Projected Growth Effects of the Biotechnology Industry in Finland: The Fourth Pillar of the Economy?

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Aims

- Aim of the study Hermans and Kulvik 2005:

  to assess the impact of the biotechnology industry on economic growth in Finland.

- Aim of this presentation:

  to provide a practical example for a construction of a forecasting procedure for a new industrial branch.

Data

1. Input-output tables from Statistics Finland,
2. Annual financial statements from The National Board of Patents and Registration of Finland
3. ETLA survey data covering 84 Finnish biotechnology companies, containing information on their
   - foreign sales
   - anticipated future sales
   - R&D expenditure
   - purchases and sales by industrial sectors
   - intellectual capital

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Problems related to utilization of unofficial classification

1. Our survey data did not cover all the Finnish biotechnology companies (80 %)
2. Biotechnological applications span several statistical subgroups in the official statistical classification → the conventional statistical categories are not applicable for this new, emerging industry
3. The anticipated future sales disclosed by the biotechnology companies do not fully reflect the exceptional risks related to both the technological feasibility and delays in research and development processes.

Overcoming the obstacles

1. The individual measures of the companies in our sample were weighed to approximate the measures within the entire sector
2. We created a new industrial class of biotechnology in the conventional input-output table of Statistics Finland
3. We applied Monte Carlo simulation, which simultaneously allows the implementation of the stochastic features of failure versus success.

1. Weighing the sample

	before 1991	1991-1996	1997-2001
ETLA sample	25	34	25
Total number	34	46	51
Percentage share of sample	74 %	74 %	49 %
Weight	1.36	1.35	2.04

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2. Creating a new industrial branch in the input-output table

Inverse matrix derived from input-output table

Inverse matrix	Agriculture and other primary production	Biotechno-logy	Food industry	Chemical industry	Other industrial production	Construction and electricity	Health care services	Other services
Agriculture and other primary production	1.2410	**0.0084**	0.4465	0.0310	0.0637	0.0422	0.0064	0.0151
Biotechnology	**0.0002**	**1.0518**	**0.0020**	**0.0018**	**0.0001**	**0.0001**	**0.0013**	**0.0002**
Food industry	0.0641	**0.0082**	1.2768	0.0294	0.0193	0.0159	0.0085	0.0223
Chemical industry	0.0247	**0.0363**	0.0178	1.0772	0.0263	0.0131	0.0092	0.0051
Other industrial production	0.0966	**0.1028**	0.2030	0.1995	1.3697	0.3564	0.0617	0.1202
Construction and electricity	0.0494	**0.0263**	0.0460	0.0484	0.0362	1.0779	0.0245	0.0652
Health care services	0.0111	**0.0034**	0.0052	0.0014	0.0016	0.0017	1.0239	0.0054
Other services	0.2439	**0.2260**	0.3688	0.2765	0.2640	0.3295	0.1898	1.3531

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2. Creating a new industrial branch in the input-output table

-The exogenous increase of one unit in demand of biotechnology products and services will add 1.0518 units to the total output of the biotechnology industry.

- A one-unit increase in the output of the biotechnology industry is reflected by a 0.226-unit increase in the demand for other services (vertical column “Biotechnology” in Table above).

- 0.0002 units of biotechnology outputs are produced for the other services (horizontal row “Biotechnology” in Table above).

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3. Dealing with the random (3.1.) and systematic (3.2.) errors of sales anticipations

The forecast procedure utilizes the companies' expectations regarding their future export growth. However, using the companies' own expectations introduces two possible types of bias to the model:

3.1. Randomness at the company level—an arbitrary assessment of anticipated future exports;

3.2. Systematic error at the industry level—a tendency of the entire biotechnology sector to over-estimate the level of anticipated future exports over the period of the survey.

