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Conclusion from the rapporteur

“Fostering the development of human resources for S&T”

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Selective answers to some key questions

- I. Mismatches in the supply and demand of S&T graduates
- II. Changing demand for R&D personnel and development of S&T education and employment
- III. Key questions to the panel

Mismatches in the scientific labor markets



Early debates on HRST: shortages of scientists and engineers & brain drain issues in a historical perspective

- ▶ Chapin (1934): “Are department of sociology overproducing trained personnel”
- ▶ Bush (Vannevar) (1945): “There is an accumulating deficit of trained personnel which will continue for many years”
- ▶ 50s-60s: widespread discussion and controversy on this subject; internationalization of the discourses (OEEC, OECD); brain drain issues in Great Britain (British Advisory Council on Science Policy) and Canada
- ▶ 70s-80s: development of theoretical models (Freeman: cobweb model, Siow, Zarkin...) and empirical studies
- ▶ 90s: studies by UNESCO, OECD on the definition and measurement issues of HRST → Camberra manual...

First step: measurement issues

- ▶ Specific data and surveys are needed (standard classifications of occupations do not apply well at the Ph.D. level. Ex: what is a post-doc?)
- ▶ Cohort data are necessary to follow careers of PhDs on long(er) periods
- ▶ Standardization of the data, of the survey methods, at the international level
- ▶ Data on international mobility

Second step: how does the labor market for scientists and engineers adjust to changes in supply and demand?

- ▶ Supply: the decision to enroll in a doctoral program or to complete a Ph.D. depends on many factors (financial support, fees, expected future earnings, job market opportunities...)
 - ▶ Demand: general economic conditions, R&D expenditures, demand for faculty...
- Cyclical behavior of the labor market. Oversupply/undersupply depending on the country, the period, the discipline...

What is undersupply/oversupply? How to measure it?

- ▶ Standards indicators: unemployment, under-unemployment → definition of the equilibrium situation
- ▶ Qualifications needed by the private sector: how to define them? Ex.: classification of occupations (R&D jobs/non R&D jobs)

Impact of policy measures on the labour market

- ▶ Policy measures: they have to be carefully implemented because of the time it takes to complete doctoral studies → difficult task

Third step: how to increase the attractiveness of scientific careers? How to retain PhDs in scientific careers ?

It's a question of satisfaction:

- ▶ A / Satisfaction expressed by the actual Ph.D.s with their studies may have an effect on the future enrollments
- ▶ B / Job satisfaction is probably essential in retaining Ph.D.s in research careers → how to increase it?

