Finance and innovation opportunities and dilemmas of the high-tech clusters in Switzerland

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Finance and Innovation –
Opportunities and Dilemmas of the
High-Tech Clusters in Switzerland

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Abstract: According to the New Growth Theory innovations are one key determinant of a country’s
growth. In order to innovate a company not only needs new ideas but also money to fi-
nance the – especially in the field of high-tech - sometimes costly research and develop-
ment (R&D) process. But studies from Switzerland concluded that companies very often
encounter difficulties in raising enough money for R&D. Thus the question prevails how
this fact could be improved. As this paper shows Switzerland has a very dense spatial con-
centration of financial institutions that are sometimes overlapping with the empirically and
statistically derived clusters of the high-tech and medical devices industry. This spatial
closeness lowers the costs for regular face-to-face contacts that are usually needed to
evaluate and monitor an investment. From this point of view Switzerland and especially
the Zurich region have good preconditions for a closer co-operation between financial in-
stitutions and banks. Because this collaboration still seems to be very weak strategies are
derived to improve this situation.

Keywords: Cluster, Innovation, Finance, High-Tech, R&D, Medical Devices Industry, Switzerland.
1 Introduction

The need to innovate in the area of high-tech industry is more important than ever. To stay ahead of competitors a country not only needs to have a stable political system and a first class public infrastructure, it also needs to create a favourable environment for companies to produce new products and processes. According to BRACZYK ET AL. the number one factor for competitive advantage is innovation (1998, p. vii). For example, Switzerland is still among the most competitive nations in the world (IMD, 2002). According to the IMD report much of Switzerland’s competitiveness originates from the implementation of the most advanced technologies and having a high intensity of research and development (R&D).

What is important for the Swiss case is not only the criteria examined by the IMD report but also the propinquity of international finance and high-tech companies, especially in the Zurich region. As TICKELL already noted, “… despite the intangibility of money, finance has an economic geography” (2000, p. 242). This spatial proximity perhaps results in the close co-operation for the financing of innovation. This paper intends to tentatively examine the spatial concentration of the ‘clustering’ of financial institutions and the high-tech companies in Switzerland. If it can be shown that banks and high-tech companies are close to each other this result might serve as a starting point for a further analysis, examining cooperation and spillovers on an individual company level.

Section 2 lists some aspects of the new growth theory relating to the interrelation between financial systems, innovation and economic growth. This is followed by empirical evidence from Switzerland, concluding that the access to financial resources is crucial for starting the innovation process. Then without investing money into R&D innovations are barely achieved.

Section 3 provides a very short overview about the current discussion about clusters, trying to work out a theoretical taxonomy. This is followed by some methodological aspects concerning the quantitative identification of clusters. In the empirical cluster analysis, the three clusters banking, high-tech and medical devices industry are presented.

Section 4 concludes by evaluating the cluster analysis and pointing out opportunities and dilemmas for the high-tech clusters in Switzerland, with special regard to the Zurich region.
2 Finance and Innovation

2.1 Aspects of the New Growth Theory

Innovations can be regarded as an important cause for economic growth in industrialised countries. The new growth theory examines exactly this connection by explaining long-term economic growth endogenously. One important component for the micro-economic founding of this theory are positive spillovers from the accumulation of human capital (BRETSCHGER 1996, p. 90). Thus the production of knowledge and the accumulation of human capital are central to the explanation of economic growth. Whereas the neoclassical growth theory does not pay much attention on the production factor ‘capital’, this is central to the new growth theory. Besides human capital, other forms are distinguished like the privately invested capital for the production of goods and services, and the public infrastructure. A constant marginal growth of revenue is then assumed to produce the above mentioned positive spillovers.

Whereas this is nowadays widely accepted among economists, the importance and significance of a financial system in economic development is still a contention. Only a few papers have paid attention to the interrelation between the financial system, innovations, and growth rates. This connection does not belong to the actual core of the new growth theory (DÜMMLER and SCHMUKI 2002, p. 6). In his 1988 paper LUCAS discussed the mechanisms that determine economic growth, nevertheless he consciously excludes the existence of a financial sector from his considerations (1988, p. 6).

However, at the beginning of the twentieth century SCHUMPETER pointed out that the services provided by the financial sector contribute substantially to the innovation activity (1997, p. 99 et sqq.). In his paper from 1997, LEVINE gives an excellent overview of the different functions of a financial system (LEVINE 1997, p. 691; for another classification see FREIXAS and ROCHET 1998, p. 2 et sqq.). LEVINE argues that financial systems:

- facilitate the trading, hedging, diversifying and pooling of risks;
- allocate resources;
- monitor manager and exert corporate control;
- mobilize savings and
- facilitate the exchange of goods and services.

