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Study on behalf of Interpharma

The Importance of the Pharmaceutical Industry for Switzerland

Polynomics
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In collaboration with
BAK Basel Economics

POLYNOMICS

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Client's Foreword

Thomas B. Cueni, Secretary General of Interpharma

Published now for the fifth time, this study on the importance of the pharmaceutical industry in Switzerland features an important innovation this year: for the first time, the results are based on official pharmaceutical data from the Swiss national accounts. The Swiss Federal Statistical Office (SFSO) now enables the use of data regarding gainfully employed persons and value creation for the pharmaceutical industry that was previously estimated by Polynomics in collaboration with BAK Basel Economics.

Publication of this data by the SFSO is doubly pleasing from the standpoint of the pharmaceutical industry. First, the Swiss economy's growth driver is now regarded with sufficient esteem to be classed as a sector in its own right rather than as part of the chemical industry, so it is no longer reported as a "quantité négligable" (negligible quantity) in the data. Second, it now becomes evident that the pharmaceutical sector is more important than was assumed hitherto. Until now, direct value creation by the pharmaceutical industry was under-assessed by more than one fifth. If we also consider that added value of 100 Swiss francs in the pharmaceutical industry produces another 80 Swiss francs for its supplier sectors, the combined direct and indirect contribution by the pharmaceutical industry amounts to 35.5 billion Swiss francs in 2012. The revision of the value creation data also impacts the job productivity level: in 2012, this amounts to some 490,000 Swiss francs, or over four times more than the average for the Swiss economy, and about twice as high as the figure for banks.

Exchange rate developments forced the pharmaceutical industry to accept severe erosion of its margins in recent years. Pressure on drug prices is also evident on the domestic front, and the ongoing growth in health expenditure and health insurance premiums is continuing to influence the debate about pricing. This remains the case even though today's Switzerland is no longer a high-price island, and the proportion of drug costs to healthcare costs in general is a mere 9.4% (2011). One encouraging development here was the Federal Council's presentation last fall of a master plan to promote biomedical research and technology. The master plan covers issues such as simplifying the approvals procedure for drugs, accelerating the approval process and the addition of drugs to the list of specialties, and promoting research into rare childhood diseases. These steps will likely enhance the pharmaceutical industry's competitive edge as compared to its international rivals, and they are welcomed by the sector. Advances in research are exemplified by developments in personalized medicine: personalized diagnoses and drugs can result in cheaper medicines with fewer side effects.

Interpharma
Thomas B. Cueni, Secretary General

1 In Brief

Previous editions of this publication used data for the pharmaceutical industry estimated by BAK Basel Economics. For the first time, the revision of official statistics now makes it possible to refer to original data gathered by the Swiss Federal Statistical Office (SFSO). An analysis of this data shows that value creation by the pharmaceutical industry was hitherto underestimated by some 20%, whereas the number of gainfully employed persons was predicted very accurately. The importance of the pharmaceutical industry as measured by the direct and indirect added value that it generates has increased slightly in overall terms.

The pharmaceutical industry will again do justice to its role as the growth driver of the Swiss economy in 2013. Given that demand for drugs is inelastic, and in view of the pharmaceutical industry's geographical diversification, growth of 3.7% in real added value is possible. This is well above the figure for the Swiss economy as a whole, which is 1.4%. With growth in added value of more than 4% last year, the pharmaceutical industry was already performing significantly better than the overall economy, which posted added value growth of about 1%. Recent years have seen a constant positive trend for value creation in the pharmaceutical industry, so the sector showed resilience to the impact of the financial crisis. In absolute terms, the sector managed to create added value of some CHF 35.5 billion in 2012 – including CHF 19.3 billion directly within the pharmaceutical industry itself –, corresponding to a 6% quota of the nominal gross domestic product. The ratio between directly and indirectly created gross value added and the direct gross value added by the pharmaceutical industry is referred to as the multiplier, and it is equal to 1.8.

Foreign countries represent a key sales market for the pharmaceutical industry. Accordingly, exports rose from CHF 8 billion in 1990 to CHF 64.1 billion in 2012. Nominal exports (including diagnostics and vitamins) increased by 6.7% in 2012, and the real increase in exports after adjustments for price developments was 6.2%. This means that prices for pharmaceutical exports rose again last year, whereas in the past two years the trend reversed due, among other factors, to the sharp increase in the value of the Swiss franc.

Table 1 | Direct and indirect importance of the pharmaceutical industry, 2012

		Direct importance	Indirect importance	Total	Multiplier
Gross value added	million CHF	19,300	16,200	35,500	1.8
	in % of total for Switzerland	3.3%	2.7%	6.0%	
Persons in gainful employment	number of persons	39,500	130,300	169,800	4.3
	in % of total for Switzerland	0.8%	2.7%	3.5%	
Hours worked	million hours	69.5	222.1	291.6	4.2
	in % of total for Switzerland	0.9%	2.8%	3.7%	
Exports	in million CHF	64,130	—	—	—
	in % of total for Switzerland	32.0%	—	—	

Source: Polynomics, SFSO, BAK Basel Economics, Directorate General of Customs (DGC).

The last decade was marked by an impressive growth phase for the pharmaceutical industry, ushered in by the international structural changes seen during the 1990s. The restructuring of the sector has yielded gains in efficiency which, even today, are not only evident in high added value growth but are also perceptible on the labour market. Growth in the number of gainfully employed persons in the economy as a whole between 2005 and 2012 averaged 1.7% per year, whereas growth in the pharmaceutical industry was almost twice as high, at 3.2%. If we also count the jobs in upstream (input) industries in addition to the 39,500 jobs offered directly by the pharmaceutical industry itself, almost 170,000 jobs were dependent on the pharmaceutical industry in 2012. The multiplier for gainfully employed persons is 4.3, significantly higher than the value creation multiplier. This can also be attributed to productivity, i.e. to the ratio between labour deployed and value added. For 2012, the pharmaceutical industry reports above-average productivity of CHF 277 per hour of work or some CHF 490,000 per person in gainful employment. Productivity is therefore four times higher than the figure for the overall economy.

Finally, the pharmaceutical industry – together with its employees – also makes an important contribution to the Swiss economy over and above the achievements just described. Tax payments and consumer spending by persons employed in the pharmaceutical sector are significantly above the national average.

2 Revision of Official Statistics: Official Data on the Development of the Pharmaceutical Industry Available at Last

For a long time, the pharmaceutical industry has occupied a subordinate position in the economic statistics. The latest revision of the General Classification of Economic Activities (NOGA) now changes this situation. In connection with the introduction of version Rev. 2 of the Statistical Classification of Economic Activities in the European Community – known by the acronym NACE from its French name (Nomenclature statistique des activités économiques dans la Communauté européenne) – the pharmaceutical industry is reported in parallel with the chemical industry. In Switzerland too, economic statistics have been adapted accordingly. The NOGA 2008 classification (Nomenclature générale des activités économiques) now makes it possible to monitor the pharmaceutical industry as an individual sector of the Swiss economy over time, and to arrive at a better assessment of its importance for Switzerland as a location.

The next sections describe the differences between the figures previously used and calculated for the pharmaceutical industry. We begin by showing how the definition of the sector group has changed, and then we consider nominal and real value creation. Finally, the differences between the figures on gainful employment are also used to analyze labour productivity.

2.1 Revision of the General Classification of Economic Activities (NOGA)

NOGA is Switzerland's general system for classifying economic sectors, and it is an important instrument for the purposes of gathering and analyzing statistical information. NOGA is taken as the basis for classifying companies according to their economic activities, and for arranging them in clear groupings. The Swiss system has been developed since 1995 in line with the European NACE system. This approach made it possible to harmonize Swiss statistics on an international basis, since national solutions such as NOGA must largely correspond to the European model: special national features can only be incorporated at a very detailed level (from the fifth level onwards).

A minor revision of NACE was implemented in 2002 and version Rev. 1.1 was published. The relevant changes also triggered adaptations in Switzerland, leading to the issue of NOGA 2002. This provided the basis for the reports that

Table 2 | Changes to the General Classification of Economic Activities, 2002/2008

NOGA 2002		NOGA 2008	
24	Manufacture of chemical products	20	Manufacture of chemical products
24.1	Manufacture of basic chemical substances	201	Manufacture of basic chemical substances, fertilizers and nitrogen compounds, plastics in primary forms and synthetic rubber in primary forms
24.2	Manufacture of pest control, plant protection and disinfectant products	202	Manufacture of pest control, plant protection and disinfectant products
24.3	Manufacture of paints and other coating materials, printing inks and putties	203	Manufacture of paints and other coating materials, printing inks and putties
24.4	**Manufacture of pharmaceutical products**		
24.5	Manufacture of soaps, washing and cleaning products, odorants and body-care/personal care products	204	Manufacture of soaps, washing and cleaning products and polishing agents
24.6	Manufacture of other chemical products	205	Manufacture of other chemical products
24.7	Manufacture of chemical fibers	206	Manufacture of chemical fibers
		21	**Manufacture of pharmaceutical products**
		211	Manufacture of basic pharmaceutical substances
		212	Manufacture of pharmaceutical specialties and other pharmaceutical products

Source: Polynomics, SFSO (2008a, 2002).

were compiled to date in this series of publications. As Table 2 shows, the pharmaceutical industry was only reported as a subgroup in NOGA 2002 ("24.4 Manufacture of pharmaceutical products"). Data at this disaggregated level were not publicly obtainable or available. The only published information related to the sector as a whole ("24 Manufacture of chemical products") or to the sector group comprising sections 23 ("23 Manufacture of coke, refined petroleum products and nuclear fuel") and 24.

In 2008, NACE Rev. 1.1 was taken as the basis for the publication of NACE Rev. 2, which entailed a number of major changes. A separate division was created for important new economic segments or existing segments whose economic or social importance had increased substantially.[1] The pharmaceutical industry, with its increasing importance for the Swiss economy, was also able to benefit from this change: in NOGA 2008, it is represented by the new division "21 Manufacture of pharmaceutical products". Table 2 shows the changes in NOGA 2008 as compared to NOGA 2002.

2.2 Impact on value creation, gainful employment and productivity

The provision of statistical data for the pharmaceutical industry makes it possible to verify the data used in the past and to substantiate the importance of the pharmaceutical industry for Switzerland with official data. The differences between the previous estimated data and the new data calculated by the SFSO are singled out below. For gross value added and gainful employment between 1990 and 2010, we consider both the change in level and the development over time for this purpose.

