Price stickiness and exchange-rate pass-through: some evidence from Indian online retail

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ABSTRACT. We use daily data for a period of 219 days on the price of imported books from an online retailer based in India in order to study price stickiness and exchange-rate pass-through. The price changes in our sample are a mixture of idiosyncratic and synchronized price changes. Exchange rate pass-through is found to exist but is imperfect.
JEL Classification: E31.

1. INTRODUCTION

Prices set by oligopolistic firms are often *sticky*—they remain unchanged for long periods of time and then change in discrete jumps. This stickiness plays an important role in the currently dominant New Keynesian macroeconomic models (see for example Woodford (2003)). To the extent that firms do not change their prices immediately in response to changes in nominal demand, it is possible for such changes in nominal demand to have an effect on real variables. This, among other things, allows monetary policy to be effective in stabilizing real output.

The macroeconomic effects of firm-level price stickiness depends on the nature of the decision-making process that gives rise to this stickiness. Caplin and Spulber (1987), for example, presented a model in which monetary policy had no real effects in the aggregate despite the presence of price stickiness at the firm level.

A better understanding of these issues has been helped by recent research using microeconomic evidence on price-setting (see Klenow and Malin (2011) for a review). Most of this research is based on the survey data underlying consumer price indices. In this paper we explore an alternate source of data—the automated collection of

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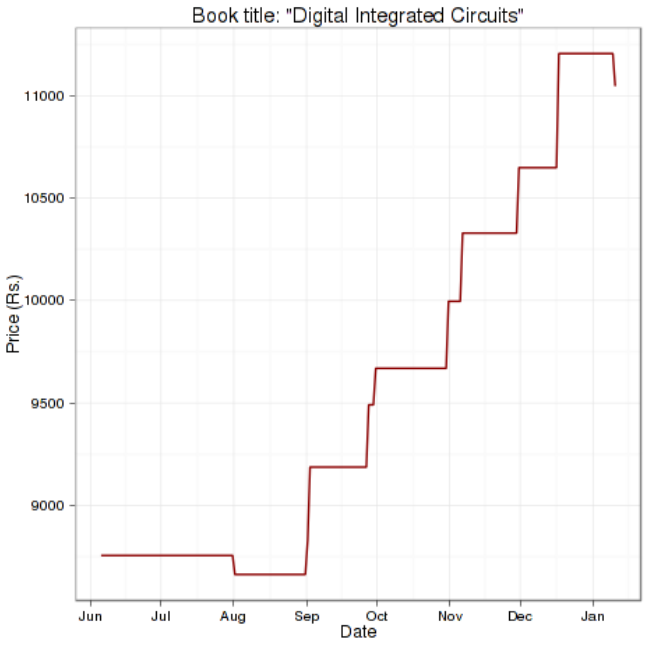

FIGURE 1. The evolution of the price of a typical book

daily prices from online retail websites—to study the behaviour of sticky prices.

2. DATA

We collected daily observations of the price of 73 books from the leading retail website Infibeam from 5th June, 2011 to 10th January, 2012—a total of 219 days. The books were chosen randomly from among books which were published abroad and where the expected delivery time mentioned by the website indicated that the book would be imported after an order was placed by the customer. For such books a major source of changes to the cost to the retailer would be changes in nominal exchange rates. This makes it easy to track how price-setting responds to cost shocks, something which is not possible in general due to the absence of cost data.

3. FINDINGS

3.1. **Prices are sticky.** Figure 1 plots the price of a one of the books in our sample over time. It shows the staircase pattern characteristic sticky prices—the price does not change for many days or weeks at an end. The other books in our sample show similar patterns.