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3.1 Dealing with the random errors of sales anticipations

3.1. Hermans and Kauranen (2005) constructed an intellectual capital model that explained 70% of the variance in anticipated future sales.
Measurable intellectual capital was tightly related to the anticipated future sales of the biotechnology SMEs:

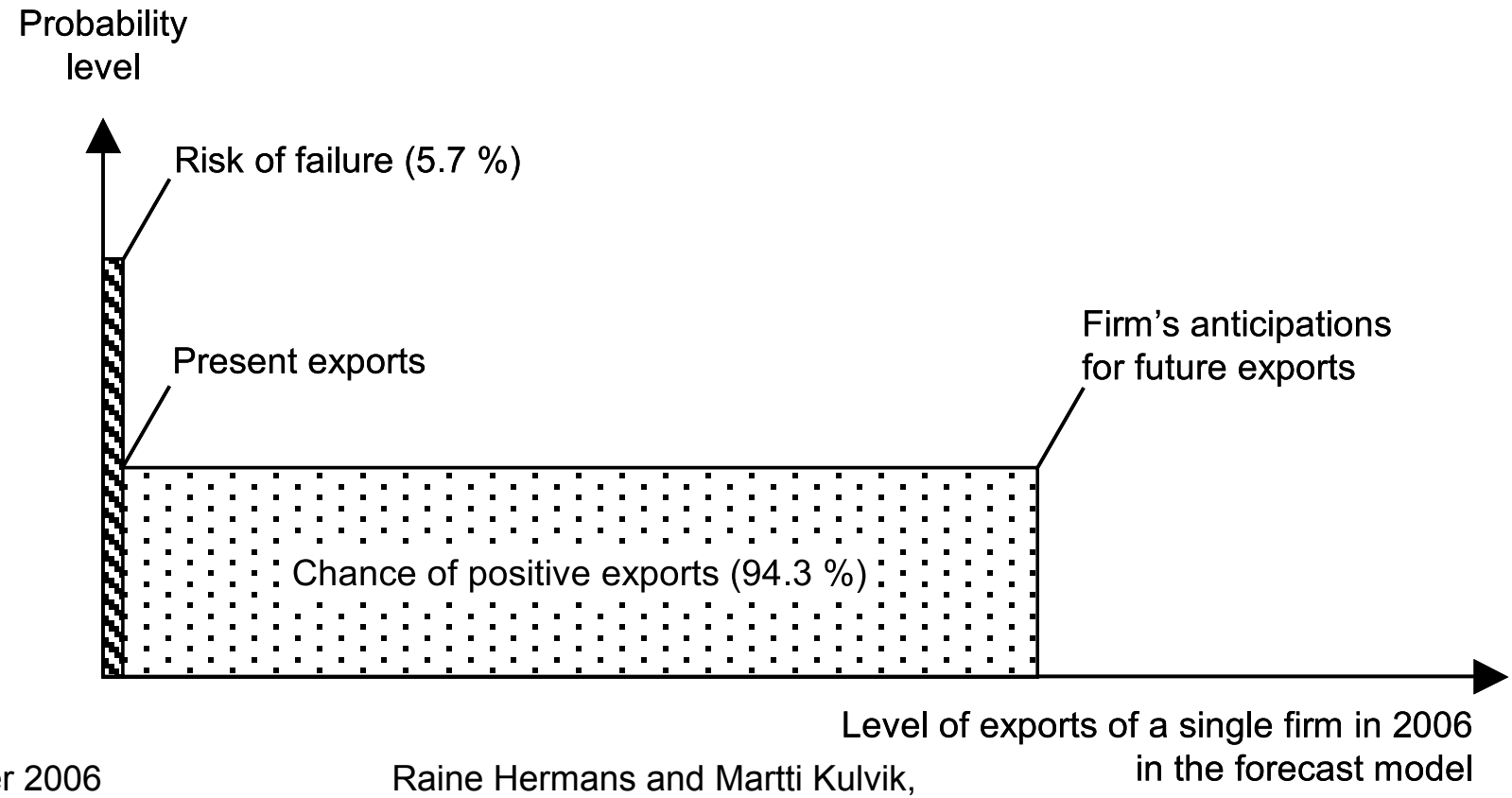
→ if a company holds a relatively high (or low) level of well-balanced intellectual capital, it also has high (or low) growth expectations, respectively.

→ we can rely on the companies' expectations in the ordinal sense: the companies with the highest anticipated future sales are those that have a high level of intellectual capital and probably sell more than those with lower expectations.