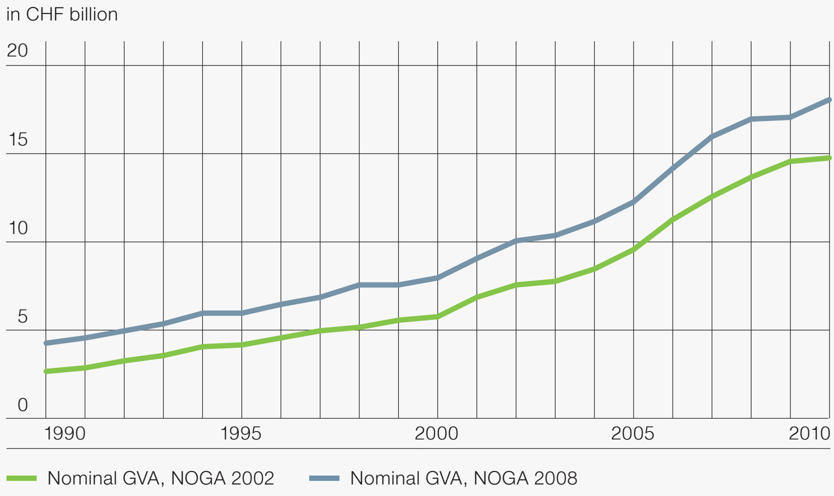
Change in value creation and gainful employment

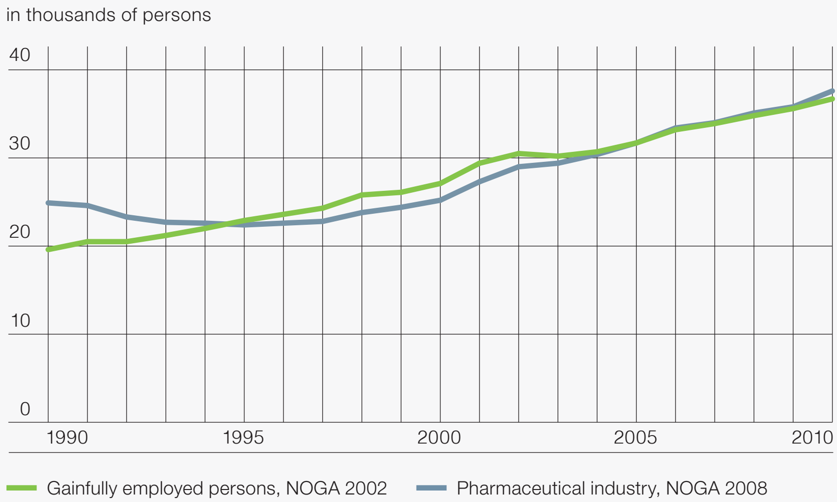
The progression of nominal value creation by the pharmaceutical industry as per NOGA 2002 and 2008 is shown on the top of Figure 1. The grey curve corresponds to nominal value creation, as calculated by the SFSO on the basis of NOGA 2008. The curve based on the new 2008 system is constantly above the series based on NOGA 2002 (green line, as used in the past) throughout the entire period from 1990 until 2010.

In 1990, nominal value creation was CHF 2.7 billion according to the data used previously; value creation by the pharmaceutical industry as now reported by the SFSO is some 60% or CHF 1.6 billion higher, at CHF 4.3 billion. For 2010, the

1 On this point, see also: BFS (2008b).

Figure 1 | Pharmaceutical industry: nominal gross value added and persons in gainful employment





Source: Polynomics, BAK Basel Economics, SFSO.

The top figure shows the progression of nominal gross value added (GVA) for the pharmaceutical industry in CHF billion. For the entire period from 1990 to 2010, the new system (NOGA 2008; grey line) indicates higher value creation than the series previously estimated on the basis of NOGA 2002 (green line). The lower figure plots the development in gainfully employed persons in thousands of persons. Especially for the more recent period, significantly smaller differences between NOGA 2008 (grey line) and NOGA 2002 (green line) are evident here.

difference is still 22% or CHF 3.3 billion. This equates to value creation as per NOGA 2008 of CHF 18.1 billion as compared to CHF 14.8 billion according to NOGA 2002.

While the level of previous estimates is below the new figures, the growth rates were constantly higher. Average growth of real value creation between 1990 and 2010, according to the SFSO on the basis of NOGA 2008, was about 9.1% per year, whereas the previously estimated data pointed to annual growth of 9.8%.

The divergences for gainfully employed persons in the years following 2005 are not as great as for value creation. In 2010, the numbers of gainfully employed persons were virtually the same: 36,700 according to the estimate and 37,600 according to the statistics on gainfully employed persons and NOGA 2008. However, the progression of the curves shows that the number of gainfully employed persons was slightly overestimated between 1995 and 2004, whereas this figure was underestimated in the period from 1990 until 1994.

Likewise, the number of gainfully employed persons according to the new system of economic sector classification rose at 2.1% per year between 1990 and 2010 – i.e. less sharply than would be suggested by the figure based on the old data (3.2% per year).

The differences in the added value trend and the number of gainfully employed persons impact the productivity[2] of the pharmaceutical industry (cf. Table 3). For instance, productivity as per NOGA 2008 in 2010 was CHF 480,000, or almost CHF 80,000 higher than the figure indicated by the estimated data based on NOGA 2002 (CHF 402,000). In 1990, the difference was only CHF 50,000, with official data indicating job productivity of CHF 171,000 as opposed to only CHF 137,000 based on the estimates.

In terms of productivity per hour, the official data now shows that the labour productivity figure for the pharmaceutical sector is CHF 287, more than CHF 50 per hour higher than the figure of CHF 234 per hour obtained on the basis of estimated data.

2 The term productivity as used here is calculated as the quotient of gross value added and the number of persons in gainful employment. The SFSO only publishes figures for productivity per full-time equivalent. For this reason, the two variables do not coincide exactly.

Table 3 | Productivity per job and per hour 1990–2010

in CHF	Productivity per job		Productivity per hour	
	NOGA 2002	NOGA 2008	NOGA 2002	NOGA 2008
1990	137,000	171,000	64	79
2000	215,000	316,000	109	177
2010	402,000	480,000	234	287

Source: Polynomics, BAK Basel Economics, SFSO.

2.3 Summary of effects due to the NOGA revision

To summarize, it may be stated that the estimates in previous studies regarding the importance of the pharmaceutical sector as an employer were very good, at least from 1995 onwards. After 2003, there is virtually no difference in the numbers of gainfully employed persons based on the estimates and on the new statistics as per NOGA 2008.

On the other hand, value creation by the sector was underestimated in the past. Due to the revision, for instance, nominal gross value added rose by some CHF 3.3 billion to over CHF 18 billion in 2010, equal to an increase of over 20%.

The development of gainful employment and value creation can also explain the sharp increase in productivity. On the basis of the new data series, this figure rose by more than 20% both per job and per hour in 2010, to reach CHF 480,000 per job and CHF 287 per hour respectively.

3 The Pharmaceutical Industry as an Employer

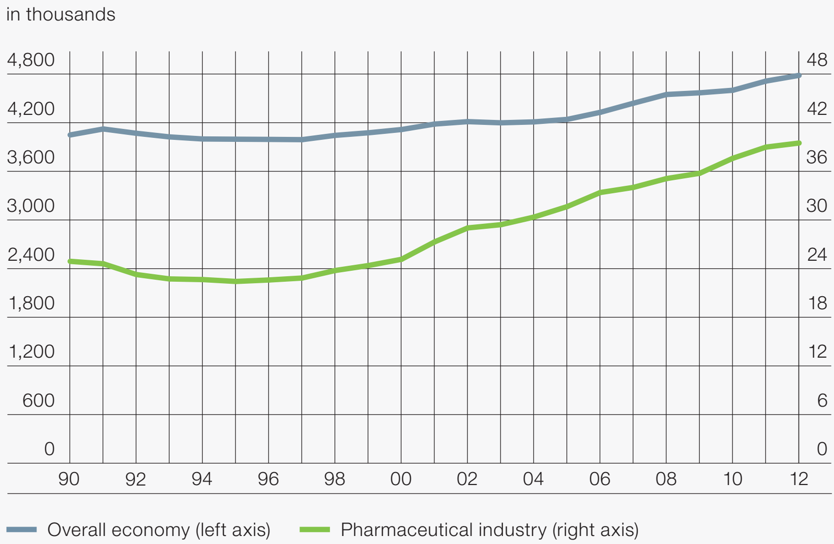
3.1 Number of gainfully employed persons

The pharmaceutical industry has continued to gain importance as an employer in recent years. Some 25,000 persons were gainfully employed in the pharmaceutical industry in 1990 whereas by 2012, the number of pharmaceutical jobs had risen to about 39,500 (cf. Figure 2). Almost 10% of jobs in the pharmaceutical industry were cut back between 1990 and 1995. This was due on the one hand to cyclical economic effects: there was also a slight decline in the number of gainfully employed persons in Switzerland as a whole over the same period. On the other hand, this development reflects the structural change in the industry, entailing Switzerland's transformation from a producer of classical chemical products into a globally important location for the pharmaceutical and agrochemical industries. Following the initial shedding of jobs, the years from 1996 onwards saw a constant increase in the number of gainfully employed persons. Between 1995 and 2012, the pharmaceutical industry created over 17,000 new jobs while the number of gainfully employed persons rose from 22,400 to 39,500.

The differences in the development of the number of jobs are also mirrored in the annual growth trend. In the pharmaceutical industry since 1995, 3.5% new jobs were created per year, whereas the corresponding growth trend for the economy as a whole was 1.1%. Throughout the period represented in Figure 2, the average annual growth of gainfully employed persons in the pharmaceutical industry was 2.1% – a higher figure than for the economy as a whole, which posted 0.8%. Between 1995 and 2005 in particular, growth in gainfully employed persons in the pharmaceutical industry proceeded more dynamically than in the economy as a whole. From 2005 onwards, growth in gainfully employed persons in the pharmaceutical sector slowed, although it still remains above the rate for the economy as a whole (with a few exceptions).

In 1990, the importance of the pharmaceutical industry as an employer was well over 0.6%, after which this figure fell slightly. Thanks to the continuous strong growth in the number of gainfully employed persons from 1995 onwards, however, this quota was increased by about one third to reach over 0.8% by 2012. The strong growth seen between 1995 and 2005 is also shown clearly in Figure 3. In recent years, the industry's importance as an employer has continued to grow in line with the sustained expansion of jobs.