LEVINE also shows that these functions not only influence real economic developments but are also influenced by them. As he proves at a theoretical and on an empirical level there exists a strong positive connection between the extent of the functional arrangement of the financial system and long-term economic growth.
Market frictions form the starting point of these considerations, because these are regarded as a necessary condition for the existence of a financial system with banks as its central (intermediate) participants (LEVINE, 1997, p. 691; see also FREIXAS and ROCHET 1998, p. 8 et sqq.).

LEVINE differentiates two channels, by which each of the five different functions of a financial system may affect steady state growth: Capital accumulation and the technological innovation. In the first case the rate of capital formation is influenced by either altering the savings rate or by reallocating savings among different capital producing technologies (see also GREENWOOD and SMITH 1997, p. 158 et sqq.). In the second case, the financial system influences the rate of technological innovation, i.e. on a company level the creation of product or process innovation is supported so that it will affect steady state growth. Further theoretical approaches can also be found in KING and LEVINE (1993).

To sum up the financial system can have an important influence on the growth rate, although there is not yet very much theoretical literature about this topic.

2.2 Evidence from Switzerland

There is some empirical evidence that the rate of technological innovation is related to the functional arrangement of the financial system. This study uses Switzerland as an example to show the connections between finance and innovation, still bearing in mind that the rate of technological innovation via positive spillovers also influences the growth rate.

Switzerland belongs to the leading countries in research and development (R&D). The expenditures for R&D amounted to 2.64% of the gross national product in the year 2000 and are among the highest in the OECD (BFS 2003). However, due to the very small size of Switzerland the absolute level of R&D expenditures are only a fraction of the absolute expenditures of large national economies, as for example the USA, Germany or Japan.

In 2000, Switzerland spent about 10.7 billion Swiss Francs on R&D. Approximately, 74% were paid by the private sector, the remainder mainly by the public universities & research institutions. This is remarkable considering that Switzerland – compared to other OECD members - follows by far the most conservative public support policy for R&D (HOTZ-HART ET AL. 2003, p. 41). The relative R&D portion of the private sector even rose in the last few years, only being surpassed by Japan (BFS 2003).

Specifically, three industries conduct the majority of the Swiss national R&D: Approximately 82% of all private R&D expenditures are from the machine and metal manufacturing industry, the chemical and pharmaceutical industry as well as the privately funded research laboratories (table 1).
Table 1  Expenditures for R&D of the private sector (in Mio. Swiss Francs)

<table>
<thead>
<tr>
<th>Industry</th>
<th>1996</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machines and Metal manufacturing</td>
<td>2'180</td>
<td>2'910</td>
</tr>
<tr>
<td>Chemical and Pharmaceutical</td>
<td>2'620</td>
<td>2'475</td>
</tr>
<tr>
<td>Private research laboratories</td>
<td>985</td>
<td>1'085</td>
</tr>
<tr>
<td>Food processing</td>
<td>355</td>
<td>390</td>
</tr>
<tr>
<td>Electronics</td>
<td>310</td>
<td>355</td>
</tr>
<tr>
<td>Other</td>
<td>610</td>
<td>675</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7'060</td>
<td>7'890</td>
</tr>
</tbody>
</table>


While the public spending mainly goes into basic research, the private sector concentrates on applied research and experimental development. This seems to make sense since R&D in the private sector needs to be financed by the generation of innovations, that are new products and processes.

Despite the relatively good position of R&D, the generation of innovations in Switzerland still faces substantial obstacles. These are particularly aspects of costs, risks and financing, as an analysis over several years has revealed (ARVANITIS 2000, p. 25). It is frequently alleged, that the project costs for R&D are too high which lead to long amortisation periods (table 2). But very often just these amortisation periods shrink due to quickening of technological change. This is a setting, which can reduce innovation especially in the high-tech sector.

Table 2  Innovation restrictions in the industrial manufacturing industry 1997-1999

<table>
<thead>
<tr>
<th>Restrictions</th>
<th>Total of answers above 20% (several answers possible)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High costs</td>
<td>38.8 %</td>
</tr>
<tr>
<td>Long amortisation period</td>
<td>29.9 %</td>
</tr>
<tr>
<td>Not enough equity capital</td>
<td>29.3 %</td>
</tr>
<tr>
<td>High market risk</td>
<td>27.3 %</td>
</tr>
<tr>
<td>Easy to copy</td>
<td>25.7 %</td>
</tr>
<tr>
<td>Not enough outside funds</td>
<td>24.0 %</td>
</tr>
<tr>
<td>Insufficient qualified employees</td>
<td>20.6 %</td>
</tr>
</tbody>
</table>

Missing or insufficient endowment with private equity and outside funding prove to be the largest obstacles for the innovation activity in empirical tests (Arvanitis 2000, p. 28). However, this does not need to be damaging, if the companies concerned have a low productivity or face a low demand. But nevertheless, especially smaller enterprises struggle for outside financing, independent of their economic performance.

