

Competitive constraints in the provision of credit card PPI: further analysis

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1 Introduction and summary

1. On 17 December 2007 Distributor submitted a paper on the competitive constraints in the provision of credit card PPI, prepared by Consultancy, to the Competition Commission in the course of the Commission's ongoing inquiry into payment protection insurance. Based on the analysis of monthly data on charges and card use for a sample of 100,000 Distributor customers covering the period from January 2005 to August 2007, the paper argued that the price of PPI has a negative impact on the likelihood of holding PPI, that a higher PPI price increases the likelihood of customers cancelling their cover, or the underlying credit card, and that higher PPI prices reduced the amount borrowed. The main purpose of that paper was to respond to the claim that the relationship between demand for PPI and demand for the underlying credit is one that can be characterised by one-way complementarity, as suggested by the Competition Commission in the report setting out its emerging thinking (whereby the price of the primary credit product might affect demand for PPI, but not vice versa), and we argued that the finding of a negative impact of the PPI price on the demand for credit suggested that this characterisation was not supported by empirical evidence.
2. Subsequently, the Competition Commission, in a note dated 19 February 2008 raised a number of questions in relation to the analysis undertaken, and these were discussed in more detail during a meeting with Competition Commission staff and some of the panel members on 11 March. At this meeting, the Commission identified three main areas in relation to our analysis where it would be looking for further clarification or additional analysis, namely:
 - **magnitude of effects:** the Commission would find it helpful if we could give more meaning to the estimated coefficients by drawing out more clearly what the numerical values implied in terms of the impact of price changes on the various variables;
 - **reliability of estimates/Moulton bias:** the Commission would find it helpful if we could address concerns about the potential bias in standard error estimates that might potentially result from the fact that our analysis was based on micro-data covering individual consumers, but examined a macro-change, namely a price change that was identical for all customers; and
 - **identification/causation:** given the overall downward trend in PPI penetration, and potential seasonal trends in outstanding balances, the Commission would find it helpful if we could provide some further evidence to support the view that the observed results are driven by changes in prices rather than just being the outcome of spurious correlation on the basis of trended data.
3. At the meeting, a number of suggestions were made with regard to how the concerns might potentially be addressed. Following the meeting, we have undertaken additional analysis in line with these suggestions, and this note presents the results of this additional analysis. Specifically:
 - in order to provide an indication of the magnitude of the effects identified in the initial paper, we present the marginal effects implied by the various coefficients from the logit models;
 - in order to address concerns about the potential bias in the standard errors of the coefficient estimates, we present estimates based on running the various models using aggregate data; and

- in order to examine the extent to which time trends in the data are driving results we (a) [\times]; (b) include a time trend in the analysis of the choice models; and (c) use the change in balance of non-PPI customers and Error Correction models to control for potential seasonal trends in balances.
4. In addition, we also provide the results of analysis to examine the timing of consumer's reaction to the change in the price of PPI. Specifically, we estimate the impact of a change in PPI price on outstanding balances incorporating further lags and leads of the price of PPI to assess when consumers reduce their balance in response to the change in the price of PPI.
 5. We are grateful to the Commission for setting out very clearly its concerns with regard to the robustness of the analysis we have undertaken, and for suggesting further analysis that might be helpful in terms of providing support for our conclusions or highlighting their limitations. Overall, we find that the results we have presented in our initial paper are by and large supported by the additional analysis undertaken, even though there are clear limitations to what can be achieved on the basis of the available data, not least given the limited variation in PPI prices and the complexity of effects which together affect consumer behaviour.

