CPSS workshop on payment system monitoring indicators

Intraday patterns and Timing of TARGET2 interbank payments

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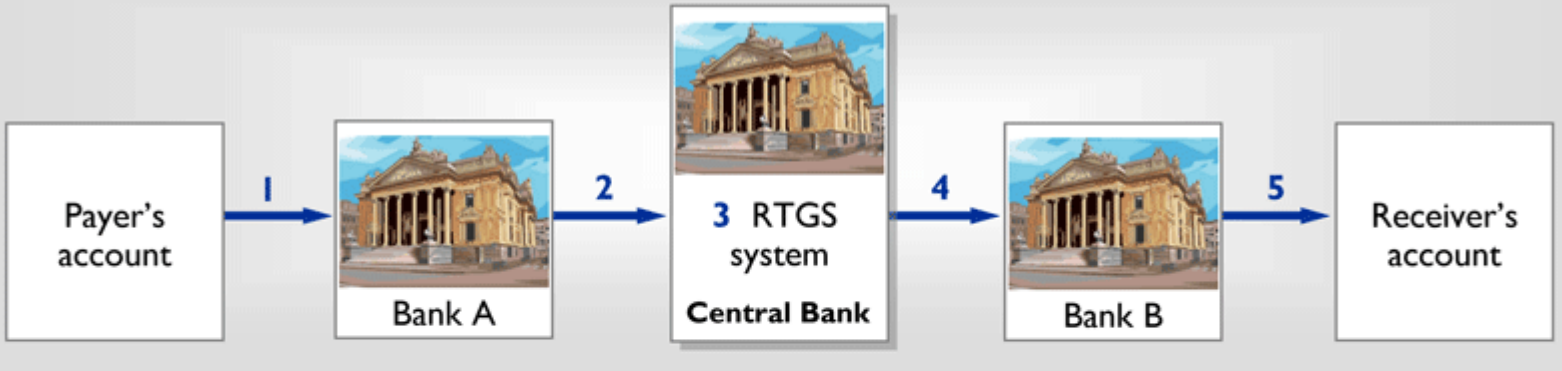
Agenda

- **TARGET2 Overview**
- **Data**
- **Descriptive statistics**
- **Small value payments and payments distribution**
- **Settlement delay**
- **Survival analysis**

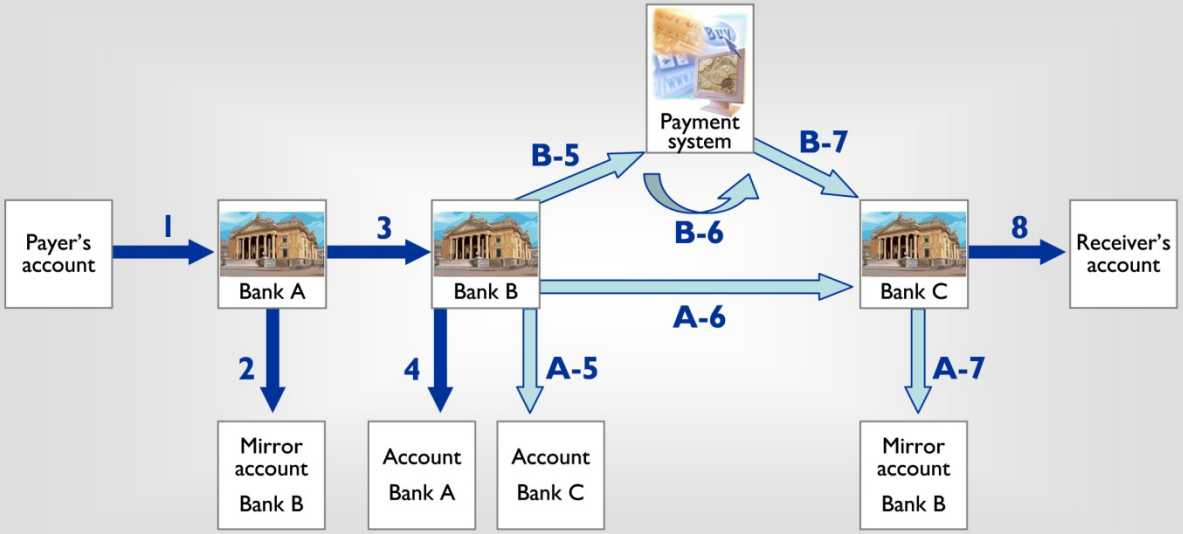
TARGET2 – RTGS



1 Debiting of payer's account with Bank A
2 Submission of payment instruction to the RTGS system
3 Settlement of payment, i.e. debiting of Bank A's account and crediting of Bank B's account with the Central Bank
4 Transmission of information on the payment to Bank B
5 Crediting of receiver's account with Bank B

Source:
ECB, as adapted from Payment Systems in Denmark, Danmark's Nationalbank, 2005

TARGET2 – RTGS



1 Debiting of payer's account with Bank A
2 Crediting of Bank B's mirror account with Bank A, which is kept for accounting purposes
3 Payment message from Bank A to Bank B via telecommunication network
4 Debiting of Bank A's account with Bank B (loro account)

