PRODUCTION ENVIRONMENT REALIZED GENETIC MERIT OF LITTER SIZE, BUT THE IMPACT DEPENDS ON HERDS

Bjarke G. Poulsen, Mark A. Henryon and Bjarne Nielsen
SEGES Pig Research Centre - Genetic Research and Development

69th EAAP, 2018
Dubrovnik, Croatia

AARHUS UNIVERSITY
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS

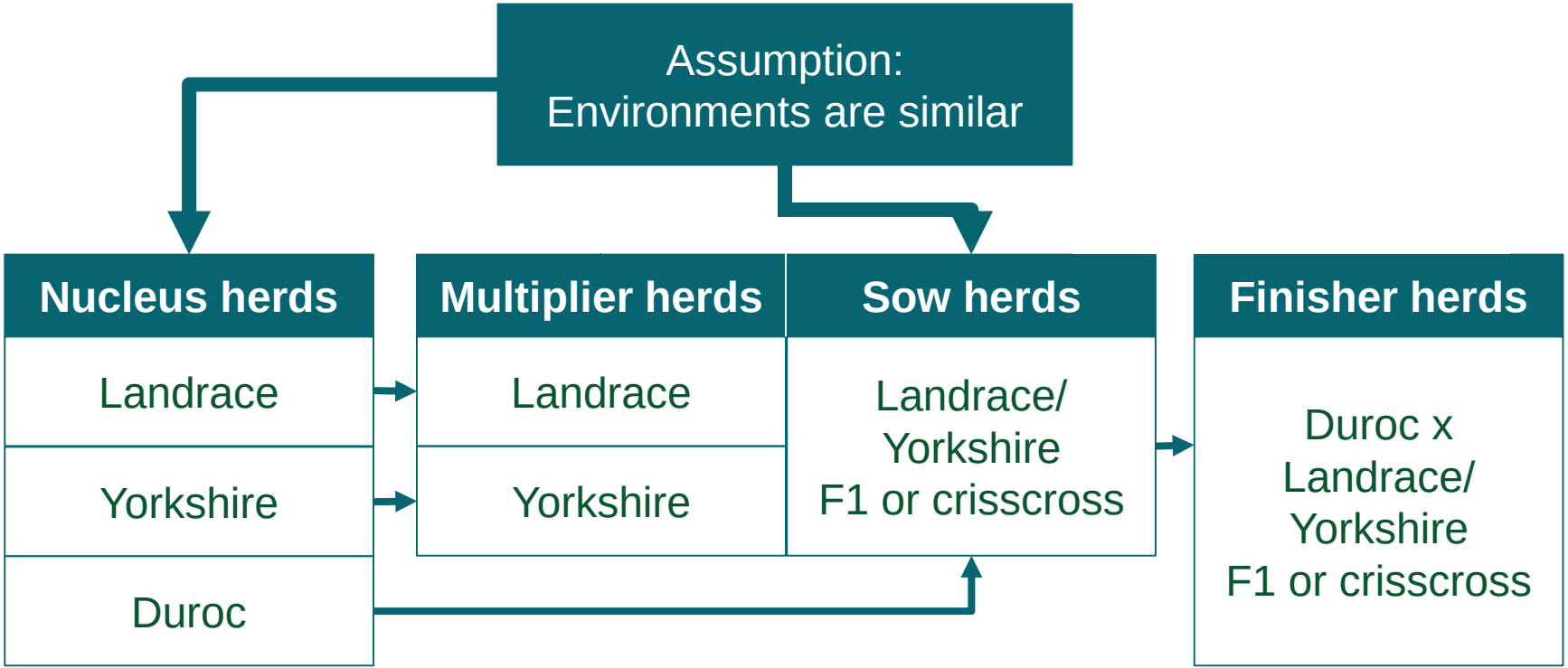
SEGES
Svineproduktion

QUESTION OF INTEREST

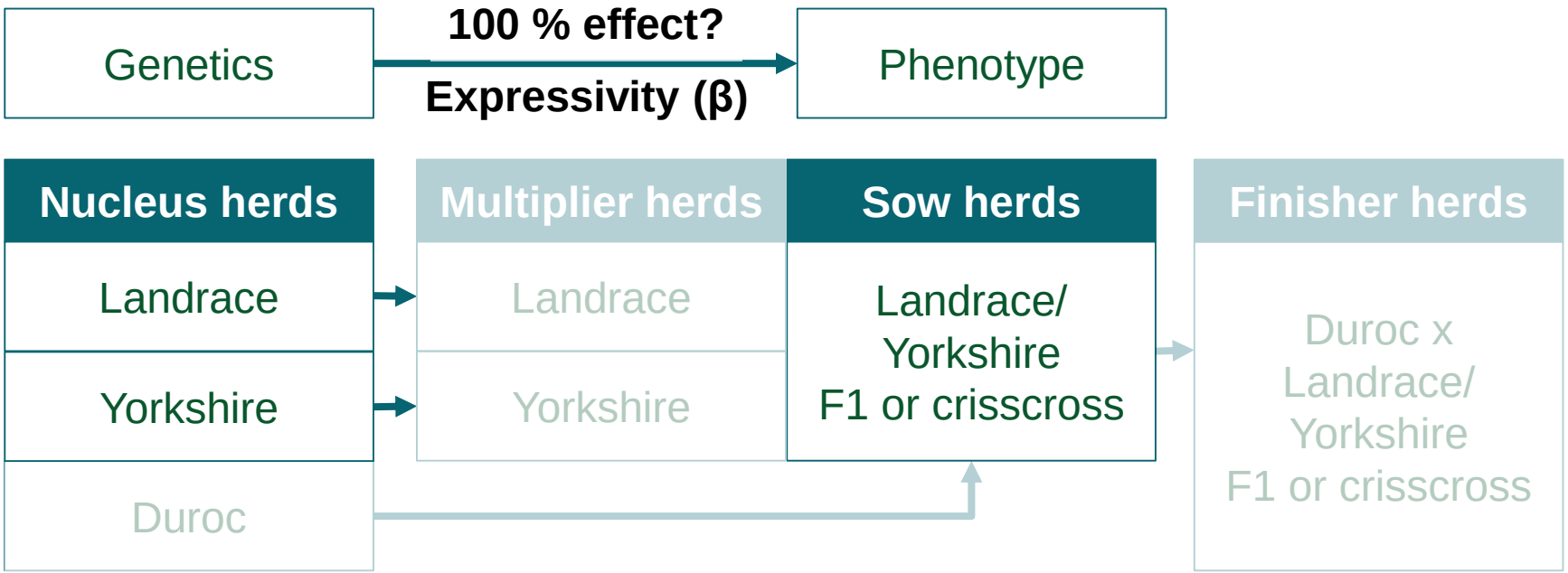
Does **genetic improvement** of purebred pigs translate into **phenotypic improvement** of crossbred production pigs?

AARHUS UNIVERSITY
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS
SEGES Svineproduktion

THE DANBRED PIG BREEDING SYSTEM



THE DANBRED PIG BREEDING SYSTEM



LITTER SIZE

Trait in purebred pigs

- Litter size at day 5 (LS5)
- Implemented in 2004
- Reduces piglet mortality

Trait in production pigs

- Total number born

AARHUS UNIVERSITY
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS
SEGES Svineproduktion

ANALYSIS OF EXPRESSIVITY

Purpose

- Analyze the association between estimated breeding values (EBVs) for LS5 in purebreds and TNB in sow herds

AARHUS UNIVERSITY
