

Evaluation of an energy efficiency program for small customers in Geneva

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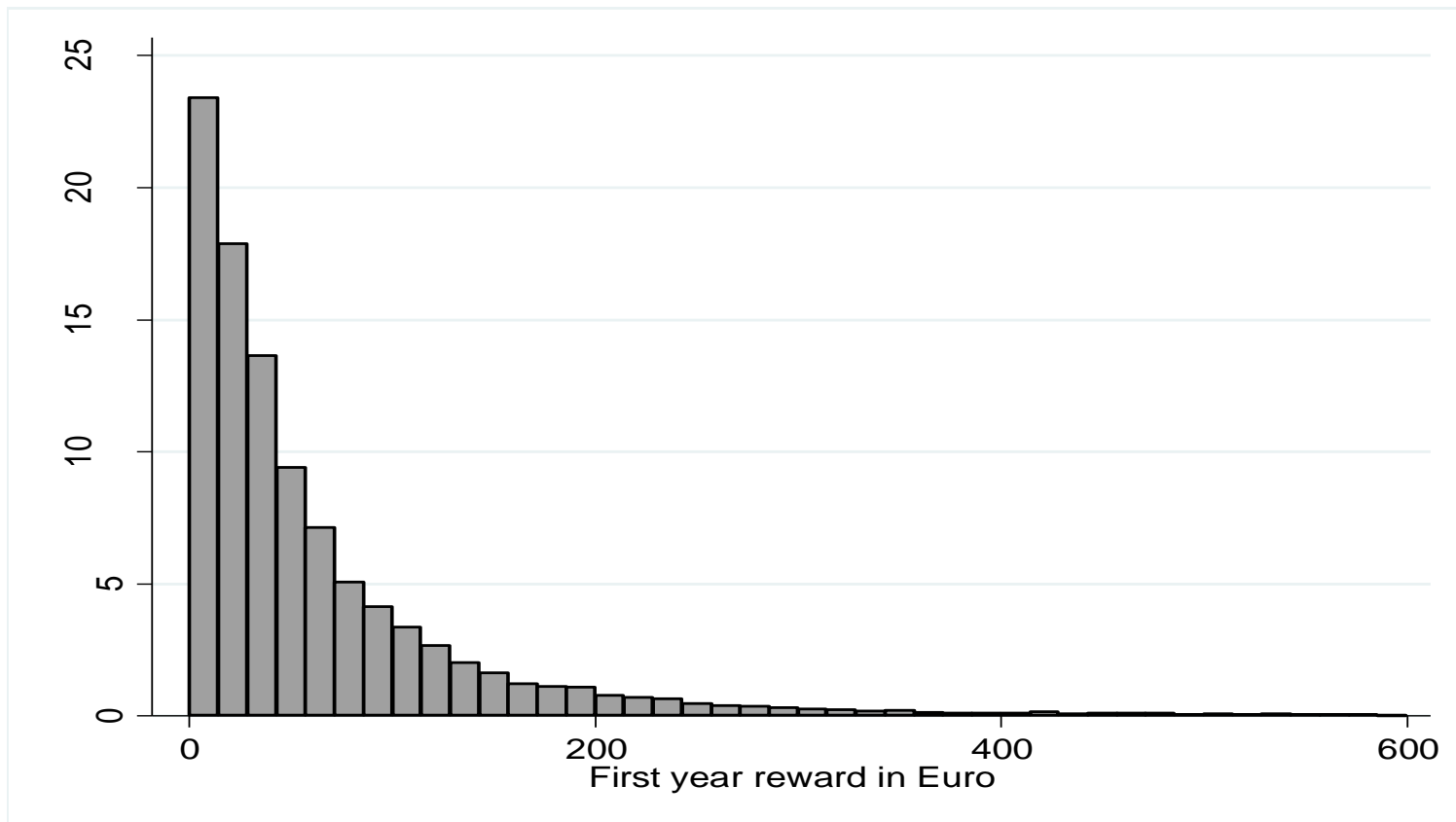
“Doubléco”

