Socio-Economic Implications of Detection, Traceability, and Identification of NGTs

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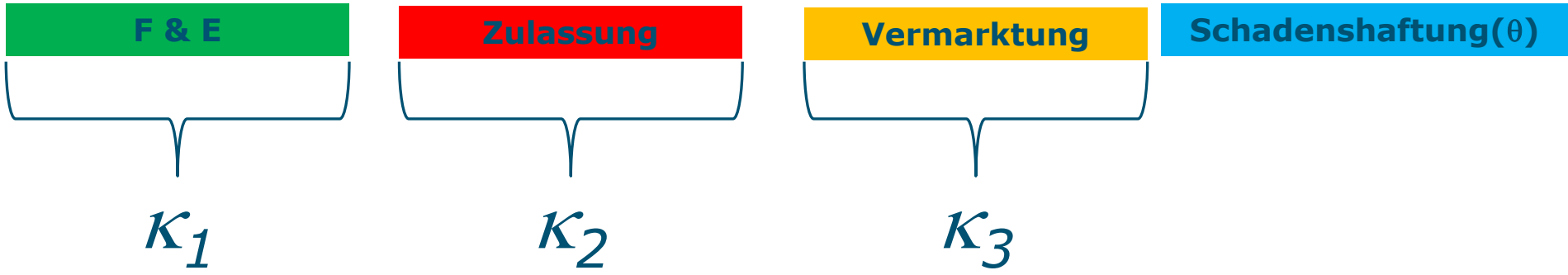
Setting

- NGTs in the EU: GMO regulation -> approval, coexistence, labeling, traceability -> costly, reduced competitiveness
- EC proposal: two categories - NGT1, NGT2 – no organic, no herbicide tolerance
- NGT1: small changes (up to 20 base pairs), labeling of seeds only, no traceability, notification and information for approval
- NGT2: larger changes, labeling and traceability, simplified risk assessment
- Amendments: labeling and traceability, patents, …
- Almost the same applies to animals…

Regulatory Implications: Model

Four phases: R&D, Approval, Marketing, Ex-post Liability



- Effect of Regulation on Immediate Investment

Model Application: simulations

Average approval length: about 6.7 years (Smart et al., 2017)

Table 1. Hurdle Rates for Different Parameter Values

$E(\kappa_1)$	10	5	2.5	1
Hurdle Rate	14.59	10.80	8.91	7.78
$E(\kappa_2)$	10	5	2.5	1
Hurdle Rate	14.59	10.70	8.76	7.59
Hurdle Rate Zero approval costs	8.66	4.88	2.99	1.86

Note: the hurdle rates are calculated applying equation 6. Other parameter values are fixed at $\mu = 0.04, q = 0.5, E(\kappa_i) = 10$ if not otherwise.

	Coefficients	*Standard Error*	*t Stat*
Intercept	0.8205	0.0015	553.39
κ_1	0.6089	0.0001	4072.26
κ_2	0.6277	0.0001	4194.04
κ_3	-0.0130	0.0001	-86.62

Simulation results

Economic Challenge

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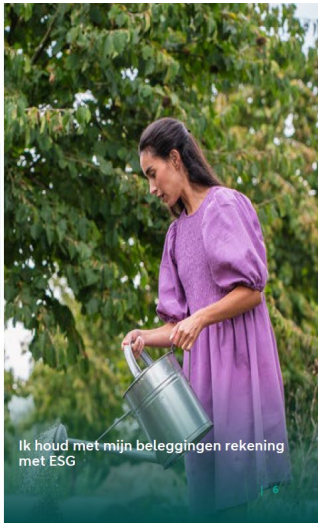
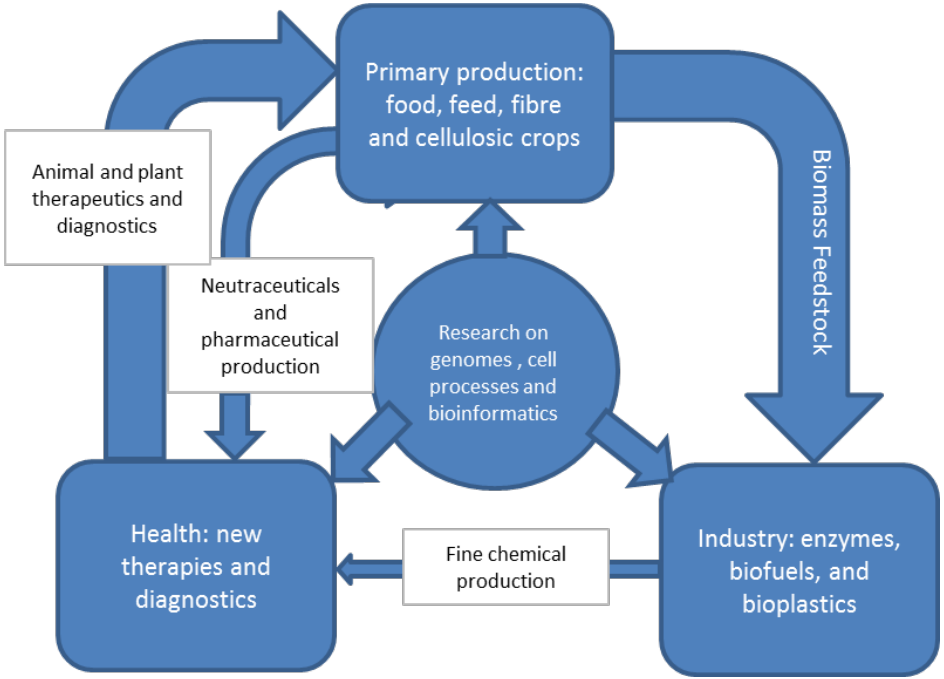
Linkage effects…

