Economics of using genomic selection at the farm level

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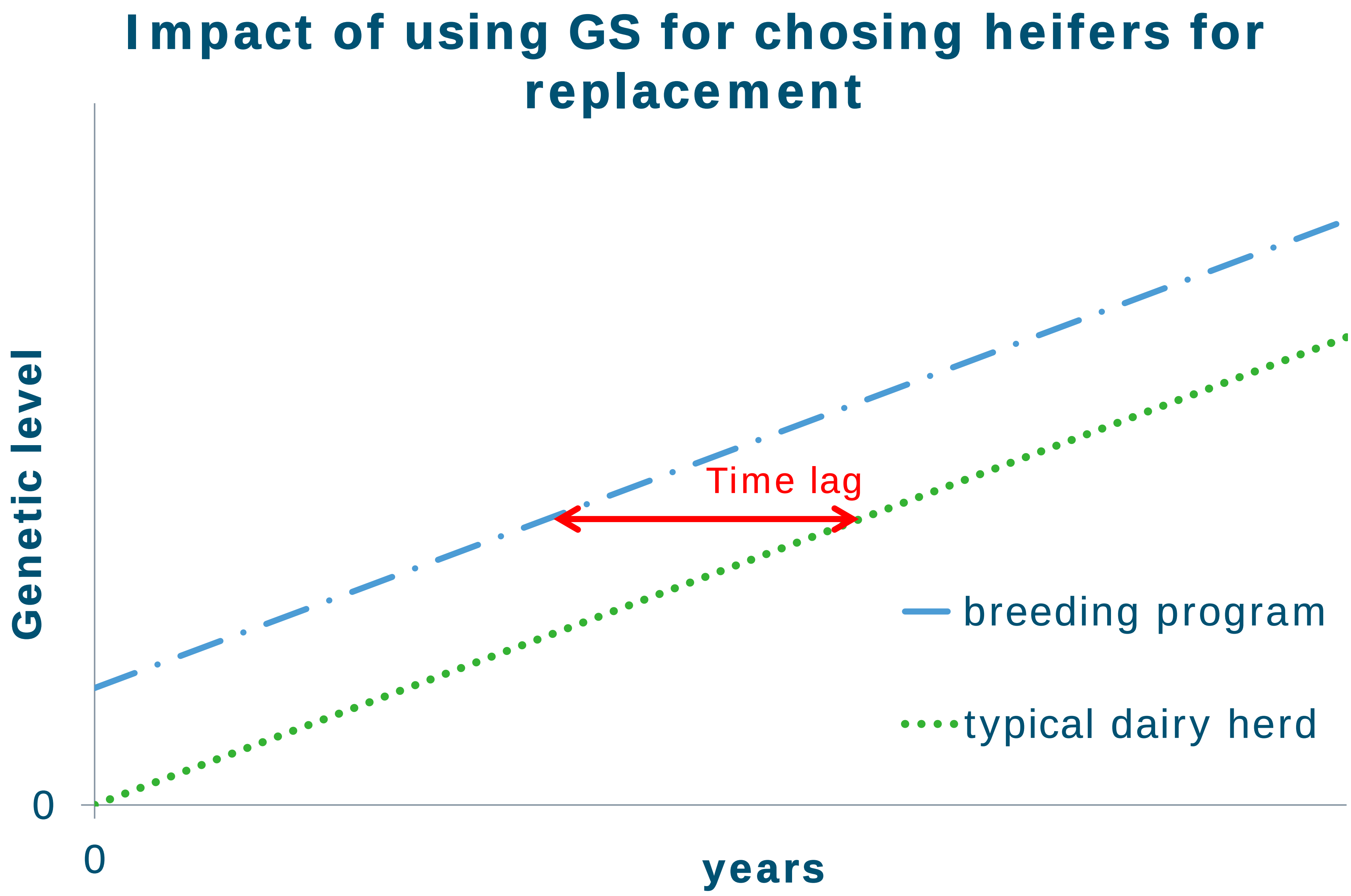
Introduction – GS in dairy cattle

- Genomic selection (GS) may increase ΔG in breeding program
  - Sires of sires
  - Bull dams
  - Sires of dams

- ΔG "reaches" commercial farms with some time lag
  - Lag > generation interval of females



Impact of using GS for chosing heifers for replacement
Genetic level
0
0
years
Time lag
breeding program
typical dairy herd

Further use of GS at the herd level?

