TAXATION AND INNOVATION, A COMPARISON OF HUNGARY AND AUSTRIA

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1. INTRODUCTION

Many governments do participate actively towards encouraging innovation entrepreneurship to achieve different goals, one of them being creating employment and hence reducing the unemployment levels. The factors that affect economic growth levels are capital, labour, land and technology. Studies have shown that innovations from individuals and companies have been contributed positively towards economic growth and development. (Autio 2014: Block 2017).

Economies are growing and a lot of multinational activities and also the growth in global value chains, hence there is a high requirement from government all over the world to participate actively in Science, Technology and Innovation (STI) polices. These policies are currently facing a lot of resources constraints, ranging from insufficient growth of some developed economies, migration patterns changing and the aging population, all this limiting skills. (OECD STI Outlook 2016).

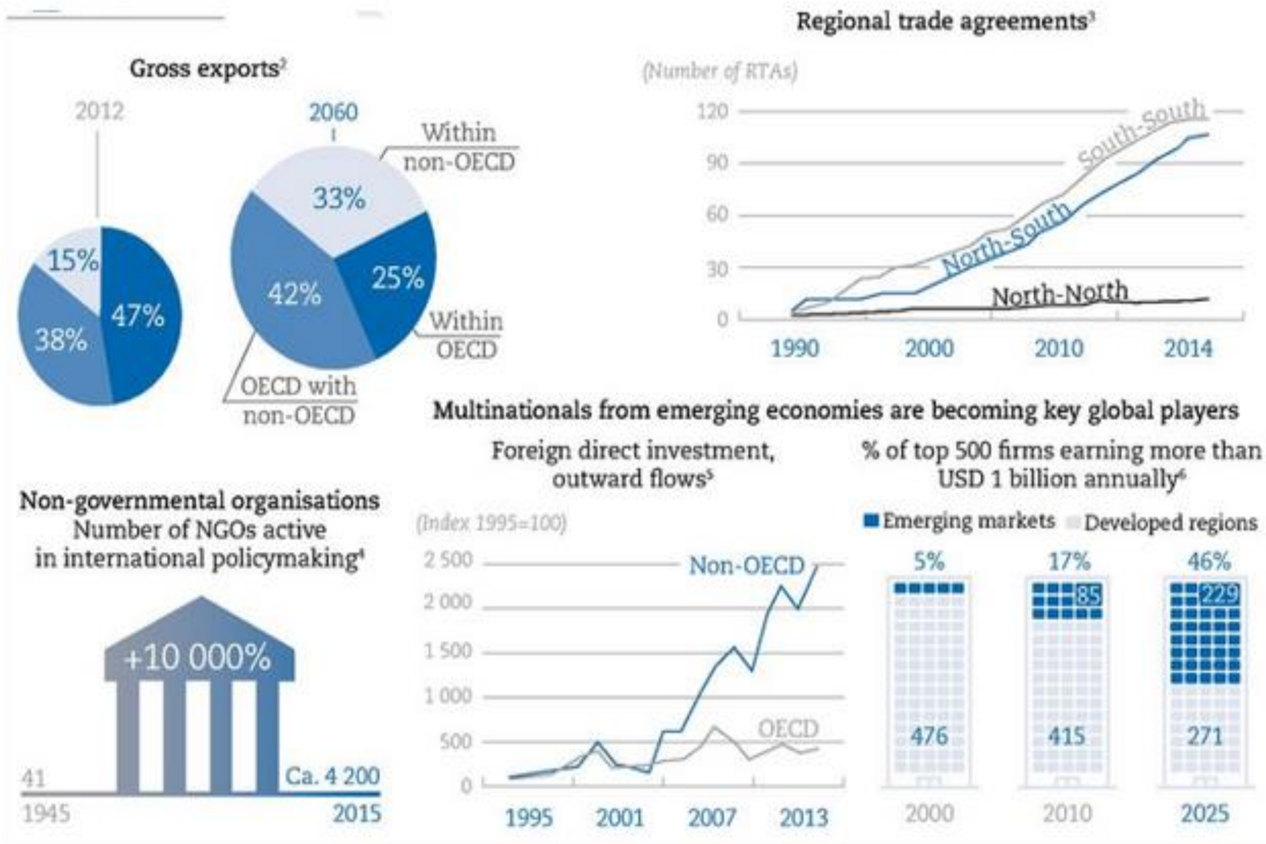
Though the advancements in technology have a positive effect, but on the other hand, some challenges have accompanied the advancements, for example the growth of artificial intelligence is a concern for future jobs where robots can be applied. Currently government prefer to apply the no-spending polices to encourage innovation. According to OECD, these policies should focus on the mega trends in the world now, namely: globalization, economy, jobs and productivity, society, health, inequality and well-being, demography, natural resources and energy, climate change and environment. (OECD STI Outlook 2016).

There has been a shift in the manufacturing capacity to developing countries from OECD countries, particularly the Eastern part of Asia, where multinationals (MNEs) are moving their operations to a more favorable locations in terms of factors of production. With production being done in segments, which are then recombined to come up with a final product through global supply chains. (OECD, 2010a, 2011). The rapid expansion of GVCs has created opportunities for developing economies to enjoy the benefits of offshoring innovation. In several nations, as part of a wider economic growth strategy, competitiveness for innovation is now a policy focus. (Ernst, 2008, OECD 2011). GVCs upgrade is about quality and innovation, which takes the form of process upgrading, product upgrading and functional upgrading. (Kaplinsky and Morris, 2002).

Participation in GVCs and increase in productivity levels usually go hand in hand, leading to a country exporting goods with a high value and more advanced, hence seen as a part towards economic growth and development. For instance, a research on 600 European Small and medium businesses showed that over 70% among those sampled agreed that they profited from both the ongoing digitalization process, and also digitalization made it easier for international buyers and suppliers to be incorporated into their own value chains (Abel-Koch, 2016).

From **figure 1**, there has been an increase in foreign value added share both on exports and final consumption, showing how the world economies are interdepending upon each other. There has also been a growth of global value chains rapidly, with the assistance of science, technology and innovation. A country like China, with the emerging economy, is trying to participate in value added activities at a higher level in GVCs, in downstream and upstream, and since for them to upgrade they have to apply innovation, hence an increase in research and development at the global level of competition.

Figure 1. Fragmented production across global value chains, percentage share of foreign value added in gross exports



Source: OECD

In addition, there has been an increase in regional trade agreements, leading to GVCs shifting more regional, with an effect in research and development. Multinationals are also participating actively in innovation and research and development, with foreign affiliates playing a huge role in research and development at domestic level. According to the Global Entrepreneurial Research Association, the rate of innovation in total early-stage technological activity is the percentage of those engaged in total early-stage technological activity that means that their idea is new to certain consumers, so that few or no businesses sell the same product.

The other part of this paper is presented as follows: section two provides more theories on innovation and taxation based on previous research papers, section three provides the data sources, methodology and the research question and lastly section four outlines the trends in innovation and taxation in Hungary and Austria from late 1980s to 2019, and section five provides a comparison of Austria and Hungary based on some indicators in innovation and taxation with general discussion on the level of innovation between the two countries.

2. TAXATION AND INNOVATION THEORY

The two related dimensions with which to focus on the interrelationship of taxation and innovation. Firstly, taxing individual's income or company's income or investments may have an adverse effect on creativity. This can be a consequence of taxes that maybe set to targets that are completely unrelated. (Saez 2000). Secondly, tax deductions may be deliberately structured not to harm creativity, or even to promote it. (Saez and Stantcheva 2016). A key distinction between personal income tax and corporate tax, for most countries, from other incomes, personal income losses are still deductible as per the Personal Tax Code but not deductible when it comes to Corporate Tax Code (Cullen and Gordon 2007; Hansson 2012). It was also noted that a decrease in the personal tax rate would minimize business risk. (Cullen and Gordon (2007). Entrepreneurs are often more likely to be involved in innovation activities of high risk and high benefits. (Harhoff et al. 1998). Therefore, if entrepreneurs are not responsible under the income tax system for their losses incurred, they are more likely to be involved in innovation activities.

There are different ways in which a government can participate in innovative entrepreneurship. This can be done through taxation and other government regulation; for example licensing, government programs for a new business or a growing business and other government policies; for example, public procurement. Taxes largely focused on labor, such as income taxes, influence growth by influencing output level growth, supply, and labor demand. Entrepreneurship income tax also impacts profitability, with corporate taxes playing a greater role too. Earlier studies have found that business retained profits as one of the key sources of capital investment by enterprises, particularly in the initial stages of the business (Henrekson and Sanandaji 2011). High corporate tax rates tends to reduce the profits from the business that could have been invested in innovation.

For example, prior studies show that there is a relationship between taxes and innovation, which is strong. So far, several studies have investigated taxes and start-up costs role with regard to innovation, which is a basic base, to this study, comparing Hungary to Austria, with a focus on taxation in innovation performance from late 1980s. For example, through taxation which is part of the cost which affects the rate of innovation. Other studies explained that taxes influence the type of innovation, quality and quantity. Taxes, which are considered as a recurring cost, which discourages innovators because they tend to reduce their profits. (Hansson 2012). Innovative and corporate taxes and personal taxes have a negative relationship. At the same time, Lee and Gordon 2005, argued that when the corporate tax rates are high then economic growth is affected negatively. Djankov (2008) also explained that corporate tax rates and economic growth have a negative correlation. Corporate tax tend to deter businesses from undertaking innovative activities (Balliamoune-Lutz and Garello 2014).

Acording to Griliches 1992 and Romer 1990, research and development plays a very important role in increasing the productivity of a given country. Some studies have explored the impact of research and development tax incentives in different countries. Guellec 2003 and Pottelsberghe noticed, in analyzing research and development tax incentives of 17 countries from OECD, the tax incentives significantly accelerated enterprise research and development (Guellec et al. 2003). Similarly, a research done by Falk where he argued that research and development tax incentives do have such a strong as well as substantial effect on the intensity of research and development. (Falk 2005).

The right way to look at the relation regarding innovation and taxation would be to perceive taxes as a monetary instrument with spending preferred to be a primary source of government revenue. Taxes on income and property, for example, are usually levied to collect funds towards State programs. Given its numerous impacts on people, plus entrepreneurs, establishing a tax system is a challenging activity (Balliamoune-Lutz and Garello 2014).

3. DATA SOURCES AND METHODOLOGY

The results of the comparison between Austria and Hungary in this paper are based on information from the Global Economy, Organization for Economic Co-operation and Development (OECD), Eurostat and The Global Economy, which provides reliable business and economics data on 200 countries sourced from United Nations, World economic Forum, The World Bank and lastly from the Global Innovation Index (GII) with data collected from INSEAD Business School, Cornwall University and World Intellectual Property. The data from these sites is usually updated after individual countries release their data. The findings are illustrated using different indicators on innovation and taxation so as to address the research question, is taxation in innovation in Hungary more effective than in Austria?

This research paper intends to show the major trends since late 1980s to 2019, in the taxation system and innovation, mostly in research and development of Austria and Hungary, then show the effect of personal income/ individual income taxes and corporate income taxes on innovation by individuals and businesses, comparing Hungary to Austria using different taxation and innovation indicators. Then a general analysis on the level of innovation of the two countries based on the indicators and some more indicators from Global Innovation Index report of 2019.

One of the advantages of the data used in this paper is that it is readily available at no or little cost from the intuition's databases and the data is up to date. Another key advantage is that the websites provide visualization platform which makes it easy for analysis of data. The only major disadvantage about the data used is some data is missing from some years and hence an estimate is used. This paper compares Hungary to Austria because in Central and Eastern Europe, in terms of research and development expenditure as a percentage of GDP, for the period between 1996 to 2017 Austria had an average growth rate of 3.39% but currently Hungary's average growth rate is the highest with a percentage of 4% among the CEE countries, hence provided an opportunity to compare the two. (World Bank).

The indicators used to show the comparison in innovation and taxation in Hungary include:

1. Tax on personal income as a percentage of the GDP
2. Tax on corporate profits as a percentage of the GDP
3. Availability of Scientists and engineers
4. IT exports as a percentage of total goods exports
5. High technology exports in million US Dollars

6. Percentage of people employed in high technology manufacturing and knowledge intensive service to total employment.
7. Percentage of research and development personnel to active population.
8. Number of patent application per million inhabitants.
9. Total gross expenditure on research and development as a percentage of GDP.
10. Gross domestic Expenditure on Research and Development (GERD) financed by abroad.
11. Business enterprise Expenditure in Research and Development (BERD) as a percentage of GDP.
12. Businesses enterprise Expenditure in Research and Development (BERD), financed by the government directly.
13. Percentage of Business enterprise Expenditure in Research and Development (BERD), Small and Medium sized enterprises to the total BERD.
14. Higher education Expenditure on Research and Development (HERD) as a percentage of GDP.
15. Basic, applied and experimental research in higher education as a percentage of the GDP.
16. Public sector expenditure on research and development (PSERD), financed by the government as a percentage of GDP.
17. Public sector expenditure on research and development (PSERD), financed by abroad.
18. Research and development expenditures of foreign affiliates, expressed as a percentage of total research and development expenditure of enterprises.
19. Research and development expenditures of domestic firms outward, as a percentage of total research and development expenditure of enterprises.
20. Foreign ownership of patents, to the number of Patent Cooperation Treaty (PCT).
21. Domestic ownership of patents invented or co-invented abroad, to the number of Patent Cooperation Treaty (PCT).
22. Global Competitive Index 4.0, 6th pillar of skills.
23. Charges for the use of intellectual property, payments (BoP).
24. Charges for the use of intellectual property, receipts (BoP).
25. Value added in the ICT sector, expressed as a percentage of the total business sector value added.

4. TRENDS IN INNOVATION AND TAXATION IN HUNGARY AND AUSTRIA FROM LATE 1980s TO 2019

4.1 Innovation, Research and Development in Hungary

Historically, Hungary performed very well on inventions, for example; Rubik's Cube by Ernő Rubik (1974), Coloured Television by Péter Károly Goldmark (1940), Transformer by Ottó Bláthy, Miksa Déri, Károly Zipernowsky (1884), and László József Bíró's Ballpoint pen (1938).

Before the political changes in **1989-1990**, the corporate demand for research and development in Hungary was poor, but there after innovation gained its role in both Central Europe and Eastern Europe. It was noted that, during years of transition, corporate innovations were mainly focusing on transfer of technology especially from abroad. In 15 years, nearly 30 billion US dollars of foreign direct investments came to Hungary, and by the time it was 2005 the share had increased by 65% in the manufacturing sector and over 50% in the other economic sectors. (Papanek G. 1999).

According to (Papanek G. 1999), the main reason why business enterprises research and development in Hungary remained weak during economic recovery was because of lack of innovation policy, which was also shown by how research and development expenditures were distributed, portraying some structural problems. Finances for research and development which were more than half came from the government, which supported almost all state owned institutions, where 58% of the government research and development went to research institutions owned by the government, 37% went to the higher education sector, whereas only 5% went to the industries. The business sector had been financing its research at a very limited and stagnant level.

As from the beginning of **2001**, the depreciation was flexible for research and development investments. And by the start of 2003, more incentives had been introduced, for instance, tax reimbursements at a fast rate, a tax relieve of 70% for research and development donations, ICT investments were also amortized and an option of up to 500 million HUF tax-free investment which contributed positively towards innovative activities and create a favorable environment for entrepreneurs in Hungary. Furthermore, corporate tax rules were modifies as from 2004, with a decrease from 18% to 16% with an aim to improve competitiveness of companies domestically. Some more measure were put in place so as encourage the innovation process in Hungary, which included, a 300% (RTD) Research and development tax allowance incase the company decide to locate its laboratory at a public research institute or at a university as from 2004 and on the field of education and research a tax free upon employment of a PhD, MBA or MSc student but only up to the minimum official wage level.

In **2002**, in the Government Programme, science and technology frame work was well defined, so as to promote development of the society and the economy at large.

The four priority areas defined by the Government were:

- Innovation-conducive legal structure,
- Making Hungary appealing as a research and development site,
- Improving the safety of intellectual property,
- Growing the innovation sources in SMEs.

One of the problems that led to low levels of corporate research and development demand was because the managements of firms had set targets which were based on assessment of technological levels which was exaggerated. 38% of firms in Hungary thought, for instance, what they produced was of the same technological level with other European countries, 41% of the firms thought with just a small effort, could have led to them being on the same European levels, and lastly 46% of these firms believed that there prices were competitive in the European markets. This led to problems in their sales and marketing networks. (OECD report, 1993).

According to a survey by Economic Research Institute (ERI), in **2002**, the ratio of employees working in the innovation sector in the small and medium enterprises in Budapest was as indicated below:

Table No.1. Number and percentage of workers dealing with innovation in enterprises of different sizes

Number of employees per firm	< 50	51-250	>250	
Number of employees dealing with innovation↓	Percentage of firms concerned			Total percentage
0	80	82	76	80
1-5	17	12	16	15
6+	3	6	8	5

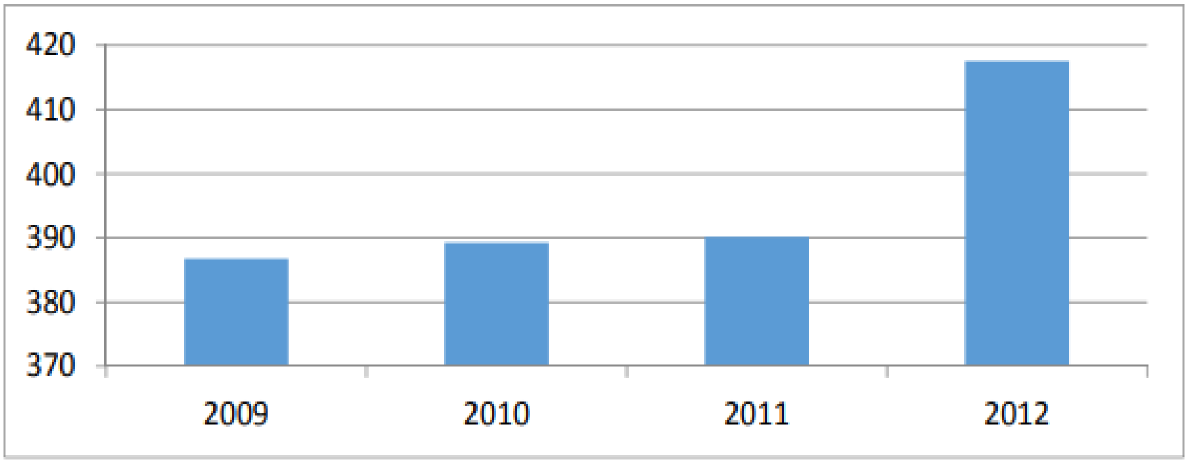
Source: *Survey taken by the Economic Research Institute,* Fall 2002, Budapest, 43.

From the data, as shown in table 1, it is seen that 80% of the SMEs had nobody engaging in innovation at the enterprises by 2002, but 5% only had more than 6 employees in the field of innovation.

By **2004**, the research and development share in the GDP was at 0.95%, which was considered to be the European average of 1.94% and the Lisbon target of 3%. Main reason for this was that, for the government research and development expenditures was in the mid-level countries, while research and development expenditures by companies as a share of GDP was very low. The companies that were owned by the state had very close ties with the research and development sector, though they performed poorly in innovation than the foreign owned companies. There were some fears in early 90s that foreign company owners in Hungary would neglect entirely the Hungarian research and development institutions and universities, but then foreign businesses used the institutions more than the private Hungarian companies. (Központi Statisztikai Hivatal 2004).

The research and development expenditures for environmental support elevated significantly, but with fluctuations, by **2012**. The environment is likewise a concern objective in the classification system by OECD of socio-economic objectives in line with the information of the Központi Statisztikai Hivatal (KSH), the research and development expenditure committed to that purpose accelerated steadily each in percentage and absolute terms to the GDP in between 2009 and 2012. It was noted that the expenditures of the national financial system for environmental purposes have remained stagnant in the latest years, as shown in **figure 2**.

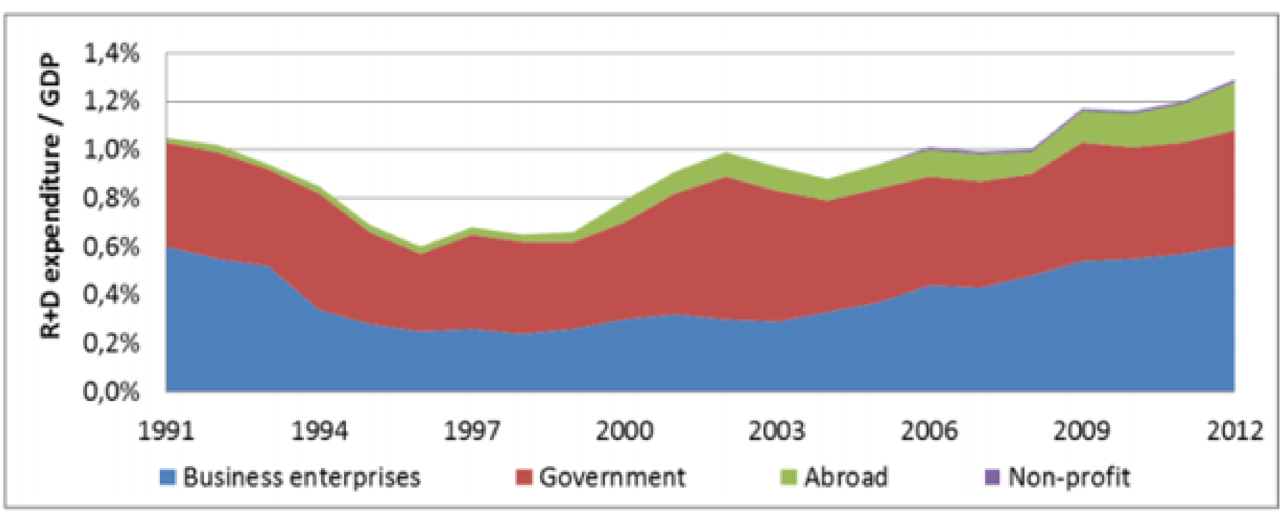
Figure 2. Research and Development for environment support per one million HUF of GDP.



Source: NIH RDI Observatory calculations on the basis of KSH

In Hungary, the research and development expenditure of the GDP ratios have increased up by 30% from 2008, and was expected to reach a high value of 1.44%, which was the highest level in twenty years past. The company research and development expenditures began to increase from the late 1990s, and their increase intensified in the following years, so that they accounted for almost half of the research and development expenditures. In addition to the company sources, the percentage and value of overseas funds gradually increased, and a sixth of the expenses by 2012 were financed by foreign investors, as shown in **figure 3**. The share of public sources was still the same throughout.

