DETERMINANTS OF TAKEOFF AND SLOWDOWN OF INNOVATION IN A SITUATION OF UNCERTAINTY ABOUT ENVIRONMENTAL AND HEALTH RISKS

Mariia Ostapchuk

Claire Auplat

Pierre Boucard

Jean-Marc Brignon

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Serenade
Safe(r) Ecodesign Research and Education applied to nAnomaterial DEvelopment.

NOVANCIA BUSINESS SCHOOL PARIS
une école de la CCI PARIS ILE-DE-FRANCE

DAUPHINE UNIVERSITÉ PARIS

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Outline

1. Background information
2. Methodology and data
3. Results
   - Estimated results
   - Over- and under-consumption of bisphenol A
4. Conclusions
5. Discussion

Background information

- Every innovation has its own inherent uncertainty.

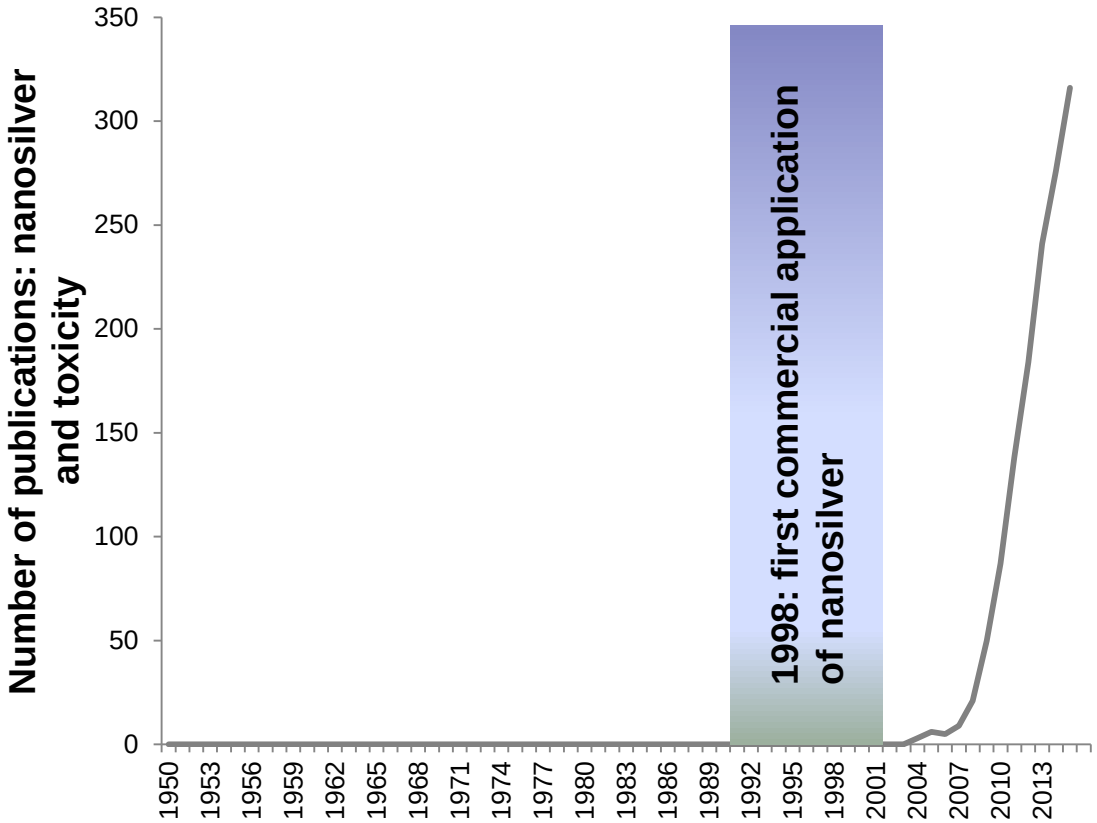
- Prior research on uncertainty and diffusion of innovation:
  - performance of innovation or its profitability (Jensen, 1982; Oren & Schwartz, 1988)
  - expectations of future price (Chandrasekaran et al., 2013; Song & Chintagunta, 2003)