ESG stands for Environmental, Social, and Governance, and it refers to a set of standards used to measure a company's sustainability and ethical impact.





Source: EC, 2007.

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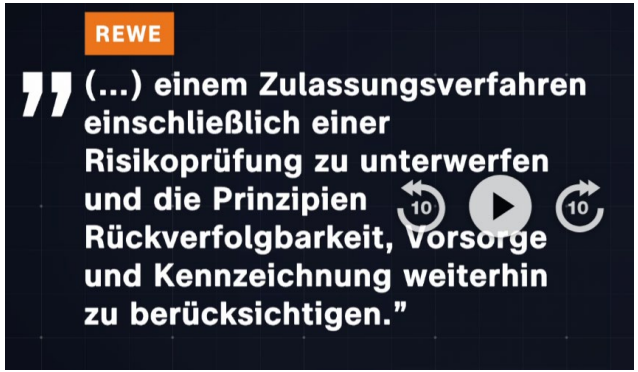
Labelling and traceability debate

Table 2: NGT labeling policies.

Country	Labeling	Thresholds (%)
EU	Mandatory Seeds (?), currently mandatory	0.9 and 0.1
China	Mandatory	*
Australia/New Zealand	Mandatory & Voluntary	1.0
Japan	Mandatory & Voluntary	5.0
US	Voluntary	5.0
Canada	Voluntary	5.0

* no specific content requirement

Sources: European Union (2003); Food Compliance International (2020); Food Standards Australia New Zealand (2023); Government of Canada (Government of Canada, 2021); Thomson (2002); USDA (USDA, 2018).



Coexistence

Policy	EU Member States apply and intend to apply
ex-ante regulations	
Prohibition and approval procedures	
prohibition of planting GM-crops in specific areas	AT, DE, HU, LU, PT, SK
case by case approval for each field by local authorities	AT*, HU, IE, SK
compulsory training of farmers planting GM-crops to be paid by the GM farmer	DK, HU, SK
consent from landowner needed	AT, BE, HU, LU, SK
consent from neighbours needed	AT, BE, HU, LU, SK
Registration and information duties	
registration of areas in publicly available database	AT*, DE, DK, GR, LV, LT, SK
registration of areas in publicly available database, restricted access	AT*, PT, EE, FI, FR, HU, NL, PL
informing neighbouring farmers and landowners	DK, AT, HU, NL, PL, SK
record keeping	DE, DK, PT, CZ, ES, HU, IT, NL, PL
Technical segregation measures	
minimum distance requirements	AT, BG, CZ, DE, DK, EE, FR, HU, NL, PL, RO, SK
buffer zones	AT, CZ, EE, FR, PL, SK
rotation intervals	GR, LT, SE
Biotech free zones	BE

Policy	EU Member States apply and intend to apply
Insurance measures	
compensation fund paid by GM-farmers (levy on GM crops) plus support from the central government	DK
compensation fund paid by private stakeholders	PT, IE, FR, NL
liability fund	BE
private insurance against damages	AT*, LU
ex-post liability rules	
Legal liability for damages	
liability based on civil law	CZ, EE, HU, SK
fault based liability	AT*, DK, FR, NL
strict liability for GM-farmers	AT*, DE, IE, PL
joint and several liability	DE
Proving damage	
burden of proof lies with GM farmer	AT, DE, FR, IT
burden of proof lies with non-GM farmer	IE
Penalties	
fines for non-compliance with ex-ante regulations	AT, CZ, EE, FR, IT, LV, LT, LU, PL, PT, SK

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Labelling and Traceability in Livestock

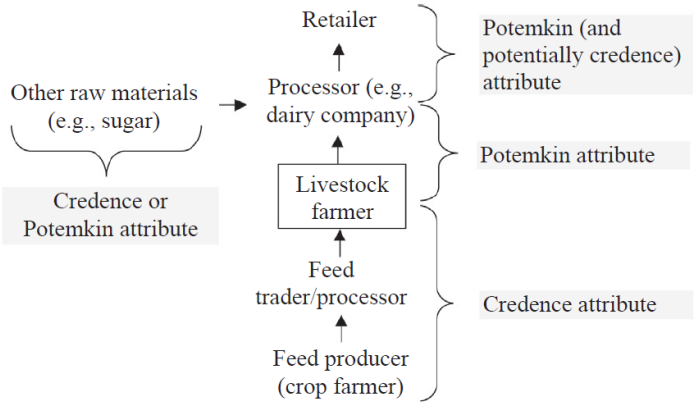

Fig. 3. Transformation of a credence attribute into a Potemkin attribute in the livestock product supply chain and its implications for traceability and documentation.
Source: Authors.