This is especially important, as most of the Swiss companies are very small in size; this includes start-ups, which can be regarded as relevant for the long-term growth rate. Small companies tend to rely on a large extent on own, private sources of financing, like personal savings (table 3). The funding via credits from financial institutions and public promotion agencies is not of much importance (Arvanitis and Marmet 2001, p. 81).

### Table 3  Relative importance of the different funding for financing start-ups 1999

<table>
<thead>
<tr>
<th>Funding</th>
<th>Total of answers in % (several answers possible)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own financing by</td>
<td></td>
</tr>
<tr>
<td>Own savings</td>
<td>71.6</td>
</tr>
<tr>
<td>Retained profits</td>
<td>32.9</td>
</tr>
<tr>
<td>Equity financing (incl. Venture-Capital)</td>
<td>3.4</td>
</tr>
<tr>
<td>Outside financing by</td>
<td></td>
</tr>
<tr>
<td>Private loans</td>
<td>16.5</td>
</tr>
<tr>
<td>Bank credits</td>
<td>9.7</td>
</tr>
<tr>
<td>Customer pre-payments</td>
<td>5.0</td>
</tr>
<tr>
<td>Credits granted by suppliers</td>
<td>2.1</td>
</tr>
<tr>
<td>Public promotion funding</td>
<td>0.9</td>
</tr>
</tbody>
</table>


Apart from the above mentioned studies that examined companies all over Switzerland, there are also regional analyses. In 1986, Mallait and Vasserot for example examined the innovative Milieux in the Jura region (north-western part of Switzerland) and asked companies about their way of financing innovations. The majority used own funds, this corresponds to the above findings of Arvanitis and Marmet more than ten years later. Mallait and Vasserot also found out that most companies regarded the guidelines of banks for granting credits as their biggest obstacle for investing in R&D (1986, p. 233). For a similar result see also Ratti and Di Stefano for the Ticino, the most southern part of Switzerland (1986, p. 330).
3 Clusters in Switzerland

3.1 Taxonomy and methodological aspects

The above evidence from Switzerland suggests that the lack of own funds or outside financing is very often the main cause for not doing as much R&D as desired. The spatial closeness between the financing banks and the innovative companies should now be examined empirically. This can be done by analysing clusters for banks and high-tech companies, paying particular attention to the medical devices industry as one special branch of high-tech.

But before turning to the empirical results of the cluster analyses this section should present some very basic theoretical elements of the cluster theory. The cluster approach became particularly famous by the works of PORTER (1990), although he cannot be regarded as its founder. It rather is LASUÉN, who in 1973 published a paper about clusters, dividing them into geographical and sectoral clusters. LASUÉN himself lists PERROUX’S work about growth poles (1952) as one important influence for creating the cluster theory.

Ever since the early 1990s, clusters have become something as a hype for social scientists, promotion agencies and entrepreneurs alike. Yet, the concept of clusters stays quite vague and open to interpretation. Table 4 tries to structure the current discussion about clusters by differentiating between a cognitive and a spatial logic, which lead to different approaches (DÜMMLER and THIERSTEIN 2002).

The following cluster analysis follows a functional and territorial approach. The examination of the above mentioned industries (banking, high-tech and medical devices) will serve as the functional approach, as the investigation area the whole of Switzerland will be analysed, on the level of the almost 3’000 municipalities (territorial approach).
### Table 4  The roles of clusters - a theoretical taxonomy

<table>
<thead>
<tr>
<th>Cognitive logic ↓</th>
<th>Spatial logic</th>
<th>Network approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional approach</td>
<td><strong>CLUSTER</strong></td>
<td><strong>INTERCONNECTION</strong></td>
</tr>
</tbody>
</table>
| Territorial approach | • Diversification and specialisation of activities  
| | • Concentration of externalities  
| | • Density of proximity contacts  
| | • Concentration of tacit knowledge  
| | • Reduction of transaction costs  
| Symbolic approach | **MILIEUX** | **SYMBOL** |
| | • Substrate of collective learning  
| | • Uncertainty-reducing operator through:  
| | - information transcoding  
| | - ex-ante co-ordination of private decisions (collective action)  
| Normative approach | **LEARNING REGION** | **INTERNATIONAL COMPETITIVENESS** |
| | • Promotion of regional innovation and production systems (RIPS)  
| | • Support for higher educational system (HES) to foster human capital  
| | • Information and mobilising platform for local and regional actors of small size clusters  
| | | • Ranking of international technological Centres of Excellence  
| | | • Support of incubator centres, start-up or spin-off firms  
| | | • International promotion platforms of locations and cluster competencies  


