



Use of digital technologies in agriculture and impacts on production: the case of French dairy farms

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Journée #DigitAg (Axes 1 et 2 - SHS)

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Presentation layout

1

Tehnological progress: history and production context

2

Theoritical framework

3

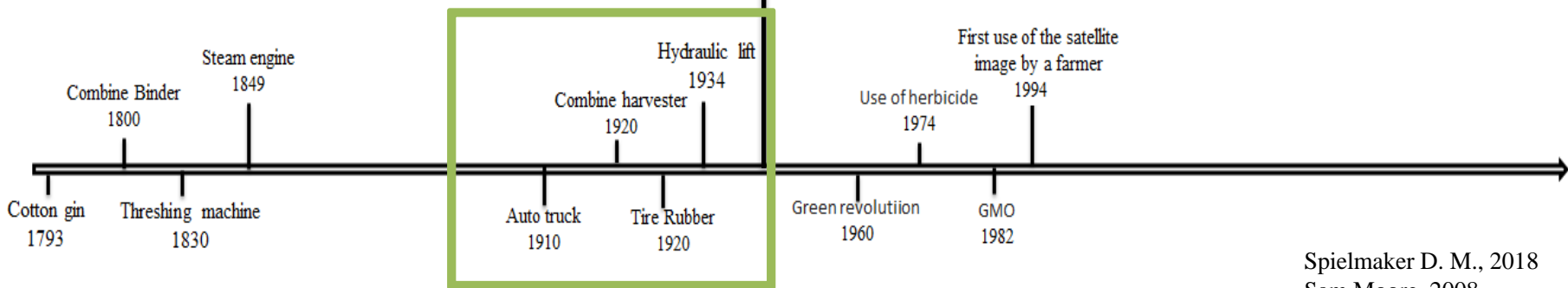
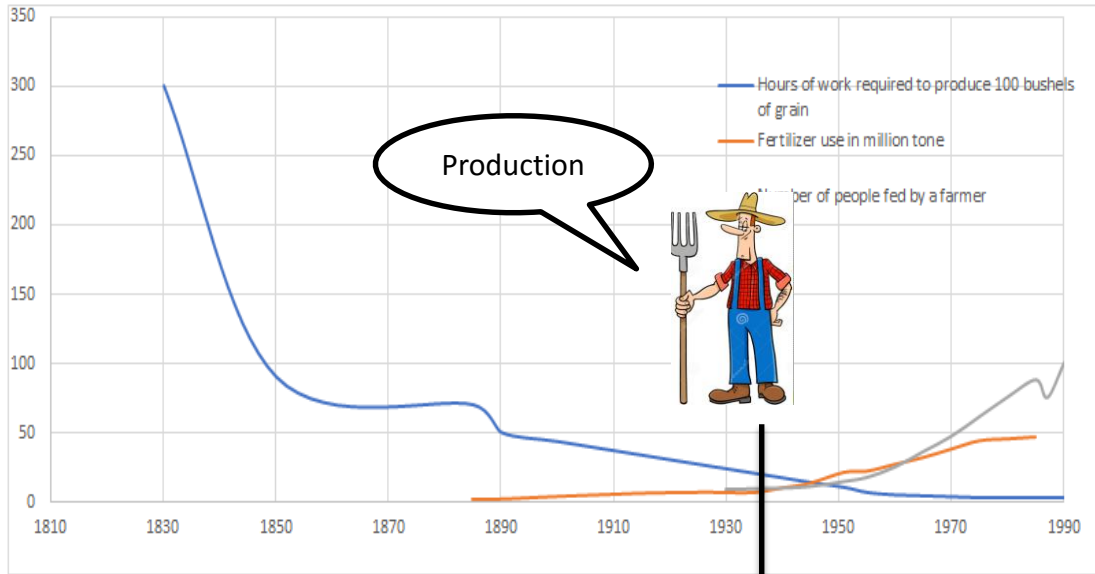
Data description

