Original Article

Stickiness: The value of saved money

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ABSTRACT   A new metric of the quality of a savings product, from the perspective of a bank, is introduced. This is the stickiness of a dollar, the average time a random deposited dollar remains with the bank. A practical algorithm for calculating stickiness is deduced and theoretical properties of the metric are derived. Stickiness is a metric that can be applied both at the aggregate and at the individual level. Examples are given from a bank with branches in different countries. With these examples it is shown that stickiness has some desirable properties: (1) stickiness at the individual level positively correlates with stickiness at the aggregate level; (2) stickiness increases with time, but slower than at a linear rate and (3) at the individual level stickiness in the future can be predicted by stickiness in the past. As a consequence, stickiness can be regarded as a stable customer variable. It is, therefore sensible to characterize demographic groups, e.g. stickiness increases with age, and to use it as active or descriptive variable for customer segments. An example is given of a new product that is relatively sticky.

INTRODUCTION

For a bank, the Internet age may be an attractive opportunity to diversify, by launching new products. The money that is attracted with these products may have a value for the bank, provided it is not withdrawn too quickly. A Dollar or a Euro that is deposited on a saving account should remain there for a considerable amount of time. It is important for a bank to have a solid and stable deposit book, which is resistant against economic headwind. However, the Internet age does not only give banks but also customers a considerable amount of freedom. The opening of a new account has become a simple procedure that usually takes no more than 1 or 2 days. Depositing and withdrawing money is even faster, a matter of mouse clicks. For a customer, the switching costs to move money from one bank to another are also lower because of the introduction of

Internet banking. From the point of view of a bank, for a product to be successful, the deposited money should have a degree of 'stickiness', it should remain with the bank for a certain amount of time. Consequently, the customer who uses the product should be a 'sticky' customer. Sticky customers may resemble loyal customers as both remain with the bank for a long period. But, stickiness entails something more: how the customer, or a group of customers, uses the product over time. In this article we propose a measure for stickiness and we investigate both the theoretical and empirical properties of this measure. The general underlying question is whether the concept of stickiness is a useful metric for monitoring the value of the deposit book – at the aggregated level – and as a marketing instrument – at the customer level.

LITERATURE

There are two different lines of research that are relevant to the fields to which a concept like stickiness may be applied. The first line is the determination of the value of a product to a bank. The stickier a savings account, the more value it represents. Usually this is calculated at the aggregate level. It is important for the department Treasury and Accountancy of a bank. The second line is the determination of the value of customers. The stickier the customer, the more value he/she represents. Usually this is calculated at the customer level. It is important for the marketing department of a bank.

The first line, the value of a savings account to a bank thus far has been studied in terms of profitability at the aggregated level. All studies agree in the result that deposits of households are stickier than a rational market would predict. This may be at least partially explained by switching costs. Flannery and James (1984) already concluded that deposits on savings accounts show 'sticky' responses to the changes in market rates: customers stay longer with a product than rational behaviour

would predict. Stickiness may have different causes: satisfaction with a provider of financial services, an emotional relationship with a certain (financial) brand or simple laziness or ignorance by the consumer. Klemperer (1987) showed in a model of two firms in two periods that consumers are locked in their first choice. Sharpe (1997) generalized this model by allowing more actors and a heterogeneous market structure. He applied the model to the market for consumer deposits, where the behaviour of banks in terms of consumer interest rates was the dependent variable. Empirical monthly data of 222 banks during November 1983 through November 1987 showed that the proportion of movers, a proxy for the proportion of consumers facing low switching cost, had a positive effect on consumer interest rates, but only in markets with low concentration. Hutchison and Penacchi (1996) show on the basis of data of 200 commercial banks that the interest rates do not follow a perfectly competitive framework. There are irrational psychological forces at work that influence the behaviour of both banks and consumers.

A model in which the value of as asset, like a savings account, is determined, is given in Hutchison (1995). He presents a theoretical model where the asset price depends on the market interest rate and the deposit interest rate. Irrational aspects like attachment to a brand or a product are not included in his model. Sheehan (2013) empirically estimated a system of regression equations where time series of total deposits, retained deposits (that is, total deposits of customers who were with the bank at the start of the sample interval of 6 years) and deposit interest rates were dependent variables. His calculation resulted in very different equations for different banks, illustrating that there is no general applicable law that works for all banks and that captures all psychological mechanisms. The outcomes were used to put a value on deposits by forecasting retention rates. This value can be interpreted as a percentage that can be added to each dollar on the account, should the

product be sold to another financial institution. Sheehan's model also predicts how long a customer stays with a savings account. His outcomes vary from 4.4 to 20 years for different financial institutions.