- Electricity conservation program
- For small consumers, i.e. typically small companies in the service sector and the residential sector
- Launched in November 2010 by the utility of the canton of Geneva (SIG)
- By the end of 2012, >50,000 participants had registered (out of a potential population close to 200,000)
- Monetary incentives

1) Recruitment

Recruitment	Households		Small companies		Total	
	Numbers	Share	Numbers	Share	Numbers	Share
Direct mailing	15'426	34.7%	2'179	35.9%	17'605	34.9%
Website	3'137	7.1%	412	6.8%	3'549	7.0%
Telephone campaign	20'434	46.0%	2'813	46.4%	23'247	46.1%
Others : direct promotion in administrations or business centers	5'409	12.2%	661	10.9%	6'070	12.0%
Total	44'406	100.0%	6'065	100.0%	50'471	100.0%

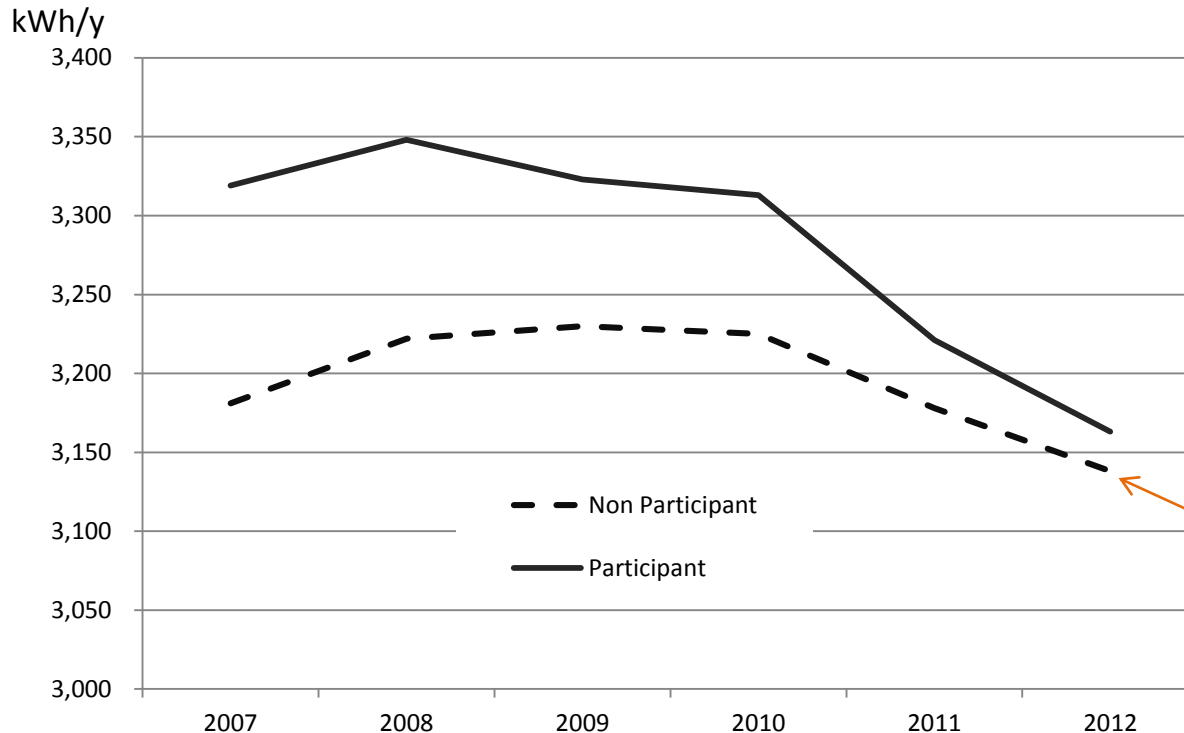
Histogram of the rewards gained by households after one year in *Doubléco*