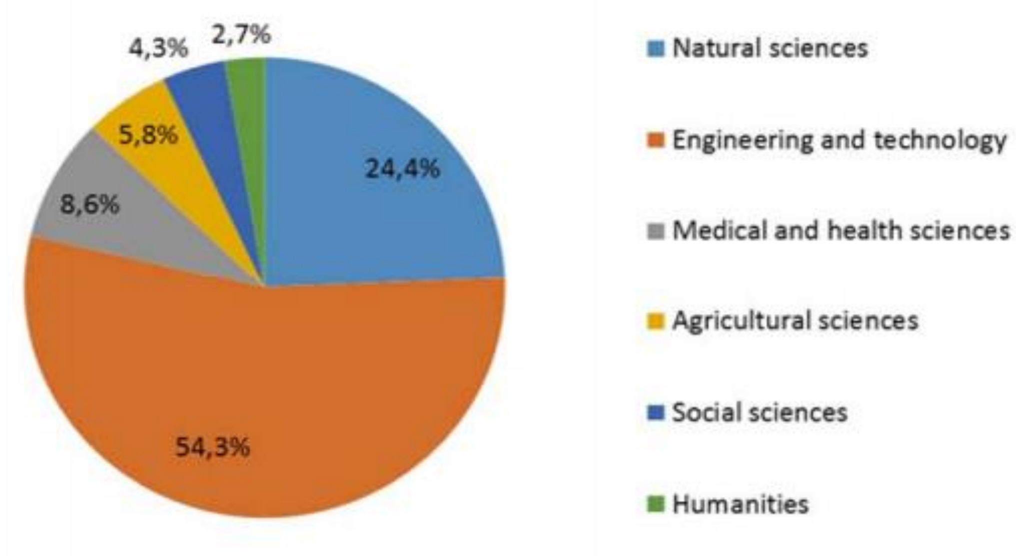
Figure 3. Sources of GDP proportionate research and development expenditure. (1991- 2012 as a %)



Source: KSH

From **figure 4**, in 2012, in the area of sciences portrayed an unequal image of research and development expenditures in Hungary, with technical sciences taking a larger share of 54.3% followed by natural sciences at 24.4%, medical sciences at 8.6%, agricultural sciences at 5.8%, social sciences at 4.3% and lastly humanities at 2.7% was the lowest.

Figure 4. Research and development expenditure shares of various areas of sciences in 2012



Source: KSH

Investment into the Future which is a government's plan was sanctioned in June **2013** to inspire and encourage the Hungarian economy. The plan was set to raise the level of total research and development reaching 1.8 per cent of the GDP, and level of Business enterprise research and development (BERD) consumption in 2020 to 1.2 per cent of GDP.

According to the National Smart Specialization Strategy **2014,** Hungary's policy on innovation for the period of 2014 to 2020 was created in coordination with other EU member states in relation to the European Union's innovation and cohesion policies hence acting as a point of reference for the country's development strategy overall. (National Smart Specialization Strategy (S3), 2014). Another major step towards improving innovation in the country, in 2014 The Hungarian government developed a national strategy known as Smart Specialization Strategy (S3) as per European Union framework, and was approved by November of 2014. The strategy was set based on 2 horizontal and 6 sectorial research and innovation priorities namely:

Sectorial

- Agricultural innovation
- Clean and Renewable energies
- Healthy traditional foods

- Sustainable environment
- Advanced technologies in industries such as vehicles and machinery
- Healthy society and wellbeing

Horizontal

- Sustainable and inclusive society
- Information Communication Technologies and Services.

By the end of 2014, companies had spent 690m Euros on research and development, and the ratio to total domestic research and development expenditure was 48%. According to National Smart Specialization Strategy, in 2014 large companies spent 30% more than medium, micro and small sized companies combined on research. On the other hand, the ratios of source of funding for research and development expenditures from public sources was, 4.1% by large companies, 18% by medium sized companies and 40% plus for micro and small companies. (National Smart Specialization Strategy (S3), 2014).

On higher education research, the industry was greatly engaged on development, collaborating with enterprises in 37.4% out of 2400 projects research in 2014. According to **figure 5**, in the manufacturing industry, the pharmaceuticals have participated more in innovation with 56.8% in product innovation and 18.2% in marketing innovation, while at the bottom was the wearing apparel with 5.2% in product innovation and 10.3% in marketing innovation. (National Smart Specialization Strategy (S3), 2014).

Figure 5. Share in percentage of companies engaged in innovation in the manufacturing industry

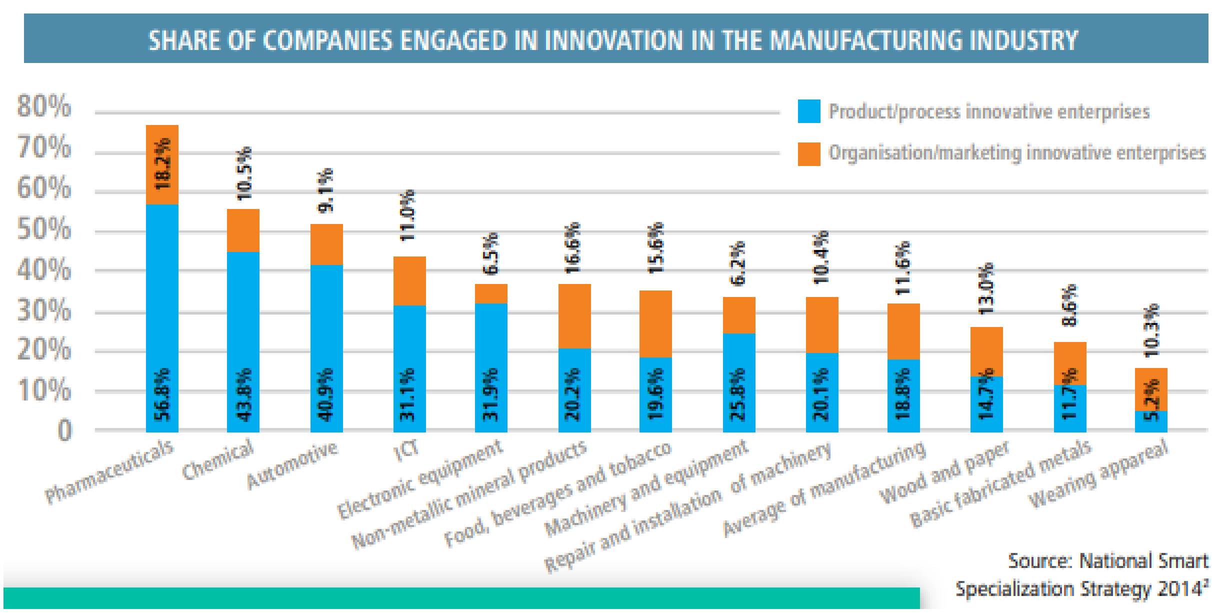
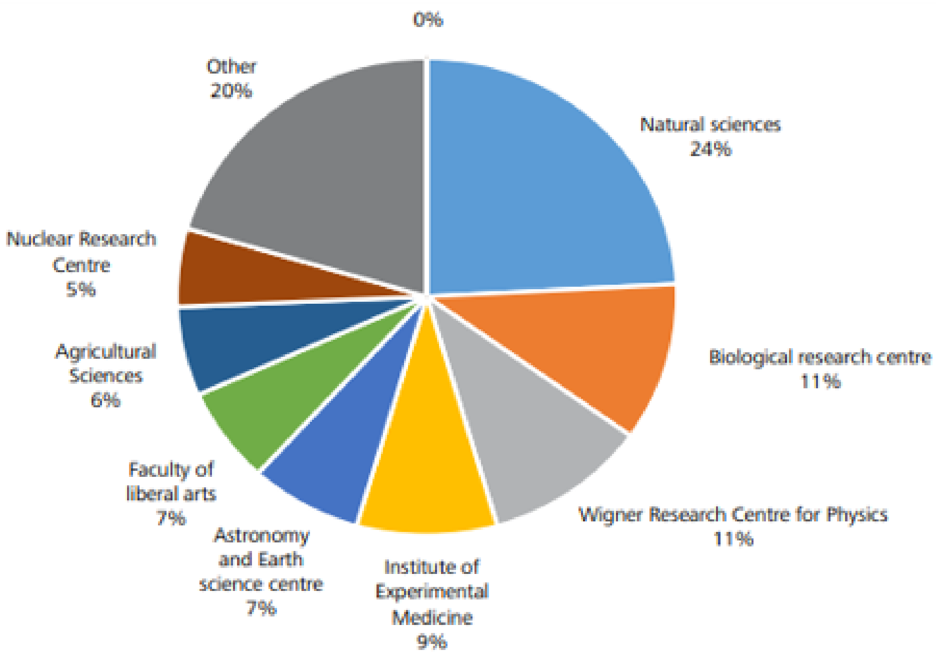


Figure 6. Share of the 167m Euros budget among faculties of the Hungarian Academy of Sciences

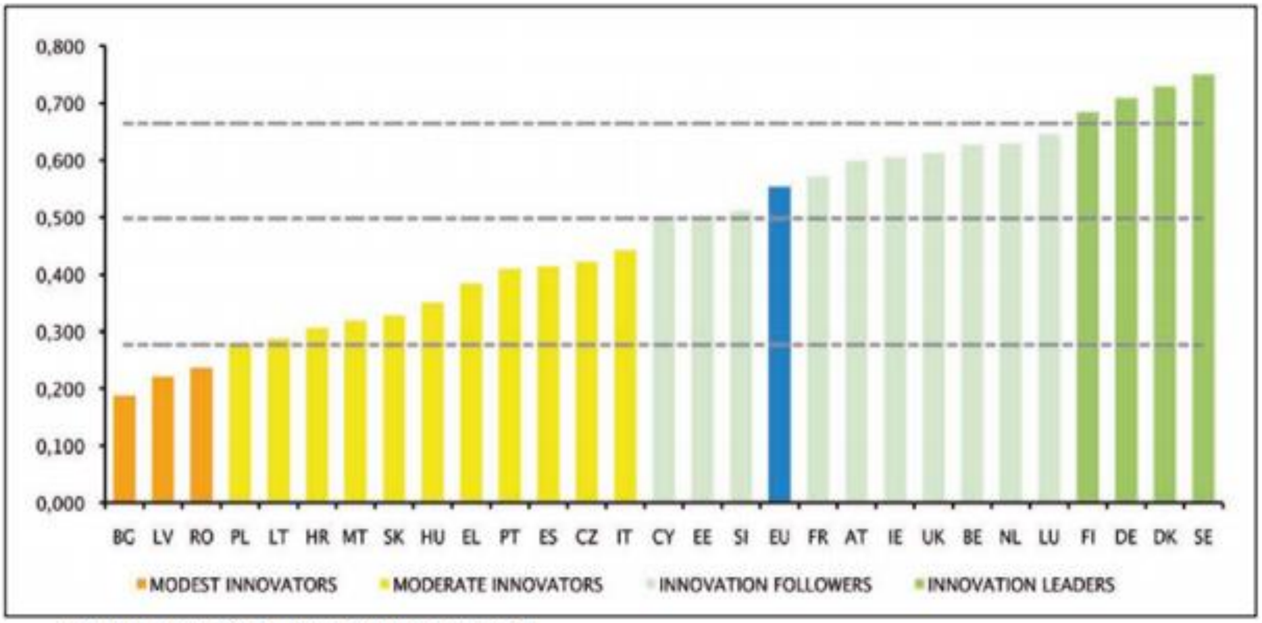


Source: National Smart Specialization Strategy 2014

The major and significant player in Hungarian research and development sector is the Hungarian Academy of Sciences (MTA). From **figure 6,** it shows how the budget of 167 m Euros was distributed among 15 faculties with natural sciences taking a larger share of 24% of the budget.

The National R&D and Innovation Fund (NRDIF) which is a separate government entity whose goal was to offer support to the government in research and development, was established in **2015**. Hungarian innovative ideas and research projects are funded by them. This was a good move by the Hungarian government to promote innovation entrepreneurship. Most of Hungary's creative entrepreneurs do not rely on local capacity for research and development because of the level of competition in both domestic and international levels. They gain their creative expertise from other companies, often foreign parent firms or often in-house inventions. This is regardless that there was a high degree of R&D, the flow of information from the R&D sector into the enterprises was slower than anticipated. (Andras Schwho, pp. 339-360)

Figure 7. An International comparison of Hungary's Innovation performance by 2014



Source: Innovation Union Scoreboard, 2014

The innovation overall performance of the EU progressed according to the 2014 rankings of the Innovation performance. Hungary was raked moderately as per **figure 5**, just like the most of the countries within the region, including the Czech Republic and Slovakia.

4.2 Taxation on Innovation in Hungary

In the early 1990s, Hungary was experiencing transition in both economic and the political systems. The led to a new system of tax to be established for the government to be able to collect taxes and provide important services to its citizens. Since the tax reforms were implemented way before some economic transitions were done, or even started, such as business regulation legislation, the tax system in the beginning not compatible with the economic system of Hungary as a whole.

The first tax laws which were effective as from 1st January 1988, were corporate tax Act No. IX and Income tax Act No. VI. The personal income was taxed on all the income on individual basis and not on household basis, not considering the source of income. The tax was based on a standard progressive table of tax, as show in **table 2**.

Table 2. Personal Income Tax Rates changes, in HUF per year from 1988 to 1992

1988		1989	
Tax base	Tax rate	Tax base	Tax rate
0- 48,000	0	0- 55,000	0
48,001- 70,000	20	55,001- 70,000	17
70,001- 90,000	25	70,001- 100,000	23
90,001- 120,000	30	100,001- 150,000	29
120,001- 150,000	35	150,001- 240,000	35
150,001- 180,000	39	240,001- 360,000	42
180,001- 240,000	44	360,001- 600,000	49
240,001- 360,000	48	600,001-	56
360,001- 600,000	52		
600,001- 800,000	56		
800,001-	60		

1990		1991	
Tax base	Tax rate	Tax base	Tax rate
0- 55,000	0	0- 55,000	0
55,001- 90,000	15	55,001- 90,000	12
90,001- 300,000	30	90,001- 120,000	18
300,001- 500,000	40	120,001- 150,000	30
500,001-	50	150,001- 300,000	32
		300,001- 500,000	40
		500,001-	50

1992	
Tax base	Tax rate
0- 100,000	0
100,001- 200,000	25
200,001- 500,000	35
500,001-	40

Source: Koltay, J. (1993). Tax reform in Hungary, p. 254.

From the **table 2**, in 1988 the tax burden was high for the Hungarians, and this was corrected as time went by, as seen as at 1992.

Corporate tax was introduced at a rate of 50% on the profits, then lowered in 1990 to 40%. One of the problems that were experienced when the tax was implemented, since there was no any unifying system of accounting in the country, hence the corporate profits could not be measured uniformly and this made it difficult to both measure and enforce the corporate tax, but the system of accounting was introduced in 1991. Another problem created by this tax was, it favored the businesses owned by the state against the private businesses. The private business were faced with double taxation, and they also had to pay part of the profits to the shareholders, while the state owned enterprises did not have such requirement. But later by 1990, state owned businesses were required to make payments too. Hence, this encouraged privatization.

In 2010, Hungary carried out a flat personal income tax of 16% and was lowered to 15% by 2016, which still remains to be at 15% to date. The corporate income tax was decreased in 1995 to 20% and then decreased again in 2016 to 9%. A tax base of 1996 was set for the company income tax by Act LXXXI on corporate income tax and was calculated as enterprise profits on items consisting of depreciation, royalties, dividends and penalties.

Hungary also started to offer tax credits to companies investing in efficient energy technologies, capital investments, and participating in research and development. In addition, tax allowances are also granted to companies categorized as small or medium enterprises. Hungary's rate of 9% as corporate tax is considered to be the lowest rate of corporate tax within the European Union, hence attracting foreign investments mostly form the Western Europe to Hungary.

4.3 Research and Development Tax Incentives in Hungary

As shown in **table 3**, Hungary's research and development tax relief is provided through:

- Tax allowances in corporate income taxes, where it is advantageous to the parties collaborating in research and development activities and tax benefits set at HUF 50 Million. And a decrease of the tax base of the taxpayer up to 50% as long they have outstanding credits.
- Development tax incentives, which is based on investments, thereby offsetting the corporate income tax and allowing credits not used to be carried forward up to 14 years. The tax benefits of research and development are only limited to 80% of the company's corporate income tax liability. The tax credit varies by company size and region where the investment is located.
- Total exemption of vocational training (VTC) and social security (SSC) contributions. The tax ceilings named above also apply to social security exemption.

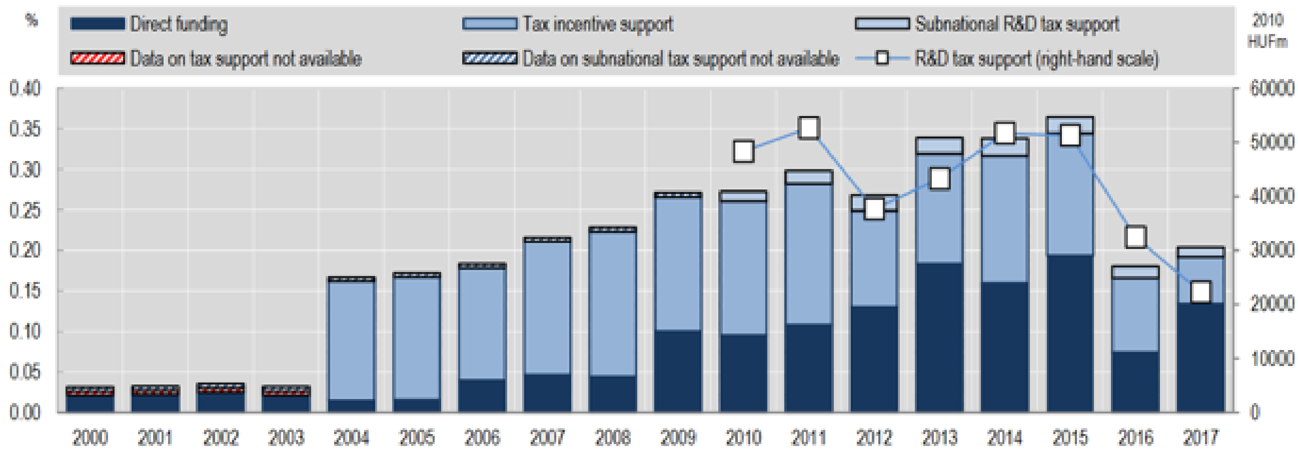
A deduction of 10% of the incurred direct costs on basic research, applied research or experimental research known as Local business tax (LBT) is also provided by the municipalities in Hungary. In Hungary, both large and medium-sized companies do pay 0.3% innovation contribution.

Table 3. Main Features of Research and Development Tax Incentives in Hungary, 2019

		R&D related tax base deductibility	SSC and VTC exemption	Development Tax Incentive	R&D tax allowance in innovation contribution**
Tax incentive		Tax allowance	SSC exemption*	Tax credit	Tax allowance
Type of instrument		Volume based	Volume based	Volume based	Volume based
Eligible expenditures†		Current	Labour	Capital, intangibles	Current
Headline rates (%)		100 (300 R&D collaboration)	100 (SSC rate: 20; 9.25 for PhD students/ doctoral candidates)	0-50 (large), 10-60 (medium-sized), 20-70 (small)***	100 (medium-sized and large firms only)
Refund		No	Redeemable against payroll/ related taxes	No	No
Carry-over (years)		5 (carry-forward)	n.a.	14 (carry-forward)	n.a.
Thresholds	Floor (R&D expenditure)	-	-	HUF 100 million	-
Ceilings	R&D tax relief		SSC liability	80% of the calculated corporate income tax	-
	-R&D expenditure		Gross wages per month: HUF 500 000 (HUF 200 000 for PhD students/ doctoral candidates)		-

Source: OECD

Figure 8. Direct government funding of business research and development and tax incentives for research and development in Hungary, from 2004 to 2017, as a percentage of GDP and 2010 prices on the right hand side



The cost estimate of tax incentive support covers the R&D tax allowance, the R&D tax allowance in innovation contribution ,the development tax incentive, the payroll withholding tax remission, the R&D tax credit on wages of researchers and the R&D tax credit in innovation contribution

Source: OECD, R&D Tax Incentive Database, http://oe.cd/rdtax, December 2019.

From **figure 8**, since 1996, Hungary has always given research and development tax incentives to the different sectors participating in research and development. From figure 18, the research and development support from 2010, increased in 2011 then decreased in 2012, and by 2017 there was a drop compared to 2010. The cost reduced to HUF 22,278 million in 2017 from HUF 48,297 million in 2010. The tax credit on research and development expired in 2019, and an introduction of advanced assurance to companies applying for research and development tax relief. A drop in research and development tax support from 2016 was contributed to by businesses reduction in taking up the research and development tax allowance.

The tax incentive support, which is measured as a percentage of the GDP, reduced to a record low of 0.06% in 2017 from 0.15% in 2004. The direct funding of Business Enterprise Research and Development (BERD) had a small drop from 2000 to 2005, then increased from 2005 to 2015, a drop in 2016, 0.074% and an increase in 2017. By 2010 the percentage was 0.095% and in 2017, 0.13% of the GDP. The percentage of research and development tax incentives of the total government support reduced between 2010 and 2017, reaching 30% in 2017 from 65% in 2010. The Subnational research and development tax incentives share was 20% of the total tax relief for BERD in 2017, an increase from 2010 of 7%.

4.4 Innovation, Research and Development in Austria

Innovation, Research and development in Austria is in control by 3 unique ministries. The Federal Ministry for Transport, Innovation and Technology (BMVIT), the Federal Ministry of Economics and Labour (BMWA and the Federal Ministry for Education, Science and Culture (bm:bwk). Federal state implements local research and development innovation policies in their own. (Weidinger, 2001).

According to Weidinger, 2001, Innovation and Research and Development activities in Austria are usually promoted by:

- The three ministries cited above (BMVIT, BMWA, bm:bwk)
- The Austrian Science Promotion Agency FFG, Section 1, which specializes in aid for businesses
- The Austria Wirtschafts Service (aws), that's a special government-owned financial institution and gives equipment for financing businesses such as bank guarantees
- The governments of the individual federal states
- The Austrian National Bank
- The Austrian Chamber of Commerce.

The traditional manner for a company or an individual in Austria to finance research and development initiatives by the use of grants provided with the General Programs (“Basisprogramme”). This program intends to guide single research and development initiatives that showcase an excessive degree of innovation. (Weidinger, 2001).

Others aimed at enhancing the science industry linkages and the transfer of technology. In Weidinger (2001) identified 49 support projects at the federal level. While that number is not well updated and a whole list difficult to compile, it is though evident that the wide variety of programs available now has virtually no longer decreased. It is equally evident that almost all the programs do put a lot of focus on research and development and innovation in High-Tech companies.

Based on (Messmann and Schiefer 2005), 1,942 companies participated in research and development activities in Austria in 2002. These companies employed about 26,800 experts in research and development, and spent almost €3.1 billion. Austria’s economic system is mainly composed of companies in Low-tech Firms and enterprises, at the same time as fundamental players in High tech businesses are not enough. According to the Austrian Institute for SME Research by 2005 there were approximately 65,300 SMEs in crafts and services, which hired more than 582,000 people in Austria and hence accounting for approximately 31% of the market oriented economy placing innovation and technology more or less equal to research and development hence suggesting that only a part of the Austrian enterprises are considered to be innovative.

It is estimated that Austrian businesses in Low-tech Firms spent round €385 Million on research and development in 2002. This corresponded to almost 12% of total research and development expenses by Austrian businesses. (Schibany, 2006). From Community Innovation Survey 3 data taken from Eurostat, where the definition of innovation is based on Oslo Manual. Based on a sample of 3,207 businesses: the findings suggested that approximately 49% of the Austrian businesses had taken into consideration innovation, implying that these companies introduced a given product or an innovation between the period 1998 and 2000 (Messmann and Schiefer, 2002).