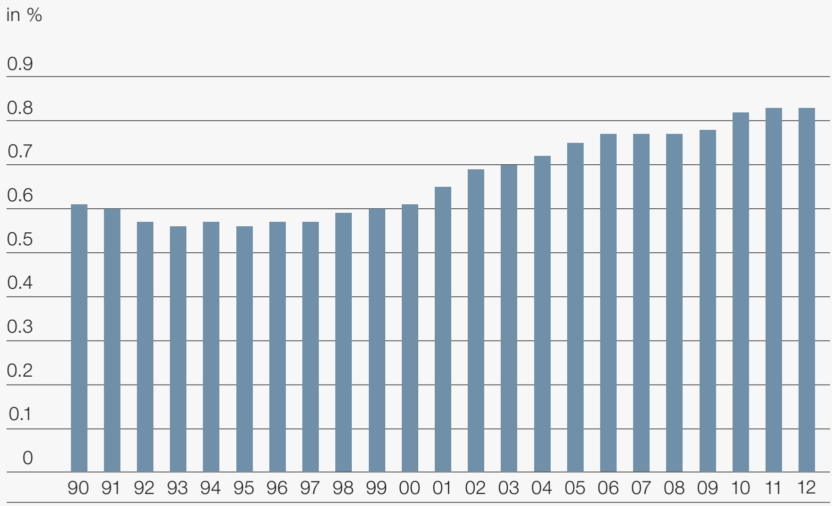
Figure 2 | Number of persons gainfully employed in the pharmaceutical industry / industry as a whole



Source: Polynomics, BAK Basel Economics, SFSO.

The figure shows the trend for gainfully employed persons (in thousands) in the pharmaceutical industry (green line; right-hand axis) as compared to the figure for the economy as a whole (grey line; left-hand axis). The pharmaceutical industry reports a more negative growth rate than the economy as a whole between 1990 and 1995, followed by a more positive growth rate thereafter. Over the entire period represented, the pharmaceutical industry shows significantly higher average annual growth than the economy as a whole.

Figure 3 | Proportion of gainfully employed persons in the pharmaceutical industry to gainfully employed persons in the economy as a whole



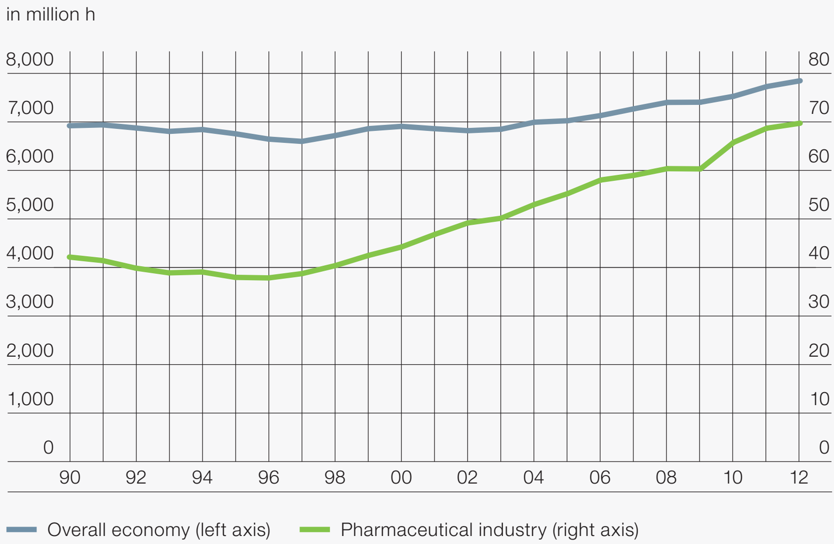
Source: Polynomics, BAK Basel Economics, SFSO.

Since 1990, the proportion of gainfully employed persons in the pharmaceutical industry to gainfully employed persons in the economy as a whole rose from about 0.6% to reach more than 0.8% by 2012.

3.2 Hours worked

The hours worked, or the volume of work done by employees in the pharmaceutical industry, has also increased in line with the development in the number of gainfully employed persons. As shown in Figure 4, employees in the pharmaceutical industry put in about 42 million hours of work in 1990. By 2012, this figure had risen by 65% to 69.5 million hours of work. It should be noted here that the number of hours of work undertaken per gainfully employed person rose from 1,690 h in 1990 to 1,760 h in 2012. In the economy as a whole, on the other hand, the hours worked per year by each gainfully employed person was seen to decline from 1,700 h to 1,640 h. Over this period, the volume of work carried out in the overall economy grew from 6,900 million to 7,830 million hours of work, or an increase of 13%.

Figure 4 | Hours worked in the pharmaceutical industry / overall economy

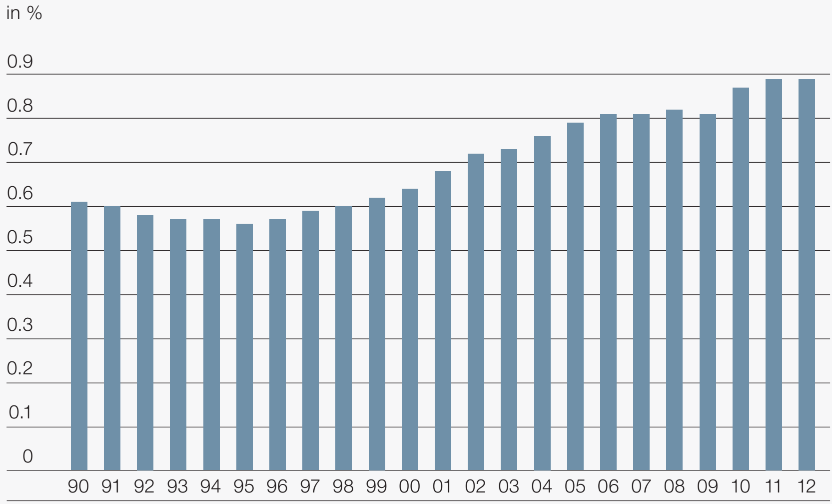


Source: Polynomics, BAK Basel Economics, SFSO.

The figure compares the development of hours worked (in millions of hours) in the pharmaceutical industry (green line; right-hand axis) to the figures for the economy as a whole (grey line; left-hand axis). Over the period considered, the pharmaceutical industry reports a sharper increase in the number of hours worked than the economy as a whole. A decline was also observed in the mid-1990s.

Between 1990 and 2012, average growth in hours worked in the pharmaceutical industry was 2.3% higher per year than the rate for the economy as a whole, which was 0.6%. In line with this faster pace of growth, there was also an increase in the proportion of hours worked in the pharmaceutical industry to the total of hours worked (cf. Figure 5). This proportion decreased until the mid-1990s, but the decline was followed by rapid growth in the number of hours worked; from 1995 onwards, the proportion of hours worked in the pharmaceutical industry rose from 0.55% to almost 0.9% in 2012. The increase in the proportion of hours worked is higher in the pharmaceutical industry than the proportionate increase for gainfully employed persons overall due to the higher number of hours worked per gainfully employed person in the pharmaceutical industry.

Figure 5 | Proportion of work volume in the pharmaceutical industry to work volume for the economy as a whole



Source: Polynomics, BAK Basel Economics, SFSO.

Since 1990, the proportion of the work volume in the pharmaceutical industry to the work volume in the economy as a whole rose from about 0.6% to almost 0.9% by 2012.

Assuming about 220 working days in one year, we obtain 40 hours of work per week or 8 hours of work per day for the pharmaceutical industry in 2012. The figures for the economy as a whole are approximately 37.2 hours per week and 7.4 hours per day. In the pharmaceutical industry, a gainfully employed person therefore works almost 8% more than the Swiss average. The extent of part-time employment may supply some of the reasons for this discrepancy. As shown in Table 4, there is a substantial difference between the quotas of part-time employees in the pharmaceutical industry and in the economy as a whole. On average, 31% of Swiss employees have a workload of less than 90% of the usual industrial working hours but in the pharmaceutical industry, this quota is a mere 13%. Part-time working is encountered somewhat infrequently among men in the pharmaceutical industry. A total of 3% of men work on a parttime basis. Less than 1% of men have workloads of less than 50%. Among women, the quota of part-time employees in the pharmaceutical industry is 26% – significantly higher than for men, but still only half of the Swiss average. The proportion of female employees with a small workload of less than 50% is 4%: again, a figure that is

Table 4 | Part-time employment in the pharmaceutical industry, 2012

	Proportion of part-time working I and II			Proportion of part-time working I			Proportion of part-time working II		
	Total	Men	Women	Total	Men	Women	Total	Men	Women
Pharmaceutical industry	13%	3%	26%	11%	2%	23%	2%	<1%	4%
Economy as a whole	31%	13%	54%	19%	8%	34%	12%	5%	20%

Source: Polynomics, SFSO.

Notes:
Part-time working I and II: employees with less than 90% of usual industrial working hours
Part-time working I: employees with 50% to 89% of usual industrial working hours
Part-time working II: employees with less than 50% of usual industrial working hours

much lower than in the economy as a whole. Hence, part-time working is encountered far more frequently in Switzerland's other economic sectors than in the pharmaceutical industry. This also explains the longer working hours in the pharmaceutical industry as compared to the economy as a whole.

3.3 Importance for other sectors

Some 39,500 gainfully employed persons earned their livelihood in the pharmaceutical industry during 2012. In order to manufacture the pharmaceutical industry's products, upstream (input) products and services are obtained from various other sectors and countries. Drug production requires machinery, and new research and production buildings are constructed with the deployment of appropriately specialized workers from the building industry. On this basis, it is possible to determine how many gainfully employed persons in Switzerland benefited from contracts and orders from the pharmaceutical industry in a given year in the past. The reciprocal dependencies are identified and relevant multipliers are calculated for this purpose on the basis of the available sector interdependence tables, known as input-output tables (cf. Annex: Methods).

In 2012, this multiplier for the number of gainfully employed persons was 4.3 (cf. Table 5). In other words, in addition to the 39,500 or so persons gainfully employed in the pharmaceutical industry itself, well over 130,000 gainfully employed persons in Switzerland assisted the pharmaceutical industry with the manufacture of its products by supplying input products. As compared to previous calculations, this multiplier has increased from 3.7 to 4.3.

Table 5 | Direct and indirect importance of the pharmaceutical industry for the labour market, 2012

		Direct importance	Indirect importance	Total	Multiplier
Persons in gainful employment	number of persons	39,500	130,300	169,800	4.3
	in % of total for Switzerland	0.8%	2.7%	3.5%	
Hours worked	million hours	69.5	222.1	291.6	4.2
	in % of total for Switzerland	0.9%	2.8%	3.7%	

Source: Polynomics, BAK Basel Economics, BFS.

The higher multiplier is due to the new database. As described in section 2.2, the reported productivity of the pharmaceutical sector has increased by about 20% due to the revision of the data system. As a consequence, less labour is required to produce an additional pharmaceutical product in the pharmaceutical industry than the quantity implied by the productivity figure used in the past. On the other hand, the number of gainfully employed persons required for the input products and services needed by the pharmaceutical industry remains unchanged. This results in an increase in the relative proportion of jobs created in the economy as a whole, leading in turn to a higher multiplier.

