations are found to be of little importance in most other studies and are often mentioned as the least important driving factor of price changes. The Romanian, Turkish, British and Canadian studies specifically analyse price setters' reaction to exchange rate shocks, but with the exception of Turkey, exchange rate movements seem to influence price setting to a much smaller degree in these countries than in Iceland. In the Romanian study, exchange rate changes rank below costs (both labour costs and raw materials), demand changes and competitors' prices in determining price increases, and they rank below competitors' prices, raw material costs, and demand changes for price decreases. Exchange rate movements are found to be the eighth most important driving factor of price adjustments in the Canadian study but play a more prominent role in the price setting of Turkish firms. In that study exchange rate changes rank second after changes in costs as the main driving factor of price increases, similar to our results for Icelandic firms, whereas they rank fourth for determinants of price decreases. We will return to the relation between exchange rate changes and price setting in Section 7.

6. Evidence on theories of price stickiness

The economic literature has provided numerous empirical studies in order to test different theories of price stickiness. However, as is pointed out by Blinder (1991), the empirical studies do not shed light on which theories are valid and which can be rejected. Therefore, in order to determine the validity of different theories of price stickiness, Blinder developed an interview method in which price setters are asked about the reasons why they leave prices unchanged. The theories are formulated in plain language, so price setters should be able to grasp them and recognise which theory of price rigidity leads the firm to keep prices unchanged despite there being some grounds for a price adjustment. In the surveys firms are able to choose between statements

reflecting different theories of price stickiness depending on their assigned importance. In the Icelandic survey firms chose between eight different theories. Table 16 presents the main results while Table 17 provides an international comparison of the ranking of these theories.

Table 16: The importance of theories explaining price stickiness by sectors[1]

	Total	*Manufacturing and fishing*	*Wholesale, retail, hotels, restaurants, transport, and communication*	*Financial intermediation, real estate, renting and business activities*	*Construction*	*Other services*
Implicit contracts	34.1	44.8	37.5	20.0	23.8	38.9
Explicit contracts	31.0	22.4	12.5	42.5	45.2	31.5
Temporary shocks	28.8	48.3	37.5	12.5	23.8	18.5
Coordination failure	26.1	24.1	21.9	37.5	31.0	18.5
Pricing thresholds	15.0	6.9	25.0	12.5	14.3	20.4

1. The significance grade was obtained according to the following equation: (("Most important"*100) + ("Second most important"*50)/Total number of answers in "Most important").

Sources: Capacent Gallup, Central Bank of Iceland.

Contracts, implicit and explicit, are perceived as the most important reasons for postponing price adjustments. Both theories concern long-term customer relationships. The term "implicit contracts" refers to an unwritten agreement between firms and their customers that prices should be kept stable. According to Okun (1981), a price hike due to increased costs is viewed as fair, while a price increase as a result of greater demand is perceived as unfair. Implicit contracts are considered an important source of price rigidity in the manufacturing sector and wholesale and retail trade while explicit contracts play a key role in the financial and construction sectors. Implicit and explicit contracts have received the highest score as a source of price rigidity in most surveys conducted in other countries. The fact that different surveys have obtained similar results, where implicit and explicit contracts are repeatedly ranked highest, reinforces the validity of these theories. Hence it seems as though the main source of price rigidity lies in firms' unwillingness to jeopardise their customer relationships.

Table 17: International comparison of the ranking of theories of price stickiness[1]

	IS	*EU*	*US*	*UK*	*CA*	*SW*	*NO*	*JA*	*BE*	*LU*	NL
Implicit contracts	1	1	4	5	2	1	2 to 3	2	1	2 to 3	1
Explicit contracts	2	2 to 3	5	1	3	3	1	3	2 to 3	1	2
Temporary shocks	3	6							6		3 to 4
Coordination failure	4	4	1	3		4	2 to 3	1	4	5	5
Pricing thresholds	5			4	4		4	4			
Menu costs	6 to 7						5				
Change non-price factors	6 to 7	7	3					5		6	6
Judging quality by price	8	5							5	4	3 to 4
Cost-based pricing		2 to 3	2	2	1	2			2 to 3	2 to 3	

1. Ranked by importance of theories explaining price stickiness according to results in individual surveys.

Sources: Amirault et al. (2006), Apel et al. (2001), Blinder et al. (1998), Capacent Gallup, Fabiani et al. (2007), Hall et al. (1997), Langbraaten et al. (2008), Nakagawa et al. (2000), Central Bank of Iceland.

Temporary shocks are another important factor for price stickiness, according to Icelandic firms. If firms believe that a demand or a cost shock is only temporary, they might decide to forgo a price adjustment, not wanting to readjust it soon thereafter. Temporary shocks receive a much higher score in Iceland than in surveys conducted elsewhere. In the euro area temporary shocks are ranked 6th out of ten theories tested (Fabiani *et al*., 2007). The economic environment in Iceland has been very unstable and this instability results in uncertainty making it difficult for agents in the economy to take informed decisions and forecast whether a shock is temporary or permanent.

Coordination failure also receives a high score, as it has in other studies and is ranked fourth here. Coordination failure regards the interaction between firms in the same competitive market. A firm might forgo a price change because of unwillingness to suffer losses if none of the other firms in its competitive market follow suit. Not surprisingly, firms whose prices are set according to competitors' prices name coordination failure as the primary reason for price stickiness. Pricing thresholds, where firms set attractive prices (e.g., 299) and do not adjust prices in response to a demand or cost shock until the optimal price approaches the next pricing threshold, rank fifth, but few respondents referred to it as an important source of sticky prices. Pricing thresholds are considered more important in the wholesale and retail trade sector, however.

Menu costs, a classic theoretical explanation for price stickiness, do not receive support from Icelandic price setters, at least not in their literal interpretation. The theory of menu costs receives its name from the fact that it is costly for restaurants to print a new menu; therefore prices are not changed until the benefit from price adjustment is greater than the cost of printing new menus. Hence menu costs refer to the fixed cost of price adjustment (see Mankiw, 1985). As in Iceland, menu costs have not received much support in other surveys conducted.

