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# Analyzing the Efficacy of the Pharmaceutical Patent System

Authors: Scott Brown, Martine Andersson

Supervisor: Steffen Juranek

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## Abstract

The purpose of this thesis is to provide insight into the complexities of the pharmaceutical industry and the subsequent role that patent protection influences both consumer markets and business operations. The methods used are a combination of detailed market research, case studies and a comprehensive analysis of fifteen industry leaders. The sector is heavily reliant on exceedingly high research and development expenditures which exemplifies the incessant need for an adequate patent system. The market is dominated by few, large multinational corporations and their patented brand name drugs. The results show that the current environment has led to several imbalances in the global pharmaceutical market. The predominant issues in the industry are limited access to affordable drugs, monopolistic market power created by extensive exclusivity periods, and skewed incentives that impact firm decision-making. The current system does not address traditional market forces that are inherent to private firms and subsequently influence research investments focused on Western markets. This has important implications on both developing nations and overall global health standards.

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## List of Abbreviations

AIDS – Acquired Immune Deficiency Syndrome
BLA – Biologics License Application
CAGR – Compound Annual Growth Rate
CETA – Comprehensive Economic Trade Agreement
CNIPA – Chinese National Intellectual Property Administration
CPTPP – Comprehensive and Progressive Agreement for Trans-Pacific Partnership
CRISPR – Clustered Regularly Interspaced Short Palindromic Repeats
DNA – Deoxyribonucleic Acid
EPO – European Patent Office
EMA – European Medicines Agency
FDA – Federal Drug Administration
FDI – Foreign Direct Investment
GDP – Gross Domestic Product
HIV – Human Immunodeficiency Virus
IMF – International Monetary Fund
IP – Intellectual Property
IPR – Intellectual Property Rights
LDC – Least Developed Countries
M&A – Mergers and Acquisitions
MNE – Multinational Enterprise
NAFTA – North American Free Trade Agreement
NGO – Non-governmental Organization
NIH – National Institutes of Health
NME – New Molecular Entity
R&D – Research and Development
SIPO – State Intellectual Property Office
TCM – Traditional Chinese Medicine
TRIPS – Trade-Related Aspects of Intellectual Property Rights
TTP – Trans-Pacific Partnership
TTIP – Transatlantic Trade and Investment Partnership
OECD – Organization for Economic Co-operation and Development
UNCTAD – United Nations Conference on Trade and Development
USMCA – United States Mexico Canada Agreement
USPTO – United States Patent and Trademark Office
WTO – World Trade Organization
WHO – World Health Organization
WIPO – World Intellectual Property Organization

## List of Definitions

**Active ingredient –** The biologically active, primary component in a pharmaceutical

**Biosimilars –** equivalent of generics for biologic pharmaceuticals**.** Unlike generics, biosimilars are not identical to the original biologic but possesses similar properties.

**Brand names** – Innovator pharmaceuticals patented by multinational corporations

**Exclusivity rights** – Exclusive rights to market a pharmaceutical that are granted by the local government regulatory body. Can run concurrently or independently from a patent

**Generics** – Pharmaceuticals with the exact same dosage, active ingredient, side effects, safety, strength and intended use as the brand name pharmaceutical they are copies of

**Novel pharmaceuticals –** innovator drugs that fill a previously unmet need. Their chemical composition has not been approved before

**Top 3 –** Pharmaceuticals that generate the first, second or third largest revenue for their respective companies

# 1. Introduction

The motivation for this topic emanates from a particular interest in the pharmaceutical sector and the reasoning behind the difficulties in providing access to affordable medication around the world. This industry encapsulates the modern globalized business environment which closely aligns with the International Business profile. Understanding the perspectives of governments, multinational corporations and the general public provides an insight into the operational complexities associated with divergent interests. Healthcare is an essential human right that remains a pillar of governmental policy across all nations, yet products are provided by private firms operating in a highly competitive marketplace. Both the commercial and consumer markets are dominated by industrialized nations, further adding to the contentious discourse. The incentives of varying stakeholders create a difficult environment to enable mutually propitious results. Incorporating intellectual property rights only adds to the intricacies related to this sector. The evolving nature of intellectual property protection enables extensive research to be conducted in order to identify both the beneficial components and potential inefficiencies of the current system.

The pharmaceutical sector represents one of the most important global industries for its economic and societal implications. Various aspects of this industry have been researched thoroughly but mainly focuses on pricing, research and development and regulatory processes. Intellectual property protection is a subject undergoing intense study due to the increasing prevalence in the modern business climate. The key areas of interest reside in the effects on innovation, competitive markets and economic development. Intellectual property encompasses a broad range of protection that includes trademarks, copyrights, industrial designs, geographical indications, trade secrets, unfair competition and patents (WIPO, 2004). Because of these varying applications, research on intellectual property rights comprises of an expansive set of industries and many contributing factors. Few papers further specify the effects of patent protection on particular components in the pharmaceutical industry such as generic competition, legal ramifications and access to drugs. This research aims to provide a detailed analysis on the current state of affairs surrounding increasingly prevalent patent protection and pharmaceutical industry development. The general research question that this thesis focuses on is the following:

*How do inefficiencies in the current patent system affect the pharmaceutical sector?*

To address this question, the following structure will be utilized. An in-depth analysis from both the organizational and public standpoint will enable an impartial perspective on these issues. The thesis will be divided into three components. Firstly, the research will be addressing the importance and complications that arise from intellectual property protection for advanced and developing economies. This section elucidates the role of intellectual property in economic development, international trade and foreign direct investment. Secondly, the research will then focus on the impact that the current system has on the pharmaceutical sector around the world. This section illustrates the effects on innovation, pricing, allocating resources and accessing drugs. Thirdly, an analysis of market leaders over the past twenty years will be utilized to identify recent developments. The initial research focuses on the inherent trade-offs associated with implementing intellectual property protection for developing nations and the increasing prevalence in geopolitical affairs. This general overview is followed by the pervasive impact the current system has on firm decision-making and the subsequent effects on global health standards. Finally, the company analysis provides substantiated context on the practical implications in the competitive marketplace. Due to the convoluted nature of relevant research, intellectual property rights and patent protection are both used extensively across all industries however, patent protection in the pharmaceutical sector becomes the predominant focus as the analysis progresses.

The unique circumstances that befall the pharmaceutical sector compared to other industries curtails the argument from whether patent protection is needed, but rather the optimal level required. This industry is capital intensive and heavily reliant on research and development. Due to the simplistic nature of products consisting of chemical compounds, imitation is easily accessible from competitors. Initially, discovery research is needed that entails significant costs and excessive risk. Thereafter, an extensive regulatory process begins in order to ensure safety and efficacy before gaining market approval. This lengthy procedure is referred to as commercialization, ranging from eight to twelve years on average from application to approval (NASEM, 2018). The expenditure needed for the entire commercialization process varies but leading researchers in this field provided recent estimates of $2.87 billion (DiMasi, Grabowski, & Hansen, 2016). The exact figure is disputed due to the incorporation of opportunity costs but the general consensus ranges from $1.5-2 billion (OECD, 2017). These estimates exclude public funding, with the clinical trial phases accounting for 48.5% of total expenditure (EFPIA, 2018). The extensive process and exuberant costs are debilitating yet even more profound when

considering that nearly nine out of every ten drugs entering clinical trials fail (NASEM, 2018). Even though manufacturing and distribution is inexpensive, the overall costs must be recuperated to enable a viable marketplace. Firms are incentivized to continually allocate capital through granted monopoly power permitted in the patent system.

The patent system is complex and varies around the world. The fundamental premise of implementing patent protection is to stimulate innovation and publicly disclose inventions in order to encourage the diffusion of knowledge. The conditions for approval require patentable subject matter, industrial applicability, novelty and an inventive step, or 'non-obviousness'. The vague terminology surrounding the question of whether the invention "would have been obvious to a person having ordinary skill in the art" is considered the most difficult standard to determine. Once granted, the inventor is rewarded with monopoly access to the market for a finite time frame, generally twenty years. After expiration, competitors may commercially exploit the invention, allowing for both society and the inventor to mutually benefit. The patent system is widely used, with 3,168,900 applications being filed in 2017. The sheer number of patents is not necessarily applicable given the array of industries but the pertinent components that need to be understood are as follows: First, there are various types of patents granted that differ in terms of value and application. Focus will be placed on the discrepancy between utility patents and design or process patents. The latter patents refer to manufacturing and industrial processes while utility patents are commonly referred to as patents for invention. These distinctions are particularly relevant in the pharmaceutical sector and will be alluded to frequently throughout the analysis. Second, International standards attempt to create a unified system, but patents are granted at the regional level and legal autonomy is given to individual countries. (WIPO, 2018; WIPO, 2004)

Globalized standards have been gaining precedence since the adoption of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) by all members of the World Trade Organization on January 1st, 1995. The TRIPS Agreement fundamentally changed the pharmaceutical industry by enforcing the adoption of pharmaceutical protection which was not present in many developing nations such as India (WTO, 1995). The pharmaceutical industry is dominated by multinational corporations residing in the United States and Europe, hence, supplementary protection is continually advocated from these governments. The perceived benefits of additional protection disproportionately affect multinational firms, leaving developing

nations in a difficult predicament. As the research progresses, emphasis on China, India, Europe and the United States will be used to illustrate the far-reaching effects from a global perspective. Increasing standards, or adding protection, may come in many forms but most notably, data exclusivity. Data exclusivity allows the owner to protect vital clinical trial information that was obtained through expensive studies (CPTPP, 2018). Without adequate efficacy and safety precautions, generic competitors are unable to gain approval and access the commercial market. Furthermore, an important industry development that is frequently referenced is biologics, which describe "a product that is produced using biotechnology processes and that is, or, alternatively, contains, a virus, therapeutic serum, toxin, antitoxin, vaccine, blood, blood component or derivative, allergenic product, protein, or analogous product, for use in human beings for the prevention, treatment, or cure of a disease or condition" (USMCA, 2018).

It is imperative to understand the practical implications that certain aspects of the current system have on firm decision making and public health. Several case studies will be referenced including Pfizer operations in the Chinese market, the North American opioid crisis and the global HIV/AIDS epidemic. This research will discuss the positive and necessary attributes associated with the current patent regime but also highlight the inherent consequences of implementing such a system. Ideally, if the patent system worked sufficiently, multinational corporations would be incentivized to adamantly invest in research and development and given the opportunity to recuperate their costs based on traditional market forces. In turn, firms would perpetuate the cycle of innovation by reinvesting these profits and further advancing pharmaceutical capabilities. For those developing and least developed countries (LDCs) that cannot afford initial drug prices, would subsequently be able to access these medicines after the eight to twelve year time period when generic manufacturing vastly reduces the costs. Adequate standards should also increase multinational prevalence in terms of both operational functions and commercial viability. These investments, as a result, could reduce costs, increase profits and improve access to affordable drugs. This analysis will aim to explore the accuracy of this scenario and provide detailed insight into the complexities that this unequivocally important industry bestows upon societies around the world.

## 2. Importance of Intellectual Property

Intellectual Property protection has been debated across all disciplines for its role in industrial and economic development. As technological progress continues to grow exponentially, leaders attempt to protect businesses and stimulate innovation while subsequently promoting competitive markets and international trade. The liberalization of trade and globalized supply chains offer opportunities for multinational corporations to utilize the principles of comparative advantage and division of labour while emerging nations are able to participate in a global marketplace and develop their economies. The divergent interests between industrialized and developing nations occurs due to the disparity in technological capacity. Innovative and technologically advanced economies are significantly more likely to benefit from stronger IP protection and in turn, develop and administer a more effective IPR system (Maskus, 2000). Conversely, countries with low levels of development, education and market freedom exhibit little to no perceived benefit from adopting intellectual property protection (Qian, 2007). This is due to the progression of economic and technological development which provides an insight into the corporate and governmental perspectives surrounding the divisive nature of IPR protection between advanced, developing and least developing economies.

IPR protection requires an expensive and complex system to stipulate compliance, enforcement and thus, beneficial results. Technological advancement generally exhibits similar patterns as nations transition from low to high income. Initially, little to no resources are devoted to innovation with economic output reliant on non-IP related industries. As development occurs, technological capabilities generally rely on transfers or imitation from more advanced economies. Over time, domestic firms and competitive markets emerge, creating overall growth and poverty alleviation. Demand gradually shifts toward higher quality products, with domestic companies encouraging IPR enforcement to protect their emerging technological capacity. Historically, this stage of economic development has been the most beneficial to ratify intellectual property protection as domestic innovation becomes globally competitive and alters the resulting dynamics of trade. Qian (2007) argues that even developed economies of Germany and Switzerland opposed national patent legislation while they were still technology importers. Post-war Japan implemented a utility model system, or second-class patent, aimed at promoting incremental innovation and the diffusion of knowledge, which was widely criticized as it encouraged numerous filings of narrow

claims that built on existing technology. In an analysis of patent activity from 1960-1993, the results strongly suggest that the utility system had a stronger effect on Total Factor Productivity growth than patent applications with the authors concluding "diffusion and imitation were more important than pure invention" (McDaniel & Maskus, 1999). The decades of rapid economic expansion have allowed Japan to become a global leader in technology creation and a member of the trilateral patent offices alongside the USPTO and EPO.

It is important to distinguish intellectual property protection as not just legislation, which many countries have adopted, but compliance from businesses and enforcement from government institutions. Ginarte and Park (1997) developed a patent index for 110 countries from 1960-1990 considering five criteria: duration, extent of coverage, membership in international agreements, loss of protection and enforcement measures. The results indicated the increase in average protection from middle income to high income countries was considerably higher than low to middle income countries while the variability amongst developed nations was significantly lower (Ginarte & Park, 1997). A follow-up study found that patent strength correlated positively to GDP per capita, share of R&D in GDP, human capital, freedom of markets and openness to international trade (Park & Ginarte, 1997). These findings suggest that overall patent protection is more of a reactive development to domestic demands. Furthermore, freedom of markets and openness to international trade are meaningful as it correlates the liberalization of trade with economic development and patent protection. A particularly noteworthy study determined there is a significant range of incomes before protection becomes stronger than the poorest nations, indicating an inverted-U relationship between patent strength and real per capita income (Maskus, 2000). This advocates that as economies develop, an initial *negative* period of IPR protection occurs. These findings are dated, but provide a viewpoint into ongoing discussions between developed and developing nations regarding intellectual property protection. Theories of economic development are consistent with regards to these analyses, although uniformly following these principles moving forward would be ill-informed in our increasingly interconnected and technological societies. In conclusion, it can be acknowledged that as economies become highly advanced, sufficient intellectual property protection is necessitated but ambiguity occurs for the optimal protection less developed nations require to stimulate technological and economic progression.

The notion of transfers of technology is oft cited by the Organization for Economic Co-operation and Development (OECD) as a beneficial component of protection enhancement. The mode and type of technology transfer from foreign companies is influenced by the host country's patent system, opting for older technology and wholly-owned subsidiaries in order to circumvent imitation in weak environments (Fosfuri, 2000). This concept was surveyed by Edwin Mansfield (1994) and how it affects foreign investment decisions from American multinational firms. There were six industries investigated, with chemicals and pharmaceuticals being integrated, which found a stronger concern about IPR protection as the type of investment facility grew more complex (Mansfield, 1994). All sectors displayed similar results but unsurprisingly, chemicals and pharmaceuticals were the most influenced by IP protection. Decisions were strongly affected 46% of the time for rudimentary production, 71% for components manufacturing, 87% for complete products and 100% for research and development facilities, with India being cited as being the least likely country to permit joint ventures and licensing for their newest or most effective technology (Mansfield, 1994). Although this survey is dated, it indicates the effects IP rights have on decision-making strategies from foreign entities and governments determined to progress past basic manufacturing processes. There are significant benefits attributed to the development of a local industry which can utilize a reduction in transportation costs and dependence on foreign suppliers while increasing expertise and local employment.

Access to affordable medicines is a pillar of governmental policy across all nations but one that becomes much more manageable with economic stability. Investing in policies related to education and healthcare have dramatic effects on the standard of living and economic development of a country. Societal benefits are multi-faceted as access to affordable medicines and economic development occur simultaneously. Research and development investments are difficult in low income countries but proven to enhance innovation and technological capacity. It is important to distinguish between private and government investments as two interconnected but entirely separate factors. In 2014, the United States government expenditure on health-related R&D was 0.2% of GDP ($33 billion), 0.05% ($11 billion) in Europe and 0.03% ($1.6 billion) in Japan (OECD, 2017). China has begun to increase public investment, rising from $0.6 to $2 billion from 2007-2012, while India has remained stagnant at $400 million (Chakma, et al., 2014). These substantial investments contribute to the distinct separation between developed and developing nations in this research-intensive industry. In 2004, only 4% of the entire global public expenditure

on health research was done by low and middle-income countries (GFHR, 2004). Private enterprises still make up the majority of research investments exemplifying the need to continually scale domestic firms.