A similar picture emerges if we consider the hours of work required for the input products and services rather than the number of gainfully employed persons. In this case, the new multiplier is 4.2 – also a higher figure than in the previous study, in which a multiplier of 3.6 was calculated. The similar increases in the multipliers for gainfully employed persons and work volume suggest that there have been no major changes in the structure of full- and part-time employment in the pharmaceutical industry and the economy as a whole. This is also evidenced by the development of the proportion of the pharmaceutical industry's work volume to the work volume in the economy as a whole, which is higher than the proportion of gainfully employed persons (cf. Figure 5).

Personalized Medicine and Benefits for Patients

Many of the outstanding successes achieved in medicine during the 20th century can be attributed to the medical paradigm of the single-cause-single-effect model, as it is known (cf. Fleßa and Marschall, 2012). According to this paradigm, a specific disease is due to a clear (biological) cause. If this cause is eliminated, health can be restored. Many infectious diseases conform to this model. They are caused by a pathogen which is combated (e.g. with antibiotics) to cure the disease. However, ageing Western societies find themselves increasingly confronted with various chronic-degenerative diseases which mostly have multiple causes (multi-cause-multi-effect model). In the first case, one could regard all patients with a disease as a complete group who would all receive the same medical treatment, but this no longer holds true automatically in the second case. A distinction is required here between different variations in biology (e.g. a patient's hereditary disposition), environment (e.g. air quality) and behaviour (e.g. smoking). A standard strategy is not appropriate to the complexity of chronic diseases which – on the contrary – call for medical treatment tailored to each individual.

Satisfactory individual treatment for many chronic diseases (e.g. cardiovascular diseases) is often not possible with today's clinical and imaging methods. For many treatments, it is impossible to predict who will respond especially well to which variant therapy. In the field of prevention too, we often do not know which individuals run a high risk of contracting a specific disease in the future, so that they could benefit greatly from specific preventive measures. These gaps are filled by personalized medicine (also frequently known as individualized medicine), which supplements established clinical information about the phenotype (e.g. age, weight, blood pressure) with biomarkers from investigations based on molecular biology (genomics, metabolomics, proteomics) in order to obtain better predictions of disease risks and successful treatments for individual groups of patients.

Personalized medicine does not represent a full-scale individualization of medicine. Although the trend is moving away from targeting prevention, diagnostics and therapy at the population as a whole, patients are still classed in (smaller) groups. Personalized medicine is therefore a stratified approach to medicine. One of the most important fields of personalized medicine – and one which is often used as a synonym for it – is pharmacogenomics (or pharmacogenetics). This involves basing the choice of a drug as well as the dose to treat a disease on individual information about the patient. For example, a breast cancer patient is tested to determine whether her tumour shows increased formation of oncogene HER2 before trastuzumab (Herceptin) is prescribed as a drug. This is the case for 20–30% of all patients. For other women, this drug does not deliver any additional benefits, but it can lead to the known sideeffects (cf. Siebert and Rochau, 2012). Another example of personalized medicine is molecule LDK378, which seems to be very effective in patients with lung cancer with a mutation in the ALK gene. This translocation affects about 3–5% of all lung cancer patients, i.e. the treatment is carried out only after prior testing for the mutation, so therapy can be targeted with great accuracy (cf. Shaw and Solomon, 2011; Shaw, 2013).

Accordingly, personalized medicine offers more accurate, individually coordinated therapies. Therapeutic success and the chances of a cure are greater for patients who benefit from medical care of this sort. At the same time, patients for whom currently available methods still do not work are relieved of unnecessary treatments and sideeffects by identifying the biomarkers. Hence, personalized medicine would have the potential to make healthcare more efficient by making it possible to reduce the costs of treatment for chronic diseases (diabetes, cardiovascular diseases, cancers).

A position paper published recently by the Swiss Academies of Medical Science (SAMS, 2012) concludes that personalized medicine already plays an important part at present, particularly as regards diagnosis and therapy. Especially in oncological diagnostics, the various types of cancer are increasingly diagnosed with the help of genetic tests. But in other fields too, such as cardiology, personalized medicine methods are improving diagnoses. The benefits extend not only to diagnostics but also to therapy. Great progress has been made in this area over recent years thanks to personalized medicine. Especially in oncology, more drugs are being approved which are only effective on patient groups with the relevant molecular characteristics. This increases effectiveness and reduces the sideeffects of the treatments. As regards prediction, i.e. forecasting the risk of contracting a certain disease in the future, the SAMS nevertheless considers that personalized medicine is still subject to significant limits. It only supplies good predictions for diseases that are attributable to a defect in one single gene. Multiple genes play a part in most cases, so gene tests are currently only meaningful to a limited extent in such instances.

4 Contribution to Value Creation by the Pharmaceutical Industry

4.1 Direct contribution to growth by the pharmaceutical industry

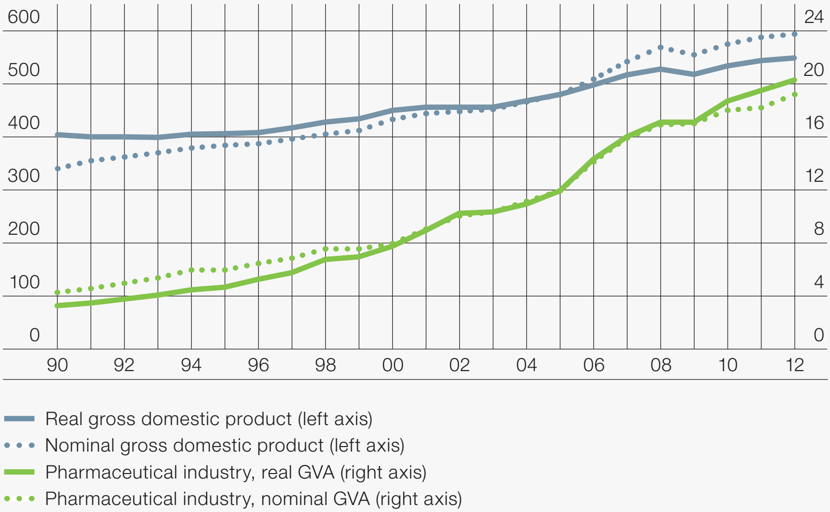
Alongside its importance as an employer, the contribution made by the pharmaceutical industry to gross domestic product growth is a second key indicator of its importance. The contribution to the gross domestic product consists of the added value generated by the sector. Added value, or value creation, measures the income from economic activity as the difference between the total output of an economic unit and the input services required to produce this performance. Value creation consists of two components: earnings (wages and salaries) and capital gains (profit and interest on borrowed capital). Gross value added therefore measures the production value of the output achieved by the sector with the deduction of the necessary input goods and services.

Figure 6 tracks the nominal and real gross value added (GVA) by the pharmaceutical industry and Switzerland's gross domestic product (GDP). The latter expresses the total of gross value added by all sectors in Switzerland. Since 1990, the pharmaceutical industry increased its real value creation – i.e. corrected for price developments – from CHF 3.3 billion to CHF 20.4 billion in 2012. This translates into average growth of almost 9% per year. This performance means that the pharmaceutical industry developed more dynamically than the economy as a whole, which was only able to achieve real annual growth of 1.4% over the same period. In other words, the pharmaceutical industry is / was responsible for more than 12% of real macroeconomic growth in the period from 1990 until 2012.

A comparison between the development of nominal and real growth for the pharmaceutical industry and the economy as a whole since 2005 highlights the price pressure that confronts the pharmaceutical industry. In the economy as a whole, growth in real gross domestic product was only above the nominal figure in 2010. Stronger real growth rates imply falling price levels. In the pharmaceutical industry, this phenomenon occurred a total of 15 times since 1990. Moreover, the other years are characterized by only moderate levels of price development. Reasons for this price trend, which is below the average for the overall economy, are to be found in the strength of the Swiss franc and the internationally observed trend towards curbing national healthcare expenditure.

Figure 6 | Nominal and real gross value added: pharmaceutical industry and economy as a whole

in CHF billion (price basis: 2005)

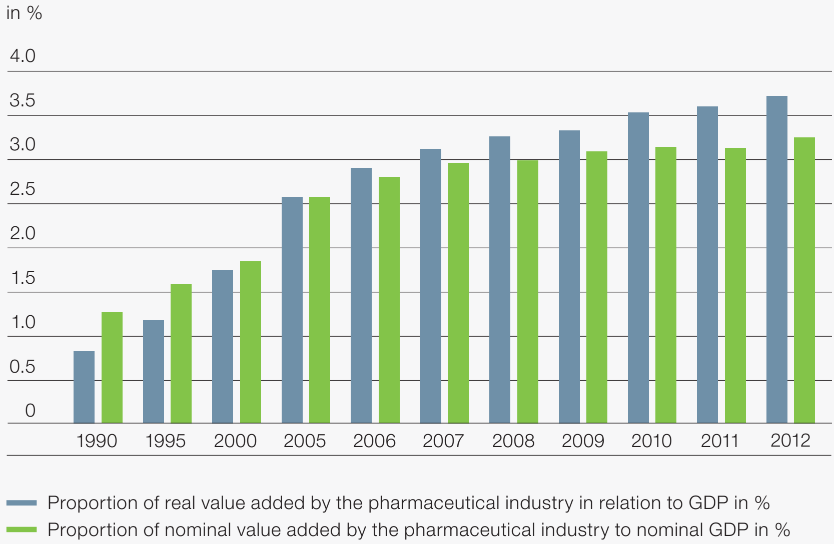


Source: Polynomics, BAK Basel Economics, SFSO.

The figure shows the development of nominal and real gross value added (in CHF billions) by the pharmaceutical industry (green line; right-hand axis) compared to the economy as a whole (grey line; left-hand axis). The figure makes it clear that prices in the pharmaceutical industry are falling – real GVA is rising more sharply than nominal GVA – whereas prices are rising in the economy as a whole.

However, Figure 6 also makes it clear that the pharmaceutical industry is confronted not with a problem of growth, but one of pricing. The real growth rate for added value from 2005 until 2010 was 7.4% per year – a figure well above the corresponding growth trend for the economy as a whole, which posted growth of 2% per year. The differential between nominal and real development, and the resulting difference in price pressure, is also evident if we consider the relevant proportions of value creation for the pharmaceutical industry in relation to the economy as a whole (Figure 7). The proportion of real value creation to real gross domestic product at 2005 prices has been higher since 2006 than the corresponding proportion if price development is taken into account. This discrepancy has widened continuously since then. At 3.7%, the proportion of real value creation in 2012 is 0.5% above the nominal proportion.

Figure 7 | Proportion of value creation by the pharmaceutical industry to gross domestic product



Source: Polynomics, BAK Basel Economics, SFSO.