An important tool for revealing clusters in a very first step is an empirical cluster analysis, with whose assistance possible spatial entwinements can be shown. As a basis for calculating the clusters, a matrix with the shortest distance between municipalities was used, multiplied by a factor reflecting driving time according to the different classes of streets, like motorways or small roads. Using a software package, the method of Ward was then applied, assuring that the merging of municipalities into different clusters results in a minimal increase of the overall distance between them. A significance test on the fusion values then revealed the number of clusters in the data.
3.2 Banking Clusters

The cluster analysis was attempted for the banking sector, representing those financial institutions funding innovative companies. Even within Switzerland only Zurich, Basle, Geneva and probably Lugano are noticed as the most important national financial places or clusters. But the following analysis draws a more differentiated picture.

To compute the banking clusters first of all those municipalities were filtered from the distance matrix that also had at least one head office. Subsequently, the balance sheet totals were aggregated for all banks within one municipality, in order to measure the importance of a municipality as location for banking services. In a second step these municipalities were clustered, resulting in 11 clusters of very different size (figure 1).

**Figure 1 Banking Clusters in Switzerland, 1998**

Source: own illustration; cartography: Lars Glanzmann; data based on SNB (1999).
For data from 1998, the two cities Zurich and Basel clearly dominate, followed by Geneva. But it must be noted that the proportion for Basle is probably overestimated, while Zurich may be underestimated. The reason for this is the legal structure of the biggest Swiss bank, the UBS Ltd. that has two head offices. Therefore half of the balance sheet total was assigned to Basel, the other half was allocated to Zurich. Yet, the relevant decisions for the strategy of the bank are made to a larger extent in Zurich. Furthermore, because the private banks in Switzerland have no obligation to publish financial ratios, the portion for Geneva may be underestimated. Geneva is known for its private banks, seven out of the 16 private banks in Switzerland have their head office there.

Table 5 shows the ranking of the banking clusters, if the sum of all balance sheet totals for each cluster is measured. A remarkable fact is that the financial place of Lugano seems to be less important than St. Gall, Berne or Aarau. One explanation may be that only few banks actually have their head office in the bank cluster Lugano, but many banks maintain branches, particularly in order to care for the foreign customers.

### Table 5 Banking Clusters in Switzerland and their ranking, 1998

<table>
<thead>
<tr>
<th>Rank</th>
<th>Main banking municipality</th>
<th>Total cluster assets in Mio. Swiss Francs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zurich</td>
<td>1’057’620</td>
</tr>
<tr>
<td>2</td>
<td>Basle</td>
<td>566’264</td>
</tr>
<tr>
<td>3</td>
<td>Geneva</td>
<td>99’625</td>
</tr>
<tr>
<td>4</td>
<td>St. Gall</td>
<td>94’603</td>
</tr>
<tr>
<td>5</td>
<td>Berne</td>
<td>54’656</td>
</tr>
<tr>
<td>6</td>
<td>Aarau</td>
<td>37’138</td>
</tr>
<tr>
<td>7</td>
<td>Lugano</td>
<td>32’950</td>
</tr>
<tr>
<td>8</td>
<td>Lucerne</td>
<td>30’263</td>
</tr>
<tr>
<td>9</td>
<td>Weinfelden</td>
<td>20’745</td>
</tr>
<tr>
<td>10</td>
<td>Sion</td>
<td>7’135</td>
</tr>
<tr>
<td>11</td>
<td>Langnau im Emmental</td>
<td>4’157</td>
</tr>
</tbody>
</table>

Source: own calculations; data based on SNB (1999).

What clearly shows up in table 5 is the strong centralisation of the banks in Zurich. The other financial clusters reach only a fraction of the size of Zurich. The majority of these clusters – apart probably from Geneva and Lugano – mainly support local customers, e.g. small- and middle-sized companies and private customers. The cluster of Zurich can therefore be regarded as the most integrated and international financial cluster within Switzerland.
3.3 High-Tech Clusters

The human capital intensive high-tech companies are important for the economic growth of Switzerland since this country is lacking almost any natural resources for production. Generally high-tech companies are regarded as particularly innovative and as shown further above, the new growth theory especially considers innovations for the explanation of economic growth. If the OECD definition of high-tech is taken (OECD/EUROSTAT 1997) and very conservatively adapted to the Swiss conditions, almost 130'000 employees in 1998 were working in a high-tech company. This corresponds to approximately 3.4% of the total labour force (for a discussion about knowledge-intensive business services in Switzerland see DÜMMLER and THIERSTEIN 2003).