- Selection response for dams of cows pathway is negligible

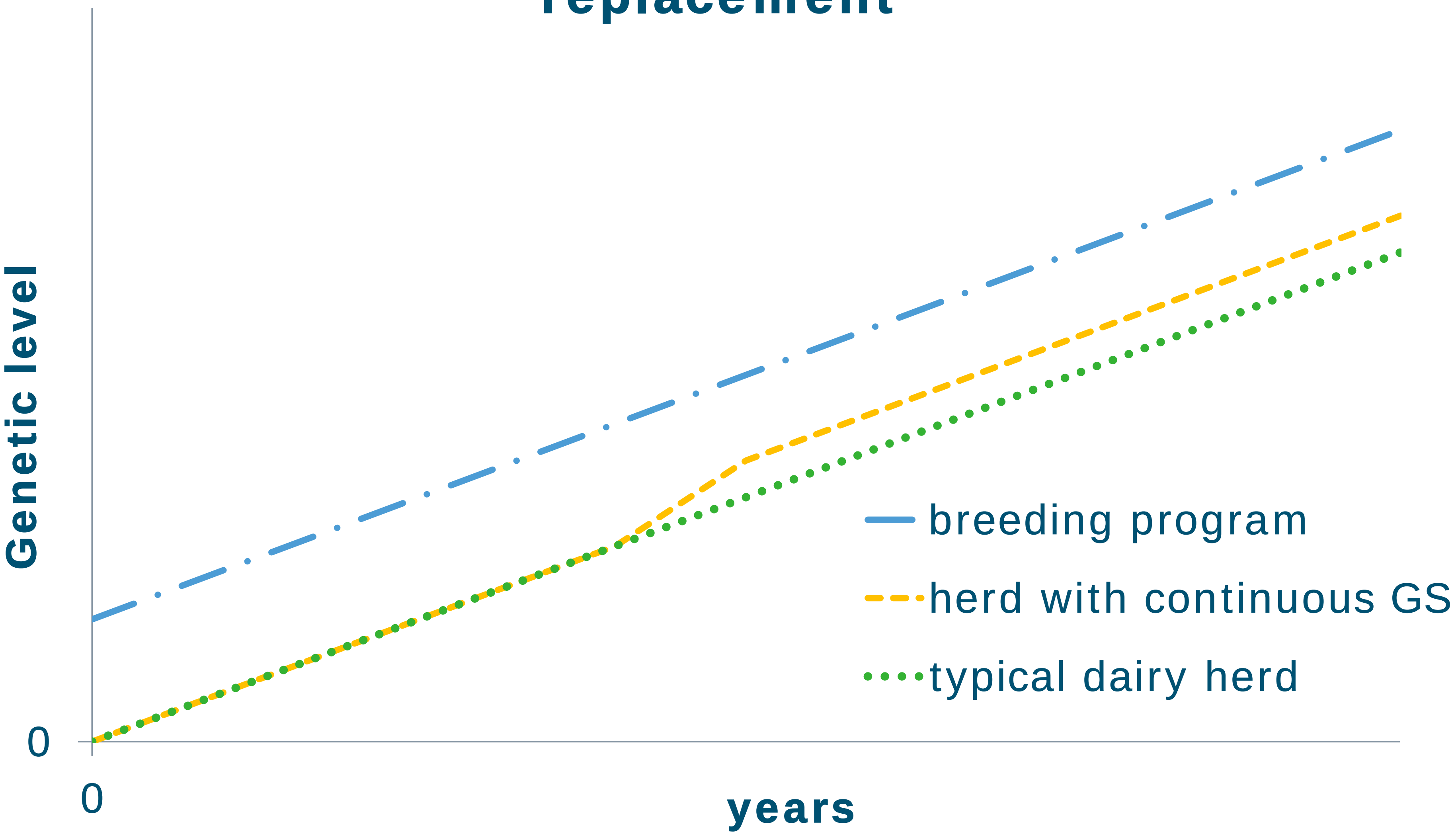
- Perhaps GS can be used to select replacement heifers
  - De Roos, A. P. W. 2011. PhD thesis, Wageningen University, Wageningen.
  - Pryce, J. and B. Hayes. 2012. Anim Prod Sci. 52:180-184.