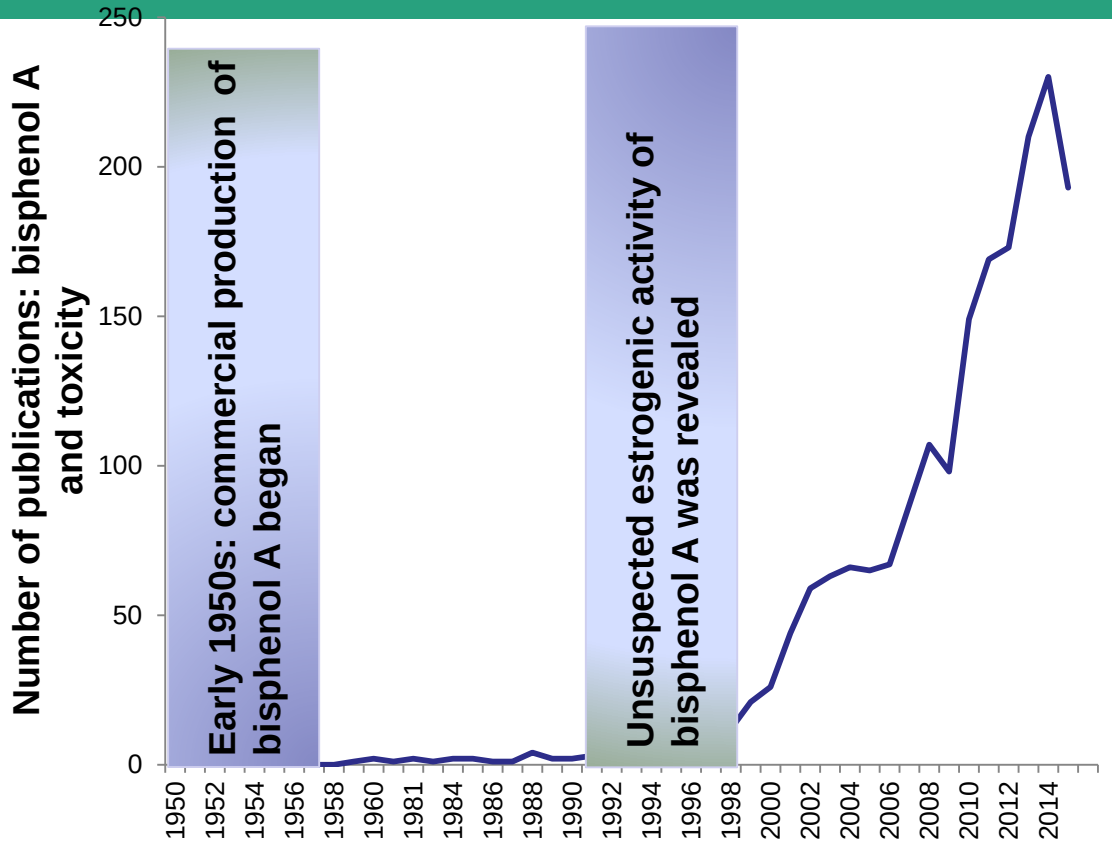
- Not much literature on uncertainty about environmental and health risks and innovation (Olson, Birge, & Linton, 2014)

- First evidence of determinants of adoption of nanotechnology: Arora et al., 2014; Köhler & Som, 2014

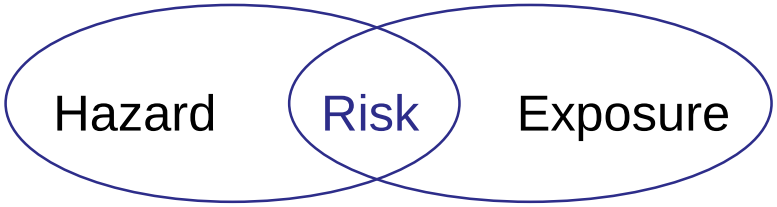
- Previous experience & rejection: GMO, asbestos…