An effective relationship which is positive between business size and innovation was observed: Of 89% of the large sized enterprises with workers more than 250 came up with new products or services, 65% of the medium-sized companies with 50–249 workers performed the same. The respective percentage of smaller SMEs at 42%, whereas, companies with much less than ten personnel were no longer included inside the survey. (Community Innovation Survey 3, Eurostat).

The government of Austria came up with its first Research, Technology and Innovation Strategy in March **2011**. Since the adoption of the new strategy, numerous processes and establishments have been installed to enforce it, many unique activities and measures have been initiated, where some have been completed. (Austrian Research and Technology Report 2016).

The Research, Technology and Innovation Strategy's objective is to increase Austria's performance in research, development and innovation in a manner that Austria is ranked top with other leading innovation countries. Progress toward this objective is, amongst different things, measured with the aid of Austria's position in international innovation ratings. According to a preliminary assessment of the innovation scores of the EU Commission, Austria was named tenth within EU member states, and the gap between Austria and the other Innovation Leaders by **2016** was less, though the gap was significant. Austria, additionally improved in different innovation ratings, but displayed a deficit compared with the top nations. (Austrian Research and Technology Report 2016).

In the Global Innovation Index, for instance, Austria stepped its ranking 5 places up since **2013**, attaining 15th place within some of the advanced industrial nations. In the Innovation Indicator published via the German National Academy of Science and Engineering and the BDI Association of German Industry, Austria was ranked 9th climbing up five places. Whereas, the other fields of innovation related indicator of the Global Competitiveness Index, by the World Economic Forum, Austria went down by one position compare to its position in **2015**. (Austrian Research and Technology Report 2016).

The improvement which has been slow, of Austria's innovation overall performance, and to a certain level its position in worldwide innovation rankings points out the successes and the efforts the government is putting, enterprise, and public research. However, additionally it is clearly seen that structural changes could be required to reduce the gap to the top countries, in the global surroundings in which all the developed industrial nations are pushing to reinforce their progressive capability, fast upgrades within this developed nations, hence can be extremely hard for Austria. This is why it is still critical for Austria to pursue the present day course of efforts and focusing on the performance of their systems. (Austrian Research and Technology Report 2016).

At the middle of the RTI strategy, a report was made of what had been carried out up to then and what was to be done, what they would likely not be able to execute and what no longer appeared well worth pursuing inside the mild of modified strategic priorities and requirements. It was made using selected thematic priorities from the specific chapters of the RTI strategy. Neither the effects of the strategy nor the related measures were analyzed, but the RTI strategy formulated crucial measures for shaping universities in Austria, making sure that they were also strengthened, mostly their core functions in research and development.

One crucial plan was to implement education funding style dividing research funding and learning, and also to broaden competitive support for projects. Although the principle functions of this type of model had been developed, due to budgetary constraints it had not yet been implemented in its entirety. After all, incentives were provided with the creation of structural funding for the higher education sector to enhance quality teaching at the universities, there were some restrictions on admission to degree programs where there's been demand. In addition, the structural funding in the institutions of higher education increased the amount of basic funding provided in different approaches. By 2016, two tasks has still not been completed, and the various stakeholders engaged had permitted further execution and integration techniques. Furthermore, a range of different initiatives were adopted which supported success in basic studies. There have even been some attempts to develop various existing projects. Austria had also created a list of development and research methods to enhance the gender diversity, but inequality also remained. A thorough review of the various policy mix to assist equity was required in order to promote sustainable change, in addition to longer-term initiatives and a resolute funding strategy. Ultimately, measures had been additionally carried out to facilitate the enlargement of research infrastructure, consisting of incentives aimed at promoting synergies and cooperation among the diverse research stakeholders. (Austrian Research and Technology Report 2016).

By 2016, Austrian agency for research (FFG) and RTI had drafted in reaction to new European legal policies for government aid. These new policy's goal was to make the awarding of funds, transparent and to prevent multiple funding. The performance agreements with institutions of research were also an important element as efforts of governance improvement. The development of the overall performance agreements with the universities led to steps closer to an extra transparent and service-based procedures for awarding public finances being carried out in a continuous basis, which also at the same time guaranteed medium-term planning protection for the institutions relevant to research studies. (Austrian Research and Technology Report 2016).

Despite Austria catching-up with the leading countries in recent years, Austria lost its dynamic momentum since the financial and economic crisis of 2008 with its aim to its overarching goals, which include becoming a member of the Innovation Leaders countries or attaining an overall R&D depth of 3.76%. The main challenge in attaining the goal is growing the research and development intensity of the private sector. Hence, a number of the RTI strategy measures were designed as incentives and assist for the private sector so as to facilitate an increase in research and development within the business enterprise sector. Apart from employment boom, increasing social prosperity is also a primary target in research, technology and innovation policy. New ventures and entrepreneurship topics have gained significance as essential elements for innovation and structural change in the latest years. (Austrian Research and Technology Report 2016).

The network of innovation in Austria, including institutions of research and the public sector, invested about 14B US dollars on R&D, which accounted for 3.19 as a percentage of GDP, becoming the second-largest EU budget on R&D following Sweden. In 2018 only, the Austrian government through its research agency provided more than 920 m US dollars to three thousand eight hundred and fifty four ideas hence invested about 80 m US dollars into upcoming startups which many were successful. In addition to helping Austrian innovative entrepreneurs the organization allowed foreign startups to move to Austria. Benefits to the startups, as for all other companies, consist of a tax refund of 14 % on research and development and an opportunity to work in one of over 60 clusters of industries. Energy, quantum physics, life sciences, information technologies, cyber security, synthetic intelligence, aeronautics, manufacturing and space are the Austria niches. Since 2014, Austria has been offered over $1.2 billion so as to support the country's efforts in research and development from the EU's Horizon 2020 research and innovation program. (Foreign Policy Magazine, 2019).

4.5 Taxation on Innovation in Austria

A change from 50 percent to 62 percent on income was the first change in the taxation system of Austria in 1989 due to changes globally of tax reduction, and also a reduction on corporate tax rate by 25% to 30%. (Genser, Bernd (1995). Austria uses PAYE taxation system since 1988 to date. Researchers and innovators pay taxes both from their employment income and personal services income, if self-employed. Same rate of tax applies where, the employer submits the tax for them, and if self-employed one files declaration of income tax to the tax offices. Highly qualified researchers do enjoy tax benefits in Austria, if they are able to pass a given criteria, if the ideas are of benefit to the public. (Researcher's Guide to Austria, 2019). The tax benefits are:

- Tax reduction of 30% on income, limit of 5 years, of research work abroad and domestically.
- Application, in six months in Austria, of a standard tax rate on income from abroad to the Ministry of Finance, to avoid tax burden, as at 2019.

Figure 9. Austrian Tax structure as a percentage of total revenues from 1970 to 2006

Source: OECD.

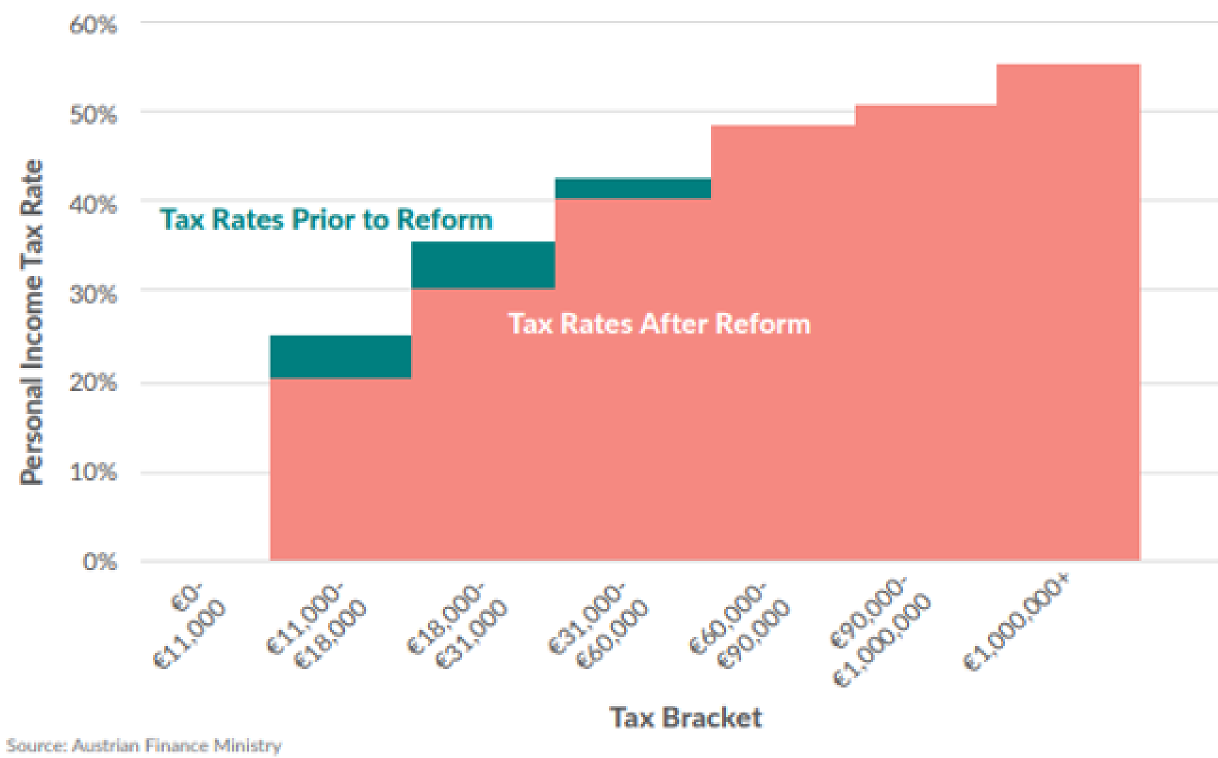
From **figure 9**, it shows the effects of tax rate reduction of both individual income and corporate income tax, with an increase in percentage of total revenues over time from 1970 to 2005 as per the OECD data. This was something positive as the government had an option of spending more on innovation and technology. (Margit, 2008).

In 2005, the income tax on corporate profits was decreased to 25 percent, and 23 percent by 2022 and lastly 21 percent by 2023, lowering tax burden by 800 m Euros approximately by each time the tax is reduced amounting to a total of 1.6 B Euros by 2023. (Daniel, Kyle, and Scott, 2018).

Apart from corporate tax rate reduction, Austrian government also introduced group taxation hence tax relief to companies and innovators. This enabled different corporation groups to clear losses from individual corporations found in the group, against profits earned by the other companies of the same group. The extension of the group was allowed beyond the borders by the new legislation, the group affiliate losses could be offset against overall profits of the groups. These tax incentives led to a higher growth rate of investment. (Margit, 2008, pg. 35).

The Austrian system of tax promotes company innovation by providing a range of instruments, additionally for small enterprises accountable only for personal profits taxes, plus a tax credit and a research and development subsidy, from 2005, as subsidies in support of research to both medium-sized and small-sized enterprises. Despite all the efforts by the government, the performance displayed in 2008 by statistics from OECD was low with most companies not taking advantage by engaging themselves in innovation of the tax reduction. (Margit, 2008, pg. 36).

Figure 10. Austrian personal income tax rates changes by 2022



Plans from the government of Austria to implement some reforms in taxation of income by 2022 starting 2021 as shown in **figure 10**, with new tax rates of twenty percent, thirty percent and forty percent, hence reducing the burden of tax and increasing entrepreneurship and innovation. (Daniel, Kyle, and Scott, 2018).

From 2022, standard base of corporate deduction will be increased 100,000 Euros from 30,000 Euros, making a maximum of an allowance of 13,000 Euros as a standard deduction, which is 13%, and this is anticipated to lower the corporate burden of tax by 100 million Euros each year. Austria has a 14 percent provision of total R&D expenses, as a premium for R&D, with 1 million Euros yearly as maximum, and this premium is expected to be expanded in the future reforms of the taxation system. (Daniel, Kyle, and Scott, 2018).

4.6 Research and Development Tax Incentives in Austria

Austria provides a research and development tax credit which is volume based as a research and development tax relief.

Table 4. Main Features of Research and Development Tax Incentives in Austria, 2019

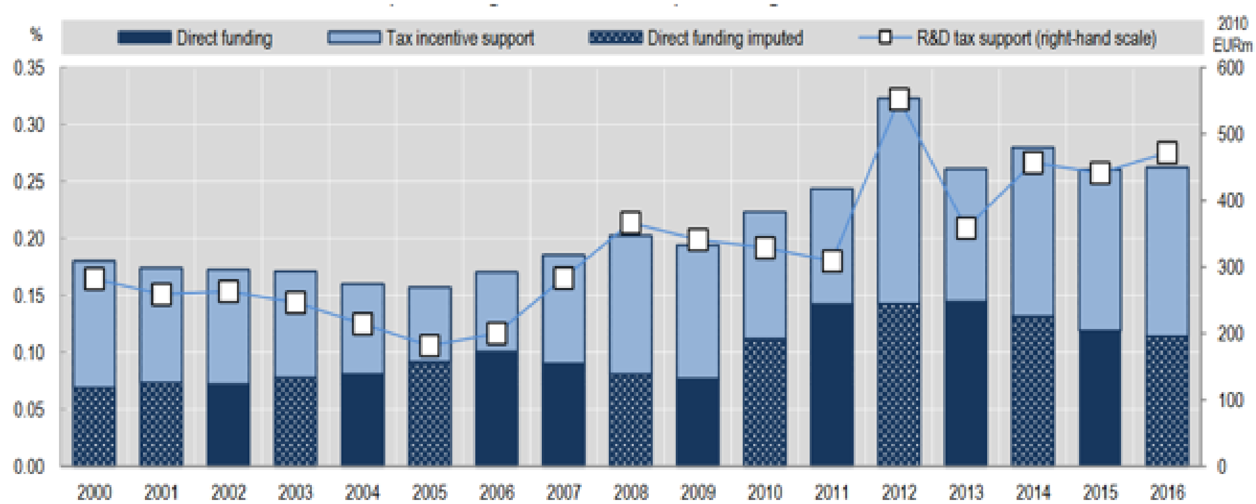
		Research premium
Tax incentive		Tax credit
Type of instrument		Volume-based
Eligible expenditures[†]		Current and capital
Headline rates (%)		14
Refund		Yes (no ceiling)
Carry-over (years)		Indefinite (carry-forward)
Ceilings	R&D expenditures (subcontracted R&D)	EUR 1 million

[†]For additional information: OECD R&D Tax Incentive Compendium and Eligibility of current and capital expenditure for R&D tax relief

Source: OECD, R&D Tax Incentive Database, http://oe.cd/rdtax, December 2019.

In a situation where the company has less tax liability, the company can be reimbursed of the unused credits, without any ceiling placed on them. Or the company can decide to carry forward the unused credits. The subcontracted research and development expenditures are always limited to 1 million Euros per year maximum, as illustrated in **table 4**.

Figure 11. Direct government funding of business research and development and tax incentives for research and development, Austria, from 2000 to 2016, as a percentage of GDP, 2010 prices on the right hand side



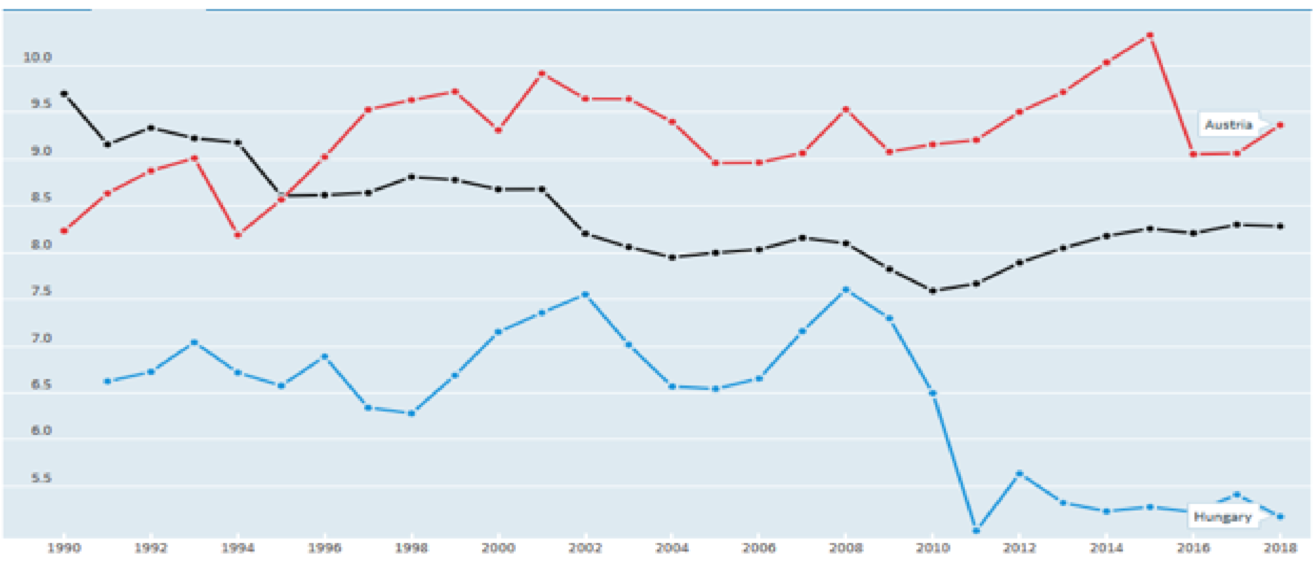
Source: OECD, R&D Tax Incentive Database, http://oe.cd/rdtax, December 2019.

Figure 11, shows the significance of R&D tax relief from 2005 to 2016 increased in Austria. In comparison to government direct support, tax significance increased too. The support on tax cost on R&D increased from 282 m Euros in 2000 to 472 m Euros in 2016. The amount of tax funding as a percentage of GDP rose from 0.11% to 0.15%, hitting a high point in 2012, 0.18%. In 2012, the cap for subcontracting R&D expenditure was raised from 100 thousand Euros to 1 million Euros and the Austrian Research Promotion Agency (FFG) was to accept the research and development credits.

5. COMPARISON OF HUNGARY AND AUSTRIA

An analysis comparing the two countries in terms of innovation and taxation for the period between 1990 and 2019, with different indicators from as indicated from figure 12 to figure 32. The data used to illustrate the differences between the two countries is gather from OECD, Eurostat, The Global Economy website and Global Innovation Index report of 2019. The Global Innovation Index report will sum up the performance of the two countries based on some innovation indicators as at 2019.

Figure 12. Tax on Personal Income, Total, % of GDP, 1990 – 2018



Source: OECD (2020), Tax on personal income (indicator). doi: 10.1787/94af18d7-en

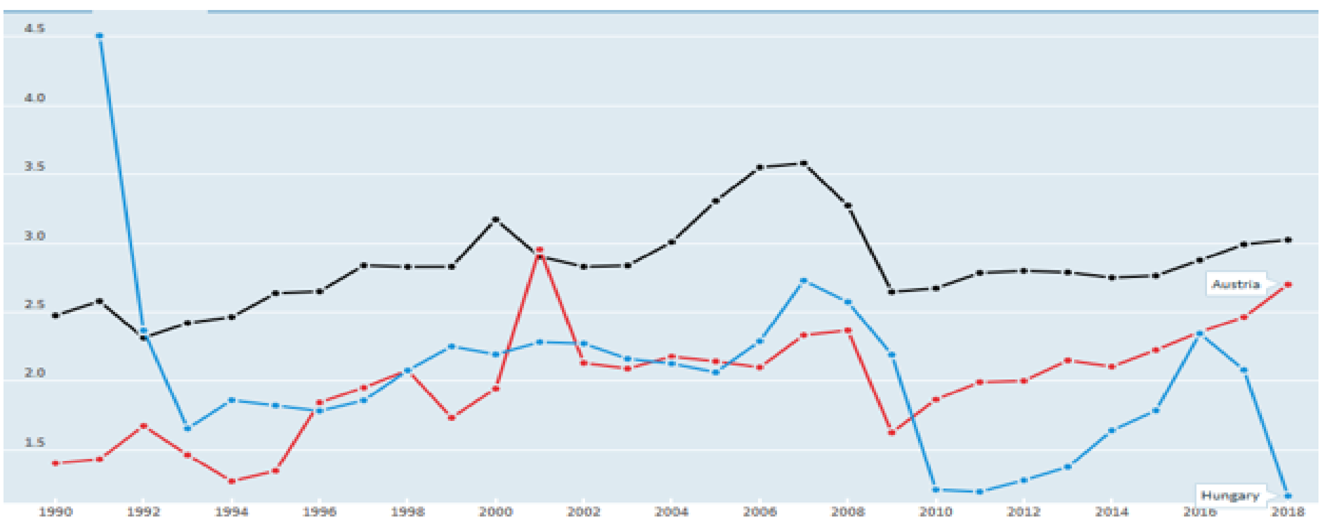
Tax on personal income is defined as the taxes levied on the net income (gross income minus allowable tax reliefs) and capital gains of individuals. This indicator relates to government as a whole (all government levels) and is measured in percentage both of GDP and of total taxation.

According to OECD, Austria has had a higher share of tax on personal income as a percentage of the GDP compared to Hungary, and surpassed the OECD's average in 1996. Austria's percentage was 8.23% in 1990 while the OECD's average percentage was 9.70%. By 2001, Austria's percentage had risen to 9.92% but the dropped to 8.96% of GDP in 2005. In 2015 it reached peak of 10.33% of GDP but then reduced to 9.37% in 2018, while the OECD's average was 8.28% of

GDP. In 1991, Hungary had a percentage of 6.62% of GDP, rose to 7.55% in 2002 and a drop in 2005 to 6.54%. There was an increase reaching high in 2008, 7.60% of GDP, but a sharp decrease to 5.02% of GDP in 2011. In 2018, the percentage was at 5.17% of GDP, as shown in **figure 12.**

The total tax on corporate profits, which is expressed as a percentage of GDP, as shown in **figure 13**, was much higher in Hungary in 1991, 4.51% of GDP compared to Austria and the OECD average. The ratio the sharply reduced to 1.66% in 1993, but then increased to 2.73% in 2007, followed again by a sharp decrease to 1.2% of GDP in 2011. The percentage rose to 2.34% in 2016 and then dropped to a record low of 1.17% in 2018. The Austria's percentage was lower compare to both of Hungary and OECD's average in 1990, with a percentage of 1.40% of GDP. There was an increase reaching peak of 2.96% in 2001, followed by a drop to 1.63% in 2009. The percentage rose to 2.70% of GDP in 2018, with the OECD's average at 3.03% of GDP in 2018.

