1 The size of cash payments: small is beautiful

How big is the average cash payment? Surprisingly small: the modal transaction, the most common size, is less than 5 Euro or Dollar. Unlike most other instruments, cash transactions are not recorded so we have to rely on surveys for the amount and size of cash transactions. Fortunately, surveys using different approaches in various (OECD) countries yield comparable results.

Figure 1 shows the distribution of transactions sizes from one of these surveys, representing a total of 2047 cash payments made by Dutch consumers.

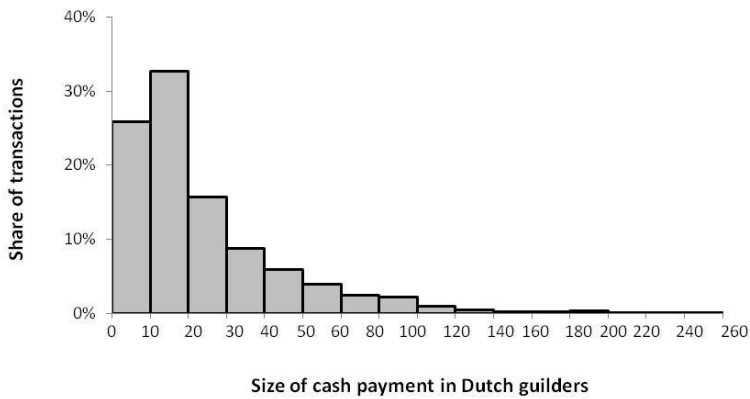


Figure 1: Frequency distribution of cash transactions[1]

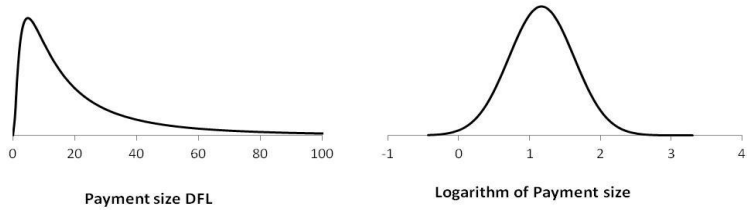
Transaction size follows something of a bell curve, but the distribution is tilted to the left: the average transaction in the sample is around DFL 25 but the median transaction is only DFL 15 (by definition half of transactions are bigger than the median, the other half are smaller). On the other hand, there is

[1] From Boeschoten and Fase (1989). A Dutch guilder is about half a euro

a 'long tail' on the right: 2.5% of transactions are bigger than DFL 100 and 0.3% are over DFL 200. In fact transaction size follows what is called a Log-normal distribution (see inset), which has a "bump" near zero and then a long tail on the right.

The Log-normal distribution

Several researchers have found that the size of cash payments follow a Log-normal distribution. A variable *x* is said to follow a Log-normal distribution if its natural logarithm, denoted *ln*(x), follows a Normal distribution, also known as the bell curve. It has the same parameters as the underlying Normal distribution: μ for place and σ for width.[2] The below figure shows the fitted curve for payment size (in Dutch guilders), with $\mu=2.7$ for place and $\sigma=0.9$. On the left is the "normal" histogram of this distribution. On the right is what you get if you were to plot a histogram of the logarithm (base 10) of payment size.



The Log-normal distribution has been observed in anything from the size of living things (including the weight and length of humans) to farm sizes and the number of words in sentences written by G.B. Shaw.[3]

It turns out that transaction sizes of non-cash instruments also follow a Log-normal distribution. The size of a SWIFT or Fedwire transaction is more than 10,000 times bigger than a cash transaction, but they still follow that same Log-normal distribution, as we will see in chapter 10.

The Netherlands has a tradition of research into cash payments, which allows us to compare cash patterns over time.

[2] For a good introduction, see Aitchison and Brown (1957).
[3] Limpert, Stahel (2001)

Table 1 summarizes the results of three such cash surveys covering the period 1987-2010.

Table 1: Comparison of Dutch Cash usage surveys[4]

Year	Cash payments per person per year	Average value[5]	Median Value	$\hat{\mu}$[6]	$\hat{\sigma}$
1987	574	19	11	2.4	0.9
1998	n/a	10	6	1.8	1.0
2010	316	12	6	1.8	1.0

A few interesting observations can be made from this. First, the overall number of cash transactions has gone down significantly. This pattern is observed across OECD countries and is of course due to the advance of electronic instruments, notable the debit card (see also chapter 6). The average transaction amount also declined, as one would expect since electronic instruments tend to be used for larger payments. But notice how the overall variance ('spread of the sample') *in*creases. This could indicate that most substitution by new instruments takes place in the *middle* range (say 30-100 EUR) while cash continues to be used for very small but also for very large transactions, for example in the grey economy (see also chapter 3).

[4] The three surveys are described in Boeschoten and Fase (1989), Kippers, Van Nierop (2003) and Jonker, Kosse (2012).
[5] The values for mean and median have been converted to 2010 Euro.
[6] These estimates have been obtained by the Maximum Likelihood method.

A comparison of the histograms of the 1987 and 2010 surveys confirms this (Figure 2). In relative terms, the extremes have been stable with relatively large reductions in the middle.

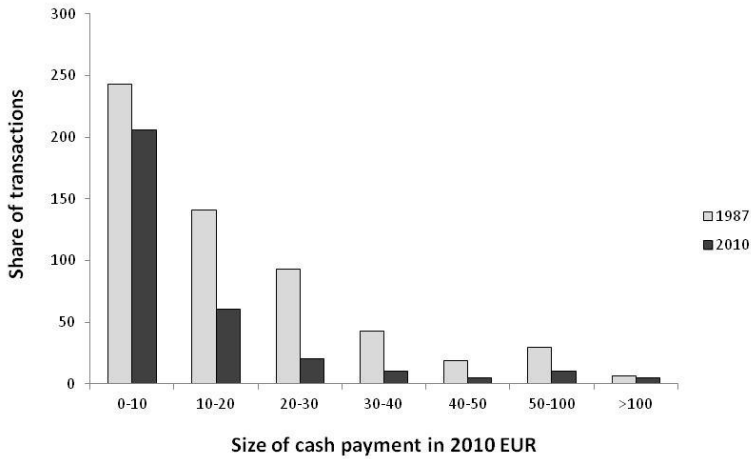


Figure 2: Comparison of Dutch 1987 and 2010 cash payment sizes[7]

[7] The figure is based on the bins used in the 2010 study of Hernandez and Jonker (2011). The bins of the 1987 study (Boeschoten and Fase 1989) were in guilders, so these have been converted to euro and corrected for inflation. The number of payments in each converted 1987 bin have then been reassigned to the 2010 bins by interpolation.