4

Regression results and discussion

5

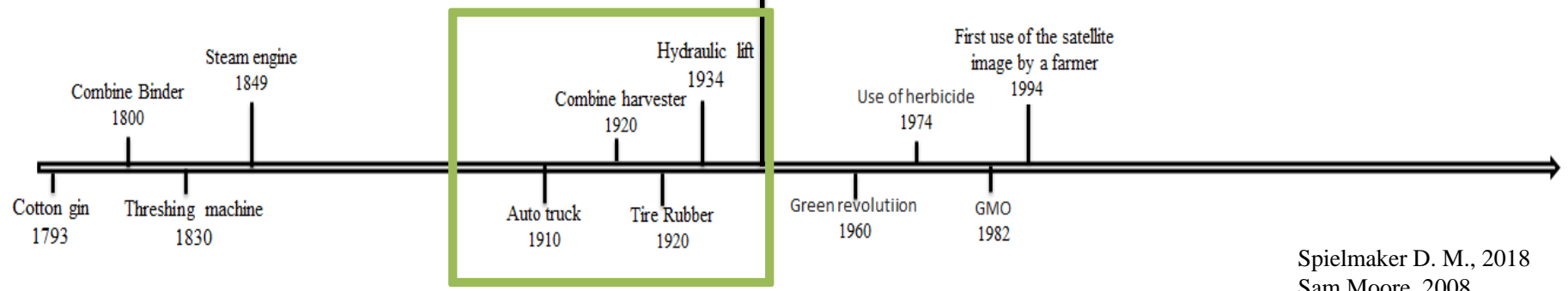
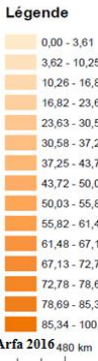
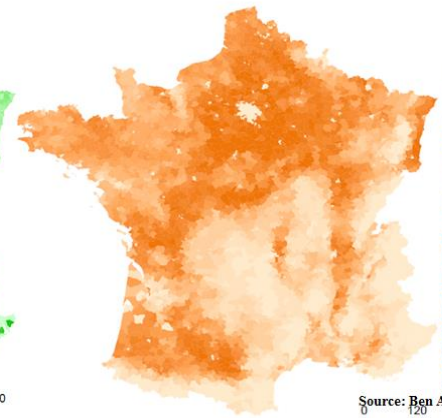
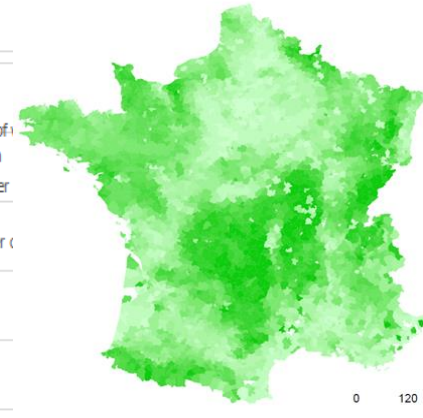
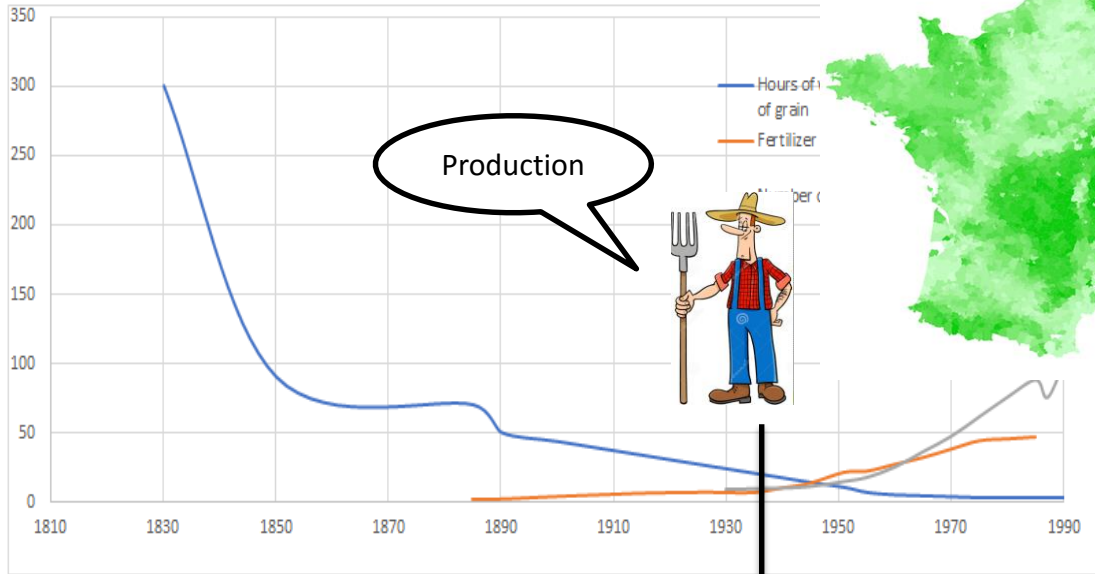
Conclusion and perspectives