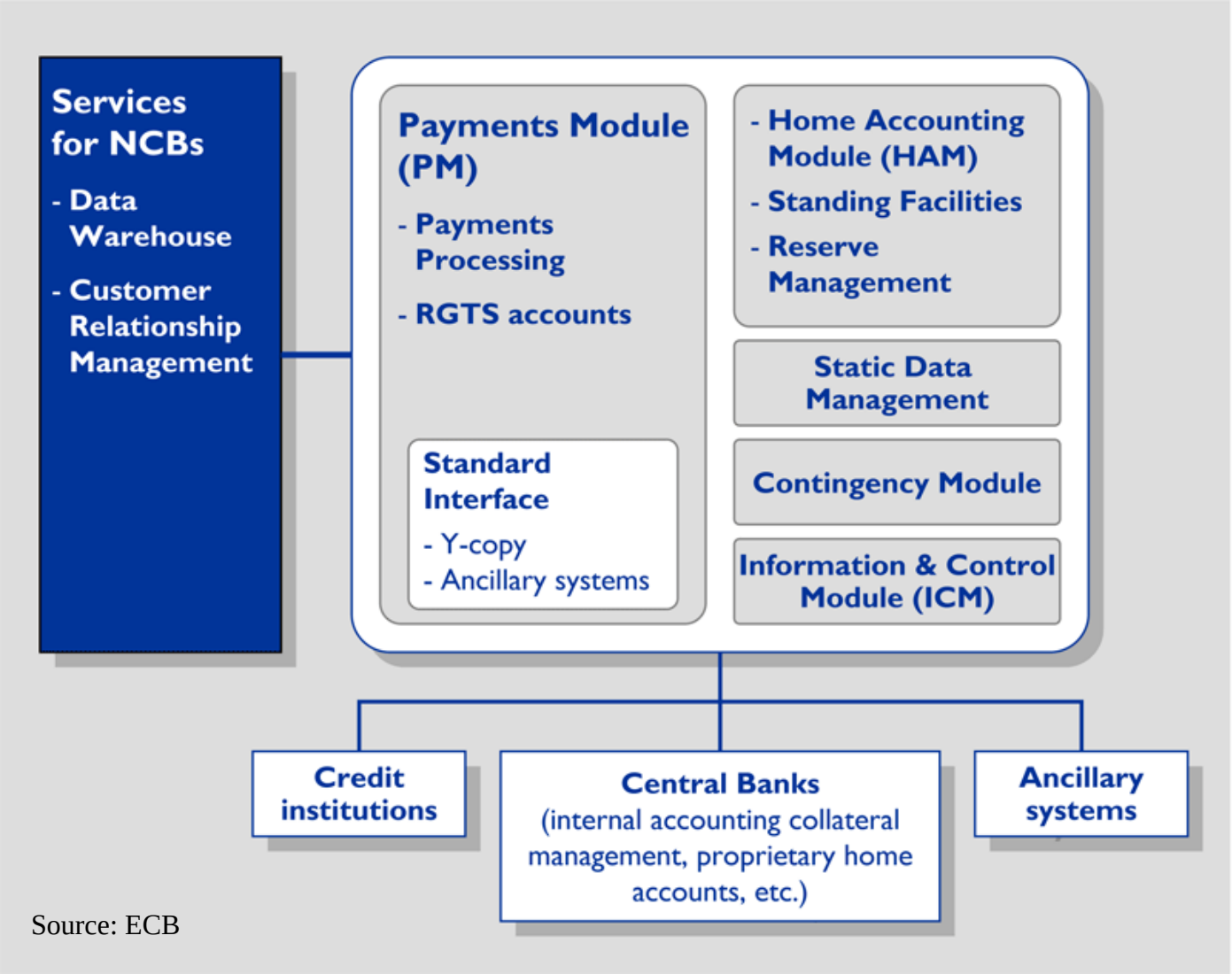
A Use correspondent banking only

5 Crediting of Bank C's account with Bank B
6 Payment message from Bank B to Bank C via telecommunication network
7 Debiting of Bank B's mirror account with Bank C, which is kept for accounting purposes
8 Crediting of receiver's account with Bank C

B Involvement of payment system

5 Payment message from Bank B to payment system
6 Settlement via payment system
7 Payment message from payment system to Bank C
8 Crediting of receiver's account with Bank C

TARGET2 – Technical Infrastructure



Source: ECB

TARGET2 – Business day

	Time	Description
Day time	06:45 a.m. – 07:00 a.m.	Business window to prepare daylight operations
	07:00 a.m. – 06:00 p.m.	Day trade phase
	05:00 p.m.	Cut-off for customer payments
	06:00 p.m.	Cut-off for bank-to-bank payments
End of Day	06:00 p.m. + 15 min.	General cut-off for the use of standing facilities
	06:00 p.m. + 30 min.	Cut-off for the use of standing facilities on the last day of the minimum reserve period
	(shortly after) 06:30 p.m.*	Data to update the accounting system will be available for central banks
Start of day & night time window for ancillary systems	06:45 p.m. – 07:00 p.m.*	Start-of-day processing
	07:00 p.m. – 07:30 p.m.*	Provisioning of liquidity until start-of-cycle message of ancillary systems
	07:30 p.m.* – 10:00 p.m.	Start-of-procedure message to set aside liquidity and ancillary system night-time processing *(ancillary system settlement procedure 6)*
	10:00 p.m. – 01:00 a.m.	Technical maintenance period of three hours. The system is shut down
	01:00 a.m. – 07:00 a.m.	Night-time processing *(ancillary system settlement procedure 6)*

*15 minutes later on the last day of the minimum reserve period

Source: ECB

TARGET2 – Data

Category	Description	Transactions (thousands)	Transactions (%)	Value (billions)	Value (%)
1.1	Customer Payments	188	55.9	132	4.3
1.2	Interbank Payments	68	20.2	641	21
2.x	Central Bank Payments	38	11.4	269	8.8
3.x, 4.x	Ancillary systems and liquidity transfers	42	12.5	2,004	65.9