Since 1990, the proportion of value creation by the pharmaceutical industry to Switzerland's gross domestic product increased from about 0.8% to 3.7% by 2012. The nominal proportion rose less sharply due to price pressure.

Biotechnology in Switzerland

Implementation of knowledge acquired in the fields of biology and biochemistry in the form of technical or technically utilizable elements is referred to as biotechnology. In particular, biotechnology includes the commercial exploitation of knowledge acquired in molecular biology, virology, microbiology and cell biology. Biotechnology is defined in two ways by the Organisation for Economic Cooperation and Development (OECD) (OECD, 2009). The first definition reads: "The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services." This definition is very comprehensive, and it also includes many traditional or conventional activities which are not covered by the current understanding of biotechnology. On these grounds, there is a second definition which consists of a list of biotechnological methods to complement the existing definition. The modern biotechnology industry can be divided into three main areas on the basis of this list. Green biotechnology deals with plants in the broadest sense, and is used for the manufacture of food and feedstuffs. Red biotechnology focuses on the development and production of drugs, for example by modifying bacterial genes to enable the manufacture of basic pharmaceutical substances such as insulin. In white (or also gray) genetic engineering, genetically modified microorganisms are used to increase the profitability and cleanness of industrial production as compared to classical manufacturing processes. Biotechnology is a cross-sectional technology that is deployed most of all in the agricultural sector, the pharmaceutical, chemical, agrochemical and food industries, medical technology, research and development and in the disposal sector; however, it cannot be directly assigned to any of these sectors.

The global financial crisis impacted the biotech industry severely in 2008, with long-lasting effects. On the basis of cost-cutting measures, however, the biotech sector as a whole was able to post profits. The impact on research and development expenditure was dramatic. According to the 25th Biotech Report by Ernst & Young (2011), these segments saw a year-on-year decline of 21% in 2009. The downturn was halted in 2010, resulting in a slight increase in spending (by 2%). The trend reported in the latest Biotech Report by Ernst & Young (2013a) for 2011 and 2012 confirms this assessment. In both these years, spending on research and development rose again by 9% and 5% respectively. The increase in spending took place mostly in large companies. Smaller companies seem to have more trouble in mobilizing resources for research and development. In 2012, turnover growth for exchange-listed biotech companies was 8%, and a figure of some USD 90 billion was attained. Corporate profits grew by USD 1.4 billion to USD 5.2 billion, signalling that it was still only possible to increase spending on a limited scale. Cost cutting and improved results seem to exert a direct influence on the market capitalization of biotech companies: market capitalization rose above 25% to reach about USD 480 billion. The number of employees rose by 2% (165,000 persons). The average size of entities grew by 4.5% from 264 to 276 persons, due to the smaller number of biotech companies – in 2012, the number of entities was 598, or 12 less than in 2011.

According to Ernst & Young (2013b), turnover of CHF 4.6 billion was achieved in Switzerland, corresponding to a 5.4% share of global biotech turnover. Turnover fell slightly short of the prior year's figure (CHF 4.7 billion). The Swiss biotech industry managed to post a profit (of CHF 480 million) again in 2012 after a loss of CHF 350 million in 2011. The number of employees shrank by 190 persons to 13,770 in 2012. Growth of almost 2% or 250 employees was still achieved in the prior year. Spending on research and development in 2012 was running at well over CHF 1.3 billion, slightly above the level in previous years. At the end of 2012, 250 biotech companies were operating in Switzerland; most of these are established in the Lake Geneva region and in the regions of Zurich and Basel. The concentration of companies in these three clusters is also reflected in terms of financing. The "Swiss Venture Capital Database" maintained by the University of Basel shows capital flows into various sectors and regions (on this aspect, cf. Gantenbein, 2013). Between 1999 and 2009, about CHF 3.2 billion of venture capital flowed into biotechnology, corresponding to over 45% of the total volume of venture capital, which was CHF 7.1 billion.

4.2 Importance for other sectors

Along the same lines as the procedure applied to the number of gainfully employed persons or working hours, added value can also be used to calculate how much value creation is triggered in other sectors by orders and contracts from the pharmaceutical industry during a specified period. In this case, the multiplier calculated on the basis of the input-output table (cf. Annex: Methods) was 1.8 for 2012 – slightly below the figure in previous studies, when it was about 2.0 in each case.

The reduction of the multiplier is caused by the SFSO's new method of calculating value creation by the pharmaceutical industry (on this aspect, cf. section 2.2). The proportion of value added by the pharmaceutical industry has increased as compared to the input services procured. This means that the manufacture of one additional unit of pharmaceutical products no longer has the same effect on the supplier industries, and the multiplier decreases accordingly.

As Table 6 makes clear, contracts and orders from the pharmaceutical industry triggered a volume of value added in excess of CHF 16 billion due to upstream products and services procured from the relevant sectors. The total contribution to direct and indirect value creation was more than CHF 35.5 billion, or about 6% of Switzerland's total gross domestic product.

Table 6 | Direct and indirect importance of value creation by the pharmaceutical industry in 2012

		Direct importance	Indirect importance	Total	Multiplier
Gross value added	million CHF	19,300	16,200	35,500	1.8
	in % of total for Switzerland	3.3%	2.7%	6.0%	

Source: Polynomics, BAK Basel Economics, SFSO.

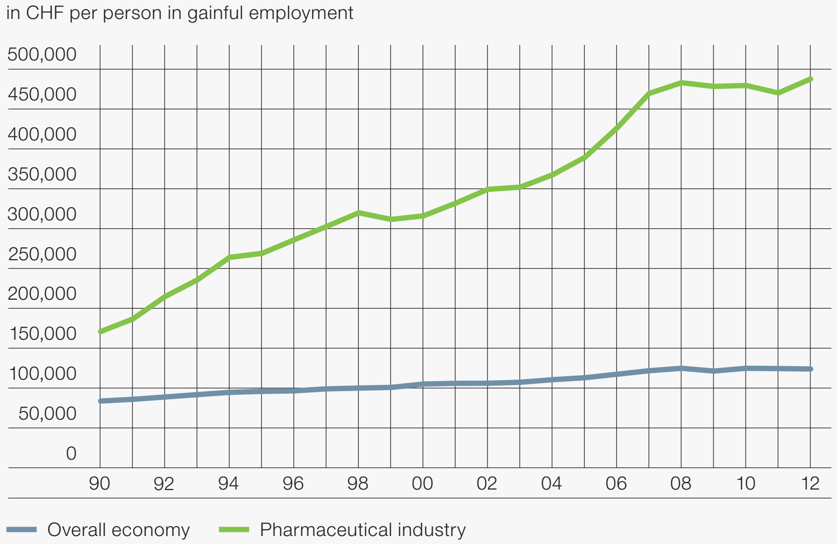
5 Productivity of the Pharmaceutical Industry

5.1 Job productivity

Productivity is a key indicator representing the ratio between the number of gainfully employed persons and value creation. For decades, above-average productivity has been a hallmark of the pharmaceutical industry as compared to the overall economy. As Figure 8 shows, nominal productivity per job in the pharmaceutical industry in 2012 was about CHF 488,000, or almost four times the figure of CHF 124,000 per gainfully employed person in the overall economy. Between 1990 and 2012, average annual growth in job productivity was running at 5.3%, well in excess of the annual increase in productivity for the economy as a whole, which was about 2% per year.

The pharmaceutical industry has managed to increase value creation per job from CHF 171,000 in 1990 to about CHF 488,000. With annual increases of 9.5%, productivity growth peaked between 1990 and 1995; this can be ascribed to the job cutbacks over this period. Productivity growth dropped to 3.3% per year between 1995 and 2000. From 2000 until 2012, the average yearly growth in nominal job productivity rose again to 4.3% per year. This encouraging development is likely due in no small measure to the focus on the core pharmaceutical business adopted towards the end of the 1990s, which subsequently triggered a growth effect.

Figure 8 | Job productivity (nominal) for the pharmaceutical industry / economy as a whole



Source: Polynomics, BAK Basel Economics, SFSO.

The figure compares the development of nominal job productivity per person in gainful employment (in CHF) for the pharmaceutical industry (green line) with the economy as a whole (grey line). For the whole period from 1990 to 2012, the pharmaceutical industry posts significantly higher job productivity, and the difference in relation to the economy as a whole has increased over time.

5.2 Value creation per hour worked

Hourly productivity is also very high in the pharmaceutical industry in Switzerland. As Table 7 illustrates, value creation per hour in 2012 was CHF 277. Between 1995 and 2012, the pharmaceutical industry boosted its productivity per hour by over 70%. Hourly productivity peaked at CHF 285 in 2009, since when it has remained close to this level.

Productivity per hour worked in the pharmaceutical industry is almost four times as high as the figure for the overall economy in 2012. As regards average productivity growth too, the pharmaceutical industry posted figures of about 3.3% per year between 1995 and 2012 – rates that are twice as high as those for the economy as a whole, at 1.6%.

The pharmaceutical industry performs very well as compared to other high value-added sectors such as financial services (insurance companies and banks), precision mechanics, optical products and watches, and also telecom. The slowdown in productivity growth over recent years is evident in all these sectors. After productivity in the banking sector fell in the wake of the financial crisis last year, this sector seems to have stabilized again and there was virtually no further decrease in productivity per hour between 2011 and 2012.

Table 7 | Nominal productivity per hour in selected sectors

in CHF per hour worked	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Pharmaceutical sector	160	181	224	246	272	282	285	275	268	277
Insurance	77	91	99	128	155	169	166	169	179	179
Banks	86	168	153	163	162	149	131	124	117	114
Precision mechanics, optical, watchmaking	79	79	101	104	107	112	99	103	103	103
Telecom	133	96	168	172	182	198	193	198	181	179
Industrial sector	57	58	72	77	81	86	82	84	83	84
Economy as a whole	54	59	64	67	70	73	71	72	72	72

Source: Polynomics, BAK Basel Economics, SFSO.