Spielmaker D. M., 2018
 Sam Moore, 2008
 Brandie Piper, 2017

Share of **grassland** in the total agricultural area in 2010

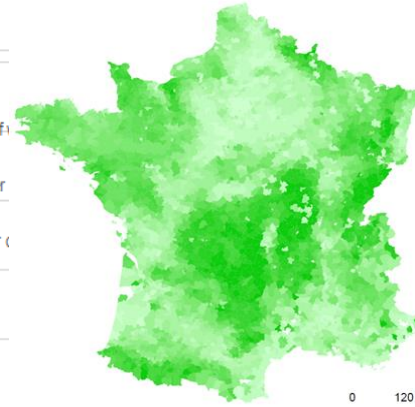
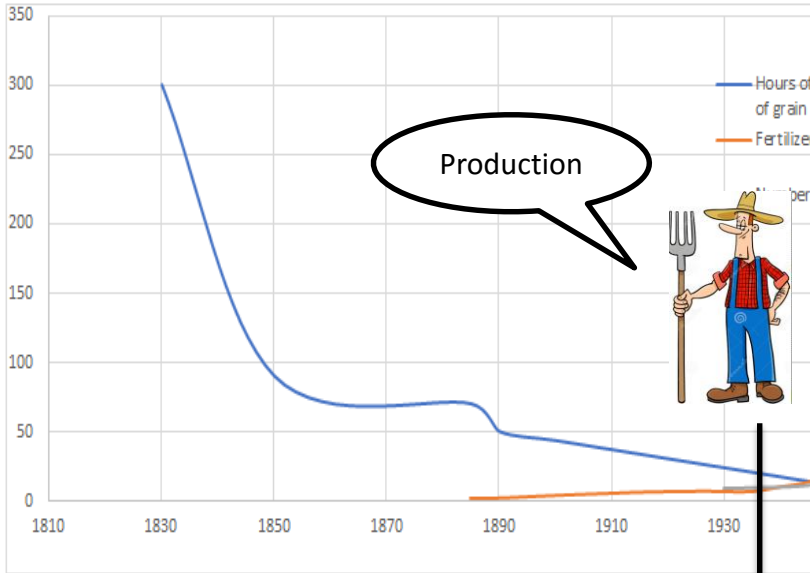
Share of **crop** surface in the total agricultural area in 2010



Spielmaker D. M., 2018
 Sam Moore, 2008
 Brandie Piper, 2017

Share of **grassland** in the total agricultural area in 2010

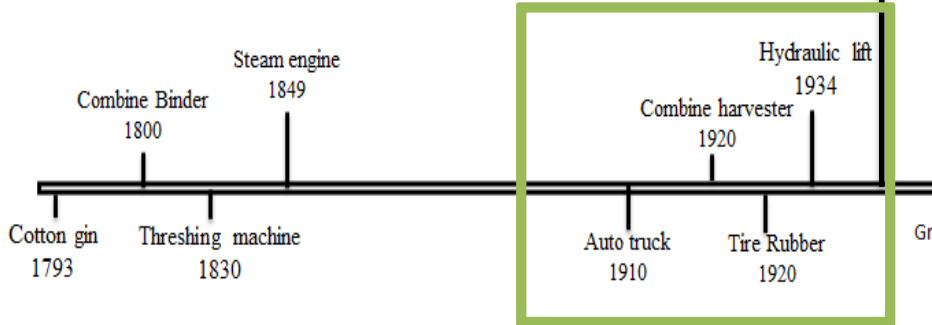
Share of **crop** surface in the total agricultural area in 2010