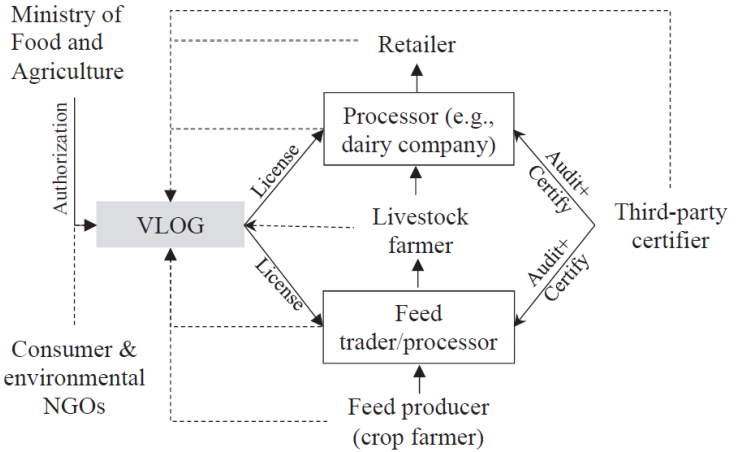

Fig. 4. VLOG membership (dashed line) of various stakeholders, licensing of the non-GMO label, and third-party auditing and certification (Note: some members are not licensees, and some licensees are not members.).
Source: Authors.

Aggregate Labelling Costs: Canada and the US

Table 6: Labeling costs reported in the literature.

Type of labeling cost	Amount
Median labeling cost estimates for a household of four in California[1]	348 - 401 USD per year
Median labeling cost estimate for a household of four in Washington State[1]	360 – 490 USD per year
Midpoint labeling estimate per capita in New York State[1]	200 USD per year
Segregation, certification and monitoring in New York state[1]	9 USD per capita and year
On-time labeling costs per product in California[2]	1 104 USD per product
Products need to be labeled mandatory in the US[2]	3% price increase
Increase in food retail prices mandatory labeling in Canada[3]	9% - 10%
Instituting mandatory labeling in Canada[4]	161.75 million USD
Recurring annual costs of mandatory labeling[4]	28.37 million USD per year
Increase in cost for Filipino food manufacturers[5]	11% – 12%

Sources: (1) Lesser (2014); (2) Bovay and Alston (2018); (3) KPMG (2000); (4) Cloutier (2006); (5) de Leon et al. (2004).

IP costs: specific food products

Table 7: Identity preservation costs for non-GM production.

Type of identity preservation cost	Amount
Oilseed rape and maize, increase in costs, processing level[1]	2.46 €/t
Elevator, increase in costs[2]	14.6%
Maize starch processors, increase in costs[2]	11%
Corn and soybean input cost increase at farm level in the US [3]	10%
Segregation, certification, and monitoring (costs per capita and year)[4]	36.60 USD
Additional costs along the supply chain from production to processing[5]	7% – 14%
IP system for GM-free products along the supply chain, additional cost at farm level[6]	6% – 17%
Costs per ton of grain at elevator level[7]	7.00 USD
Extra costs for wheat seed[8]	1.4%
Costs per ton of wheat at farm level in Germany (Denmark)[9]	10.85 €/t (4.87 €/t)
Costs per ton of wheat for starch at elevator level in Germany[9]	13.65 – 16.09 €/t
Costs per ton of wheat for feed at elevator level in Denmark[9]	11.72 – 13.55 €/t
Costs per ton of bread-quality wheat at elevator level in Denmark[9]	6.91 €/t
Costs per ton of wheat starch at the processing level in Germany[9]	~ 26 – 39 €/t
Costs per ton of wheat compound feed at the processing level[9]	~ 14 – 17 €/t
Costs per ton of wheat flour and bran at the processing level[9]	~ 11 €/t
Extra costs for sugar beet seed in Germany[9]	8.1%
Costs per ton of sugar at the processing level in Germany[9]	~ 28 €/t
Costs per ton of sugar at the processing level in Germany[9]	~ 17 – 22 €/t
Extra costs for rapeseed oil seed[9]	10% – 20%
Cost per ton of rapeseed oil at farm level in Germany (Denmark)[9]	74.4 €/ha (40.1 €/ha)
Cost per ton of rapeseed oil at elevator level in Germany[9]	17.29 €/t
Cost per ton of rapeseed oil at processing level in Germany (Denmark)[9]	74.1 €/t (83.16 €/t)
Price increase for frozen pizza[10]	26.56 €/t
Cost for frozen pizza in percent of turnover[10]	0.47%
Price increase for chocolate[10]	24.13 €/t
Cost for chocolate in percent of turnover[10]	0.67%

Sources: (1) Gawron and Theuvsen (2008); (2) Gabriel and Menrad (2014); (3) Lesser (2014); (4) Alston and Sumner (2012); (5) EC (2023); (6) Miraglia et al. (2004); (7) Maltsbarger and Kalaitzandonakes (2000); (8) Tolstrup et al. (2003); (9) Menrad et al. (2009); (10) Gabriel and Menrad (2014).