Several studies reinforce the difficult quandary government officials face to correctly balance domestic industry, innovation and affordable medicines while simultaneously encouraging foreign investment. Qian (2007) analyzed pharmaceutical patent coverage from 1978-2002 and found no statistically significant relationship between pharmaceutical patent protection and domestic R&D investments in developing nations. These findings align with the progression of economic development but do not examine the effects in an international context. Lerner (2002) analyzed 177 changes in patent policy across sixty countries over 150 years and their subsequent effects on patent applications from both domestic and foreign entities. A ten-year period spanning before and after a significant policy change was used, showing a dramatic increase in foreign entity applications in combination with a considerable domestic decline in developing nations (Lerner, 2002)(See Appendix Figure 1a). This comprehensive study controls for confounding factors and references a nation with relatively constant IP protection, Great Britain, to highlight the disparity from foreign and domestic firms. Many papers analyze the effects of intellectual property on innovation from a domestic perspective but the importance of foreign entities cannot be understated. For countries in the initial stages of economic development, incorporating all of these factors is needed to determine an adequate level of IP protection to satisfy foreign and domestic industry. From a macro perspective, China has maintained an unprecedented economic growth period but replicating the governmental policies may not generate similar results. The policies developing nations like India or Brazil utilize will have significant implications on their capacity to emerge as economic powers. The subsequent impact on trade relations should be addressed when considering the optimal level of IP protection, and most importantly, enforcement.

## 2.1 US-China Relations

While intellectual property has always been prevalent regarding companies expanding to new markets, recent instances of IP theft have leapt to the forefront of discussions. The economic success of China has captured the world's attention and created a frenzy of businesses attempting

to gain exposure to this rising power. The economic growth of China has been unparalleled in recent decades, resulting in the world's second largest economy with a GDP in 2017 of $12.24 trillion (IMF, 2018). While many factors are involved in this success, ascending into the World Trade Organization in December 2001 was a significant component in allowing China to attain its current trading power. This can be seen in comparison with the United States' economy, with a notable exponential growth occurring since the 2000s (Trading Economics, 2019)(See Appendix Figure 2a). As China transitions from an industrial to a more complex services-based economy, ensuring IPR protection will be a critical component to achieving success.

International trade dynamics shift in relation to other developed nations as technology advances and services become the dominant output. Patent intensive industries have become a substantial component of trade for the EU with the United States, representing 69% of imports and 71% of exports (EPRS, 2014). In the United States, IP-intensive industries account for 38.2% of annual GDP, supporting 45.5 million jobs, or 30% of all employment (USPTO, 2016). These significant figures detail the impact that intellectual property has on employment, international trade and the overall economy. The United States holds the world's largest trade surplus in services at $250.6 billion in 2016, followed by the United Kingdom at $129.1 billion (USITC, 2018). These figures are substantial considering the growing trade deficit between the United States and China which has become a contentious political discussion (US Census Bureau, 2019)(See Appendix Figure 2b). As China rapidly develops its innovative and technological capacity, there will be an inevitable shift in the balance of trade. China's intellectual property office, CNIPA, has been exponentially increasing its global share of patent applications, contributing 43.6% of total submissions in 2017 while the USPTO and EPO only filed 19.2% and 5.3%, respectively (WIPO, 2018). Reducing the technology gap will affect international trade relations with both advanced and developing nations which will dramatically impact China's economy.

Advanced economies provide additional benefits that exceed traditional trade dynamics, with services supplied by U.S. owned foreign affiliates totaling $1.4 trillion dollars in 2015, having the United Kingdom, Canada and Ireland representing roughly one third (USITC, 2018). The wage disparity between IP-intensive and non-IP intensive industries is also worth noting to provide context on the extent of economic multipliers. The wage premium in the U.S. has grown from 22% in 1990 to 46% in 2014, with patent intensive industries amongst the highest at a 74% premium

(USPTO, 2016). With wages increasing rapidly in China, consumer demand and employee expectations should only enhance the desire for higher quality products and job opportunities. Due to their remarkable economic development, China has pulled millions of people out of poverty in a finite time frame. As urbanization, improved working conditions and demand for adequate healthcare occurs, China must address intellectual property concerns in order to achieve sustainable growth. The next steps will be critical; a dramatic technological transition must transpire so levels of economic output equal to the United States, EU and other developed nations are attainable. Although these are broad economic indicators that incorporate a variety of industries, intent is to provide an insight into the stages of economic development that can be referenced in a similar country like India.

## 2.12 Dispute Resolution

The World Trade Organization (WTO) is an important entity as it's principled on being an impartial party encouraging fair trade and developing market economies around the world. The fundamentals of open market economies have enabled the development of integrated supply chains and a global marketplace. Important information pertaining to intellectual property is found in the Agreement on Trade-Related Aspects of Intellectual Property Rights, or TRIPS, which came into effect on January 1st, 1995 and incorporates all members of the World Trade Organization. The TRIPS Agreement introduced global standards of IPR protection, including a minimum patent requirement of 20 years and forbids the exclusion of pharmaceuticals (WTO, 1995). This comprehensive agreement is considered to have the greatest impact on the pharmaceutical industry, with over forty countries in the world not granting patent protection for pharmaceutical products prior to this agreement (WHO, 2019). Specific requirements of product patents enable absolute protection, whereas prior process patents enabled different forms of manufacturing that led to generic versions of patented medicines (WHO, 2019). Countries were given different transitional periods, depending on their economic status, in order to fulfill these requirements with developing nations receiving an additional five years and least developed nations given ten years (WHO, 2019). China is still considered a developing nation under the WTO, enabling more leniency through certain provisions than other members. The Doha Declaration, enacted in 2001,

allowed for least developed nations to not enforce market exclusivity or data protection for pharmaceutical products until 2016 (Abbott, 2002).

In this Agreement, there is a specific emphasis on dispute prevention and settlement, with resolution occurring through the engagement of *multilateral* procedures (WTO, 1995). This is an important principle because as more countries are participating in global trade, following this precedent is critical to reduce conflicts and minimize negative geopolitical factors. The notion of integrating economies to encourage cooperation was the underlying theory of the Marshall Plan, established in Europe after the Second World War. The creation of the European Union in 1993 has creating fully interconnected economies of the 28 Member States, with limited conflicts arising from a continent that had constantly changing borders throughout history. Moreover, fair and unbiased dispute resolution measures have allowed successful free trade agreements, such as the North American Free Trade Agreement, to occur between the significantly smaller and less developed nation of Canada and Mexico with the economy of the United States. According to Chapter 11, a private investor can enter a lawsuit towards a host government by immediately bypassing domestic courts and is given the right to an impartial tribunal which consists of three members, one chosen by each party and a mutually agreed third party representative (NAFTA, 1994). There has been a total of eighty-five claims put forth, eight involving pharmaceutical companies, with a total of $386 million in damages being paid out since the bill was enacted (CCPA, 2018).

Since China's accession into the World Trade Organization in 2001, contentious disagreements have occurred surrounding IP protection. The United States has continually used WTO regulations as a mechanism for combatting infractions from China however, futile efforts have caused a recent change in administrative policy that promises new unilateral tools outside of the WTO (Donnan, 2018). The US wants to end what is has labelled as decades of state-coordinated Chinese theft of American intellectual property. The annual cost to the US economy is estimated between $225 and $600 billion, with 87% of seized counterfeit goods originating from just China and Hong Kong (NBAR, 2017). These figures are predominantly based off of copyright and trademark infringement, but display the economic importance and specific focus on Chinese practices. Strategic usage of mandatory joint ventures, local content requirements and forced technology transfers have developed China's technological capacity while frustrating

multinational organizations. Two examples will be cited to illustrate the consequential effects. In the early 2000s, foreign companies from France, Germany and Japan controlled roughly two thirds of the Chinese market for high-speed railway systems where they subcontracted manufacturing of simple components to state owned enterprises. In 2009, every new contract required a joint venture where 49% was the maximum equity stake, 70% of each system had to be made locally and companies had to foreclose their latest designs. The subsequent impact was a reduction of market share below 20% and global competitors who outbid on contracts in Australia and New Zealand shortly thereafter. Similarly, from 1996-2005, foreign companies held a 75% share in wind energy projects when the government introduced corresponding measures. By 2009, foreign market share fell below 33% while failing to win a single government-funded wind energy project after 2005 (Hout & Ghemawat, 2010).

Although extremely multifaceted, these factors have certainly contributed to the current US-China trade war which has enveloped tariffs on $250 billion worth of goods and put stress on the global economy. The OECD, World Bank and International Monetary Fund (IMF) have pared back expectations on global growth, with the WTO citing the worst-case scenario of a continuing trade conflict would result in a reduction of 17% for global trade by 2022, higher than the 12% decrease following the 2008 financial crisis (WTO, 2019). While concessions have been made by both parties, intellectual property rights continue to impede negotiations. Out of 369 cases since China has been a member of the WTO, China and the United States have utilized this process against one another 38 times, with an extensive 18 member complaint towards China on March 23rd, 2018 regarding "certain measures concerning the protection of intellectual property rights" (WTO, 2019). The recent unilateral actions that have recently taken place have caused the WTO to launch an investigation into the validity of the United States' China tariffs under the violation of the 'most favored nation' rule to not discriminate against trading partners. The impartial dispute settlement process has been one of the fundamental principles since the establishment of the World Trade Organization in 1995. WTO Director-General Roberto Azevedo recently stated, "If we forget the fundamental importance of the rules-based trading system we would risk weakening it, which would be an historic mistake with repercussions for jobs, growth and stability around the world" (WTO, 2019). The global economy awaits the resulting effects of the current trade war with implications to continue for years to come. The World Trade Organization was established to

encourage global trade under beneficial rules for all parties but faces an existential threat that could have a wide-ranging impact.

## 2.13 Pfizer in China

The case of Viagra in China provides a brief insight into the complexities of operating within the Chinese market. Throughout its history, China has implemented unique restrictions on providing market access to foreign businesses. Companies must adhere to specific rules that require a partnership with a local Chinese company. This may be in the form of an equity joint venture, cooperative joint venture, a wholly foreign owned enterprise or a representative office. Certain sectors are restricted and navigating through the business climate provides its own set of difficulties that have proved fatal for highly established companies like eBay. Pfizer began Chinese operations in the 1980's that included a joint venture in 1986, a $60 million-dollar plant in 1989 and a representative office for its animal health line in 1995 (Abrami & Manty, 2010). Pfizer is currently the leading foreign pharmaceutical company with over 11,000 employees and an accumulated investment of $1.5 billion (Pfizer, 2019). It is safe to assume that Pfizer had been a beneficial foreign entity and was viewed positively by Chinese officials.

The circumstances surrounding Viagra as it became accessible around the world was complex due to a number of high-profile lawsuits involving competitors such as Eli Lilly, Bayer, Merck, Sanofi and Bristol Myers Squibb (Liu, 2013). Pfizer won their lawsuit in the United States, however, lost several cases around the world, mainly due to obscurities in the patent application process. The Supreme Court of Canada unanimously invalidated Pfizer's patent for the sole reason of insufficient disclosure, by stating:

> Why did the disclosure not simply state that the compound in Claim 7 was sildenafil? The patent plays "hide and seek" with the reader. The reader is expected to look for the "needle in the haystack", or "the tree in the forest". Remember, Claim 1 is for a range of compounds which includes *260 quintillion compounds*. (SCC, 2012, p. 135).

While each case entails its own investigation into the patent applications and relevant evidence, China provides a unique set of circumstances. China has a four-tier judicial system with the Supreme People's Court being the highest level in the land. Formerly known as the State

Intellectual Property Office (SIPO), the Chinese National Intellectual Property Administration (CNIPA), is the primary entity responsible intellectual property rights protection in China. Patent applications undergo either a preliminary examination for utility model or design patents which are granted ten-year terms, while a substantive examination occurs for inventive applications with subsequent protection being granted for twenty years. Contrary to the cascading claims present in other applications, the Pfizer patent in China included only one compound, *sildenafil.* In addition, trademarks were registered on the shape, colour and names of Viagra in English and Chinese. Pfizer applied in 1994 and was granted a patent in September 2001 for its single claim:

> The use of 5-[2-ethoxy-5- (4-methyl-1-piperazinylsulphonyl)- phenyl]-1-methyl-3-n-propyl-1,6-dihydro-7H-pyrazolo[4,3-d] pyrimidin-7-one or of a pharmaceutically acceptable salt thereof, or of a pharmaceutical composition containing any of the same, for manufacture of a medicament for curative or prophylactic treatment of erectile dysfunction in a male animal, including man. (Chen, 2010, p. 31).

The same day Pfizer was granted its patent in 2001, a consortium of Chinese companies, whose legal representative was a former employee of the Patent Re-examination Board, requested an invalidation. Shortly after Viagra was launched, it quickly became known as "Wei Ge" across China, while its trademarked brand name was "Wan Ai Ke." In 2003, a Chinese company, Welman, launched an erectile dysfunction drug named "Wei Ge" with a similarly blue colour and rhombus shape. Pfizer filed a lawsuit in 2005 citing Article 6bis of the Paris Convention which states, "cancel the registration, and to prohibit the use…of any such well-known mark or an imitation liable to create confusion therewith" (WIPO, 1979). In July 2004, the Patent Re-examination Board invalidated Pfizer's patent after three years of investigation which was quickly followed by a group of Chinese companies forming a joint-stock company to produce a similar drug at half the price. Pfizer filed an appeal and sued the Re-examination Board for wrongful invalidation. The Beijing Intermediate Court ruled in favour of Pfizer in 2006, which was, unsurprisingly, further appealed by the Chinese consortium, bringing the case to the Beijing High People's Court. The issue became very politicized with international news coverage and threats of sanctions from the United States if the Beijing High Court did not rule in favour of Pfizer. (Abrami & Manty, 2010)

There was major backlash following the initial 2004 ruling from SIPO. It was deemed the Viagra Heist by U.S. media, citing "China decided to ignore market principles, its own World Trade Organization commitments and the long-term interests of its people by overturning the drug's patent" (WSJ, 2004). The Deputy U.S. Trade Representative claimed there may be retaliation with tariffs aimed at China's domestic pharmaceutical industry if Pfizer ended up losing its patent (Kyne, Hensley, & King, 2004). Furthermore, American officials stated that "it's difficult not to view this case within a pattern of intellectual property infringement," and asserted it was a test of their commitment to international trade rules (Gardiner, 2004). The American Chamber of Commerce in China stated that the decision caused great concern in not only pharmaceutical industry but the entire business community (Andrews, 2006). The far-reaching consequences of this initial decision are revealing to the extent of political influence that the pharmaceutical industry possesses. Since the beginning of the lawsuit in 2001, almost every high-ranking US official discussed this matter with their Chinese counterpart (Sun, 2006).

The Beijing High Court ended up ruling in favour of Pfizer, which was monumental as less than 20% of SIPO decisions were reversed during that time (Flicker & Dunne, 2005). There are several underlying aspects of this case that incorporate both the importance and complexity of the global patent system. The patent system is subject to national interpretation, adding to a convoluted series of processes that an international organization must adhere to in order to gain global protection. This is a costly, time-consuming endeavour that has a significant effect on corporate decision making. Three major pharmaceutical companies including Eli Lilly & Co., operate in China but have been unwilling to establish R&D facilities, nor bring its most current pharmaceutical advancements due to protection concerns (Andrews, 2006). Disclosure is an important component that international companies must incorporate into their strategic decisions. Sufficient information must be submitted to government agencies which presents a risky but necessary step in order to be granted legal protection. While it is entirely reasonable that corporate leaders may express their concerns, government officials rarely engage in such widespread criticism, as demonstrated through the Pfizer case. The potential adverse effects that were threatened by foreign governments upon an entirely independent judicial process signifies the growing importance and highly politicized nature that intellectual property entails. There was no negative feedback from government officials on the invalidation verdicts from the United Kingdom or Canada.

While China has been justifiably criticized for its violations, significant progress has been made to the relatively new litigation system since its adoption in 1985. The fact that a consortium of Chinese companies chose the legal route instead of illegally mass-producing generics pays homage to the legitimacy and recognition of pharmaceutical patent protection. This recognition has led China to surpass the United States as the most litigious patent country in the world (Bloomberg, 2014). Furthermore, China has agreed to virtually every international IP agreement (See Appendix Figure 3a). The adoption of these standards is important, however, enforcement becomes the critical factor to truly achieve a successful worldwide system. In an updated patent strength index that encompasses enforcement dimensions over book-law conditions, China experienced volatility but showed no overall improvement from 1998-2011 (Papageorgiadis, Cross, & Alexiou, 2014). In 2017, the U.S Administration initiated a probe into allegations of IP theft but only six companies were willing to come forward even though thousands of government complaints were registered (Sherman, 2017). This is a clear indication of the immense bargaining power the Chinese market possesses and the inherent risks associated with any public criticism. The balance of power is typically heavily one sided in favour multinational corporations but the unique characteristics of economic growth and the world's largest marketplace have caused the inherent predicament that businesses face around the world. This example represents a microcosm into business operations in China, with similar difficulties occurring with technology companies such as Google and Facebook. The intricacies of each specific allegation can be examined further to determine an unbiased outcome. The noteworthy facet of this case is the immense backlash that China received, which demonstrates the importance and geopolitical influence that intellectual property protection garners. There have been several high-profile lawsuits in recent years in China and the burgeoning pharmaceutical markets of India and Brazil. As developing countries transition their economies, IP protection will remain at the forefront of political discussions and trade talks. While trademark and copyright infringement are important issues, the consequences are less severe and predominantly economical. The specific intricacies of the pharmaceutical industry have significant consequences that need to be addressed as a pertinent global issue.