Figure 13. Tax on Corporate Profits, Total, % of GDP, 1990 – 2018



Source: OECD (2020), Tax on corporate profits (indicator). doi: 10.1787/d30cc412-en

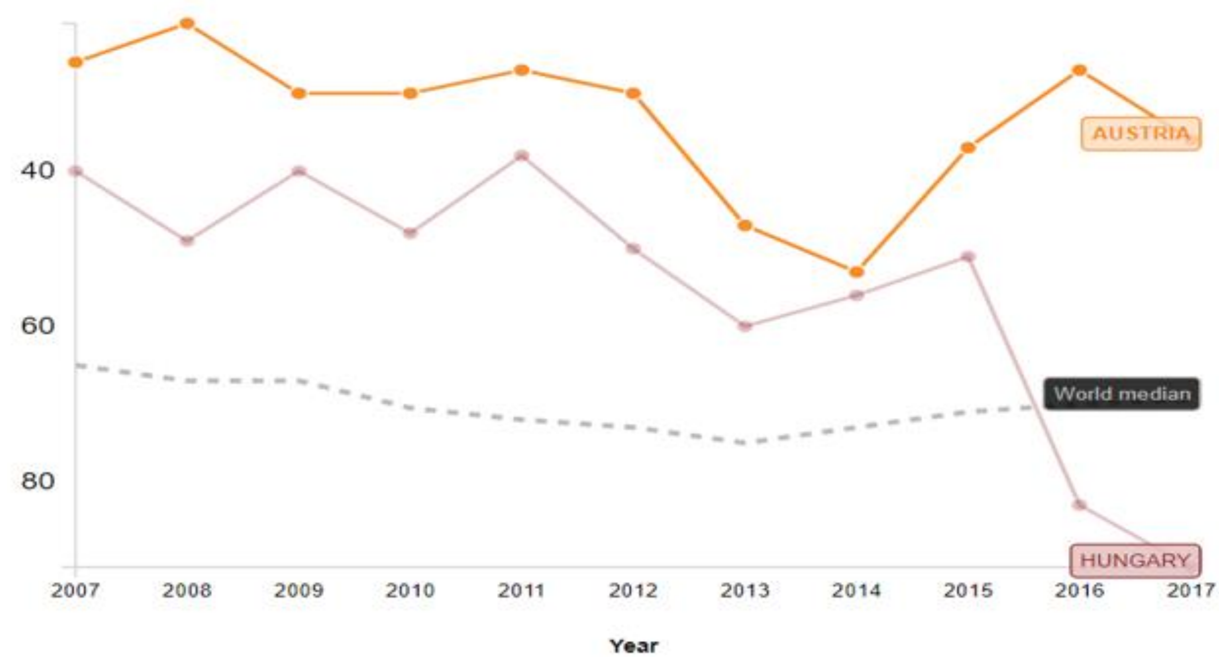
Tax on corporate profits is defined as taxes levied on the net profits (gross income minus allowable tax reliefs) of enterprises. It also covers taxes levied on the capital gains of enterprises. This indicator relates to government as a whole (all government levels) and is measured in percentage both of GDP and of total taxation.

According to Forbes, taxes on personal income tend to reduce the elasticity of the patents by 0.6 to 0.7 and that of citations by 0.8 to 0.9. According to research, companies tend to invest more in new technologies when faced with lower corporate taxes due to an increase in profits after tax, at the same time, negatively this may reduce government revenues hence less spending of government in innovation.

According to World Economic Forum, Austria dropped by 10 in ranking from 2007 to 2017 in the Availability of Scientists and engineers. In 2008, Austria had its best rank of 21, but in 2017, out of 137 countries, Austria was ranked number 36. Hungary dropped by 51 from 2007 to 2017. Hungary had its best rank of 38 in 2011, and in 2017 it was ranked at position 91 out of 137 countries as shown in **figure 14.** Finland was ranked the top in 2017 and Mauritania was the lowest at position 137.

From **figure 15**, Hungary has always exported more goods in information communication and technology compare to Austria. The percentage of information technology exports, to total goods exported by Hungary was 23.75% in 2001. The percentage increased to record high of 28.29% in 2004. Since 2004, the percentage has been decreasing, though in 2009 there was an increase to 26% and later a sharp decrease to 11.18% in 2017. Austria's percentage of information technology exports, to the total good exported was 6.03% in 2001 which was the highest, but the percentage has been going down since 2001, with the slope being not steep, hitting 3.48% in 2017.

Figure 14. Availability Of Scientists And Engineers, Value, 2007-2017

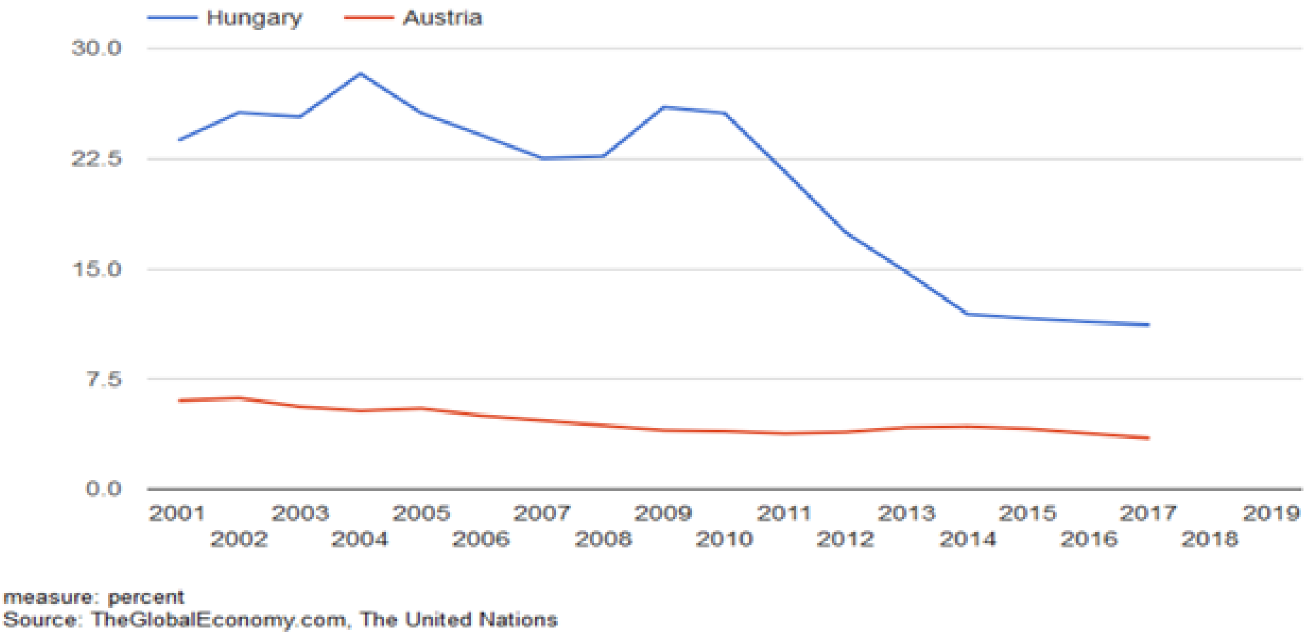


Source: World Economic Forum Global Competitiveness Index

According to World Trade Organization report on trade in value added and global value chains, by 2015, computer and electronic products came second to motor vehicles in the export industries both domestic and foreign value added content of exports, compared to Austria where the top three were transport, wholesale and other machinery, electronics missing in the top exports. By 2015, the forward GVC participation was 24.1% of Hungary inputs to Germany, as a percentage of share in total exports of domestic inputs sent to third countries, while in Austria it was 26.9% also to Germany.

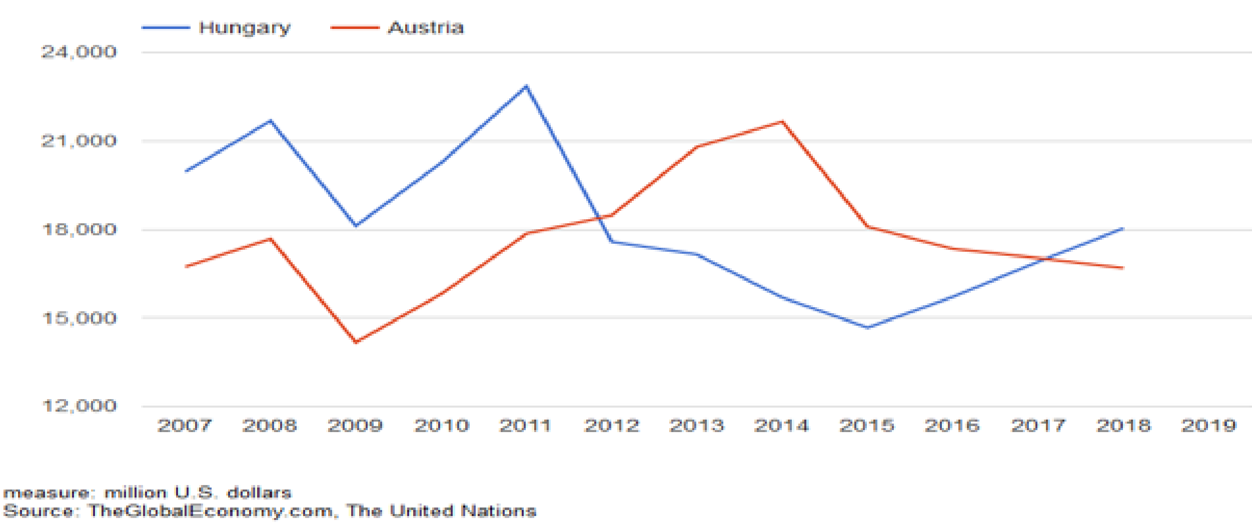
As shown in **figure 16**, Hungary's high technology exports were more compared to Austria, which were worth 19,947.35 million US dollars by 2007, then increased in 2008 to 21,676.18 million US dollars but then dropped in 2009. In 2011 it increased to a high of 22,847.6 million US dollars, but a sharp decrease in 2012 to 17,580.69 million US dollars. In 2015 it hit a record low of 14,668.17 million US dollars, but started to increase again surpassing Austria, reaching 18,033.48 million US dollars in 2018.

Figure 15. Information Technology Exports, Percentage of Total Goods Exports, 2001-2017



Definition: Information and communication technology goods exports include computers and peripheral equipment, communication equipment, consumer electronic equipment, electronic components, and other information and technology goods (miscellaneous).

Figure 16. High Technology Exports in Million US Dollars, 2007-2018



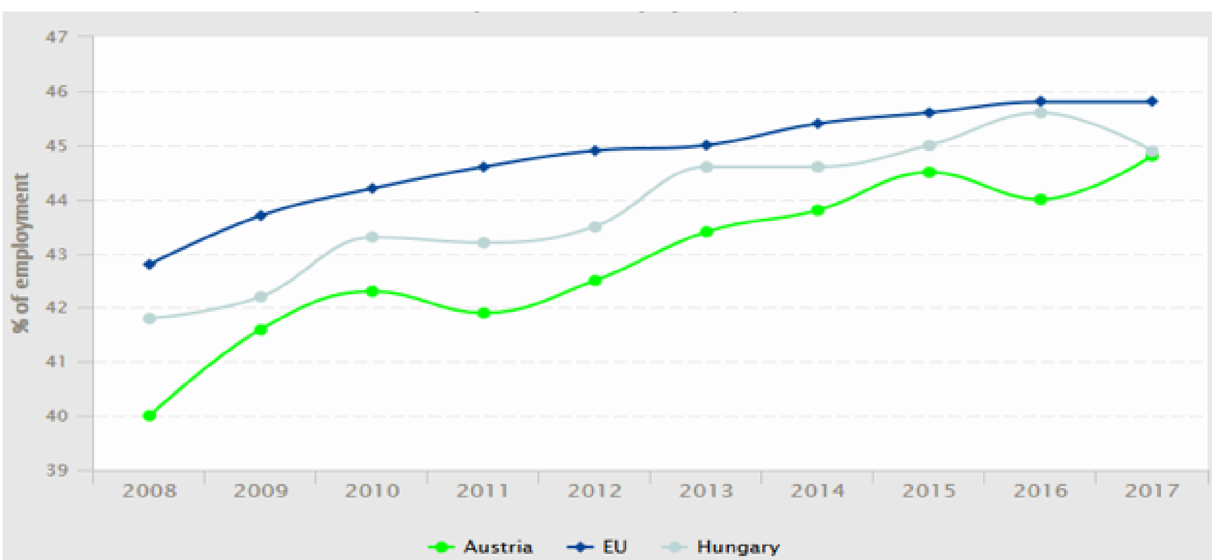
Definition: High-technology exports are products with high R&D intensity, such as aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. Data are in current U.S. dollars.

In Austria, the high technology exports were worth 16,729.87 million US dollars, lower than the exports by Hungary. The exports increased in 2008 to 17679.27 million US dollars, but later a sharp decrease to 14,167.23 million US dollars in 2009. The exports then increased steadily, surpassing Hungary in 2012, while the Hungary's exports were declining, reaching a high value of 21,648.68 million US dollars in 2014. Since 2014, the exports have been reducing, reaching 16,687.5 million US dollars in 2018.

According to the Global Economy and The United Nations, the high technology export percentage of manufactured exports in Hungary was 25.98%, while that of Austria was 13%. The Hungary's percentage increased to 26.71% in 2009, which was the highest value. But has since been declining since 2009, reaching 16.91% by 2018. The Austria's percentage increased to 15.53% in 2014 and has since decreased to 11.64% in 2018.

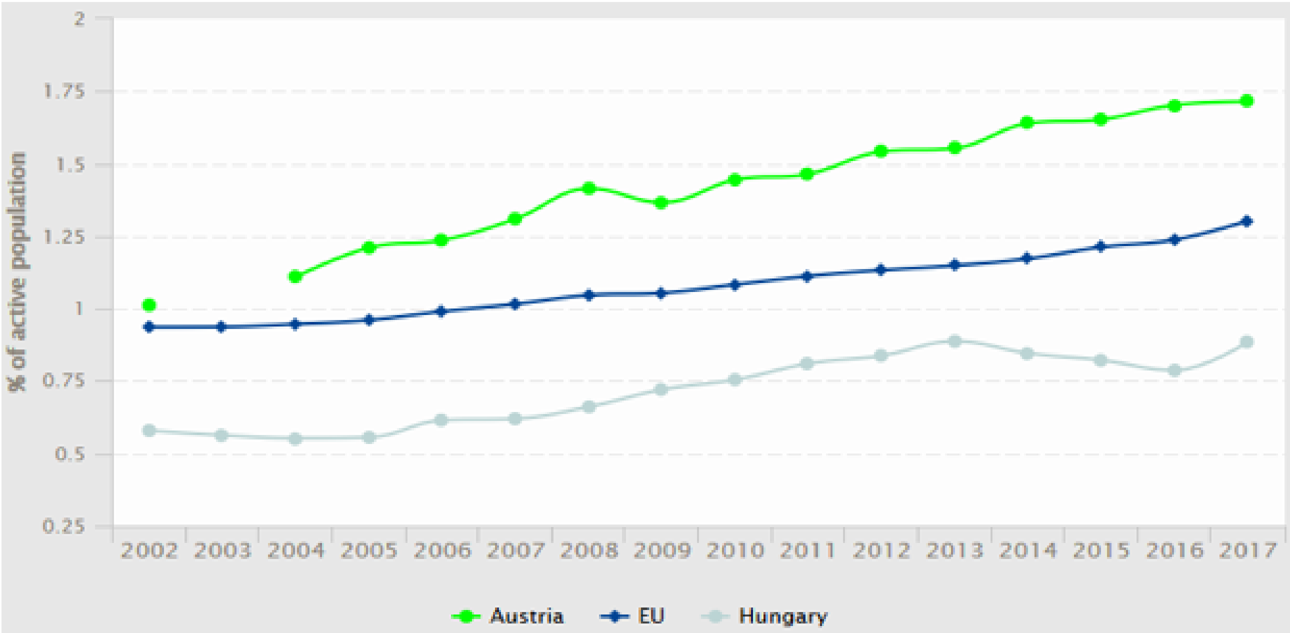
From **figure 17**, the percentage of people employed in high technology manufacturing and knowledge intensive service to total employment has been high in Hungary compared to Austria, but lower than the EU's percentage. In 2008, the percentage was 41.8%, and the percentage has been increasing overtime though at some point there was a decrease. By 2010, the percentage was 43.3% then decreased to 43.2% in 2011. In 2016, the percentage reached a high of 45.6%, closer to EU's percentage which was 45.8%. But in the 2017, the percentage reduced to 44.9%. The Austria's percentage was 40% in 2008. The percentage has also been increasing since then, but decreased in 2011 and 2016. In 2010 the percentage was 42.3%, then decreased to 41.9% in 2011. The percentage was 44.5% by 2015, then reduced to 44% in 2016 and rose to a high value of 44.8%, closer to Hungary's percentage which had reduced.

Figure 17. People Employed In High Technology Manufacturing and Knowledge Intensive Service as a Percentage of Total Employment, 2008-2017



Source: Eurostat

Figure 18. Research and Development Personnel as a Percentage of Active Population, 2002-2017



Source: Eurostat

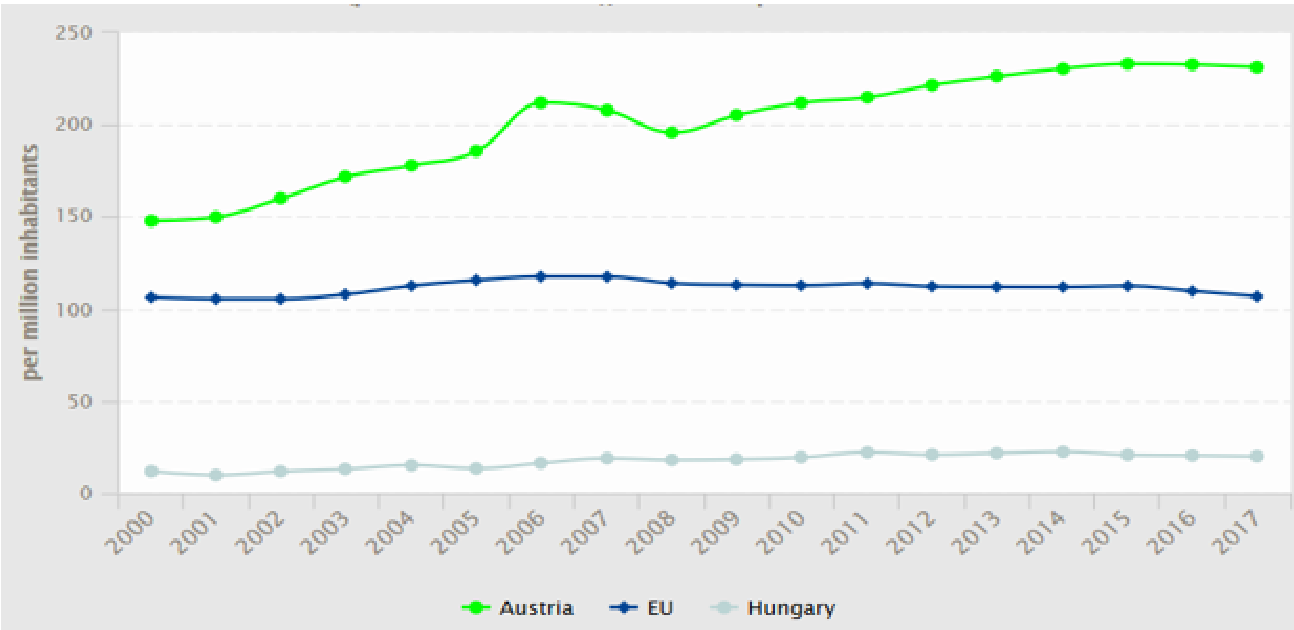
From **figure 18**, the percentage of research and development personnel to active population of Austria as at 2002 was 1.0142% and higher that the EU's percentage of 0.9363%, and higher than Hungary's since then up to 2017. Austria's percentage has been increasing but there was a decrease in 2009, but thereafter it kept increasing. In 2008 the percentage was 1.415% then decreased to 1.3659% in 2009. The percentage increased constantly reaching 1.7146% in 2017.

In Hungary, the percentage has been below 1%. In 2002, the percentage was 0.5795%, slightly went down to 0.556% in 2005. The percentage then increased from 2005 reaching high of 0.8875% in 2013, but then decreased to 0.7871% in 2016, and by 2017 the percentage was at 0.8857%.

According to European Patent Office, as shown in **figure 19**, the number of patent application per million inhabitants by Austria has been above the Hungary's number and the EU's average too. In 2000, the ratio of patents applied by Austria was 147.86, whereas that for EU was 106.31. The ratio then increased constantly up to 212.0 in 2006. There was a drop in 2008 with a ratio of 195.74, and thereafter an increase reaching a high of 233.15 in 2015. The ration dropped slightly to 231.35 in 2017.

The Hungary's Patent application to the European Patent office, per million inhabitants has been low since 2000 to 2007. In 2000 the ratio was 11.88, far much lower than Austria's ratio and EU's average ratio. The Hungary's ratio has not had a big change, with only some slight increase and in 201 the ratio was the highest, which was 22.51, then decreased to 20.08 by 2017.

Figure 19. Patent Application to the European Patent Office, per million inhabitants, 2000-2017

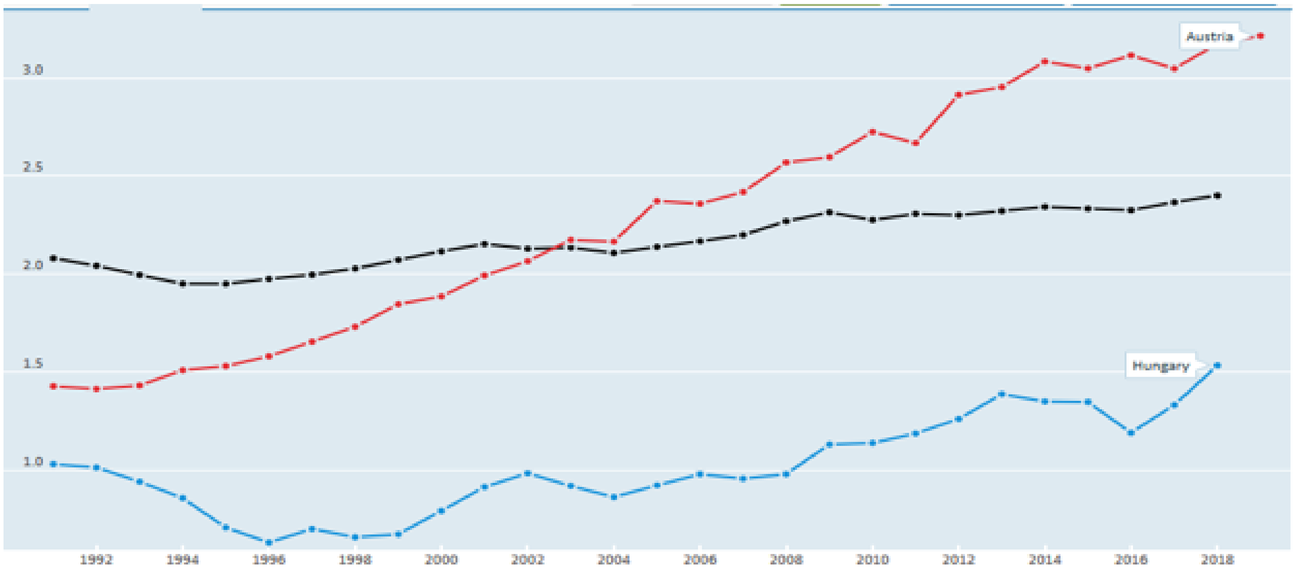


Source: Eurostat, European Patent Office

According to OECD, as shown in **figure 20**, in 1991, the total gross expenditure on research and development as a percentage of GDP of both Austria and Hungary were less that the OECD's total percentage of 2.081% which was 629,962 million US dollars. Austria's gross expenditure on research and development as a percentage of GDP has been higher compared to that of Hungary, with 1.427% of GDP in 1991, amounting to 4,010 million US dollars, and kept increasing and surpassing OECD's percentage in 2003, achieving a percentage of 2.175%. Even though the percentage kept increasing, there was a drop in 2004, 2011 and in 2017. In 2019, the percentage was at 3.217% which was 15,083 million US dollars and higher than OECD's total percentage of 2.401% which was 1,368,340 million US dollars.