Background information



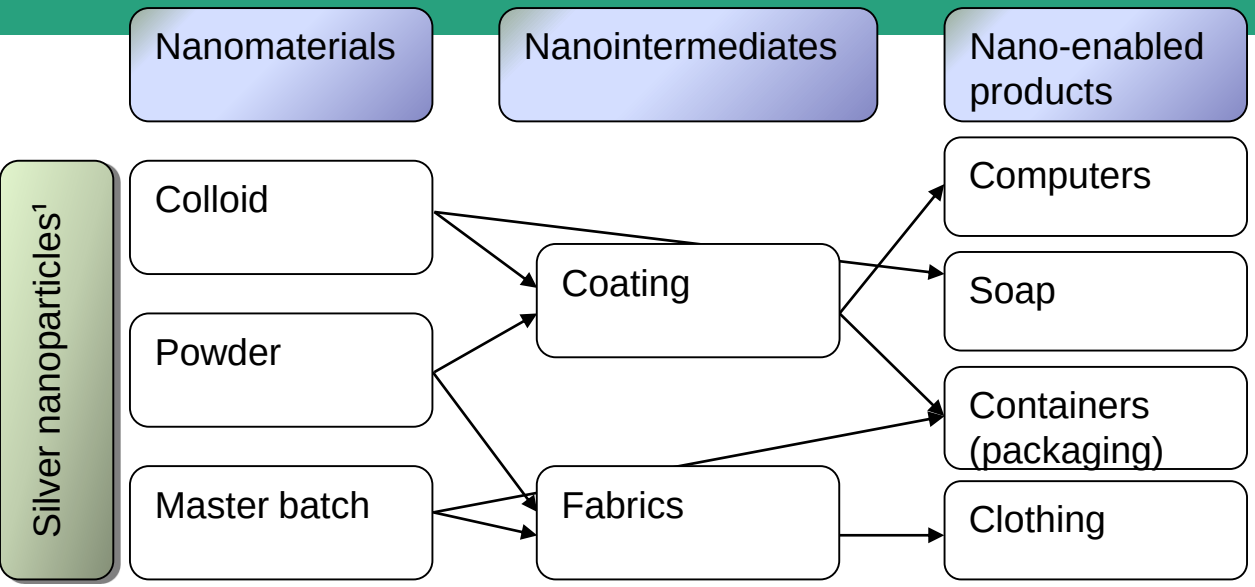


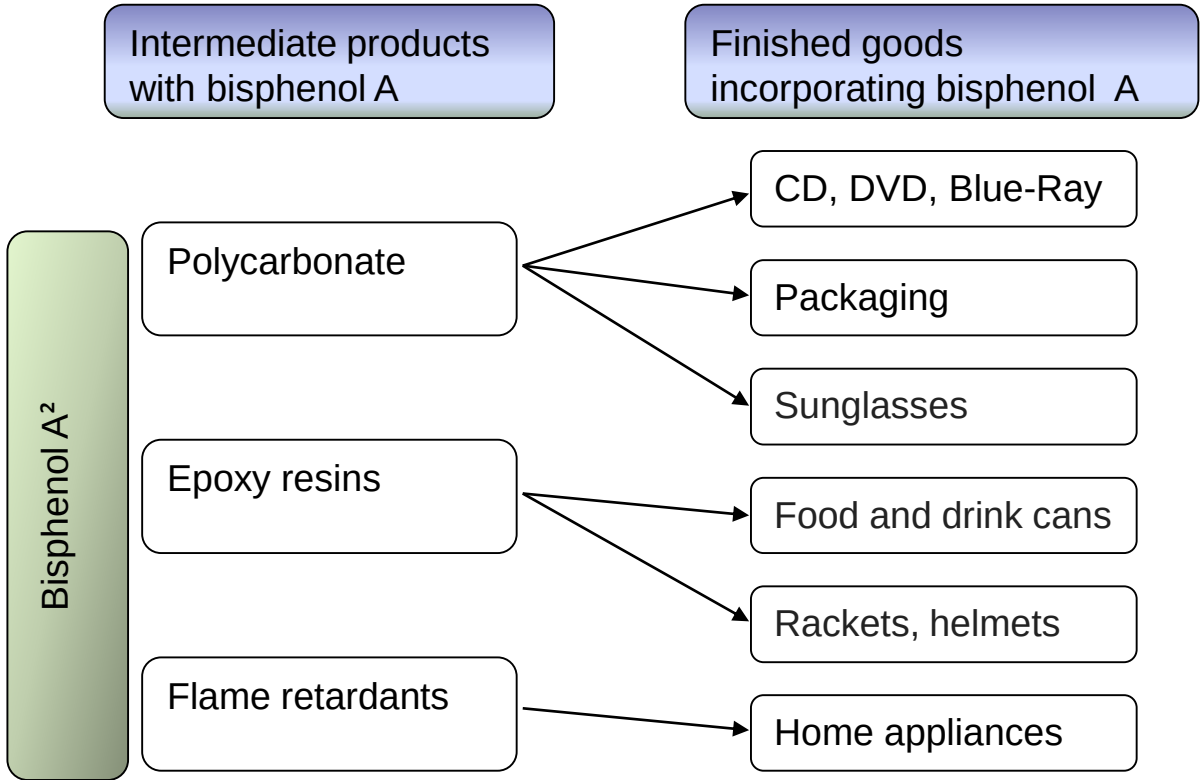
Source: Ostapchuk, based on PubMed



Source: Berube et al. (2010); Wiesner et al. (2006)