## 2.2 Ethical Issues

Economic development is prioritized by every nation with difficult trade-offs becoming inevitable. As the global economy becomes increasingly interconnected, ensuring adequate intellectual property protection is a necessity in order to maintain a fair, open trading system and reduce the threat of nationalistic policies. While copyright and trademark infringement are important issues that have notable economic consequences, a unique importance befalls protection in the pharmaceutical industry. Governments face an undesirable predicament enumerating from combatting public health crises, providing access to affordable, innovative medicines while subsequently encouraging foreign direct investment and maintaining positive geopolitical relations. On the other hand, this highly competitive, research intensive industry compels companies to recuperate their astronomical R&D and commercialization costs in a finite time frame. Extensive societal scrutiny arises given that companies have a marginal cost of virtually zero for new medicines, exacerbating public discourse. These inimitable circumstances have substantiated the rise of one the most socially, economically, and politically influential global industries.

The Pfizer case incorporates the underlying objectives that encompass the pharmaceutical sector, providing global access to drugs while minimizing the potential adverse health effects. Viagra is deemed a lifestyle drug which is an important distinction from life-saving medicines that affect public health. Viagra quickly became the most counterfeited drug in the world, with 90% of Viagra sold in Shanghai being faked (Abrami & Manty, 2010). The majority of counterfeit drugs contain inefficacious compounds, making Viagra an easy target with limited risk as opposed to oncology, HIV or malaria drugs. The World Health Organization (2017) analyzed 100 studies from 2007-2016, covering 48,000 drug samples, and concluded that 10.5% of worldwide drugs were fake or substandard. The difficulty in measuring is ostensible but it is estimated that the global counterfeit medicine trade generates $30 billion dollars annually (WHO, 2006). The stark divide across nations is perpetuated with a prevalence of less than 1% in developed countries while Nigerian health officials estimate at least 70% of drugs in circulation are counterfeited from China, India, Pakistan and Indonesia (WHO, 2006). These significant concerns encapsulate innocent citizens and cause hundreds of thousands of unwarranted deaths every year. One of the key motives for this illicit business is an inadequate legal framework where counterfeiting is only

treated as a trademark violation, creating a low risk environment (World Bank, 2005). Out of 193 World Health Organization member states, only 20% have sufficient regulation and enforcement for medicines (WHO, 2006). There is an incessant need to provide access to affordable medicines and developing pharmaceutical industries outside of OECD countries is a beneficial means, but the complex oversight of pharmaceutical products and ease of global distribution invokes a detrimental burden of responsibility that goes far beyond the consequences of copyright or trademark theft.

The patent system plays an important role in society but occasionally encounters ethical and moral disputes. In the 1980s, Harvard University produced a genetically modified mouse, deemed the oncomouse, specifically designed to be highly susceptible to cancer by introducing a gene that can trigger the growth of tumours (WIPO, 2006). Patent authorities faced a moral dilemma and were required to set a highly controversial precedent. The United States granted the patent, Canada ruled that higher life forms were not patentable while the EPO applied a utilitarian test; granting the patent on the likelihood of substantial medical benefits outweighing the potential animal harm (WIPO, 2006). This was an interesting approach because a similar application for the Upjohn mouse was denied due to the fact that treatment for hair loss did not outweigh the moral concerns (Mayer & Alexander, 1991). Similar genetic engineering cases have gained media attention and public scrutiny including Monsanto seeds, a company recently acquired by Bayer for $63 billion. In 1980, the U.S. Supreme Court allowed seed patents in a 5-4 decision, paving the way for Monsanto to become the world leader in genetically modified seeds and winning 674 biotechnology patents (Mercola, 2014). Agricultural practices subsequently changed, with farmers not being able to re-plant or sell naturally growing seeds without a license fee. Patents will undoubtedly continue to play a significant role in ethical discussions with new technologies coming to fruition such as the gene-editing tool CRISPR. The potential benefits and ramifications from modifying DNA are incomprehensible. In 2014, the USPTO granted the Broad Institute of the Massachusetts Institute of Technology a patent for “CRISPR-Cas systems and methods for altering expression of gene products” (US Patent No. 8,697,359, 2014). Patents establish a legal precedent that have long term consequences on not only domestic industries, but international policies as well.

## 2.3 Multi-lateral Trade Agreements

While it is difficult to quantify the role of intellectual property on the decisions of government officials, it becomes apparent that there is an increasing importance on pharmaceutical protection due to the prevalence in recent trade deals. Many skeptics argue that recent trade deals are inherently formed in large part for corporations to enhance the protection of global assets while expanding to new markets. Osgood and Feng (2018) found that in twelve recent U.S. trade agreements, patent focused firms were more likely to join ad hoc coalitions and pursue political behaviours both publicly and directly to lawmakers through lobbying. According to the U.S. Special 301 Report, pharmaceutical reform is currently being pressured by the United States towards South Korea, Japan, China, India, Indonesia, Argentina, Saudi Arabia, United Arab Emirates, Canada and Mexico (USTR, 2018). While Free Trade Agreements are generally supported, the pharmaceutical industry receives the most scrutiny by opposition parties for the potential negative consequences in accessing affordable drugs. Because the industry is dominated by industrialized countries, it can be construed that the interests of multinational firms are prioritized over the needs of developing nations. From the company's perspective, protecting their fundamental invention is necessary in order to adequately compensate for extensive research and development, further enabling the innovation process that will contribute to the improvement of global health standards. Encouraging global trade through the usage of free trade agreements is critical to reduce barriers and enable the allocation of financing around the world. The inclusion of detailed pharmaceutical protection in recent trade deals incorporates the growing sentiment on the political and economic importance of this industry.

*CPTPP – Comprehensive and Progressive Agreement for Trans-Pacific Partnership*

This agreement has been recently implemented as of December 2018 and includes the nations of Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore and Vietnam. Formerly known as the twelve country Trans-Pacific Partnership (TPP), the United States have withdrawn their support resulting in the ratified eleven nation CPTPP agreement. Before their departure, U.S. Trade Representative Michael Froman stated that data protection on biologics is "one of the most difficult outstanding issues in the negotiation" (Hernandez, 2015). While there were several quarrelsome issues, discussions surrounding patent

exclusivity for biologics was a persistent topic. This is an interesting trade agreement as the Party that would benefit the most from additional protection withdrew, enabling the remaining parties to amend certain aspects. Enhanced patent protection is found in certain provisions relating to patent linkage and grace periods. Patent Linkage refers to notifying original patentees when generic suppliers are hoping to gain marketing approval through the brand name drug's clinical trial information. Critics argue this enables drug companies to further extend patent protection while advocates claim this procedure provides a safeguard because it provides a legal mechanism for early resolution and ensures regulatory entities do not inadvertently infringe on the rights of a foreign entity by granting marketing approval (Son, Lopert, Gleeson, & Lee, 2018).

Article 18.38 refers to the grace period, which provides the inventor up to one year of protection after they publicly disclose an invention. This is a common provision in patent law and particularly important for public research institutes, universities, individual inventors or small sized companies. The provision encourages researchers to quickly publish works, enabling amelioration, additional funding and advancing access to knowledge. Grace periods are commonplace, however several countries, including China and the EPO, opt for a six-month term. While there were very few changes from the original agreement, almost the entirety of Article 18 Section F Subsection C: Measures Relating to Pharmaceutical Products – is suspended. Article 18.37 suspends obligations dealing with new uses, methods and processes of a known product as well as inventions derived from plants. Article 18.46 removes patent term adjustments for unreasonable granting authority delays, unreasonable curtailment from the marketing approval process and patent applicant requests to expedite the examination process. The major distinction incorporates data exclusivity, where pharmaceutical products lost their five-year exclusivity but agricultural chemical products maintained a 10-year exemption. Biologics were completely suspended, removing the eight-year exclusivity set forth in the TPP agreement. It is certainly noteworthy that the majority of pharmaceutical patent protection was suspended when the United States withdrew from the agreement. (CPTPP, 2018)

*TTIP – Transatlantic Trade and Investment Partnership*

Negotiations began in 2013 between the United States and European Union. This would become the world's largest trade agreement but talks have been suspended since 2017. While

Japan, the United States and European Union have the most advanced IPR standards, there are still conflicts that arise in negotiation processes surrounding these issues. An important distinction is that US businesses are starkly divided on "reconciling across the board differences," with the pharmaceutical industry viewing this as a necessity moving forward while internet and software companies are advocating to not even have an IPR chapter included (EPRS, 2014). Many business leaders in internet and technology have supported reform and limiting patent protection however, further research would be needed to determine other industry perspectives. The world's two largest economies with a dominant market share in the pharmaceutical sector would have a dramatic impact on access to drugs and global protection standards. According to the European Parliament and the European Commission' Joint Transparency Register, GlaxoSmithKline had fifteen meetings with the EU Commission, Novartis had eight, while Johnson and Johnson and Sanofi each had six in a five month span during TTIP negotiations (Tansey, 2015). The pharmaceutical lobbying industry is always influential but even more so during trade negotiations; having quadrupled its budget and the percentage of total corporate lobby meetings from 2012-2014 increased from 2.4% to 16.5% (Cann & Silva, 2015). Even though negotiations have been suspended, it should be emphasized the significance of this potential deal and the subsequent effect it could have on nations around the world. (European Commission, 2015)

*CETA – The Comprehensive and Economic Trade Agreement*

This recent trade agreement is between the European Union and Canada. Pharmaceuticals were of particular concern for European parties, as they are Europe's most valuable category of exports to Canada (Webster, 2014). Some of the notable provisions include extending patent protection, "*sui generis*," for an additional two years, totalling twenty-two from the time of filing. Although aligning with Canada's current IP regime, guaranteeing data protection for eight years restricts future governments from ever shortening the term length. Article 20.28 details "if a Party relies on patent linkage mechanisms…it shall ensure all litigants are afforded equivalent and effective rights of appeal." Canada introduced Notice of Allegation linkage regulations in 1993 where the patent holder has 45 days to initiate a lawsuit when a generic manufacturer is attempting to gain market approval (Lexchin & Gagnon, 2014). The one-sided nature of the patent linkage system is perplexing, given the European Union gains access to Canada's system but is not required to enforce one themselves, and considering they formally requested that Italy remove

theirs and adhere to EU rules when they attempted implementation (European Commission, 2012). It is estimated that this Right to Appeal provision could further delay generic entry in Canada by 6-18 months (Grootendorst & Hollis, 2011). This comprehensive agreement contains extensive details on the pharmaceutical industry with a focus on strengthening Canada's current IP regime. (CETA, 2016)

*USMCA – United States Mexico Canada Agreement*

The updated version of the North American Free Trade Agreement was recently signed by all three leaders but still needs to be ratified by the governments of Mexico, Canada and the United States. There were only a few notable changes from the original North American Free Trade Agreement which include the dairy industry, automobile manufacturing, labour regulations and intellectual property. Article 20.F.14 refers specifically to biologics, citing all parties must "provide effective market protection…*mutatis mutandis,* for a period of at least ten years from the date of first marketing approval of that product in that Party." This refers to data exclusivity which is an increase from Canada's eight-year and Mexico's five-year term but still lower than the United State's twelve-year protection that was enacted in the Affordable Care Act. A noteworthy addition to this agreement is included in Article 32.10, which obliges all parties to be informed three months prior to negotiations with any non-market economy, with the ability to "terminate this Agreement on six-months notice." This is widely assumed to provide veto power to the United States for any country involved in negotiations with China. (USMCA, 2018)

These examples of Free Trade Agreements exemplify the importance that is placed on the pharmaceutical industry. The consistent discussions and common occurence validate the disputable nature of the ultimate beneficiaries from strengthening protection. The withdrawal of the United States from the TPP and subsequent suspension of several provisions validated the notion that they were the Party responsible for such extensive protection. While the CPTPP and USMCA involve highly dissimilar IP economies, CETA incorporates numerous provisions even though intellectual property standards are closely aligned. The EU has a distinctive advantage in the pharmaceutical industry, leading to apparent concessions from their Canadian counterparts. Deriving data from the U.S. Chamber of Commerce's International IP Index, Canada is shown to have considerably lower patent indicators, notably pharmaceutical-related enforcement, than their

U.S., EU and Japanese counterparts (GIPC, 2017)(See Appendix Figure 4a). The reasoning for Canada's ranking is cited as the Federal Court decisions to invalidate patents on the basis of lack of utility for 28 biopharmaceutical cases including a Supreme Court verdict against AstraZeneca versus a generic manufacturer. By incorporating all patent related indicators, India obtains a score of 1.25, China 4.35 and Canada 5.05 while the U.S., EU and Japan all received scores above 7 out of a possible 8. This has contributed to an overall IP ranking of 43rd from India, 27th from China, 17th from Canada while the U.S., UK, Germany, Japan, France and Switzerland are ranked within the top 7. China was scrutinized for not having a patent linkage system, something Canada possesses but EU members do not.

While IPR protection must continually adapt to new technologies and sharing of information in our increasingly knowledge-based economies, trade agreements are able to provide minimum requirements and set a global precedent. The TRIPS agreement covers roughly half of intellectual property regulations while the original TPP agreement covers approximately 70% when compared with the benchmark index of the top forty-five global economies (GIPC, 2017)(See Appendix Figure 5a). As economies become increasingly more diverse, IP protection will be needed to ensure effective beneficial results through trade negotiations. The inclusion of less developed nations into the world economy through the WTO and multi-lateral trade agreements is critical in providing adequate opportunities to realize economic potential. The accession into NAFTA, European Union and WTO have resulted in monumental economic growth for the nations of Mexico, Poland and China. Reducing trade barriers is a necessary component to achieve comparative advantages but ensuring proper IP protection is vital to facilitate fair market practices. The TRIPS agreement provided an adequate global standard for intellectual property protection that remains a sufficient benchmark. With many newly established comprehensive trade agreements in negotiations or recently finalized, it becomes evident that increasing intellectual property protection is prioritized with a notable emphasis on the pharmaceutical industry.

## 2.4 Foreign Direct Investment

Countries are shifting towards liberalization and free market economies, as exemplified in 84% of policies from 2003-2017 promoting international investment while only 16% were restricting (UNCTAD, 2017)(See Appendix Figure 6a). Foreign Direct Investment (FDI)

accounted for 39% of total incoming finance for developing economies and accounted for 47% of the $1.43 trillion invested in 2017 (UNCTAD, 2017). These FDI flows are mainly from MNEs in developed nations, accounting for roughly one trillion dollars. This is the leading source of external financing and the most resilient to economic shocks. These numbers are staggering and provide a perspective on the importance of the allocation of money around the world. FDI is an important indicator and can provide adequate resources to transition a country economically and increase the standard of living for its citizens. China is an excellent example of this transition, with record inflows of $136 billion in 2017 and hundreds of millions of people being lifted out of poverty over the course of a generation (UNCTAD, 2017). While there are many contributing factors to economic development, FDI is an instrumental component and indicates a level of stability since MNEs are able to able to offset the potential risks to achieve positive returns on investment.

Globalization has allowed multinational organizations to reap the economic benefits of comparative advantages, divisions of labour and advancements in technology. The evolving operations of multinational organizations have enabled FDI in developing countries to increase from less than $10 billion in 1980 to $670 billion in 2017 (UNCTAD, 2019). Extensive research has been conducted on the drivers of FDI in developing nations that include market size, openness, country risk levels, geographic location and traditional endowments. Due to the relatively new acquisition of IP standards for many countries since the inception of the TRIPS agreement, an inflection point occurs to accurately assess the effect on FDI for these nations. TRIPS was enacted on January 1st, 1995, in the middle of a remarkable upsurge of FDI growth in developing countries from 39$ billion in 1991 to 231$ billion in 2000 (UNCTAD, 2019)(See Appendix Figure 7a). The fundamental premise of the TRIPS agreement was to "engender positive impacts in developing countries, including more local innovation and additional inward foreign direct investment and technology transfer" (UNCTAD, 1996). Focusing specifically on the relationship between IPR protection and FDI in developing nations, ambiguous results have occurred. Glass and Saggi (2002) concluded IPR protection had a negative impact on FDI and innovation due to a resource wasting and imitation disincentive effect, while Li and Qiu (2014) found strengthening IPR protection increased FDI and innovation. Distinguishing between general IPR and FDI complexities and patent protection surrounding technology intensive FDI enables a more detailed analysis into the specific issues concerning China and India's pharmaceutical industries.