All models and calculations discussed above are based on aggregate, mostly monthly, data of banks, where the individual customer is invisible. This is different in the second line of research, that of customer loyalty. Although it does not entail the stickiness of money on an account, it may be seen as the time during which a customer sticks with a bank, and in this way it also influences the stickiness of his money. Results from marketing research on loyalty may also be valid for stickiness. A general approach to loyalty can be found in Labarbera and Mazursky (1983). They give a general longitudinal model for consumer purchases, based on satisfaction/dissatisfaction, which may (slowly) change over time. The model is developed for fast moving consumer goods. Rust and Zahorik (1993) describe a market model for banks where customers come and go dependent on their customer experience. For a banking world that is vastly different from the current landscape, they calculate for a concrete bank that the optimal investment for the training of front-line personnel is equal to US$70 000. Later, Muñoz-Gallego and Cruz (2005) confirmed that the well-known SERVQUAL model (Zeithaml et al, 1990) also works for banks: perceived service quality leads to higher satisfaction. Chu et al (2012) showed for e-banking that customer service influences loyalty; this relationship is mediated by customer satisfaction. Terpstra et al (2012) found that there is a positive relationship between customer satisfaction with banks and customer revenues on a later date. Customer satisfaction in 2005 predicted relatively high customer revenues not only in 2005, but also in 2006 and 2007.

Stickiness is a measure of the value of a customer. Sticky customers have a higher value than non-sticky customers as their deposited money is more dependable. For this reason, the literature on Customer Lifetime Value (CLV) also may apply. The CLV is the sum of the revenues minus the costs of a given customer within a certain timeframe that may be bounded or unbounded (see, for example, Jain and Singh, 2002; Kumar et al, 2004). Marketing models have been developed to maximize the total CLV (see, for example, Rust et al, 2004; Venkatesan and Kumar, 2004; Kumar et al, 2004). Practical application of CLV hinges on the question whether customer characteristics or behaviour during a limited amount of time may predict the profitability of a customer in the long run. This is one of the criteria by which the stickiness metric may be judged.

As satisfaction and loyalty are attitudinal constructs, there is also evidence that banking behaviour varies with basic demographic variables. Tesfom and Birch (2011) found that bank switching depends on age, the older, the less. Older customers attach more importance to both relational benefits such as being known by the staff and the possession of special privileges and switching costs such as required effort and time. Van den Poel and Lariviere (2004) found that attrition rate decreases with age. Men are more likely to leave a bank than women. This confirms an effect that was also found in a more general context by Mittal and Kamagura (2001): repurchase behaviour increases with age and women have higher repurchase rates than men.

DEFINITION OF STICKINESS

The definition of stickiness has to satisfy a number of requirements. In the first place it has to reflect the time during which a bank can use the money (raised with the product) for its own purposes: for money market trades and other treasury operations. This is what makes the money particularly valuable for the bank. Second, in order to use the concept for marketing purposes, stickiness has to allow for calculation at different levels: at the product level, at the level of groups of customers and

at the level of individual customers. This makes it possible to target those groups of customers that are good prospects. Third, the definition has to be independent of the actual amount of money, the turnover or the level of deposits. This makes stickiness a property of the individual dollar that is deposited. When the product is a savings account, a definition that satisfies these three requirements is the following

> the stickiness is the time that a randomly drawn deposited dollar remains on the account.

Essential in this definition is that a dollar which is deposited, then withdrawn and then again deposited are counted as different dollars. Figure 1 may serve as an example of an individual account to which the definition is applied. It shows how the account may develop over time. The account is opened at t_0, with a deposit of $b_1 = \$1000$. At t_1, a second deposit of $b_2 - b_1$ ($400) is made, at t_2 a deposit of $b_6 - b_2$ ($1900), at t_3 a withdrawal of $b_6 - b_4$ ($1300) and so on. The current time, or the time on which the stickiness of the account calculated, is denoted by t_c. The way the

stickiness may be calculated is stated in the following theorem.