Note: Rewards \geq savings

2) Descriptive approach

Annual average electricity consumption of households (constant sample)



In 2009, the Swiss Government adopted the same standards for electric appliances as the European Union (2009/125/CE), which introduced drastic measures in 2010 and 2011 (in particular the phase-out of incandescent light-bulbs and class B and C refrigerators)

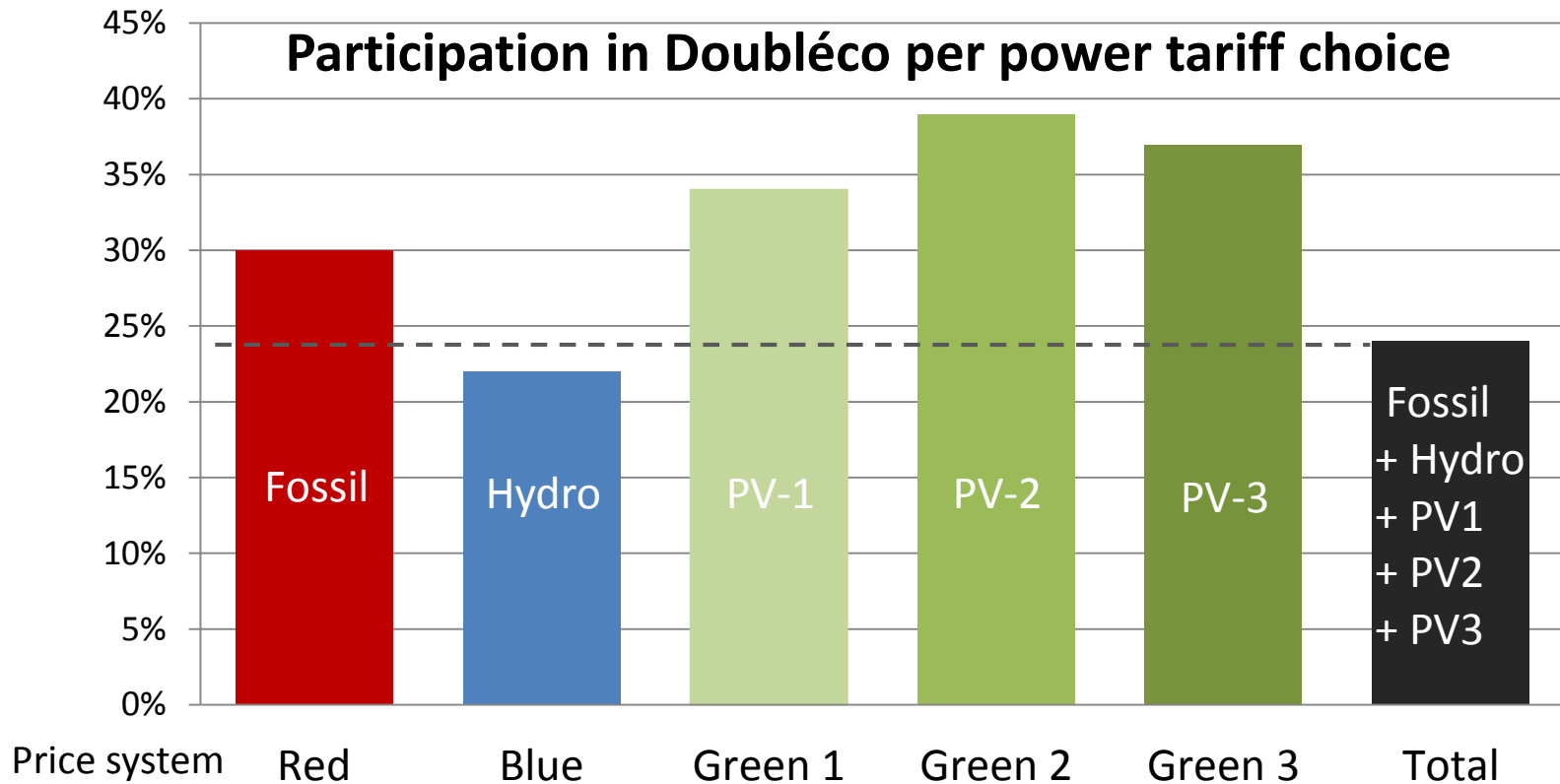
The comparison with a control group is needed because