Adversaries of the TRIPS Agreement argue there is an inherent disadvantage that technology importing nations face while the main beneficiaries will be top producing technology countries like the United States. Proponents of the Agreement emphasize that any losses occurred will be more than offset by the gains in market access, efficiency and innovation. McCalman (2001) concluded patent protection generates large transfers of rent appropriation for inventions, with the United States receiving 40% of the gains associated with trade liberalization. Overlooking the potential benefits arising from role of trade and multinationals, developing countries paid 64% of net transfers, alongside Canada contributing over $1 billion dollars in net losses (McCalman, 2001). The harmonization of patent standards inadvertently effects smaller developed nations, as the United States is able to unilaterally benefit from seeking international patent protection while inventors already sought protection in the United States beforehand. This can be used to explain the net losses attributed to twenty-two nations, while only six countries, including Germany, US and France, benefitted (McCalman, 2001). Zhang and Yang (2016) analyzed FDI data from 1985-2012 for twenty-three developing economies, specifically focusing on seven drivers of FDI which include GDP, trade, R&D, openness, country risk, investment safety and TRIPS adoption. Utilizing the System Generalized Method of Moments econometric technique, the results show TRIPS enforcement has a positive relationship with inward FDI, at the 1% significance level (Zhang & Yang, 2016). In addition, R&D levels were positively correlated with inward FDI. These results further validate the notion that while it is in the best interest of technologically innovative countries like the United States, developing nations are able to extract value through foreign direct investment.

China has benefited immensely from FDI inflow since becoming a more market-based economy in 1978, with the World Bank citing FDI as a key factor in their economic growth after this period (World Bank, 1997). China's recent IP reform provides a desirable timeline to analyze the effects of these modifications on FDI decisions. Awokuse and Yin (2009) investigated the impact of China's IP laws on FDI from 1992-2005. The analysis uses two measures as a proxy to determine IPR strength; annual foreign patent applications and the previously alluded to Ginarte and Park (1997) index, which was further updated by Park (2008). China had an average patent strength score of 1.33 from 1960-1990, before exponentially increasing to 2.12 in 1995, 3.09 in 2000 and 4.08 in 2005 (Park W. G., 2008). From 1992-2005, foreign patents exponentially increased at an annual growth rate of 19%, the majority coming from United States, Japan and EU

members, with the results demonstrating a 1% increase in foreign patent applications led to an FDI increase of 0.6% (Awokuse & Yin, 2010). Panel data was used for 38 countries, signifying the strengthening of IP protection had a positive effect on FDI inflows and supported a market expansion effect (Awokuse & Yin, 2010). These findings suggest that IPR protection was able to stimulate horizontal FDI in a country with a discernable threat of imitation. Although many issues are still prevalent, the swift introduction of a patent system positively influenced China's attractiveness to foreign investors.

There are many factors involved in the strategic decision making of multinational firms for the location of FDI which is even further exasperated when comparing across nations due to the various country specific factors involved. Du, Lu and Tao (2008) analyzed the role of intellectual property rights and contract enforcement, referred to as economic institutions, on the FDI location choices of US multinationals, focusing on locations within China. The data set includes 6288 US multinationals that have invested in various regions across China from 1993-2001. A discrete choice model was used, analyzing four key factors which include IP protection, government intervention, government corruption and contract enforcement. Controlling for agglomeration, wages, infrastructure, education, US embassy or consulates and government promotion policies, the results show a positive correlation between all four factors. Intellectual Property Rights protection, at the 1% significance level, is a critical component in determining the location of US multinational FDI decisions. This study is particularly insightful as it avoids important variables such as culture, language, political systems, corporate tax, national trade and investment policies that vary across countries. (Du, Lu, & Tao, 2008)

Multinational corporations have several options when accessing a foreign market: exports, FDI, joint ventures and licensing. Host countries want to incentivize investments and spur economic activity in order to develop domestic industries and enable technological progression. Licensing, however, increases costs for domestic firms while reducing overall investment. Aligning with several related studies, Smith (2001) found strong foreign patent rights, or FPRs, reduce affiliate output and sales, while increasing licensing agreements. Deterring licensing agreements and persuading optimal investment decisions allows for high quality FDI, enabling pervasive technological advancement and economic capabilities. Utilizing a unique firm level data set, Javorcik (2004) examined FDI inflows for Eastern European countries following the collapse

of the Soviet Union. Lack of adequate IP protection was found to be a deterrent for all investors, especially IP intensive industries, as well as a dissuading factor for undertaking local production (Javorcik, 2004). As a result, foreign entities instead focused on distribution networks, which was present across all sectors. This aligns with the previously alluded to analysis from Mansfield (1994) relating to firm decision making and technology transfers. Additionally, Nunnenkamp & Spatz (2004) analyzed FDI on a disaggregate level, finding R&D expenditure by US affiliates rises with stronger IP protection. IP effects are significant only when the host country has a local imitative capacity, while particularly strong IP protection induces a substitution of licensing for FDI (Nunnenkamp & Spatz, 2004). While FDI inflows and IP protection vary significantly across industries, the pharmaceutical sector has a distinctive global supply chain in which developing nations and domestic industry can benefit from foreign investment. Strengthening intellectual property protection suffers from diminishing returns, exemplifying the need to strike the correct balance in order to encourage the optimal foreign investment, R&D expenditure.

Government officials face difficult decisions due to the flexibilities offered under the TRIPS agreement. Members are able use the subject matter of a patent without authorization in the case of a "national emergency or other circumstances of extreme urgency or in cases of public non-commercial use" (WTO, 1995). Public non-commercial use refers to member states being able to issue compulsory licenses as long as the product is not intended for monetary compensation. Contentious discussions have surrounded the ambiguous phrasing of these provisions. Several countries have utilized these provisions for epidemics such as HIV/AIDS but it imposes particularly convoluted boundaries. Between 2006-2008, Thailand issued compulsory licenses under this provision for two HIV drugs, a heart disease drug and four anti-cancer drugs (Ho, 2009). Plavix, a popular heart disease drug manufactured by Sanofi, became the first "lifestyle drug" or non-infectious disease to be targeted for compulsory licenses. The arguments can be justified from both parties involved. Heart disease and cancer are leading causes of death so providing access to all citizens is a public health priority. 25% of Thai citizens lived on less than two dollars per day while Plavix was listed at roughly two dollars per dose (Ho, 2009). With Thailand being classified as a middle-income country, the pharmaceutical industry proposed valid concerns with this precedent. Low income countries will be more inclined to follow suit and it is not a sudden national emergency such as AIDS or the recent Ebola outbreak. In addition, it provides a disincentive for

private R&D investment while disproportionately affecting publicly funded R&D from developed countries and risking the viability of TRIPS if it contains significant loopholes (DeRoo, 2011).

The WTO has not defined public non-commercial use which has allowed for not-for-profit government healthcare to fall under this definition and thus, provides limited legal justification for pharmaceutical companies. Moreover, government health care programs make up the majority of purchasing power for pharmaceuticals which imposes an innate quandary. Difficult circumstances are inevitable as finding the correct balance between reducing public healthcare costs and appeasing foreign entities must occur. Thailand experienced immense political pressure and global backlash as a consequence of these decisions. The United States elevated Thailand to the Priority Watch List in 2007, citing the specific use of compulsory licenses even while acknowledging the ability to issue such licenses under WTO rules (USTR, 2007). The potential consequences of governmental decisions are not limited to middle-income countries. AstraZeneca simply removed their drug from the New Zealand market amid pressure to lower prices while Novartis announced it would redirect hundreds of millions of R&D investments as a result of Indian's patent office not granting its Gleevec patent (Friedman, 2009). While oncology and life-saving drugs provide a reasonable justification for government action, Viagra does not fall under that classification. Egypt, the largest and most established pharmaceutical market in the Middle East, authorized twelve local companies to produce a generic version of Viagra just two months after being on the market, citing the "interests of the poor people" (Allam, 2002). This was allowed under the phase in clause that permitted a grace period for enforcement from LDCs and developing nations. Political pressure ensued, and American direct investment fell to $390 million that fiscal year, down from $1.6 billion two years prior (Allam, 2002). While there are several contributing factors that affect the decision making and risk assessment involved in foreign direct investment, intellectual property protection is indicative when it comes to the pharmaceutical industry.

It is a difficult predicament that government officials must face with multiple power levers at play. While providing affordable, generic access may win public support in the short-term, potential adverse effects may occur in the long term. The research surrounding IP protection and economic growth is unclear, but generating foreign direct investment is a critical component for emerging economies. An extensive study analyzed panel data of 103 countries between 1970-2009 and found that a 10% increase in a country's ratio of FDI to GDP leads to a 3% increase in

economic growth (Kashcheeva, 2013). While introducing the optimal patent laws are widely discussed, enforcement was shown to provide "clear evidence that all countries can potentially benefit from strengthened levels of patent enforcement, this being the case especially if they also receive high levels of FDI" (Alexiou, Nellis, & Papageorgiadis, 2016). FDI flows have a mediating effect on patent enforcement and economic growth, particularly for developed countries but nonetheless, still positively correlated across all economies. The central distinction is the differentiating factors of enforcement and patent law; exemplified by increased patent law protection having a negative effect on developing countries while being insignificant for developed nations (Alexiou, Nellis, & Papageorgiadis, 2016). This suggests that developing nations can improve both domestic industry and FDI through patent enforcement. These results can be explained by the essential need for compliance from companies while agreeing to a complex system without the adequate resources may render it ineffective. With many countries around the world focusing on developing their pharmaceutical industries, it is important to consider the strategic implications of governmental policies.

Mergers and Acquisitions are an important tool for multinational corporations to generate value, improve cost efficiency and access new markets. With many companies becoming conglomerates possessing subsidiaries around the world, smaller firms are able to benefit by accessing this lucrative market. Cross-border M&A transactions totalled $98 billion in 1990, while that figure reached $887 billion in 2016 (UNCTAD, 2017). Although these business transactions can achieve positive growth for the target company and host country, a focus on greenfield investments provides more predictable outcomes. Greenfield investments simply refer to foreign direct investment that establishes a new project or firm in the host country, while M&A transfers ownership of an existing firm. Shesha (2018) analyzed the effects of these two foreign investment options and the subsequent impact on economic growth across 51 countries from 2003-2017. Greenfield investments had a positive growth effect that was robust across various estimation methods and subsamples, whereas M&A had no significant effect on growth (Shesha, 2018). Focusing on the beneficial interests of both developing nations and multinational corporations, mergers and acquisitions provides ambiguous results that differ each transaction based on the interests of the acquiring firm. Undoubtedly, M&A represents a considerable component of growth strategies in the pharmaceutical sector, epitomized by several multi-billion dollars blockbuster deals in recent years including Bristol-Myers Squibb acquiring Celgene for $74 billion dollars

(BMS, 2019). However, due to the unpredictability and variance across firm's motives, mergers and acquisitions will not be considered when addressing the effects of IP protection on multinational decision making.

The growth and development of the Indian pharmaceutical industry has been directly impacted from global standards relating to patent protection. In the 1970s, the national sector was extremely small, accounting for less than 25% of the domestic market and only two of the top firms in retail sales were Indian (Redwood, 1994). India implemented the Patents Act in 1972, greatly weakening intellectual property protection by making pharmaceutical product innovations unpatentable, shortening the statutory term on medicines to 5-7 years, and endorsing Licenses of Right after three years "on the ground that the reasonable requirements of the public with respect to the patented invention have not been satisfied or that the patented invention is not available to the public at a reasonable price" (IPIndia, 1970). The impending results show a steep decline in patents granted; from 3,923 (3,294 foreign) in 1970-1971 to 1,019 (670 foreign) in 1980-1981 (OPPI, 1996). It is evident that foreigners, in particular, did not perceive utility from obtaining Indian patent protection after the implementation of these measures. By the 1990s, Indian firms accounted for six of the top ten firms by pharmaceutical sales, 70% of bulk drugs and 80% of formulations (Hamied, 1993). India became a dominate player in the pharmaceutical sector, containing the largest number of US FDA approved drug manufacturing facilities outside the United States (Sampath, 2005). Predominantly focusing on generic manufacturing, India was the most active country in adamantly opposing the requirement of product patents for pharmaceutical innovations in the TRIPs Agreement (Lanjouw J. O., 1998).

The Indian marketplace offers multinational corporations a great opportunity to access a large, growing consumer market and incorporate distinct cost advantages into business operations. The generic drug manufacturing industry incorporates a unique business model that aligns with India's comparative advantages. Strong reverse engineering and chemistry skills in conjunction with a low-cost structure has enabled India to test, develop, manufacture and market a generic medicine at a cost of 20-40% of an identical drug in the West (Lanjouw J. O., 1998). There are several stages in the commercialization of a new drug, from discovery research to lengthy clinic trials before approval is granted. At the time, most projects from Indian companies had to be licensed out to multinationals for later stage development, mainly clinical trials, due to limited

capital, inadequate facilities and lack of expertise (Jha, 2007). Indian had capitalized on their comparative advantages by developing a successful pharmaceutical industry based on generic manufacturing, but enhanced expertise and technology would be needed for further development and innovative capabilities. An increase in R&D expenditure would be needed, which averaged 1.9% of total sales from 2000-2005, far below their American and European counterparts (Sampath, 2005). The TRIPs Agreement provided both difficulties and opportunities for the Indian market to exploit, as multinationals could reduce costs while Indian companies could obtain capital and gain expertise. For perspective, starting salaries for research scientists were 20% of those in the United States (Lanjouw J. O., 1998). India quickly became a favoured destination for large scale clinical trial research in Stage 2 and 3 of development (Jha, 2007). While the TRIPs Agreement had negative implications, India was forced to adapt their existing patent regime which had dramatic impact on their pharmaceutical sector. India had an average patent score of 1.03 from 1960-1990, out of a possible 5, before dramatically increasing to 2.27 in 2000 and 3.76 in 2005 (Park W. G., 2008). Subsequently, the share of FDI in the pharmaceutical sector increased from 2.5% from 1998-2002 to 4.6% between 2002-2006 (Jha, 2007).

The similarities of the Chinese and Indian markets allow for an in-depth perspective on the role that patent protection has played in the development of their pharmaceutical sectors. A comparative analysis by Rai (2009) provides insight into India's pharmaceutical industry *vis-à-vis* China from 1990-2007. India and China often get compared from an economic perspective due to the unique market size, regional proximity and similar development stages. China has far surpassed India economically in recent years, providing a reasonable path for India to follow. From a multinational perspective, however, China and India offer dissimilar comparative advantages in the pharmaceutical industry. India has an expertise in chemistry processes and a larger base of low cost, IT-skilled and an English proficient population. China has a scientific workforce alongside a large number of R&D centers, better port facilities and less regulation pared with a well-defined incentive structure. Ratio transformation was used on the Inward FDI Potential Index and inward FDI Performance Index of both countries to account for these negatively related factors. These indexes are broad indicators of the attractiveness and absorptive capacity of FDI worldwide by the UNCTAD. While both countries provide distinctive differences, the results found China's business environment has a direct impact on FDI decisions in India. Strong patent law in combination with administration and enforcement were found to strongly influence foreign decision making.

Furthermore, incentive policies and riskiness in terms of economic and political stability were negligible factors. These results further validate that IP protection is a substantial factor in FDI decisions in this industry, while China and India are vying for the same global market share despite inherent differences. Limitations occur because full compliance of the TRIPS Agreement was not mandated until 2005, and economic disparity has further increased so additional research would be needed for a present-day perspective. (Rai, 2009)

There are certainly trade-offs that governments, companies and the public must address when administering global pharmaceutical protection standards. There are immanent opportunities for developing nations to extract from these additional measures. Pliva, a small Croatian company, discovered a new antibiotic but did not have the resources necessary to mass produce and market. After developing a patent globally, they entered into a licensing agreement with Pfizer and the drug subsequently became the market leader for antibiotics with total sales peaking at $2 billion in 2005 (Jelic & Antolovic, 2016). In addition, 23 correlating benefits are recognized for economies with IP protection above the median average which include fifteen times more clinical trial activity in biomedical FDI and overall being 53% more attractive for FDI (GIPC, 2018). The globalized supply chain of the pharmaceutical sector has enabled developing nations to benefit from multinational investments and contribute towards economic development. To summarize, governments hoping to entice foreign investors need to understand the implications on both domestic industries and multinational decision making. Stronger IP protection reduces the threat of imitation and may encourage higher quality FDI, moving past basic production and distribution networks. On the other hand, enhanced IP protection creates a monopolistic effect that may reduce affiliate output and encourage licensing, resulting in lower FDI and higher costs for domestic firms. This innate conundrum requires government officials to espouse the precise level of IP protection and enforcement.

While debate can endure on the righteousness of the increasingly globalized standards enforced upon nations, the importance of intellectual property cannot be ignored and is only becoming more prevalent in today's modern business environment. Similarities are found across several global indicators. In the Ease of Doing Business Index, the US ranks 6$^{th}$, UK 7$^{th}$, Canada 18$^{th}$ and China 78$^{th}$ (World Bank, 2018). In the Global Innovation Index, the US ranks 4$^{th}$, UK 5$^{th}$, Canada 18$^{th}$ and China 22$^{nd}$ (WIPO, 2017). In the Global IP Index, US ranks 1$^{st}$, UK 2$^{nd}$, Canada

18th and China 25th (GIPC, 2018). There are various contributing factors related to these indexes but IP protection has become an indicative component on the hierarchy of economic powers. As developing economies around the world discuss essential policies in their growth strategies, enabling adequate IP protection should become a priority in order to fully embrace their economic potential. There is not a consensus on the direct relation between intellectual property protection and foreign direct investment but it is indicative that IP intensive industries are more affected and strategic decision making on technology transfers is strongly correlated. While it is difficult to quantify the effects of IP protection on bilateral relations, the persistent political engagement and detailed requirements in several new trade agreements suggests a significant importance on international trade.