Theorem 1 *The stickiness of an account between time 0 and time t, S_t, is equal to A_t/D_t, where A_t is the area between the graph of the account balance between 0 and t, and D_t is the sum of all deposits before t.*

This theorem is proved in the appendix. It allows for relatively easy calculation of the stickiness at different levels. At the individual level, the changes are 'real' deposits and withdrawals. At the aggregate level, however, the changes are the differences between the sum of individual deposits and withdrawals on a day to day basis. Compared with CLV measures, stickiness is a *relative* measure. CLV is the *absolute* difference between revenues and costs of a client. For stickiness, A_t is associated with revenue, D_t is associated with the acquisition cost of the client's dollar, but the quotient is independent of the amount of dollars.
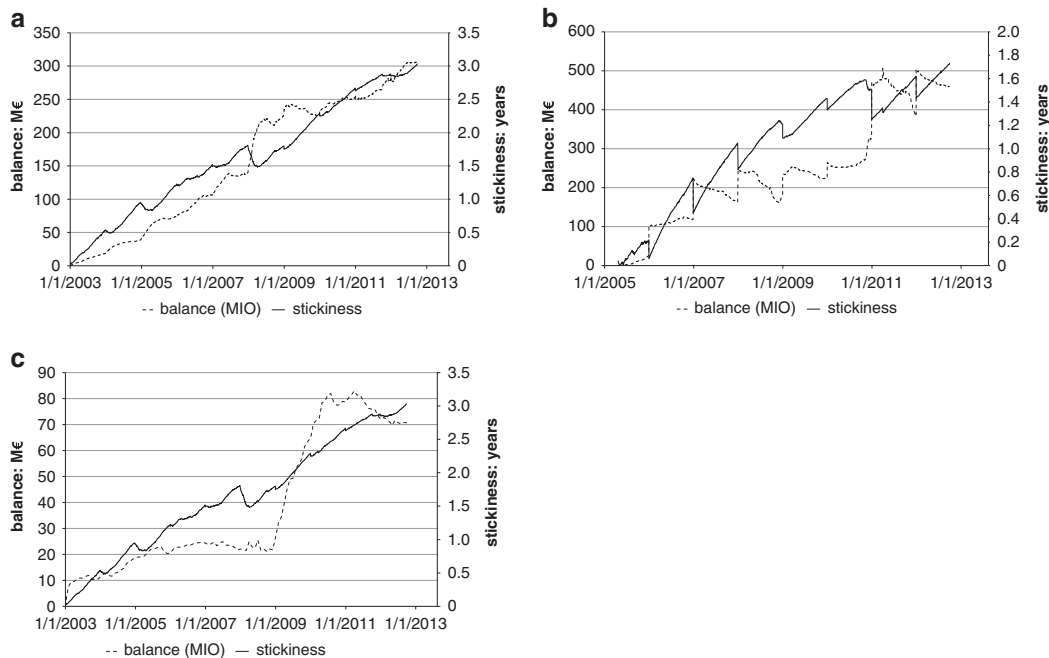
For some idealized cases, the exact value of the Stickiness can be calculated as a reference to judge real life situations. Two examples are:
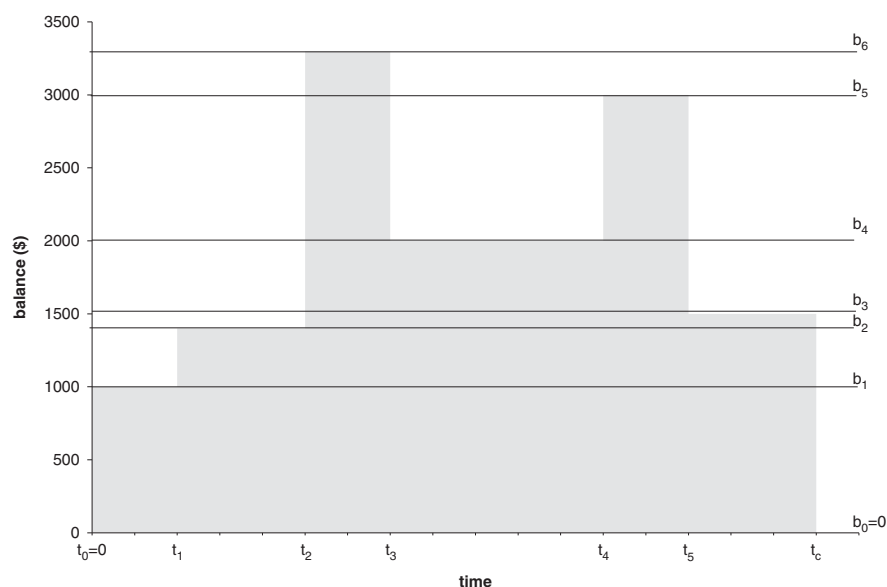
Figure 1: Development over time of a savings account.
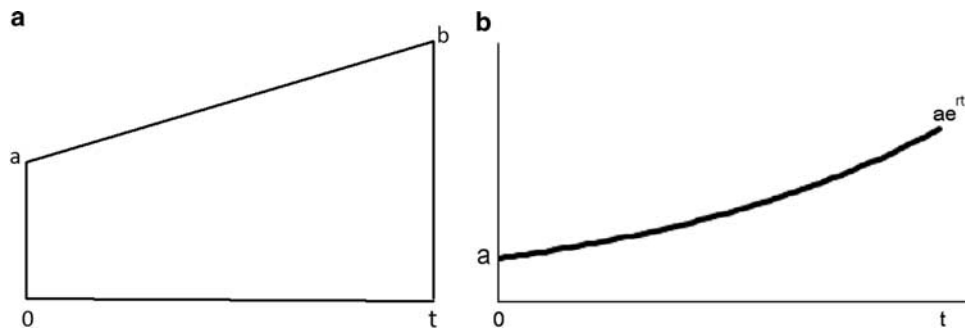
Figure 2: (a) Linear growth from *a* to *b*; (b) Exponential growth from a with rate *r*.