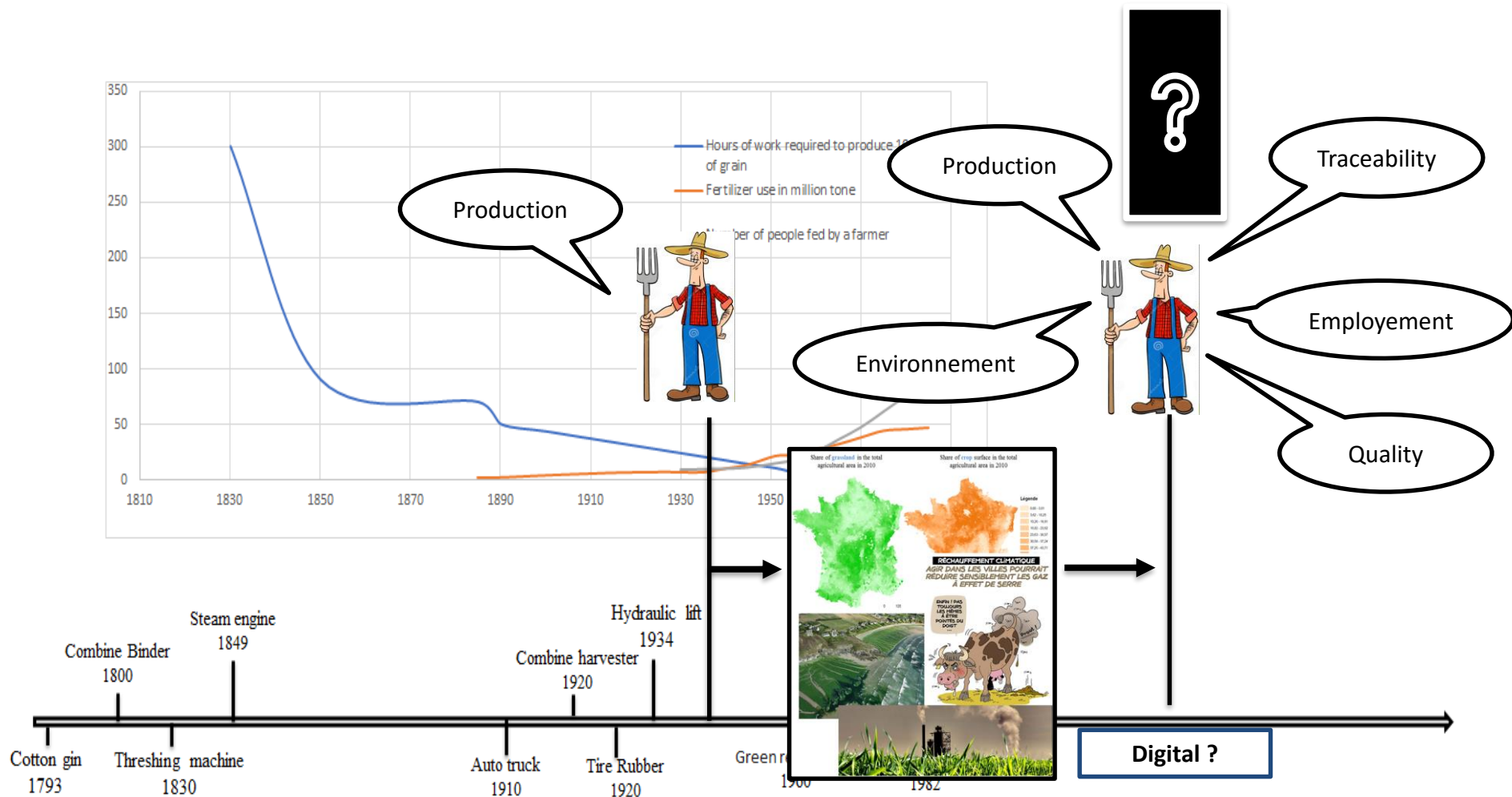


Légende

0,00 - 3,61
3,62 - 10,25
10,26 - 16,81
16,82 - 23,62
23,63 - 30,57
30,58 - 37,24
37,25 - 43,71
43,72 - 50,02
50,03 - 55,81
55,82 - 61,47
61,48 - 67,12
67,13 - 72,77