GMOfree Dairy Production

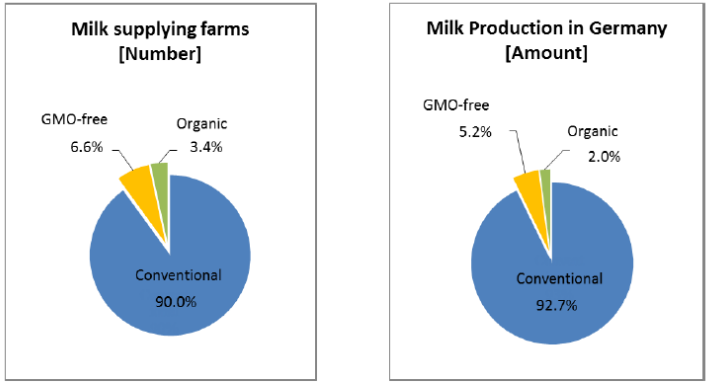

Figure 1 Percentage distribution of milk supplying farms and amount of milk production in Germany in 2011 (Venus and Wesseler, 2012).

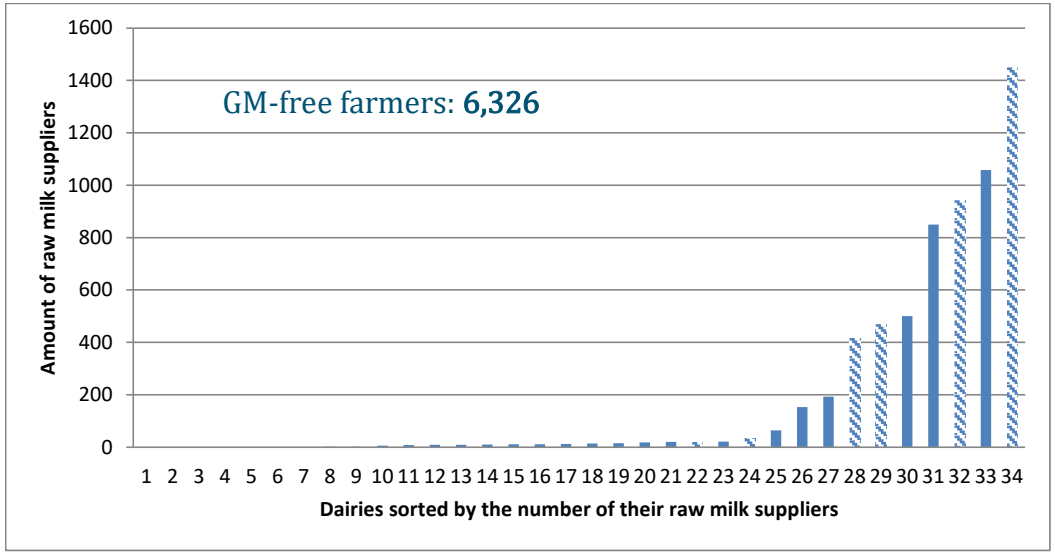

Figure 1: German milk producing firms, sorted by the number of GM-free suppliers

Table 1: Amount of GM-free dairies compared to conventional dairies separated by the milk amount produced

	Amount of dairies	Amount of GM-free dairies	Percentage of GM-free dairies per size group.
<50,000 kg	95	31	33 %
>50,000 kg	127	7	5 %
TOTAL	**196**	**38**	**19 %**

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GMO-free labeled milk: net-price premium?