Figure 3: Balance and Stickiness at the aggregate level from 1 September 2002 to 1 January 2013.

At $t=0$ the balance is equal to *a*; it grows linearly to *b*. For $b \geqslant a$, Stickiness $S_t = (t)/(2)(1+(a)/(b))$

The line from $(0, a)$ to (t, b) is straight; in practice the line may go up and down, which indicates a loss of Stickiness. For $a=0$ the Stickiness reduces to $S_t = t/2$. For $a=b$ we have $S_t = t$ (Figure 2a).

At $t=0$ the balance is equal to *a*; it grows exponentially to ae^{rt}. For $r>0$, Stickiness $S_t = (1-e^{-rt})/(r)$

independent of *a*. For $r \downarrow 0$ (no growth), again S_t goes to *t* (Figure 2b).

SOME EMPIRICAL EXAMPLES

In practice, stickiness may show many different patterns. This is illustrated by empirical data from an international bank with saving products in many countries. We will give examples of three countries. For reasons of confidentiality, the countries will not be disclosed, but denoted by letters. In Figure 3, stickiness is given as a function of time, from the moments that the saving products are introduced. All analyses are based on large samples from customers of
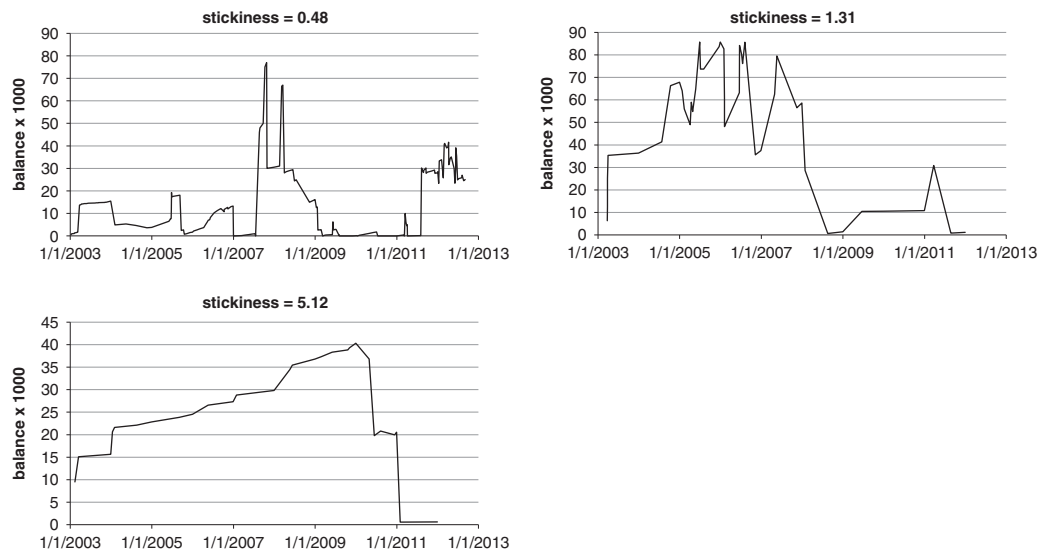
Figure 4: Three examples of Stickiness at the individual level.

the bank. For Country A, both balance and stickiness increase more or less linearly over a period of 10 years. The stickiness, however, does not rise to the 'ideal' value of 5 years (see example a in the previous section), but maximizes at 3 years because of the withdrawals in the reference period. In Country B, large sums of money are deposited at the beginning of the year. This is visible in the Stickiness that drops in January because the deposited money is not sticky yet. In Country C, the dotted line indicates that after the financial crisis in 2007, many new customers sought refuge at this bank. Stickiness, which was growing steadily during the first 6 years of the product, suddenly dropped, as the new customers still had to prove they were sticky customers.