Background information

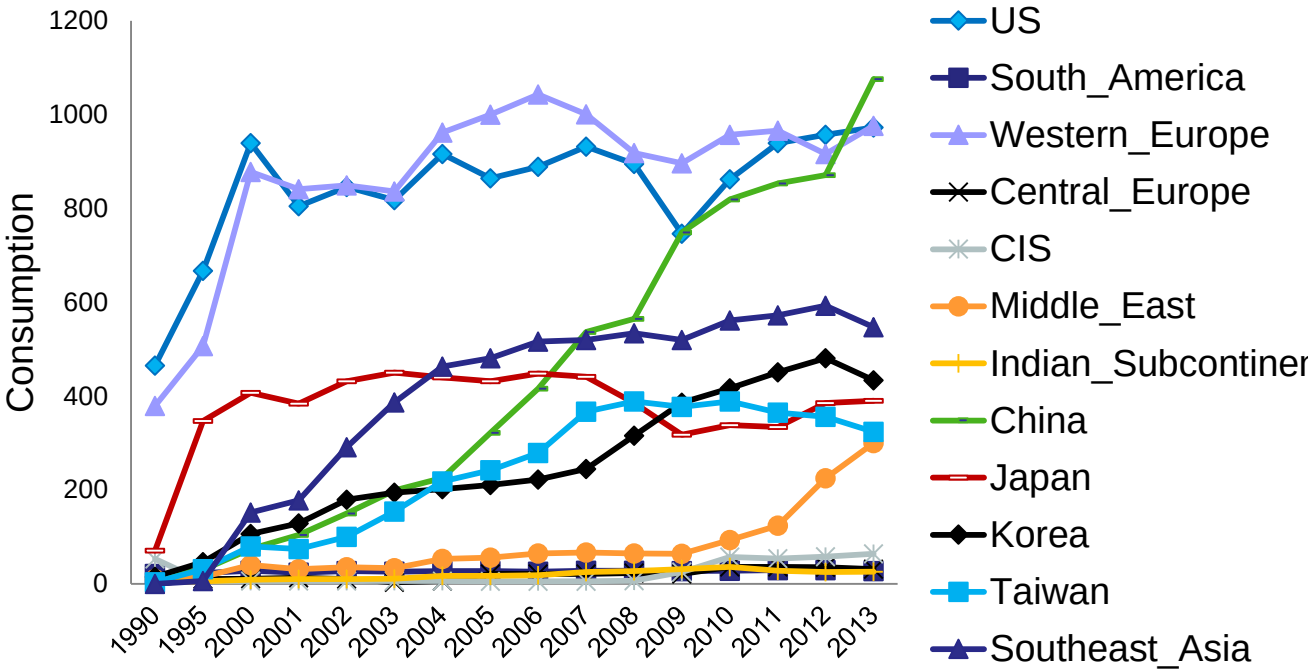




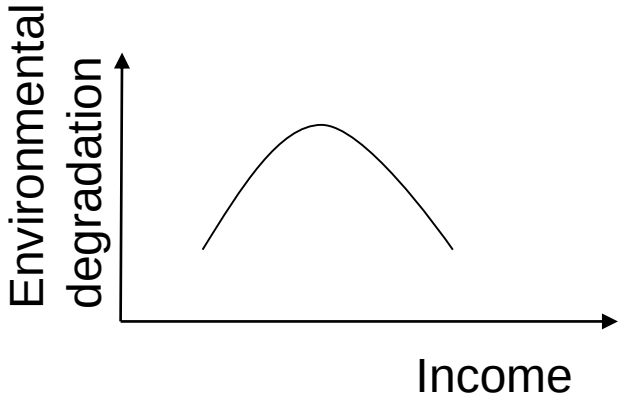
Source¹: Adapted from Frederick (2011)
Source²: Ostapchuk, based on (Brignon & Gouzy, 2010)

Background information

BPA annual consumption, thousands of metric tons



Source: Ostapchuk, based on IHS Chemical Economics book on Bisphenol A, thousands of metric tons



Source: Dinda (2004)

- The relationship between economic growth and BPA has not yet been studied
- Not much literature on the Environmental Kuznets Curve in a situation of uncertainty about environmental and health risks

Is there an Environmental Kuznets Curve (EKC) for bisphenol A consumption?

Empirical methodology

log of GDP *pc* in region *i* at time *t*

dummy variables

$$Bisphenol_{it} = \beta_0 + \beta_1 Inc_{it} + \beta_2 Inc_{it}^{\ 2} + \beta_3 Inc_{it}^{\ 3} + \alpha_t Year + (u_i + v_{it})$$

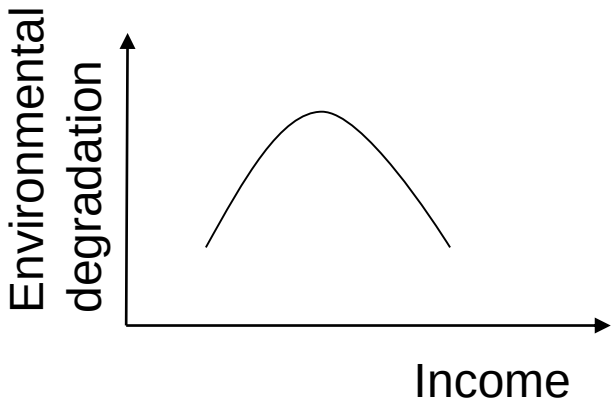
log of BPA consumption *pc* in region i at time t

unobserved time-invariant effect,
idiosyncratic error

Model (extended)

$$+ \beta_4 X_{it}$$

X:
- Country characteristics
- Market characteristics
- Industry characteristics
- Regulations