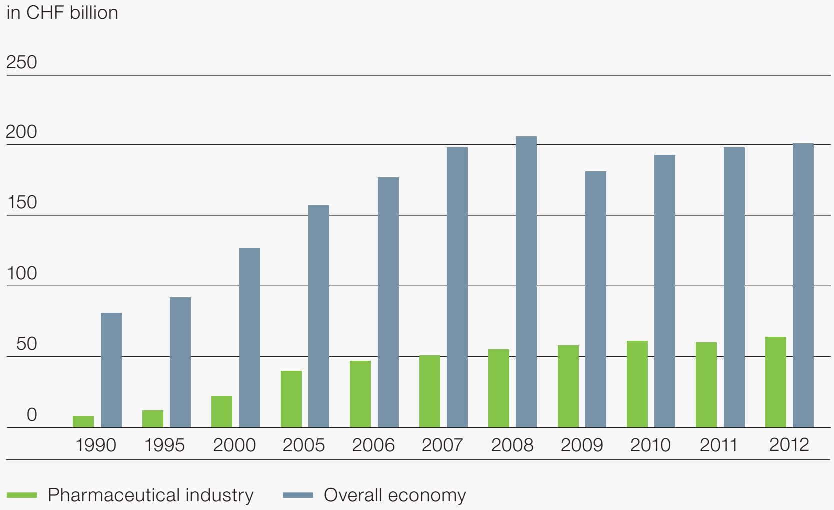
6 The Pharmaceutical Industry as an Export Sector

The pharmaceutical industry is a sector with a strong international orientation, as a glance at the export trend clearly shows. In 2012, the volume of exports reached a new peak of CHF 64.1 billion. Measured against total exports, pharmaceutical exports account for almost one third (32%). It is especially encouraging to note that the pharmaceutical industry coped very well with the challenge of the strong Swiss franc in the last two years, as compared to the overall economy. Total exports suffered a real collapse in 2009, plunging by almost 13% year-on-year. By contrast, pharmaceutical exports managed to grow by over 5% in 2009 despite the hostile circumstances. Last year, growth in nominal pharmaceutical exports of 6.7% was posted, whereas total exports of goods rose by a mere 1.4%.

Once again, this development shows that the pharmaceutical industry is less dependent on economic cycles than other export sectors. In fact, projects to reform health policy in target export countries play a key part, and the principal focus here is on pricing.

The average annual growth statistics demonstrate the importance of pharmaceutical exports for the Swiss national economy. Pharmaceutical exports in 1990 totalled CHF 8 billion and each year, the sector has been able to post increases averaging almost 10% to attain the current figure of more than CHF 64 billion. Considered over the last 20 years, this growth trend is significantly higher than the trend for total exports, which was 4.2% per year.

Figure 9 | Pharmaceutical exports and total exports from Switzerland (excluding precious metals)



Source: Polynomics, BAK Basel Economics, Directorate General of Customs (DGC).

The figure compares the development of exports (in CHF billion) for the pharmaceutical industry (green bars) with the the economy as a whole (grey bars). The figure clearly shows that exports by the pharmaceutical industry trended more dynamically over the period under consideration than exports from all sectors combined. In overall terms, pharmaceutical exports have grown eightfold since 1990 while total exports could only manage a growth factor of 2.5.

Master Plan to Promote Biomedical Research and Technology

The pharmaceutical industry is also a regular focus of interest in the political world. Parliament has repeatedly submitted interpellations and motions aimed at maintaining the sector's international competitive edge. Three motions submitted in 2011 proposing a master plan to strengthen Switzerland as a research and pharmaceutical location were passed by parliament to the Federal Council. Parliament commissioned the compilation of the "Master Plan to Promote Biomedical Research and Technology" which was presented for the first time by Federal Council member Alain Berset in September 2012. The master plan addresses the following issues, among others (cf. NZZ, 2012):

- **Simplified approvals procedure for drugs**
  For conventional therapeutic products and those used in complementary medicine which are already approved abroad, simplified approval along the lines of the Cassis de Dijon principle should be implemented for the Swiss market.

- **Acceleration of the Swissmedic approvals procedure**
  Swissmedic, the drug approval authority, is to process 99% of applications within 330 days by 2014. Swissmedic staff will be provided with better equipment to achieve this goal. The work of the ethics committees will also be speeded up, and they will only be given 60 days to make their assessments in the future.

- **Accelerated addition of products to the list of specialties**
  Mandatory health insurers must only pay the costs of therapeutic products if the drug in question is on the list of specialties. The period until a therapeutic product is added to the list should be reduced to 60 days in the future.

- **Combating rare childhood diseases**
  Work in this area is to be promoted by two measures: first, improved patent protection can provide more appropriate compensation for outlay by the pharmaceutical industry. In addition, more encouragement should be given to collaboration with researchers abroad.

- **Promotion of research**
  More money should be spent on clinical research. In this context, the Federal government should pay the costs of new drugs that are used in clinical studies at Swiss university hospitals. Consideration is also being given to technical support for academic clinical studies with professional staff, and medical research should also be encouraged during medical studies.

  The Federal Council's proposals generally met with a positive response from the representatives of the medical profession, patients, the medical technology and pharmaceutical sectors, health insurers, hospitals, cantons and the Swiss Academy of Medical Science (SAMS) who were invited to round table discussions.

  As far as the pharmaceutical industry is concerned, there are two areas that offer potential for improvements, which could be implemented at short notice thanks to the ongoing revision of the Swiss Law on Therapeutic Products:

- **Rare diseases affect everyone**
  The restriction on drugs for rare diseases that can only be used on children is regarded as too limiting. It would make sense to introduce a concept which also protects therapeutic products that can be administered to adults. Likewise, it is argued that drugs for children would usually be developed as a complement to those for adults, and not as stand-alone products.

- **Research into new areas of application for known drugs**
  Numerous research results show that certain substances can also be used to treat diseases that differ greatly from the original indication. These possibilities should be researched systematically. When the patent protection for a drug runs out, however, it becomes virtually impossible to finance high-risk research. This problem should be countered with documentary protection triggered by the new indication for a drug.

7 Estimate of Tax Revenue and Consumer Spending

In addition to the economic interdependencies at corporate level, the state (as the recipient of taxpayers' money) and the employees (as recipients of salaries) as well as the manufacturers of consumer goods and providers of personal services benefit from the economic strength of the pharmaceutical industry. One possible way of calculating these effects would be to form comprehensive multipliers. These tend to overestimate the importance of a sector because – in the case of salaries, for example – the social insurance system ensures that replacement income is available if a job is lost. The "absence" of the pharmaceutical industry would therefore have a less drastic impact on the income of gainfully employed individuals than on companies. As a representative example, let us take a look at salaries and the way they are used. The payroll total paid out by the pharmaceutical industry in 2010 was about CHF 4 billion, corresponding to over 20% of total value added (which was CHF 18 billion). Measured against salaries in the economy as a whole, pharmaceutical salaries account for over 1%. A comparison with the proportion of employees (0.8%) shows that the pharmaceutical industry pays above-average salaries. In fact, median salaries in the Swiss pharmaceutical industry during 2010 were almost CHF 9,000 per month, or about 50% above the figure for the overall economy of CHF 6,000 per month. Two effects are responsible for the higher average salary level. First, the pharmaceutical industry has proportionately more gainfully employed individuals with higher educational qualifications (26% as opposed to 19%) and fewer with primary education (16% as opposed to 21%). Second, the pharmaceutical industry pays higher salaries within the respective educational categories.

Due to the higher average salaries paid by the pharmaceutical industry, the sector's employees pay out more money in tax and consumer spending. Of the payroll total for the pharmaceutical industry, about 9% is paid over to the state. For the economy as a whole, this amount is only about 4.5%. Tax revenue from gainfully employed persons in the pharmaceutical industry was about CHF 360 million in 2010, equivalent to about 2.4% of the revenue from gainfully employed persons in the overall economy. The median figure for the amount paid over to the state in income tax by a person in gainful employment in the pharmaceutical industry is about CHF 9,500.

Despite higher taxes, the higher salaries in the pharmaceutical industry mean that average consumer spending by one gainfully employed person in the pharmaceutical industry is CHF 98,000, or more than 40% higher than the figure for an average gainfully employed person (CHF 68,000). Accordingly, consumer spending by pharmaceutical employees added up to about CHF 3.7 billion in 2010, accounting for about 1.2% of consumer spending by all gainfully employed persons.

As a result of the heavy concentration of pharmaceutical companies in areas close to frontiers, such as those within the Basel economic region, a relatively large quota of crossborder commuters is present among the gainfully employed persons in this sector. Estimates suggest that about 20% of gainfully employed persons are resident in neighbouring foreign countries. The figures for tax and consumer spending should be regarded as upper limits, since crossborder commuters pay tax on part of their income abroad, and part of their consumer spending also occurs outside of Switzerland.

8 Summary

This updated study on the macroeconomic importance of Switzerland's pharmaceutical industry presents the latest available results on the basis of updated data. In contrast to previous studies, original data from the SFSO could be taken as the basis for the direct importance of the pharmaceutical industry in this case. The officially determined statistics now available vary from the previous estimated figures, so the results of this study can no longer be compared directly with previous results.

In this study, the indirect importance of the pharmaceutical industry is again added to the statistical data in order to indicate the overall importance of the pharmaceutical industry for the Swiss economy. The main results of the study are summarized in Table 8.

Employment growth in the pharmaceutical industry continues to maintain a very high level. Average growth in gainfully employed persons in the pharmaceutical industry has been over 2% per year since 1990, with virtually no downturn even in the last financial crisis. In 2012, about 39,500 persons were employed in the pharmaceutical industry. The pharmaceutical industry is developing into an employer of ever greater importance for Switzerland. The proportion of persons in gainful employment as compared to the figure for the economy as a whole rose from 0.6 to 0.8% between 1990 and 2012. The picture is similar for the number of hours worked: growth in the volume of work in the pharmaceutical industry between 1990 and 2012 was also in excess of 2%. At 0.9%, however, the proportion of hours worked to the figure for the economy as a whole in 2012 is higher than the quota of gainfully employed persons. This is because part-time working in the pharmaceutical industry is not so widespread as in the rest of the economy – for men as well as women – so the number of hours worked per person in gainful employment is therefore higher.

In order to provide its products, the pharmaceutical industry requires not only labour and capital, which it makes available itself, but also additional upstream inputs in the form of goods and services from other sectors. This sectoral interdependence can be illustrated with the help of an input-output table, which can be used as the basis for calculating the impact of a sector on the rest of the economy in terms of value creation and employment. The effects calculated in this way are known as multipliers (on this aspect, cf. Table 9).

Table 8 | Direct importance of the pharmaceutical industry

	1995	2000	2005	2008	2009	2010	2011	2012
Persons								
in gainful employment	22,400	25,200	31,700	35,100	35,800	37,600	39,000	39,500
in % of the economy as a whole	0.6%	0.6%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%
Value creation (nominal)								
in million CHF	6,000	8,000	12,300	17,000	17,100	18,100	18,300	19,300
in % of the economy as a whole	1.6%	1.8%	2.6%	3.0%	3.1%	3.1%	3.1%	3.3%
Productivity								
in CHF per person in gainful employment	269,000	316,000	390,000	483,000	479,000	480,000	471,000	488,000
economy as a whole	96,000	105,000	113,000	125,000	121,000	125,000	124,000	124,000
in CHF per hour of work	160	181	224	282	285	275	268	277
economy as a whole	54	59	64	73	71	72	72	72
Exports								
in million CHF	11,970	21,980	39,690	55,150	58,070	60,560	60,100	64,130
in % of total exports	13.0%	17.4%	25.3%	26.7%	32.2%	31.3%	30.4%	32.0%

Source: Polynomics, BAK Basel Economics, SFSO, Directorate General of Customs (DGC).