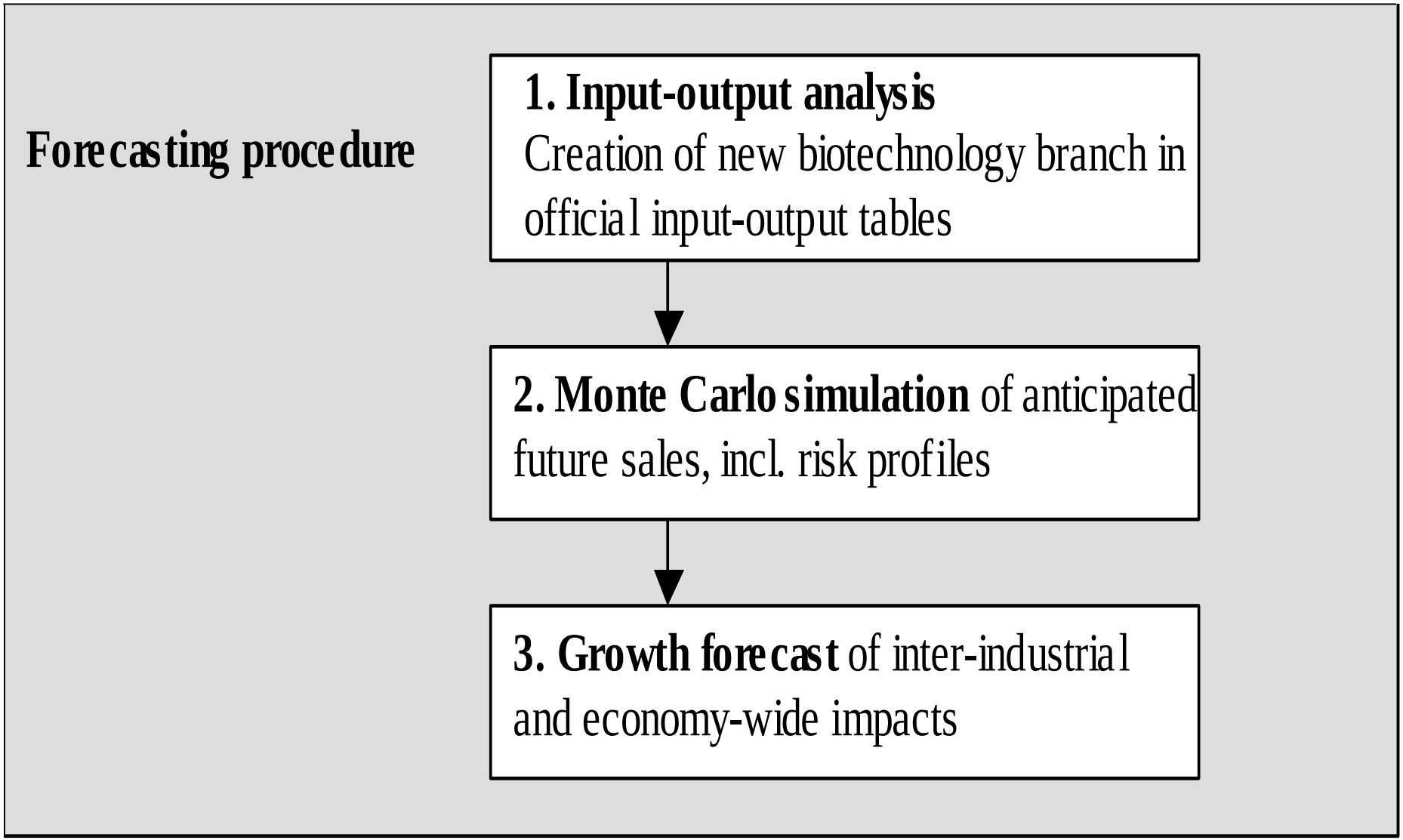
3.2 Dealing with the systematic errors of sales anticipations

3.2. Hermans and Kulvik (2005): probability distributions in Monte Carlo simulations while forecasting the economic impacts.