Using GS for replacement

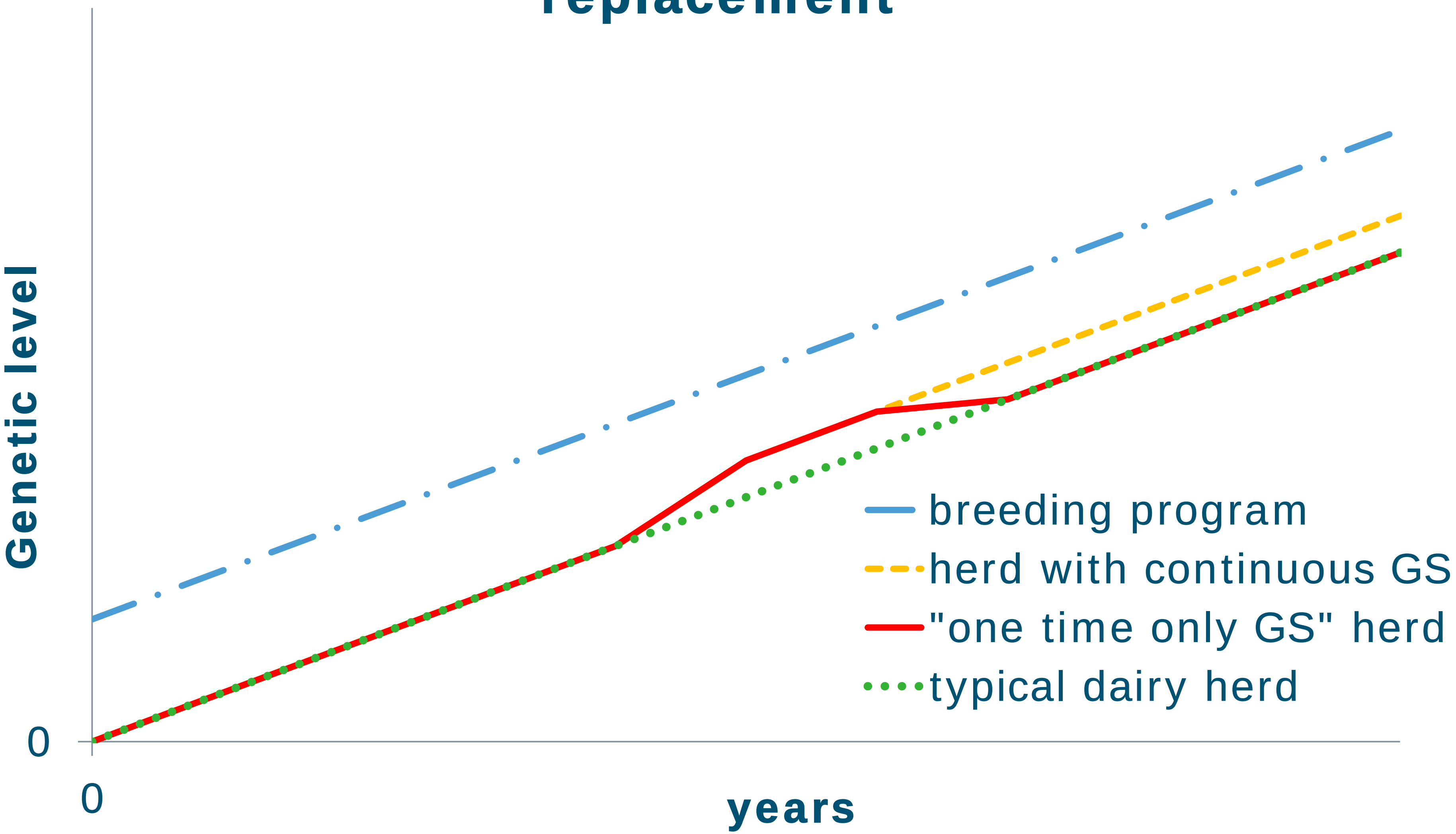
- Economic benefit comes through selecting better heifers

- "One-time-only" effect
  - Reduces time lag (temporarily) for ΔG to reach herd
  - If heifer is culled, the benefit disappears
  - Impact on ΔG at population level (DD pathway) is negligible

Impact of using GS for chosing heifers for replacement



Impact of using GS for chosing heifers for replacement



Objective

Investigate:

- Economic impact of GS for replacement
- Compared to replacement based on parent average
- Derive break-even cost for genotyping

Impact of GS for replacement - Scenarios

Commercial herd:

- 100 cows
- Number of heifers available = 15 - 40
- Replacement rate 15 - 30%
- Survival female calves = 80%
- Use of conventional or sexed semen (SS)
  - SS doubles number of heifers available (30 – 80)
- Proportion of heifers genotyped
  - All
  - Pre-selection based on parent average (PA)