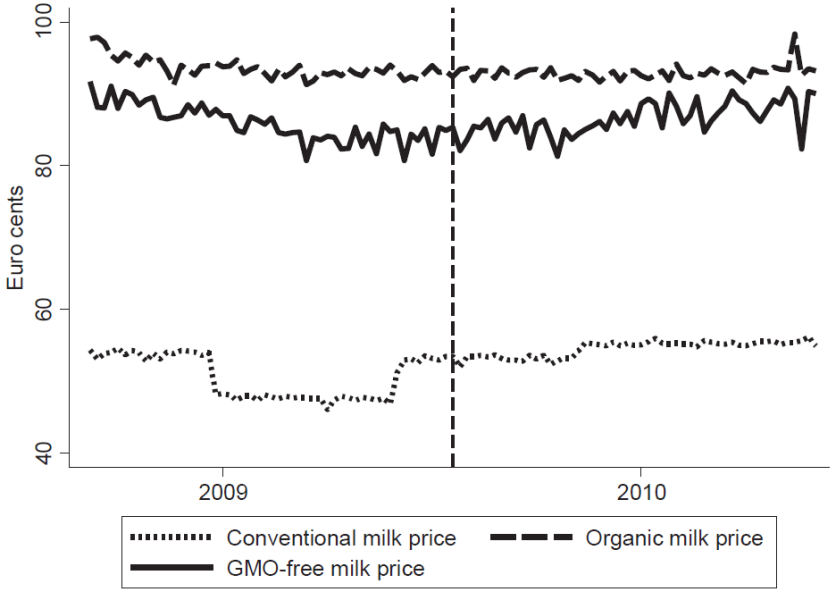

Fig. 1. Price dynamics of different milk labels, 2009–2010.

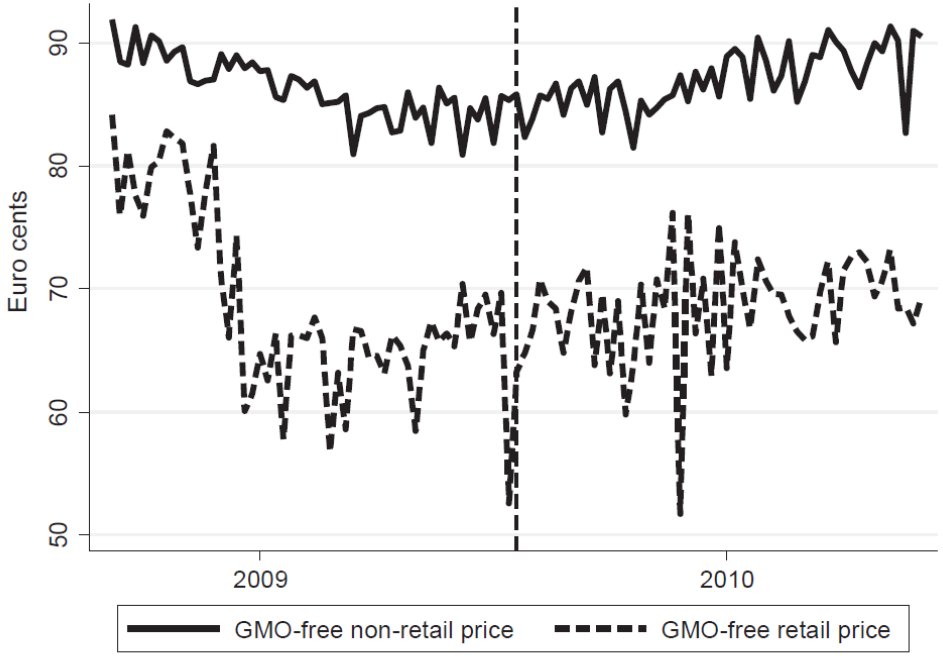

Fig. 2. Price dynamics of GMO-free-labeled milk by brand category, 2009–2010.

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NON-GMO Labelling in Germany

Table 1
Comparison of non-GMO labeling regulated under the Novel Foods Regulation and Germany's Genetic Engineering Act (GGEA).
Source: Based on Federal Ministry of Germany (1998, 2004).

	Novel foods regulation (before 2008)	GGEA (after 2008)
GM enzymes and additives in feed allowed	No	Yes
GM medical products for animals allowed	No[a]	Yes
Periods in which GM feed is allowed	Zero	Egg: 6 weeks Poultry: 10 weeks Dairy: 3 months Pork: 4 months Beef: 12 months (and maximally ¼ of animal life)
Threshold of adventitious presence of GM material	Zero	0.9 wt-% for feed 0.1 wt-% for food
GM enzymes and additives in food product allowed	No	No

Note:
[a] GM medicine for animals was allowed if no alternative non-GM version was available.

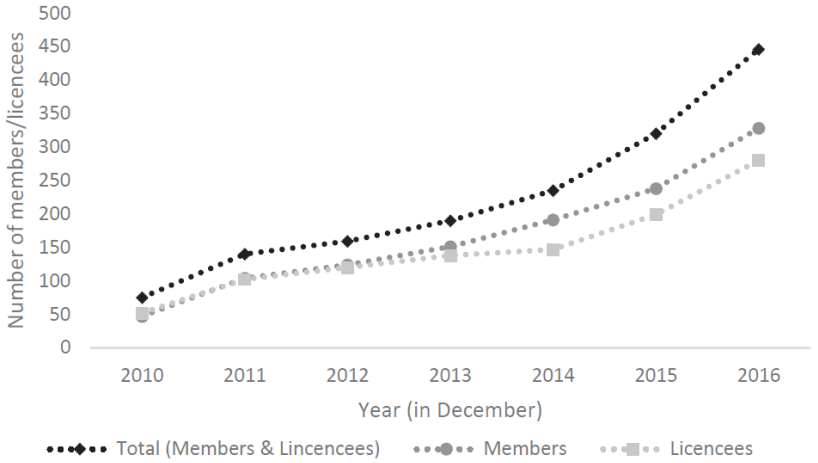

Fig. 1. Development of members and licensees of the German Association of Food without Genetic Engineering (VLOG) (Note: The total does not correspond to the sum of members and licensees, because some members are not licensees and some licensees are not members.)