January 2008 – December 2010, based on the TARGET2 Simulator dataset

TARGET2 – Data

Focus on interbank payments

- **High-average value**
- **Systemic importance**
- **Time discretion**

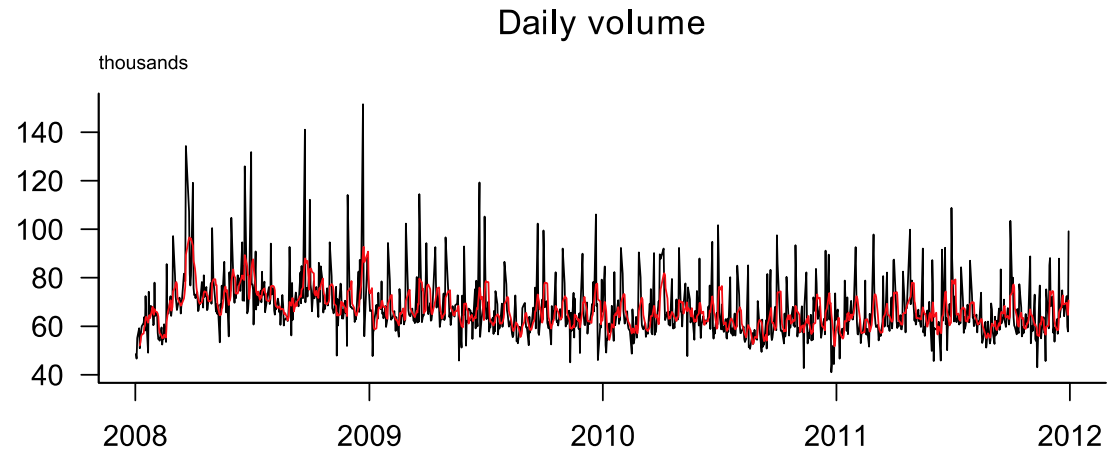
Objective

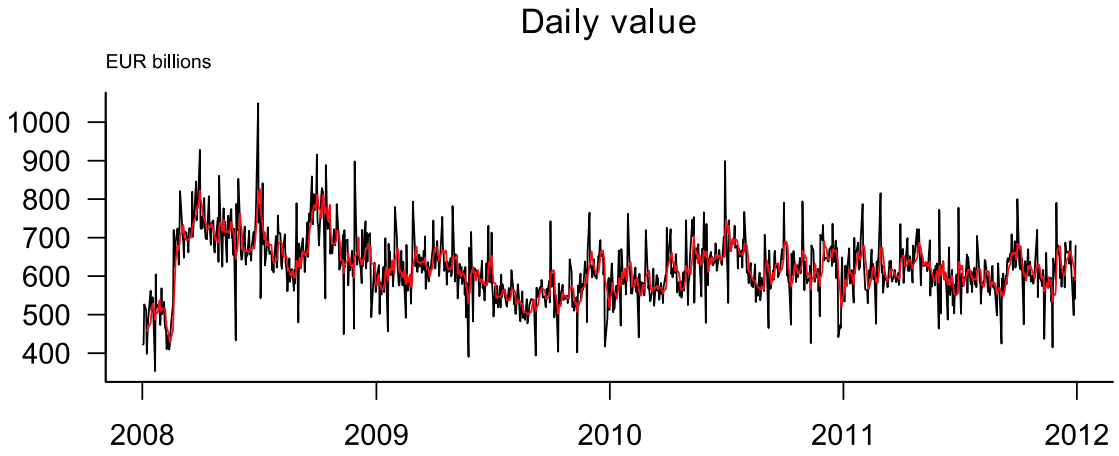
- **Analysis of the intraday behaviour of interbank payments. Assessment of the deviations from the average intraday patterns.**

- **Study of payments timing by focusing on the settlement delay as key indicator. Potential early warning indicator.**

Volume and Value (time series)

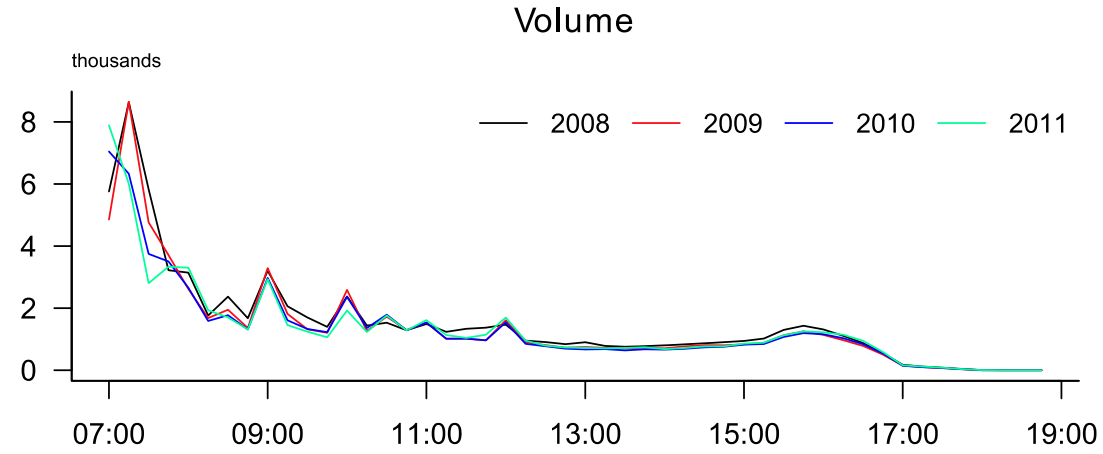
- **Waves of countries joining the system**
- **Volume of about 68,000 payments daily**
- **Value decreasing over time**

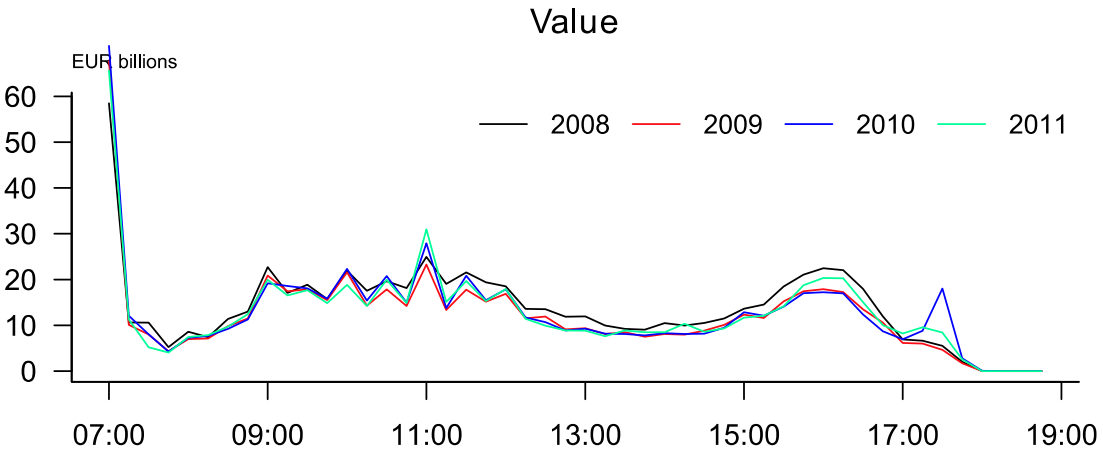




Volume and Value (daily average)