- **a discrete probability distribution covers the bankruptcy risk, and**
- **a uniform distribution covers the sales expectations between the present and anticipated future exports**



The forecasting procedure's three phases



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Forecast Growth Impacts in 2006

(percentage points on annual average)

Branch	1. Annual growth contribution to a single branch (2002-2006), percent, range of 90 % probability	2. Annual growth contribution to GDP (2002-2006), percentage units, range of 90 % probability
Agriculture, forestry and other primary production	0.03 – 0.06 %	0.00 – 0.00 %
Biotechnology SMEs	18.3 – 33.7 %	0.02 – 0.04 %
Chemicals	0.18 – 0.99 %	0.00 – 0.01 %
Other industry	0.03 – 0.10 %	0.01 – 0.02 %
Construction	0.01 – 0.03 %	0.00 – 0.00 %
Services	0.02 – 0.04 %	0.01 – 0.02 %
GDP	**0.05 – 0.09 %**	**0.05 – 0.09 %**

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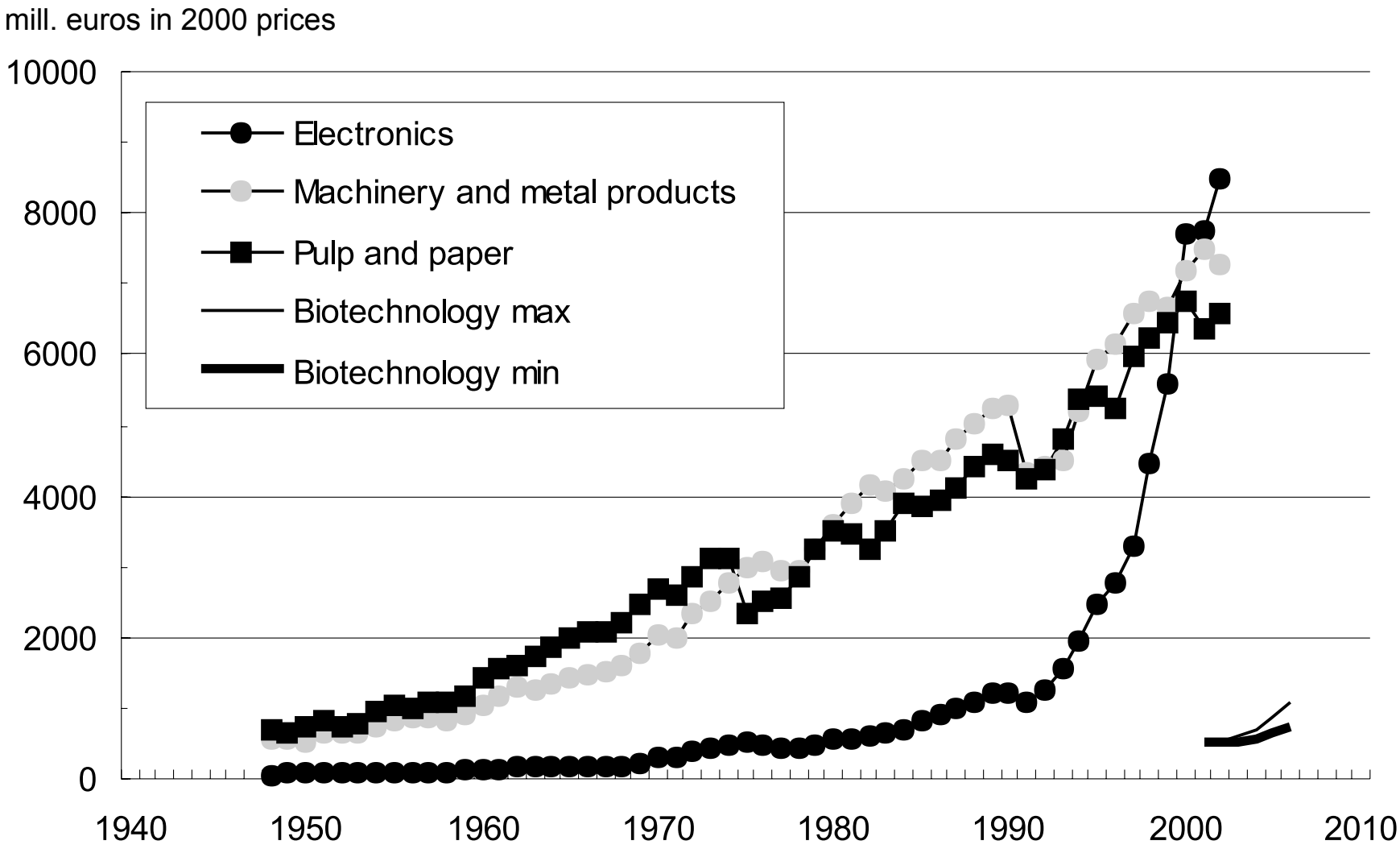
Putting biotechnology into the context of the Finnish economy



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