7. The nexus between exchange rate movements and price setting

This section focuses on the relation between the exchange rate and firms' price setting behaviour in the domestic market. Exchange rate movements and volatility have considerable effects on firms' price setting decisions in a small open economy such as Iceland. Hence it is valuable to gain more knowledge about firms' pricing reactions to exchange rate developments and how the degree of exposure to exchange rate changes affects the price setting mechanism in general. The actual fluctuations in the exchange rate and high exchange rate pass-through in Iceland provide a unique opportunity to use survey methods to analyse firms' reactions to particular exchange rate shocks, asymmetries in those reactions, methods to restore profit margins following a depreciation of the króna, and the relationship between price setting decisions and firms' exposure to exchange rate changes.

As previously mentioned, a few other surveys have included specific questions regarding the role of the exchange rate in price setting. The novelty of our approach is

to base our analysis on a categorisation of firms based on their direct exposure to exchange rate movements, which we define in terms of imported input costs as a share of total production costs.[12] Firms whose imported input costs constitute a relatively large share of total production costs are, by definition, more exposed to fluctuations in the exchange rate and are likely to have a more volatile cost structure. In order to cast a better light on the relationship between firms' cost structure and price setting, we also group firms based on domestic labour costs relative to total production costs. The main benefit of this approach is to allow us to analyse various features of the price setting mechanism in light of the composition of the cost structure, such as the type and frequency of price setting reviews, determinants and frequency of price changes, and firms' reaction to actual and hypothetical exchange rate movements. Here we can contrast firms that have a relatively high share of stable costs consisting of wages with firms that have a relatively high share of volatile costs consisting of imported inputs.[13] Finally, we are interested in whether there are foundations for the perceived asymmetry in exchange rate pass-through, with a stronger tendency for depreciation to pass through to higher prices than appreciation into lower prices.

7.1 Exchange rate exposure and price setting

The median share of imported input costs of total production costs is 15 per cent in our sample. The share is highest in the category representing wholesale, retail, transport and various services sectors, where it is 35 per cent, as well as in manufacturing, where it is 30 per cent. Financial intermediation, real estate, renting and business activities, as well as other services, have insignificant direct exposure to exchange rate movements. Labour costs' median share of total production costs is 40 per cent, and it has an inverse relation with the share of imported inputs, so that the labour share is high in sectors where exchange rate exposure is low, and vice versa (see Table 18). These shares are similar to the findings of a survey among Norwegian firms where wage costs constitute 30-40 per cent and imported input costs 10-20 per cent of total production costs (Langbraaten *et al.*, 2008). The study on price setting behaviour of Norwegian firms finds that imported input costs as a share of total production costs only influences the degree of forward-looking price setting behaviour and the importance of pricing decisions of suppliers for firms' own price setting. In contrast, our findings indicate that firms' imported input costs relative to total production costs affect various aspects of the price setting mechanism, as we discuss below, and clear evidence of an important role

[12] Of course, we do not capture firms' indirect exposure to exchange rate movements; e.g., when firms with purely domestic costs compete with importers or firms with costs due to imported inputs. Furthermore, we do not capture exposure to exchange rate changes due to unhedged foreign currency borrowing. Langbraaten *et al.* (2008) also included questions on both wage costs and imported input costs as a share of total production costs in their survey among Norwegian firms but they make limited use of that information in their analysis.

[13] The variability of input costs has received some attention in the price setting literature and pricing decisions of firms whose labour cost constitute a large share of total production costs have been contrasted with pricing by firms that are very exposed to fluctuations in commodity prices (see e.g. Altissimo *et al.*, 2006).

for exchange rate changes in price setting, which is different from the results of the Norwegian survey. This is in line with evidence of very different exchange rate pass-through in the two countries, despite roughly similar exchange rate volatility (see Table 1).

Table 18: Composition of firms' cost structure

	Total	*Manufacturing and fishing*	*Wholesale, retail, hotels, restaurants, transport, and communication*	*Financial intermediation, real estate, renting and business activities*	*Construction*	*Other services*
Median share of labour costs of total production costs	40	25	20	40	40	65
Median share of imported input costs of total production costs	15	30	35	0	15	4.5

Sources: Capacent Gallup, Central Bank of Iceland.

We now consider various aspects of the price setting mechanism that have been discussed in previous sections with regard to the composition of firms' cost structure. A distinguishing feature of the pricing strategies of Icelandic firms is the widespread price indexation to the consumer price index, as is discussed in Section 3.2. It is noteworthy that the share of firms using indexation as their main price setting method increases as imported input costs decline as a share of total production costs. Hence it seems as indexation is more commonly used by firms that are less exposed to exchange rate developments (see Table 19). This provides important insight into inflation dynamics across sectors within the Icelandic economy. If an exchange rate depreciation causes firms that are very exposed to exchange rate changes to raise their prices, causing a rise in the consumer price index, this initial increase in inflation induces further price adjustments by less exposed firms through the use of price indexation. Hence price indexation makes inflation even more dependent on exchange rate changes than would be expected based only on firms' direct exposure to exchange rate fluctuations. This could explain in part the asymmetric exchange rate pass-through for which we find abundant evidence, as is discussed in Section 7.3. In addition to this interaction between sectors through price indexation there may exist a wage channel where wage increases in exposed firms give rise to wage increases in less exposed firms due to the high centralisation of wage setting in Iceland, which again leads to additional price increases and a further rise in inflation.

The combination of high and asymmetric exchange rate pass-through among firms exposed to exchange rate fluctuations, and price indexation among less exposed firms, poses a serious challenge for monetary policy in Iceland which may be further exaggerated through the labour market. This is further discussed in Section 8.

Table 19: Type of price setting and share of imported input costs of total production costs

	0%	*1-10%*	*11-40%*	*over 40%*
Constant or variable mark-up on costs	33	37	53	53
Taking the price of the main competitor as reference	37	43	30	35
Price tied to the evolution of the CPI index	30	20	18	12

Sources: Capacent Gallup, Central Bank of Iceland.