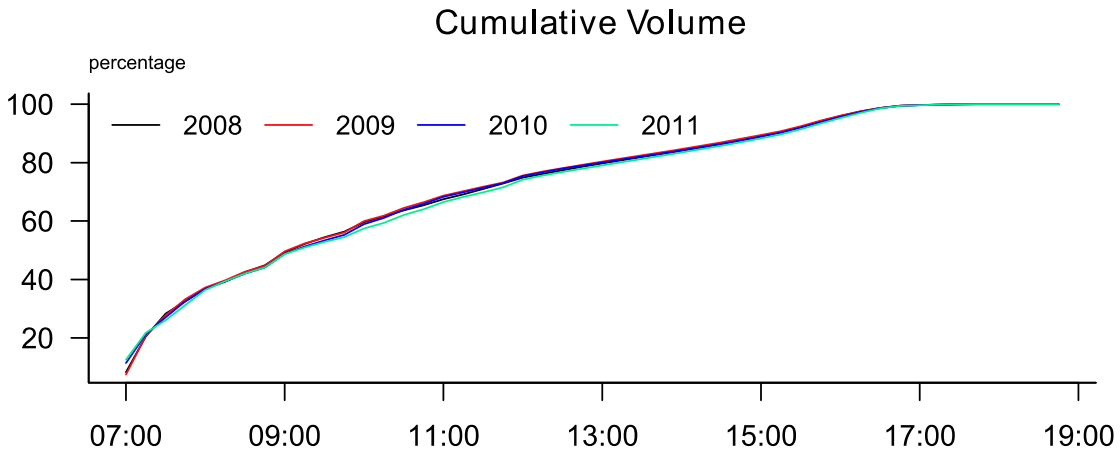
- **Stable trend over the years**
- **Critical times: opening and morning**
- **Pattern due to access policy to intraday credit**

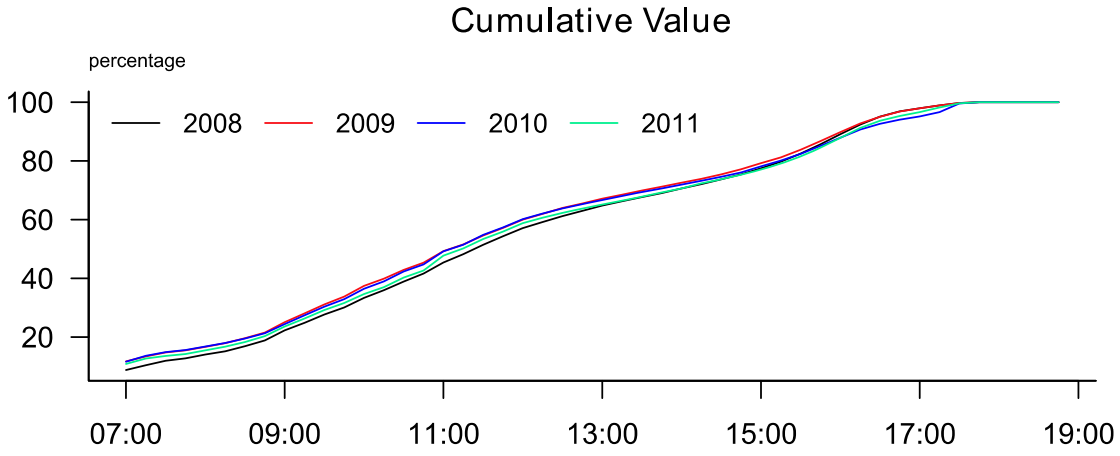




Volume and Value (daily average) II

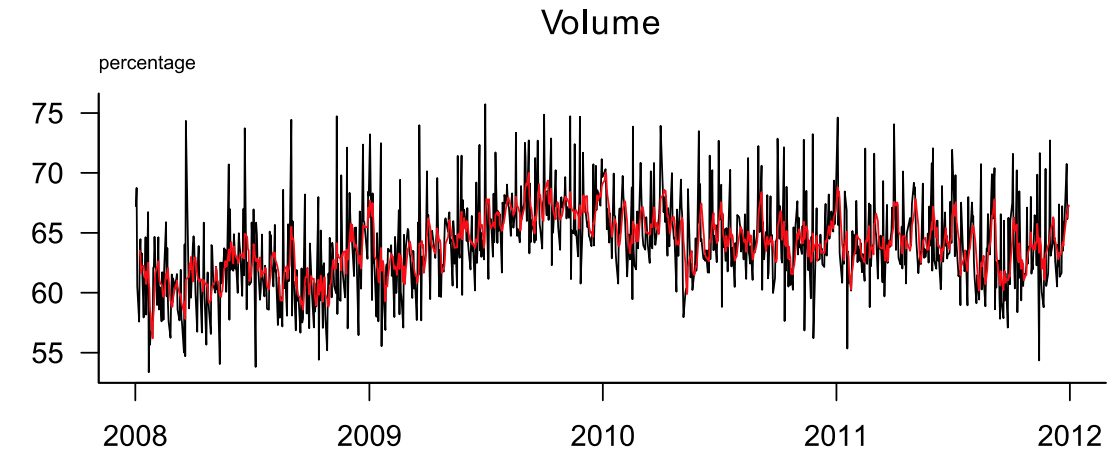
- **No throughput guidelines**
- **More than 60% of payments settled before noon**
- **No big change in participant's timing**