## 3. Impact of IP Protection

The underlying assumption is that creating adequate IP protection permeates the incentive to innovate. By granting exclusivity and preventing competitors for a fixed time period, the patent system allows for sufficient access to a highly profitable market. The subsequent economic incentives would be to heavily invest these profits into research and development, enabling constant innovation. The ensuing benefits would be the democratization of knowledge, inventive medicines and an overall improvement of public health. Once the protection has expired, the world will obtain affordable, potentially life-saving medicines through an ensuing competitive market. While the theoretical justification is rightly principled, the current business climate offers a much more ambiguous contemplation. Innovation is a complex topic in and of itself, becoming difficult to quantify the effects of the underlying factors. There has been sufficient research into this domain, providing tangible results and subsequent discussions but ultimately unable to enumerate the optimal level of protection needed to maximize innovation.

Munos (2009) analyzed 1,222 new drugs, classified as new molecular entities (NMEs) or new biologics (BLAs), approved by the US FDA from 1950-2008. The new drug output from pharmaceutical companies has essentially remained constant over this time period despite a significant increase in expenditure. This analysis highlights the difficulties many companies face, the extremely low success rate as exemplified by only 261 organizations registering a new

innovation while 4300 companies were engaged. Substantial turnover has occurred, with 229 of those organizations having been acquired, merged or failed while only 32 have remained in existence throughout the entirety of this period. This study primarily focuses on new drug innovations which does not provide the full innovative perspective, but elaborates on the difficulties of discovery and limited advancements despite exponential investments. In 2008, only 27% of companies had costs under $1 billion per NME, while the cost has grown at an annual compound rate of 13.35% since the 1950s (Munos, 2009). Deriving data from the Federal Drug Administration Approval Reports, an updated perspective on new drug approvals can be determined. Incorporating a time period from 2009-2018, results vary significantly from year to year (See Appendix Figure 8a). In 2018, NMEs and BLAs both totaled highs of 41 and 17, respectively, while 2016 saw lows of 15 and 7 (FDA, 2019). The skewed natured of innovation incorporates many different factors, making a conclusive argument on the effects of certain aspects of IP protection unattainable.

Adversaries argue the simple invention of new drugs is not an adequate indicator of innovation, but rather focusing on therapeutic benefits. From 1975-1994, only 11% of internationally marketed new drugs were considered pharmacologically innovative and therapeutically beneficial (Barral, 1996). Furthermore, more recent studies have concluded similar results, indicating approximately 85-90% of all new drugs provide few or no clinical advantages to patients (Light & Lexchin, 2012; Luijn, Gribnau, & Leufkens, 2010). This has occurred despite the fact that there has been a 50% increase in real terms of R&D expenditure by OECD countries from 2004-2014, leading to a steady decline in approvals per inflation-adjusted R&D expenditure (OECD, 2017). This contradictory pattern has been coined “Eroom’s Law,” attributing the effect of constant output with rising costs despite technological advancements as a combination of regulatory costs, a focus on complex conditions and rising drug prices (OECD, 2017). The research process is exceedingly complex, but innovation in the pharmaceutical industry is imperative for advancing society. The advent of innovative medicines has widely contributed to the overall health improvements of nearly every indicator over the past century. As we continue to push the limits of science, inventive medicines and newly discovered research will play a predominant role in the progression of global health standards.

Biologics were marked to become a revolutionary industry that could alter the research and innovation process. This potential disruptive industry led to all OECD members to include biotechnology as part of their strategic development plans and science & technology policies (OECD, 2004). Investments were strategically prioritized towards biotechnology, attaining tens of billions of private investments annually (Ernst and Young, 2004). Despite governmental initiatives that allow R&D tax credits, easier clinical trials and lower regulatory hurdles, the biologic revolution remained at a relatively constant initial growth rate (Hopkins, Martin, Nightinggale, Kraft, & Mahdi, 2007). Due to a variety of factors including a complex research process and longer development time, biologics require a much higher level of R&D investment and overall price point (OHE, 2012). While the prevalence of biopharmaceuticals has increased substantially in recent years, it is difficult to determine the role of IP protection. Williams and Sampat (2015) explored a new field of research, human genomes, to test the effect of patenting on subsequent scientific research and commercial investments. Due to the specificity of gene sequences, comparisons can be made when examining successful and unsuccessful patent applications on how it impacts follow-on innovation. The results find no difference between ensuing research and investment between the invalidated and patented genomes (Sampat & Williams, 2015). Furthermore, Williams (2013) examined the impact on genetic sequencing firm Celera, finding evidence that patented genes saw a reduction in subsequent research and investment by 20-30% compared to genes that were available in the public domain. This suggests a short-term negative effect on innovation and contradicts the perception that insufficient patent protection would inhibit commercial investments.

While innovative new medicines have certainly contributed to the consistent increase in public health indicators, it is difficult to quantify the role of intellectual property rights empowering this innovation. The constant increases in pharmaceutical protection appear to have a limited effect, but several contributing factors distort an overall conclusion to this topic. Eliminating protection standards would assume to disincentivize the excessive R&D spending but evidence of subsequent innovations resulting from an increase in IP standards cannot be determined. Similar to investigating the role of intellectual property rights on industry development, the pharmaceutical sector deviates from other industries. After finding patent invalidation leads to a 50% increase in subsequent citations to the focal patent, Galasso and Schankerman (2014) conclude that patent rights block downstream innovation, but is not found to

be the case in drugs or chemicals. The unique characteristics of the pharmaceutical industry require specific attention in order to address the potential impact of policy initiatives. From an economic development and competitive advantage standpoint, it is certainly desirable to develop innovative capabilities. Countries and companies who lead economically are consistently at the forefront of innovation however, the complexities associated with the pharmaceutical industry make it difficult to enumerate the role of additional protection standards on incentivizing innovation.

## 3.1 Healthcare Costs

One of the fundamental principles that spans across political spectrums is the intent on providing citizens with access to affordable healthcare. The cost of healthcare is complex, incorporating many different factors as societies contain varying levels of government involvement. The cost comparisons between the United States and other developed nations is staggering, with the U.S. expenditure as a percentage of GDP approximately twice as high on average (Papanicolas, Woskie, & Jha, 2018). In fact, the United State's spends more money annually than the entire gross domestic product of all but four nations worldwide. These costs encompass an array of factors however, pharmaceutical spending per capita was $1443 in the U.S. compared to a range from $466 to $939 for other nations (Papanicolas, Woskie, & Jha, 2018). This information is particularly important given that intellectual property protection is closely aligned, indicating that other governmental policies are a much more significant factor in healthcare pricing than pharmaceutical protection. An oft cited argument is that the excessive costs in the United States offset the lower healthcare costs for the rest of the world. If the revenues were on par with other nations, the level of investment and research would greatly diminish, curtailing a subsidizing effect that the U.S. provides to the world. While no politician or citizen would be against a reduction in healthcare expenditure, the United States is by far the most influential market in terms of both revenue and multinational firms. The reliance on the United States market predicates its role as the influential global leader in relegating access to affordable medicines around the world. A primary focus on the U.S. market in relation to developing nations enables more valuable insight as opposed to a comparison with Japanese or European markets.

By granting a monopolization effect, pricing power is given to owners with few restrictions. There is a lack of basic economic principles incorporated in the healthcare industry due to the price inelasticity of consumers regarding medical treatment. To illustrate the vulnerable position consumers are placed in, it is estimated that two-thirds of personal bankruptcies in the United States can be partly or entirely attributed to medical expenses (NASEM, 2018). The unwillingness of consumers to forego medicines contradicts the basic supply and demand notion, leaving the marketplace susceptible to unfair pricing practices. As a result, the cost of medicines continually increases at one of the highest rates of any industry comparative to the consumer price index, increasing 127% compared to 11% from 2008-2014 (Rockoff & Silverman, 2015). Moreover, between 2009-2015, brand name drugs rose by 12.9% annually, eight times the rate of inflation (Patel, 2017). The effect is particularly prevalent in life-saving drugs, illustrated by the average annual price of cancer therapy in 1999 between $5000-$10,000 to over $100,000 by 2012 (Kantarijan & Rajkumar, 2015). The exuberant prices do not necessarily correlate with safety or efficacy, but rather the ability to circumvent traditional market forces through monopolistic tendencies.

Unfair pricing practices are pervasive throughout the industry, resulting in constant media and public scrutiny. Known as price fixing, several recent examples have gained national attention. Valeant Pharmaceuticals has developed a business model on acquisitions and price gauging, having raised the list price 122 times by at least 20% from 2011-2015 (Rockoff & Silverman, 2015). Onerous markups of 500% or more are commonplace, leaving the burden on government, insurance plans and ultimately costing private citizens. In 2013, Valeant acquired the intellectual property rights on a lead poisoning treatment, raising the price from $950 to $26,927, a 2700% increase in one year (Patel, 2017). 500 miles away, 8000 children in Flint Michigan suffered one of the worst lead poisoning crises in history. Other notable examples include the price of Daraprim increasing from 13.50-750$ overnight, alongside a 50-$600 dollar hike for a two-pack EpiPen (Patel, 2017). These anticompetitive practices have overwhelming societal implications that affect the lives of millions of citizens. Many of these issues are a result of the fragmented United State's healthcare system, but intellectual property protection and generic entry have a profound effect on drug pricing. On average, the cost of a generic drug in the United States is between 80-85% less than its brand-name counterpart (FDA, 2018). Ideally, generic products should gain market access the day after patent expiration and provide affordable drugs to the public, however this is not

always the case. Several of the largest generic manufacturers are divisions of major pharmaceutical firms which are currently involved in an illegal price fixing collusion that is “pervasive and industrywide” and alleges price inflations up to 1,000% (Murphy, 2019). This further exemplifies the importance of a sufficient generic pharmaceutical industry to provide an adequate competitive market and limit oligopolist tendencies after patent expiration. Analyzing Medicare expenditure data from 1991-2008, Kelton et al. (2014) concluded that for every additional generic introduced, the relative reimbursement price would decrease by 13%. Diminishing returns occur after five entrants, indicating an increasingly competitive generic market would inhibit some of these undesirable practices, especially regarding orphan drugs.

Orphan drugs refer to drugs specifically designed for small patient groups, affecting less than 200,000 people. The Orphan Drug Act was enacted in 1983 and included several incentives like research grants, tax credits, quicker approval processes and a 7-year market exclusivity provision. This 7-year exclusivity is the longest lasting protection granted by the FDA, with new chemical entities only gaining five years and pediatrics receiving six months. This additional protection allows for the delay of generic entry into the market, enabling extended pricing power. The median annual cost for an orphan drug is almost $100,000, compared to $5000 for non-orphan drugs. Although aligned with good intentions, these protections have enabled the ‘everyone is an orphan’ notion where orphan drugs currently account for more than 40% of FDA approval. There are several manoeuvres that are exploited to garner the benefits of additional market protection. ‘Spillover pricing’ is accomplished through off-label use, where the drug is distributed for a use other than the one described in the initial application. ‘Salami slicing’ refers to separating the patient population into different stages of the disease, reducing the intended population to the 200,000 target. Cancer related drugs have been the main recipient of these designations. Overall, the cost impact has not been justified, with one third of orphan drugs since 1983 being either repurposed mass market drugs or drugs that have received multiple orphan designations. This dramatic increase in designations has inflated the price and created perverse incentives that organizations continue to exploit. (Feldman, 2018)

Patent protection is not the most important but just one of many relevant factors involved, with European nations experiencing far fewer issues with similar standards. Notably, the United States does not regulate excessive drug prices with only a violation of antitrust law providing legal

justification (OECD, 2018). The obscene prices incurred in the United States compared to the rest of the world are significant however, the advent of generic manufacturers should induce competitive markets and affordable drugs once protection has expired. It is difficult to properly incentivize private firms on essential public concerns such as rare diseases, but curtailing exploitive behaviour is in the best interest of the public. The substantial burden of responsibility is placed on the FDA, given the responsibility of the approval process on the length of protection. While discussions surrounding the role of patent protection on innovation or research decisions can be disputed, pharmaceutical prices indubitably increase as rights are enhanced. The multifaceted issue of incentivizing innovation while providing access to affordable drugs requires sufficient regulatory oversight. The occurrence of price manipulation appears to have become more commonplace in recent years, indicating the significant importance on adequate regulations. Due to the highly profitable U.S. marketplace, market forces will inevitable exploit any deficiencies in the governing process. Policies and regulatory procedures can induce a consequent impact on not only pharmaceutical pricing, but public health as well.

## 3.12 Regulatory Influence

One of the unique characteristics that has been trending upwards is the increasing priority status given by the FDA. After deriving data, it was found that Priority Status of New Drug Approvals has increased at a CAGR of 20% while Biologics License Application have increased at a CAGR of 33% from 2009-2018 (FDA, 2019). The FDA has granted priority review status to 44% of all new drugs from 2000-2010 (FDA, 2019). This trend is significant as the FDA began to receive funding from companies for the approval process in 1992, strongly correlating with the rise in accelerated reviews (Lexchin & Gagnon, 2014). Regulatory agencies outside of the United States have indicated noticeably lower results of both accelerated reviews and assigning significant therapeutic advancement classifications (Lexchin J. R., 2012). Known as “Pay To Play,” companies are able to influence FDA policies and processes. This review process garners the majority of expenditure from companies and provides vital information to ensure public safety. Regulatory institutions in the pharmaceutical process have a significantly larger responsibility over controlled substances than other industries due to the widespread potential impact on public health.

An example of regulatory negligence occurred over the past two decades, with the consequences still being felt across North America today.

OxyContin was approved in 1995 after just 11 months and 14 days, representing the quickest approval of any analgesic product by the FDA. There are specific reasons as to why this pain killer became the leading drug of abuse in the United States by 2004. The FDA regulates the advertising and promotion of prescription drugs however, OxyContin was aggressively marketed as a miracle drug with no side effects. In 2001, the company spent $200 million dollars alone and ignored doctor's perception that OxyContin was weaker than morphine and could be prescribed for minor back pain. While proclaimed as a long-lasting alternative, the simplistic capabilities to circumvent the long-lasting effects of the drug by grinding the pills for inhalation or injection has been widely considered as the leading cause for the increase in opioid addictions. Reports began to immediately surface of widespread abuse and addiction. The most fascinating aspect of this case is the fact that OxyContin was not an innovative new product that was underestimated. OxyContin had a unique time-release design but was just oxycodone in pure form, a drug which has been used for many years in common medications such as Percocet. Clinical trial testing in 1995 even revealed that 68% of the oxycodone could be extracted from an OxyContin tablet when crushed. It becomes abundantly clear that the commercial success of OxyContin was not because of its innovative capabilities, but rather regulatory neglect. (Zee, 2009)

As a result of illegal marketing strategies, Purdue was forced to pay $600 million in 2007, even though they had amassed revenues of $2.8 billion by 2001 (Griffin & Miller, 2010). Other than a label change in 2001 and a warning letter to the manufacturer in 2003, the FDA did not begin addressing the situation until 2009 (FDA, 2017). Purdue Pharma, the manufacturer of OxyContin, designed a new formulation in 2010 called OxyNeo that was unable to be crushed and therefore, abuse deterrent. In Canada, authorities simply removed OxyContin from the market with only OxyNeo being available to patients, and subsequent dispensing rates fell by 46.4% (Gomes, et al., 2017). This is due to the addictive nature of OxyContin which, alongside heroin and other prescription painkillers, are widely considered the most difficult drugs to quit. As health officials began reducing the number of available prescriptions, the millions of addicted patients turned to stronger drugs such as fentanyl and heroin. The FDA originally approved the use of fentanyl in 1998, and further granted off-label, transmucosal immediate-release fentanyl in 2011 (FDA, 2017).

Fentanyl has become the predominant drug of choice with illicit variations contaminating drug supplies such as cocaine, causing a spike in accidental overdoses. China is the main source of supply for illicit fentanyl that flows into Canada, the United States, and Mexico while China itself does not to have a fentanyl consumption issue (DEA, 2018). China only recently agreed to ban all variants of synthetic fentanyl, as part of trade negotiations. Chinese regulators previously assessed each classification of a controlled substance on a case by case basis, which has been widely criticized as ineffective and profiting from deaths (Myers & Goodnough, 2019). As a result, there has been a total of 399,230 drug overdoses involving opioids in the United States from 1999-2017 (CDC, 2018). The overwhelming societal ramifications of this issue have led the United State's government to declare a state of emergency under federal law in October 2017. Authorities, undoubtedly, bear a significant responsibility to ensure public safety and in this instance, the unintended consequences have been detrimental to society.