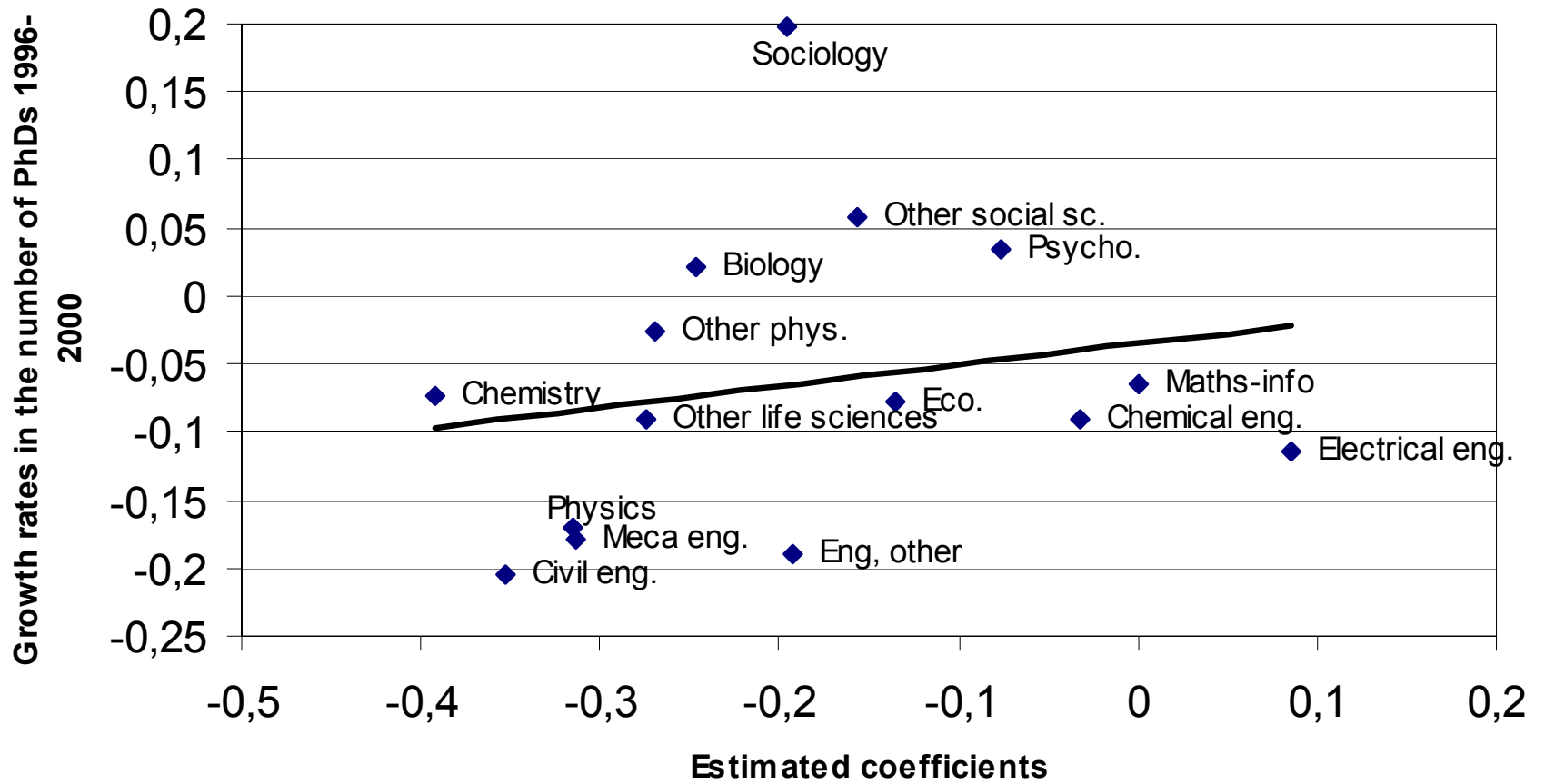
A / Satisfaction with field of study

- ▶ Question in the SDR 1997 (NSF/SRS) : “If you had the chance to do it again, knowing what you do now, how likely is it that you would choose the same field of study for your highest degree?”.
- ▶ Three possible answers: very likely, somewhat likely, very unlikely.
- ▶ Sort of measure of satisfaction with doctoral studies in a specific field
- ▶ Can be thought as an advice given to other students on the way to begin a PhD

Probability of being satisfied with the choice of field of PhD (sample of recent PhD graduates)

Female	ns
Sector of employment: academic	+0.213***
Annual salary	+8.74E-6***
Discipline of doctorate: physical sciences	-0.339***
Life sciences	-0.249***
Engineering	-0.132***
Social sciences	-0.217***
Number of obs.	9726

ML estimation of ordered probit models with selection on a sample of recent PhD graduates from SDR 1997 (NSF/SRS)



- ▶ Feelings of PhDs about past careers, present situation and future plans have an impact on the enrollments of PhDs
- ▶ Is the equilibrium model of supply and demand still relevant?
- ▶ Multidimensional perspective needed

B / Job satisfaction for PhDs depends on many factors:

- ▶ Conditions of employment (sector, work arrangements...)
- ▶ Earnings
- ▶ Socio-demographic characteristics (age, gender...)
- ▶ **Expectations concerning future careers**

The data

- ▶ Individual data on a Sample of 500 “young” French PhD graduates
 - ▶ Employment situation between 3 and 5 years after completing doctorate
- Estimation with econometric models of the probability of being satisfied with job, other things equal

Probability of being satisfied with job

Gender	ns
Doctorate in life sciences	-22%***
Absolute salary	Ns
Individual "particularly well-paid"	+20%**
Individual well-paid	+12%*
Employed in academia; preferred sector of employment at the beginning of PhD: academic	+63%***
Employed in the private sector; preferred: private	+66%***
Employed in academia; preferred sector: private	+32%***
Employed in private sector; preferred: academic	-3%

ML estimation of probit models with selection. Iredu survey 2001.

Changing demand for R&D personnel and development of S&T education



The context

- ▶ The knowledge economy: changes in the innovation systems.
 - Changes in the public/private mix and a shift towards development.
 - Emergence of new innovative actors (SMEs, entrepreneur-researchers, hybrid structures)
 - Changes in the organization of research: new links between actors (academic sector, large firms, new actors). Complexity of the innovation process (not simply a linear model of innovation). Increased reliance on external R&D, increased collaboration.
 - Geographic location: globalization vs. concentration.
 - Fields: ICT, biotechnology...
- ▶ People (skills), structures and actors combine to create this new context.

The Consequences

- ▶ On the scientific employment: new types of research jobs?
- ▶ On the individual research careers:
 - Development of non-attractive temporary jobs or new opportunities?
 - Increased mobility (between sectors, occupations & at the international level)
- ▶ On the training of researchers

Training of PhDs

- ▶ Positive perspective: what can we learn from past and current experience in the training of PhDs?
- ▶ Normative perspective: what should be done in this new context? Promoting multidisciplinary, transdisciplinary. Curricula to be developed.

Some key questions



Some questions (I)

- ▶ Questions related to the data: standardization, internationalization...
- ▶ Is the supply and demand model still useful to understand the scientific labor markets? Do we need to find new approaches?
- ▶ How to meet the new needs of the R&D sector?
- ▶ Quality vs. quantity of education

Some questions (II)

- ▶ How to improve the training of PhDs? Which curricula to be developed?
- ▶ How can we assess the experience of innovative universities, of new experiences of training, of new pedagogical skills?