The examples show that stickiness need not be the only objective of a bank's policy. New money is by definition unsticky. But then, the value of new money is unclear as it may be the kind of money that quickly disappears when the circumstances in the market change. Stickiness is a metric that may measure the degree of reliability of the balance, the degree to which a bank may use it for its own purposes.

Figure 4 shows stickiness at the customer level. Examples are given of three long-time customers with different levels of stickiness. It may be argued that the money of the customer with stickiness 0.48 is worth nothing to the bank. All his savings are at immediate risk to be withdrawn. The customer with stickiness 1.31 started saving steadily in 2003, displayed wild behaviour from 2005 and withdrew almost all his money in 2009 and ended with a moderate recovery in 2011. The customer with stickiness 5.12 increased his balance steadily until 2010.

THE RELATION BETWEEN THE AGGREGATE AND THE INDIVIDUAL LEVEL

Stickiness at the aggregated level obviously is a desirable property for a product. It is a direct measure for how long money that is deposited on a savings account can be used for Treasury activities. It therefore seems attractive to market to potentially sticky customers or to encourage customers to behave in a sticky way. There is, however, no simple connection between stickiness at

the individual level and stickiness at the aggregate level. Even under rather simple assumptions, this relation is mathematically very complex. It is therefore more attractive to study this relationship empirically. For stickiness to be a useful concept, the following three conditions have to be fulfilled

Condition 1: *Stickiness at the level of individual customers is positively correlated to stickiness at the aggregate level.*

Condition 2: *Stickiness at the individual level increases with time, but at a slower than linear rate.*

Condition 3: *At the individual level, stickiness in the future can be predicted by stickiness in the past.*

With regard to the first condition, the opposite would be true if the variation in balances of non-sticky customers cancel out when aggregated, yielding no clear influence on the aggregated balance. Figure 5 shows, however, a clear monotone relationship between individual and aggregated stickiness, thus confirming Condition 1.

Customers with stickiness between 0 and 0.5 yield an aggregate stickiness of around 0.7 years, whereas customers with stickiness larger than 5.5 years have as an aggregate a stickiness of more than 6 years. It is conceivable that this relation is largely spurious, as customers who quickly leave the bank or who became

Figure 5: Aggregate Stickiness as a function of individual Stickiness in the three countries.

customer only recently necessarily have low stickiness, but also contribute little to the aggregate stickiness of the bank. This, however, appears to be not the case. This can be demonstrated in different ways. In the first place, limiting the analysis in Figure 5 to customers who hold the savings account for more than 4 years has hardly any effect on the outcome. In the second place, Condition 2 may apply: the relationship between individual stickiness and the duration of the account is non-linear. This is confirmed in Figure 6.

It appears that individual stickiness can well be described as a function of $\ln(d+1)$ where d is the duration of the account. Table 1 shows that $\ln(d+1)$ yields higher correlations in all three countries than linear regression of duration on stickiness. Effectively, the rise in average individual stickiness after 4 years is limited.

Condition 3 essentially states that stickiness may be a psychological characteristic of the customer, a variable that is for a considerable part a personal characteristic. If that is true, individual stickiness at a given time interval should successfully predict stickiness at another interval. In Table 2 it is shown that this is indeed the case. Stickiness during the first year (up to 31 December 2003) has a correlation with the stickiness during the total period (up to and including 2012) of 0.181. The correlation with stickiness in the far later interval 2008–2012 is 0.055. When the length of the initial interval increases, the correlations become higher. For Country C, a time length of 4 years (up to 31 December 2006) yields a correlation as high as 0.606 for the total interval and 0.384 for the interval 2008–2012.