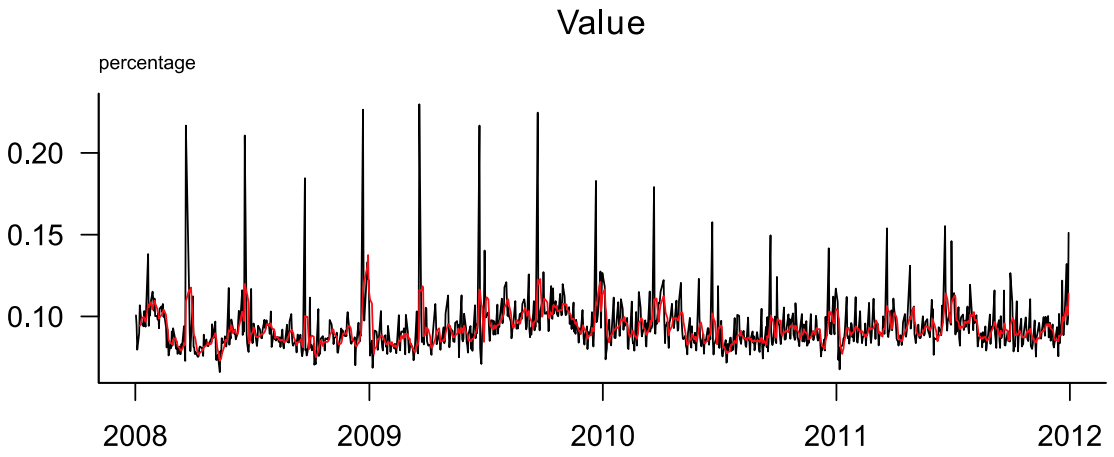




Small value payments

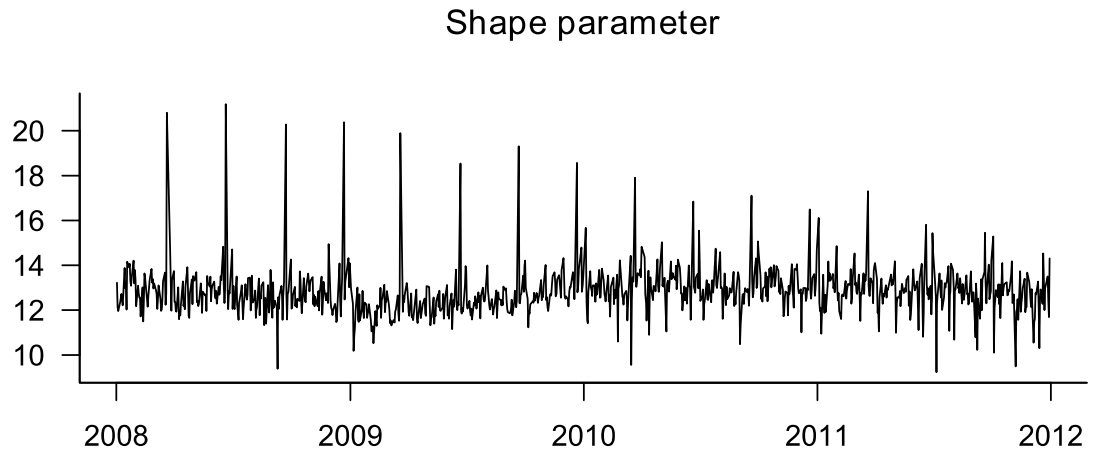
- **High percentage of small value payments**
- **Peaks around triple witching days**
- **Link between financial market transactions and interbank payments**

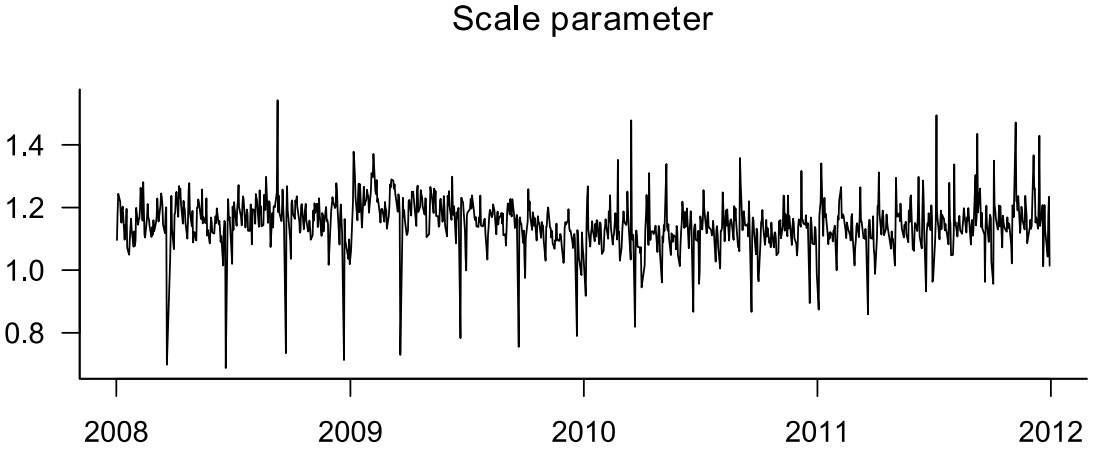




Distribution of payments

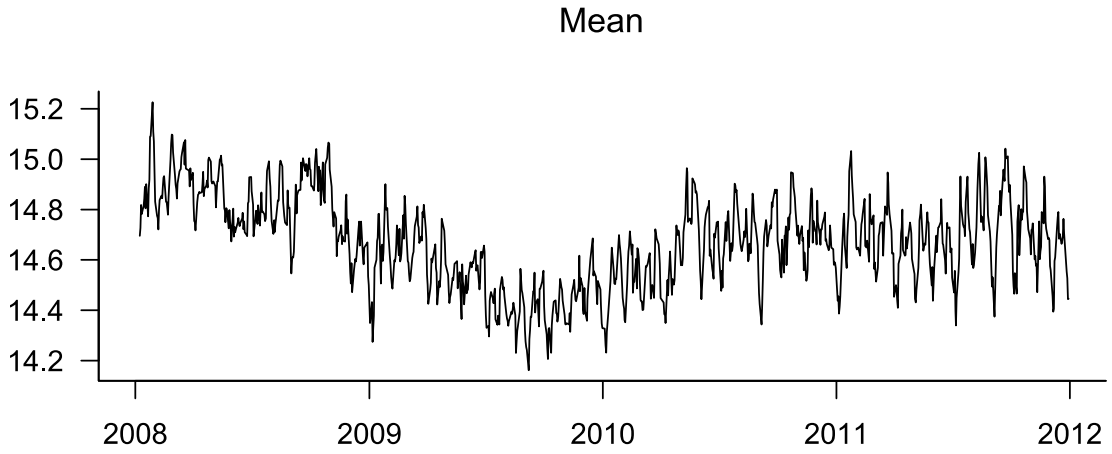
- **Fitted gamma distribution on log of payments value**
- **Peaks and troughs on triple witching days**

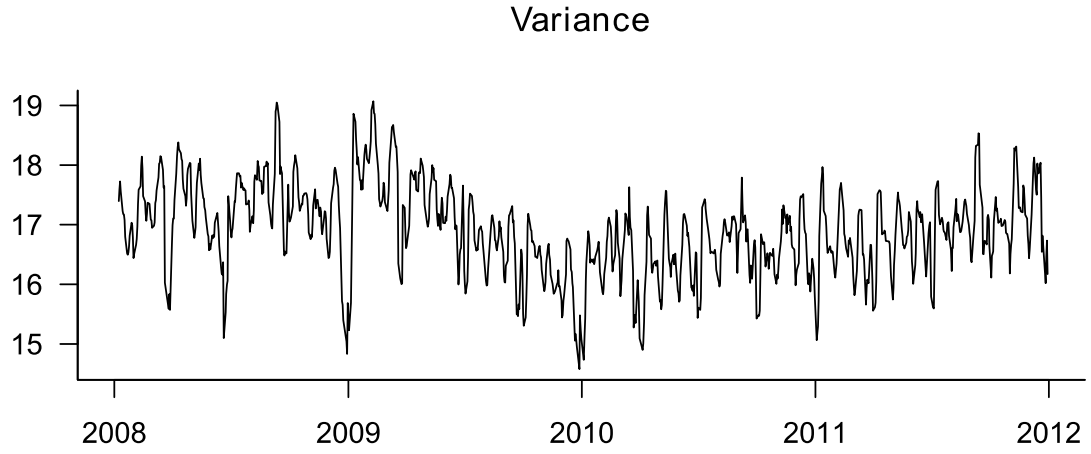




Distribution of payments II

- **Mean as in time series of value**
- **Distribution of payments more concentrated around triple witching days**