A second noteworthy feature of the price and exchange rate nexus is the apparent effect of the composition of firms' cost structure on price review strategy and frequency. The share of firms that use pure time-dependent price review strategies increases in line with the rise in labour costs as a share of total production costs. This is not surprising, as labour costs are relatively fixed, only reviewed at certain intervals (e.g. annually), and rather predictable, so firms with a relatively high share of labour costs are less prone to shocks to the cost structure, making them more likely to set prices at fixed intervals.[14]

The share of firms that use state-dependent price reviews increases in line with the rise in imported input costs as a share of total production costs (see Table 20). This indicates a high degree of exchange rate pass-through in Iceland, since firms that are more exposed to exchange rate fluctuations are more likely to review their prices following shocks than at a fixed interval.

Langbraaten *et al.* (2008) find that the degree of forward-looking behaviour is higher among Norwegian firms whose imported input costs constitute a larger share of total production costs. The evidence from our survey is not clear-cut in this regard but it is nevertheless the case that 38 per cent of firms whose imported input costs exceed 40 per cent of total production costs evaluate their prices mainly on the basis of expectations about future conditions, whereas the share is 28 per cent for firms not directly exposed to exchange rate changes. This could indicate that firms with more exposure to exchange rate fluctuations attempt to assess future developments to a larger extent than less exposed firms where price indexation is more common.

[14] Our results are in line with recent evidence on wage setting in Sigurdardottir and Sigurdsson (2011) who find clear evidence of time-dependency in wage setting in Iceland using extensive micro data on wages; nominal wages are changed at certain intervals with most changes taking place in January. They find limited evidence of state-dependency in nominal wage setting.

Table 20: Price reviewing strategies and composition of firms' cost structure

Share of imported input costs of total production costs	*Total*	*0%*	*1-10%*	*11-40%*	*over 40%*
Time-dependent	39.3	50	42	41	23
Mainly time-dependent but also in reaction to specific events	46.7	36	52	46	58
State-dependent (non-regular)	14.1	14	6	12	19
Share of labour costs of total production costs	*Total*	*0-20%*	*21-40%*	*41-60%*	*over 60%*
Time-dependent	39.3	28	29	48	62
Mainly time-dependent but also in reaction to specific events	46.7	56	49	48	27
State-dependent (non-regular)	14.1	17	23	3	12

Sources: Capacent Gallup, Central Bank of Iceland.

As expected, the frequency of price reviews seems to rise in line with rising imported input costs as a share of total production costs. The median firm whose imported input costs exceed 40 per cent of total production costs reviews its prices every ten weeks, compared to every four months for the entire sample. Nevertheless, the actual price change frequency of the median firm is – surprisingly - the same. The price review frequency declines in line with rising labour costs relative to total production costs, again reflecting a more stable cost structure and relatively fewer shocks. The median price change frequency is unaffected by labour costs relative to total production costs (see Table 21).

Table 21: Frequency of price reviews and actual changes in the last 12 months and composition of firms' cost structure

Share of imported input costs of total production costs	*Total*	*0%*	*1-10%*	*11-40%*	*over 40%*
Median price review frequency	3	2	3	3	5
Median price change frequency	2	2	2	2	2
Share of labour costs of total production costs	*Total*	*0-20%*	*21-40%*	*41-60%*	*over 60%*
Median price review frequency	3	4	2.5	2.5	2
Median price change frequency	2	2	2	2	2

Sources: Capacent Gallup, Central Bank of Iceland.

As expected, it turns out that exchange rate changes gain importance as a driving factor of price adjustments as imported input costs rise as a share of total production costs. Almost 60 per cent of firms whose imported input costs constitute over 40 per cent of total production costs claim that changes in the exchange rate are the most important factor in a decision to increase prices. On the other hand, a lower share, or 48 per cent of firms in the same category, claim that exchange rate changes are the most important factor in a decision to decrease prices. Decreased demand is a stronger driver of price decreases than other factors in firms whose imported input costs constitute a small or non-existent share of total production costs. Not surprisingly, costs become a more important driving factor of price increases, and exchange rate changes become less influential, as domestic labour costs rise as a share of total production costs.

Nevertheless, the asymmetry of price adjustments following exchange rate movements is larger for less exposed sectors with the construction, the financial, and other services sectors, being much more inclined to increase prices following a depreciation than to lower them following an appreciation (see Table 22).

Table 22: Importance of factors driving price changes and share of imported input costs of total production costs

	Total	*0%*	*1-10%*	*11-40%*	*over 40%*
Price increases[1]					
Costs	82.0	90.4	78.3	82.9	73.1
Exchange rate changes	35.2	7.7	16.7	50.0	59.6
Competitors' price	14.4	19.2	21.7	11.0	5.8
Demand	12.8	21.2	25	4.9	9.6
Price decreases[1]					
Costs	53.8	50.0	53.4	61.5	44.0
Exchange rate changes	27.3	2.0	12.1	39.7	48.0
Competitors' price	33.6	30.0	43.1	26.9	36.0
Demand	30.7	56.0	36.2	20.5	20.0
Assymmetries in price changes (Importance for increases/Importance for decreases)					
Costs	1.5	1.8	1.5	1.3	1.7
Exchange rate changes	1.3	3.9	1.4	1.3	1.2
Competitors' price	0.4	0.6	0.5	0.4	0.2
Demand	0.4	0.4	0.7	0.2	0.5

1. The significance grade was obtained according to the following equation: (("Most important"*100) + ("Second most important"*50)/Total number of answers in "Most important").

Sources: Capacent Gallup, Central Bank of Iceland.

7.2 Methods to restore profit margins following an exchange rate depreciation

When firms were asked what methods they mainly use to restore profit margins after an exchange rate depreciation, they indicate that reducing costs is a more important method than increasing prices, with 47 per cent of respondents mentioning cost reduction as the most important method (see Table 23). Furthermore, there is a clear difference in firms' reactions following a króna depreciation dependent on their exposure to exchange rate changes. Hence, 54 per cent of firms whose imported input costs exceed 40 per cent of total production costs rely primarily on increasing prices to restore profit margins after an exchange rate depreciation (see Table 24).

Table 23: Share of firms in % which use the following methods to restore profit margins after a depreciation of the króna

Reduce costs	47.1
Increase price	37.0
Increase productivity or production quantity	6.7
Change supplier	2.5
Other means	6.7

Sources: Capacent Gallup, Central Bank of Iceland.