The two key variables we study are the duration of price spells and size of price changes. We use "price spell" to denote an interval of

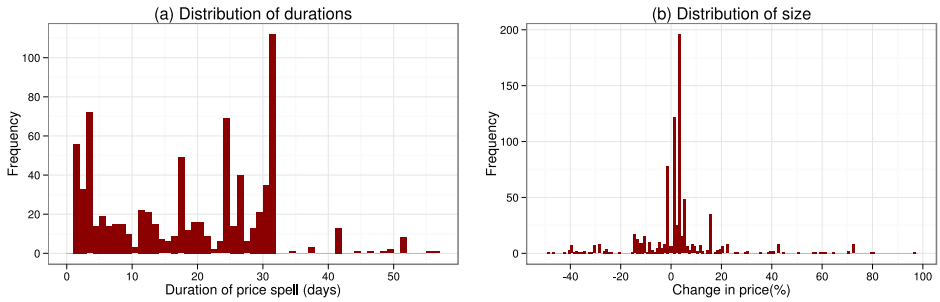

FIGURE 2. Distribution of durations and sizes

time during which the price of a particular book remains unchanged. Figure 2 shows the distribution of these two variables.

Taken across our entire sample, the median duration for which a price remains unchanged is 18 days. As can be seen from Figure 2(a), the distribution of durations is roughly bimodal, with one peak occuring at durations of three days or less and the other peak occuring at durations of about a month.

From Figure 2(b) we see that most price changes are small in magnitude. The median size of price changes (in absolute value) is 3.4%. Price reductions make up 30% of all price changes. Looking at price increases and reductions separately, the median size of the former is 3.3% while that of the latter is 8.3%. This suggests that the costs of reducing prices is higher than the cost of increasing them and therefore the firm avoids reducing prices until the loss from not making the reduction becomes too high. This higher threshold might explain the larger median of price reductions when they happen. Possible reasons for the asymmetry between increases and reductions include the fact that price reductions (but not increases) might be seen as competitiors as the beginning of a price war and a reduced price might induce regret among long-term customers who had bought at the older, higher, price. However, along with this asymmetry, it is perhaps equally important to note that price reductions do in fact happen and there is no absolute downward rigidity to oligopolistic prices.

Figure 3 plots the size of price changes against the duration of the immediately preceding price spell together with a smooth curve fitted by the lowess procedure (the grey band indicates the 95% confidence interval for this smooth curve). The large vertical spread of the points shows that there is no strong relation between duration and size, though taken on an average longer price spells end with a price change of a larger size. This supports the idea that prices are changed infrequently because firms find it costly to constantly monitor cost and demand conditions. In that case, products whose

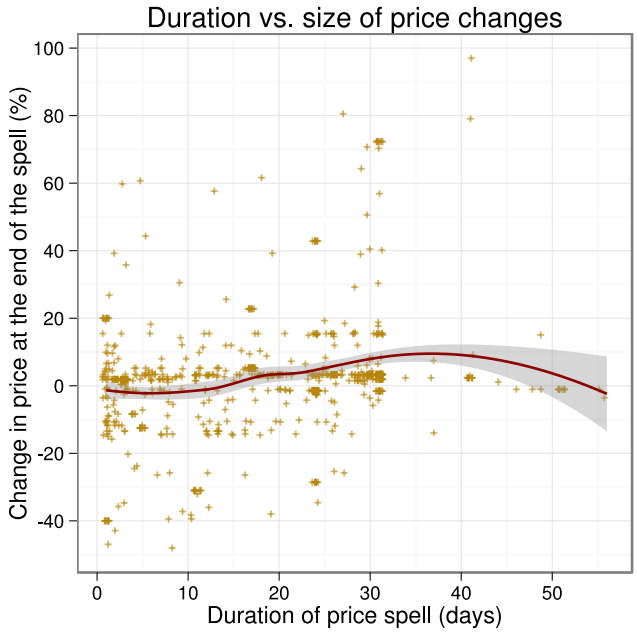

FIGURE 3. Duration of price spells vs. size of price changes

prices are not revised for long are more likely to accumulate larger changes in the 'ideal' price and hence see larger price revisions. On the other hand if the firm were to monitor the 'ideal' price constantly and makes a revision in the actual price whenever it is worthwhile to do so there would be less reason to see a dependence between duration and size.

3.2. **There exist both idiosyncratic and synchronized price changes.** Figure 4 plots against each date the number of books whose prices were changed on that date. This graph is dominated by the sharp spikes showing that there were a few days on which a large number of prices changed. Such days generally appear once a month at the beginning or the end of a month, though there are two spikes at the end of September and there are spikes in the middle of December and January. For convenience, we shall refer to the days with more than 50 price changes as 'spike days' in what follows. The occurence of these days and their roughly periodic character is again consistent with sticky prices being a result of infrequent decision-making since the actual shocks to costs and demand, even if they are common across books, are unlikely to be periodic.