$$EKC: \beta_1 > 0, \beta_2 < 0, \beta_3 = 0$$

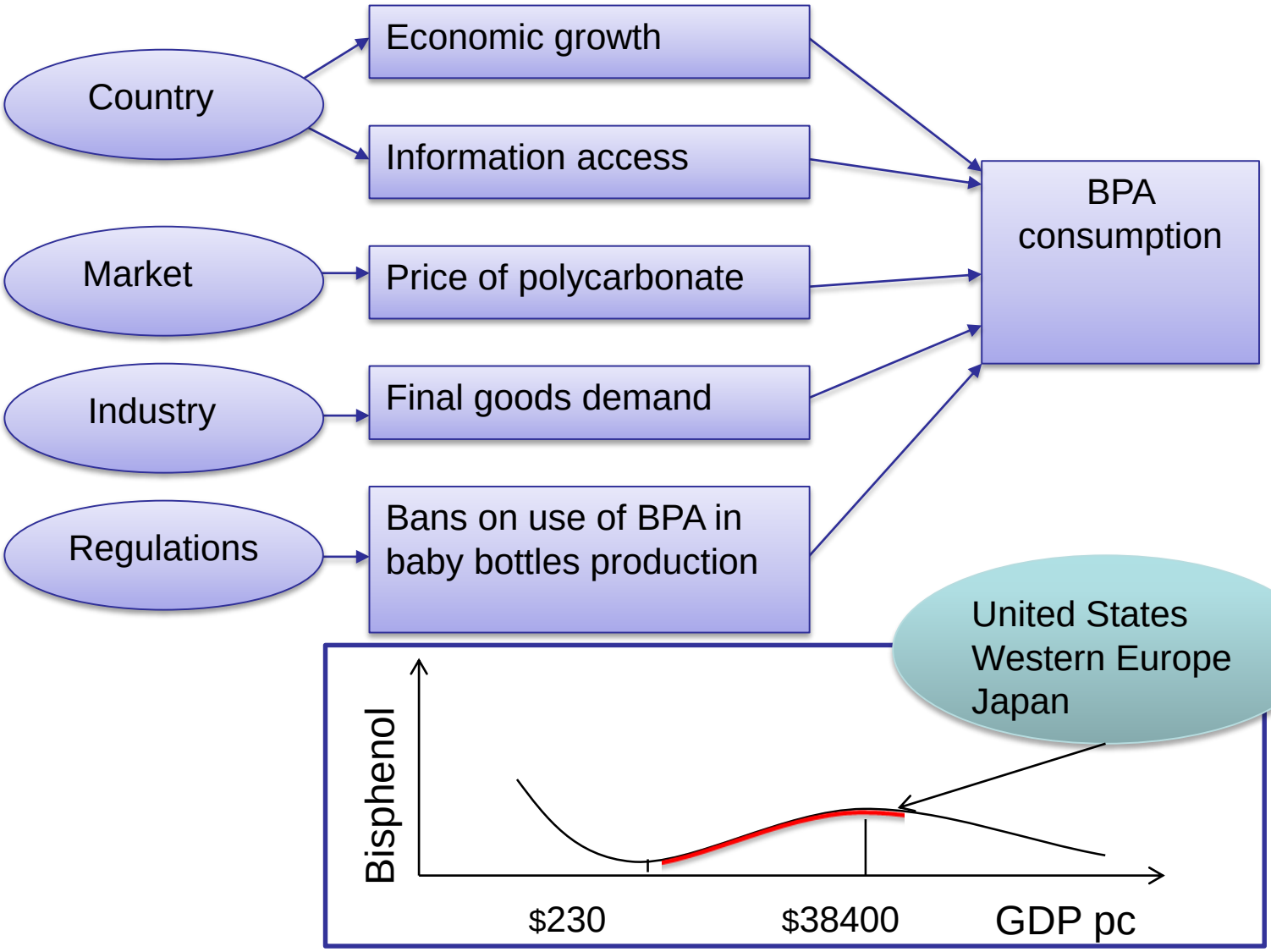
Source: Dinda (2004)

Estimation methods:
RE GLS with robust standard errors,
FGLS with heteroscedastic error structure

Data sources
Chemical Economics Handbook: Bisphenol A, IHS Chemical
The World Bank
Passport/Euromonitor International + national data sources
Hofstede et al. (2010)
PIE: Plastics Information Europe
PubMed