Hungary's gross expenditure on research and development as a percentage of GDP was 1.029% as at 1991, 1,710 million US dollars, then experienced a drop hitting low in 1996 of 0.630%. The percentage then increased but a small drop in 1998 to 0.657% was experienced. There was an increase to 2019, but a decrease in 2004 and 2016 with percentages 0.861% and 1.190% respectively. In 2019 the percentage was 1.533%, 4,510 million US dollars, still far much below OECD's total percentage.

Figure 20. Gross Domestic Spending on Research and Development as a percentage of GDP, 1991-2018

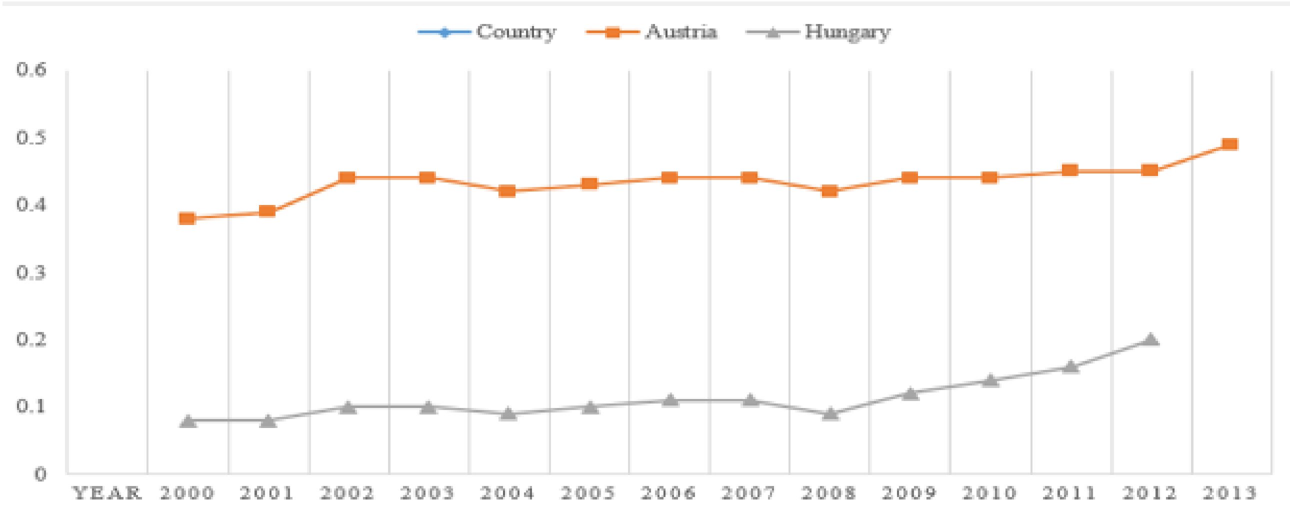


Source: OECD (2020), Gross domestic spending on R&D (indicator). doi: 10.1787/d8b068b4-en

Gross domestic spending on R&D is defined as the total expenditure (current and capital) on R&D carried out by all resident companies, research institutes, university and government laboratories, etc., in a country. It includes R&D funded from abroad, but excludes domestic funds for R&D performed outside the domestic economy. This indicator is measured in USD constant prices using 2010 base year and Purchasing Power Parities (PPPs) and as percentage of GDP.

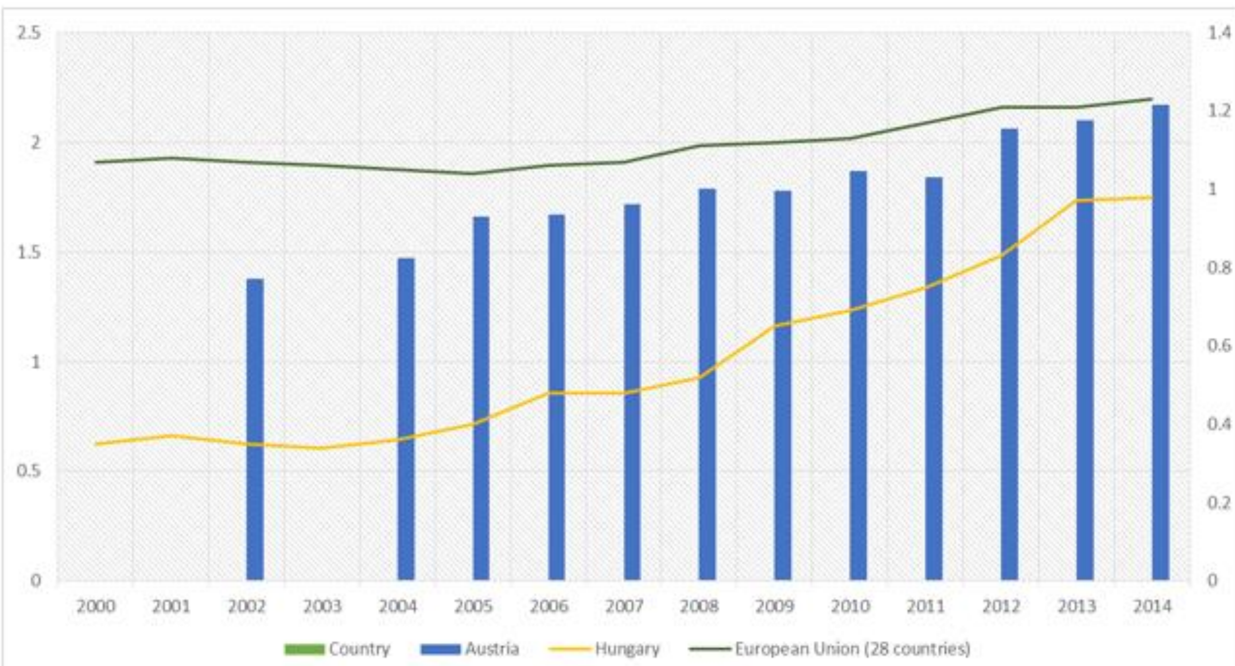
Gross domestic Expenditure on Research and Development (GERD) financed by abroad, as a percentage of GDP has been high in Austria compared to Hungary. **Figure 21**, shows that the Austria's percentage increased from 0.38% (at 888.95 million USD PPPs) in 2000 to 0.49% (at 1,980.19 million USD PPPs) in 2013. In Hungary, the percentage was 0.08% (at 103.86 million USD PPPs) in 2000 but has since increased to 0.2 in 2012 (at 440.56 million USD PPPs) and by 2014 the amount was 594.5 million USD PPPs, compared to Austria which dropped to 1,883.85 million USD PPPs.

Figure 21. GERD, financed by abroad, % of GDP, 2000-2013



Source: OECD.Stat

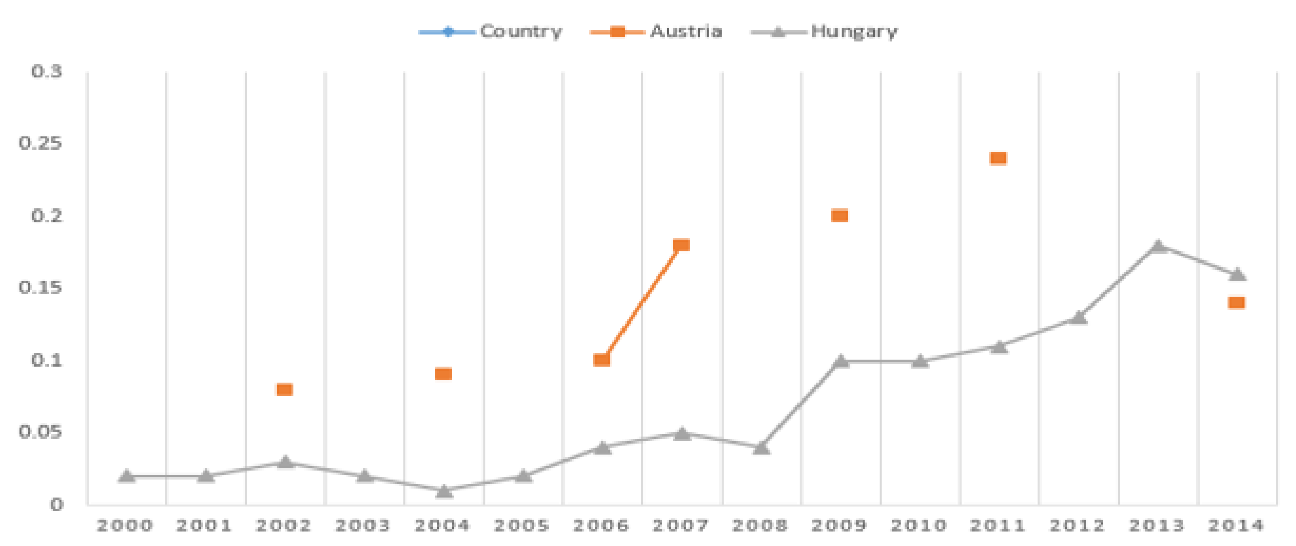
Figure 22. BERD, % of GDP, 2000-2014



Source OECD.Stat

As shown in **figure 22**, the Business enterprise Expenditure in Research and Development (BERD), which is expressed as a percentage of GDP has been high compare to both EU's total and Hungary's percentages. The Austria's percentage was 1.38% in 2002 and rose to 2.17% in 2014, while that of Hungary was at 0.35% in 2002 and has since been increasing reaching high of 0.98% in 2004.

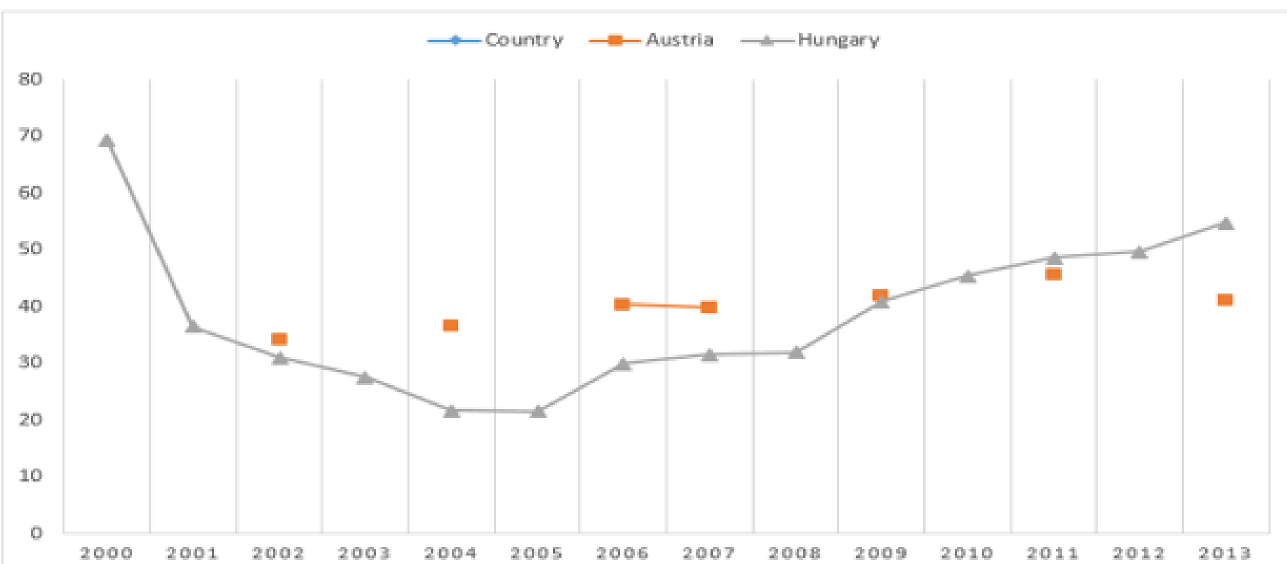
Figure 23. BERD, financed by government (direct), % of GDP, 2000-2014



Source: OECD.Stat

From **figure 23**, the Austria's Businesses enterprise Expenditure in Research and Development (BERD), financed by the government directly, expressed as a percentage of the GDP has been high compare to Hungary, but Austria was surpassed by Hungary in 2014. Austria's percentage was at 0.08% in 2002. The percentage increased reaching peak in 2011 of 0.24% and decreased to 0.14% in 2014. The Hungary's percentage was low compared to that of Austria's. In 2000 the percentage was 0.02% and rose reaching peak in 2013 of 0.18%, showing a sharp increase compare to that of Austria. But by 2014 the percentage decreased to 0.16%.

Figure 24. BERD, SMEs, % of total BERD, 2000-2013

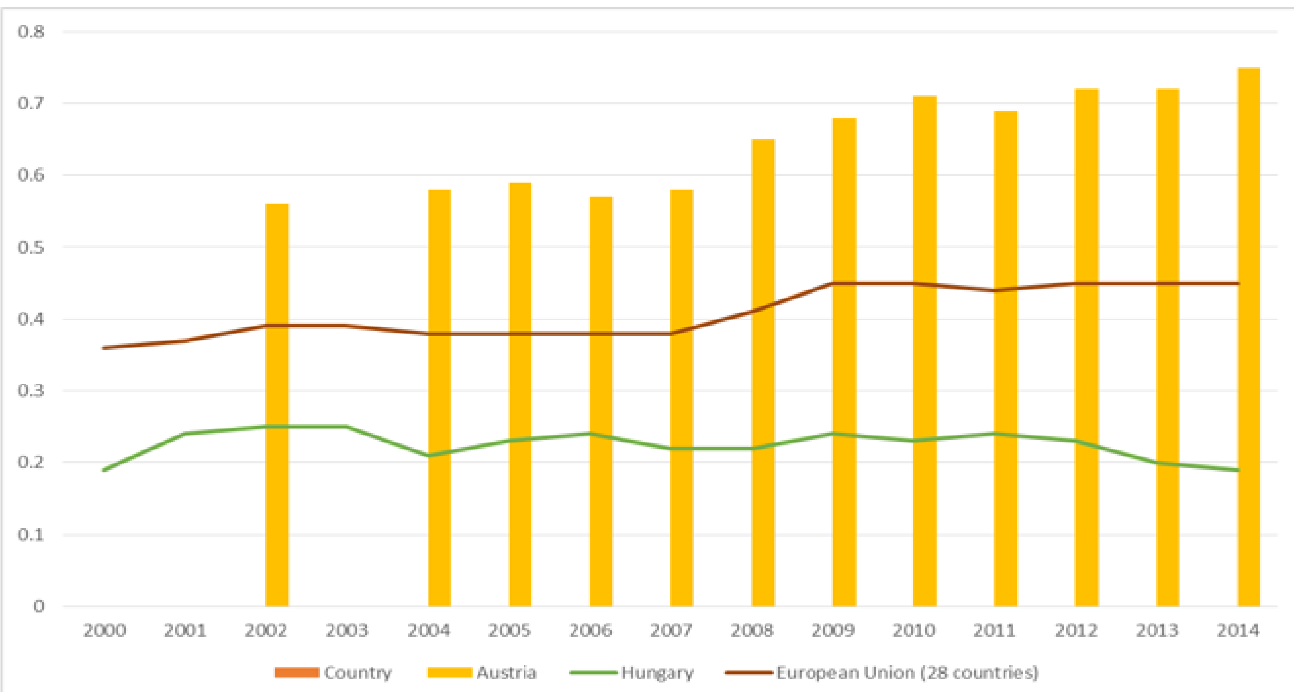


Source: OECD.Stat

From **figure 24**, in 2000 the percentage of Business enterprise Expenditure in Research and Development (BERD), Small and Medium sized enterprises to the total BERD of Hungary was higher compared to that of Austria, showing how SMEs have been significant in research and development in Hungary. The Hungary's percentage decreased hitting low of 21.5% in 2005 from 69.25% in 2000. The percentage then later increased to 54.78% in 2013. The Austria's percentage was far much lower, by 2002 the percentage was 34.07%, reaching peak of 45.72% in 2011 and a drop to 40.99% in 2013.

Figure 25, shows the Higher education Expenditure on Research and Development (HERD) as a percentage of the GDP. Since 2002 to 2014, the Austria's percentage was higher compared to both Hungary's and EU's total percentage, but Hungary's percentage below the EU's total. In 2002, Austria's percentage was 0.56%, amounting to 1266.1 million Euros and has since increased reaching 0.75% in 2004, amounting to 2456.29 million Euros. Hungary's percentage was 0.19% in 2000 (25310.4 million HUF), reaching peak in 2002 and 2003 of 0.25% and 67924.3 million HUF in 2011. In 2004, the percentage dropped to 0.19%, amounting 59537.2 million HUF.

Figure 25. HERD, % of GDP, 2000-2014

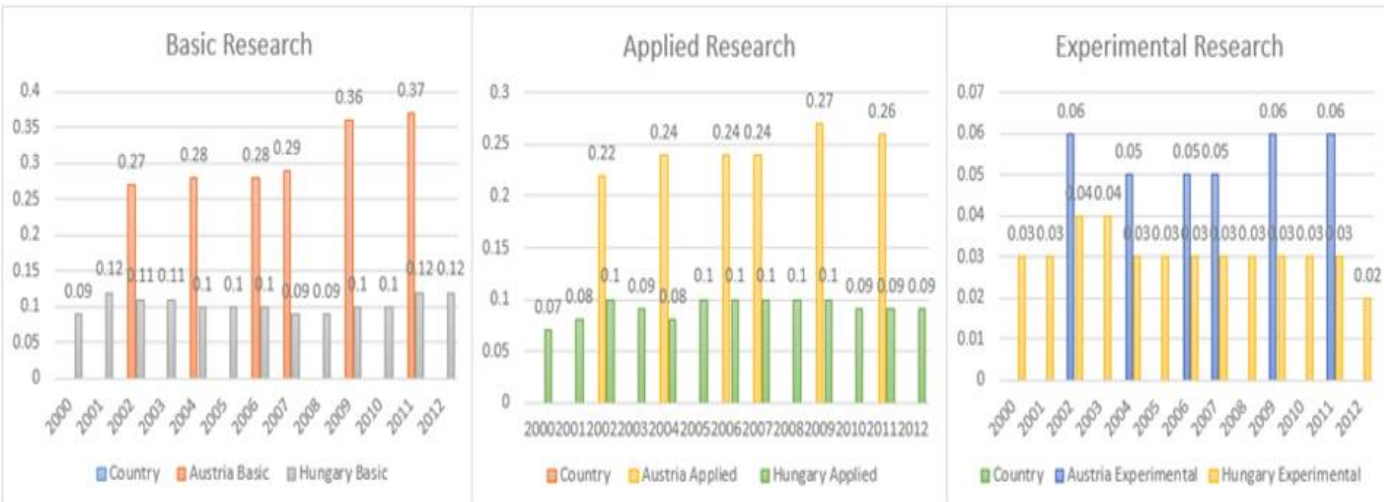


Source OECD.Stat

Figure 26, shows a comparison of Austria and Hungary in participation of basic, applied and experimental research in higher education as a percentage of the GDP. The percentage in Hungary was 0.12% in 2001, 2011 and 2012 which was the highest, but the amount spent in 2011 was 33,657.7 million HUF with 2000 being the lowest with 11,654 million HUF. Austria has been spending more than Hungary, with 0.37% being the highest percentage in 2011 of amount 1,140.78 million Euros, though in 2013 the spent 1.271.16 million Euros.

The same also applies to applied research, which has been higher in Austria than in Hungary, the highest percentage in Austria was in 2009 with a percentage of 0.27, amounting to 769.14 million Euros but the highest amount was spent in 2013, 867.85 million Euros. In Hungary, the percentage was 0.07% in 2000 and increased reaching peak of 0.1%, with 2009 being the year where a larger amount was spent during the period 2000- 2012, with an amount of 27,413.3 million HUF.

Figure 26. Basic research, applied research and experimental research expenditures, higher education, percentage of GDP, 2000-2012



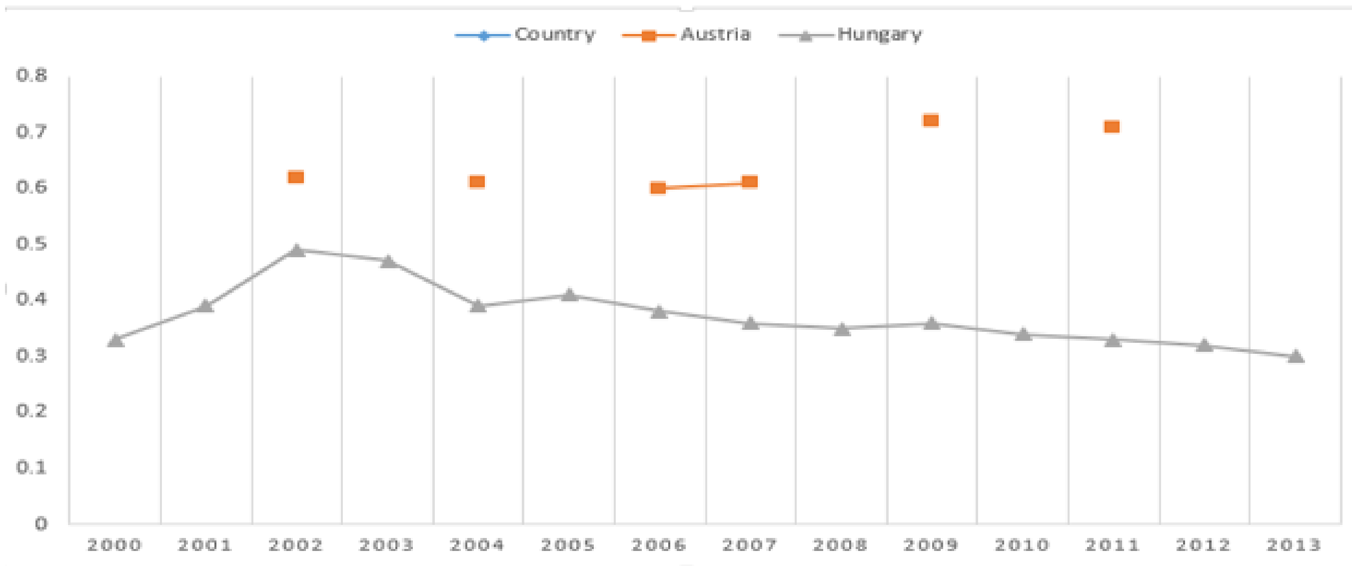
Source: OECD.Stat

According to OECD, Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. Applied research is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective. Experimental development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices; to installing new processes, systems and services; or to improving substantially those already produced or installed.

In Experimental research, Austria has had a higher percentage compared to Hungary, though a smaller difference compared to both applied and basic research percentages. In Austria, the percentage has remained between 0.05% and 0.06%, with the highest amount of 188.74 million Euros spent in 2013. While in Hungary, the percentage was 0.02% in 2000, increased to 0.04% in 2002 and 2003, then dropped to 0.02% by 2012, with the highest amount of 9,386.7 million HUF spent in 2008.