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Products and Revenues: nonGMOs

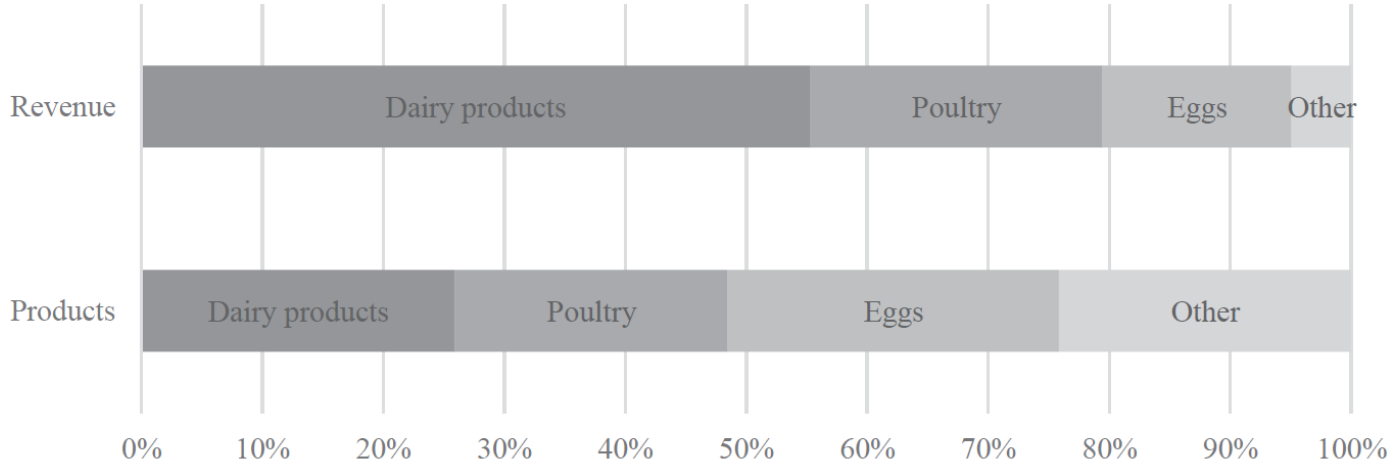


Fig. 2. Share of product type on the total number (6170) and revenue (4415 million euros) of non-GMO labeled products certified by VLOG. Source: Based on VLOG (2017).

Labeling and traceability scenarios

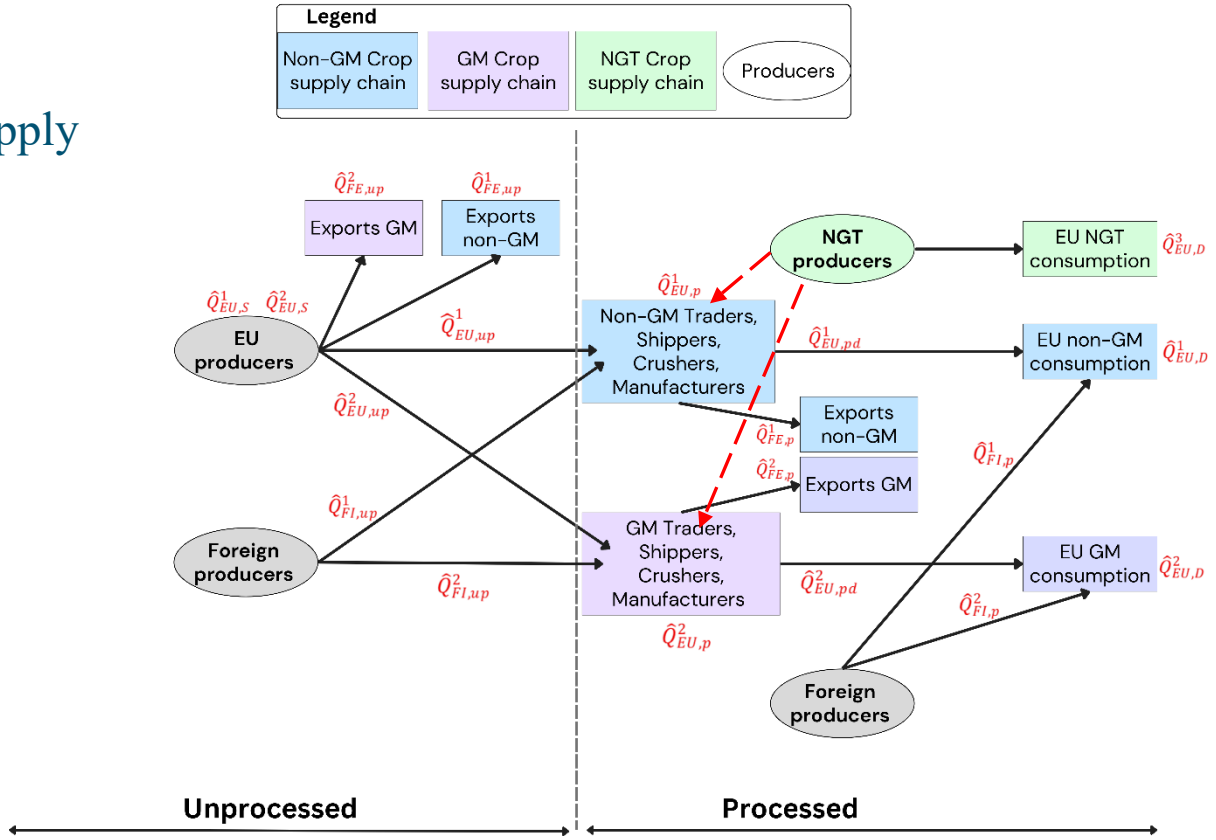
- Possibilities:
  - Indication on the label: just printing costs
  - Via varieties: costs increase exponentially
  - Documentation (block chain) similar to other credence goods
  - Identification for labeling (if possible): high cost scenario
  - Combinations of the above
- Identity Preservation: non-NGT bears the additional costs