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS
SEGES Svineproduktion

SOW HERD DATA

Characteristics

- Herds have on-farm production of gilts
- Landrace and/or Yorkshire sows
  - Crisscross crossbred
  - F1 crossbred
  - Purebred
- Primary registrations
  - Ancestry of production sows
  - Farrowing results
    - Sow ID
    - Date
    - Litter size

AARHUS UNIVERSITY
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS

SEGES Svineproduktion

SIZE OF DATA

	Number of levels
Herds	173
Sires of sows	2,921
Sows	98,322

STATISTICAL MODEL

$$y_n = Xb_t + L\beta + Sr_h + Hd_h + Mf_k + Zu_m + e_n$$

Expressivity depending on herd

Overall expressivity $\approx 50\%$

y: TNB in a sows first litter

X, L, S, H, M, Z : Design matrices
b: Parameter vector for fixed effects
β: Regression coefficient for EBVs of LS5 in sire of sow
r: Regression coefficients for EBVs of LS5 in sire of sow
d: Herd effects
f: Sire of sow effect
u: Herd-year-month effect
e: Residual term

$$\begin{bmatrix} r \\ d \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_r^2 & \sigma_{rd} \\ \sigma_{dr} & \sigma_d^2 \end{bmatrix} \otimes I_h \right)$$