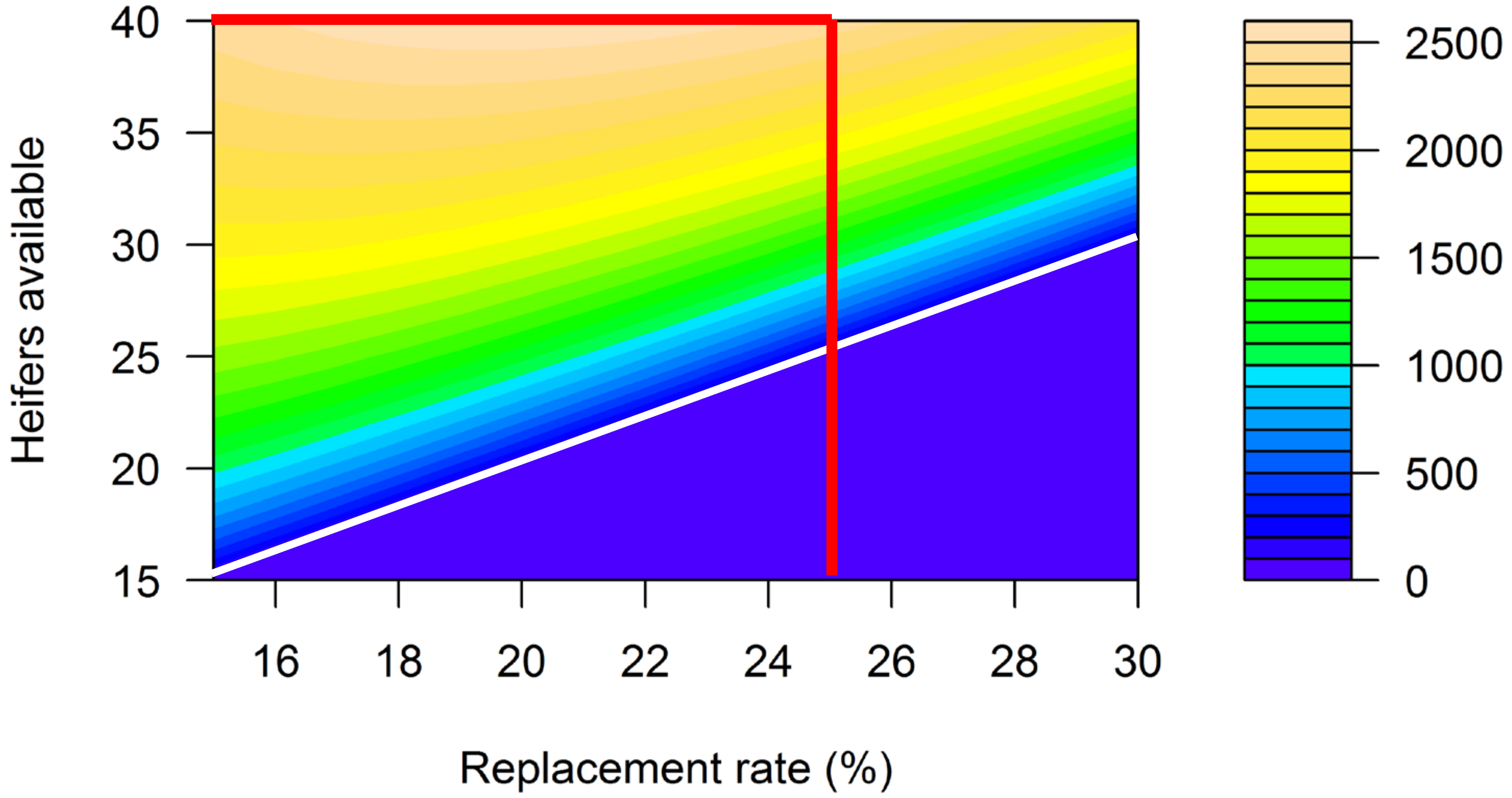
Impact of GS for replacement - Parameters