Market leaders seem to be more inclined to raise prices to restore their profit margins following an exchange rate depreciation, whereas market followers and firms operating in a market with no market leaders seem more likely to reduce costs. This is evidence of competition limiting the exchange rate pass-through of depreciation into higher prices (see Table 24).

As expected, firms that focus on reducing costs following a depreciation seem to have conducted the fewest price reviews during the previous twelve months while roughly half of those that had reviewed their prices four times or more during the reference period claim that increasing prices is the most important method to restore profit margins. Analysis by firm size reveals that small firms seem to rely more on price increases to restore profit margins following a depreciation, while larger firms emphasise cost reduction and other solutions (see Table 24).

These results further indicate the sources of high exchange rate pass-through in the price setting behaviour of Icelandic firms, showing that firms that are significantly exposed to exchange rate developments, as well as smaller firms and firms with greater market power in general, seem to be inclined to increase prices to restore their profit margin following an exchange rate depreciation.

Table 24: Share of firms in % which use the following methods to restore profit margins after a depreciation based on different firm characteristics

Share of imported input costs of total production costs

	Total	*0%*	*1-10%*	*11-40%*	*over 40%*
Reduce costs	47.1	50	56	53	25
Increase price	37.0	18	24	43	54
Other means	15.9	32	20	5	21

Market power

	Total	*Market leaders*	*Market followers within monopolistic competition*	*Competition*
Reduce costs	47.1	35	55	47
Increase price	37.0	48	30	35
Other means	15.9	16	15	18

Number of price reviews in the previous 12 months

	Total	*No price review*	*1 price review*	*2 to 3 price reviews*	*4 or more price reviews*
Reduce costs	47.1	100	54	53	28
Increase price	37.0	0	31	28	54
Other means	15.9	0	15	19	17

Firm size (number of employees)

	Total	*9 or less*	*10 to 20*	*More than 20*
Reduce costs	47.1	43	52	50
Increase price	37.0	47	31	26
Other means	15.9	9	17	24

Sources: Capacent Gallup, Central Bank of Iceland.

7.3 Asymmetric exchange rate pass-through

Firms were also asked about their price reactions to two actual exchange rate shocks. The króna appreciated by approximately 10 per cent in the first half of 2007 and depreciated by roughly 30 per cent in the first half of 2008. Even though the relative size of these shocks is not the same, firms' reactions can provide insight into the link between exchange rate movements and price setting.[15] The survey results suggest that there is strong evidence for asymmetric exchange rate pass-through, as approximately two-thirds of firms raised their prices following the depreciation in 2008, while only a fifth of firms lowered their prices in reaction to the appreciation in 2007 and three-fourths of firms kept prices unchanged (see Table 25).

Table 25: Reaction to króna appreciation in H1/2007 and depreciation in H1/2008 (share of firms in %)

Appreciation in H1/2007	
Decreased their prices	20.0
Increased their prices	4.2
Unchanged price	75.8
Depreciation in H1/2008	
Decreased their prices	2.4
Increased their prices	62.6
Unchanged price	35.0

Sources: Capacent Gallup, Central Bank of Iceland.

Furthermore, the average increase in prices following the roughly 30 per cent depreciation of the króna was 14.7 per cent, which is roughly in line with empirical evidence regarding the degree of exchange rate pass-through, estimated at 0.43 (see Table 1). However, the price increase was considerably larger among firms that changed their prices more often than among other firms over the previous twelve months. The average price increase following the depreciation in 2008 was 23 per cent among firms that changed their prices four times or more in the period in question (implying a pass-through coefficient of 0.77) but roughly 10 per cent among those that changed their prices only once (implying a pass-through coefficient of 0.33).

The asymmetric exchange rate pass-through following the actual exchange rate changes in 2007 and 2008 seems evident in all sectors, both those where the exchange rate plays an important role and those less exposed to exchange rate movements. As expected, the share of firms that adjusted their prices in response to the two actual exchange rate shocks increases with rising imported input costs relative to total production costs. Interestingly, a third of firms with no direct exposure to exchange rate

[15] The cyclical position of the economy during the two exchange rate shocks was to a certain extent similar. Average seasonally adjusted year-on-year growth in domestic demand was -1.3 per cent in the first half of 2007 but -2.6 per cent in the first half of 2008 whereas average seasonally adjusted year-on-year growth in GDP was 4.7 per cent in the former period and 4.2 per cent in the latter period.

changes actually increased their prices following the depreciation in 2008 while none of them lowered their prices following the appreciation in 2007 (see Table 26).

Table 26: Price reaction to two actual exchange rate shocks for firms with different direct exchange rate exposure (share of firms in %)[1]

	Total	*0%*	1-10%	11-40%	over 40%
Appreciation in H1/2007					
Decreased their prices	20	0	8	28	31
Unchanged or higher price	80	100	92	73	69
Depreciation in H1/2008					
Increased their prices	62.6	32	35	80	92
Unchanged or lower price	37.4	68	65	20	8

1. Direct exposure to exchange rate changes is captured by the share of imported input costs of total production costs.

Sources: Capacent Gallup, Central Bank of Iceland.

If firms' reactions to exchange rate changes are analysed based on the degree of competition, the results show that competition does not seem to play a role in passing an appreciation into lower prices but is found to play a role in limiting the price increase following a depreciation of the króna (see Table 27).

Table 27: Price reaction to two actual exchange rate shocks for firms with different number of competitors (share of firms in %)

	Total	*0 to 3*	*4 to 15*	*16 or more*
Appreciation in H1/2007				
Decreased their prices	20	25	34	13
Unchanged or higher price	80	75	66	87
Depreciation in H1/2008				
Increased their prices	62.6	72	67	55
Unchanged or lower price	37.4	28	33	45

Sources: Capacent Gallup, Central Bank of Iceland.