To identify the cluster potential for high-tech the location quotient was computed for each municipality on the basis of the people employed in the high-tech industry. The location quotient expresses the relationship between an area's share (e.g. a municipality) of a particular industry and the national share. Thus, the location coefficient for a given area equals the percentage of people employed in an industry in a given area divided by the percentage employed nationally in that industry. The location quotient therefore shows whether employment in high-tech companies in an examined municipality is over (> 1), equally (= 1) or under-represented (< 1) compared to the whole of Switzerland. A location coefficient of 1.5 indicates that 1.5 times the percentage of workers is employed in high-tech than the percentage employed nationally in that industry. The basic data used for this calculation were taken from the federal census of companies in 1998 (BFS 2000).

Figure 2 shows in a first step the distribution of employees in high-tech for each municipality with a location quotient of greater or equal one. Then in a second step a cluster analysis was done for these municipalities that have a location quotient of greater or equal two, resulting in 17 different clusters. The two most important regions, Berne-Jura and Zurich are mapped in detail, showing clusters that encompass municipalities with a location quotient of greater or equal two.

As a first result it can be stated that most of the high-tech companies are located in the western and north-western part of Switzerland, many of them in bigger cities or their agglomeration. This especially is the case in the Zurich, Basle and Geneva region. An exception in this regard is the Jura region where no large agglomeration is very close. The Jura region is well known for its high-tech watch industry, producing since more than 100 years most of the Swiss watches. This special case of the Jura region will be discussed in more detail in section 3.4 when the medical devices industry as a part of the high-tech branch is being examined. Noteworthy for the discussed connection between finance and innovation is also the presence of the high-tech industry in the Ticino as the most southern canton of Switzerland.
Figure 2 High-Tech Clusters in Switzerland, 1998

Source: own illustration; cartography: Lars Glanzmann; data based on BFS (2000).
Table 6 shows the ranking of the high-tech clusters according to their size in terms of total employees per cluster. Not very surprisingly the cluster of Basle (1) is leading, encompassing many companies of the pharmaceutical industry, followed by the cluster of Kloten (2, near Zurich) with high-tech companies that manufacture parts for air- and spacecraft construction and electronics. Third is the cluster of Baden (3, also near Zurich) with its companies producing turbines and equipment for the electricity industry. La Chaux-de-Fonds ranking fourth is the biggest cluster of the Jura region.

### Table 6 High-Tech Clusters in Switzerland and their ranking, 1998

<table>
<thead>
<tr>
<th>Rank</th>
<th>Main high-tech municipality</th>
<th>Total cluster employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basle</td>
<td>19'742</td>
</tr>
<tr>
<td>2</td>
<td>Kloten</td>
<td>11'522</td>
</tr>
<tr>
<td>3</td>
<td>Baden</td>
<td>11'125</td>
</tr>
<tr>
<td>4</td>
<td>La Chaux-de-Fonds</td>
<td>10'079</td>
</tr>
<tr>
<td>5</td>
<td>Grenchen</td>
<td>9'663</td>
</tr>
<tr>
<td>6</td>
<td>Mendrisio</td>
<td>6'171</td>
</tr>
<tr>
<td>7</td>
<td>Herisau</td>
<td>5'772</td>
</tr>
<tr>
<td>8</td>
<td>Stans</td>
<td>4'478</td>
</tr>
<tr>
<td>9</td>
<td>Le Chenit</td>
<td>4'313</td>
</tr>
<tr>
<td>10</td>
<td>Plan-les-Quates</td>
<td>3'772</td>
</tr>
<tr>
<td>11</td>
<td>Saint-Imier</td>
<td>3'531</td>
</tr>
<tr>
<td>12</td>
<td>Villars-sur-Glâne</td>
<td>2'413</td>
</tr>
<tr>
<td>13</td>
<td>Bassecourt</td>
<td>1'796</td>
</tr>
<tr>
<td>14</td>
<td>Wartau</td>
<td>1'511</td>
</tr>
<tr>
<td>15</td>
<td>Neuhausen am Rheinfall</td>
<td>940</td>
</tr>
<tr>
<td>16</td>
<td>Evionnaz</td>
<td>695</td>
</tr>
<tr>
<td>17</td>
<td>Lalden</td>
<td>387</td>
</tr>
</tbody>
</table>

Source: own calculations; data based on BFS (2000).