$$f \sim N\left(0, [\sigma_f^2] \otimes I_k\right)$$

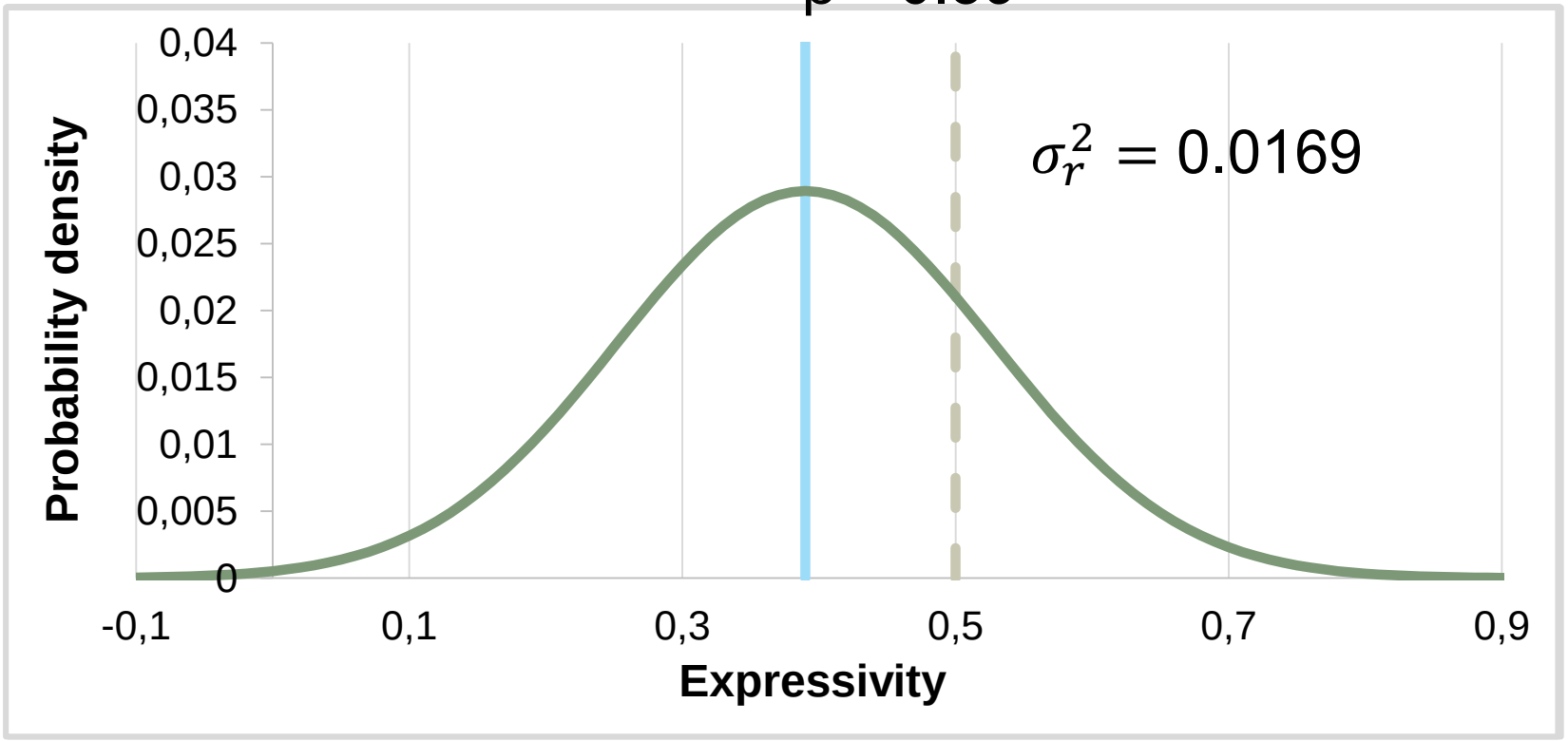
$$u \sim N(0, [\sigma_u^2] \otimes I_m)$$

$$e \sim N(0, [\sigma_e^2] \otimes I_n)$$

Lengths of vectors:
n: Production sows
t: Fixed parameters
h: Herds
m: Herd-year-month
k: Sires of sows

AARHUS UNIVERSITY
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS
SEGES Svineproduktion

RESULTS



AARHUS UNIVERSITY
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS

SEGES Svineproduktion

INTERPRETATION

Genetic potential for LS5 in sire	Average herd	Herd with low expressivity ($\beta - 1.96\sigma_r$)	Herd with high expressivity ($\beta + 1.96\sigma_r$)
-2	-0.78	-0.24	-1.32
-1	-0.39	-0.12	-0.66
0	0.00	0.00	0.00
1	0.39	0.12	0.66
2	0.78	0.24	1.32

AARHUS UNIVERSITY
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS
SEGES Svineproduktion

DISCUSSION

Expected regression coefficient (β_p) calculated from (co)variance components

- $\beta_p(\boldsymbol{C}) = ½ \frac{\sigma_{LS5,TNB}}{\sigma^2_{LS5}}$

LS5 breed	TNB breed	$\beta_p(C)$	Sig. Dif. from β
Landrace	Landrace	0.62	Yes
	F1	0.37	No
Yorkshire	Yorkshire	0.43	No
	F1	0.24	Yes

(B. Nielsen, et. al., 2016) J. Anim. Sci. 2016.94:1827–1833 doi:10.2527/jas2015-0199

AARHUS UNIVERSITY
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS

SEGES Svineproduktion

DISCUSSION

Why do we detect more expressivity in some herds?