According to OECD, as shown in **figure 27**, the Public sector expenditure on research and development (PSERD), financed by the government as a percentage of GDP was higher in Austria compared to Hungary in the period 2000-2013. In Austria, the percentage was 0.62% in 2002 reaching peak of 0.72% in 2009, with the lowest amount spent in 2002 of 1,556.06 million USD PPPs and highest amount in 2013 of 2,945.24 million USD PPPs. Hungary's percentage was 0.33% of GDP in 2000, then increased reaching peak in 2002 of 0.49% of GDP but then dropped to 0.3% in 2013. In terms of amount spent, by the Hungarian government, in 2000 the amount was 403.21 million USD PPPs and the highest was spent in 2011, amounting to 738.59 million USD PPPs during the period 2000 to 2013.

Figure 27. PSERD, financed by government, % of GDP, 2000-2013



Source: OECD.Stat

Table 5. PSERD, financed by abroad, million, National currency, 2000-2014

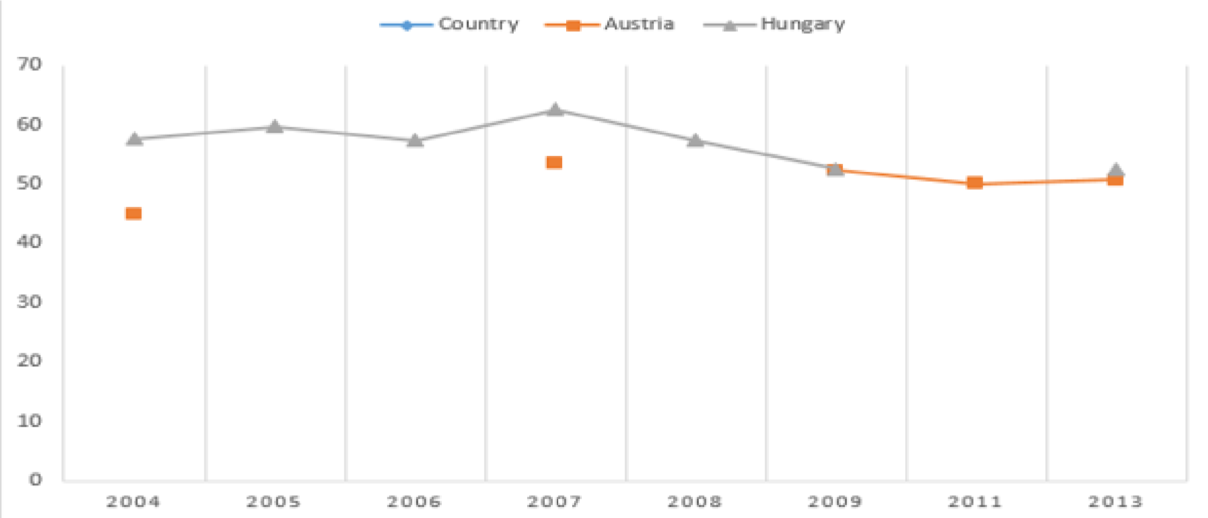
Country \ Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Austria	..	..	68.38	..	88.41	..	113.64	112.42	..	126.35	..	166.6	..	206.59	..
Hungary	29.44	30.82	35.12	36.66	40.38	45.82	67.16	62.94	67.5	77.38	83.53	95.34	108.98	149.92	129.75

Source: OECD.Stat

According to OECD, in **table 5**, the public sector expenditure on research and development (PSERD), financed by abroad was also high in Austria compared to Hungary during the period 2000-2014. In 2002, the amount spent by abroad in Austria was 68.38 million Euros, and the amount has been increasing since then, reaching high in 2013, an amount of 206.59 million Euros. In Hungary, the amount was 29.44 million HUF in 2000, and the amount has increased constantly reaching high in 2014, an amount of 129.75 million HUF spent by abroad in research and development in Hungary.

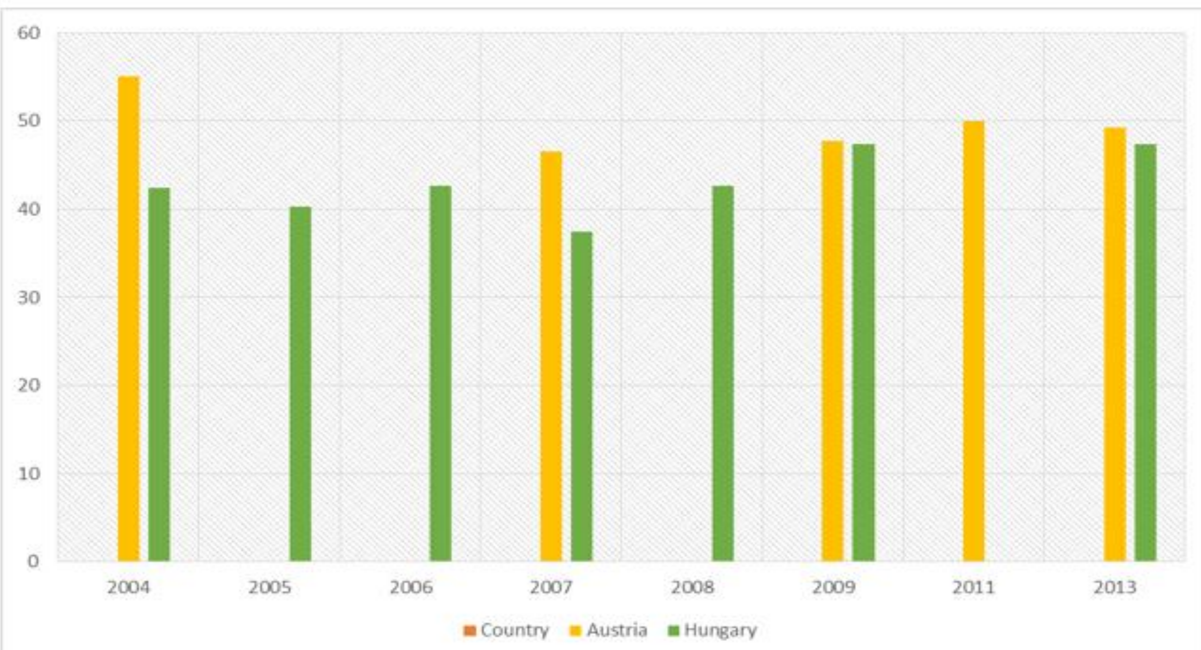
Figure 28 shows the research and development expenditures of foreign affiliates, expressed as a percentage of total research and development expenditure of enterprises, for the period 2004-2013. Compared to Austria, Hungary has had a higher percentage during the period 2004-2013. In 2004, Hungary's percentage was 57.59%, with the highest percentage of 62.56% in 2007, and a drop to 52.57% in 2013. Austria's percentage was 44.89% in 2004, which increased reaching peak in 2007, of 53.5%, then a drop to 50.7% in 2013.

Figure 28. R&D expenditures of foreign affiliates, % of total R&D expenditure of enterprises, 2004-2013



Source: OECD.Stat

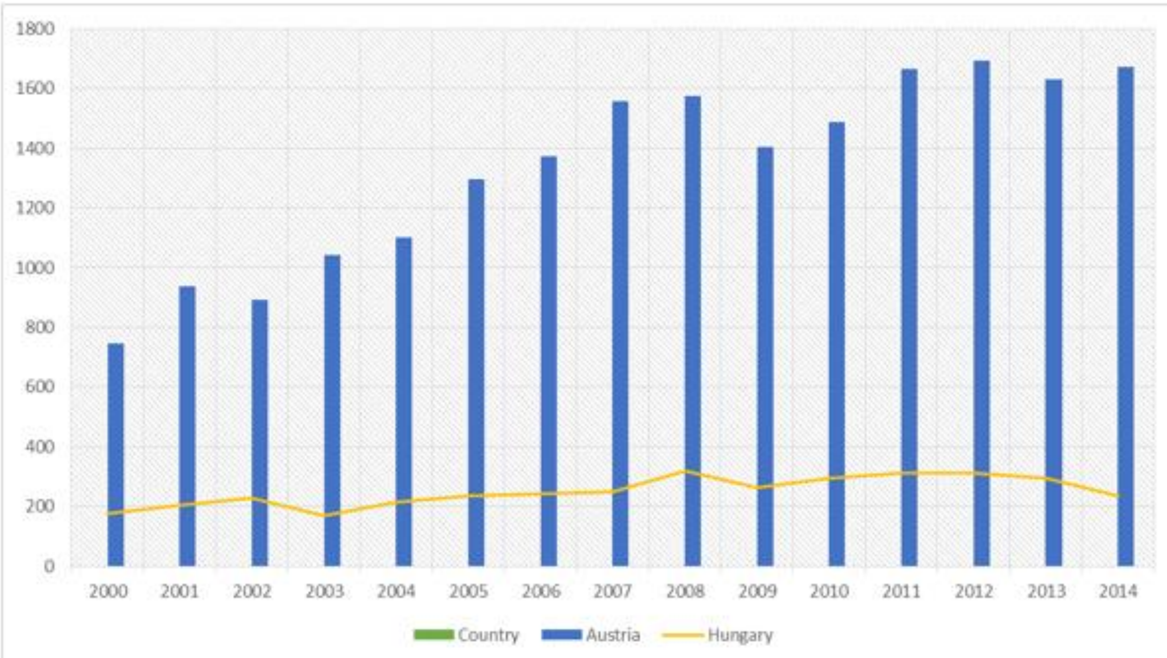
Figure 29. R&D expenditures of domestic firms outward, % of total R&D expenditure of enterprises, 2004-2013



Source OECD.Stat

Austria's research and development expenditures of domestic firms outward, as a percentage of total research and development expenditure of enterprises, for the period 2004-2013 was higher compared to that of Hungary. Austria's percentage was high in 2004 at 55.11% and has since declined to 49.3% in 2013, with the lowest percentage in 2007 of 46.5%. In Hungary, the percentage was 42.41% in 2004, a drop in 2007 to 37.44% and an increase to 47.43% in 2013, as shown in **figure 29**.

Figure 30. Foreign ownership of patents, number of PCT patent applications, 2000-2014



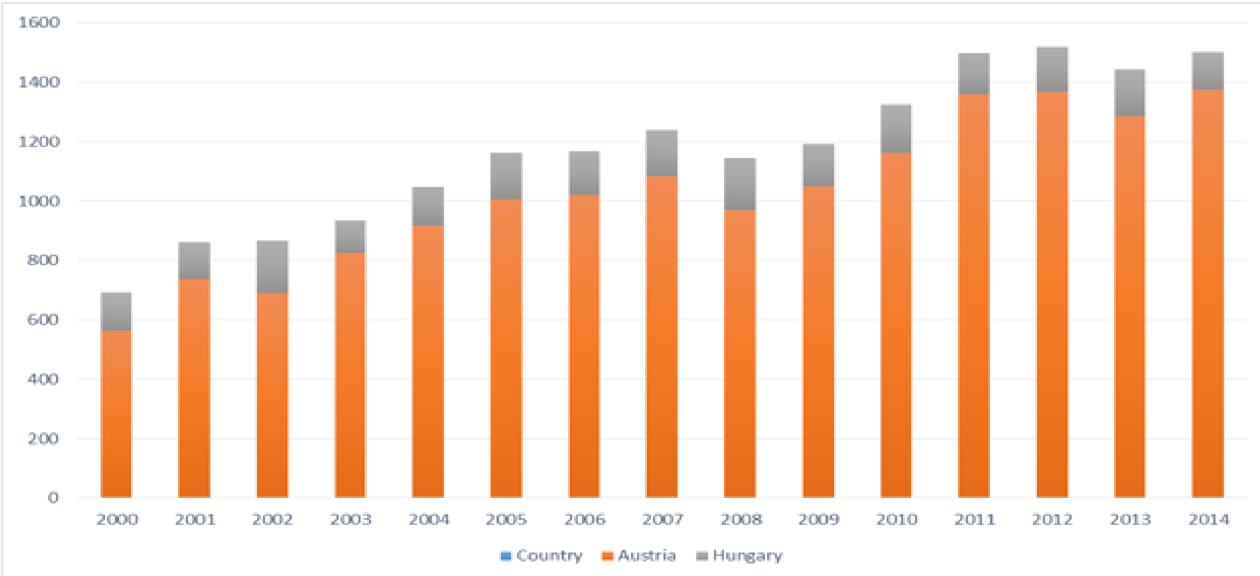
Source: OECD.Stat

Patent Cooperation Treaty (PCT) was signed in 1970 and entered into force in 1978, enabling a patent applicant, by means of a single procedure, to obtain a patent in some or all of the contracting states. PCT applications are administered by the World Intellectual Property Organization (WIPO).

As shown in **figure 30**, the foreign ownership of patents, to the number of Patent Cooperation Treaty (PCT) patent applications in Austria has been higher and increasing constantly from 2000 to 2014, compared to that of Hungary. In 2000, the number of patents in Austria was 747 with an increase reaching peak in 2012, with a number of 1.692 patents applied. In Hungary, there has not been a major change in terms of the patent applied during the period 2000-2014. In 2014, the number of patents applied in Hungary was 175 with a slight increase reaching 318 patents in 2008, then a drop to 235 in 2014. In the European Union, according to OECD statistics, the total number of patents applied in 2000 was 34,902, with the highest number of 54,117 patents in 2008 and a drop to 49,408 patents in 2014.

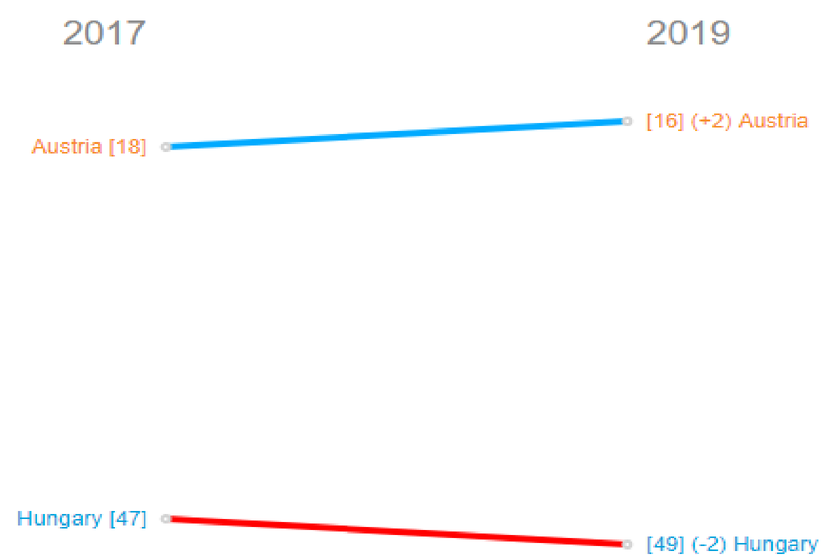
The domestic ownership of patents invented or co-invented abroad, to the number of Patent Cooperation Treaty (PCT) patent applications, from 2000 to 2014, is shown in **figure 31**, where the number of patents from Austria has been more compared to that of Hungary. In 2000, the number in Austria was 564 and this number increased constantly reaching high of 1,375 patents in 2014. In Hungary, the number has remained to be low over the period, a number of 130 patents in 2000, an increase to 179 in 2002 and then a decline to 127 patents in 2014.

Figure 31. Domestic ownership of patents invented or co-invented abroad, number of PCT patent applications, 2000-2014



Source: OECD.Stat

Figure 32. GCI 4.0: Pillar 6: Skills, Rank, 2017-2019



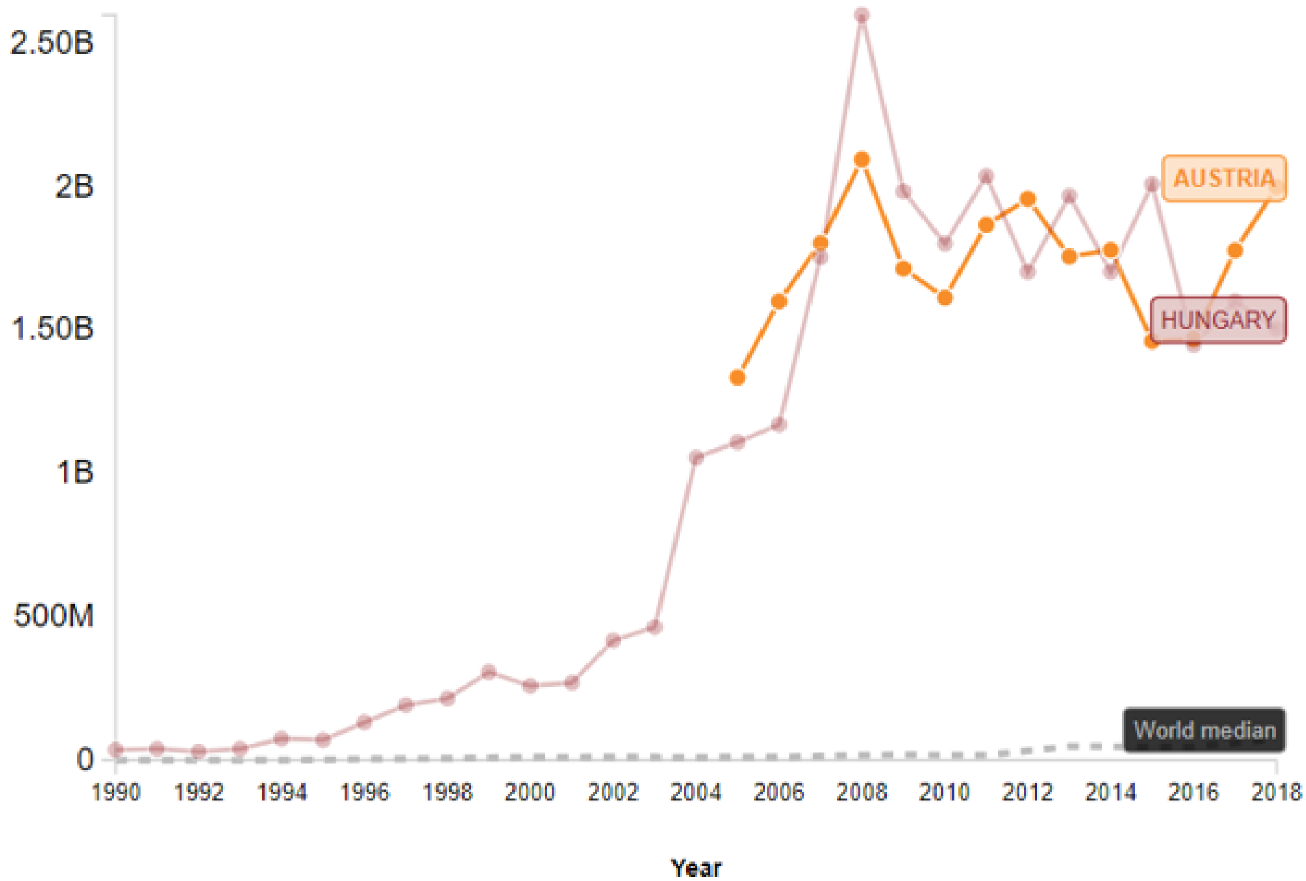
Source: World Economic Forum Global Competitiveness Index

The general level of skills of the workforce and the quantity and quality of education. While the concept of educational quality is constantly evolving, important quality factors today include: developing digital literacy, interpersonal skills, and the ability to think critically and creatively. Education embeds skills and competencies in the labour force. Highly-educated populations are more productive because they possess greater collective ability to perform tasks and transfer knowledge quickly, and create new knowledge and applications.

According to the World Economic Forum, the Global Competeviness Index 4.0 which is due to the emergency of the Forth Industrial Revolution, on the sixth pillar of Skills, Austria was ranked

16th out of 141 countries in 2019, moving up by 2 positions from 18th in 2017. Hungary was ranked at position 47 in 2017 and went down to position 49 in 2019, as shown in **figure 32**. Switzerland was position 1 in 2019 while Chad was ranked the lowest at position 141 in 2019.

Figure 33. Charges for the Use of Intellectual Property, Payments (BoP, Current US$), BoP, Current US$, 1990-2018

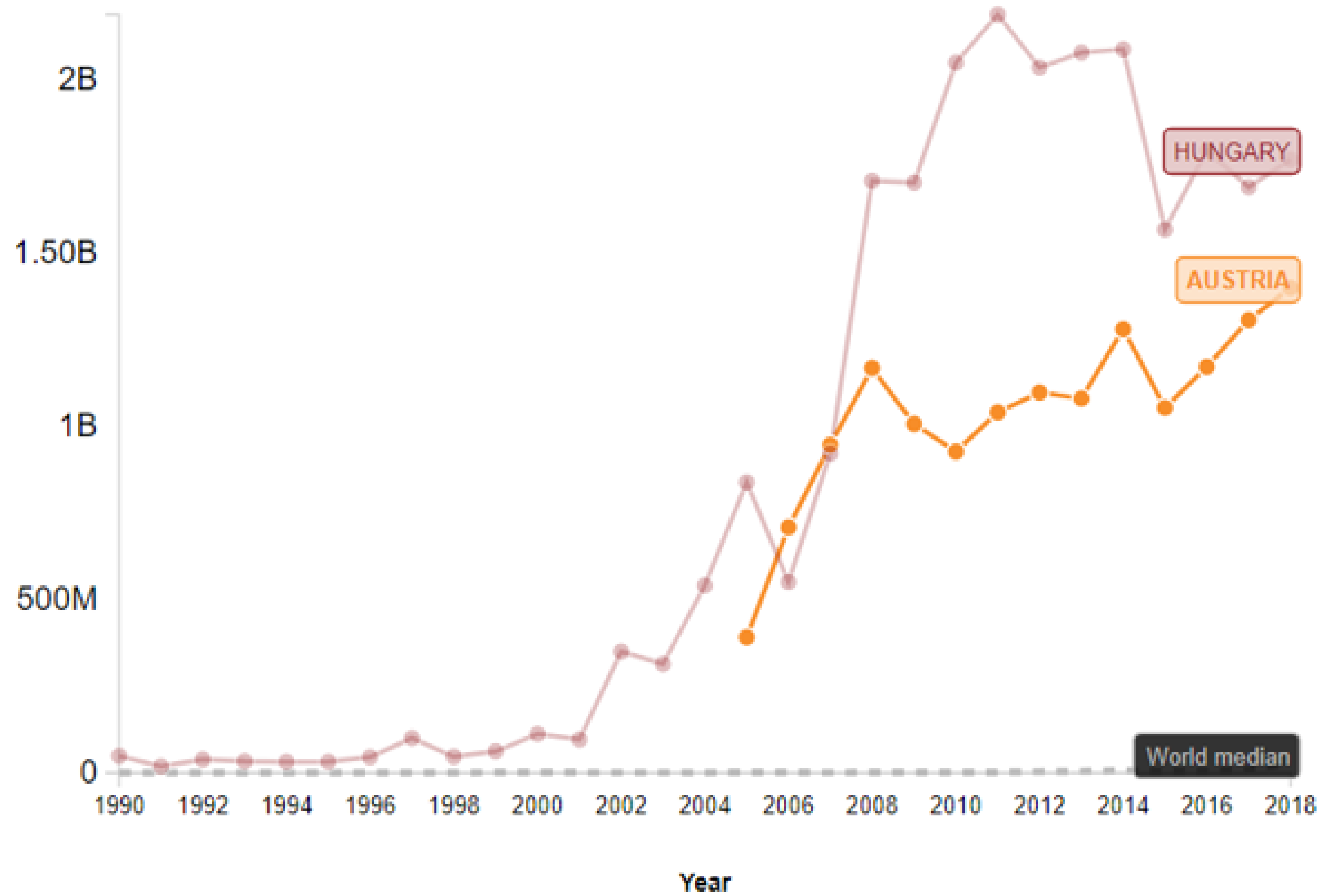


Source: IMF Balance of Payments Statistics Yearbook

Charges for the use of intellectual property are payments and receipts between residents and nonresidents for the authorized use of proprietary rights (such as patents, trademarks, copyrights, industrial processes and designs including trade secrets, and franchises) and for the use, through licensing agreements, of produced originals or prototypes (such as copyrights on books and manuscripts, computer software, cinematographic works, and sound recordings) and related rights (such as for live performances and television, cable, or satellite broadcast). Data are in current U.S. dollars. Sum.