1. Results

A conceptual framework for the factors influencing BPA consumption: Model

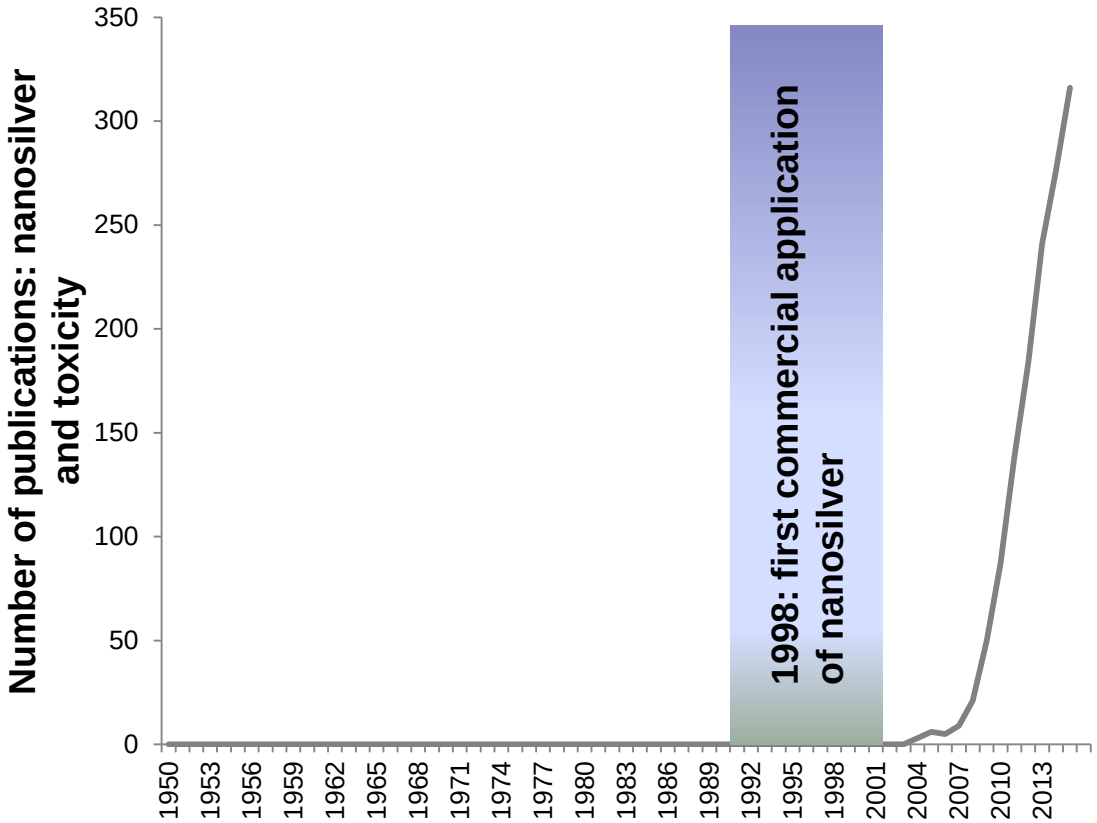


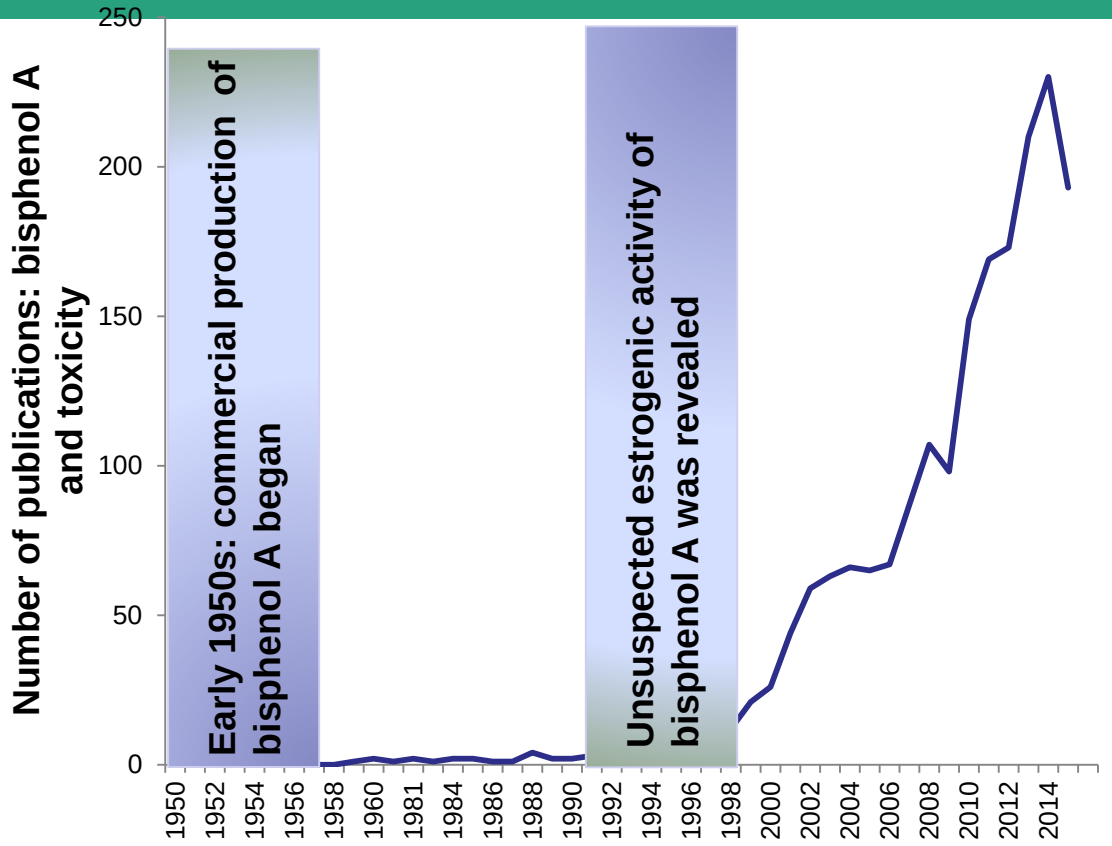
Source: Ostapchuk, based on World Bank and IHS Chemicals

	Model (extended) FGLS
VARIABLES	
GDP	-12.90***
	(4.790)
GDP^2	1.797***
	(0.560)
GDP^3	-0.0749***
	(0.0215)
Cable TV	0.0330***
	(0.00211)
CD	0.00421
	(0.00323)
Constant	16.53
	(13.40)
Time dummies	Yes
Observations	190
N of regions	12

*** denotes statistical significance at 1% level
,**denotes statistical significance at 5% level ,
*denotes statistical significance at 10% level

New scientific knowledge





Source: Ostapchuk, based on PubMed

Is there a link between the introduction of new scientific knowledge about potential risks and consumption of bisphenol A?