2 Marginal effects

6. Coefficients in logit models capture the extent to which the extreme value of the logit transformation of the model is affected by a particular attribute. However, because the logit transformation is not linear, the predicted change in the probability varies dependent upon the point at which the change is evaluated, and specifically the values of the attributes included in the model. An alternative to the presentation of logit coefficients is the calculation of marginal effects which reflect the percentage change in the estimated probability resulting from a given change in the level of a particular attribute.
7. The marginal effects in Table 1 presents the estimates of the percentage change in the in the estimates of the probability of having PPI, cancelling PPI and cancelling the primary credit, for a 10% change of the various attributes from their average level across the sample (with the exception of the price of PPI for which the current price of [\times] per £100 balance is used), holding all other attributes at their average value. For the balances model, the average expected change in balance is reported. We note that caution should be used when assessing the marginal effect of the price of PPI because the price change occurred at the same time as [\times], and therefore the marginal effects are likely to underestimate customers' reaction to a real price change. We also note that, owing to the complexity and interrelationship of various effects, these estimates seem to be unsuited for attempting to quantify the impact of a change in the PPI premium on the relevant economic variables. In order to undertake such an exercise, the inter-relationship between the various effects would need to be taken into account, which in turn would require an integrated model capable of dealing with these linkages.

Table 1: Marginal effects of a 10% increase in the various attributes on ...

	$PPPI_{i,t}$ ¹	$r_{i,t}$ ²	$CS_{i,t}$ ³	$B_{i,t}$ ⁴
Having PPI	[<]	[<]	[<]	[<]
Cancelling PPI	[<]	[<]	[<]	[<]
Cancelling primary credit - PPI customers only	[<]	[<]	[<]	[<]
Cancelling primary credit - all customers cancelling credit card	[<]	[<]	[<]	[<]
Balances - Fixed effects	[<]	[<]	[<]	[<]
Balances - Random effects	[<]	[<]	[<]	[<]

Source: Consultancy Analysis of Distributor data.

3 Analysis of aggregate data

8. The Commission was concerned that our analysis may be affected by so-called Moulton Bias, whereby as a result of analysing the response of a number of individuals to a change in a variable affecting all of them in the same manner (and largely at the same time), standard errors on coefficient estimates may be biased downwards, which in turn may suggest that some effects appear to be statistically significant where in fact they are not.
9. One practical method proposed by the Commission to examine whether our analysis was suffering from such bias was to re-run the analysis but using aggregate rather than individual data. Whilst this has the advantage of providing results relatively quickly, it does not directly assess the extent of any bias. In particular, where coefficients remain significant in aggregate level regressions, this suggests that there is no (or no material) Moulton bias. However, if by contrast coefficient estimates are insignificant, this does not necessarily prove the existence of Moulton bias, but may simply suggest that customer level variation is required in order correctly to identify an impact.
10. We have aggregated the data by calculating the average values for each variable across customers for each time period, income group and issuer. These aggregate data were then used to perform the analysis. More specifically:
 - For our initial logit models, where the aggregate variable becomes the proportion of customers making a particular choice, the logit approach is no longer appropriate. Instead these models

¹ Price of PPI – pence per £100 balance

² APR – percent

³ Credit score

⁴ Balance - Pounds

have been estimated using a Generalised Linear Model (GLM) on the basis of an underlying logit function and binomially distributed errors.⁵

- For the change in balance model the individual fixed and random effects used in the disaggregate level models were dropped and the model estimated using standard OLS.
11. The results of the analysis of the aggregate data are shown in Table 2, Table 3, and Table 4, alongside the results from the original analysis using disaggregated data for comparison.
 12. As we have noted above, the direct comparison of results based on the use of aggregated and disaggregated data does provide at best indirect evidence of Moulton bias, given that there may simply be insufficient variation in aggregate data to obtain significant results. If the only impact of using disaggregated data were to reduce standard errors, and thus create the mistaken finding of statistical significance, one might still find coefficients that are largely unchanged, and if this were the case, this might be taken as a strong indication of Moulton bias.
 13. Overall we find the following:
 - Aggregating the data has no discernable impact on the significance of the price of PPI for the models of cancelling PPI and cancelling the primary credit (whereas interest rates cease to be statistically significant in the latter), suggesting that the results of these models are not suffering from Moulton bias.
 - By contrast, the price of PPI becomes insignificant in the model of having PPI when using aggregate level data. However, the coefficient on the price of PPI also reduces by an order of magnitude, which suggests that there may not be sufficient variation in the aggregate data to allow one to identify the impact accurately.
 - Similarly, the coefficients on the price of PPI, the interest rate and the credit score, as well as the constant, become insignificant when aggregate level data are used in the balances model (see Table 4). This may suggest that without taking account of customer heterogeneity there is insufficient variation in order to determine the impact of any of the variables, including those that should clearly be expected to have an impact on balances (in particular the interest rate).