- the energy use of non-participants declines from 2010 onwards
- The variation of power consumption across the years is substantial

Mean change of electricity consumption between 2009 and 2013

		Mean change of electricity consumption between years 2009 and 2013 : kWh, % and standard deviation in % of the mean 2009 consumption			
		Number	Change in kWh	Change in %	Sd in % of 2009 consumption
Households	Participants	33,976	-165	} $\Delta = -2.2\%$	38.0%
	Non- participants	99,106	-94		-3.4 %
Small companies	Participants	4,519	-345	} $\Delta = -2.1\%$	35.9%
	Non- participants	13,605	-213		-3.2 %

3) *Statistical model*



Overrepresentation of clients with
 a) susceptibility to electricity conservation programs
 or
 b) interest in low-priced electricity

 **Bias!**

Modelling “treatment effects”

Household or small company i

Difference
between two
annual
electricity
consumptions

$$\Delta_i = x_i' \beta + \delta z_i + \epsilon_i$$

Other explanatory
variables (2009
consumption in kWh)

Treatment status (0/1), i.e.
participation in Doubléco
(no/yes)

+

bias correction:

$$\delta + \rho\sigma \left[\frac{\varphi(w_i\gamma)}{\Phi(w_i\gamma)\{1-\Phi(w_i\gamma)\}} \right]$$

Random
component

Estimated mean savings

	Δ year 1	Δ year 2	Δ year 3
Households			
Estimated mean change due to <i>Doubléco</i> (kWh) relative to 2009	-56.4	-86.9	-64.0
Std Dev.	2.7	6.7	7.8
Mean consumption 2009	2930	2930	2930
Change in percent	-1.92	-2.97	-2.18
Small companies			
Estimated mean change due to <i>Doubléco</i> (kWh) relative to 2009	-87.1	-137.6	+17.2
Std Dev.	9.2	11.6	25.1
Mean consumption 2009	6460	6460	6460
Change in percent	-1.35	-2.13	+0.28

For comparison, without bias correction:

$\Delta=-2.2\%$

$\Delta=-2.1\%$

Conclusions

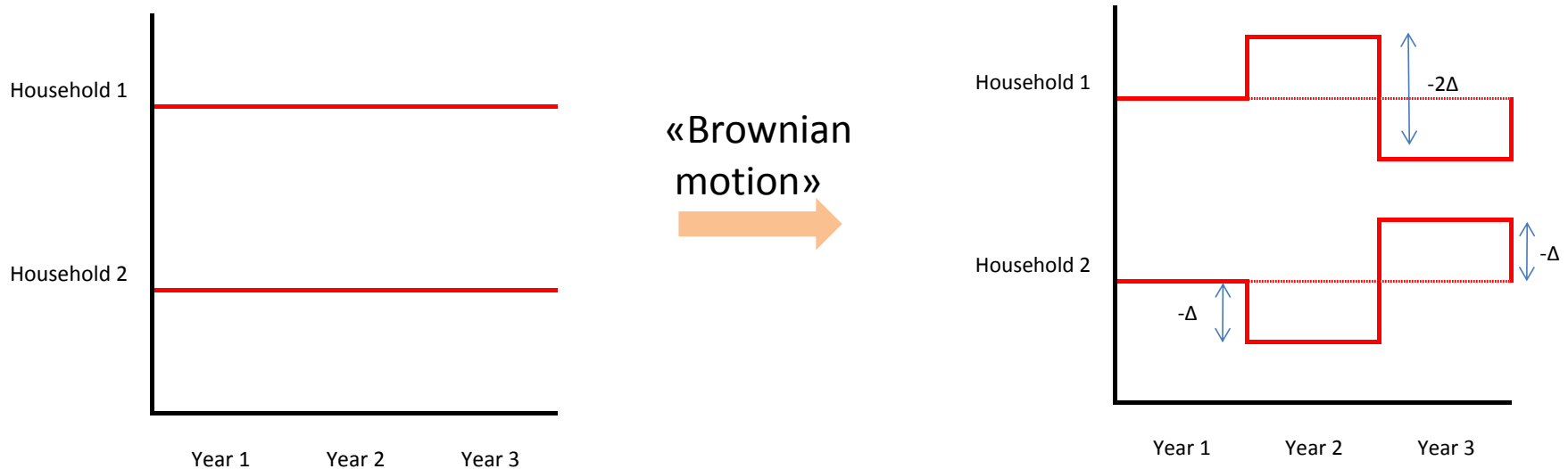
- Energy savings instigated by Doubléco are small but statistically significant (*2-3% for households; 1-3% for small consumers except for Y3*).
- Without a treatment effect model it would not have been possible to reach statistically significant results.
- Further work is recommended on
 - indicators allowing to determine the need for bias correction
 - best practices for bias correction.