New scientific knowledge variable

The PubMed search engine keywords:

"Bisphenol A" + "epidemiology/toxicity/endocrinology"

1469 abstracts over the 1960-2013 period were evaluated

4 groups:

"Risk": 464

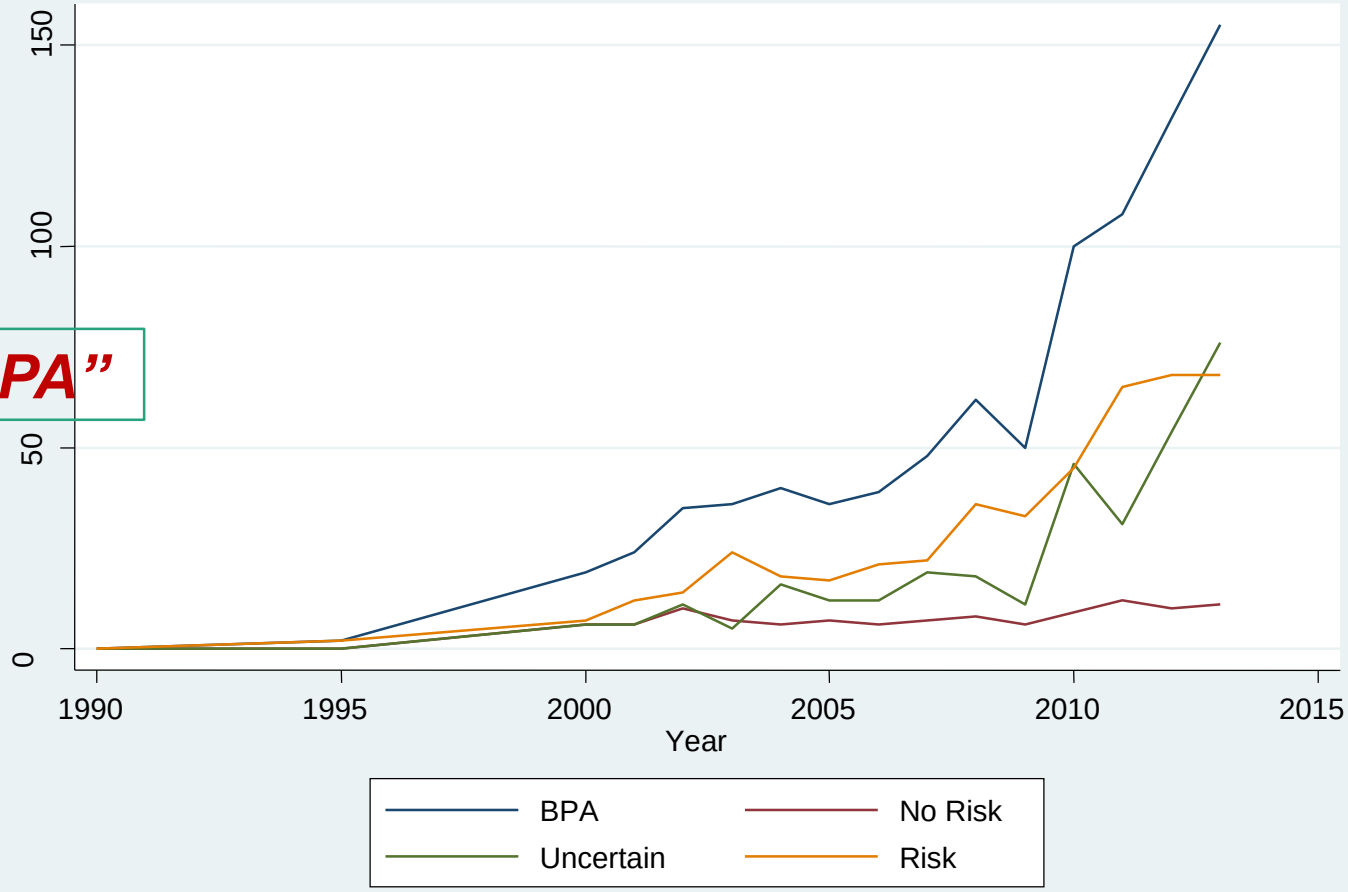
"No risk": 120

"Uncertain": 334

"Irrelevant"

"BPA"