⁵ For a discussion of Generalised Linear Models see “Generalized Linear Models and extensions”, J Hardin and J Hilbe, 2001, Stata Press. The GLM fits a model by maximum likelihood where the mean of the proportion of respondents making a particular decision (for example to cancel PPI) is expressed as a logit function, with the proportion of customer taking a particular decision, given a set of variables x being expressed as $e^{bx}/(1+e^{bx})$.

Table 2: Impact on having or cancelling PPI of ...

	Having PPI		Cancelling PPI	
	Original	Aggregate	Original	Aggregate
$PPPI_{i,t}$	[\times]	[\times]	[\times]	[\times]
$r_{i,t}$	[\times]	[\times]	[\times]	[\times]
$CS_{i,t}$	[\times]	[\times]	[\times]	[\times]
$B_{i,t}$	[\times]	[\times]	[\times]	[\times]
Income dummies				
£10k-£20k	[\times]	[\times]	[\times]	[\times]
£20k-£30k	[\times]	[\times]	[\times]	[\times]
£30k-£40k	[\times]	[\times]	[\times]	[\times]
£40k-£50k	[\times]	[\times]	[\times]	[\times]
Over £50k	[\times]	[\times]	[\times]	[\times]
Unknown income	[\times]	[\times]	[\times]	[\times]
Year dummies				
2006	[\times]	[\times]	[\times]	[\times]
2007	[\times]	[\times]	[\times]	[\times]
Constant	[\times]	[\times]	[\times]	[\times]
Observations	[\times]	[\times]	[\times]	[\times]
Accounts	[\times]	[\times]	[\times]	[\times]
Joint test of significance ⁶	[\times]	[\times]	[\times]	[\times]

Source: Consultancy Analysis of Distributor data.

Note: The p-values for test statistics for individual coefficients are presented in parentheses.

⁶ P-value for the chi² test of joint significance.

Table 3: Impact on having or cancelling primary credit of ...

	Original		Aggregate
	PPI customers only	All customers cancelling credit card	All customers
$PPPI_{i,t}$	[\times]	[\times]	[\times]
$r_{i,t}$	[\times]	[\times]	[\times]
$CS_{i,t}$	[\times]	[\times]	[\times]
$B_{i,t}$	[\times]	[\times]	[\times]
Income dummies			
£10k-£20k	[\times]	[\times]	[\times]
£20k-£30k	[\times]	[\times]	[\times]
£30k-£40k	[\times]	[\times]	[\times]
£40k-£50k	[\times]	[\times]	[\times]
Over £50k	[\times]	[\times]	[\times]
Unknown income	[\times]	[\times]	[\times]
Year dummies			
2006	[\times]	[\times]	[\times]
2007	[\times]	[\times]	[\times]
Constant	[\times]	[\times]	[\times]
Observations	[\times]	[\times]	[\times]
Accounts	[\times]	[\times]	[\times]
Joint test of significance ⁷	[\times]	[\times]	[\times]

Source: Consultancy Analysis of Distributor data.

Note: The p-values for test statistics for individual coefficients are presented in parentheses.

⁷ P-value for the chi² test of joint significance.