$R = i \times \rho \times \sigma_H$

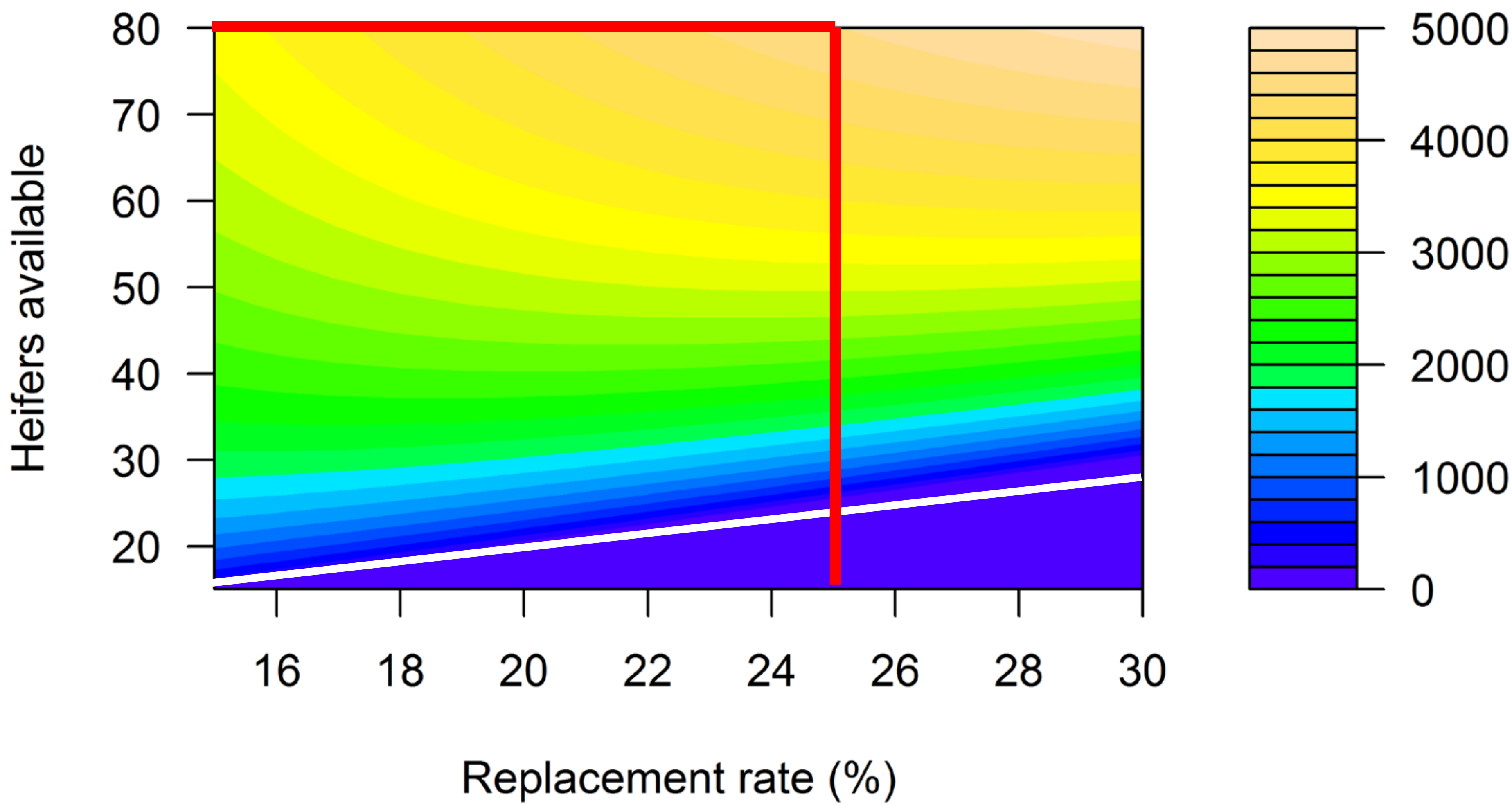
- R = response in Euros
- i = selection intensity
- ρ = accuracy of selection, *not* EBV accuracy (Bijma, 2011)
- $\rho_{PA} = 0.15$; $\rho_{GS} = 0.7$
- σ_H = SD breeding goal = 300 Euro (de Roos, 2011)
  - 100 Euro per SD per lactation x 3 lactations
- Additional response:

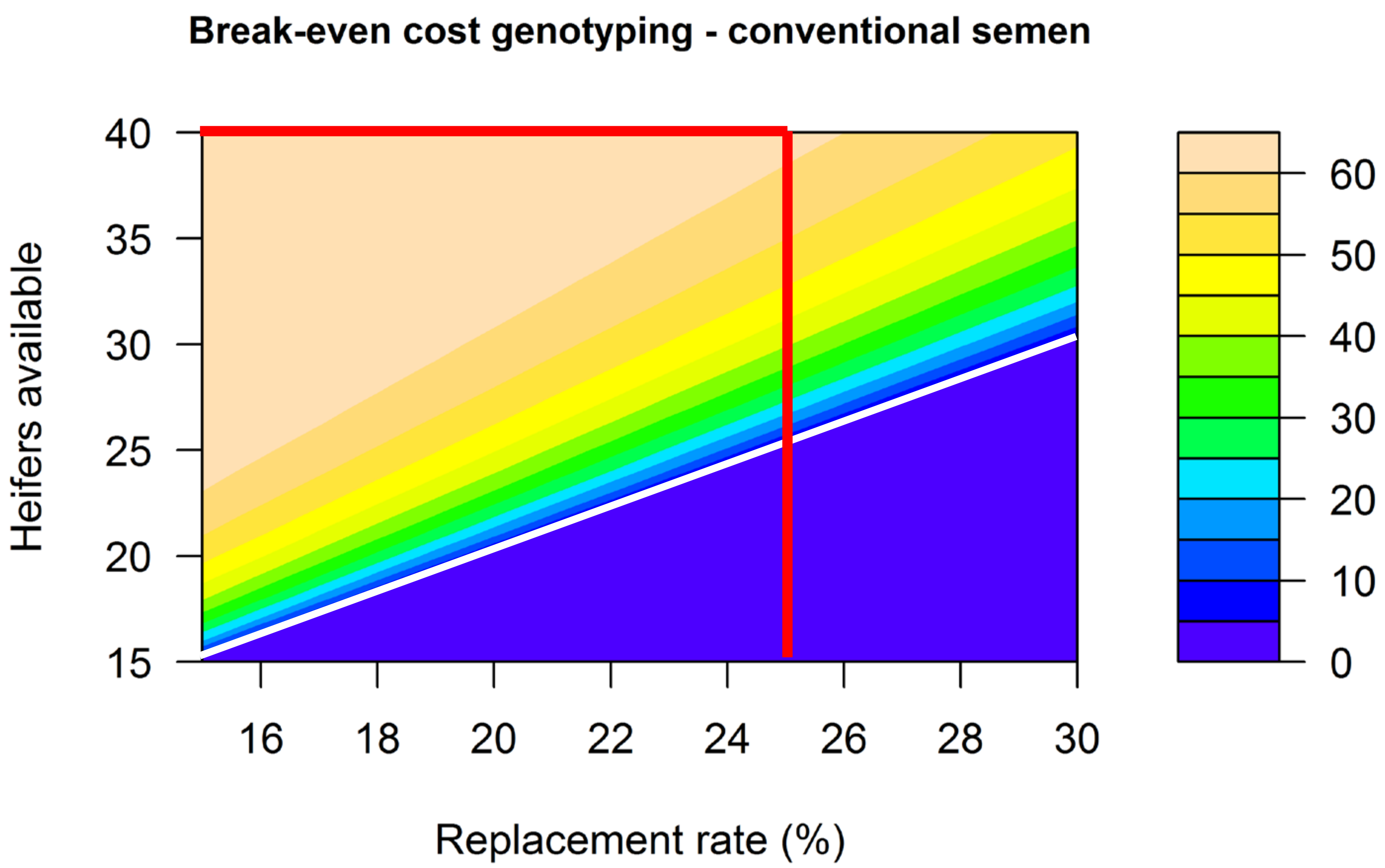
$R = i \times (\rho_{GS} - \rho_{PA}) \times \sigma_H$