On the contrary, it is not the case that price changes happen only at periodic intervals. The eight spike days account for only 52% of the 1053 price change events in our sample.

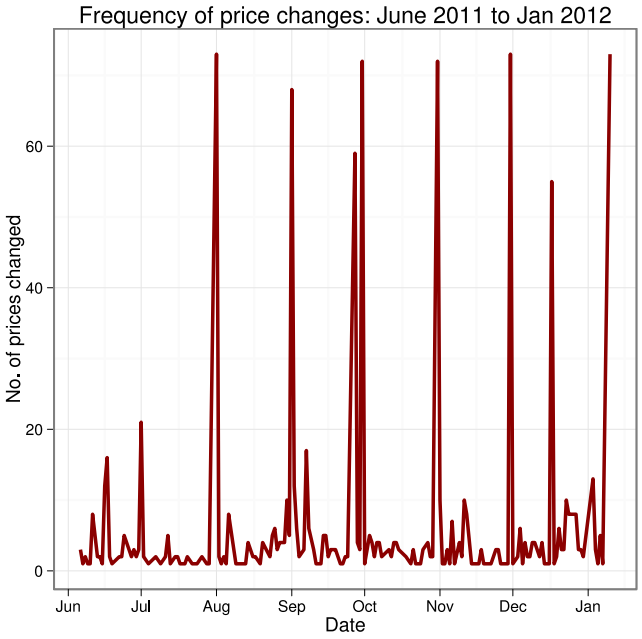

FIGURE 4. Price changes by date

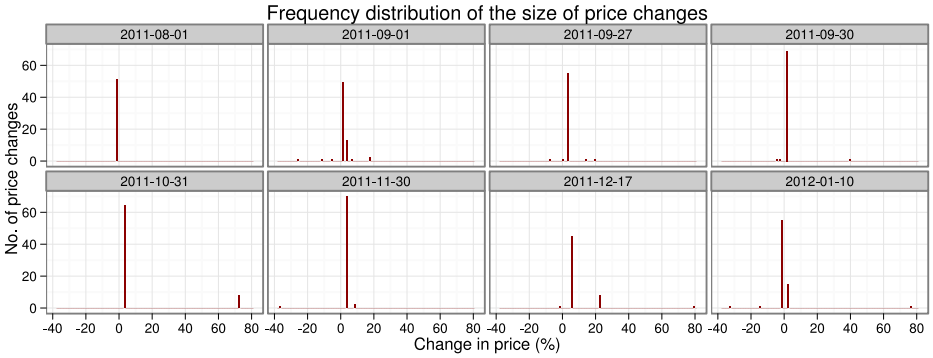

FIGURE 5. Distribution of price changes (spike days)

Figure 5 shows the distribution of the size for price changes for each of the spike days. We see that on each of these days most of the price changes are bunched together in magnitude, with the histograms showing one or two sharp peaks. On the other hand we can see from Figure 2(b) or Figure 3 that the overall distribution of the size of price changes is much more diffuse.

One way to reconcile all these facts is to continue with our presumption that price changes are infrequent due to the costs of decision-making but assume that decision-makers receive information from many channels not all of which are equally expensive to monitor.

Then the spike days may be the result of decisions based on an information source which is costly to monitor but which affect many books similarly while the price changes spread throughout the month are a result of signals from cheaper channels which however are more book-specific (such as publisher's list prices).

3.3. **Nominal exchange rate pass-through is imperfect.** One candidate for the common factor which drives price changes on spike days is the exchange rate. This seems paradoxical in the first instance since the exchange rate is public knowledge and given that it affects all book prices in the same way there is an incentive for the seller to keep track of this variable and update prices based on it at a much higher frequency than once a month. Indeed, it would be a simple matter to build the exchange rate conversion directly into an online retailer's software so that prices would be sticky in the publisher's currency but not in Rupee terms. We have seen above that this is not so.