Additional slides

The challenge of measuring energy savings

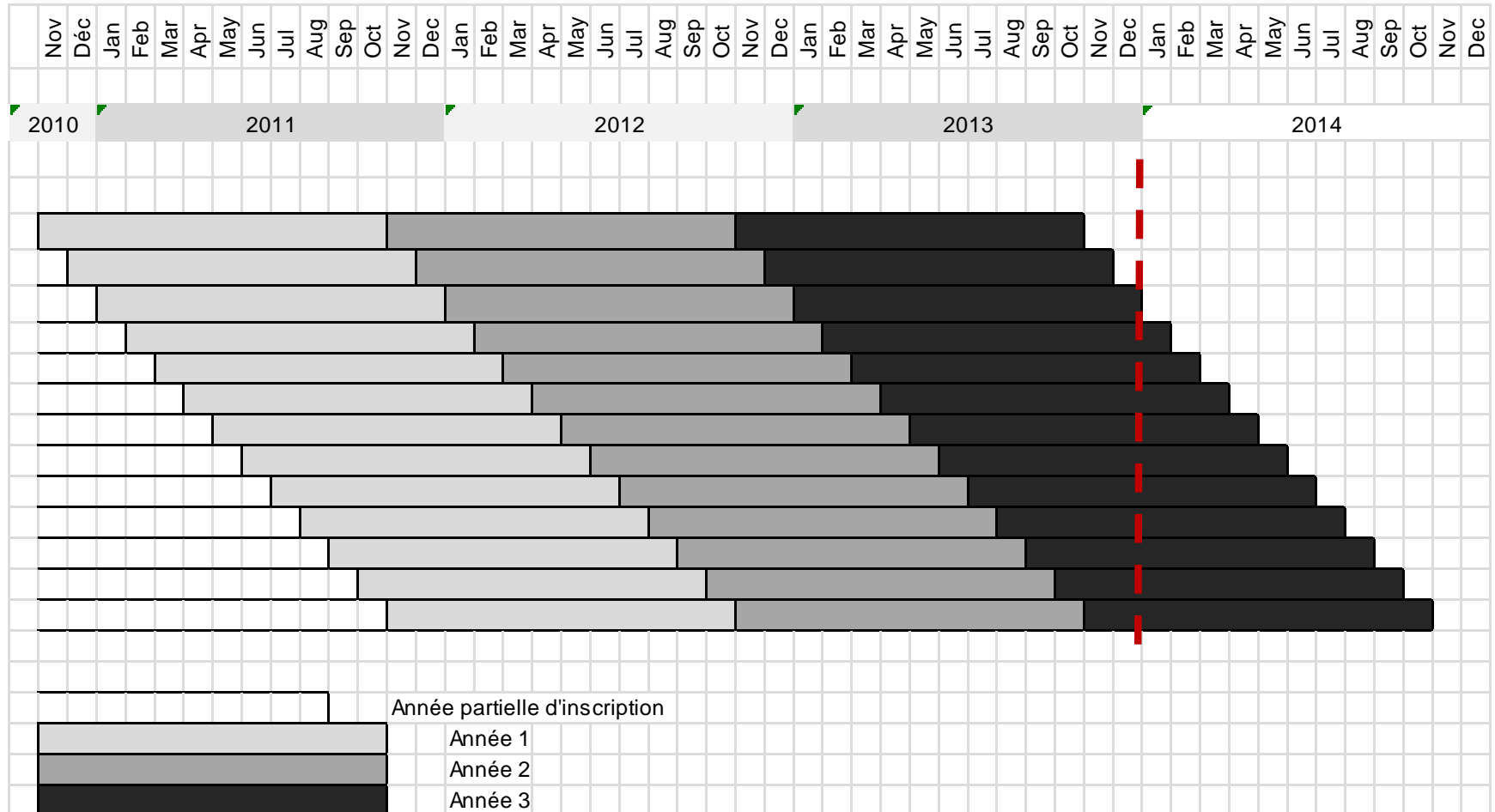
Or: Rewards do no necessarily represent savings