For an even better comparison these 17 clusters are assigned to eight geographically defined regions:

1. The Berne-Jura region, encompassing the five clusters La-Chaux-de-Fonds (4), Grenchen (5), Saint-Imier (11), Villars-sur-Glâne (12) and Bassecourt (13) with a total of more than 27’000 employees is the biggest high-tech region in Switzerland;

2. the Zurich region with the clusters of Kloten (2), Baden (3) and Neuhausen am Rheinfall (15), including almost 24’000 employees;

3. the Basle region with the cluster of Basle (1);
4. the Geneva-Lausanne region with the clusters of Le Chenit (9), Plan-les-Quates (10) and Evionnaz (16), adding to a total of nearly 9’000 jobs;

5. the eastern part of Switzerland, especially the Rhine-Valley with the clusters of Herisau (7) and Wartau (14), having more than 7’000 employment in high-tech;

6. the Ticino with the cluster Mendrisio (6);

7. Central Switzerland with the cluster of Stans (8) and finally

8. the upper Valais with the very small cluster of Lalden (17).

The Berne-Jura, Zurich and Basle region are clearly dominating Switzerland’s high-tech regions offering 72% of all jobs within that industry.

3.4 Medical Devices Industry Clusters

As mentioned above, the medical devices industry as a part of the high-tech industry will now be analysed in more detail. The market for products of the medical devices industry is growing each year due to the ageing of the population in the OECD countries, making it a promising industry for the future. This industry is characterized by a very high innovation intensity, especially for product innovation (HOLLENSTEIN 2000, p. 22). Price competition is not very important, to stay ahead of competitors a company needs to invest in R&D for new products and pay attention to maintain a very high quality level for the product and the after sale services.

Switzerland holds a good position in the medical devices industry. As in most countries small companies dominate. The 1’700 Swiss producers with roughly 14’500 employees have an estimated turnover of 4.5 Bio. Swiss Francs a year (FASMED 2003), exporting more than 90% of their products. Since 1997 the exports have almost doubled, reaching 4.2 Bio. in 2001. The most important products were medical devices for surgery purposes, followed by cardiac pacemakers (SDA 2002).

The procedure for analysing the medical devices industry is the same as for high-tech. First calculating the location quotients for all municipalities with employment in the medical devices industry, then taking only these municipalities that have a location quotient of greater or equal one. The result is shown in figure 3. In a next step the same municipalities (location quotient greater or equal one) were taken for the cluster analysis, resulting in 14 clusters. Table 7 lists the medical devices clusters, ranked according to their total of cluster employees.
All of these 14 clusters can be grouped into seven regions:

1. The Zurich region with the clusters of Bülach (2), Risch (3), Stäfa (5) and Baden (10), being the biggest with over 4’000 employees;
2. followed by the Berne-Jura region, with the three clusters Bettlach (1), Le Locle (7) and Cressier (12) and a total of more than 3’000 employees;
3. third is the Geneva-Lausanne region with the clusters of Ballaigues (4) and Tolochenaz (8), having almost 1’500 employees;
4. on the fourth rank is the Basle region with the only cluster Oberdorf (6);
5. next is the Ticino with the cluster Mezzovico-Vira (9);
6. sixth the Rhine-Valley with the clusters of Au (11) and Rhäzuns (13b), having almost 400 employees in total and finally
7. the upper Valais with the very small cluster of Raron (13a).
For the medical devices industry the regions of Zurich, Berne-Jura and Geneva-Lausanne are leading, having 84% of all employment in that industry.

Table 7  Medical Devices Industry Clusters in Switzerland and their ranking, 1998

<table>
<thead>
<tr>
<th>Rank</th>
<th>Main medical devices municipality</th>
<th>Total cluster employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bettlach</td>
<td>2'292</td>
</tr>
<tr>
<td>2</td>
<td>Bülach</td>
<td>1'745</td>
</tr>
<tr>
<td>3</td>
<td>Risch</td>
<td>1'210</td>
</tr>
<tr>
<td>4</td>
<td>Ballaigues</td>
<td>830</td>
</tr>
<tr>
<td>5</td>
<td>Stäfa</td>
<td>775</td>
</tr>
<tr>
<td>6</td>
<td>Oberdorf (BL)</td>
<td>714</td>
</tr>
<tr>
<td>7</td>
<td>Le Locle</td>
<td>691</td>
</tr>
<tr>
<td>8</td>
<td>Tolochenaz</td>
<td>582</td>
</tr>
<tr>
<td>9</td>
<td>Mezzovico-Vira</td>
<td>563</td>
</tr>
<tr>
<td>10</td>
<td>Baden</td>
<td>521</td>
</tr>
<tr>
<td>11</td>
<td>Au (SG)</td>
<td>342</td>
</tr>
<tr>
<td>12</td>
<td>Cressier (FR)</td>
<td>273</td>
</tr>
<tr>
<td>13a</td>
<td>Raron</td>
<td>56</td>
</tr>
<tr>
<td>13b</td>
<td>Rhäzuns</td>
<td>56</td>
</tr>
</tbody>
</table>

Source: own calculations; data based on BFS (2000).