Settlement delay

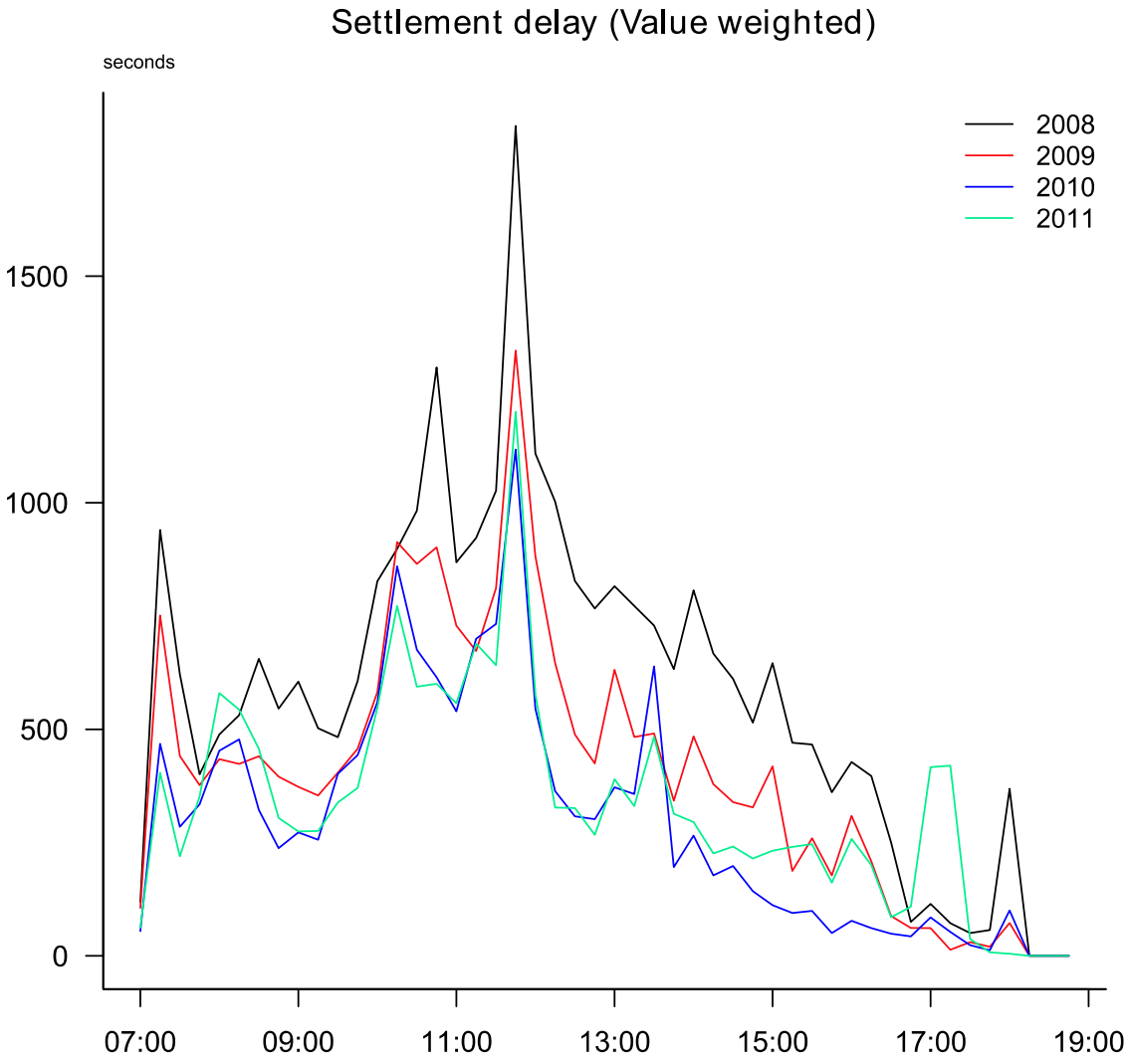
Several timestamps in a payment message

- **Introduction time** i_t
- **Earliest and latest debit time** e_t , l_t
- **Settlement time** s_t