Table 4: Impact on changing balance using aggregate data

	Original		Aggregate
	Fixed effects	Random effects	OLS
$\Delta PPPI_{i,t+1}$	[\times]	[\times]	[\times]
$\Delta r_{i,t}$	[\times]	[\times]	[\times]
$\Delta CS_{i,t}$	[\times]	[\times]	[\times]
Have PPI	[\times]	[\times]	[\times]
Constant	[\times]	[\times]	[\times]
Number obs	[\times]	[\times]	[\times]
Number of Accounts	[\times]	[\times]	[\times]
Joint test	[\times]	[\times]	[\times]
Hausman ⁸	[\times]	[\times]	[\times]

Source: Consultancy Analysis of Distributor data.

Note: The p-values for test statistics for individual coefficients are presented in parentheses.

4 Time trend analysis

14. The Commission expressed concern that long term trends in the propensity of consumers to hold and cancel PPI (in line with the downward trend in penetration) in conjunction with a single price increase for PPI over the period covered in our analysis may be driving our findings with regard to the impact of PPI charges on the likelihood of having or cancelling PPI, and that seasonal behaviour of credit card customers may affect the assessment of the link between balances and the price of PPI.
15. To address the Commission's concerns, we have undertaken four additional pieces of analysis:
 - first, we look [\times];
 - second we include a time trend in the logit models to capture long term trends in the propensity to have PPI;
 - third we use the change in balance of non-PPI customers to correct for any seasonal behaviour in relation to outstanding balances in our model of changes in balances; and
 - fourth we incorporate shifts away from the long term trend in balances using an Error Correction Model.
16. Overall, we find no evidence that time trends are driving the finding that consumers are price sensitive with respect to PPI, either when choosing to have PPI, cancel the primary credit or when deciding how much to borrow.

⁸ As noted in our original paper, the Hausman test essentially tests whether the coefficient estimates from the efficient random effects model are different from those of the fixed effects model. For p-values less than 5%, or 10%, the null hypothesis that the coefficient estimates are identical has to be rejected, and thus the fixed effects model is the preferred specification.

4.1 [X]

17. [X]

18. [X]

19. [X]

20. [X]

21. [X]

22. Overall, this is consistent with the view that the trend in cancellations has no impact on the finding of price sensitivity.

4.2 Including a time trend

23. Over the period analysed, consumers have tended to move away from PPI, as reflected in a downward trend in penetration. The Commission was concerned that this long term trend may be responsible for finding a link between the PPI price and having (or cancelling) PPI without there being any underlying causation.

24. The preferred method for controlling for these long term trends would have been to include the proportion of all UK credit card consumers who do not have (or have cancelled) PPI to capture the wider propensity to have (or cancel) PPI. However, data on a monthly basis that could be used to capture such effects was not available to us, and we have therefore included a simple time dummy (a variable increasing month-on-month by one) to provide a linear approximation for any long-term trend in the dependent variable.

25. As Table 8 and Table 9 show, including a time trend has no discernible impact on the logit model estimates. Specifically, across all models, the coefficients on the price of PPI retain the sign and remain significant, indicating that even accounting for long term trends consumers remain sensitive to the price of PPI.

Table 5: Impact on having or cancelling PPI of ...

	Having PPI		Cancelling PPI	
	Original	With time trend	Original	With time trend
$PPPI_{i,t}$	[\times]	[\times]	[\times]	[\times]
$r_{i,t}$	[\times]	[\times]	[\times]	[\times]
$CS_{i,t}$	[\times]	[\times]	[\times]	[\times]
$B_{i,t}$	[\times]	[\times]	[\times]	[\times]
Income dummies				
£10k-£20k	[\times]	[\times]	[\times]	[\times]
£20k-£30k	[\times]	[\times]	[\times]	[\times]
£30k-£40k	[\times]	[\times]	[\times]	[\times]
£40k-£50k	[\times]	[\times]	[\times]	[\times]
Over £50k	[\times]	[\times]	[\times]	[\times]
Unknown income	[\times]	[\times]	[\times]	[\times]
Year dummies				
2006	[\times]	[\times]	[\times]	[\times]
2007	[\times]	[\times]	[\times]	[\times]
Time trend	[\times]	[\times]	[\times]	[\times]
Constant	[\times]	[\times]	[\times]	[\times]
Observations	[\times]	[\times]	[\times]	[\times]
Accounts	[\times]	[\times]	[\times]	[\times]
Joint test of significance ⁹	[\times]	[\times]	[\times]	[\times]

Source: Consultancy Analysis of Distributor data.