NGT labeling scenario: market segregation

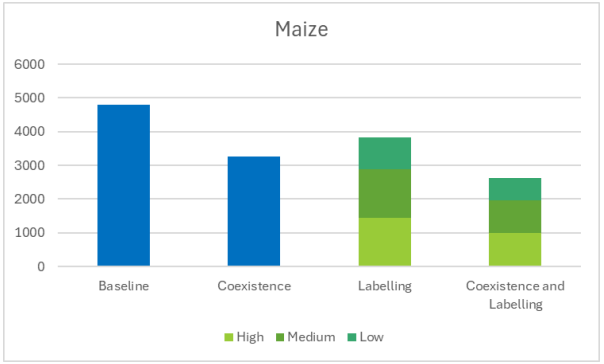
- Assumptions:
  - Market segregation: a new NGT supply chain introduced
  - Labeling and traceability along the supply chain required
  - Labeling and traceability costs: low, middle, high
    - Low: may contain NGTs, no tracing
    - Middle: contains NGTs, w/o specification but traceability
    - High: contains NGTs, with specification and traceability
- Result: lower benefits for producer, processor, consumer, import and export,
  - Difference to baseline scenario costs/benefits

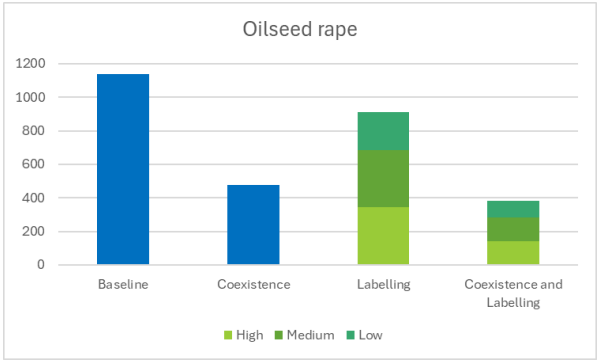
NGT labeling scenario: market segregation

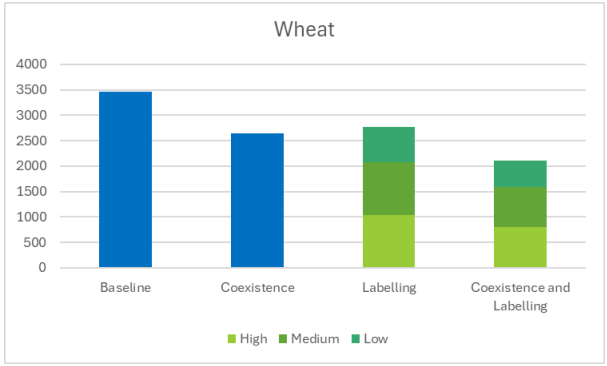
Figure 4: Crop Supply Chain in the EU



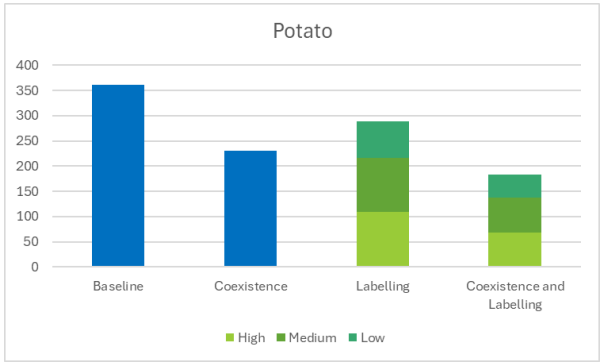
Crop examples

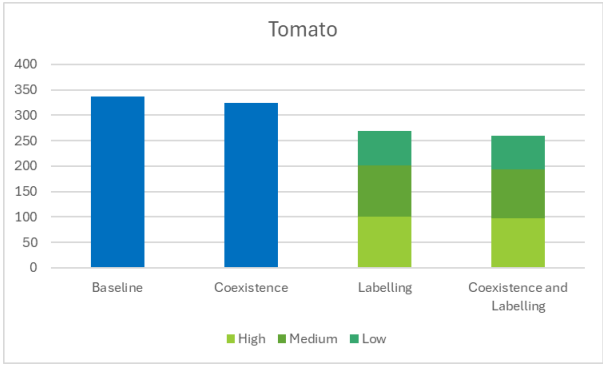






Total surplus in million Euro (average per year)