Firms were also asked about the magnitude of hypothetical exchange rate changes necessary to affect price setting. According to the average response the króna must depreciate by 11.4 per cent in one quarter in order for firms to raise prices, but it must appreciate by almost 16 per cent in one quarter if a firm is to lower prices. This is further evidence of asymmetric exchange rate pass-through (see Table 28). Firms in all sectors cite a lower threshold for a depreciation to be passed into higher prices than for an appreciation to be passed into lower prices. As expected, the firms that had changed prices most often during the reference period seem to have the lowest threshold for exchange rate changes before they choose to adjust their prices. These results are different from survey evidence from firms in the United Kingdom where firms seem to respond symmetrically to exchange rate depreciations and appreciations (Greenslade and Parker, 2008).

Table 28: Mean size of an exchange rate change within a quarter necessary to induce a price adjustment

	Total	*Manufacturing and fishing*	*Wholesale, retail, hotels, restaurants, transport, and communication*	*Financial intermediation, real estate, renting and business activities*	*Construction*	*Other services*
Size of depreciation to induce a price increase	11.4	10.2	12.8	9.8	10.5	13.2
Size of an appreciation to induce a price decrease	15.9	13.7	15	13.8	18.5	18.7

Sources: Capacent Gallup, Central Bank of Iceland.

The survey further addresses the issue of incomplete pass-through of exchange rate appreciations by asking firms to give the main reasons for not lowering prices to fully take into account the effects of an exchange rate appreciation. Rising costs seem to be the main reason for incomplete pass-through of a strengthening króna, as 18 per cent of firms mention that increased costs stood in the way of decreasing prices. There is also evidence of forward-looking estimates of the sustainability of the exchange rate appreciation, which indicates that firms expect the exchange rate to depreciate in the short-term and may view a price decrease as premature. Furthermore, strong demand and limited competition play a surprisingly small role as reasons for incomplete exchange rate pass-through of appreciation into lower prices (see Table 29). The manufacturing sector, which is very exposed to exchange rate changes, points to a larger extent than other sectors towards increased costs and unsustainability of the appreciation as the main reasons for incomplete pass-through of appreciations.

Table 29: Share of firms in % which attach importance to the following reasons for incomplete pass-through of króna appreciation into prices

Increased costs	17.6
Unsustainable appreciation	15.2
Insufficient appreciation	6.4
Large demand	5.6
Competitors do not lower their prices	4.0
Not valid for the firm	51.2

Sources: Capacent Gallup, Central Bank of Iceland.

The results above clearly suggest that exchange rate pass-through in Iceland is both high and asymmetric, causing difficult challenges for the monetary authorities in their aim of maintaining price stability. To a certain extent, of course, the high pass-through reflects the small and open nature of the economy as well as shallow financial markets, making Icelandic firms exposed to exchange rate movements with limited opportunities for hedging, which affects their pricing decisions. The characteristics of exchange rate movements could also play a part as appreciations tend to be gradual whereas depreciations are often swift, but that is nevertheless a pattern which is evident in other countries without leading to similar pass-through dynamics.

Our analysis indicates that smaller firms and firms with greater market power have a greater tendency to pass depreciations into higher prices. Increased consolidation

and structural reforms to intensify competition could therefore lower exchange rate pass-through in Iceland, but of course, these two features are contradictory to the extent that larger firms lead to fewer firms with greater market power.

Taylor (2000) points towards the relation between monetary policy credibility and exchange rate pass-through. Hence we asked firms how likely they considered it that inflation would be close to the Central Bank's inflation target in five years' time. The results clearly reflect the poor credibility of monetary policy in Iceland at the time of the survey, as only 31 per cent considered it very or rather likely that inflation would be close to target in five years. Interestingly, credibility is lowest in those sectors which expressed the lowest threshold for an exchange rate depreciation necessary to induce a price increase and where the asymmetry in firms' price reaction to changes in costs is largest (see Section 5.2 and Tables 28 and 30). Hence increased credibility could be an efficient way to reduce exchange rate pass-through and the impact of cost-push shocks on inflation in Iceland. Additionally, there seems to be a relation between the frequency of actual price changes and the Central Bank's credibility. Around 70% of firms that kept their prices unchanged during the previous twelve months believed it very or rather likely that inflation would be close to target in five years. On the other hand, only less than a third of firms that changed their prices four times or more in the reference period were as convinced.

Table 30: Credibility of the Central Bank of Iceland's inflation target

Firm's confidence that inflation will be at target in five years (share of firms in %)	*Total*	*Manufacturing and fishing*	*Wholesale, retail, hotels, restaurants, transport, and communication*	*Financial intermediation, real estate, renting and business activities*	*Construction*	*Other services*
Very or rather likely	30.5	15.6	50.0	30.0	25.0	38.7
Neither likely nor unlikely	21.4	15.6	11.1	26.7	25.0	25.8
Very or rather unlikely	48.1	68.8	38.9	43.3	50.0	35.5

Sources: Capacent Gallup, Central Bank of Iceland.

8. Conclusions

The price setting literature has grown with leaps and bounds in recent years as a wealth of micro datasets and survey results have become available and provided increased insight into firms' price setting behaviour. This survey among Icelandic firms aims to make two contributions to the literature. On the one hand, it considers whether the perspective on price setting provided by the above-mentioned evidence still holds within a more turbulent yet advanced economy setting. On the other hand, the study casts light on the relation between exchange rate movements and price setting, whereas surveys have only been used for that purpose to a limited extent in the literature.

We find that, by and large, Icelandic firms set their pricing in a fashion similar to firms in other countries despite the more macroeconomic volatile conditions. As expected, price stickiness is less profound than in many advanced economies, but

nevertheless similar to levels reported for the United Kingdom, Ireland and Luxembourg. The median frequency of price reviews and price changes among Icelandic firms is in the high-end of the results from similar studies. Icelandic firms review their prices every four months and change them every six months. The underlying sources of price rigidities are the same as are found in other advanced countries, with explicit and implicit contracts playing a prominent role and the most common price setting method being based on mark-ups over costs. Price indexation is a pricing strategy used by a larger share of firms in Iceland than in other advanced countries, however. In Iceland, temporary shocks receive a higher ranking as a source of price stickiness than in most other studies, reflecting the more volatile circumstances. The share of Icelandic firms following a purely time-dependent price review strategy is a bit higher than in the euro area, and the degree of backward-looking price-setting behaviour among Icelandic firms is considerably higher than is found in most other studies. To a large extent, distinctions across firm size and sectors are similar to results from other studies, except that prices are less rigid in some parts of the services sector in Iceland than in manufacturing due to high exposure to exchange rate changes. Furthermore, competition seems to play a smaller role in price setting in Iceland than in many other advanced countries. Unsurprisingly, exchange rate movements are a more important driving factor of price changes in Iceland than in other studies, although the results are broadly in line with those in a survey for Turkey.