Revenue GS (Euros) - conventional semen

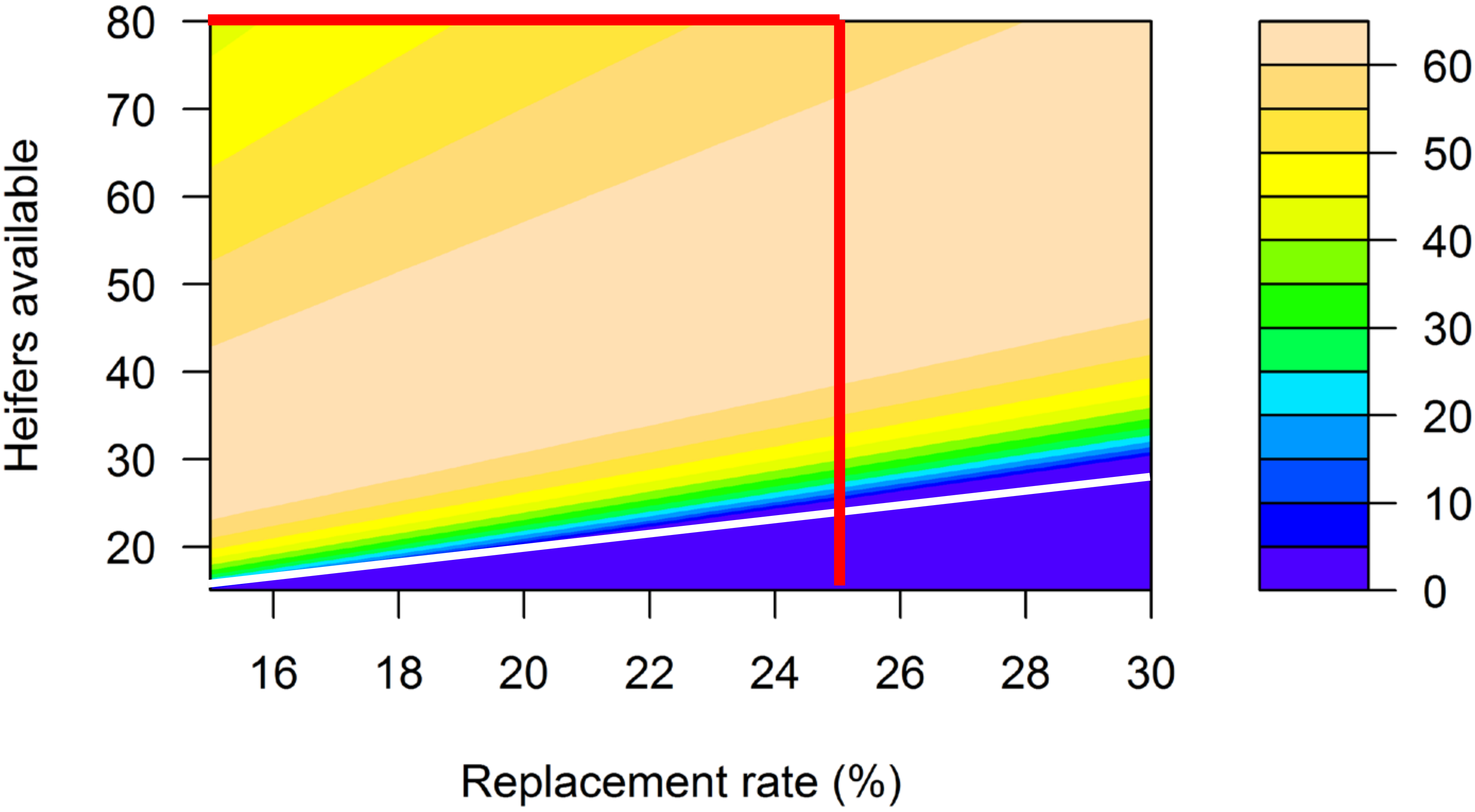


Revenue GS (Euros) - sexed semen



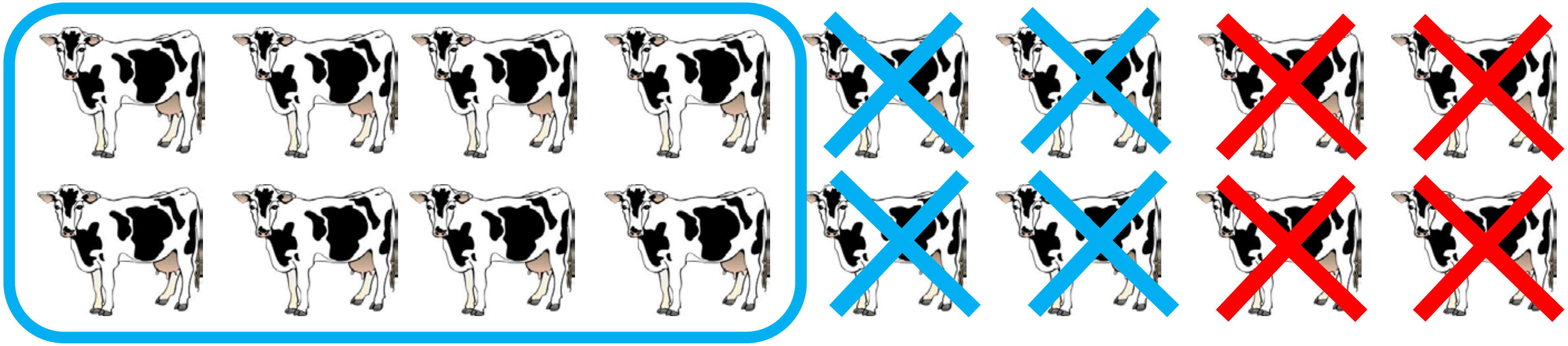

Break-even cost genotyping - conventional semen
Heifers available
40
35
30
25
20
15
16
18
20
22
24
26
28
30
Replacement rate (%)
60
50
40
30
20
10
0