Ever since the cluster concept got fashionable an increasing number of economic promotion agencies follow a specially designed program to promote and support clusters in their respective region. In Switzerland there are currently two major programs trying to develop a cluster strategy for the medical devices industry: The ZURICH MEDNET and the ‘MEDICAL CLUSTER BERNE’ (MCB).

In December 1999, building on a close relationship between the cities of Zurich and Winterthur, ZURICH MEDNET became the medical/biotech cluster of the GREATER ZURICH AREA (GZA), a non-governmental public-private partnership (GZA 2003). Today ZURICH MEDNET is a public information resource and business development network serving the medical and biotechnology community of the Zurich region. A virtual community, comprising more than 400 companies, universities, institutes, foundations, hospitals and labs, ZURICH MEDNET claims to be the single largest medical/biotech cluster in continental Europe (ZURICH MEDNET 2003).
The Medical Cluster Berne (MCB) was established 1997 on the initiative of different entrepreneurs of the medical devices industry, the pharmaceutical industry and the health service in co-operation with the cantonal economic promotion agency and the University of Berne. The main goal of the MCB is to strengthen and develop the medical devices industry to a major industry in the region (MCB 2003). This industry is well developed in the north-western part of cluster 1, geographically belonging to the Jura region.

It was in the Jura region, where medical devices industry emerged from the tradition and the innovative milieux of the watch industry. This can be seen as a path dependent development, because during the crisis of the Swiss watch industry in the 1980s skilled labour force was laid off without having the chance to find a new employment within the shrinking watch industry. It was during these times that the production of medical devices absorbed many of the labour force. The main reason was that the skills and the know-how developed for manufacturing watches, like precision engineering, quality management and exporting are very much also characteristics of the medical devices industry. So the innovative milieux of the watch industry served as an ideal breeding ground for the medical devices industry. Today still most of the Swiss watches are made in the Jura region but also a growing number of medical devices companies are located within that area.

4 Conclusions

4.1 Evaluating the Cluster Analysis

The empirical analysis of economic concentration within Switzerland produced some useful results, showing that there are indeed certain spatial concentrations of the different industries examined. But a proximity that is only geographic in nature can provide the basis for the presence of an agglomeration of firms, but not necessary for the presence of a system of innovation. As already mentioned in section one, the here presented analysis focuses solely on the spatial concentration of companies of the same kind (horizontal clusters). Backward and forward linkages (with suppliers and customers as in vertical clusters) or upstream and downstream linkages (with firms of related branches as in lateral clusters) were not analysed. In this regard the current available statistical data only leads to a quantitative top down analysis, leaving out the actual micro-economic connections between companies. For this a second step would be necessary, looking at the individual company level, trying to find out if and how these companies are truly integrated in a cluster or even a regional innovation system. This means gaining more qualitative data about a company for a bottom-up analysis of a cluster.
The presented clusters of the medical devices industry seem to be very small and negligible, especially on an international level. Thus, on a strategic policy level, does this mean that there is no legitimacy for such a cluster? Or does it just happen that these clusters are still in their embryonic phase and thus not yet fully developed in order to cross the threshold of being recognised internationally?

These questions do not have definitive and precise answers. Clusters tend to grow and it is exactly that growth pattern which interests researchers and politicians alike. But there is no uniform growth pattern due to the varying initial spatial-economic and cluster-specific conditions as well as the organising capacity of a cluster. But nevertheless, various empirical evidence from scientific analysis and case studies lead to formulate the following ‘virtuous circle’ for cluster development (figure 4).

**Figure 4  An ideal growth pattern for cluster development - the ‘virtuous circle’**

![Diagram of the virtuous circle for cluster development](Source: DÜMMLER and THIERSTEIN (2002)).
How does one interpret this ‘virtuous circle’? Obviously there is no fixed starting point. Specialisation and investment in the cluster superstructure - for example privately operated training and education institutions - foster knowledge spillovers. Consequently this will lead to a higher quality and attractiveness of the clusters output that in turn impacts positively on the demand of the clusters products that are not only goods and services but also structures and know-how. And again, attractiveness and success breeds success: the already existing actors within the cluster will thrive and new ones start-up, spin-off or locate within its area. Finally the ‘virtuous circle’ completes itself and a self-sustaining critical mass will be reached.