$$d_t = s_t - \max(7, i_t, e_t)$$

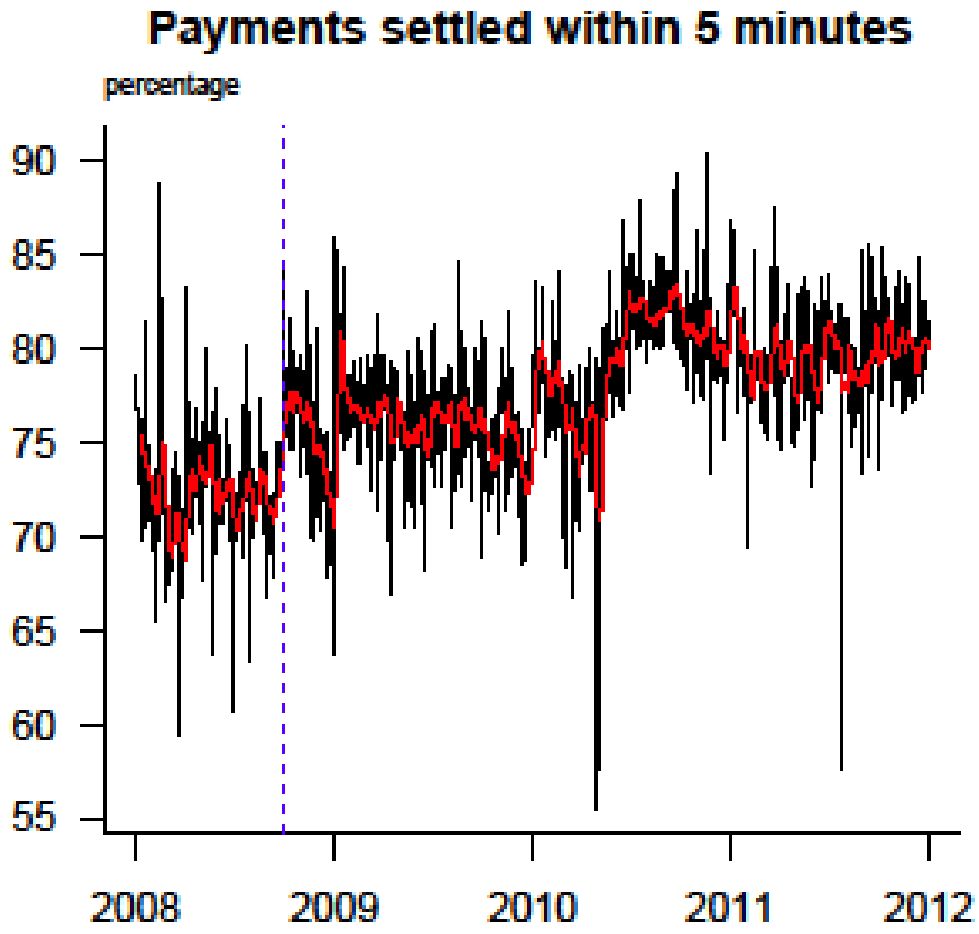
Settlement delay II

- **Morning hours most relevant**
- **Magnitude of delays decreasing over time**
- **Peaks around settlement cycles of ancillary systems (e.g. CLS)**



Settlement speed

- **Increasing trend**
- **End-of-year effect**
- **Emergency monetary policy measures visible**



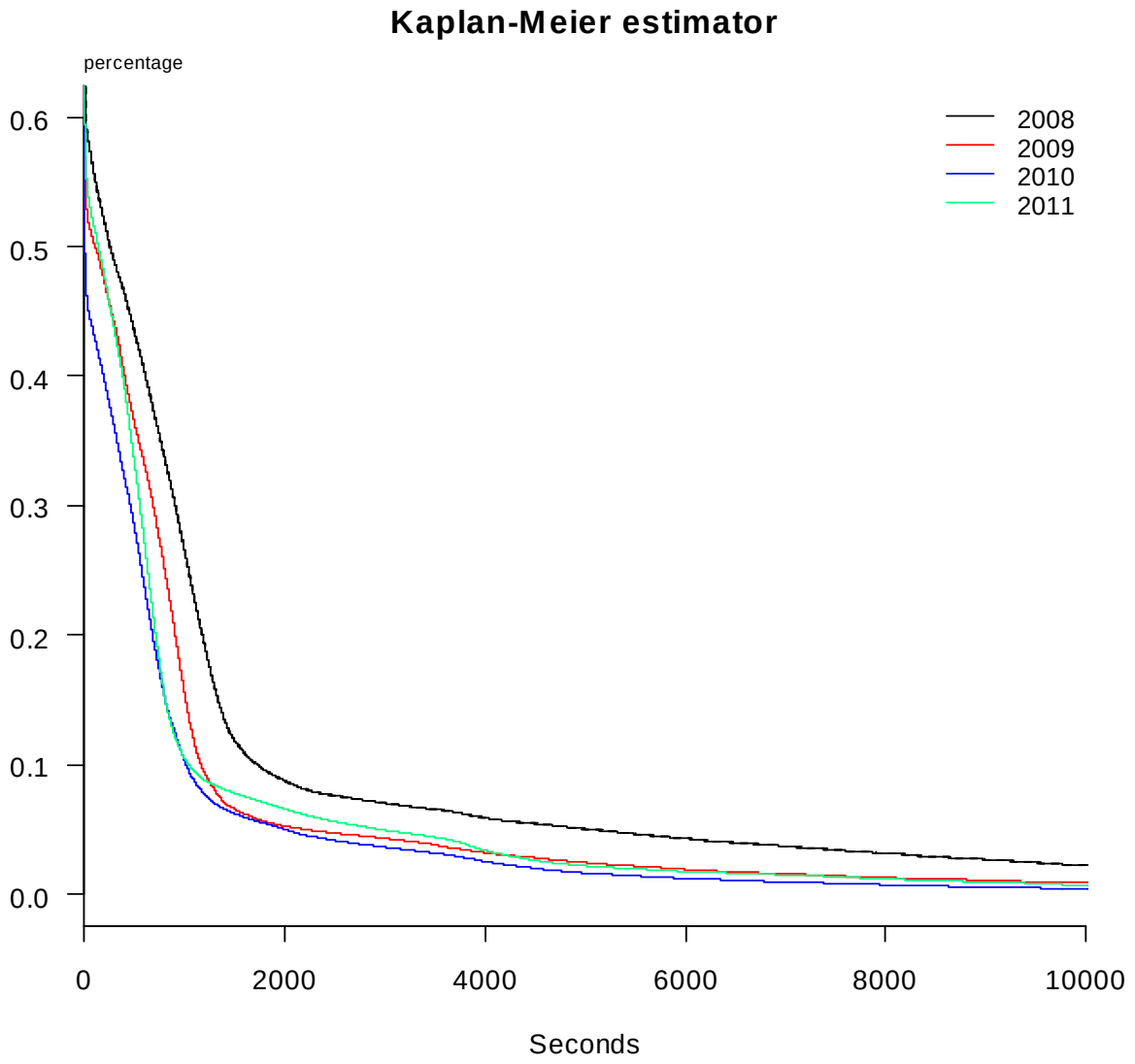
Modelling settlement delay

Modelling settlement delay by means of survival analysis:

- **Payments queued as survivor**
- **Settlement of a payment is the death event**
- **No censoring or truncation**
- **Different approaches**