RÉCHAUFFEMENT CLIMATIQUE
AGIR DANS LES VILLES POURRAIT RÉDUIRE SENSIBLEMENT LES GAZ À EFFET DE SERRE

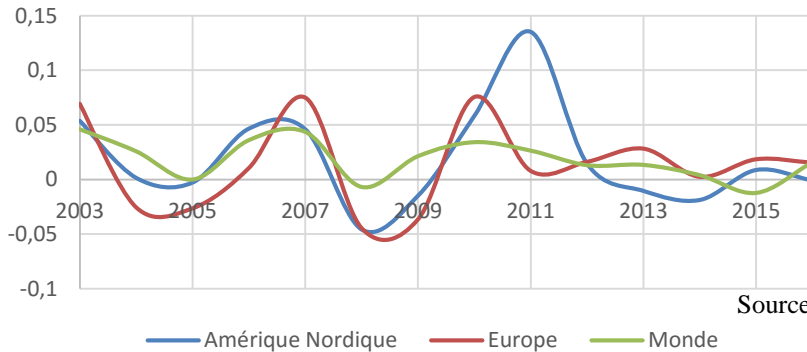




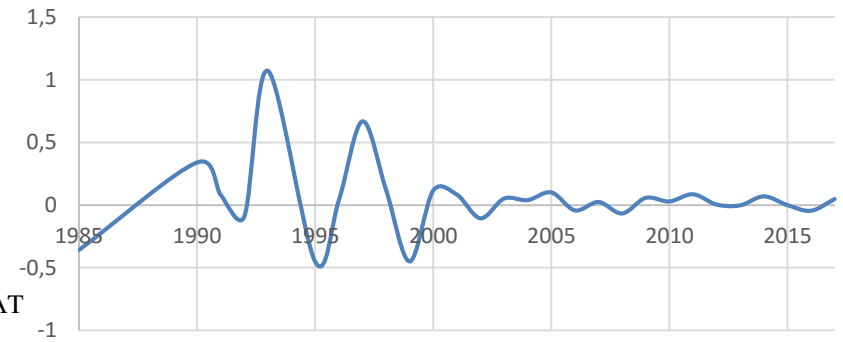
Spielmaker D. M., 2018
 Sam Moore, 2008
 Brandie Piper, 2017