Table 9 | Direct and indirect importance of the pharmaceutical industry, 2012

		Direct importance	Indirect importance	Total	Multiplier
Gross value added	million CHF	19,300	16,200	35,500	1.8
	in % of total for Switzerland	3.3%	2.7%	6.0%	
Persons in gainful employment	number of persons	39,500	130,300	169,800	4.3
	in % of total for Switzerland	0.8%	2.7%	3.5%	
Hours worked	million hours	69.5	222.1	291.6	4.2
	in % of total for Switzerland	0.9%	2.8%	3.7%	

Source: Polynomics, BAK Basel Economics, SFSO.

For jobs and volume of work, the multipliers are 4.3 and 4.2 respectively. The employment multipliers are higher than the value creation multiplier due to the above-average productivity of the pharmaceutical industry. In other words, the 39,500 or so gainfully employed persons in the pharmaceutical industry are joined by about 130,300 persons in other sectors who benefit from demand from the pharmaceutical industry in 2012, corresponding to a proportion of about 3.5% of gainfully employed persons in the economy as a whole.

Another indicator used to gauge the importance of an economic sector is value creation. It is clear that the pharmaceutical industry achieves above-average growth in nominal gross value added. Nominal gross value added by the pharmaceutical industry more than quadruples between 1990 and 2012, from CHF 4.3 billion to CHF 19.3 billion, whereas the nominal gross domestic product grew by a mere 75%. Growth in real value creation between 1990 and 2012 was continuously above the rate for the economy as a whole. On the other hand, nominal growth rates were running below the overall economy for several years. This reflects the sustained price pressure to which the pharmaceutical industry is exposed.

A multiplier of 1.8 is obtained for gross value added by the pharmaceutical industry. This means that the indirect impact of the pharmaceutical industry on Switzerland's nominal gross domestic product in 2012 was about CHF 16.2 billion. The overall direct and indirect importance of the pharmaceutical industry for the national economy therefore amounts to some CHF 35.5 billion, or a proportion of 6% of the gross domestic product.

Pressure on prices is also due to the fact that the pharmaceutical industry is a highly export-oriented sector. By far the largest proportion of goods manufactured in the Swiss pharmaceutical industry is exported. Since 1990, the proportion of pharmaceutical exports to total Swiss exports has risen from 13% to 32%. In 2012 alone, the value of goods exported by the Swiss pharmaceutical industry was CHF 64.1 billion. The value of the Swiss franc therefore plays a particularly important part in terms of nominal value creation. Since 2009, the value of the Swiss franc has increased by between 15% and 20% against the currencies in the two key pharmaceutical export regions of Europe and the US. The direct consequence is that if prices remain constant in foreign currency, the income converted into Swiss francs will decrease. On the other hand, production costs incurred in Switzerland only vary by the proportion of upstream goods and services that are imported, and which can now be obtained more cheaply abroad due to the rise in the value of the Swiss franc. The remaining production costs, such as salaries and rents, remain unchanged. The consequence of this development is (considerable) pressure on margins, which is reflected over the short term in falling profits and also directly in nominal value added.

One key yardstick for competitiveness is the productivity of a given sector. Productivity measures the deployment of capital and labour by companies in order to manufacture their products. Efficient deployment of these production factors results in greater competitiveness. In the long term, salary increases in a sector are also geared to the growth rates for productivity per job or per hour.

As regards labour productivity, the pharmaceutical industry is far ahead of the economy as a whole. The pharmaceutical industry posts significantly higher productivity than the overall economy, in terms of productivity per job as well as per hour. With value creation of CHF 488,000 per person in gainful employment or CHF 277 per hour of work, the pharmaceutical industry was almost four times as productive as the overall Swiss average in 2012. Together with telecom and insurance, it numbers among Switzerland's most productive sectors, far outstripping other productive sectors such as precision mechanics, optical products and watches or banks.

Annex: Methods

The identification of indirect effects is based on the determination of multipliers. This approach is suitable for indicating, within a past period, the influence that a given sector has exerted on other sectors due to its demand. The following sections contain, first, a description of the concept of sectoral interdependencies (the input-output table) on which the calculations are based, followed by a presentation of the actual calculation of the multiplier.

Input-output tables

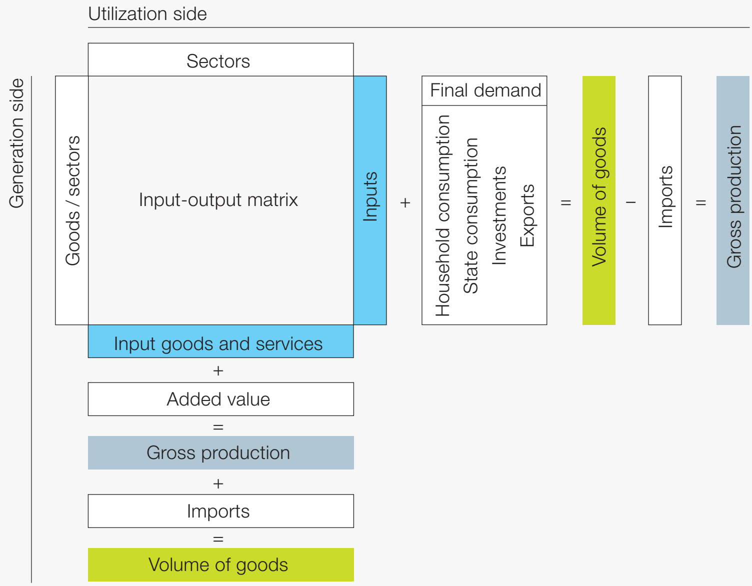
The basis for the analyses that were undertaken is provided by a schematic representation of the Swiss national economy. Flows of goods within the overall economy can be portrayed with the help of an input-output table. On the one hand, such a table illustrates the supplies of goods flowing between the sectors. On the other, an interdependency matrix of this sort also makes it possible to represent the final consumption of the goods produced, including the associated import quota. Figure 10 shows a schematic input-output table.

The horizontal axis shows the utilization of the goods manufactured in the sectors. These either flow into other sectors as input goods, or are consumed, invested or exported directly as final demand. From this perspective, the interdependency matrix shows what amounts of goods produced by one sector are supplied to other sectors. The sum of final demand and input goods and services gives the total volume of goods.

As well as the relationships between input goods and services and final demand already mentioned, the input-output table also allows a second type of analysis. Based on the interdependencies, it is possible in the vertical dimension to deduce which and how many goods a sector requires as input goods for its production. If the value creation for the sector is then added, the gross production value of a sector is obtained. The sum of the gross production value and the imports again gives the total volume of goods.

With the help of the interdependency matrix, it is possible to examine the influence on the entire economy of an increase in demand for goods from a given sector. Due to the interdependency in connection with input goods, the additional demand for goods triggers further production increases in other sectors. The sum of all these effects can be calculated with the help of an input-output model, and it corresponds to the multiplier for the total volume of goods.

Figure 10 | Structure of an input-output table



Source: Polynomics.

Methods used to calculate multipliers

Multipliers can be calculated in several ways, and also for several economic variables. For example, there are goods-related multipliers for the total volume of goods in a national economy, the production value or the added value. However, it is also possible to calculate multipliers based on labour market variables such as the number of employees, the hours worked or the payroll costs.

The level of a multiplier and hence the determination of the sector's overall importance for the national economy are related, among other factors, to the choice of method for calculating the multiplier. In general terms, a distinction may be drawn between two different multipliers: multipliers of type I and type II. These multipliers differ as regards the demarcation of their effect. Whereas type I multipliers are restricted to the additional effects arising from the input goods, the type II multiplier also reintegrates the income generated for private individuals and companies into the cycle. Hence, a type I multiplier includes the direct and indirect effects of a sector on the national economy, whereas the type II multiplier also includes what are known as the induced effects.

The common feature of both multipliers is that they reproduce the effects within the national economy at a specified point in time, and are therefore of a static nature. Dynamic adaptation processes due to changes in demand are only taken into account on a limited basis. This static analysis is particularly problematic in the case of type II multipliers. It is assumed here that consumers and employees do not adapt to a change in income or in the job situation. The accusation that adaptations are not taken into account can also be levelled at multipliers of type I, but because sectoral structures change much more sluggishly, this aspect is less important. For these reasons, the present study only makes use of the type I multiplier. The induced effects are analyzed separately on the basis of salary and consumption considerations (cf. section 7).

There are several methods of measuring the indirect importance of a sector in accordance with a type I multiplier; all of them are based on input-output tables, but they differ as regards their complexity. A specific distinction may be drawn between:

- input-output models,
- structural econometric models, and
- general equilibrium models.

Input-output models

Input-output models are used most frequently to determine the indirect effects. The advantage of these models is that they can easily be understood and communicated. Moreover, they are based on effective interdependencies among the sectors. However, these advantages are counterbalanced by some drawbacks: input-output models are static models, so the time dimension is neglected. In particular, it is not possible to take account of reactions to changes in demand on the part of companies and consumers. Multipliers based on input-output models are able to measure the indirect importance of a sector at a specified point in time, but they do not permit any conclusions regarding the evolution of a sector's importance over time.

Structural econometric models

As compared to simple input-output models, structural econometric models contain more information about the economic context, because they are not based on a reporting year, but instead take account of historical changes in the interdependencies among the sectors. At least at the level of the national economy, they are able to map productivity increases and the substitution between labour and capital because they take account of relative changes in salaries and prices. Structural models also make it possible to represent simple adaptations of sector structures after a change in demand, in which case the adaptations are based on historical behaviour patterns.

General equilibrium models

The third option for calculating the indirect importance of a sector is based on general equilibrium models. In this case, decisions by companies and consumers are modelled explicitly: they attempt to maximize their profit or benefit over time. Thanks to this comprehensive modelling approach, reactions by companies and consumers to increases in demand are more subtly differentiated than in a simple input-output model. The importance of a sector can be analyzed more accurately. As in the case of structural models, it is also possible in this case to track reactions over time. On the other hand, the modelling outlay is greater for this type. Moreover, it is very difficult to communicate the results from the models because the complexity of general equilibrium models is high, and the necessary assumptions regarding maximization of benefit and profit can be of decisive significance.

Comparison of added value multipliers

Table 10 shows several multipliers calculated with the help of input-output and structural models, as examples of the different types of multiplier. The added value multiplier for the chemical-pharmaceutical industry is 2.1 for the sector model, and is therefore somewhat higher than the multiplier for the pharmaceutical industry which, according to the calculation with the input-output table, is 1.8 for 2012.