In 1990, Hungary made payments of 35.9 m US dollars for the use of intellectual property rights, and the highest payment on 2.6 B US dollars in 2008. Then dropped to 1.6 B in 2017. In Austria, in 2005, they made a total of 1.33 B US dollars of payments for the use of intellectual property rights, with the highest payment of 2.09 B US dollars in 2008 and 2 B US dollars in 2018. Compare to Austria, Hungary had the highest average growth rate of 4.93% while Austria had a growth rate of 4.03% as shown in **figure 33**.

Figure 34. Charges for the Use of Intellectual Property, Receipts (BoP, Current US$), BoP, Current US$, 1990-2018



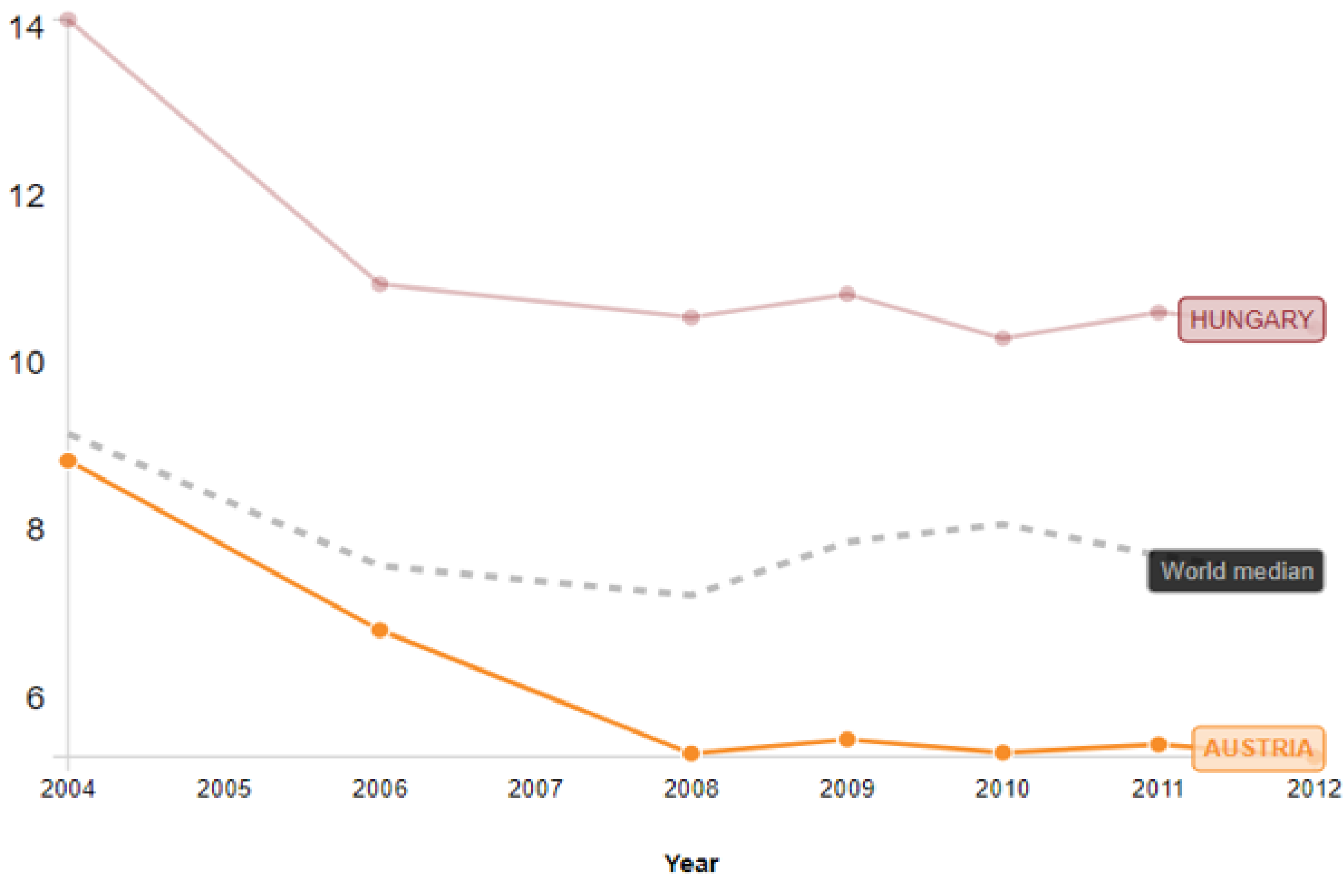
Source: IMF Balance of Payments Statistics Yearbook

Charges for the use of intellectual property are payments and receipts between residents and nonresidents for the authorized use of proprietary rights (such as patents, trademarks, copyrights, industrial processes and designs including trade secrets, and franchises) and for the use, through licensing agreements, of produced originals or prototypes (such as copyrights on books and manuscripts, computer software, cinematographic works, and sound recordings) and related rights (such as for live performances and television, cable, or satellite broadcast). Data are in current U.S. dollars. Sum.

From **figure 34**, in 1990, Hungary received a total of 48.53 m US dollars for the use of property rights with an increase to highest amount received in 2011 of 2.19 B US dollars, but then dropped to 1.77 B US dollars in 2018. Austria, received a total of 390.57 m US dollars in 2005 which has since increased reaching 1.4 B US dollars in 2018. Compared to Hungary, Austria had an average growth rate of 12.56% while Hungary had a 9.95% as the average growth rate.

The Value added in the ICT sector, which is expressed as a percentage of the total business sector value added has been higher in Hungary compare to Austria. In 2004, Hungary had a percentage of 14.11% of value added in the ICT sector and has since reduced to 10.43% in 2012. Austria had a percentage of 8.84% in 2004 and has since decreased to 5.30% far much below Hungary, as shown in **figure 35**. Austria's average of growth rate was -0.15% while that of Hungary was -0.23%.

Figure 35. Value Added In the ICT Sector (%), % of Total Business Sector Value Added, 2004-2012



Source: United Nations Conference on Trade and Development Statistics

Proportion of total business sector workforce involved in the ICT sector.

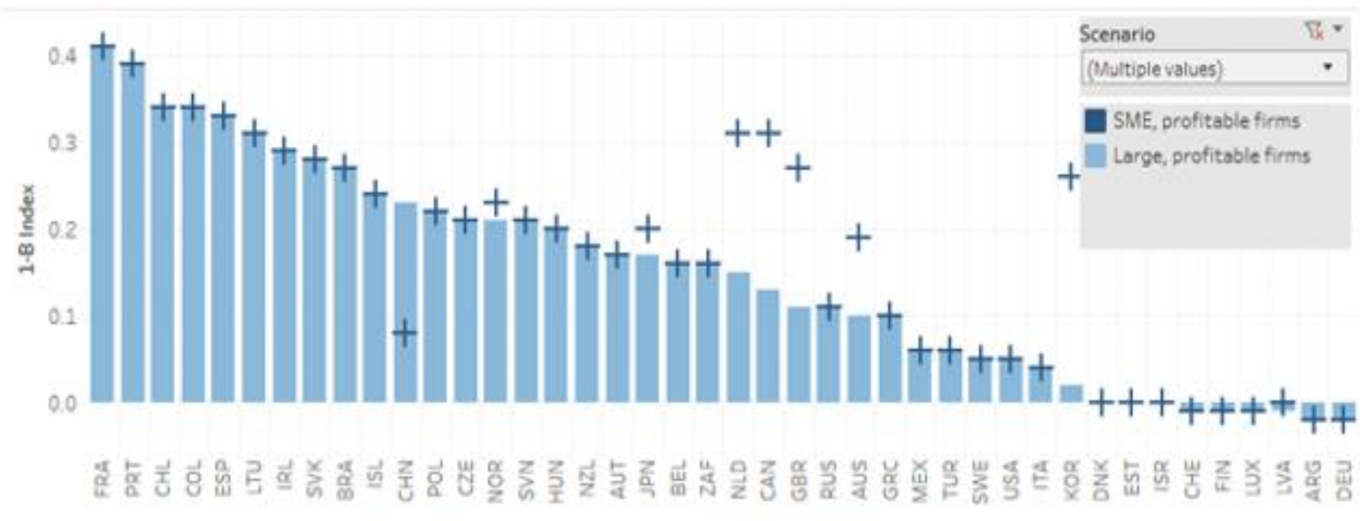
6. RESEARCH AND DEVELOPMENT TAX INCENTIVES GENEROSITY

Tax incentives in research and development is considered to be a tax relief measure, where the government offers tax support to firms engaging in research and development. France had the highest level of tax incentives for both SMEs and large firms on the profitable scenario. (OECD, R&D Tax incentive Database, 2020).Tax incentives generosity is currently on the rise, where governments are investing bravely in tax incentives and the emerging economies are providing tax incentives environment which are competitive.

Figure 36 presents tax subsidy rates on research and development expenditures for the profit scenario of SMEs and large companies. For the case of both large firms and SMEs profit making scenario is the index is highest in France. Compared to Austria, Hungary's index was higher for both SMEs and large firms. In 2019, the Hungary's index of the large firms was 0.2 while that of

SMEs was 0.2. Austria's index was 0.1 for large profitable firms and 0.19 for SMEs profitable firms. The gap in tax subsidies between SMEs and large firms is large compared to Hungary where the index for both the SMEs and large firms are equal. Tax subsidies tend to be generous to SMEs more than large firms in Austria, while in Hungary the subsidies are generous to both SMES and large firms.

Figure 36. Tax subsidy rates on R & D expenditures, 2019, 1-B-Index, Profit scenario for SMEs and Large firms



Source: OECD, R&D Tax Incentive Database, http://oe.cd/rdtax , December 2019. Data & notes: https://oe.cd/ds/rdtax

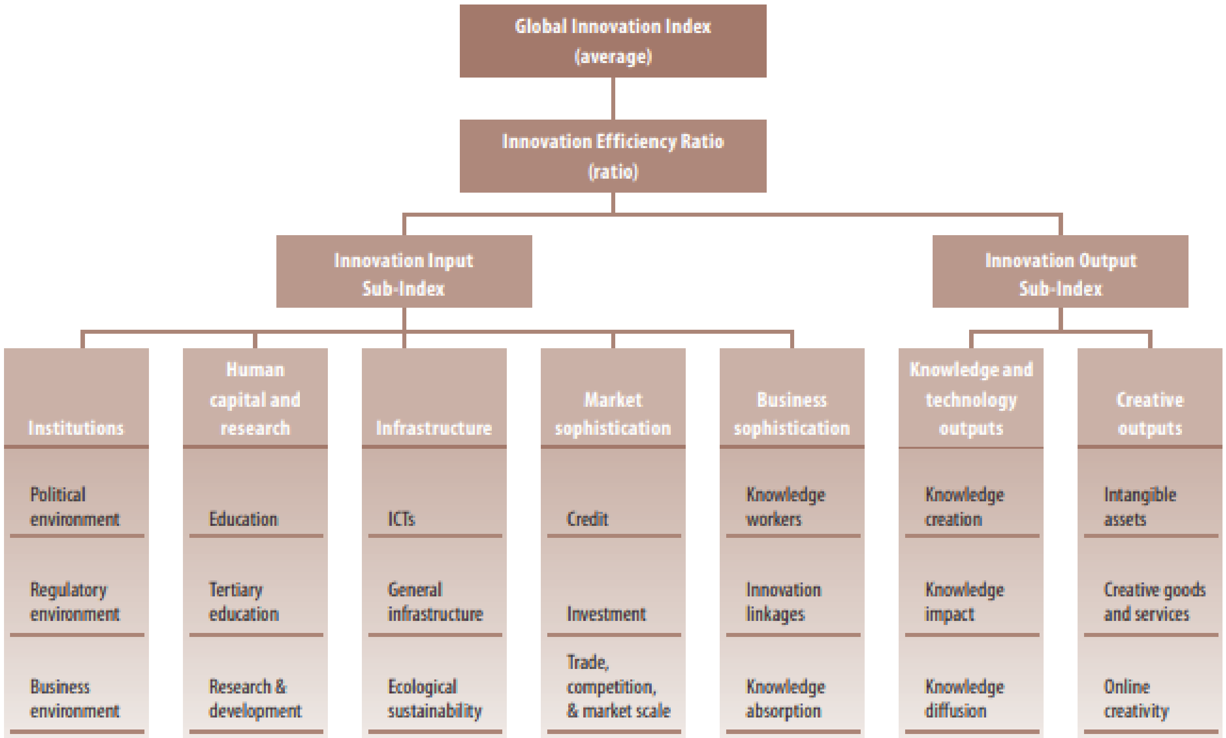
The B-Index (B) -A minimum present value of before-tax income necessary to pay the cost of R&D and to pay the corporate income taxes, so that it becomes profitable for the firm to conduct R&D. 1-B = Tax Subsidy (if positive) or Tax Burden (if negative).

7. SUMMARY OF THE ANALYSIS

To sum up the analysis of the indicators discussed from part 5 above which are among the 80 indicators used, overall to find the Global innovative Index score. The Global Innovative Index (GII) is used to give a general comparison between Hungary and Austria. GII gives the latest performance in the innovation. GII is based on two sub-indices, namely, Innovation input sub-index and the second is the innovation output sub –index. These pillars are then divided to sub-pillars where each sub-pillar consists of the 80 individual indicators as shown in **figure 37**. (GII Report 2019).

The two sub-indices are comprised of pillars, where the input sub-index has five pillars while the output sub-index contains two pillars, making a total of seven pillars.

Figure 37. Global Innovation Index Framework, 2019



Source: Global Innovative Report 2019

The seven pillars are:

a) Innovation Input sub-index- Defining environmental factors that are favorable for innovation in an economy.

1. Institutions- Political environment, Regulatory environment and business environment.
2. Human capital and research- Education, Tertiary education, Research and development.
3. Infrastructure- ICTs, General Infrastructure and Ecological sustainability.
4. Market sophistication- Credit, Investment and Trade, competition and market scale.
5. Business sophistication- Knowledge workers, Innovation linkages and Knowledge absorption.

b) Innovation Output sub-index- The outcomes of innovative practices within the economy are shown.

1. Knowledge and technology outputs- Knowledge creation, Knowledge impact, Knowledge diffusion.
2. Creative outputs- Intangible assets, Creative goods & services and Online creativity. (GII Report 2019).

Table 6. Institutions pillar, 2019

INSTITUTIONS	Hungary			Austria		
The Institutions pillar captures the institutional framework of a economy.	Rank	Score		Rank	Score	
Overall	**41**	**71.6**		**17**	**86.0**	
Political environment	41	67.4		17	83.9	
Political and operational stability	25	84.2		18	87.7	
Government effectiveness	43	59.0	◇	16	82.0	
Regulatory environment	36	75.8		10	93.7	●
Regulatory quality	42	59.4		18	80.5	
Rule of law	40	60.4		9	94.3	●
Cost of redundancy dismissal	50	91.8		1	100.0	●
Business environment	59	71.5		32	80.3	
Ease of starting a business	66	87.9		91	83.2	○ ◇
Ease of resolving insolvency	60	55.0		20	77.5	

Source: Global Innovative Report 2019

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies

It is important for innovation to be cultivated by an institutional environment which stimulates business and promotes growth by offering good governance and the right levels of support and incentives. This pillar of institutions encompasses a country's institutional structure. Austria performed better in institutions overall compared to Hungary, with Austria being ranked 17th out of 129 countries with a score of 86 while Hungary was ranked 41st with a score 71.6 out of 100. In the rule of law with a score of 94.3 and ranked 9th and cost of redundancy dismissal with a score of 100 and ranked 1st were an innovation strength to Austria, and in the ease of starting business with a score of 83.2 and ranked 91st were an innovation weakness in Austria and relative to the other top 25-ranked GII economies. In the government effectiveness with a score of 59 and ranked 43rd was considered to be an innovation weakness in relation to the top 25 ranked GII countries for Hungary as shown in **table 6**.

Table 7. Human capital and research pillar, 2019

HUMAN CAPITAL AND RESEARCH	Hungary		Austria		
This pillar gauges the human capital of economies.	Rank	Score	Rank	Score	
Overall	**41**	**41.0**	**8**	**60.2**	●
Education	52	51.8	22	60.7	
Expenditure on education	59	40.8	28	51.0	
Government funding per secondary student	45	33.8	17	46.5	◆
School life expectancy	49	55.3	28	62.8	
Assessment in reading, mathematics, and science	36	64.2	25	72.4	
Pupil-teacher ratio, secondary	30	90.2	20	92.3	◆
Tertiary education	47	36.8	3	61.7	● ◆
Tertiary enrolment	59	37.6	12	68.1	●
Graduates in science and engineering	45	38.5	12	59.4	◆
Tertiary level inbound mobility	22	32.5	10	60.0	●
Research and development (R&D)	34	34.4	18	58.1	
Researchers	31	35.3	9	65.9	●
Gross expenditure on R&D (GERD)	25	29.4	6	68.9	●
Global R&D companies, average expenditure top 3	27	52.5	25	55.4	
QS university ranking average score top 3 universities	50	20.5	28	42.0	

Source: Global Innovative Report 2019

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies

A country's level and quality of research and education are key determining factors of a country's innovation capability. This pillar aims to measure country's human capital and research. The human capital and research input pillar was an innovation strength for the Austria's innovation index, with a score of 60.2 and was ranked 8th, hence a good environment to support innovation. Government funding per secondary student with a score of 46.5 and ranked 17th, pupil-teacher ratio in secondary with a score of 92.3 ranked 20th, graduates in science and engineering with a score of 59.4 and ranked 12th were considered to an innovation strength to Austria relative to the other top 25 ranked GII economies. Tertiary enrolment with a score of 68.1 and ranked 12th, researchers in R&D with a score of 65.9 and ranked 9th and the gross expenditure on R&D (GERD) with a score of 68.9 and ranked 6th were an innovation strengths in innovation in Austria. On the other hand, Hungary had a score of 41 overall in the human capital and research pillar and was ranked 41st. There were no innovation strengths or weaknesses for Hungary in this input pillar as shown in **table 7**.

Table 8. Infrastructure pillar, 2019

INFRASTRUCTURE	Hungary			Austria		
The third pillar measures Information and communication technologies (ICTs), General infrastructure, and Ecological sustainability.	Rank	Score		Rank	Score	
Overall	**40**	**52.7**		**17**	**61.4**	
Information and communication technologies (ICTs)	54	71.5	◇	26	82.3	
ICT access	34	77.9		13	85.2	
ICT use	48	63.6	◇	29	74.7	◇
Government's online service	57	73.6	◇	32	86.8	
Online e-participation	67	70.8	○ ◇	45	82.6	◇
General infrastructure	52	37.8		14	51.3	
Electricity output	58	11.9		27	27.2	
Logistics performance	30	63.4		4	91.8	●
Gross capital formation	62	37.9		41	43.1	
Ecological sustainability	35	48.9		28	50.5	
GDP per unit of energy use	61	29.0		37	37.4	
Environmental performance	39	65.0		8	79.0	●
ISO 14001 environmental certificates	11	56.2	● ◆	37	19.6	

Source: Global Innovative Report 2019

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies

Effective and ecologically favorable infrastructure, transport and energy systems, promote and develop the sharing of innovations, goods and services and integrate with the country's innovation systems via enhanced productivity and efficiency, reduced transaction fees, improved market accessibility and sustained country's growth. From **table 8**, Hungary is compare to Austria in the infrastructure pillar of innovation input. Overall, in this pillar Hungary had a score of 52.7 and was ranked 40th while Austria had a score of 61.4 and was ranked 17th. Hungary, in the use of ICT which they had a score of 63.6 and ranked 48th, government's online service with a score of 73.6 and ranked 57th and online e-participation, hence an innovation weakness compared to the top 25 ranked GII economies, but under the ecological sustainability sub-pillar, Hungary had a score of 56.2 and ranked 11th in the ISO 14001 environmental certificates, hence becoming an innovation strength to Hungary compared to the top 25 ranked GII economies. Austria had an innovation weakness compared to the top 25 ranked GII economies in ICT use with a score of 74.7 and ranked 29th and online e-participation with a score of 82.6 and ranked 45th. In this pillar, Austria had an innovation strength in Logistics performance with a score of 91.8 and ranked 4th and in environmental performance with a score of 79 and ranked 8th.

Table 9. Market sophistication pillar, 2019

MARKET SOPHISTICATION	Hungary			Austria		
The Market sophistication pillar has three sub-pillars structured around market conditions and the total level of transactions.	Rank	Score		Rank	Score	
Overall	**76**	**45.7**	○	**44**	**52.8**	◇
Credit	46	44.5		39	47.3	
Ease of getting credit	29	75.0		77	55.0	○
Domestic credit to private sector	89	14.0	○ ◇	34	39.6	
Microfinance institutions' gross loan portfolio	n/a	-		n/a	-	
Investment	124	27.1	○ ◇	81	38.8	○ ◇
Ease of protecting minority investors	93	50.0	○ ◇	30	68.3	
Market capitalization	62	6.2	○	48	11.7	○ ◇
Venture capital deals	56	2.3	○	38	6.9	○ ◇
Trade, competition, & market scale	51	65.5		28	72.4	
Applied tariff rate, weighted mean	23	90.0		23	90.0	
Intensity of local competition	110	59.3	○ ◇	13	78.8	
Domestic market scale	54	56.3		43	60.4	

Source: Global Innovative Report 2019

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies

Credit availability as well as an atmosphere that encourages investment, entrance to the foreign markets, competitiveness and market size are mostly crucial to the success of companies and to innovation of a country. From **table 9**, overall, Hungary had a score 45.7 and was ranked 76th in the market sophistication pillar in 2019, hence was an innovation weakness. Austria had a score of 52.8 and was ranked 44th and was an innovation weakness to Austria compared to the other top 25 ranked GII economies. In domestic credit to private sector indicator, Hungary had a score of 14 and was ranked 89th, ease of protecting minority investors with a score of 50 and ranked 93rd, market capitalization with a score of 6.2 and ranked 62nd, venture capital deals with a score of 2.3 and ranked 56th and in the intensity of local competition indicator had a score of 59.3 and ranked 110th, were an innovation weakness for Hungary in the 2019 GII report. Austria had an innovation weakness in ease of getting credit, with a score of 55 and ranked 77th, market capitalization with a score of 11.7 and ranked 48th and in venture capital deals with a score of 6.9 and ranked 38th. In 2016, the domestic market scale, as determined by the GDP of an economy, was introduced, hence the last sub-pillar which takes into account the effect that an economy's size has over its ability to come up with and test inventions throughout the market places

Table 10. Business sophistication pillar, 2019

BUSINESS SOPHISTICATION	Hungary			Austria		
The fifth enabler pillar tries to capture the level of business sophistication to assess how conducive firms are to innovation activity.	Rank	Score		Rank	Score	
Overall	**33**	**40.8**		**18**	**53.8**	
Knowledge workers	51	42.1		17	65.0	
Employment in knowledge-intensive services	38	60.4		25	73.6	
Firms offering formal training	84	16.4	○ ◇	n/a	-	
GERD performed by business enterprise	22	25.1		6	56.3	●
GERD financed by business enterprise	17	72.0		21	69.0	
Females employed with advanced degrees	43	43.8		35	52.5	◇
Innovation linkages	57	27.3		11	50.8	●
University/industry research collaboration	53	44.4		16	65.2	
State of cluster development	62	46.8		14	66.7	
GERD financed by abroad	21	31.6		24	30.5	
Joint venture/strategic alliance deals	73	6.1	○	31	21.6	◇
Patent families filed in at least two offices	35	5.6		12	62.5	●
Knowledge absorption	16	53.0	●	26	45.6	
Intellectual property payments	22	35.6		49	17.8	
High-tech imports	17	46.7	●	54	26.5	○
ICT services imports	58	31.0		18	54.9	
Foreign direct investment, net inflows	9	69.3	●	127	40.3	○
Research talent in business enterprise	11	73.7	●	9	74.3	

Source: Global Innovative Report 2019

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies

This final pillar aims at measuring the degree of business sophistication so at to determine how favorable business are when it comes to innovation in a given country. In the second pillar, human capital and research, the conclusion was that the development of human capital by the use of education, especially through higher education and also by prioritizing activities of research and development. By employing highly skilled professionals and specialists, it shows the innovation ability of the business, competitiveness and the business productivity. In this pillar, Hungary was ranked 33rd with a score of 40.8 while Austria was ranked 18th with a score of 53.8. Hungary had an innovation weakness in the firms offering formal training indicator with a score of 16.4 and ranked 84th and in joint venture/strategic alliance deals with a score of 6.1 and ranked 73rd.

