

INNOVATION DEVELOPMENT FACTORS: SWITZERLAND EXPERIENCE

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Abstract: To achieve the aims of sustainable development of a country, it is necessary that the values of the innovative economy are shared, if not by the whole society, then at least by its main driving forces. The innovation process is no longer dependent on the efforts of one innovator. It has become interactive: in addition to the direct developers of innovation, other agents are involved in innovation development. Therefore, innovation should be seen as a product of multidimensional interaction of many participants. This is a specific environment where not only innovators are present, but also financiers, lawyers, marketers, logisticians, consultants, etc. Switzerland has become a highly successful example of a country, which developed such interaction. In current research, we discuss what factors led to innovation success in Switzerland.

Key words: innovation development, Switzerland, innovation factors, technology, effectiveness.

Introduction

Switzerland is recognized as a highly developed country with sound regulation of intellectual property rights, simplified mechanism for considering applications for inventions, dense transport network, high level of service and energy supply, high-speed telecommunications, minimum level of government interference in private business and market relations, which creates favorable conditions for competition. Furthermore, the country is also characterized by preferential tax and credit system for innovative enterprises, reimbursement of costs for land development. Some organizations and investors are completely exempt from taxes for 10 years (KPMG, 2021). Additionally to effective public support, the private sector also invests in the field of health and life sciences, as well as in micro and nanotechnologies.

Researchers from Switzerland are the authors of approximately 1.2% of all scientific papers published in the world. Their works focus mainly on such areas as biological sciences (26%), clinical medicine (24%) and physical, chemical and earth sciences (23%) (Duczmal, 2020; Frenken et al., 2017; Pokusa, 2020).

Switzerland ranks 2^d in the world after Japan in terms of the complexity of exported products. Switzerland is a leader in the pharmaceutical, chemical, electrical and mechanical engineering industries. Biological technologies and pharmaceuticals account for 40% of the country's exports (World Trade Organisation, 2020).

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Switzerland has the highest concentration of healthcare companies in Europe, attracting talent and capital from around the world (OECD, 2020; Wei et al., 2020). The country has the second largest health care expenditure per capita after the United States, making it an attractive market for medical technology and equipment manufacturers (European Commission et al., 2020). In regards with the fintech industry in Switzerland, its scale accounts for 10% of all European fintech businesses, which is mainly concentrated in Zurich. In 2017, the Swiss fintech industry became an important driving force for innovation as startups managed to penetrate the financial system at many different levels. Great success has been achieved as Swiss banks realized that the way to ensure their future lies through the automation of business processes (European Commission and Directorate-General for Research and Innovation, 2020; Suryono et al., 2020).

It should be also noted that Switzerland is one of the world's most innovative biotechnology centers. Swiss companies in this sector attract capital, partners and clients from all over the world (Mitchell et al., 2020). In current paper, we discuss the factors of Switzerland's innovation success.

Literature review

Earlier research of Hotz-Hart (2012) has shown that in order to achieve innovation success, public authorities focus on strengthening R&D infrastructure, education, and training, keeping the labor market flexible and allowing open access to major international activities. Author has also mentioned that during many difficult phases of economic development, Switzerland appeared to be extremely flexible and adjustable to changes in the international context.

When researching sociotechnical innovation pathways of geothermal energy in Switzerland, Ejderyan, Ruef and Stauffacher (2020) have concluded that it is necessary to relate in federal countries federal policies to local realities. Nevertheless, there are political goals, specific implementation measures and single projects that should have high level of acceptance. Federal mechanisms and instruments alone appear not to be sufficient in making innovations acceptable to local populations. At the same time, acceptance is mainly developed at the local level by taking into consideration contextual factors. According to the authors, specific federal tools, such as the federal guarantee that enables the sharing of financial risks among subnational states, or the ability of states to promote regulations that focus on local concerns might contribute to making projects more acceptable locally.

According to Tschanz et al. (2020) Switzerland innovation forms an ecosystem that enables innovative companies and universities to cooperate and use their research results for the development of new products and services, provides grounds for innovations and enhances Switzerland as an innovation country.