Hence, while the perspective on price setting is in many ways intact despite the more volatile macroeconomic conditions, our analysis provides new insight into the nexus between exchange rate fluctuations and price setting. A novel aspect of our approach is to base our analysis on a categorisation of firms by their direct exposure to exchange rate movements, which we capture as imported input costs relative to total production costs. We also group firms based on their domestic labour costs as a share of total production costs. This allows us to analyse various features of the price setting mechanism in light of firms' composition of cost structure, such as the type of price setting method, strategy and frequency of price reviews, determinants and frequency of price changes, and firms' reactions to actual and hypothetical exchange rate movements. We find that firms that are more exposed to exchange rate movements are more likely to use state-dependent pricing, to adjust their prices due to exchange rate changes, and to rely on raising prices rather than lowering costs to restore profit margins after an exchange rate depreciation. They also seem to review their prices more often but nevertheless have the same price change frequency as the median firm. The median firm whose imported input costs constitute over 40 per cent of total production costs reviews its prices every ten weeks, compared to four months for the entire sample. On the other hand, price review frequency declines and time-dependent pricing increases as labour costs rise relative to total production costs.

Our results suggest an average pass-through of exchange rate shocks of just below 0.5, which is consistent with existing empirical evidence. However, we find strong evidence of asymmetric exchange rate pass-through, with a depreciation more likely to

be passed through to higher prices than an appreciation to be passed into lower prices. Smaller firms and firms with greater market power seem to have a greater tendency to pass an exchange rate depreciation into higher prices, and limited credibility of monetary policy is likely to exacerbate this tendency among Icelandic firms.

8.1 Modelling and monetary policy implications

What are the implications of our results for modelling the relation between exchange rate fluctuations and price setting or inflation dynamics in general? First, it is important to incorporate a variety of sectors into macro models to take into account significant differences in the composition of the cost structure of firms across sectors and the effects of these differences on the type of price setting method used and the choice of price review strategies. For a small open economy with high exchange rate pass-through, it is important to capture the different degree of exposure to exchange rate fluctuations and the effect on price setting behaviour and inflation dynamics. For Iceland, it seems important to capture the interaction between price changes by firms exposed to exchange rate movements and further price adjustments in less exposed sectors through price indexation. Second, the findings provide microfoundations for a hybrid new Keynesian Phillips curve in the sense that both backward- and forward-looking price setting behaviour seem relevant. Intrinsic inflation persistence seems to be a more important source of overall inflation persistence in Iceland than in many other countries, which reflects the extensive backward-looking behaviour of Icelandic firms and widespread use of price indexation. Third, our findings accord with the results of the *Eurosystem Inflation Persistence Network* emphasising the price-wage relation, which has given rise to increased research on the interaction between wage setting and firms' pricing decisions. Similar studies could provide important evidence on the interrelation between wages, prices and exchange rate movements in Iceland. Finally, our study shows that it can be beneficial to include surveys as a natural part of central banks' toolkit for understanding inflation dynamics, the monetary policy transmission mechanism, and business cycles in general. Special emphasis should be given to the ability to categorise firms by the composition of their cost structure - e.g., their exposure to exchange rate developments - when designing such surveys, interpreting their results, and using them as inputs in forecasting. Furthermore, it could be beneficial to question firms about how certain they are about their expectations, as the survey results show that firms' price setting is affected by their expectations regarding the sustainability of exchange rate changes.

In addition to modelling implications, there are important monetary policy considerations that follow from our results. First, the study highlights the challenge posed by high and asymmetric exchange rate pass-through in such a small open economy. Monetary policy in Iceland is further challenged by the widespread use of price indexation and the high degree of backward-looking behaviour in the Icelandic firms' price setting strategies, as well as price setters' limited confidence in the Central

Bank's ability to deliver price stability, all of which contribute to high intrinsic and expectations-based persistence in inflation dynamics and limit the smooth transmission of monetary policy through management of firms' expectations. Furthermore, our results reveal the challenging interaction between exchange rate pass-through and price indexation, causing the effects of an exchange rate depreciation to spread to sectors less exposed to such changes through the use of indexation. These effects could be further exaggerated through wage increases originating in firms exposed to exchange rate changes spreading to less exposed sectors due to the high centralisation of wage setting in the Icelandic labour market - causing further price increases as labour costs rise. These characteristics of price setting in Iceland make inflation control even more challenging than is indicated solely from the high and asymmetric exchange rate pass-through.

Second, the degree of intrinsic inflation persistence influences how monetary policy should react to cost-push shocks. The high degree of intrinsic persistence in the Icelandic economy makes the effects of such a shock larger and more persistent, as firms reset their prices to a large extent in a backward-looking manner, have little confidence in the ability of monetary policy to ensure price stability, and through the automatic effects of price indexation. Hence higher intrinsic inflation persistence worsens the inflation-output variability trade-off faced by the monetary authorities (see e.g., Altissimo *et al.*, 2006). That is in line with findings from Hunt (2006) that Iceland faces a considerably less favourable trade-off than many other advanced countries.

In light of the above, our results question the benefits of conducting independent monetary policy in such a small currency area with these challenging characteristics. Our results also imply that if a fully floating exchange rate regime is to be reinstated in Iceland, some measures must be taken to enhance credibility and intensify competition to ease the challenges faced by the Central Bank of Iceland from high and asymmetric exchange rate pass-through and the extensive backward-looking behaviour in the pricing strategies of Icelandic firms. Otherwise, there is a risk that the cost structure of Icelandic firms will continue to be volatile and unpredictable, and the Central Bank's ability to manage private agents' expectations will continue to be limited, giving rise to unstable and uncertain inflation dynamics.