But to be precise, on the strategic level of location or regional policy it is not so important that a cluster is recognised by its pure size but by its excellence and network capabilities. And although a success story sets in motion a ‘virtuous circle’, there still is no deterministic development pattern. Empirical evidence is strong enough to send warning signals to all actors involved that success is not stationary and may carry the germ of failure. Lock-in phenomena, conservatism among the key players and change agents will eventually lead to sclerosis and inertia.

To sum up, having analysed location quotients and numbers of employees, only a closer look with the help of an integral framework approach will identify the singular qualities and features within a cluster. The ZURICH MEDNET serves as an example for a small-scale cluster that at first sight is barely visible but eventually surfaces and may thrive to become a first-class address on an international level. There is no sure-fire way to guarantee success but smart cluster and location management will help some (DÜMMLER and THIERSTEIN 2002).

4.2 Opportunities and Dilemmas

As the above analysis showed, Switzerland has – relatively to its size - several advantages for a strong position in the high-tech industry. First of all from a top down analysis high-tech clusters could be identified, especially in the Berne-Jura, the Zurich and the Basle region. Picking out the medical devices industry it could be shown that again the clusters of the Zurich and the Berne-Jura are leading. As BAPTISTA and SWANN (1998) concluded in their econometric approach, a company is considerably more likely to innovate if the employment in the same industry is high. This partly can be explained by location externalities on the innovative performance, which is usually associated with the phenomenon of clustering. Secondly Switzerland still holds a good position in citation indexes, R&D expenditure, registered patents and other criteria related to innovation, making it one of the most competitive countries (ELIAS 2000, p. 14). Even during the recession in the 1990s Switzerland maintained a high level of R&D, increasing the efficiency of the innovation process (HOLLENSTEIN 2000, p. 16).
And finally Switzerland also has an important international financial services industry, being among the leaders for corporate finance. According to this view everything just seems to be perfect for running the ‘virtuous circle’ and create economic growth.

But of course there are also a few disadvantages to be mentioned that blur this perfect picture. In the first place the clusters within Switzerland are very limited by their size, it is questionable if they can ever reach a critical mass, growing to a size that is comparable to clusters in Italy, the UK or even the US. Secondly although Switzerland holds good positions in innovation indexes the impediments of lacking financial resources for R&D are persisting. Especially managers of small- and medium-sized companies often complain, that the Swiss financial services industry does not offer appropriate and attractive instruments for financing innovation processes. One reason might be that these companies often innovate in less seminal, and little value added fields of the high-tech industry. Swiss companies are rather characterized by skill-based activities than by science-based production (ELIAS 2000, p. 13; HOLLENSTEIN 2000, p. 23). This has to do with the path dependencies, grown out of the industrial tradition, leaving little chance for radical innovation. It is rather the strategy of incremental innovation, focusing on application and customer specific demand that is dominant for most Swiss companies.

So what are the opportunities?
Which strategies should be followed to support innovation and growth in clusters?

Clusters have not only connotations with spatial concentration of economic activities, but also include functional relationships between actors, facilitate networking and the mobilisation of localised and specific resources (DÜMMLER and THIERSTEIN 2002). As the empirical analysis of this paper showed Switzerland already fulfils one requirement for clusters: The spatial concentration of activities, especially in the Zurich region. It is there, that the larger clusters of the high-tech and the financial services industry are overlapping, creating opportunities for establishing networks and the close co-operation for financing innovation.

As the cited studies suggested, this co-operation could still be improved. But only facilitating the networking between banks and high-tech companies cannot do this. It also needs some additional efforts by the high-tech and the financial services industry. High-tech companies need to increase their attractiveness as borrowers. In the banking language this means a better financial data record and a promising market outlook. This can positively influence the individual credit rating and facilitate the access to capital for financing innovation.
There are several strategies that might help to reach this goal:

One strategy could be to focus R&D more on new and seminal fields of technology, with a higher market potential and greater economies of scale in the production process. The increase of co-operation and networking with domestic but also international partners can reduce the risks associated with this strategy.

Another strategy would be not to invest in the research for new technologies, but to adapt them quickly and develop them further for the implementation in new products. It then would also make sense to very closely link the development and marketing together, ensuring that the products developed meet market needs.

The third possible strategy - especially for smaller companies - would be to specialise in one field of technology, trying to secure a market niche and meet individual customer demands with a high quality level. To use the expression of SIMON (1996), this could be named the ‘Hidden Champions’-strategy.

The financial services industry on the other hand needs to further improve their financial products, making them more suitable and attractive for high-tech companies. Tailor-made finance solutions also for smaller high-tech companies, offered by specialised banks or investment funds might help in this regard.

Switzerland and especially Zurich has good preconditions for the financing of innovation. Although certain dilemmas exist the opportunities to strengthen existing clusters should be taken in order to support innovation and economic growth.
References