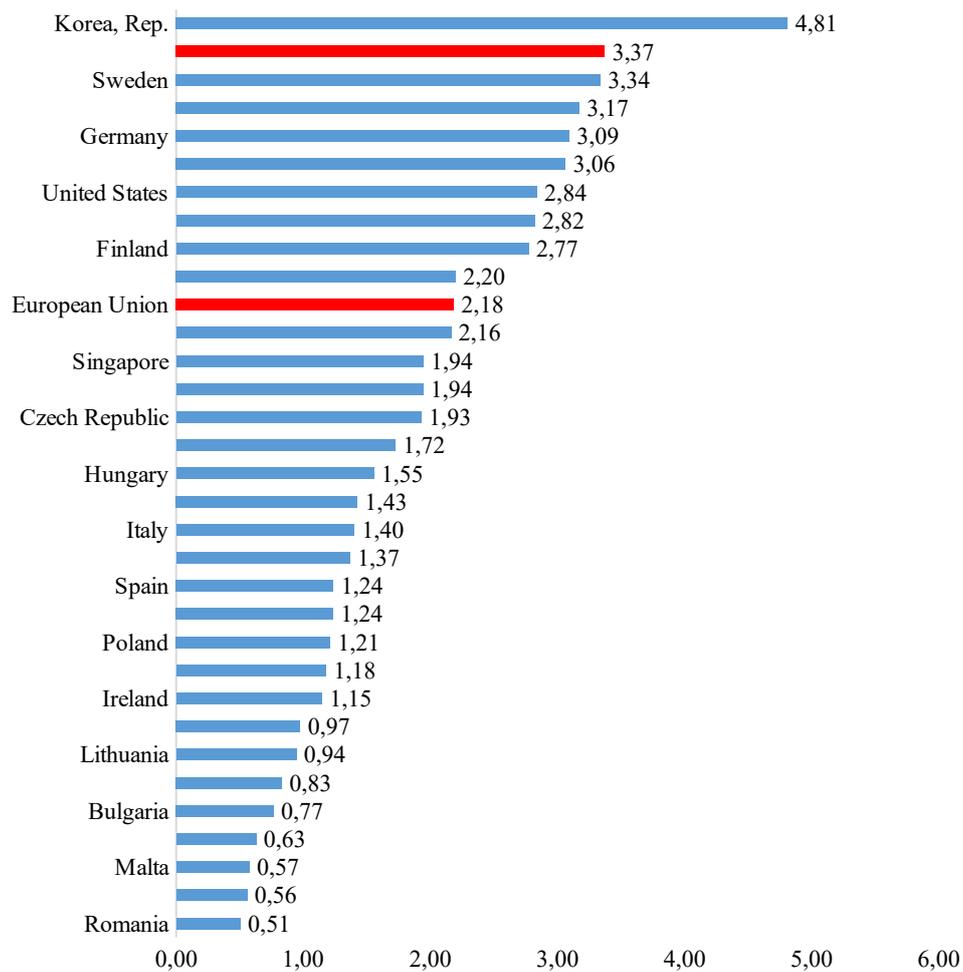
When researching Swiss innovation ecosystem in food and nutrition Bozzi and Matthes (2020) have concluded that Switzerland is a unique location for innovation due to the exceptional education, sound and liberal economic system, political stability, great infrastructure, close links to foreign markets.

Pharmaceutical and chemical industries, as well as life science are great contributors of innovations. Moreover, there are well established multinationals partnerships with SME businesses, research and educational institutions and universities.

The research of Beck et al. (2020) devoted to analysis of knowledge and technology transfer in Switzerland has shown that the contribution of institutions of higher education to society goes beyond their original mission of education and basic research in Switzerland. Cooperation between public research institutions and SMEs also contributes to the commercial success of innovative products and services. R&D investments appear to be a typical feature of knowledge and technology transfer active firms. They indicate that a better understanding of public research institutions and internal aspects are important but not a necessary constraint. Appropriate fundamentals for knowledge and technology transfer at the public research institutions and at the interface to the enterprises should be in place. Information lack about research activities at the universities, complications in finding appropriate contacts, a lack of entrepreneurial thinking at universities, no guaranteed confidentiality or lack of exclusiveness and diverse priorities contribute to the fact that R&D-active enterprises do not perform knowledge and technology transfer. In the next section, we consider the global innovation ranking of Switzerland.