Non-parametric I

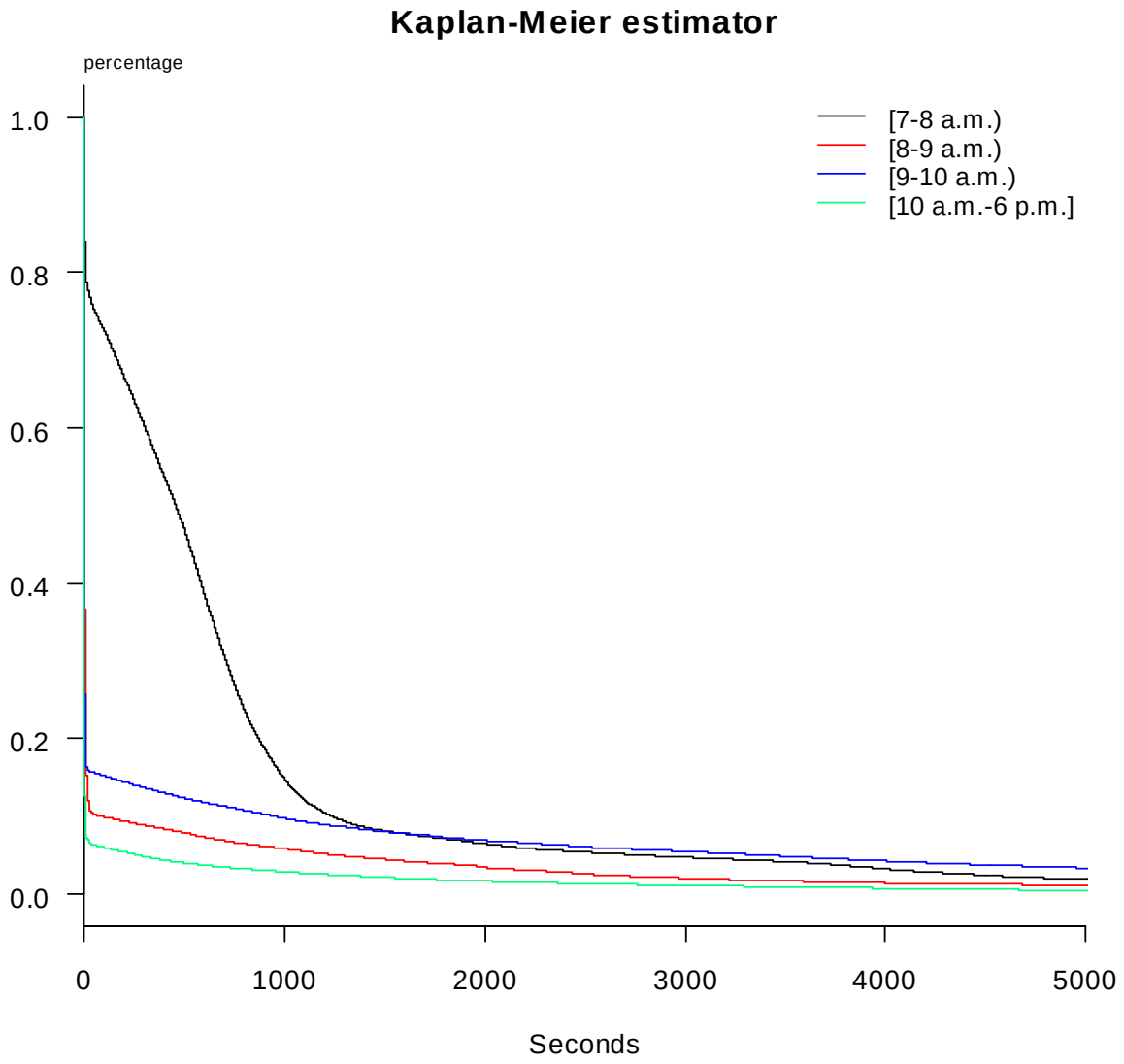
- **Non-parametric approach**
- **Probability of survival past any given time decreases through time**



Non-parametric II

- **Survival estimator given the introduction time**

- **Payments introduced early in the morning have a higher probability of being delayed**



Semi-parametric I

Cox (1972, 1975) proportional hazard model

$$\lambda_i(t) = \lambda_0(t) exp(\beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + \cdots + \beta_8 x_{i8})$$

- **Non time-varying covariates**
  - Logarithm value
  - Priority
  - Hour dummies

Semi-parametric II

- **All coefficients are statistically significant at the 1% level**
- **Larger payments have lower probability of being further delayed**
- **Priority effect varies**

Variable	Hazard Rate	Std. Error	z	p-value	95% Conf. Interval
			2008		
log(value)	0.960	0.000	-430.5	0.000	0.960 - 0.960
priority	1.076	0.001	-220.3	0.000	1.074 - 1.078
dummy7	0.191	0.000	-1105.3	0.000	0.190 - 0.191
dummy8	0.424	0.001	-425.3	0.000	0.423 - 0.426
dummy9	0.409	0.001	-390.8	0.000	0.407 - 0.410
dummy10	0.494	0.001	-458.3	0.000	0.492 - 0.495
dummy11	0.577	0.001	-157.0	0.000	0.575 - 0.579
dummy12	0.730	0.002	-95.6	0.000	0.727 - 0.733
			2009		
log(value)	0.964	0.000	-422.2	0.000	0.964 - 0.965
priority	0.886	0.001	-95.5	0.000	0.884 - 0.889
dummy7	0.184	0.000	-1274.9	0.000	0.183 - 0.184
dummy8	0.487	0.001	-455.6	0.000	0.486 - 0.489
dummy9	0.454	0.001	-495.7	0.000	0.453 - 0.455
dummy10	0.557	0.001	-349.6	0.000	0.555 - 0.559
dummy11	0.681	0.001	-181.0	0.000	0.678 - 0.684
dummy12	0.858	0.002	-72.0	0.000	0.854 - 0.861

Semi-parametric II

- **All coefficients are statistically significant at the 1% level**
- **Priority positive effect increases**
- **Dummy coefficients?**

			2010		
log(value)	0.964	0.000	-414.0	0.000	0.964 - 0.964
priority	0.733	0.001	-264.2	0.000	0.731 - 0.735
dummy7	0.225	0.000	-1212.5	0.000	0.224 - 0.225
dummy8	0.561	0.001	-389.5	0.000	0.560 - 0.563
dummy9	0.485	0.001	-483.9	0.000	0.483 - 0.486
dummy10	0.655	0.001	-273.9	0.000	0.653 - 0.657
dummy11	0.760	0.001	-142.3	0.000	0.757 - 0.762
dummy12	0.816	0.002	-102.5	0.000	0.813 - 0.819
			2011		
log(value)	0.950	0.000	-530.9	0.000	0.949 - 0.950
priority	0.745	0.001	-248.2	0.000	0.743 - 0.747
dummy7	0.201	0.000	-1105.0	0.000	0.201 - 0.202
dummy8	0.553	0.001	-352.9	0.000	0.551 - 0.555
dummy9	0.352	0.001	-562.9	0.000	0.351 - 0.354
dummy10	0.446	0.001	-413.2	0.000	0.445 - 0.448
dummy11	0.663	0.001	-186.3	0.000	0.660 - 0.666
dummy12	0.844	0.002	-70.6	0.000	0.841 - 0.848

Questions time….