Note: The p-values for test statistics for individual coefficients are presented in parentheses.

⁹ P-value for the chi2 test of joint significance.

Table 6: Impact on having or cancelling primary credit of ...

	PPI customers only		All customers cancelling credit card	
	Original	With time trend	Original	With time trend
$PPPI_{i,t}$	[\times]	[\times]	[\times]	[\times]
$r_{i,t}$	[\times]	[\times]	[\times]	[\times]
$CS_{i,t}$	[\times]	[\times]	[\times]	[\times]
$B_{i,t}$	[\times]	[\times]	[\times]	[\times]
Income dummies				
£10k-£20k	[\times]	[\times]	[\times]	[\times]
£20k-£30k	[\times]	[\times]	[\times]	[\times]
£30k-£40k	[\times]	[\times]	[\times]	[\times]
£40k-£50k	[\times]	[\times]	[\times]	[\times]
Over £50k	[\times]	[\times]	[\times]	[\times]
Unknown income	[\times]	[\times]	[\times]	[\times]
Year dummies				
2006	[\times]	[\times]	[\times]	[\times]
2007	[\times]	[\times]	[\times]	[\times]
Time trend	[\times]	[\times]	[\times]	[\times]
Constant	[\times]	[\times]	[\times]	[\times]
Observations	[\times]	[\times]	[\times]	[\times]
Accounts	[\times]	[\times]	[\times]	[\times]
Joint test of significance ¹⁰	[\times]	[\times]	[\times]	[\times]

Source: Consultancy Analysis of Distributor data.

Note: The p-values for test statistics for individual coefficients are presented in parentheses.

4.3 Non-PPI customers as a control group

26. The Commission raised the concern that seasonal patterns in consumers' use of credit cards (and in particular seasonal trends in outstanding balances arising from expenditure and repayment patterns) may be driving the finding that consumers reduce their balance in response to an increase in the price of PPI. One method of examining whether such effects are prevalent discussed at the meeting with Commission staff was to include the average change in the balance of non-PPI customers as a control for seasonal changes.
27. Table 10 shows the results of the regression of change in balance including non-PPI customers' average change in balance as a control, alongside our original analysis. The models remain

¹⁰ P-value for the chi2 test of joint significance.

remarkably consistent when including the control, indicating that seasonal variations are not driving the finding that consumers reduce their balance in response to an increase in the price of PPI.

Table 7: Impact on changing balance including control for customers' seasonal behaviour

	Fixed effects		With control	
	Original	With control	Original	With control
$\Delta PPI_{i,t+1}$	[\times]	[\times]	[\times]	[\times]
$\Delta r_{i,t}$	[\times]	[\times]	[\times]	[\times]
$\Delta CS_{i,t}$	[\times]	[\times]	[\times]	[\times]
Have PPI	[\times]	[\times]	[\times]	[\times]
Change in balance of non-PPI customers	[\times]	[\times]	[\times]	[\times]
Constant	[\times]	[\times]	[\times]	[\times]
Number obs	[\times]	[\times]	[\times]	[\times]
Number of Accounts	[\times]	[\times]	[\times]	[\times]
Joint test	[\times]	[\times]	[\times]	[\times]
Hausman	[\times]	[\times]	[\times]	[\times]

Source: Consultancy Analysis of Distributor data.

Note: The p-values for test statistics for individual coefficients are presented in parentheses.