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Supply chain: maize

Table 12: Changes in the surplus of maize due to the introduction of NGT in the market and the presence of traceability for non-GM producers along the supply chain.

	ΔTS	ΔCS	ΔPS
Δ Importers of unprocessed GM (mio. Euro)	-19	-9	-9
Δ Importers of unprocessed non-GM (mio. Euro)	-16	-6	-10
Δ Traders, shippers, crushers, manufacturers GM (mio. Euro)	-33	-17	-16
Δ Traders, shippers, crushers, manufacturers non-GM (mio. Euro)	-1 721	-1 022	-669
Δ Importers of processed GM (mio. Euro)	-0 812	-0 519	-0 292
Δ Importers of processed non-GM (mio. Euro)	2	-1	-0 938
Δ non-GM producers (mio. Euro)	-326	-193	-132

Source: Authors elaboration. Model details explained in the text

Table 13: Changes in maize NGT surplus due to the presence of labeling for NGT producers.

	ΔTS	ΔCS	ΔPS
Δ NGT producers unprocessed (mio. Euro)	-189	-112	-77
Δ NGT producers processed (mio. Euro)	-327	-194	-133

Source: Authors elaboration. Model details are explained in the text.

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Conclusions

- Animal products directly and indirectly affected.
- Labeling costs depend on the labeling requirements
    - EU currently prohibitively high
    - Strong international trade effects
- Traceability costs:
    - Linked with IP preservation

Conclusions

- International trade effects:
  - Importers of Non-GM mainly affected in dual markets
  - Spill-over effects on other regions
- Overall effects:
  - Labeling and traceability prevents application at EU level.
  - They act as a barrier to submitting proposals for approval for import and processing of NGTs.
- We need to think of the applications as one!

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Thank you for your attention!

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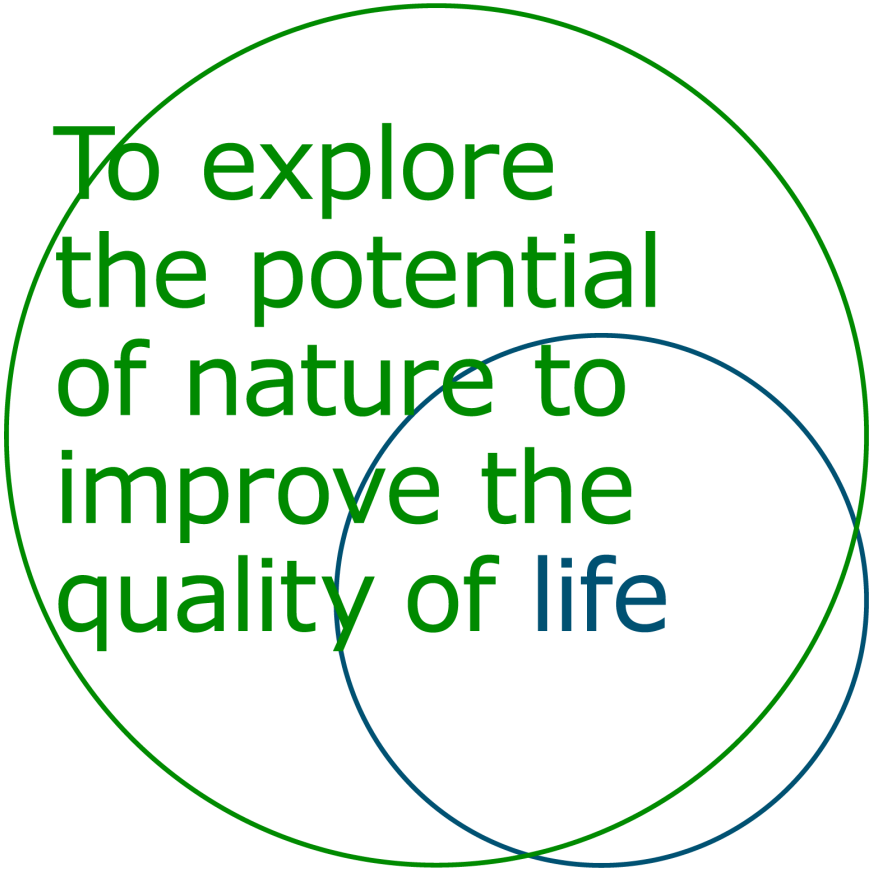

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