Summarizing, the results show that (i) high stickiness at the individual level yields high stickiness at the aggregate level, (ii) stickiness depends only moderately on the duration of a savings account and (iii) for a considerable part stickiness is a personal characteristic. It therefore makes sense not only to study how to induce sticky behaviour with the customers of a bank, but to analyse which personal
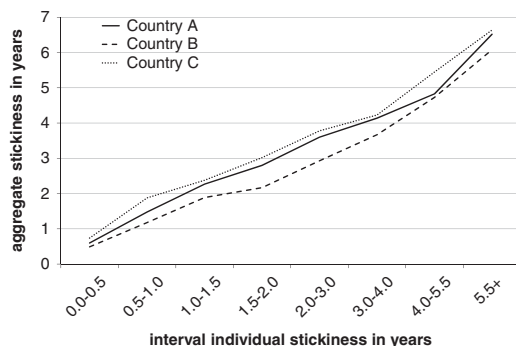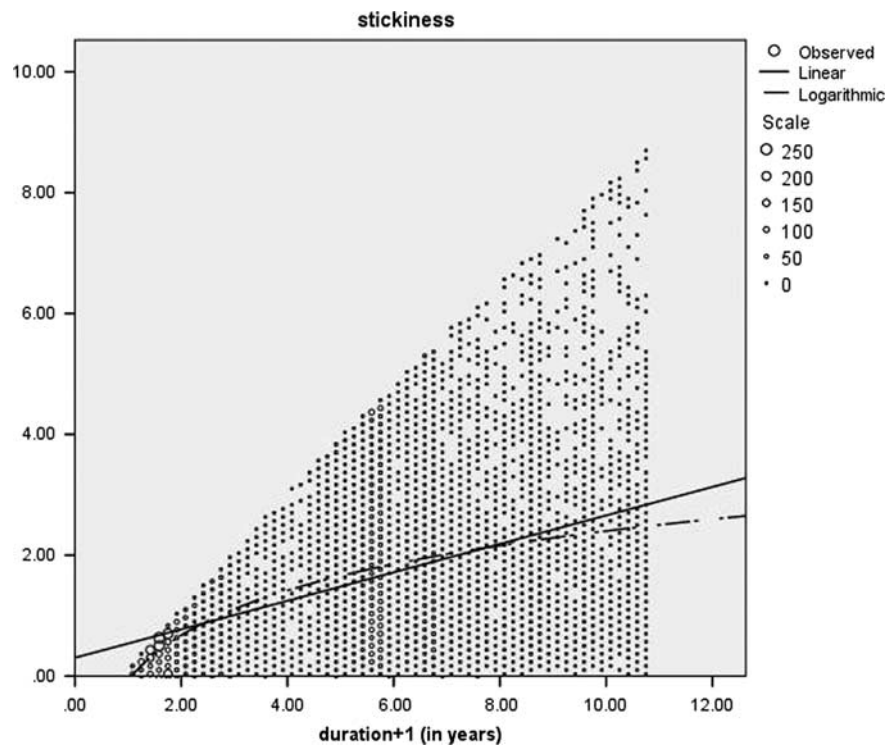
Figure 6: Individual Stickiness as a function of the duration of the account for Country A.

Table 1: Linear regression results of *d* (duration of account) and ln(*d*+1) on stickiness

	Country A	Country B	Country C
linear *d*			
constant	0.303	0.434	0.600
b	0.236	0.131	0.123
R	0.433	0.232	0.232
ln(*d*+1)			
constant	−0.068	0.207	0.110
b	1.072	0.588	0.726
R	0.470	0.255	0.245

characteristics correlate with stickiness in order to identify the most sticky target groups.

## STICKINESS AND DEMOGRAPHICS

A first exploratory analysis of differences between individual customers is that of the most common demographic variables: age and gender. The literature on brand loyalty

may apply here. Van den Poel and Lariviere (2004) use a proportional hazards model to show that older persons and women are less likely to end a relationship with a bank. Tesfom and Birch (2011) found that older customers perceive a relatively strong relationship with their bank and high switching costs. Both papers predict increasing stickiness with age. However bank switching is only one aspect of stickiness and does not cover all behavioural aspects. Still, we may hypothesize that stickiness increases with age, and that the money of women is stickier than that of men. Demographic data to test these hypotheses were available only in Countries A and B. The age hypothesis is confirmed by Figure 7: in both countries customers become stickier as they grow older. However, in Country A there is no significant difference between men and women.

In Country B, women are significantly stickier ($t = 9.95$, $P < 0.001$). The increase in stickiness is non-linear; it is faster at a higher age.

