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**Strategies Pursued by Swiss Firms in
Investing in R&D at Foreign Locations**

An Empirical Analysis Based on Firm-level Data

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Research

Outline

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- Research questions
- Data
- Identifying foreign R&D strategies
- Productivity effects of foreign R&D strategies
- Are foreign and domestic R&D substitutes or complements?
- Conclusions and policy implications

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Background

Background

- Outward-investments pertain not only to manufacturing but *increasingly to R&D* as well.
- We notice from casual observation and empirical research that *motives* for performing foreign R&D are *changing* (what is reflected in theoretical thinking).
 - *cost-* and *resource-*oriented strategies (classical theory)
 - *market-seeking* (asset-exploiting) strategies (product cycle model)
 - *asset-seeking* (asset-augmenting) strategies based on technology sourcing (evolutionary theory; capability view of the firm)

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Background

- *Increasing concern* in the public that foreign R&D erodes the domestic knowledge base (“relocation”, *substitution*)
- *On the other hand:*
Based on the belief that technology sourcing primarily is a means for augmenting strategic assets of the headquarter firm, it is hypothesised that foreign and domestic R&D are *complements*.

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Research questions

Research questions

- *What strategies* firms pursue in performing R&D at a foreign location?
- Which of these strategies are *most prevalent*?
- Do the different strategies differ in terms of their impact on the *productivity* of the (headquarter) firm?
- What do the results imply for the relevance of the two competing hypotheses: *substitution vs. complementarity*?
- Besides:
 - *Policy* implications
 - Usefulness of *qualitative variables*

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Data

Data

- *Firm-level data* stemming from the Swiss Innovation Survey 2002
- *Sample:* manufacturing, construction and (private) services firms with at least 5 employees
- Response rate: 40% = 2583 firms, of which:
 - 1078 firms performing R&D
 - 156 firms performing R&D at foreign locations
- These *156 firms* are the *final sample* of the analysis
- The data set contains a significant number of *SME*'s
- Many variables are *qualitative measures* (ordinal or nominal scale)

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Identifying foreign R&D strategies

- Firms *may* be driven to invest in foreign R&D not by one but rather by several motives that differ in their (relative) importance.
- A firm's foreign R&D strategy can be described by its specific (weighted) *combination* of motives ("multiple" strategies).
- In order to identify different multiple strategies we draw on information on the importance of *seven motives* for performing foreign R&D.
(assessments of the firms themselves on a 5-point scale)

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Motives for performing foreign R&D

(multiple answers)

% important
(value 4 or 5)

→ Supporting local production/sales	40
→ Proximity to leading edge universities	26
→ Proximity to (networks of) highly innovative firms	35
→ Transfer of knowledge/technology to the (domestic) headquarter	26
→ Lower R&D costs	26
→ Higher government support for R&D investments	12
→ Ample supply of R&D personnel	38

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Identification of R&D strategies using a two-step procedure

Step I

- *Cluster analysis of the 7 motives* of foreign R&D: the resulting *four clusters* contain firms which pursue (very) similar foreign R&D strategy in terms of the underlying combination of motives.
- The *four clusters* identified in this step are the outcome of a *purely statistical procedure* (classification method).
 - ➡ The interpretation of the four clusters as specific R&D strategies is *preliminary*.

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Step II

- In order to *check* whether the clusters identified in the first step *effectively* may be interpreted as specific R&D strategies, we *characterise these groups of firms* in terms of *four sets of variables* (cluster mean/median):
 - **Motives** of foreign R&D (as used in step I)
 - A large number of (mostly qualitative) variables representing the main ingredients of the **OLI paradigm** of explaining FDI
 - *Q-advantages*: innovation input/output, use of external knowledge, appropriability, technological opportunities, human capital intensity, firm size, labour productivity
 - *L-disadvantages*: innovation barriers in Switzerland
 - *I-advantages*: R&D co-operation, firm size
 - **Market environment** of the firm: demand prospects, intensity of price and non-price competition
 - **Structural characteristics** of the firm: industry affiliation, firm size, export orientation, firm age, company status

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The four strategies of foreign R&D

- (1) UNIV: Firms pursuing a *broad-based* strategy in terms of motives, with exploiting knowledge from *universities* and embodied in *specialists* as the core elements (25% of firms, 11% of employment)
- (2) NETWORK: Firms strongly embedded in foreign *networks of innovative firms* complemented by an intensive *knowledge transfer* to the domestic headquarter (24% of firms, 24% of employment)
- (3) MARKET: Firms pursuing a *strongly focused* strategy, with foreign R&D almost exclusively used as a means to extend the foreign local *market* (36% of firms, 58% of employment)

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- (4) COST: Firms pursuing, in terms of motives, a *quite narrow-based* strategy that aims at reducing *R&D costs* and gaining access to *highly skilled personnel* (15% of firms, 8% of employment)

Assessment

- The two-step procedure yields specific “*types of foreign R&D strategies*” which are
 - satisfactory according to *statistical* criteria (cluster analysis)
 - well-founded in the *theory* of FDI (OLI paradigm)
- Analysing international R&D in terms of “*multiple strategies*” is *appropriate*, although not all clusters represent broad-based strategies.