- Management?
- Confounding effect?

Possible usages

- Detection of factors affecting expressivity
- Find herds in need of counselling

AARHUS UNIVERSITY
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS
SEGES Svineproduktion

CONCLUSION

Does genetic improvement of purebred pigs translate into phenotypic improvement of production pigs?

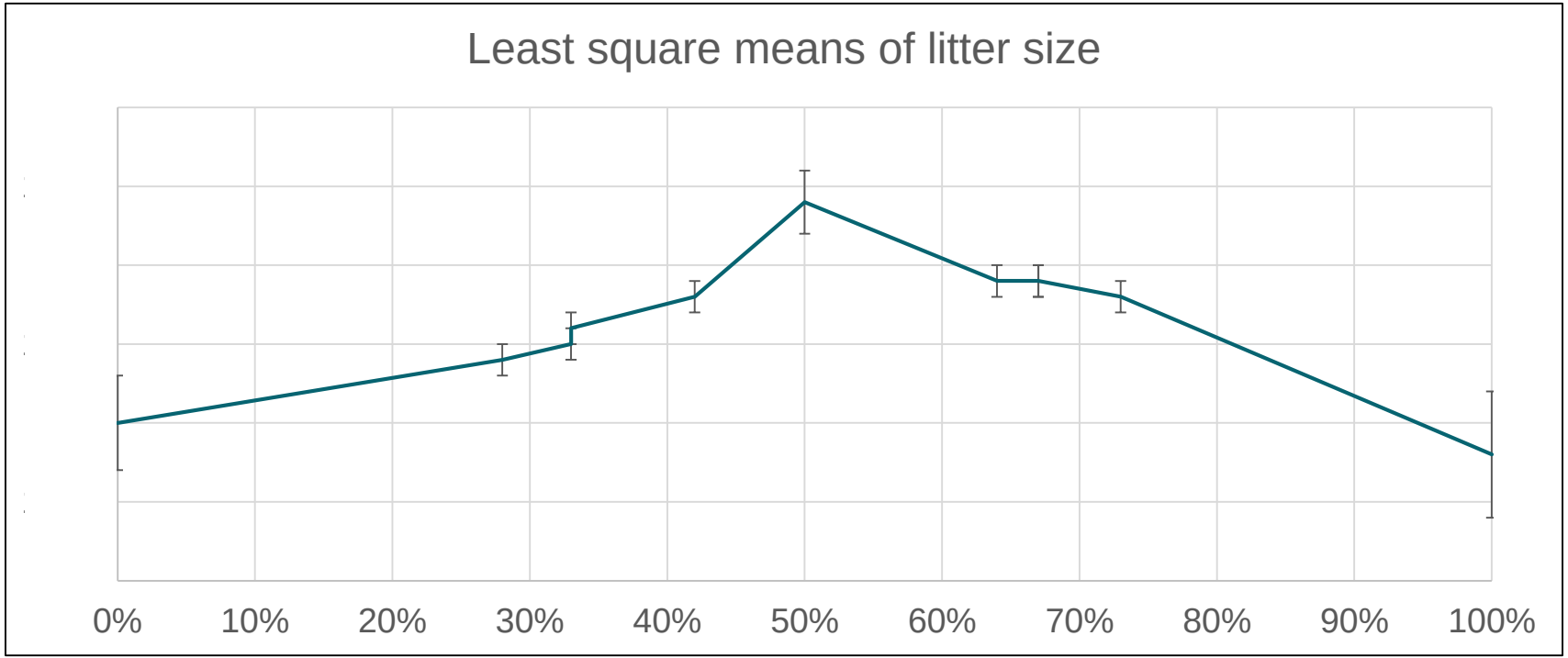
1. Yes. Genetic superiority **resulted in the expected phenotypic superiority** in production herds.
2. However, expressivity varied between herds!

THANK YOU FOR YOUR TIME

AARHUS UNIVERSITY
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS

SEGES
Svineproduktion

PERCENTAGE OF YORKSHIRE X HETEROSIS



AARHUS UNIVERSITY
DEPARTMENT OF MOLECULAR BIOLOGY AND GENETICS

SEGES Svineproduktion