Hungary had an innovation strength in this pillar, in the high-tech imports indicator with a score of 46.7 and ranked 17th, in foreign direct investments, net inflows with a score of 69.3 and ranked 9th and in the research talent in business enterprise with a score of 73.7 and ranked 11th. In this pillar, Austria had innovation weakness in high-tech import with a score of 26.5 and ranked 54th and in foreign direct investment, net inflows with a score of 40.3 and ranked 127th. Austria also had an innovation weakness compared to the other top 25 ranked GII economies in the females employed with advanced degrees indicator, with a score of 52.5 and ranked 35th and in the joint venture/strategic alliance deals indicator with a score of 21.6 and ranked 31st. Austria had innovation strength in the gross expenditure on R&D (GERD) performed by business enterprise, with a score of 56.3 and ranked 6th and in the patent families filed by residents in at least two offices with a score of 62.5 and ranked 12th, as shown in **table 10.**

Table 11. Knowledge and technology outputs, 2019

KNOWLEDGE AND TECHNOLOGY OUTPUTS	Hungary			Austria		
This pillar covers all those variables that are traditionally thought to be the fruits of inventions and or innovations.	Rank	Score		Rank	Score	
Overall	**17**	**42.8**	●	**25**	**36.7**	◇
Knowledge creation	43	20.3		18	41.3	
Patent applications by origin	42	11.7		13	55.8	
PCT international applications by origin	36	8.4		11	53.6	
Utility model applications by origin	31	11.0		23	15.7	
Scientific and technical publications	34	43.8		20	61.5	
Citable documents H index	33	28.3		17	43.4	
Knowledge impact	15	49.6	●	33	43.6	
Growth rate of GDP per person engaged	54	68.4		65	65.7	○
New business density	37	12.4		80	2.2	○ ◇
Total computer software spending	36	27.5		15	53.1	
ISO 9001 quality certificates	16	48.7	●	36	19.9	
High-tech and medium high-tech output	8	72.5	● ◆	15	55.3	
Knowledge diffusion	8	58.4	● ◆	40	25.1	◇
Intellectual property receipts	16	42.6	●	24	15.8	
High-tech exports	11	72.8	● ◆	21	43.6	
ICT services exports	58	18.0		33	29.0	
Foreign direct investment, net outflows	1	100.0	● ◆	124	12.1	○ ◇

Source: Global Innovative Report 2019

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies

This pillar includes all those indicators historically seen as the results of inventions. In this pillar, Hungary performed better than Austria, becoming an innovation strength with a score of 42.8 and ranked 17th while Austria had a score of 36.7 and ranked 25th, hence a weakness compared to the other top 25 ranked GII economies. In the ISO 9001 quality certificates indicator, with a score of 48.7 and ranked 16th and in intellectual property receipts with a score of 42.6 and ranked 16th, Hungary had an innovation strength. Hungary had an innovation strength compared to the top 25 ranked GII economies in high-tech and medium high-tech output with a score of 72.5 and ranked 8th, in high-tech exports with a score of 72.8 and ranked 11th and in foreign direct investment, net outflows with a score of 100 and ranked 1st in the world. Austria had an innovation weakness in the growth rate of GDP per person with a score of 65.7 and ranked 65th. Austria also had a weakness compared to the other top 25 ranked GII economies in the new business density indicator, with a score of 2.2 and ranked 80th and in foreign direct investment, net outflows with a score of 12.1 and ranked 124th, very low compared to Hungary in position 1, as shown in **table 11**.

Table 12. Creative outputs, 2019

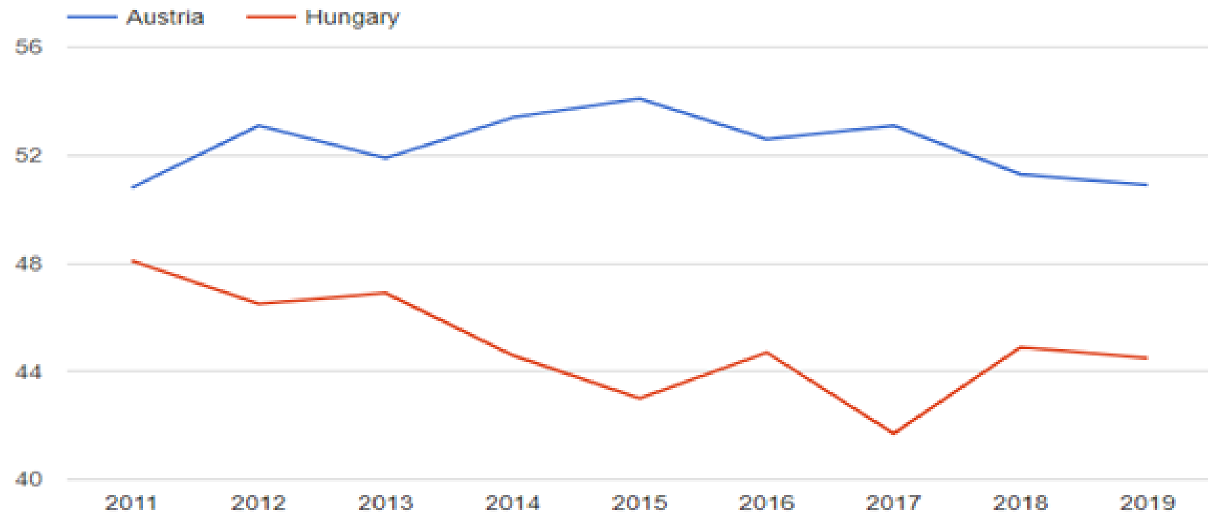
CREATIVE OUTPUTS	Hungary			Austria		
The last pillar on creative outputs measures the role of creativity for innovation.	Rank	Score		Rank	Score	
Overall	**38**	**34.6**		**25**	**41.4**	
Intangible assets	56	43.0		30	51.2	
Trademark application class count by origin	64	16.0	○	45	21.4	
Industrial designs by origin	40	17.5		17	40.6	
ICTs and business model creation	50	65.5		27	72.6	
ICTs and organizational model creation	42	60.3		29	64.9	◇
Creative goods and services	24	31.6		38	27.1	
Cultural and creative services exports	36	20.3		23	29.2	
National feature films produced	42	19.4		28	26.8	
Entertainment and media market	29	14.1	◇	8	65.3	
Printing, publications & other media output	75	13.1	○	42	23.6	○
Creative goods exports	9	70.8	● ◆	45	10.6	
Online creativity	32	20.6		22	36.2	
Generic top-level domains (gTLDs)	39	10.4		19	36.0	
Country-code top-level domains (ccTLDs)	20	29.1		11	57.9	●
Wikipedia yearly edits	21	36.2		20	36.5	
Mobile app creation	46	6.7		33	14.4	

Source: Global Innovative Report 2019

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies

In the creative outputs pillar, which has 3 sub-pillars as show in table 12, Hungary was ranked 38th with a score of 34.6 while Austria had a score of 41.4 and ranked 25th. Hungary had an innovation weakness in the trademark application class count by origin indicator with a score of 16 and ranked 64th and in printing, publications & other media outputs with a score of 13.1 and ranked 75th. Compared to the top 25 ranked GII economies, Hungary had a weakness in entertainment and media market indicator with a score of 14.1 and was ranked 29th. But Hungary performed well in creative goods export indicator with a score of 70.8 and ranked 9th, hence becoming a strength compared to the other top 25 ranked GII economies. Austria also had an innovation weakness in printing, publication & other media output indicator, with a score of 23.6 and ranked 42nd. Austria had a weakness compared to the other top 25 ranked GII economies in ICT and organizational model creation with a score of 64.9 and was ranked 29th. In this pillar, Austria had an innovation strength in the country-code top level domains (ccTLDs) with a score of 57.9 and ranked 11th.

Figure 38. Global innovation Index (GII) in points, 2011- 2019



measure: points
Source: TheGlobalEconomy.com, Cornell University, INSEAD, and the WIPO

The Global Innovation Index includes two sub-indices: the Innovation Input Sub-Index and the Innovation Output Sub-Index. The first sub-index is based on five pillars: Institutions, Human capital and research, Infrastructure, Market sophistication, and Business sophistication. The second sub-index is based on two pillars: Knowledge and technology outputs and Creative outputs. Each pillar is divided into sub-pillars and each sub-pillar is composed of individual indicators.

As shown in **figure 37**, generally, Austria has performed better compared to Hungary in innovation over the period 2011-2019. By 2011, Austria's innovation index was at 50.8, increased to 53.1 points by 2012, and a record hi of 54.1 points in 2015 and then a decrease to 53.1 point in 2017, but in 2019 they had 50.9 point, ranked position 21st. In Hungary, the innovation index was high at 48.1 points in 2011, had a slight decrease to 46.5 in 2012, and a big drop to 43 points by 2015 and by 2017 it was at 41.7 points which was the lowest. By 2019 Hungary had 44.5 points, ranked at position 33rd worldwide, with Switzerland leading with a score of 67.24 points.

Figure 39. Relationship between GII and total tax on corporate profits, Hungary and Austria 2011 -2019

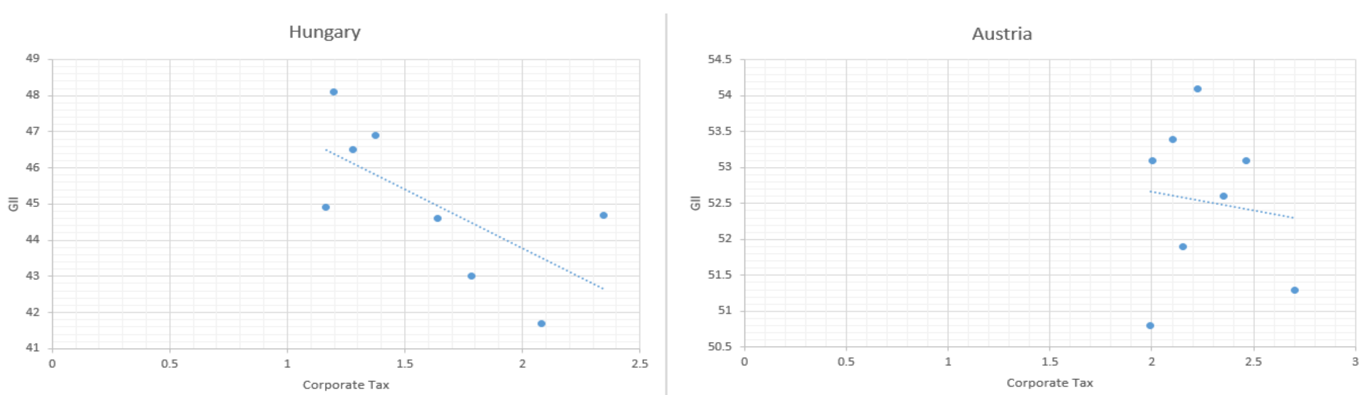
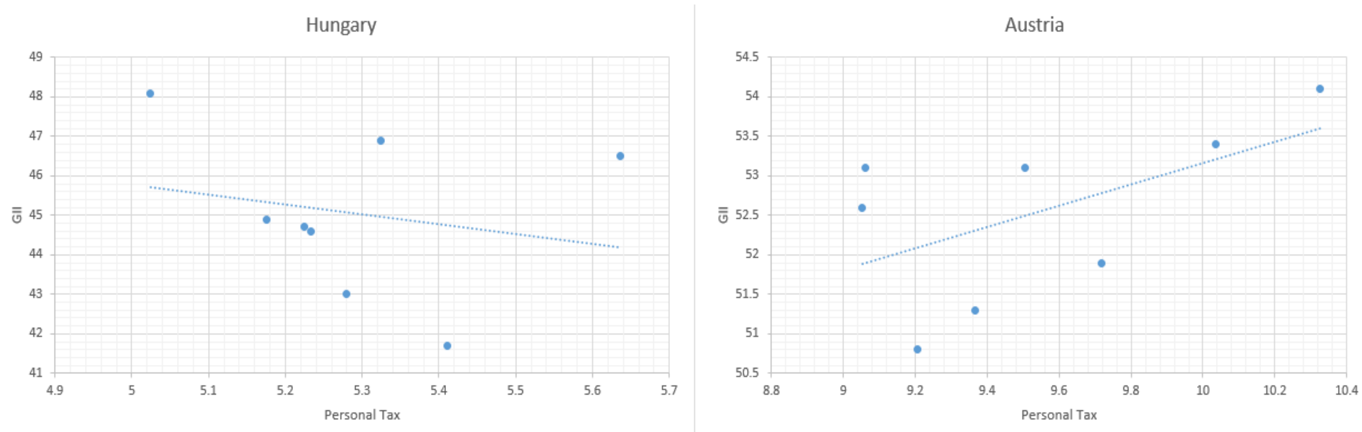


Figure 40. Relationship between GII and total tax on personal profits, Hungary and Austria, 2011-2019



Previous research, as discussed in the literature review in section two, the relationship between innovation and taxation was mentioned. From this paper there is a negative relation between GII and both corporate tax and personal tax in Hungary, but positive for personal tax in Austria, as shown in **figure 39 and 40**. This more explained in the conclusion with more reference.

8. THE R&D SECTOR SUCCESSFUL STORIES

In this section, the paper aims to show some of the successful startups from both Hungary and Austria and their performances to date. (Invest in Austria, Hungarian investment projects).

7.1 Austria

Runtastic

Created by four students at the school of Applied Sciences in Hagenberg, Adidas acquired it for 220 million euros in 2015. Runastic is a pioneer in the field of digital health and wellness, offering personalized monitoring tools for the collection, management and review of fitness and workout data, as well as customized content. The Austrian company has been part of Adidas team since 2015 and aims to create innovative fitness and practice applications to achieve the dream of the two companies, of changing lives through sports. Currently, the app has 157 million registered users with 297 million appstore downloads and is in 15 languages with appstore rating of 4.6.

Shpock

It was founded in 2012 by Armin Strbac and Katharina Klausberger, until the Norwegian media company, Schibsted took over in 2015. Shpock is a virtual platform bringing together millions of sellers and buyers, and business at a local level. The categories vary from appliances, fashion and furniture to vehicles and properties. Shpock does have more than ten million monthly users and also more than two billion interactions on website. Goods valued over one billion pounds are sold annually, as at 2018. They have a network of multinational staff of 100 plus, who are accountable for the general performance of the platform. Those figures and regular number one rankings throughout the three key markets of United Kingdom, Germany and Austria makes it to be a shopping app which is dominant in Europe. In 2017 they were awarded as the best app by Apple, in the sustainability category.

Bwin

It was established in 1997 by twelve staff and currently headquartered in Vienna with GVC Holdings as the parent organization. The company currently has about 25,000 employees globally and is the largest online gaming company with 760 million US dollars as annual revenues. The company offers a wide variety of games online, over 900 games and they are offered in 21 different languages in 19 different currencies.

Jajah

It is a web based telecommunication supplier founded by Roman Scharf and Daniel Mattes in 2005. It was then acquired in 2009 for 145 million Euros by a Spanish business called Telefonica. Jajah was shut down in January 2014, since the company was not growing, did not new users and did not have any new products.

Paysafecard

The Company was set up in 2000, and has emerged as the European market leader today with its development of the first online mean of payment approved by banking law. It offers gamers with an easy and secure way of making payments online and has supported the gaming industry since 2000. The company currently has approximately 650,000 global distribution centers in nearly 50 nations. During the year 2018, transaction payments of 130 million in number were made via paysafecard, worth 3 billion euros, which was an improvement of ten million transactions worth of 100 million euros. A number of 270 transactions per minute are always made using paysafecard. Paysafe links companies and customers in more than 40 currencies around the world, via 200 payment forms.

UBIMET

It was formed in 2004 as a start-up by Manfred Spatzierer and Michael Fassnauer, and headquartered in Vienna and has branches in New York, Melbourne, Zurich, Munich and Karlsruhe with 250 employees in 25 countries. Since then, the start-up has grown overtime, supplying meteorically services privately globally that improve safety and productivity. The experience of UBIMET and efficient forecast services have assured clients from different industries, for example from media, rail, energy, aviation, construction, event planners and insurance. UBIMET has been supplying reliable weather forecasts, since 2014, to FFA, PGA, Australian Sailing team, Formula 1 and many more sporting institutions across the globe.

The founders are still providing more support in the company who are aiming at investing more into coming up with new standards in providing meteorological services. Red Bull has been part of the company since 2012. The digital forecasting application MORECAST hit the download record of 15 million users in 2017. The UBIMET Weather Cockpit got the 2017 World Summit Award Austria.

AFFiRiS

Established in 2003, as a biotech company which invents vaccines against Diabetes, Parkinson's and Alzheimer's. In 2012, they were able to come up with the first vaccine for Parkinson. AFFiRiS has attracted funds with half of it coming from revenue gained from licenses and grants from government, totaling to approximately 130 million Euros. They also have some project sponsored by European Union. The company at its Bio-center Campus in Vienna, it has employed 60 highly skilled employees

7.2 Hungary

Prezi.com

Prezzi offers a web based presentation database and a software for presentations. It was launched in 2009 and its customer base has grown steadily over the years. The number of active users, by 2015 December had reached 75 million and the presentations numbers produced had reached over 260 million. From the figures, it is true to say that Prezzi is leading in the world when it comes to web based presentations. To show it's potential to develop in future, Prezzi received in 2014, 57 million US Dollars of investment.

UStream

It was established in the year 2007. It is a platform which provides streaming of videos which is capable of hosting 1.5 million viewers simultaneously. The company increased their earnings and revenues by 400 per cent over the years and by the end of 2014 the company was able to achieve an average of 50 million active subscribers. The Doll Capital injected 11 million US Dollars in the company in 2008, in 2010, 20 million US Dollars were pumped into UStream by Softbank. UStream was acquired by IBM in 2016 at an estimate of 130 million US Dollars.

3DHISTECH

3DHISTECH, who are the founders of the digital pathology, the development and manufacture of digital slides software, digital slides scanners and some many more products and applications such as tissue microarray equipment. Found in 1996 by Bela Molnar and has employed 120 highly qualified employees and profits of 8 million Euros. They not only support regular pathology schedules but the do support pharmaceutical and medical education and research. They have sold systems more than 800 worldwide to companies such as Sanofi Aventis, Roche and Harvard Medical School research institute.

LogMeIn

The LogMeIn was established in Budapest in 2003. This is a platform software for team work, management of IT and customer interaction service and online networking services which is cloud based. The computers user who are in remote areas are easily given access by the products from LogMeIn to the administrators and the systems. The LogMeIn servers are rate to be powerful than other servers, and proved link to more than 300 million devices worldwide. 800 and more people are employed worldwide by the company. The company is valued at 2 billion US Dollars.

9. CONCLUSION

According to Autio, 2010, innovators are always part of economic growth in a given country. When it comes to innovation, tax systems can be used by governments to make sure that innovators are able to overcome the cost of innovating and hence motivate innovation activities. Tax benefits and measure which are considered to be part of cost in innovation can be used in a way and an aim of encouraging innovation and more so in research and development. (Jeffrey and Michael). More research has shown that taxes are always seen to reduce innovation gains and profits, hence can discourage innovation or encourage innovation. (Hansson 2012). High taxes in terms of both corporate and personal can discourage innovation activities. (Cullen and Gordon 2007). This paper found out that, there is a negative relationship between GII (innovation) and corporate taxes and personal taxes in Austria and Hungary. But corporate taxes had a strong relation while personal taxes had a little relationship with GII, to the extent of personal tax in Austria showing a positive relation, as shown in **figure 39 and 40.**

Out of the 25 indicators used in this paper, Austria performed better in 18 of them and Hungary in 7 hence this contributed to Austria to top Hungary in the GII. By 2008, according to OECD report of 2008 on innovation, innovation had played a major role in the productivity levels in Hungary since 1990 and mostly through FDI importation, even though by then the levels of innovation in Hungary were still low. But as time went by, from 2008, as shown in this paper, Hungary was able to improve the innovation activities in institutions of learning but are still not enough compared to Austria. The government of Hungary still can provide more support to Hungarian institutions so as to improve the capabilities of innovation by creating an environment favorable and taking advantage of the European Union funds in research and development and making sure that innovation is supported by the financial sector.

In the summary section, Austria is seen to have invested in institutions more than Hungary, but still there is need to support the private sector, and mobilize them to fund the innovation sector. In Ireland, they are supporting the companies and innovators at a very early stage by making sure there is more equity available by coming up with support polices. (Taylor, 2018). More support through Angle investment in Austria as other European countries has been suggested in other reports too. (European Commission 2017b). According to Joanneum Research, 2015, Austria's level of venture capital was compared to other European countries. Fenandez, in 2016 suggested that Austria needed to improve on transfer of knowledge to companies from universities so as to improve in innovation.

In my opinion, Austria has performed well in innovation compared to Hungary, but in future Hungary is most likely to overtake Austria. Hungary is performing better in the world currently in FDI net outflows, ranked first while Austria was ranked 124 in 2019 report by GII, despite Austria performing better in innovation inputs. Generally Hungary performed better in knowledge and technology outputs as at 2019, achieving more strengths than Austria, which is positive for Hungary in the near future, if the government continues to support and invest more in the innovation inputs and mostly in the human resources input and lastly encourage the participation of multinational companies in innovation, creating favorable environment for them and hence maximize on the benefits.

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