Global innovation ranking of Switzerland

According to the Global Innovation Index 2020 (Cornell University, 2020), Switzerland was ranked as the most innovative economy in the world in 2020. It should be noted that the country has held first position for ten years. In 2020, the country ranked 13th on the pillar *Institutions*, 6th on the pillar *Human capital and research*, 3^d on the *Infrastructure* pillar, 6th on *Market sophistication* pillar, 2^d on *Business sophistication* pillar, 1st on *Knowledge and technology outputs* pillar, 2^d on *Creative outputs* pillar. Regarding subpillars Switzerland ranked best in terms of *Political environment* – 2^d place, *Government effectiveness* – 2^d place, *Rule of law* – 3^d place, *ICT use* – 3^d place, *Environmental performance* – 3^d place, *Domestic credit to private sector* – 3^d place, *Market capitalization* – 1st place, *Knowledge-intensive employment* – 3^d place, *University/industry research collaboration* – 2^d place, *Patent families* – 1st place, *ICT (information communication technologies) services imports* – 3^d place, *Patents by origin* – 1st place, *PCT patents (patent cooperation treaties) by origin* – 3^d place, *Scientific and technical articles* – 3^d place, *Computer software spending* – 3^d place, *High- and medium-high-tech manufacturing* – 3^d place, *Intellectual property receipts* – 1st place, *Global brand value* – 2^d place, *Global brand value* – 1st place, *Country-code TLDs (top-level domains)* – 1st place. Furthermore, country's R&D expenditures are the highest among the EU countries and rank 2^d among high-income countries, after Korea Republic (Figure 1).

Figure 1. Research and development expenditure (% of GDP)

*Note: Data for Switzerland and Singapore are as of 2017 due to lack of the data for 2018.
Source: Author's workings based on data from the World Bank (2021).*

Thus, as can be seen from Figure 1, Swiss innovation system is highly effective. In the next section, we consider factors of innovation development in Switzerland.

Factors of innovation development in Switzerland

In this section, we focus on several vital factors of innovation development of Switzerland, which according to the literature drive innovations in the country. These factors are effective education system, which is differentiated, innovative private sector and effective government support.

Education system

Switzerland is characterized by an educational system proposing both occupational and academic career pathways, and significant flexibility within the two. This confirms that there is appropriately skilled labor force along the entire of the innovation and value-creation chain.

The higher education sector offers undergraduate and post-graduate education, guiding research and knowledge and technology transfer and runs services for third parties. Contribution of higher education sector to innovations depends mainly on international cooperation. It is vital for Switzerland, as a small country, to be able to attract the most qualified international researchers, to take part in international research programmes, such as European Union Framework Programmes for Research and Innovation (State Secretariat for Research and Innovation SERI, 2021) and to be among international research establishments if its higher education institutions are to stay leaders in international research and participate in knowledge distribution globally. Another important factor of the country's innovative success is Switzerland's dual vocational education and training. About two thirds of school-leavers select this path, which gives them practice-oriented education and training designed to the latest necessities of the workplace. Moreover, this path allows them to continue studies at tertiary level.

Innovative private sector

As mentioned above, in 2017 Switzerland invested 3.37% of its GDP in R&D. Two thirds of this amount was contributed by the private sector (European Commission, Joint Research Centre, 2017). A few of international corporations in the food, chemical, pharmaceutical and machine engineering industries contribute a great share of this funding and drive the most innovation and R&D. Though the number of SMEs conducting R&D has deteriorated since the first decade of this century, they still play a significant role in Swiss innovation system. If compared with other European countries, Swiss SMEs are principally strong in introducing innovations in the marketing and organization field (European Commission and Directorate-General for Internal Market, 2019). Start-ups also greatly contribute to innovation development, for instance, in the field of financial services and life sciences.

Another important aspect of the sufficient impact of Swiss private sector on innovation development of the country is highly developed partnerships between companies, clients and universities in R&D and innovation procedures. The diversity of local economic systems and the advantageous conditions under which they work make vital contribution to the innovative soundness of Swiss businesses.