Performances of conventional technologies stagnate

Average consumption of nitrogen fertilizers growth rate

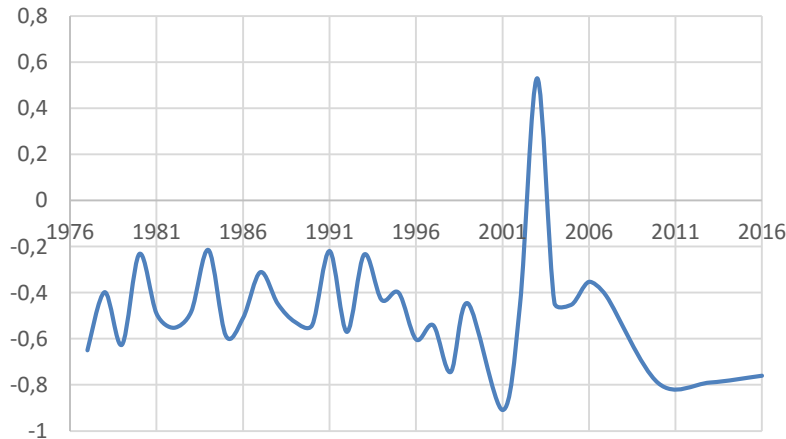


Tractor power growth rate

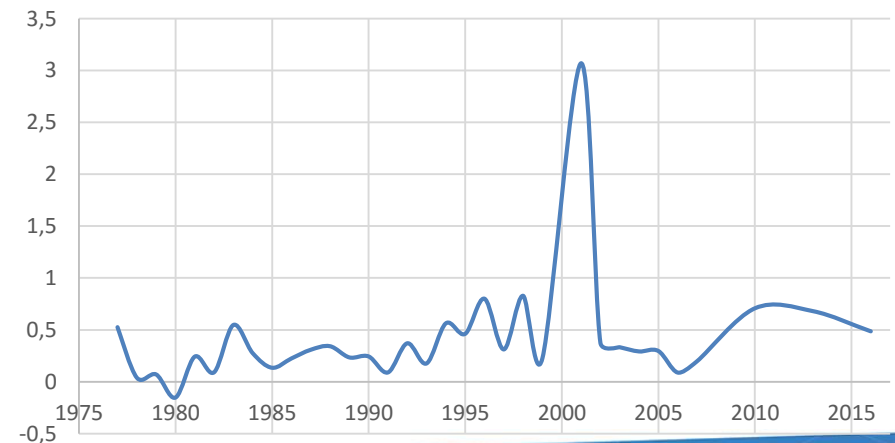


The rise of digital technologies performance

Cost of a microprocessor growth rate



Processor speed growth rate

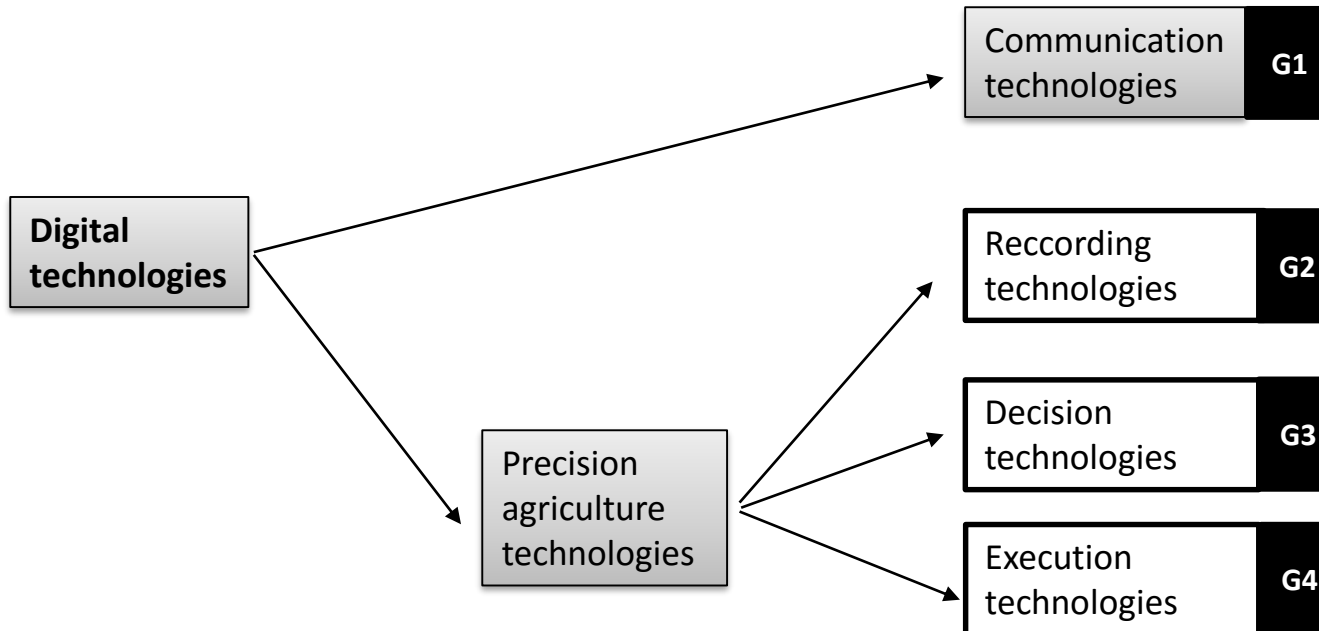


Q1: Do digital technologies improve the production ?

Q2: Will digital technologies impact farm agglomeration ?

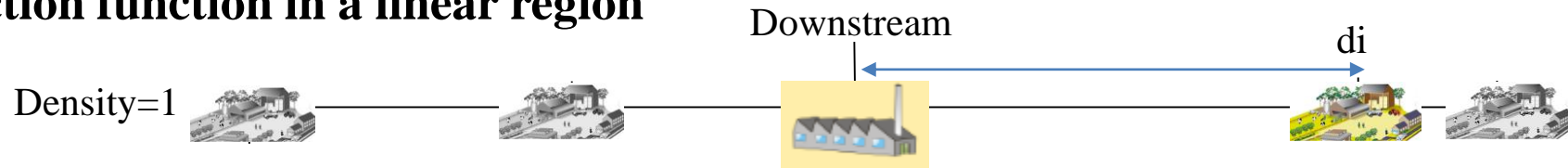
Hypothesis: If there is a agglomeration spillover induce by digital technologies, digital technologies must be more productive in farms dense area.

Digital technologies are any technologies in agriculture that use an updated information during its operation



Schimmelpfennig, 2016)

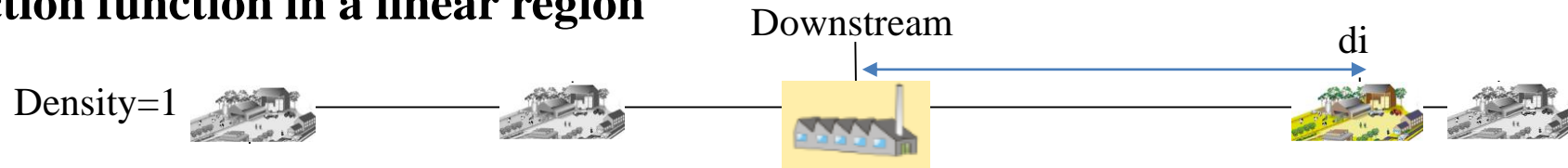
Production function in a linear region



$$(1) \quad hi = C.S_i * f(w, k, t) = C.Den(di).e^{-b.(di)}.w^\alpha k^\beta t^\gamma$$