Break-even cost genotyping - sexed semen



Two-stage selection

- Stage 1: pre-selection based on parent average



- Stage 2: selection using GS

Two-stage selection

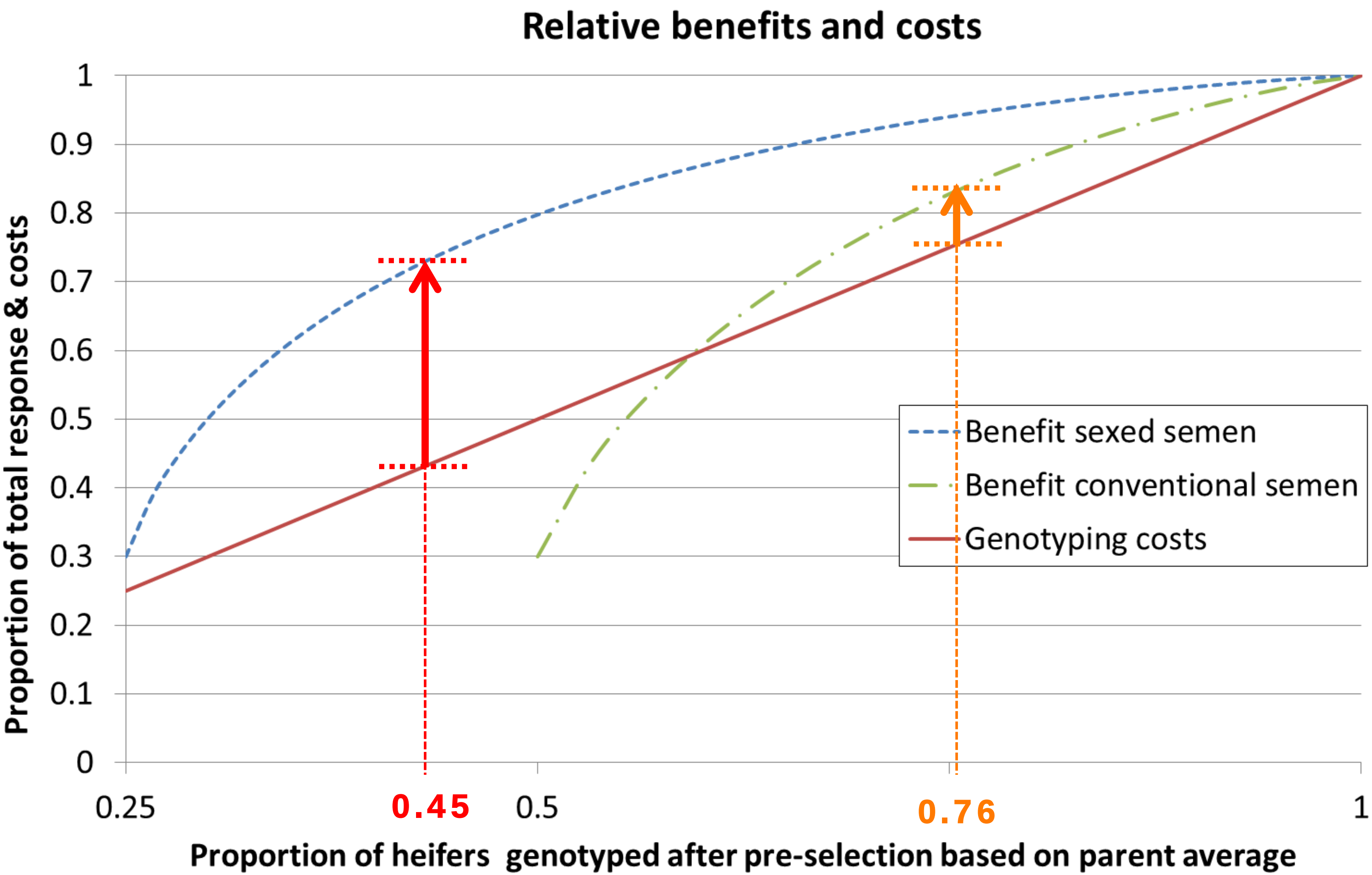
- Reduce genotyping costs by pre-selection based on parent average

What is (relative) impact on:

- Total genotyping costs
- Additional revenues due to GS

Using replacement rate = 15%;

Scenario	#heifers available	Proportion selected
Conventional	30	50%
Sexed	60	25%



Relative benefits and costs
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Proportion of total response & costs
0.25
0.45
0.5
0.76
1
Proportion of heifers genotyped after pre-selection based on parent average
Benefit sexed semen
Benefit conventional semen
Genotyping costs

Impact pre-selection

- Break-even cost of genotyping:

Scenario	All genotyped	Pre-selection
Conventional	40	**45**
Sexed	63	**105**

=> GS for replacement easier affordable with pre-selection

Discussion

- Using GS at the level of the dams yields additional benefits (not considered here):
  - "Avoid" conceiving calves with low breeding value
  - Perhaps use a beef bull instead

- Response to GS (for replacement) $\propto (\rho_{GS} - \rho_{PA})$

- We used $\rho_{PA} = 0.15$ & $\rho_{GS} = 0.7$
  - $\rho_{GS} = 0.5$ yields a 36% lower benefit
  - $\rho_{GS} = 0.9$ yields a 36% higher benefit

Conclusions

- GS for replacement of heifers is beneficial, provided:
  - There is some room for selection
  - Genotyping costs are ~<50 Euro

- Use of sexed semen (SS) increases potential benefit
  - Increased costs for SS were not considered

- Pre-selection based on PA is beneficial
  - By reducing genotyping costs
  - Especially when using sexed semen

Acknowledgements

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