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Appendix 1 - Central Bank of Iceland Price Setting Survey

Objectives
The objectives of this survey are to explore the characteristics of and determining factors in Icelandic companies' pricing decisions and to research price stickiness. It is important that central banks have an understanding of how companies set prices, as price formation plays a key role in economic modelling, inflation dynamics, and monetary policy transmission.

The survey is divided into four parts. The first part asks about companies' price setting. The second part examines the effects of the exchange rate of the Icelandic króna on price setting. The third focuses on factors that result in delays in price adjustment. The fourth pertains to general information about the company. All participants should choose one response for each question.

Main product
Questions about a company's main product refer to the product or service which generates the greatest share of its sales revenues/turnover. Where there is not a single main product, it is possible to use the most important product group as a reference; for example, motor vehicle insurance for an insurance company, food in a grocery store, beds in a furniture store, loans in banks, etc.

If a company's sales take place in both domestic and foreign markets, it is requested that the answers refer to the domestic market.

Price
Questions about price refer to the actual selling price in Icelandic krónur, not the list price. If the list price is discounted, the respondent is asked to answer based on the final price of the product, after factoring in the discount. If different types of customers are charged different prices, the answer should be based on the most common type of customer (or the largest customer).

Exchange rate of the króna
Questions about the effect of the ISK exchange rate on pricing refer to the exchange rate of the króna against the currencies that weigh most heavily in the company's imports.

1.
What is the company's main product in the domestic market; that is, what product generates the most turnover?

- ❑ ____
- ❑ Do not wish to answer
- ❑ Don't know

2.
How many competitors are there in the domestic market for the main product?

- ❑ 0-3
- ❑ 4-15
- ❑ 16 or more

3.

How large a proportion of domestic sales of the main product takes place in the consumer market, and what proportion is sold to other firms?

- ❑ 100% in consumer market ___%
- ❑ 100% to other firms ___%
- ❑ Majority in consumer market
- ❑ Majority to other firms
- ❑ Distributed equally between consumers and other firms

4.

Is the largest purchaser of your main product a long-term customer or a group of random customers?

- ❑ Long-term customers
- ❑ Random customers
- ❑ Don't know

5.

Which of the following factors is most important for the competitiveness of the company's main product in the domestic market?

- ❑ Price
- ❑ Quality
- ❑ Uniqueness of product
- ❑ Long-term contractual agreements
- ❑ Do not wish to answer
- ❑ Don't know

6.

Which factor is second most important?

- ❑ Price
- ❑ Quality
- ❑ Uniqueness of product
- ❑ Long-term contractual agreements
- ❑ Do not wish to answer
- ❑ Don't know

7.

Is your company the market leader in the domestic market for the main product, is another company the market leader, or is no company the market leader?

- ❑ My company
- ❑ Another company
- ❑ No company is the market leader
- ❑ Do not wish to answer
- ❑ Don't know

8.

Approximately what percentage of the total production cost of the main product is due to wage cost?

- ❑ 0-20%
- ❑ 21-40%
- ❑ 41-60%
- ❑ More than 60%
- ❑ Don't know

9.

Approximately what percentage of the total production cost of the main product is due to imported factors of production?

- ❑ 0%
- ❑ 1-10%
- ❑ 11-40%
- ❑ More than 40%
- ❑ Don't know

On price setting

10.

Does the company itself determine the price of the main product, or is the price determined by other factors, such as the parent company or external regulatory instruments?

- ❑ The company itself
- ❑ Parent company or external regulatory instruments **(Do not answer further questions in this survey.)**
- ❑ Do not wish to answer
- ❑ Don't know

11.

Which of the following statements best applies to the price setting method of the main product?

- ❑ The price is based on a FIXED mark-up on costs
- ❑ The price is based on a VARIABLE mark-up on costs
- ❑ The price is influenced by competitors' prices
- ❑ The price changes with the consumer price index
- ❑ Do not wish to answer
- ❑ Don't know

12.

In determining the price of the main product, which is more important: an assessment of the outlook for the future or an assessment of the current situation and recent developments?

- ❑ Assessment of future outlook
- ❑ Assessment of current situation and recent developments
- ❑ Do not wish to answer
- ❑ Don't know

13.

Is the price of the main product the same for all customers, is it determined by volume sold, or is it determined case-by-case?

- ❑ Same for all customers
- ❑ Determined by volume sold
- ❑ Determined case-by-case
- ❑ Do not wish to answer
- ❑ Don't know

14.

Is the price of the main product reviewed on a regular basis?

- ❑ Yes; for example, daily, weekly, monthly, or annually
- ❑ Yes; usually on a regular basis but also following specific events
- ❑ No
- ❑ Do not wish to answer
- ❑ Don't know

15.

In the past 12 months, how often has your company examined whether there were reasons to change the price of its main product, but without then necessarily changing the price?

- ❑ Never
- ❑ Once
- ❑ 2-3 times
- ❑ 4 times or more
- ❑ Do not wish to answer
- ❑ Don't know

16.

How often in the past 12 months has your company actually changed the price of its main product?

- ❑ Never
- ❑ Once
- ❑ 2-3 times
- ❑ 4 times or more
- ❑ Do not wish to answer
- ❑ Don't know

17.

Which of the following factors is most important in a decision to RAISE the price of the main product?

- ❑ Increased costs
- ❑ Competitor raises prices
- ❑ Demand grows
- ❑ ISK exchange rate changes
- ❑ Do not wish to answer
- ❑ Don't know

18.

Which factor is second most important?

- ❑ Increased costs
- ❑ Competitor raises prices
- ❑ Demand grows
- ❑ ISK exchange rate changes
- ❑ Do not wish to answer
- ❑ Don't know

19.

Which of the following factors is most important in a decision to LOWER the price of the main product?

- ❑ Lower costs
- ❑ Competitor cuts prices
- ❑ Demand declines
- ❑ ISK exchange rate changes
- ❑ Do not wish to answer
- ❑ Don't know

20.

Which factor is second most important?

- ❑ Lower costs
- ❑ Competitor cuts prices
- ❑ Demand declines
- ❑ ISK exchange rate changes
- ❑ Do not wish to answer
- ❑ Don't know

21.