Farm production

Production function in a linear region



(1)

$$hi = C \cdot S_i * f(w, k, t) = C \cdot Den(di) \cdot e^{-b \cdot (di)} \cdot w^\alpha k^\beta t^\gamma$$

Farm production

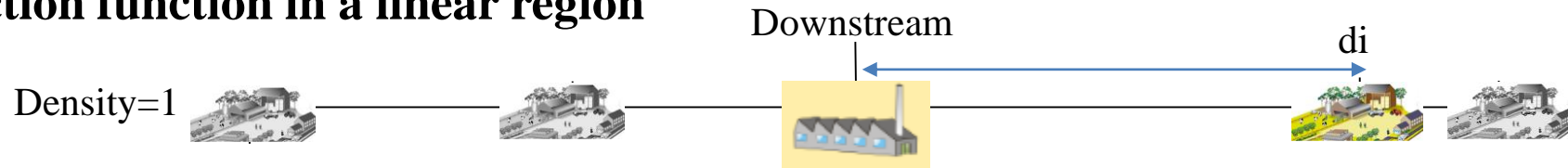
Labor

Land

Capital

Cobb–Douglas production function

Production function in a linear region



Technical spillover: Advantages to be near to peers, like to be informed about new product or an innovation

(1)

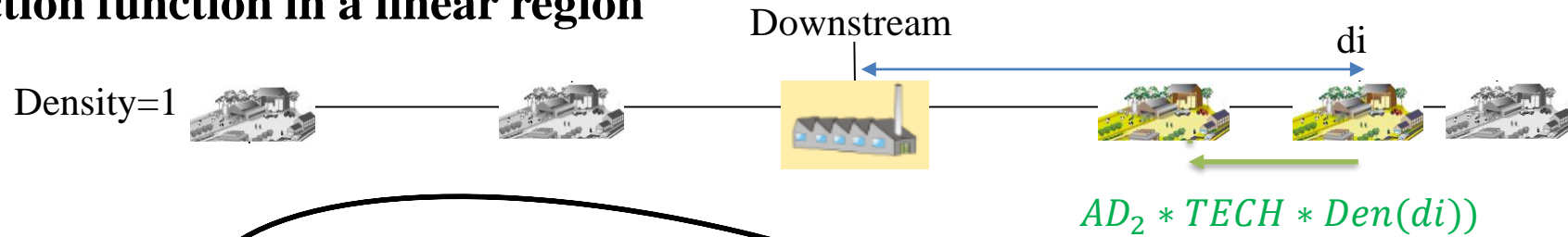
$$h_i = C \cdot S_i * f(w, k, t) = C \cdot \text{Den}(d_i) \cdot e^{-b \cdot (d_i)} \cdot w^\alpha k^\beta t^\gamma$$

Farm production

Agglomeration density at distance d_i
(Fujita and Thisse, 2001)

The decay of Technical spillover by distance to the center of the agglomeration (Fujita and Thisse, 2001)

Production function in a linear region



Q2 AD_2 : Effect of digital on the Technical spillover

(2) $hi = C.S_i * f(w, k, t) = C.Den(di). e^{-b.(di - AD_2 * TECH * Den(di))}. w^\alpha k^\beta t^\gamma . TECH^{AD_1}$