These unfortunate events have occurred even though OxyContin "had not been shown to have a significant advantage over conventional, immediate-release oxycodone" (Zee, 2009). By increasing patent protection, the power being authorized to companies is justified on the basis of recovering exuberant research costs in a finite timeframe for the overall improvement of public health. Feldman (2018) did a comprehensive study on all market drugs between 2005-2015 and concluded that "rather than creating new medicines, pharmaceutical companies are largely recycling and repurposing old ones." Analyzing 60,000 data points in which every instance a company added a new patent or exclusivity was documented, the results found that 78% of new patents were from existing drugs. There was also a strong correlation of extending patent protection amongst blockbuster drugs, with 80% of the 100 best selling drugs having extended at least once while 50% extended multiple times (Feldman, 2018). This has become a common occurrence with many companies creating patent thickets around their top selling products. Aside from the product patent claim, or active ingredient patent, companies can obtain a process, formulation or method of use patent to inhibit competition and extend protection past the initial expiry date. The world's top selling drug Humira and OxyContin have both been granted over 100 patents during their life cycle (USPTO, 2019). This unfortunate case incorporates another important component of the pharmaceutical industry; as OxyContin continues to remain the most litigated trade name in pharmaceutical patent cases (Lex Machina, 2015).

## 3.2 Litigation Costs

In the United States, patent litigation is becoming more prevalent, with the number of cases growing at a compound annual growth rate of 6% from 1991-2016. There were over 5000 cases filed in 2016 with a steadily increasing $8.9 million dollars as the median damage awarded. This is a critical component of business operations that becomes a costly endeavour that companies must adhere to. Importantly, patent lawsuits are a frequent occurrence in the pharmaceutical industry, accounting for 14% of all identified cases, exceeding both the computer electronics and software industries and second only to consumer products. Nevertheless, medical devices, biotechnology and pharmaceuticals far exceed any other industry in terms of median damages awarded from 1997-2016. An interesting caveat that befalls owners is the 33% success rate by patentees. This surprisingly low rate is worrisome for patent holders, and further intensified by the fact that from 2006-2014, 75% of decisions were appealed and more than half resulted in a modified outcome. These figures indicate the both the pervasiveness of patent litigation and onerous costs associated with extensive court cases that engulf the pharmaceutical industry. (PwC, 2017)

From an international perspective, China has become a dominate market, surpassing the United States as the most patent litigated country with over 30,000 cases between 2006-2012 (Bloomberg, 2014). The Chinese patent and legal systems are still maturing and impose distinct differences from operating in the American market. The international influence is ubiquitous, with companies in the US, France, Japan and Germany representing 50% of all plaintiffs but less than 5% of all defendants (Cox & Sepetys, 2009). These figures indicate the risk associated with the Chinese market and the predictable costs related to numerous litigation disputes. The distinct difference in patent infringement is representative by an average median damage award of $3.8 million from 2001-2007 while the median award across all IPR cases was only $15,000 (Cox & Sepetys, 2009). The prevalence of global patent litigation is dominated by the United States and China for economic and market factors as well as unique legal characteristics. China is considered to have the fastest time to trial, while the United States has the highest damage awards and lowest chance of going to trial (Bloomberg, 2014). The commonness of settlements and higher potential rewards entices frequent litigation in the United States while a quick process and imitative business environment has escaladed Chinese disputes over Asian and European counterparts. From 2008-

2013, patent infringement filings in China, the United States and Germany have grown at a CAGR of 19%, 25%, and -1%, respectively (Bloomberg, 2014).

As emerging markets, especially China, begin to develop sufficient intellectual property standards and dominate economies, multinational firms need to incorporate expected costs and risks associated with obtaining patent protection and potential legal disputes. Legal costs vary significantly across jurisdictions due to a multitude of factors. Even within a similar European market, estimates for each party range from $60,000 to $250,000 for France and Germany while the U.K. exceeds one million (WIPO, 2018). These differences represent a microcosm into the complexities of global operations for an industry that is dependent on IP protection as a company's predominant comparative advantage. These circumstances should change within Europe however, as a unitary patent and unified patent court system will provide a more simplified process. There are several reasons as to why patent litigation has become so rampant. IMAK (2018) analyzed the top-selling drugs on the market and found an average of 71 granted patents and 38 years of attempted protection per drug. The sheer number of patents granted nullifies the intended purpose of the patent system and becomes a strategic ploy for major firms. The vast majority of patents are obtained from large firms and unsurprisingly, more than twice as many patents from large firms are unused compared to small firms, at 40% and 18%, respectively (Giuri, et al., 2007). Considering almost half of patents obtained are unused signifies the strategic importance placed on either seeking potential infringement lawsuits, or patent trolling, and preventing competition from entering the market. These added costs negatively impact all parties involved but disproportionately hinder smaller firms and create additional barriers to entry.

It is easy to construe patent litigation as a specific form of intellectual property that has similar litigation tendencies across all forms and industries. As alluded to previously, the pharmaceutical industry represents a distinctive set of characteristics from other sectors. The disparate differences are demonstrated by the litigation costs significantly outweighing the profits gained from patents in all other industries while the inverse occurs for the pharmaceutical/chemical sector (See Appendix Figure 9a, 9b). This can be explained by the ambiguous boundaries of certain patents; most notably software patents which have the highest rate of appeals over the meaning of patent claims (Bessen & Meurer, 2008). Furthermore, litigation costs are particularly low for compounds with higher patent values while electronics and software have higher litigation rates

and lower values (Bessen & Meurer, 2008). The lower frequency of lawsuits for compounds can be explained by the specific nature of the patent leading to less ambiguity and interpretation. Interestingly, invention patents in China only account for 11% of total cases while design patents represent 46% (Bloomberg, 2014). These findings further exemplify the unique characteristics associated with patent protection in the pharmaceutical industry. The value and strategic importance organizations allocate to patents is significantly higher than any other sector by a substantial margin. Although excessive patenting is a frequent occurrence, the distinct characteristics associated with patenting a specific compound provide an optimistic component compared to other sectors.

From a multinational firm's perspective operating in a hyper competitive global market, the legal implications cause an inevitable burden that embodies non-negligible opportunity costs. The exponential increases of both patents granted and infringement lawsuits around the world influence strategic and operational decision making. The difficulties of obtaining national patents and subsequent lawsuits entails barriers that negatively impact resulting pricing and accessibility. The magnitude of this issue can be epitomised by a recent case involving Idenix Pharmaceuticals, a wholly owned subsidiary of Merck and Co., who won the largest patent infringement verdict in U.S. history against Gilead Sciences, valued at $2.54 billion (Merck & Co., 2018). Roche (2018), Pfizer (2018), and Novartis (2018) have all spent in excess of $700 million dollars from 2016-2018 on litigation costs, notwithstanding ongoing investigations. It becomes very convoluted if all lawsuits and legal proceedings are included due to the additional product liability lawsuits inherent in this business. To put this in perspective, Merck (2018) has approximately 4,085 cases for Fosamax, 775 for Proscar, 1235 for Januvia, that are filed or pending as of December 31$^{st}$, 2017. Novartis (2018) claims to have over 1000 individual cases currently pending, with an aggregate total of $1.5 billion, in which a provision is not even stated due to a payment being "either not probable or cannot be reliably estimated." The complexities and considerable number of ongoing lawsuits have a dramatic impact on strategic operations and generic competition entering the market.

The cycle of patenting and exclusivity creates a dilemma for generic drug companies. Before gaining market approval, there are two paths a company can take. In order to compete for market access of an off-patent molecule with still-patented cousins, they must prove the derivative

patents are either invalid or that they are not infringing upon those patents (Collier, 2013). Even if a generic company is found to not be infringing upon existing patents, brand-name companies are still able to sue for infringement after the product is already on the market. Furthermore, patent linkage systems that are being encouraged around the globe force generic companies to send a notice to the patent holder, allowing for subsequent lawsuits to delay clinical data to be accessed. The notion of extending patents and preventing competition is known as evergreening, and it becomes evident there is a strong correlation between blockbuster drugs, the number of patents, and imminent litigious action. The exuberant number of patents granted and impending lawsuits represents a burden on legal systems and company's operations. The compounding effects of consistently incorporating significant sums of expenditure on patent costs and ongoing legal disputes defers from adequate investment in research, innovation and providing affordable medicines around the globe. The sheer number of cases is overwhelming and inhibits further growth opportunities for multinational firms. The fact that a small minority of all infringement cases involve inventive patents and the pervasive nature of patent fortresses amongst the best-selling drugs indicates an inefficient system that represents a significant barrier to generic entry. The compounding effects of costly lawsuits and delayed competition must be overcome to ensure the world is able to access affordable drugs.

## 3.3 Access to Drugs

These unique circumstances apparent in the pharmaceutical industry play an intricate role in the fundamental objective; providing the world with access to drugs. The provoking nature of this industry can be summarized by a canonical statement: "The first pill can cost more than $1 billion while the second costs only a dime" (NASEM, 2018). The realistic illustration of this development process incorporates the innate predicament that all stakeholders must confront. Business operations are reliant on research and development and the recurrent revenues associated with blockbuster drugs. The underlying quandary is the marginal cost of additional medicines is completely negligible and could help the lives of millions of people. On a case by case basis, the solution seems obvious from a moral standpoint but accounting for world population and business operations, the resolutions become much more ambiguous. Providing access to life-saving drugs

is a highly contentious issues that encompasses fundamental human rights and morality in a complex business environment. The complexities of successfully operating a multinational corporation heavily involved in risk and capital expenditure do not align with public health objectives. Many diseases only occur in impoverished nations, creating a public issue that has not been solved by private industry. Several initiatives have been brought forth, but this remains one the most pressing global issues with an estimated two billion people unable to access essential medicines (WHO, 2017).

In 2005, North America, Japan and Europe accounted for 90% of the world's pharmaceutical purchases (IMS Health, 2006). In contrast, Sub-Saharan Africa represented only 1-2% of the global market share (CIPIH, 2006). The disparate figures create perverse market incentives for multinational firms to maximize shareholder value. Public health issues are present in all nations, but certain diseases are more prevalent in developing nations. The private marketplace does not provide the adequate incentives for firms to heavily invest in these life-saving drugs, even if it is the most beneficial for society. Due to the inherent market failures that exist, research and investment is predominantly focused on the lucrative Western markets. This is known as the 10/90 gap, where only 10% of R&D spending is directed at 90% of the global disease burden (GFHR, 2004). After analyzing 1393 new chemical entities discovered from 1975-1999, Trouiller et al. (2002) determine that only 16 were directed at tropical diseases and tuberculosis. This represents 1% of marketed drugs, 13 times lower than central-nervous-system or cancer related discoveries (Trouiller, et al., 2002). The asymmetric interests between advanced and developing nations only intensifies the difficulties surrounding this issue. The burden of cost is overwhelmingly placed on the United States, resulting in a justified desire for other countries to adopt stronger protection policies and reduce imitative capabilities. Trade negotiations certainly pigeon hole countries to agree to disproportionately strict pharmaceutical protection. The results of this are difficult to quantify and striking the right balance of enforcement remains a unique question that developing nations need to address.

The ongoing discussion culminates around how to create global access to drugs while protecting the interests of pharmaceutical companies. Lanjouw and Cockburn (2001) studied the initial effects of the TRIPS agreement on the forty less-developed signatories that implemented pharmaceutical protection for the first time and found R&D remained level or slightly decreased

on products specifically intended for those markets. Similarly, Kyle and McGahan (2009) examined clinical trial data and concluded the increase in patent protection did not alter R&D investments. These results are in stark contrast to one of the principle arguments for introducing patent protection, which was the inevitable increase in investment and research for previously neglected diseases. Unsurprisingly, even though additional protection may bring higher prices and stronger revenues, developing nations still represent a fraction of total sales for multinational firms. An imperative determinant is the difference in healthcare expenditure; in which the cost is almost entirely received from third parties in developed nations while consumers pay directly more often in LDCs and developing countries. Even with a monopoly, companies are limited with their pricing power due to the elastic nature of the demand side. During the 1990's, 70% of Indians did not have national health insurance (Lanjouw J. O., 1998). This additional revenue, in turn, would be negligible for companies to differ research focus or enhance innovative capabilities. The resistance to TRIPs from developing nations was rational, given the power bestowed upon member states. The obligation of minimum standards prevents countries from changing their laws to suit national interests if they are at variance with the Agreement and furthermore, cross-sectoral retaliation through the dispute settlement process can occur in the event of noncompliance (WHO, 2008). By introducing pharmaceutical standards, countries were conceding pricing power that would dramatically impact pharmaceutical access.

Drug prices subsequently increased for patented medicines but research activities remained largely focused on Western markets. Added protection enables many beneficial effects, however, it innately causes higher pricing. When China introduced exclusive marketing rights in 1991 and amended its patent law in 1992, uncontrolled prices of protected drugs had risen by a factor of three to four on average (Maskus, 2000). The importance of domestic industries is fundamental in the goal of providing worldwide access to drugs. Many countries, especially LDCs, lack the technological capacity or manufacturing capabilities to satisfy the demands of their citizens. The incessant need for generic alternatives and increased competition enables a cost reduction and easier access to medicines. In addition, Bate (2008) confirms that research decisions are altered by regional implication, demonstrated by increased investment in local diseases by Indian firms compared to international companies. The TRIPs Agreement was an audacious attempt to globalize standards but incorporated several provisions that allowed sufficient flexibility

developing nations. The discourse between advanced and developing nations reached its culmination over a particularly crisis, the HIV/AIDS epidemic.

The TRIPs Agreement came to fruition during an influx in HIV infections, with 4.7 million new diagnoses occurring in southeast Asia and sub-Saharan Africa in 1995 alone (Mann & Taratola, 2000). Although initial outbreaks occurred in California during the 1980's, the disease quickly spread to impoverished nations, resulting in fourteen million fatalities and becoming the number one cause of death in Africa by 1999 (WHO, 1999). By the 21st century, AIDS had the highest percentage imbalance amongst any indicator related to death on the poorest 25% of the world (GFHR, 2005). The global crisis mobilized extensive research and complex treatment options to combat the spread and devastation of this disease. However, at a cost in excess of $10,000 per patient per year, only 1000 people living in Africa had access to treatment during the first International AIDS Conference held in South Africa (Berger, Hoen, Calmy, & Moon, 2011). Although flexibilities were enabled through the TRIPs Agreement via compulsory licensing, the United States successfully deterred implementation through trade legislation in the form of benefits under the Generalized System of Preferences, or GSP, and Special 301 Watch Lists (DeRoo, 2011). Africa was dealing with a crisis of unprecedented proportions, leading Nelson Mandela to issue compulsory licenses and sign amendments to South Africa's Medicines and Related Substances Control Act in order to buy cheaper drugs via parallel importation. Remarkably, the following occurred in the subsequent year: thirty-nine pharmaceutical companies filed a lawsuit against the South African government, the USTR placed South Africa on the Special 301 Watch List, GSP benefits were suspended and the U.S. Congress cut off all aid into the country (DeRoo, 2011). This overt reaction to a justifiable resolution from an impoverished nation in crisis received global scrutiny for both government and industry actions.

The United States government and pharmaceutical companies eventually conceded amidst immense pressure from the public, NGOs and world organizations. Following this international crisis, members agreed upon the Doha Declaration in November 2001, affirming that "each Member has the right to grant compulsory licenses and the freedom to determine the grounds upon which such licenses are granted" (DeRoo, 2011). Furthermore, LDCs were given an extended time period until 2016 to implement pharmaceutical protection alongside a set deadline in which a solution was to be found for countries unable to produce generic alternatives themselves (UNDP,

2006). This provision enabled India to export low cost, generic versions with one Indian manufacturer introducing the same ARV therapy for $350 dollars per year (WHO, 2008). Due to the predominantly lower income population affected, five million people were able to gain access to ARVs as a result (Berger, Hoen, Calmy, & Moon, 2011). Prior to the its adoption period in 2005, the Indian pharmaceutical industry was critically important in providing access to cheap drugs, with an estimated 30% of all generic drugs in developing nations being supplied by India (WHO, 2008). Overall, the DOHA Declaration was monumental in the fight against HIV/AIDS and has since provided more than 60 lower income countries large scale generic versions of patented medicines (Berger, Hoen, Calmy, & Moon, 2011). The success of combatting this spiralling epidemic is a testament to the capabilities of global cooperation and effective use of the pharmaceutical industry. This case is a representation of both the immense implications and political influence associated with the pharmaceutical sector.

Progress was made during this time period but as previously alluded to, significant protection is being implemented in recent trade negotiations. Compulsory licensing has been internationally accepted for HIV/AIDS, as stated in Article 18.6, "…it being understood that public health crises, including those relating to HIV/AIDS, tuberculosis, malaria and other epidemics, can represent a national emergency or other circumstances of extreme urgency" (CPTPP, 2018). Although HIV/AIDS had a positive impact on TRIPs flexibilities, the United States and other developed nations are frequently enforcing TRIPs-Plus provisions as part of negotiations. These provisions may seem minor, but could have a profound effect on nations in years to come. For example, Canada granted 613 compulsory licenses for generic medicines from 1969-1992, leading to the lowest medicine prices in the industrialized world (Berger, Hoen, Calmy, & Moon, 2011). After agreeing to NAFTA, the median price difference for medicines was found to be 56% higher in Canada compared to the United States by 2001 (WHO, 2002). Although placing a substantial burden industrialized healthcare budgets, the significance of additional protection disproportionately affects access to drugs in lower income countries. The HIV/AIDS still remains prevalent but has been contained due to successful research efforts and billions of dollars of investment from governments, non-profit organizations and multinational corporations.