How likely or unlikely do you think it is that inflation will be close to the Central Bank's inflation target in five years' time?

- ❑ Very likely
- ❑ Rather likely
- ❑ Neither likely nor unlikely
- ❑ Rather unlikely
- ❑ Very unlikely
- ❑ Do not wish to answer
- ❑ Don't know

On the effects of exchange rate movements

22.

Which of the following actions is your company most likely to take in order to restore profits following a depreciation of the Icelandic króna?

- ❑ Raise prices
- ❑ Increase productivity or production volume
- ❑ Cut costs
- ❑ Switch suppliers
- ❑ Other (please specify):
- ❑ Do not wish to answer
- ❑ Don't know

23.

Sometimes firms do not reduce prices commensurate with ISK appreciation. There could be various reasons for this. Which of the following applies best to your company?

- ❑ Appreciation is not large enough
- ❑ Appreciation is transitory
- ❑ Strong demand for principal product
- ❑ Competitors do not cut prices
- ❑ Costs have risen
- ❑ Does not apply
- ❑ Do not wish to answer
- ❑ Don't know

24.

How much must the króna depreciate in one quarter in order for your company to raise the price of its main product?

- ❑ Less than 10%
- ❑ 10-15%
- ❑ More than 15%

25.

During the current year, the króna has depreciated considerably. What impact has this had on the pricing of your company's main product?

- ❑ Price has risen
- ❑ Price has fallen
- ❑ Price remained the same
- ❑ Do not wish to answer
- ❑ Don't know

26.

How much did the price rise?

- ❑ 0-10%
- ❑ More than 10%

27.

The ISK appreciated in the first half of 2007. What impact did that have on the pricing of the main product?

- ❑ Price has fallen
- ❑ Price has risen
- ❑ Price remained the same
- ❑ Do not wish to answer
- ❑ Don't know

28.

How much did the price fall?

- ❑ Less than 10%
- ❑ 10% or more

29.

How much must ISK appreciate in one quarter in order for your company to reduce the price of its main product?

- ❑ Less than 10%
- ❑ 10-15%
- ❑ More than 15%
- ❑ Don't know

On deferral of price changes

30.

Which of the following factors is most important when your company decides to postpone a price change or to change prices only slightly, even though there are grounds for a larger change?

- ❑ Cost associated with price change
- ❑ Competitor does not change prices
- ❑ Do not want price to exceed a given threshold (e.g., ISK 1999)
- ❑ Previously existing contracts with customers
- ❑ Customers want constant price levels
- ❑ Grounds for price change not lasting
- ❑ Lower price interpreted as lesser product quality
- ❑ Instead of changing prices, other factors are changed, such as quality or service level
- ❑ Do not wish to answer
- ❑ Don't know

31.

Which factor is second most important?

- ❑ Cost associated with price change
- ❑ Competitor does not change prices
- ❑ Do not want price to exceed a given threshold (e.g., ISK 1999)
- ❑ Previously existing contracts with customers
- ❑ Customers want constant price levels
- ❑ Grounds for price change not lasting
- ❑ Lower price interpreted as lesser product quality
- ❑ Instead of changing prices, other factors are changed, such as quality or service level
- ❑ Do not wish to answer
- ❑ Don't know

32.

Some products have limited shelf life. In some instances, the price of these products is held unchanged during their short shelf life. Does this apply to your main product?

- ❑ Yes
- ❑ No
- ❑ Do not wish to answer
- ❑ Don't know

Analytical variables

33.

Under what industrial sector are your company's activities classified?

- ❑ Industry, mining, and utilities
- ❑ Agriculture, forestry, and fishing
- ❑ Retail trade, hotel, and restaurant
- ❑ Transport and communications
- ❑ Financial services, pension funds, insurance, and real estate
- ❑ Building and construction
- ❑ Other services
- ❑ Do not wish to answer
- ❑ Don't know

34.

How many permanent employees worked for your company as of year-end 2007?

- ❑ ___ employees
- ❑ Do not wish to answer
- ❑ Don't know

35.

What was your company's turnover in ISK millions in 2007?

- ❑ ISK ____ million
- ❑ Do not wish to answer
- ❑ Don't know

36.

What was your company's turnover from your main product in ISK millions in 2007?

- ❑ ISK ____ million
- ❑ Do not wish to answer
- ❑ Don't know

Appendix 2 – International comparison of price change frequency in survey data

Table A1 Number of price changes per year (%) in survey data

Country	*Less than 1*	*1*	*2 to 3*	*4 or more*	*Median*	*Mean (in months)*[1]
Austria	24	51	15	11	1	12.7
Belgium	18	55	18	8	1	11.9
Canada	8	27	23	44	2 to 3	6.8
Estonia	14	43	25	18	1	10.0
Euro Area	27	39	20	14	1	12.3
France	21	46	24	9	1	11.8
Germany	44	14	21	21	1	13.5
Iceland	8.5	30.2	44.2	17.1	2	8.0
Italy	20	50	19	11	1	11.9
Japan	23	52	11	14	1	12.5
Luxembourg	15	31	27	27	2 to 3	9.0
Mexico	-	-	-	-	-	5.7
Netherlands	10	60	19	11	1	10.7
Portugal	24	51	14	12	1	12.7
Romania	-	-	-	-	-	4.1
Spain	14	57	15	14	1	11.1
Sweden	29	43	6	20	1	12.7
Turkey	-	-	-	-	-	3.0
United Kingdom	6	37	44	14	2 to 3	8.2
United States	10	39	29	22	1	8.8

1. Mean implicit duration obtained from the interval-grouped data using the following assumptions as in Klenow and Malin (2010): for firms declaring "at least four price changes per year", 8 price changes are considered (i.e. mean duration of 1.33 months); for those declaring "two or three price changes per year", 2.5 price changes are considered (i.e. 4.8 months); for those declaring "one change per year" a duration of 12 months, and for those declaring "less than one price change per year", a change every two years is considered (i.e., 24 months).

Sources: Capacent Gallup, Klenow and Malin (2010), Cental Bank of Iceland.