Q1

AD_1 : Effect of digital on the production function

	Definition	Unit	Year of observation	Mean or percentage
Dependent	Milk production	1000 liters	2015 (LPS)	464.36
Context variables	Does the farm produces meat?	1 if yes	2015 (LPS)	23%
	Commune populations number in 2010	Numeric	2015 (LPS)	1507.25
	Year of installation of the manager	Numeric	2015 (LPS)	1991
	Direct sale	1 if yes	2015 (LPS)	4%
Production variables	Does the farm feed his cow out?	1 if yes	2015 (LPS)	11%
	Total labor engaged per day	Hours per day	2015 (LPS)	10.04
	Utilized Agricultural Land	Hectare	2015 (LPS)	94.4
	Total of food (bought or produced) for dairy cow	Tones	2015 (LPS)	114.77
Proximity variables	Farm density	Number/ha	2010 (ACF)	0.51
	Dairy farm density	Number /ha	2010 (ACF)	0.12
Digital variables	Does the farm have internet connection?	1 if yes	2010 (ACF)	69%
	Does the farm have a Milking robot?	1 if yes	2015 (LPS)	7%
	Does the farm have use a Decision Support Tool?	1 if yes	2015 (LPS)	42%
	Do the farm use any electronic monitoring?	1 if yes	2015 (LPS)	15%
Instrumental variables	Agricultural multi-risk insurance	1 if yes	2010 (ACF)	
	Multi-risk insurance for farm buildings	1 if yes	2010 (ACF)	
	Multi-risk insurance of contents in farm buildings	1 if yes	2010 (ACF)	
	Crop insurance against climate risks	1 if yes	2010 (ACF)	
	Crop insurance against climate risks	1 if yes	2010 (ACF)	
	Accession to solidarity covering health or environmental risks	1 if yes	2010 (ACF)	

LPS: Livestock practice survey 2015 / **ACF:** Agricultural census of farms 2010

Definition	No endogeneity	Assuming the endogeneity of digital technologies choices					
	OLS Model	2SRI Internet	2SRI Robot	2SRI DSS	2SRI Monitoring		
Dependent variable	Log (Milk production)						
Context variables	Meat production presence	-0.162***	-0.163***	-0.167***	-0.163***	-0.166***	
	Commune populations number in 2010	NS	NS	NS	NS	NS	
	Year of installation of the farm manager	NS	NS	NS	NS	NS	
	Direct sale practices	-0.104**	-0.113**	-0.109**	-0.108**	-0.109**	
Production variables	Feeding dairy cow outdoor	NS	-0.04**	-0.0575**	-0.0506*	-0.0522*	
	Log (Total labor engaged per day)	0.203***	0.186***	0.203***	0.189***	0.188***	
	Log (Utilized Agricultural Land)	0.238***	0.236***	0.234***	0.239***	0.234***	
Proximity variables	Log (Food for dairy cow)	0.355***	0.359***	0.357***	0.358***	0.359***	
	Farm density	0.146***	0.141***	0.0954***	0.0843***	0.0899***	
Use of digital	Dairy farm density	NS	NS	NS	NS	NS	
		-	0.140***	0.161***	0.174***	0.129***	
Digital variables	Internet connection	0.155***	NS	-	-	-	
	INTERNET* Dairy farm density	0.381*	0.0938*	-	-	-	
	INTERNET* farm density	-0.104*	0.46**	-	-	-	
	Milking robot	0.354***	-	NS	-	-	
	ROBOT* Dairy farm density	NS	-	-0.141**	-	-	
	ROBOT* farm density	-10.157**	-	-0.629**	-	-	
	Decision Support Tool	0.0803***	-	-	NS	-	
	Decision Support Tool * Dairy farm density	NS	-	-	NS	-	
	Decision Support Tool * farm density	NS	-	-	0.261*	-	
	Electronic monitoring	0.107***	-	-	-	NS	
	SURVEIL_ELECTRO* Dairy farm density	NS	-	-	-	0.108*	
	SURVEIL_ELECTRO* farm density	NS	-	-	-	0.443**	
	Residuals 2SRI		-	NS	0.138***	NS	NS
	R2 adjusted		0.56				

NS: Not Significant | *** <0.05; 0.05>** >0.01; 0.1>* >0.5

Degree of liberty: 2026

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Dependent variable	Log (Milk production)					
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	Year of installation of the farm manager	NS	NS	NS	NS	NS
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	Decision Support Tool * farm density	NS	-	-	0.261*	-
	Electronic monitoring	0.107***	-	-	-	NS
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	Residuals 2SRI		-	NS	0.138***	NS
R2 adjusted		0.56				

NS: Not Significant | *** <0.05; 0.05>** >0.01; 0.1>* >0.5

Degree of liberty: 2026

Q1: Do digital technologies improve the production ?

Yes , but it seems like those who adopt the technologies are the ones who are the most productive.

Does this mean that digital technologies increase the inequality between farmers ?

Q2: Will digital technologies impact farm agglomeration ?

Yes, especially for the communication, recording and decision technologies. Nonetheless, we have to do more research to explain the negative impact of farm density on milking robot production.

What about the impact on the farm profitability ?

Limitations of the study:

- The lack of instrumental variables
- Failure to take into account the actual distance between farms

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