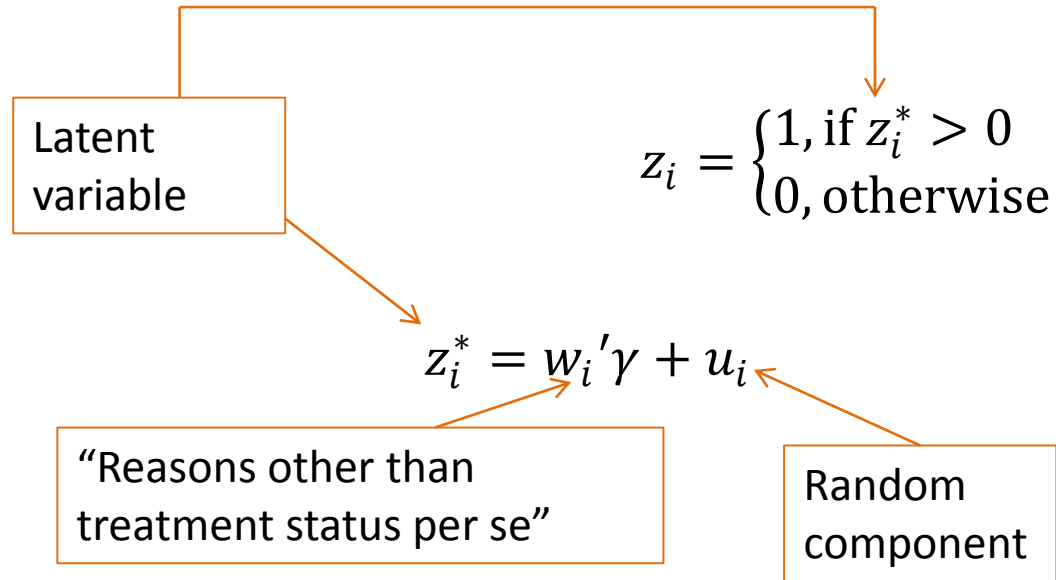
Ex. electricity's consumption of two households : no savings



... the program has to pay for 4Δ

Electric meters for small consumers are read only once a year





The two random components ϵ_i and u_i are supposed bivariate normal with zero mean and covariance matrix

$$\begin{bmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & 1 \end{bmatrix} \quad E(\Delta_i | z_i = 1) - E(\Delta_i | z_i = 0) = \delta + \rho\sigma \left[\frac{\varphi(w_i \gamma)}{\Phi(w_i \gamma) \{1 - \Phi(w_i \gamma)\}} \right]$$

Estimation of the bias, between -1 and + 1