## 3.31 Research funding

The justification for exceedingly high drug prices is the massive amount of R&D investments and inventive capabilities of pharmaceutical companies. In theory, the system grants substantial revenues for inventors and as a result, all stakeholders benefit from innovative medical discoveries. In reality, unbeknownst to the majority of the public, discovery research is heavily funded by public resources. A recent study examined all 210 NMEs approved from the FDA between 2010-2016 and found the National Institute of Health, or NIH, contributed to every single process (Ekaterina Cleary, Khanuja, McNamee, & Ledley, 2018). In total, over $100 billion, or 20% of the total budget, was spent on these discoveries from 2000-2016. During this same time period, the budget of the NIH has ballooned at a CAGR of 24%, increasing from $973,146,000 in 2000 to $32,311,349,000 in 2016 (NIH, 2019). The funds are generally allocated to exceedingly risky basic research, which complements industry investments that are primarily focused on applied research. Public resources play an intricate role in the success of pharmaceutical research however, transparency is imperative for the public to understand the sizeable role that taxpayer funds contribute to this sector.

Deriving data from clinical trial information provided by NIH's U.S. National Library of Medicine, insights can be determined on the extent of public and charitable funds for certain classes of medicines. For HIV/AIDS, there are currently 3735 ongoing or recently completed clinical studies with funding from industry contributing to 1429, or 38% of the studies. For diabetes, 46% or 2481 out of 5440 clinical trials received funding from the pharmaceutical industry. Malaria only received funding for 29% of the 103 studies conducted while cancer is the most predominant source of clinical trial studies with 34,023 trials being conducted and only 40% funded by the private industry investment (NIH, 2019). These results enable an understanding on the significant contributions provided by government entities, charitable organizations and academic institutions. Incorporating cancer-related patent data from the USPTO Cancer Moonshot Database, Stanford University contains the largest number of patents applications at 241, while Novartis sits atop private industry with 85 (USPTO, 2019). Furthermore, a comprehensive study was conducted by Robert Kneller (2010) who identified 252 new drugs approved by the FDA from 1998-2007 in which 215 were classified as New Molecular Entities and 37 were under Biologics Licence Applications. By identifying the inventors and their places of employment, stark contrasts

were found. 61% of new drugs discovered in the United States came from academia or small biotech companies while it was less than 25% across European and Japanese markets (Kneller, 2010). To put this in perspective, universities and small biotech companies in the United States accounted for more drug discoveries than Japan, Germany, Switzerland, Canada, Australia and the rest of the world excluding Europe combined (See Appendix Figure 10a).

While it is noteworthy to determine the sources of inventive discoveries, attention should be focused on results and societal implications. Budish, Roin and Williams (2015) investigated the source of research investments on the decision making strategies of firms. The empirical study uses cancer research data using critical trials, determining whether late-stage treatment is prioritized due to shorter project durations and approvals. Separating the stages based on five-year survival rates, the results visibly show a significant inclination for late-stage cancer research with terminal patients receiving the majority of research (See Appendix Figure 11a). These results are insightful and indicate time to market is a critical component of research decisions. Secondly, the study contrasts the decision making based on public or private investment sources. Although commercialization lags reduce both public and private investments, the correlation is significantly more negative for privately funded research. Additionally, it was determined that all cancer prevention and chemoprevention drugs have been publicly funded with no private investment. One of Roche's top selling drugs, Avastin, was initially approved to extend to the life of late-stage lung cancer patients by two months. The findings suggest that market forces and corporate short-termism impact the research decisions of private organizations and the patent system does not incorporate these incentive effects. (Budish, Roin, & Williams, 2015)

To help fill this funding gap, non-profit foundations have increased their investments in discovery and development for new drugs specific to their diseases of interest. The Bill and Melinda Gates Foundation continues to impact global health with several initiatives aimed at combatting malaria, pneumonia, diarrheal diseases and Ebola. To illustrate the significance of the Gates Foundation, the 2007 expenditure of $1.65 billion on global health programs equaled the World Health Organization's annual budget. The crowning achievement thus far has been the impact on malaria research, as evidenced by $2.9 billion spent on grants and $2 billion towards the Global Fund to Fight AIDS, Tuberculosis and Malaria. The Gates Foundation is the largest private grant-making foundation in the world which has aided the exponential increase in malaria

research from $84 million annually in the late 1990s. The magnitude of this disease can still be felt as 90% of deaths were in African nations, with 60% being children under the age of five and an estimated 219 million people suffering in 2017. These neglected diseases provide a limited market for private firms, but signify a dramatic social and economic impact for entire regions. The $4.9 billion dollars in expenditure have enabled hopeful results, reducing the number of deaths by half since 2000. From 1998-2007, $8.95 billion was allocated to various organizations, with 40% expended to multinational firms and $3.27 billion specifically towards basic science research. The significant figures and important influence that non-profit organizations possess can dramatically impact research focus and considerably effect global health initiatives. (McCoy, Kembhavi, Patel, & Luintel, 2009) (Gates Foundation, 2019)

While it is easy to criticize multinational firms for exceedingly high prices and selective research decisions, one must examine the countless clinic trials and failures along the commercialization process to gather an unbiased perspective. The attrition rate of Alzheimer's disease was found to be 99.6% between 2002-2012, representing substantial expenditure for virtually no return (Cummings, Morstorf, & Zhong, 2014). The excessive long-term costs of bringing drugs to market requires substantial capital with a distressingly high risk tolerance. Even with government and non-profit funding for discovery research, it is estimated that 90% of drugs do not complete the clinical trial requirements (NASEM, 2018). The pharmaceutical industry is also the most charitable, donating considerably more than any other sector in proportion to revenue. Pharmaceutical companies represented 5% of all companies, but contributed 40% of total donations from 2009-2015 (CAF, 2016). The constant public scrutiny and misaligned expectations from private firms operating in a globally competitive market creates an inexorable environment. However, the perception is understandable from the average citizen. The innate conundrum that predisposes American taxpayers is that although 85% basic cancer research is publicly funded, they pay a 50-100% price increase compared to other nations (Kantarijan & Rajkumar, 2015). Due to the vital importance and global impact of this industry, the public should be rightly concerned about regulatory processes, research funding, and access to affordable medicines.

## 3.4 Current Industries

As countries continue to develop economically, healthcare becomes a primary focus of both governmental policy and societal demands. The current state of affairs for China and India vary from an operational and consumer expenditure standpoint. Both countries have burgeoning pharmaceutical sectors that will enable a more disperse marketplace for revenues and an increasingly competitive environment in terms of innovative capabilities and generic manufacturing. The international business environment is becoming globalized and the pharmaceutical industry will continue to dominate political discussions, trade negotiations and public interest. Integrating an adequate level of intellectual property protection is a complex and multifaceted issue that encompasses a wide range of benefits and challenges that many industries must address. The pharmaceutical sector incorporates a distinct set of characteristics that necessitates sufficient protection to recover excessive R&D costs but also dramatically impacts public access and global health standards. The complexities involved with enforcing universal standards and continual pressure of adopting advanced economy's IP rights has affected both emerging and industrialized nations. The Chinese and Indian economies are at different stages in development but provide an insightful perspective on the challenges and opportunities these pharmaceutical markets present for the near future.

The sheer size of the Chinese middle class represents significant commercial opportunities that are difficult to ignore. It is estimated that two thirds of the world's middle class will come from greater Asia by 2030, with China accounting for upwards of 780 million. China is, undoubtedly, a significant economic superpower but still lags behind OECD countries on a per capita basis and almost all health-related indicators. Priorities have shifted in concurrence with economic development, exemplified by the Chinese pharmaceutical market expanding from the 9$^{th}$ largest segment in 2007 to currently the second largest. China contains an aging population and boasts the world's largest medical insurance system which enabled pharmaceutical sales to increase at a CAGR of 15.5% between 2010-2015. Housing and healthcare are projected to become the fastest growing categories in consumer spending so in its current state, demand far exceeds supply and a historic reluctance to trust domestic manufacturers remains high. Quality and safety will need to be addressed but a shift in innovative capabilities has the potential to alter this global industry. The domestic industry is still dominated by generics at a market share of 75% with an

additional 11% towards Traditional Chinese Medicines, or TCMs. As previously alluded to, the United States and Europe dominate new discoveries, with China only representing 4% of the total market over the previous decade. R&D reinvestment currently accounts for approximately 5% of sales, which is far below Western counterparts but expected to increase alongside considerable government spending. Many new initiatives, including Healthy China 2030, have been implemented with a notable emphasis on research funding, biopharma development and regulatory overhaul. The anticipated expansion of the National Reimbursement Drug List reveals an equivalent prioritization towards Western medicines and herbal/TCMs. This sizeable revenue stream should induce further research to an already exponentially growing herbal medicines industry, expected to eclipse over $200 billion globally in the next five years. As domestic industries and the prospering population evolves, innovation will become more prevalent and alternative herbal or TCM medicines could seriously impact the pharmaceutical sector going forward. (GBR, 2018)

Similar to China, the Indian market represents a vast population with rising incomes and increasing public demand for adequate health standards. The Indian government recently launched the world's largest publicly funded medical insurance scheme, labelled 'Modicare,' which drastically increases expenditure aimed at covering an additional 500 million people. Government disbursement has increased 13.1% and medicine spending is projected to grow at a CAGR between 9-12% over the next five years, leading India to ascend into the top ten consumer markets. Comprising of a vast population in the earlier stages of economic development, generic access is imperative for improving health standards. The domestic pharmaceutical industry in India is the largest provider of generic drugs globally, accounting for 50% of global vaccines and 40% of the U.S. generic market. Notably, exports represented $17.3 billion in sales while domestic revenue amounted to $18.1 billion in 2018. FDI has contributed immensely in the development process, accumulating $15.9 billion between 2000-2015 with a predominant focus on greenfield investments. The Indian pharmaceutical sector is a representation of the positive spillover effects associated with a maturing domestic industry. India's globally competitive generic sector contains the most FDA approved manufacturing facilities outside of the United States and received the largest number of Abbreviated New Drug Application approvals with 304 in 2017. This can be attributed to technological advancement and reinvestment in R&D which continues to steadily rise, increasing from 1.9% between 2000-2005, 5.3% in 2012, to 8.5% in 2018. Collaboration with

Western companies through licensing or private equity deals is pervasive and new government initiatives included in Pharma Vision 2020 are aimed at becoming a global leader in end-to-end manufacturing through incentive schemes. The market share of generic manufacturing is 71% and continues to decline as companies further develop technological and innovative capabilities. The pharmaceutical sector is poised for growth and represents one of India's most important industries in terms of global competitiveness, employment and societal impact. (IBEF, 2019)

The vital importance of this industry cannot be overstated for both the Indian marketplace and global partners. In 1999, industrialized nations accounted for 93% of global pharmaceutical exports with domestic industries predominantly focusing on the local market (WHO, 2012). From research processes to distribution networks, business operations have become globalized with significant opportunities for India and China to capitalize. China's economic expansion has created a highly competitive technological capacity that could influence research and inventive capabilities in years to come. Domestic demand for intellectual property rights and increasing enforcement should stimulate innovation and a dominate consumer market will garner substantial growth. For India, adequate standards and advanced manufacturing capabilities have enabled a burgeoning industry that should present further opportunities for innovative proficiency and technological advancement. Extensive and trustworthy regulatory processes have given India a significant comparative advantage over its Chinese counterparts for growing market share in global drug supply. Focusing on a macro perspective, Africa faces the biggest challenges regarding access to essential medicines. Limited infrastructure and domestic industries necessitate the vast majority of drugs to be imported, which has resulted in widespread counterfeit medicines. The India-Africa partnership for access to medicines is fundamental for safe, affordable pharmaceuticals and substantial investments in distribution and development show positive signs for a growing industry. Indian firms account for the majority of vaccines and currently supply over 80% of the antiretroviral drugs used globally to combat HIV/AIDS come from Indian companies (IBEF, 2019). The Meningitis Vaccine Project was a successful partnership between the Gates Foundation and an Indian vaccine company which saw a key conjugation technology transferred by the FDA to organize clinical trials across Africa, resulting in a $0.50 cent vaccine that was successfully launched in six countries (Wilson & Rao, 2012). Collaboration needs be utilized in order to address global concerns over access to affordable medicines and align both public and private interests in this worldwide industry.

The pharmaceutical sector continues to be dominated by industrialized economies but the advent of the Chinese and Indian markets will play a predominant role in the years to come. The importance of mature industries outside of OECD nations is critical for distribution networks, regional focus, and providing sufficient competitive markets. The United States may be the largest beneficiaries as they represented over 40% of the $1.14 trillion dollar pharmaceutical market in 2017 (EFPIA, 2018). A globally competitive market can facilitate cost reductions and comparative advantages to enable a more efficient and accessible pharmaceutical sector. Health standards are prioritized in governmental policies and growing consumer demand provides ample opportunities for sufficient revenue streams. Multinational firms are able to mutually benefit from population growth, untapped markets and globalized supply chains. Collaboration is necessary between government, non-profit organizations and multinational firms from around the world to mutually benefit and support paramount objectives. The success of improving health standards and access to affordable medicines is predicated on the evolving intellectual property rights system. The unique characteristics of the pharmaceutical sector represent distinct challenges for multinational firms to overcome and necessitates adequate protection to recuperate a capital intensive commercialization process. Elements of the current patent system enable exploitative tendencies and inhibit a fully competitive marketplace. An insight into the market leaders can provide a thorough perspective on the impact that the patent system has in this vitally important industry.

## 4. Company Analysis

Fifteen of the biggest pharmaceutical companies are analyzed in order to provide a detailed insight into the day-to-day operations and present a unique perspective into the current business climate that the patent system has created. The fifteen companies were chosen based on annual revenues in 2017, with a focus on brand name pharmaceuticals. For instance, Celgene was chosen over Abbott Laboratories even though revenues were less than half in 2017, because Abbott's main sources of income focus on medical devices, diagnostics and generic pharmaceuticals while Celgene produces the second-best selling drug, Revlimid. The analysis also includes AbbVie, previously Abbott Laboratories' branded pharmaceutical business that spun off from Abbott Laboratories in 2013. We use the same fifteen companies throughout 20 years, from 1997 to 2017,

in order to analyse the historical development for these companies. The companies we define as the biggest in 2017 may not have been amongst the fifteen biggest historically, but they have all been major players in the global pharmaceuticals market since 1997 and therefore provide a solid foundation to build the analysis on. The fifteen multinational enterprises included in the analysis are composed of many different subsidiaries and have a diverse range of corporate structures. The headquarters are based in the United States and Europe, with nine corporations residing in the U.S., two in Switzerland, two in the United Kingdom, one in France and one in Germany. Japan is the third largest market, outside of the US and EU, with several pharmaceutical companies exceeding $1 billion in annual revenue. The majority of drug patents held by these companies are valid across the US, EU and Japan with only minor variations on application and expiry dates. The fifteen companies by highest aggregated pharmaceutical revenue in 2017 are presented below. Revenue is in USD billion.

| | |
|---|---|
| **Roche** | 54,123 |
| **Pfizer** | 52,546 |
| **Novartis AG** | 43,085 |
| **Johnson & Johnson** | 36,256 |
| **Merck & Co.** | 35,390 |
| **GlaxoSmithKline** | 28,917 |
| **Sanofi** | 28,387 |
| **AbbVie** | 28,216 |
| **Gilead Sciences** | 26,107 |
| **Eli Lilly** | 22,871 |
| **Amgen** | 22,849 |
| **AstraZeneca** | 22,465 |
| **Bristol-Myers Squibb** | 20,776 |
| **Bayer** | 19,037 |
| **Celgene** | 13,003 |

The largest pharmaceutical market is the United States alongside the majority of headquarters so US dollars are utilized to create a comparable analysis. Four organizations used different currencies in their reporting, consisting of Euros, British Pounds and Swiss Francs. The annual average conversion rates were used aligned with the company's intended method, in order to provide all information in reference to US dollars. All data in the following section is based on the companies' annual reports, the FDA drug approval database, the European Medicines Agency and the national medicines registers for select European Union and European Economic Area member states unless otherwise specified. Due to an incomplete repertoire of 2018 annual reports, the data presented is for the previous 20 years starting in fiscal year 2017.

The term *Top 3* will be referenced frequently to highlight the pharmaceuticals that generate the first, second or third largest revenues for their respective companies. In other instances, the *Top 3* pharmaceuticals are grouped into nine main categories. This enables a more detailed perspective on the variances in the pharmaceutical market. The following categories will be utilized throughout the analysis:

*Cancer* – pharmaceuticals that are primarily used to treat different types of cancer or health-related issues related to cancer.

*Blood Medication* – pharmaceutical used to treat issues related to the patient's blood stream. Includes hypertension, i.e. high blood pressure medications, hypotension, i.e. low blood pressure, anticoagulants to prevent blood clots, anemia medication and blood thinners.