Quantity of evaluated scientific articles 1990-2013



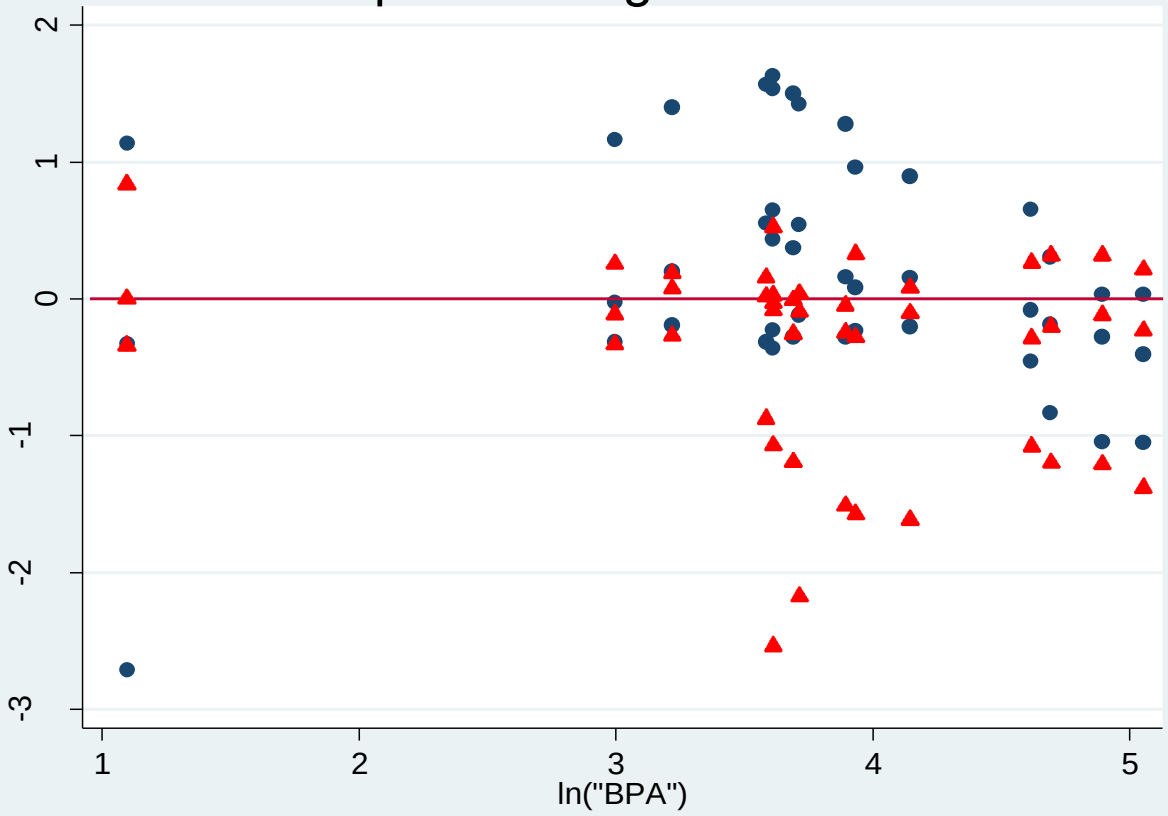
Source: Ostapchuk, based on PubMed

2. Results: over- and under-consumption of bisphenol A

(drawing on the study of Ghimire and Woodward (2013))

Over-consumption and under-consumption: actual values - predicted values

Scatter plot: over- and under-consumption of bisphenol A against “BPA”



Uncertainty avoidance index (UAI)

● UAI<43
China, India, Southeast Asia

▲ UAI>78
Central Europe, South Korea, Japan

The more negative the value of the residual, the more likely it is that bisphenol A is under-consumed.

The more positive the value of the residual, the more likely it is that bisphenol A is over-consumed.

Source: Ostapchuk, based on World Bank, Passport/Euromonitor International, PIE: Plastics Information Europe and IHS Chemicals

Conclusions

1. An inverted N-shape relationship between consumption of bisphenol A *pc* and economic growth is found.
2. Uncertainty avoidance has a moderating effect on the relationship between scientific knowledge about potential risk and over/under-consumption of BPA.

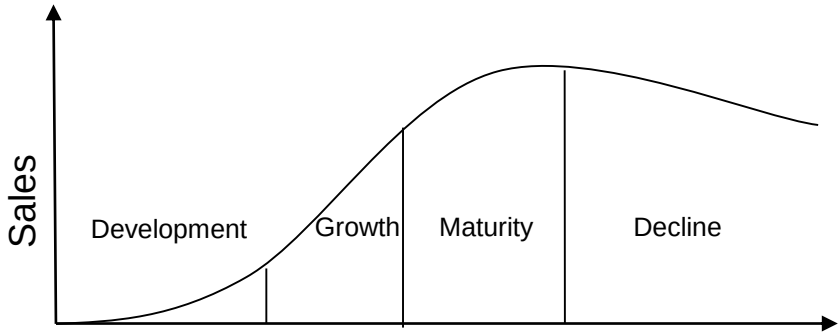
   The hypothesis that the higher the number of scientific articles related to potential risks of BPA, the greater the under-use of BPA, could not be rejected.

Potential limitations:

- Unavailability of disaggregated data
- Price of BPA + other factors which influence BPA consumption are not addressed in this study
- Further research on the relationship between the introduction of new scientific knowledge about potential risks of BPA and its over- and under-consumption

Discussion

The Generalized Product Life Cycle



Source: Levitt (1965)

- Over the studied period:
  - Sales of nanosilver: the development stage
  - Sales of Bisphenol A: the period of transition from the growth to maturity stage across multiple countries
- Previous findings:
  - Decrease in income increases the probability of slowdown (Golder & Tellis, 2004)
  - Controversial evidence of the impact of health information on demand (Van Ravensway and Hoehn 1991, Moon and Ward 1999 , Kenkel and Chen, 2000)
- But under conditions of uncertainty:
  - It is likely that an increase in income increases the probability of slowdown
  - Information shock may be one of the factors which decreases the time to takeoff and increases the time to slowdown

Thank you!

mariia.ostapchuk@ineris.fr

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