4.4 Error Correction Model

28. The model of the impact of PPI price on balances uses first differences because balances appear to be trended over time. In order to examine consumers' deviation from their long term trend in balances, we have used an Error Correction Model¹¹ (ECM), which incorporates an individuals' deviation in their balance from any long term trend (e.g. as a result of seasonal variation) by including the difference between an individual's balance and their expected balance as an error correction term.
29. The results of the ECM with fixed and random effects are show in Table 11. The coefficient on the error correction term (ECM) is negative and less than one, indicating that consumers change their balance towards a long term trend. The coefficients on $\Delta PPI_{i,t+1}$ and $\Delta r_{i,t}$ remain negative and significant.

¹¹ For a description of the ECM see "Time Series and Dynamic Models", C Gourieroux and A Monfort, Translated by G Gallo, 1997, Cambridge University Press.

Table 8: ECM of impact on changing balance

	Fixed effects		With control	
	Original	ECM	Original	ECM
$\Delta PPI_{i,t+1}$	[\times]	[\times]	[\times]	[\times]
$\Delta r_{i,t}$	[\times]	[\times]	[\times]	[\times]
$\Delta CS_{i,t}$	[\times]	[\times]	[\times]	[\times]
Have PPI	[\times]	[\times]	[\times]	[\times]
ECM	[\times]	[\times]	[\times]	[\times]
Constant	[\times]	[\times]	[\times]	[\times]
Number obs	[\times]	[\times]	[\times]	[\times]
Number of Accounts	[\times]	[\times]	[\times]	[\times]
Joint test	[\times]	[\times]	[\times]	[\times]

Source: Consultancy Analysis of Distributor data.

Note: The p-values for test statistics for individual coefficients are presented in parentheses.

5 Additional lags and leads

30. Table 12 shows the results of models of the impact of PPI price on customers' balances, including controls for seasonal variations (both non-PPI holders average change in balance, and separately ECMs) with additional lags and leads of the change in price of PPI. The model controlling for seasonal effects using the average change in non-PPI customers' balances indicates that consumers react to the change in the price of PPI most strongly in the month prior to the price change and that there is also a significant reduction in balance two months prior to the price change¹² as well as in the month of the price change, but that consumers do not continue to reduce their balance following the price change. In the random effects model, consumers' balances increase following the price change, but the increase is considerably smaller than the fall in balance prior to the price change.
31. The ECMs show a similar reduction of consumers' balances in anticipation of the price change. In addition, consumers continue to reduce their balance for the two months following the price change, with the impact becoming insignificant in the third month following the change. This is consistent with consumers adjusting their balance over a period of time, and/or most consumers adjusting their balance prior to price change and fewer reacting after the change.

¹² Customers were informed of the price change generally [\times] in advance.

Table 9: Impact on changing balance with time controls and additional lags and leads of the change in price of PPI

	Non-PPI balance as control		ECM	
	Fixed effects	Random effects	Fixed effects	Random effects
$\Delta PPI_{i,t}$				
2 months prior to change	[<]	[<]	[<]	[<]
1 month prior to change	[<]	[<]	[<]	[<]
At change	[<]	[<]	[<]	[<]
1 month following change	[<]	[<]	[<]	[<]
2 months following change	[<]	[<]	[<]	[<]
3 months following change	[<]	[<]	[<]	[<]
$\Delta r_{i,t}$	[<]	[<]	[<]	[<]
$\Delta CS_{i,t}$	[<]	[<]	[<]	[<]
Have PPI	[<]	[<]	[<]	[<]
Change in balance of non-ppi customers	[<]	[<]	[<]	[<]
ECM	[<]	[<]	[<]	[<]
Constant	[<]	[<]	[<]	[<]
Number obs	[<]	[<]	[<]	[<]
Number of Accounts	[<]	[<]	[<]	[<]
Joint test	[<]	[<]	[<]	[<]

Source: Consultancy Analysis of Distributor data.

Note: The p-values for test statistics for individual coefficients are presented in parentheses.