Effective government support

Swiss federal government is mainly responsible for R&D and innovation funding. It is mainly controlled by the Federal Department of Economic Affairs, Education and Research (EAER) and its State Secretariat for Education, Research and Innovation (SERI) (Gilaninia, 2017).

The Federal Act on the Promotion of Research and Innovation (RIPA) largely controls the tasks and arrangement of federal support for R&D and innovation at both national and international level (UNESCO, 2015). RIPA also places the tasks, measures and responsibilities of funding organizations. Under the Federal Act on the Funding and Coordination of the Higher Education Sector (HEdA), federal and cantonal establishments cooperate to guarantee the quality and competitiveness of the whole Swiss higher education sector (European Commission, 2017). Cantonal authorities also support R&D and innovation in sponsors of cantonal universities, universities of teacher education and universities of applied sciences. Furthermore, they support business start-ups, either at their own initiative or in partnership with other cantons. Locally, municipal authorities support innovation by developing technology and innovation parks. There are also other significant measures to promote innovations in Switzerland, which we have systemized in Table 1 below, including those ones highlighted in the literature review.

Table 1. Measures to driving innovations in Switzerland.

Measure	Actions being performed
High quality of framework conditions	Switzerland offers some of the best framework conditions for R&D and innovation worldwide, highly developed infrastructure, low taxation, a flexible labor market, a steady political system and good quality of life.
Efficient R&D and innovation promotion	State R&D and innovation promotion is conducted on a competitive basis. The funding tools let researchers to choose their own topics and projects to a great extent.
Broad international cooperation	Swiss researchers have been participating in the EU research framework programmes since 1988, either under the terms of Switzerland's third country or related partner status. EU research framework programmes are the key source of public funding for R&D and innovation in Switzerland. The country is also a member and partner of other international research programmes, infrastructures and initiatives. For instance, it is a host country and member of the European Organization for Nuclear Research (CERN) in Geneva, a member of the European Space Agency (ESA). Additionally, Switzerland collaborates with non-European countries and preserves a global network of Swiss consular agencies devoted to technology and science.

Effective knowledge and technology transfer	Technology transfer agencies have been established at several institutional levels with diverse responsibilities to stimulate and promote knowledge and technology transfer. The Swiss Innovation Park plays a significant role in developing knowledge and technology transfer in Switzerland. There are two hub locations, one near the ETH Zurich and the other near the EPF Lausanne. There are also three other locations dedicated to science and business that are combined together within a similar network. Finally, most cantons and many urban areas in Switzerland have technoparks where knowledge and technology transfer is present.
Outstanding research and innovation staff	More than 40% of the Swiss labor force is involved in the creation, spreading and application of technological knowledge. Between 2000 and 2017, the number of foreign R&D labor force at higher education institutions and firms doubled. In 2017, foreign R&D staff accounted for 43% of total university R&D staff (28% in 2000) and 42% of R&D workforce in private firms (32% in 2000). Furthermore, over half of researchers working at higher education institutions (52%) and in the private sector (51%) were foreign residents.
Well-developed patent application system	Compared to the size of the population, Switzerland has the highest number of international patent applications, followed by Japan and Sweden. Switzerland works the most effectively with foreign countries: 42% of internationally patented inventions are the result of international collaboration, with 30% being from collaboration with the European Union researchers.
Structural change ability	Switzerland is able to actively respond to new market developments, to blow the capacity of technological progress and to adjust to structural changes in competition and demand. Sectors with intensive research activities account for over half of nominal added value. Only Germany, USA and South Korea have equally great proportions.

Source: Deloitte (2021), Weltgesundheitsorganisation et al.(2020).

Conclusions

In current research, we have reviewed Switzerland's position in Global Innovation Index 2020 and found out that the country is characterized by highly developed innovation index, ranking among the top countries on many pillars and ranking first globally. We have considered what drives innovations in Switzerland. Our

finding is that Switzerland has highly developed education system, innovative private sector, effective government support, high quality of framework conditions, efficient R&D and innovation promotion, broad international cooperation, effective knowledge and technology transfer, outstanding research and innovation staff, well-developed patent application system, structural change ability. Of course, not all the countries are able to introduce immediately the same measures to promote innovation system. However, one of the best options is to start with developing international cooperation and sources of funds to support currently present research centers and then broaden research funds.

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