Table 2: Correlations between individual stickiness in different time intervals

| | Second interval | | | | | |
| | Country A | | Country B | | Country C | |
First interval	Total	2008–2012	Total	2009–2012	Total	2008–2012
Up to 31 December 2003	0.181	0.055	—	—	0.133	0.194
Up to 31 December 2004	0.341	0.145	—	—	0.475	0.319
Up to 31 December 2005	0.449	0.203	0.003	−0.007	0.522	0.325
Up to 31 December 2006	0.538	0.222	0.172	0.057	0.606	0.384
Up to 31 December 2007	0.557	0.220	0.281	0.089	0.668	0.436
Up to 31 December 2008	—	—	0.569	0.209	—	—
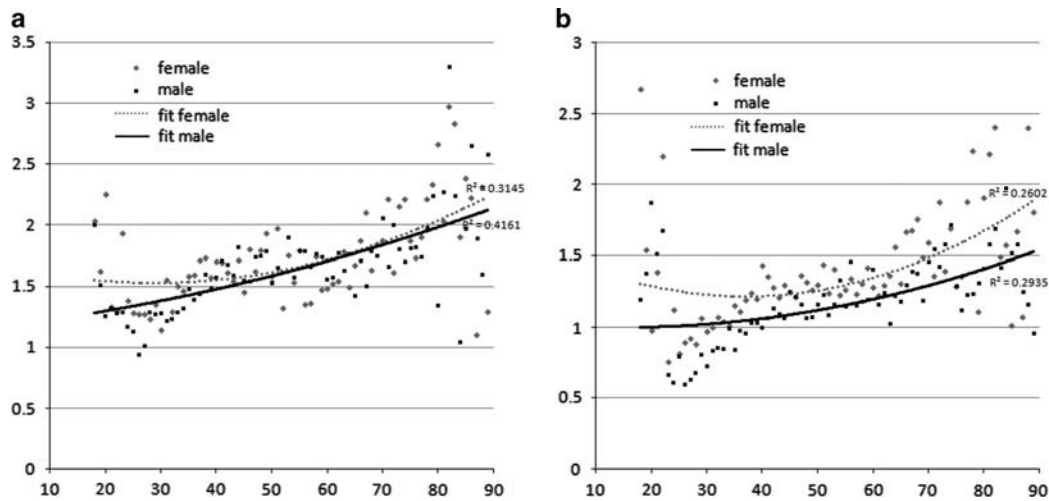
Figure 7: Stickiness, age and sex; curves based on quadratic regression of ages in years, separate for women and men.

In a situation of a joint account where two persons, for example, husband and wife are both account holders, the husband is the contact person most of the time. It is unknown within a household who takes the financial decision and who logs on the secure banking site and performs the transactions.

STICKINESS AND TRANSACTIONAL SEGMENTATION

For marketing purposes the bank has developed a customer segmentation based on the recency (R) of transactions, the frequency (F) of transactions and the monetary value (M) of the transactions. A cluster analyses was conducted to find homogenous groups of customers regarding their transactional behaviour. All customers fall into one of the following RFM segments (except for millionaires and new customers who are in different segments):

- Segment 1: Sleeping Savers

  ○ Low recency and frequency of deposits and withdrawals, high monetary value of deposits and withdrawals

- Segment 2: Savvy Savers

  ○ High recency and frequency of deposits and withdrawals, low monetary value of deposits and withdrawals

Table 3: Average stickiness per customer segment[a]

Individual stickiness	Segment 1		Segment 2		Segment 3	
	Sleeping Savers		Savvy Savers		Long-Term Savers	
Average	Size (%)	Average	Size (%)	Average	Size (%)	Average
Country A	33	1.75	28	1.14	17	2.60
Country B	42	1.23	30	0.70	14	2.86

[a]Segment new customer and segment millionaires are not included in this table.

- Segment 3: Long–Term Savers

  ○ No withdrawals, low recency and frequency of deposits

The RFM segmentation was conducted for several direct banks; but it is fair to say that we found the same types of segments in different countries. Looking at the definition of stickiness – see Section 'Definition of stickiness' – it is clear that stickiness depends on the recency and frequency of transactions as well of the monetary value of the deposits and the withdrawals. In Table 3, the relation between Stickiness and the RFM segments for Country A and Country B are given.

For both countries we see that Long–Term Savers (never a withdrawal) have on average the highest Stickiness. Savvy Savers (very active) have on average the lowest stickiness. Apparently it is possible to find sticky customers for marketing campaigning – not sure if you want to 'wake them up', because as soon they start doing transactions their stickiness is impacted. Communication may discourage stickiness. The goal is to find out what type of marketing activities effective for Sleeping Savers and Savvy Savers to bring in more sticky money.

DISCUSSION AND CONCLUSIONS

We introduced stickiness as a new concept that resides on the intersection between two different lines of research. The first line is the determination of the value of a savings account to a bank; this is in the area of treasury and accountancy. The second one is in the area of marketing, especially the behaviour of consumers regarding the usage of the savings account over time.

We investigated and described both the theoretical and empirical properties of this measure. An important requirement is that stickiness is independent of the actual balance, the turnover or the level of deposits – this makes stickiness a property of the individual Dollar (or Euro or any other currency) that is deposited. We define stickiness as *the time that a randomly drawn deposited dollar remains on the account*. We calculate Stickiness S_t, of an account between time 0 and time t, is equal to A_t/D_t where A_t is the area between the graph of the account balance between 0 and t, and D_t is the sum of all deposits. This algorithm allows for relatively easy calculation of the stickiness at different levels. Several empirical examples were provided. We proved the relationship between individual stickiness and stickiness at an aggregated level. We also found evidence that individual Stickiness can be predicted by stickiness in the past. Therefore it would make sense to market potentially sticky customers or to encourage customers to behave in a sticky way.