However, suppose that the retailer orders a book only when it receives an order itself from a customer and therefore the exchange rate which it faces is some exchange rate in the future when its order would be billed. On the other hand, the retailer makes the sale at a Rupee price which it had announced when the order was placed by the customer. In that case it would have to make forecasts of the exchange rate when announcing Rupee prices. This forecast would be expensive to make and therefore might be made only infrequently. The spike days might precisely be the days when this forecast is revised.

Figure 6 shows the average price of all the books in our sample divided by the Rupee/Dollar exchange rate and the exchange rate itself. The dotted lines mark the spike days. We see that the upward trend in the exchange rate since August 2011 does not translate into a secular downward trend in the Dollar price of books. To that extent there is some degree of pass-through from nominal exchange to domestic prices. However, the dollar price of books is far from stable.

If our hypothesis that the spike days reflect exchange rate forecast updates is true then we would expect the dollar price to fluctuate due to actual changes in the exchange rate in the interim between such days and then be reset to a more stable rate on the spike days. To investigate this hypothesis Table 1 compares the exchange rate changes and the rupee price changes between the spikes.

Table 1 does not show any strong correlation between the Rupee price changes and either simultaneous, lagged or future changes in the exchange rate. This does not necessarily refute our hypothesis regarding what drives spikes since it is possible that these events are

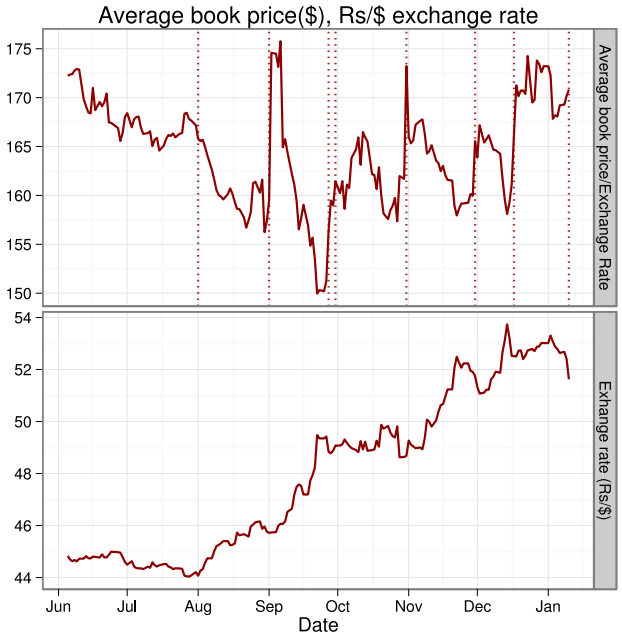

FIGURE 6. Average price of books expressed in Dollars and the exchange rate

Date	Count	Avg.Price(Rs.)	(% change)	Rs/$	(%change)
2011-08-01	73	7305.92		44.07	
2011-09-01	68	7291.48	-0.20%	45.72	3.74%
2011-09-27	59	7638.84	4.76%	48.84	6.81%
2011-09-30	72	7922.88	3.72%	49.08	0.49%
2011-10-31	72	8432.53	6.43%	48.68	-0.80%
2011-11-30	73	8567.69	1.60%	51.75	6.30%
2011-12-17	55	8932.19	4.25%	52.50	1.45%
2012-01-10	73	8818.34	-1.27%	51.63	-1.67%

TABLE 1. Average price of books and exchange rate for days on which prices of more than fifty books were changed.

driven by exchange rate forecast updates but that the firm get these forecasts wrong.

What this does show is that contrary to what is often assumed in open-economy discussions, it is not the case that nominal exchange rate changes are directly passed on to domestic prices, even in the case like ours where imports are directly sold to consumers without much additional value-added.

4. CONCLUSION

Even when looking at a single firm and a very narrow class of products we have found actual price-setting behaviour that is much more complex than the very simple assumptions that underly many contemporary macroeconomic models. Some of this complexity may cancel out at the aggregate level due to the diversity of firms, though it would still remain interesting for an understanding of price competition at the industry level. Given our limited data set we have been able to only conjecture about the underlying economic forces driving this complexity. We are in the process of collecting a larger data set spanning multiple firms and product categories that we hope will provide greater insight into the issues raised by the present study.

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