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Example: characteristics of strategy UNIV

- **Motives**
Broad-based strategy in terms of *motives*, with exploiting knowledge from *universities* and *specialists* as core elements
- **O-advantages: very strong**
 - *Highly innovative*, with special emphasis on *world novelties* and *patenting*, based on large *internal expenditures* for R&D and innovation and the intensive use of *science-related external knowledge*
 - Very favourable *supply side* conditions of innovative activity (appropriability, technological opportunities), while *demand pull* factors are somewhat less advantageous
 - Very high *unspecified O-advantages* (labour productivity)
- **I-advantages: average**

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- **L-disadvantages: quite important**
 - Excessive regulation
 - Deficiency of highly skilled personnel
 - **Structural firm characteristics**
 - Above-average share of firms that are
 - highly *export-oriented*
 - *medium-sized*
 - (relatively) *young*
- ➡ *The other three strategies differ – partly very significantly – in terms of motives for performing foreign R&D as well as the three elements of the OLI paradigm, the market environment and some of the structural firm characteristics.*

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Productivity effects of foreign R&D strategies

- Do the four *strategies differ* in terms of their impact on the *productivity of the headquarter* firm?
- A *comparison* of the *average productivity* of the four clusters shows large differences. This result, however, is *not conclusive*, since the intensity of use of input factors strongly differs among the four clusters.
- As a consequence, we analyse the productivity effect of foreign R&D strategies in a *production function framework*.

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Assessment

- The *results* are quite *plausible*:
 - *Market-oriented* strategies (MARKET), reflecting the exploitation of domestic assets, are *directly linked* to the headquarter's *productivity* (positive effect):
 - R&D-induced market expansion that generates additional export sales of intermediate goods
 - *Technology sourcing* (UNIV, NETWORK), in the *short- and medium run*, *augments the knowledge base* of the headquarter firm rather than its productivity:
 - *Positive productivity effects* may be expected only in the *longer run* (and are difficult to identify)
 - *Cost-oriented* strategies (COST) *tend to dampen* productivity growth at the headquarter

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Are foreign and domestic R&D substitutes or complements?

- The analysis is in line with the *complementarity* hypothesis: (supporting evidence from our previous work):
 - 60% of firms employing *81% of the workforce* pursue an *asset-exploiting* strategy (MARKET) or combine technology sourcing with an *efficient transfer of knowledge/technology* (NETWORK). Both strategies are *positively* related to *domestic R&D*.
 - Only 15% of firms (*8% of employment*) pursue a *cost-oriented* strategy (COST) which may indicate *substitution*.
 - In addition, MARKET (58% of the workforce) is *positively* related to domestic *productivity*, and there is *no evidence* for a *negative* impact on productivity of the *other strategies*.

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Conclusions

- The *two-step method*, which – for the first time – is applied to identify multiple foreign R&D strategies, proves to be a *suitable approach*.
- By applying *cluster analysis* to a set of *motives* for performing foreign R&D, we identified *four clusters* (first step).
- Since these clusters show *distinct patterns* in terms of the motives for foreign R&D and the variables representing the *main ingredients of the theory of FDI*, they safely can be interpreted as specific *"types of foreign R&D strategies"* (second step).

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Conclusions

- *Most frequently*, firms chose a *market-oriented* R&D strategy (MARKET). The opposite is true for *cost-oriented* strategies (COST). These two strategies, particularly MARKET, are *highly focused*.
- Less prevalent than MARKET – but more common than COST – are the other *two strategies* that are based on *technology sourcing*:
 - UNIV is a *broad-based* strategy (in terms of motives) but the firms of this cluster exploit to a particular large extent *knowledge from universities and specialists*.
 - Firms pursuing the NETWORK strategy also are driven by several motives – but to a lesser extent than UNIV. They profit, in the first instance, from knowledge generated in *networks of innovative firms*, which then is *transferred* to the headquarter.

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Conclusions

- The results imply that the *traditional motives* for performing foreign R&D (i.e. COST and the asset-exploiting strategy MARKET) *still are more prevalent than asset-augmenting* R&D strategies based on technology sourcing (UNIV, NETWORK).
- Nevertheless, in accordance with some recent work, the two types of *asset-augmenting* R&D strategies already have become *quite wide-spread*.
- This result clearly indicates how strongly the Swiss economy is *embedded in the worldwide system of knowledge production and diffusion*.

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Conclusions

Usefulness of qualitative measures

- The analysis yields *satisfactory results* for each step of the analysis according to statistical, economic and plausibility criteria.
- Therefore, we may safely conclude, that the use of *qualitative measures is a valuable means* in order to investigate complex problems such as the present one (high degree of differentiation).
- Nevertheless, I recommend to be *cautious* when using such measures (measurement errors, partial information). I suggest to always work with alternative indicators.
- Big advantage: it is much easier to collect qualitative information; for some problems, it is not feasible at all to collect quantitative information.

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Policy implications

- General measures for *strengthening Switzerland as a location for headquarter companies*
 - Moderate taxation of profits
 - Better access to (large) foreign markets (e.g. EU)
- Improve conditions for knowledge creation and the firms' capacity to absorb knowledge from abroad (technology transfer)
 - Increase output / quality of tertiary education and public research
 - Remove the still remaining barriers for highly qualified foreigners
 - Provide tax incentives for business R&D
 - Support clustering of knowledge-intensive activities (enhances knowledge spillovers)

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Limitations

- *Small number of observations*: are findings robust ?
- Since the data refer to one year only, we are restricted to a *cross-section analysis*
- As a consequence, we are not able to investigate some interesting topics such as:
 - Has there been any change in the relative importance of alternative foreign R&D strategies in recent years?
 - Did firms switch from one to another strategy, and is there a typical sequence of such changes?
 - Short-term vs. longer-term productivity effects of alternative R&D strategies
- As we have now some *longitudinal data* at hand (1999, 2002, 2005), we shall get some insights into these topics in the near future

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