The multiplier effect on gross value added in Germany during 2008 is 1.8, which is rather lower than in Switzerland and also lower than the 2006 value for Germany. In 2008, 1 euro earned in the pharmaceutical industry increased value creation in Germany by an additional 80 cents.

International studies on the importance of the pharmaceutical industry
The influence of the pharmaceutical industry on the national economy as a whole is also analyzed in other countries. Several of these studies are summarized below.

For the United States, there is a current study by the Battelle Technology Partnership Practice (2011). They calculate indirect as well as induced effects based on the input-output matrix for 2009. The direct effect of the biopharmaceutical sector in relation to value creation was USD 131 billion. With multipliers of type I or type II of 2.1 or 3.3 respectively, this produced overall importance of USD 273 or USD 426 billion respectively. The multipliers for employment (3.1 for indirect effects and 5.9 for induced effects) are significantly higher than for value creation. As in Switzerland, labour productivity in the sector will play a decisive part.

In "The Biopharmaceutical Sector's Impact on the U.S. Economy", Archstone Consulting (2009a) describes the multipliers for 2006. They obtain an induced multiplier of 3.3 for gross value added and one of 4.7 for employment. If the induced effects are disregarded and only the indirect effects are counted, significantly smaller multipliers are obtained. They still amount to 2.0 for real value creation and 2.5 for the number of gainfully employed persons.

In addition to the nationwide importance of the biopharmaceutical industry, Archstone Consulting (2009b) also calculated this factor in 2006 for the regional economy of the State of New York. The multipliers for employment (type I: 1.7; type II: 2.4) as well as value creation (type I: 1.5; type II: 1.8) are lower than for the overall US economy.

For 2003, the analysis by the Milken Institute (2004), "Biopharmaceutical Industry Contributions to State and U.S. Economics", produced multipliers with and without induced effects of 2.7 and 2.1 respectively for gross added value, and 4.5 and 3.0 respectively for employment.

This evolution of the multipliers suggests that the induced effects in the US increased over time for gross value added as well as for employment, whereas the indirect effects remained virtually constant as regards added value.

Table 10 | Comparison of added value multipliers for the pharmaceutical industry

Calculation method	Gross value added			
	2006	2008	2010	2012
Switzerland: input-output model (2001/2006/2008/2008)[1]	2.1	2.0	2.0	1.8
Switzerland: BAK sector model	2.1	2.1	2.1	—
Germany: input-output model (2000/2005)	2.1	1.8	—	—

Source: Polynomics, BAK Basel Economics, DESTATIS, Nathani et al. (2011), SFSO.

[1] Figures in parentheses indicate the year of the input-output table that was used.

Table 11 | Overview of international studies on the pharmaceutical industry

Country / region	Year	Aggregate	Type I	Type II
US				
Battelle Technology Partnership Practice (2011)	2009	Gross value added	2.1	3.3
		Persons in gainful employment	3.1	5.9
Archstone Consulting US (2009a)	2006	Gross value added	2.0	3.3
		Persons in gainful employment	2.5	4.7
Archstone Consulting New York State (2009b)	2006	Gross value added	1.5	1.8
		Persons in gainful employment	1.7	2.4
Milken Institute (2004)	2003	Gross value added	2.1	2.7
		Persons in gainful employment	3.0	4.5
Scotland				
Ewen Peters Associates (2006)	2003	Gross value added	—	1.6
		Persons in gainful employment	—	1.6
Germany				
Weiss et al. (2004)	1995	Gross value added	1.7	—
		Persons in gainful employment	1.9	—
	2000	Gross value added	1.8	—
		Persons in gainful employment	1.9	—
Weiss et al. (2005)	2002	Gross value added	1.8	—
		Persons in gainful employment	2.0	—
Nusser and Tischendorf (2006)	2003	Gross value added	—	—
		Persons in gainful employment	1.6	2.3
Polynomics (2009)	2005	Gross value added	1.5	2.1
		Persons in gainful employment	1.8	3.0

In Scotland, the study by Ewen Peters Associates (2006), "Contribution of Pharma-Related Business Activity to the Scottish Economy", compiled on behalf of the Association of the British Pharmaceutical Industry (ABPI), also takes account of direct, indirect and induced effects. This study is based on an input-output table for 2003 and it uses a type II multiplier of 1.6 for added value as well as employment.

According to our own calculations (cf. Polynomics, 2009), the values for the multipliers in Germany, including induced effects and on the basis of the input-output table published for 2005, amount to 2.1 for value creation and 3.0 for employment. The value creation multiplier is still 1.5 if the induced effects are disregarded. A figure of 1.8 is obtained for the employment multiplier in this case. As regards employment, Nusser and Tischendorf (2006) calculate multipliers for gainful employment of 1.6 (type I) and 2.3 (type II) on the basis of the 2003 input-output matrix. The study by Weiss et al. (2004), "Die pharmazeutische Industrie im gesamtwirtschaftlichen Kontext: Ausstrahlung auf Produktion und Beschäftigung in den Zulieferbranchen" ["The pharmaceutical industry in the macroeconomic context: impact on production and employment in the supplier sectors"] focused only on the direct and indirect effects of the pharmaceutical industry. The updated version of this study in 2005 (Weiss et al., 2005), based on adjusted employment figures, identifies added value multipliers of 1.7 for 1995 and 1.8 for 2000 and 2002. For the employment multiplier, Weiss et al. (2004, 2005) obtain a value of 1.9 for 1995 and 2002, and a value of 2 for 2002. This means that the type I multipliers in Germany showed virtually no changes between 1995 and 2005. For the gross added value, the indirect effects declined somewhat after a slightly higher figure at the start of the new millennium, whereas they remained constant in respect of employment.

The referenced studies are based on input-output analyses. Weiss et al. (2004), like Ewen Peters Associates (2006), base themselves directly on the official input-output tables of the national statistical agencies. Nusser and Tischendorf (2006) use the Fraunhofer input-output model, ISIS. The Milken Institute (2004), on the other hand, uses a regional economic model (RIMS II: Regional Input / Output Modeling System) produced by the Bureau of Economic Analysis (BEA), a US governmental agency. The RIMS includes prestandardized multiplier analyses for all the American states. The multipliers calculated here are summarized in Table 11.

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Glossary

Volume of work, work volume
Total of all hours worked in order to create the gross domestic product. (Source: Gabler, 2013).

Employees (positions occupied)
"Employees" denotes occupied positions. Although the areas covered by the meanings of these two terms overlap to a great extent, the terms "employees (occupied positions)" and "persons in gainful employment" should not be understood as synonymous, since a person in gainful employment may hold several positions. In this case, the term used is "multiple gainful employment". (Source: SFSO, 2013).

Biomarker
Substance that indicates damage due to disease or similar causes in an organism. (Source: Duden, 2013).

Persons in gainful employment
Persons in gainful employment are deemed to be persons aged at least 15 who, during the reference week:

- have worked for at least one hour in return for remuneration
- or, despite temporary absence from their workplace (due to sickness, vacation, maternity leave, military service, etc.) continued to have a job as self-employed
- or employed persons, or who have worked without remuneration in a family enterprise.

Regardless of the location where the activity is performed (in a company, at home [homeworking] or in another private household), this definition includes all employees, self-employed persons, family members working in their own family company, apprentices, recruits, non-commissioned officers and officers who are able to retain their job or employment contract during cadet school or military service, school pupils and students who engage in gainful employment in addition to their education, and pensioners who are still gainfully employed after retirement. Housework in one's own household, unpaid neighbourhood assistance and other honorary activities are disregarded. (Source: SFSO, 2013).

Genome
Single set of chromosomes in a cell; totality of genes in an organism. (Source: Duden, 2012).

Genomics
Research into the genomes of organisms. (Source: Eckhardt et al., 2014).

Genotype
Totality of characteristics determined by hereditary disposition as opposed to their [individual] form as phenotypes. (Source: Duden, 2013).

Input-output table
Part of the (Swiss) National Accounts (VGR) which takes the form of a self-contained calculation model showing the flows of goods between the production units grouped together as production areas in one economic region over a specified period. The interdependence in terms of goods is made visible in this way, i.e. which goods are used by each production area and to what extent, and which goods are inputted for intermediate and final use. (Source: Gabler, 2013).

Metabolism
Defined as the totality of all processes relating to the absorption and incorporation of nutrients into the organism, and to the decomposition, combustion or excretion of these substances. (Source: Duden, 2012).

Metabolomics
Research into chemical processes in organisms that result in metabolites. (Source: Eckhardt et al., 2014).

Elasticity of demand
Relative change in the volume demanded (demand) in relation to a relative, (infinitesimally) small change in price (price elasticity) or an (infinitesimally) small change in income (income elasticity of demand). (Source: Gabler, 2013).

Oncogene
Cellular gene that is incorporated into the genetic material of viruses from the genetic material of a tumour cell by means of recombination (source: Duden, 2012) or gene that can bring about the development of malignant tumours. (Source: Duden, 2013).

Oncology
Study of the origin, development and treatment of tumours and tumour-related diseases. (Source: Duden, 2012).

Phenotype
"Observable characteristics" of an individual or species, the special form or modification of the genetic disposition determined by environmental factors, as opposed to the genotype. (Source: Duden, 2012).

Pharmacogenetics
Study of the possible effects of drugs on the genome. (Source: Duden, 2012).

Pharmacogenomics
A research discipline that deals with the influence of genetic disposition on the effect of drugs. (Source: Eckhardt et al., 2014).

Prediction
Forecasting by means of scientific generalization. (Source: Duden, 2013).

Productivity
Within an enterprise, production activities require the combined deployment of factors such as machinery, buildings, energy or labour. These factors can be assigned to various categories. For the purpose of growth analyses, a distinction is drawn between the two main categories: labour and capital. The ratio between gross value added (GVA) and one of these factors is designated as factor productivity. Thanks to this quotient, it is possible to measure the efficiency of utilization of a production factor. (Source: SFSO, 2013).

Proteome
Totality of the proteins in a cell, tissue or organ; in contrast to the genome, it is specific to a cell type and is variable over time. (Source: Duden, 2012).

Proteomics
Research into proteins that are expressed by a genome, tissue, organ or an entire organism. (Source: Eckhardt et al., 2014).

Stratification
Allocation of patients to a specific group by investigating biomarkers. (Source: Eckhardt et al., 2014).

Venture capital
denotes equity capital that is invested in newly established companies. Financing new start-ups often entails a greater risk, so classical bank financing based on borrowed capital is used less frequently. (Source: Gabler, 2013).

Value creation, value added, added value
Value creation or value added denotes the increase in the value of goods resulting from the production process. In the national accounts, this figure is the net balance of production value minus upstream (input) services. (Source: SFSO, 2013).

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