In addition, we also showed the relationship between stickiness and a customer segmentation, which is based on the recency (R), the frequency (F) and the monetary value (M) of the transactions. It appeared that the segment 'Long-Term Savers' (never a withdrawal) have on average the highest stickiness; Savvy Savers (very

active) have on average the lowest stickiness. So, it is possible to find sticky customers in your customer base. The goal is to find out what type of marketing campaigning you can do for Savvy Savers to bring in more sticky money. As stickiness had proved to be a personal characteristic we investigated whether stickiness increases with age, and that the money of women is stickier than that of men. We found that at a later age customers become stickier, and in one country we found that women are significantly stickier. The increase in stickiness is non-linear; it is faster at a higher age.

Managerial implications

In practice, there are a few things can be done to bring in more sticky money and to improve the stickiness of the deposit book, for example:

- *Pricing*: Introduce tiered pricing with different interest rates to discourage rate chasers; reward customer loyalty with bonus rates. Promotional rates are killing for stickiness.
- *Product*: Develop specific products to counter-act volatility in the savings balance. As a concrete example, the bank developed a new product 'the Notice Saver'. The Notice Saver has a relatively higher interest rates than other saving products, but the customers were asked to give a 90-day notice in advance if they want to withdraw their money. This has a noticeable effect on stickiness.
- *Service*: Create loyalty programs, for example, invite potential sticky customers for events; apply special service levels for potential sticky customers in the call centre.
- *Campaigning*: Spread execution of campaigns over time to subdue the volatility of the deposit book. Send retention campaigns to avoid that customers will withdrawn their money.

An important benefit of stickiness is the ability that to link marketing activities with the financial goal of having a sticky deposit book. Marketers should consider the effect of their campaigns on stickiness. In the end it is important for a bank to have a solid and stable deposit book. Stickiness appears not only as a useful marketing instrument but also as a unambiguous metric for monitoring the value of the deposit book.

Further research

If individual stickiness can be an attribute in the marketing database, more research is needed to investigate the relationship between stickiness and Customer Value. A segmentation based on these two dimensions may divide the customer base into groups of profitable and loss-making customers with sticky money and non-sticky money. As stickiness can be conceived as a personal characteristic we suggest to investigate the correlation between personality traits – known from the Big Five personality traits (Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism) studies – and Stickiness. Each personality trait is associated with specific characteristics, for example, Openness to experience refers to a intellectual curiosity and preference for novelty a person has, or Conscientiousness refers to discipline and planned rather than spontaneous behaviour; this may have an impact on the switching behaviour of customers. As an end result, this may lead to a connection between personality and profitability.

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APPENDIX

Proof of Theorem 1

We prove the theorem by induction with respect to the moments of change (deposit or withdrawal) $t_0, t_1, \ldots, t_n, t_{n+1}$. The time a random deposit remains on the account between t_0 and t_n we denote by τ_n. Its expected value is $E\tau_n$. Denote by $A_{n,n+1}$ the area below the balance between t_n and t_{n+1}, $A_n = A_{0,n}$. For $n = 1$ the theorem holds as $A_1 = D_1 \star (t_1 - t_0)$, $A_1/D_1 = t_1 - t_0$, the time the first deposit has remained on the account. Now assume that the theorem holds up to n: $E\tau_n = A_n/D_n$. Now there are two possibilities:

(1) at t_n a deposit d_n is added to the account balance
(2) at t_n a withdrawal w_n is subtracted from the account balance

In Situation (1)

$$
\begin{aligned}
E\tau_{n+1} &= \frac{D_n}{D_n + d_n} E\tau_n \\
&+ \frac{d_n + b_n}{D_n + d_n}\left(t_{n+1} - t_n\right) \\
&= \frac{A_n}{D_n + d_n} + \frac{A_{n,n+1}}{D_n + d_n} = \frac{A_{n+1}}{D_{n+1}}
\end{aligned}
$$

In Situation (2), where there is no deposit at t_n, $D_{n+1} = D_n$

Consequently

$$
\begin{aligned}
E\tau_{n+1} &= E\tau_n + \frac{b_n - w_n}{D_{n+1}}\left(t_{n+1} - t_n\right) \\
&= \frac{A_n}{D_{n+1}} + \frac{A_{n,n+1}}{D_{n+1}} = \frac{A_{n+1}}{D_{n+1}}, \quad \text{QED}
\end{aligned}
$$

Formally, the proof only pertains to the moments of change, but it is easily expanded to arbitrary moments.