*Immunosuppressants* – pharmaceuticals used to reduce or supress the strength of the body's immune system. Often related after organ transplants, rheumatoid arthritis, psoriasis and Crohn's Disease.

*Antivirals* – pharmaceuticals used to kill or inhibit a virus. *Antivirals* include both antiviral and antiretroviral pharmaceuticals. Drugs included in the category are used to treat a multitude of viral infections but most antivirals are used to treat Hepatitis C while most antiretrovirals are used to control the HIV and AIDS virus.

*Antibiotics* – pharmaceuticals used to treat infections bacterial infections. Also includes anti-inflammatories that reduce inflammation and often relieves pain.

*Diabetes* – pharmaceuticals used to treat symptoms of Type 1 and Type 2 diabetes. Regulates the body's insulin.

*Statins* – lipid-lowering pharmaceuticals used to treat high or low cholesterol. Often related to cardiovascular disease.

*Other* – all *Top 3* pharmaceuticals that do not treat any symptoms included in the main categories.

## 4.1 Research and development

The pharmaceutical industry is the most research and development intensive industry in the world and spends the most on R&D relative to revenue annually. The development of any pharmaceutical is both time-consuming and costly. There are multiple stages of research and development required to ensure the pharmaceutical is both safe and effective. After basic research and drug discovery, each pharmaceutical goes through multiple stages of clinical trials before going through approval processes from government regulatory bodies. The average time from basic discovery to market is ten to fifteen years, which is higher than in any other industry. The analysis does not consider R&D expenditures in relation to specific pharmaceuticals but focuses on total company and industry expenditures. Funding of R&D in pharmaceuticals often comes from a complex mix of both private and public sources. Whether a pharmaceutical is funded by public, private or a combination of sources is not included in the analysis as the aim is to get a clearer picture the total amounts spent on research and development in the industry. The analysis shows how research and development expenses have developed for the fifteen major companies and the industry as a whole. All research and development expenses for the firms are only related to pharmaceuticals and not other industries the respective firm might operate in. All amounts are in USD billions. Because of limited data, only the R&D analysis excludes 1997 and 1998.

Data on total global R&D expenditures from 1999 to 2017 was collected from Raghavendra et.al. (Raghavendra, Raj, & Seetharaman, 2012), total industry R&D expenditures for the U.S. collected from Statista (Statista, 2019) and expenditures for the fifteen companies are collected from their annual statements.

### 4.1.1 Main findings

The accumulated research and development expenditures for the fifteen companies in the analysis show an average annual increase of 8 percent. Only three years contain a decrease in accumulated R&D spending; 1999 to 2000, 2009 to 2010 and 2011 to 2012. The decreases in 2010 and 2012 are most likely reactions to the 'Great Recession' that occurred in the U.S. between 2007 and 2009 that lead to a global economic downturn. Total R&D expenditures in the pharmaceutical industry in the U.S and globally follow a similar pattern in fluctuation. The U.S., on average, accounts for 42.77 percent of the annual total global R&D expenditures. At an all time high in 2016, the U.S. accounted for 58 percent of total global pharmaceutical R&D expenditures. For comparison, the same year Japan held the second highest share at 13 percent. For a full overview of shares of R&D expenditures of leading pharmaceutical R&D countries (APBI, n.d.), see Figure 12 in the Appendix. The fifteen major companies included in the analysis account for 46 to 70 percent of total global pharmaceutical R&D each year, with an average of 56 percent.

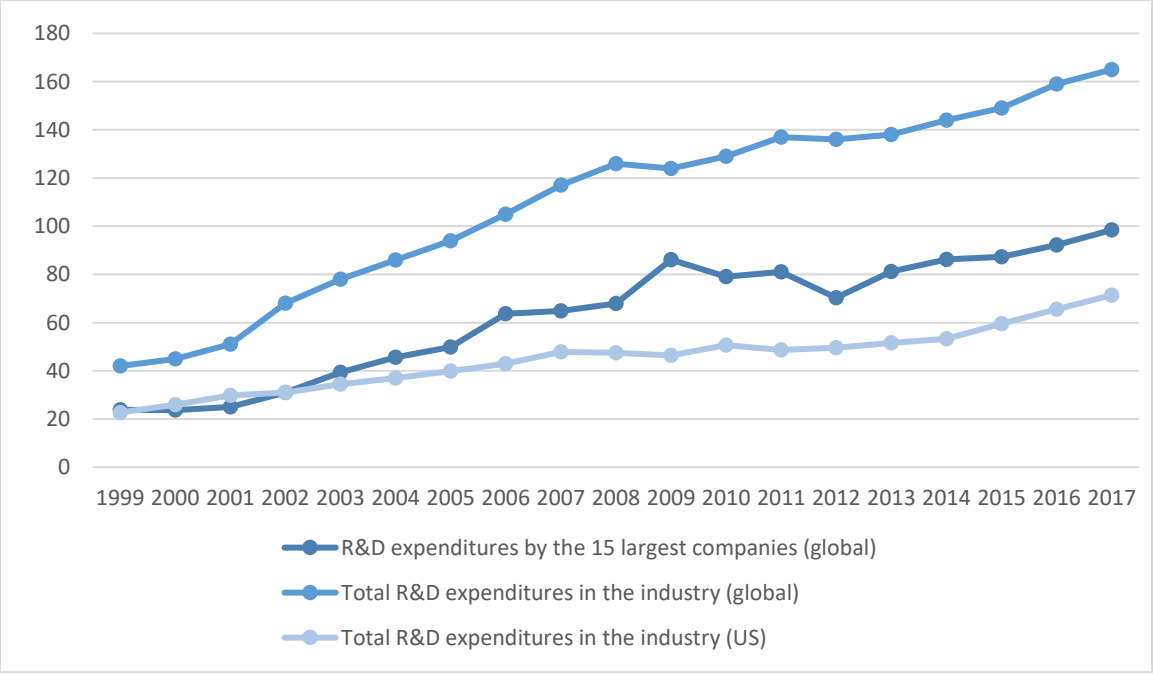


*Figure 1: Overview of Pharmaceutical R&D expenditures*

There are no clear cycles of increased R&D expenditures among the top fifteen companies and investment has remained stable for all companies between 1999 and 2017. Dollar amounts each company spends on research and development varies based on company size and generated revenue. However, all companies have similar R&D expenditure to revenue ratios. On average, the fifteen companies included in the analysis invests 26.15 percent of their annual revenue on research and development between 1999 and 2017. Comparable technology companies, which had the highest R&D to revenue ratio between 2014 and 2016, spend less than half that of pharmaceutical companies with an average of ten percent of their revenue being spent on research and development investments (Kim, 2017). This continuous and constant investment in development within the pharmaceutical industry is mainly because of the significant resources it takes to bring a product to market. With ten to fifteen years from initial discovery to market launch, the companies cannot begin development in 'bulks' as patent expiration of current top selling pharmaceuticals are expiring to cover lost revenue from generic competition. Instead, new products must always be in the pipeline. This becomes even more critical as companies face constant risk of their pharmaceuticals becoming discontinued or patents being invalidated in court, thereby losing both revenue and exclusivity rights connected to the product. Discontinuation often happens in cases where long-term negative side effects that were not discovered in initial clinical trials come to light after the product is brought to market. Patent invalidation can include the full patent or certain claims related to a patent, narrowing its scope and rights.

R&D in relation to revenue does not vary significantly across companies or years and there is no clear correlation between research and development investments and new FDA drug approvals, market launches or patent expirations. Accumulated annual averages for R&D spending as a percentage of revenues for all companies are illustrated in Figure 2.

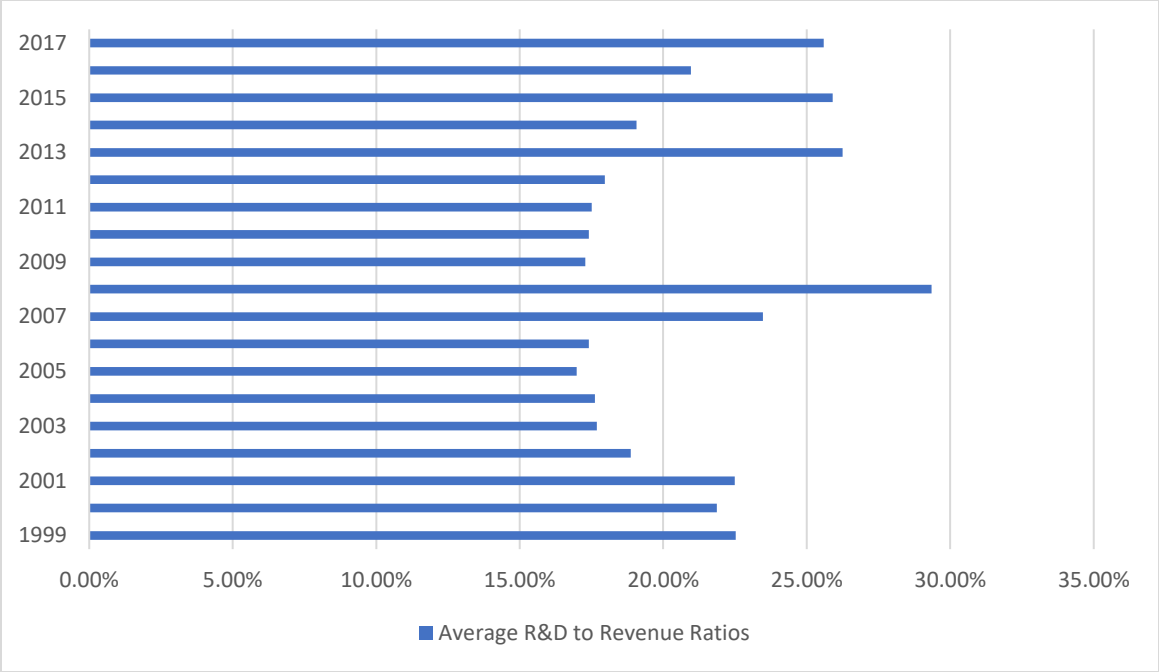


*Figure 2: Accumulated average R&D to Revenue Ratios*

## 4.2 FDA and EMA approvals

The U.S. Food and Drug Administration (FDA) protects public health by regulating a wide range of products including human and animal drugs, medical devices, biologics, food, cosmetics, tobacco products and electronic products that give out radiation. Pharmaceuticals cannot legally be sold in the US without FDA approval that is granted if the agency can prove the drug is safe and effective for its intended use (FDA U. F., 2018). Dates for FDA approval are included in the analysis to highlight that, with few exceptions, FDA approval is the deciding factor for when a pharmaceutical product enters the U.S market. Data was collected from the FDA's drug products approval database (FDA, Drugs@FDA: FDA Approved Drug Products, n.d.). In Europe, the European Medicines Agency grants and consolidates pharmaceutical approvals for market authorization in Europe. All data on EMA approvals is collected from the EMA drug approval database (EMA, n.d.). EMA approval is predominantly used in European Union (EU) Member States. Some pharmaceuticals are granted approval in one or more European countries through national procedures prior to receiving EMA approval or going through consolidation processes to assure consistent guidelines throughout the EU. Approvals through local regulatory bodies are not

included in the analysis. All data on European approval is based on EMA approval because this date reflects the most accurate date of when the given pharmaceutical was granted approval in most European countries.

The pharmaceutical approval system helps highlight the complexities associated with this industry. Most pharmaceuticals go through a multitude of FDA and EMA approval processes for different variances of the same drug. This includes new or supplemental indications for already approved drugs. We illustrate this by using the examples of Gilead Sciences' blockbuster drug, Harvoni, and Eli Lilly's Humulin. The Harvoni case highlights how additional approvals can expand a pharmaceuticals patient population, while Harvoni shows how approval can be given to extend the products uses in treatment for varying symptoms of a disease. By extending uses and patient population, in addition to performing new clinical trials for the same product but in treatment of other symptoms, the company can extend its total exclusivity period in the market further.

Harvoni was granted initial FDA approval for treatment of Hepatitis C virus in adults in 2014. In 2015, the drug received an additional approval for a new dosing regimen. In 2016, approval for new patient population was given, expanding its use to patients with other genotypes. In 2017, the drug once again received approval for a new patient population; this time to include treatment of adolescents aged 12 to 17.

Humulin was granted its initial FDA approval under the name Humulin R and Humulin N, both in 1982. It went on to receive additional approvals in 1985, 1986, 1987, 1989 and 1992 for Humulin, Humulin BT, Humulin U, Humulin 70/30 and Humulin 50/50, respectively. Each of these consist of the same active ingredient but with minor variations within the insulin molecules that affect how fast acting the medication is and the amount of time effects of the drug lasts (Humulin, n.d.). All variations also hold its own set of patents. In the analysis, data for Humulin is based on information pertaining to Humulin as it accounts for the largest global revenue share.

To ensure consistency throughout the analysis, the initial FDA approval dates for each drug are used. With few exceptions, the brand name drugs included in the analysis enter the U.S market the same year it is granted FDA approval and the European market the same year approval is granted by the EMA. Most pharmaceuticals are approved and launched in the U.S. one year prior to Europe.

### 4.2.1 Main findings

The most significant pattern related to approvals and market entry is the tendency for pharmaceuticals in the same category to receive FDA approval and subsequently enter the market in clusters. Two classes of pharmaceuticals are highlighted to illustrate the patterns found. In *Antidepressants and antipsychotics*, consisting of ten separate pharmaceuticals marketed by six different companies, all but one product is launched around the same time as another, similar brand name pharmaceuticals. In 1996 alone, three antidepressants from three separate pharmaceutical companies were launched on the U.S. market – Zyprexa by Eli Lilly, Seroquel by AstraZeneca, Risperdal by Johnson&Johnson. All three of these pharmaceuticals also leave their status as *Top 3* within 2011. For an overview of all pharmaceuticals in the category of antidepressants & antipsychotics and the year they enter the U.S market, see Table 1.

| **Company name** | **Pharmaceutical** | **Revenue as *in years as Top 3*** | **Status last year as a *Top 3 drug*** | **Years as a *Top 3 drug*** | **Market entry U.S.** | **Loses status as *Top 3 drug*** |
|---|---|---|---|---|---|---|
| GlaxoSmithKline | Welbutrin XL | 1,558 | 3 | 1 | 1985 | 2003 |
| Eli Lilly | Prozac | 12,548 | 2 | 5 | 1987 | 2001 |
| Pfizer | Zoloft | 24,432 | 3 | 10 | 1991 | 2006 |
| GlaxoSmithKline | Seroxat(EU)/Paxil(US) | 13,127 | 3 | 5 | 1992 | 2004 |
| Eli Lilly | Zyprexa | 54,467 | 1 | 15 | 1996 | 2011 |
| AstraZeneca | Seroquel | 35,311 | 3 | 10 | 1996 | 2011 |
| Johnson & Johnson | Risperdal | 28,686 | 3 | 7 | 1996 | 2011 |
| Bristol-Myers Squibb | Abilify | 20,146 | 1 | 9 | 2002 | 2014 |
| Eli Lilly | Cymbalta | 26,890 | 1 | 8 | 2004 | 2013 |
| Johnson & Johnson | Trevicta/Invega Trinza | 2,569 | 3 | 1 | 2015 | Still Top 3 |

*Table 1: Antidepressants and antipsychotics*

The same pattern is found in the category *Blood pressure.* Except for Zestril (AstraZeneca) and Adalat (Bayer) that are launched in 1988 and 1985 respectively, all pharmaceuticals in this category enter the market within the same five years from 1992 to 1997 (see Table 2).

| Company name | Pharmaceutical | Revenue as *in years as Top 3* | Status last year as a *Top 3 drug* | Years as a *Top 3 drug* | Market entry U.S. | Loses status as *Top 3 drug* |
|---|---|---|---|---|---|---|
| Bayer | Adalat | 8,074 | 2 | 9 | 1985 | 2006 |
| AstraZeneca | Zestril | 3,506 | 2 | 3 | 1988 | 2001 |
| Novartis | Cibacen/Lotensin | 0,475 | 3 | 1 | 1991 | 2001 |
| Pfizer | Norvasc | 39,944 | 2 | 11 | 1992 | 2007 |
| AstraZeneca | Seloken/Toprol-XL | 2,590 | 3 | 9 | 1992 | 2005 |
| Novartis | Lotrel | 1,352 | 3 | 1 | 1995 | 2006 |
| Merck & Co. | Cozaar/Hyzaar | 19,379 | 2 | 6 | 1995 | 2009 |
| Novartis | Diovan | 54,579 | 2 | 13 | 1996 | 2013 |
| Sanofi | Aprovel | 1,502 | 3 | 4 | 1997 | 2002 |
| Bristol-Myers Squibb | Avapro | 2,186 | 3 | 2 | 1997 | 2007 |

*Table 2: Blood Pressure*

## 4.3 From approval to *Top 3* pharmaceuticals

### 4.3.1. Clarifications

For the twenty year time period, three pharmaceuticals with the highest revenue are collected for each of the fifteen companies. These products are called *Top 3 drugs* throughout the analysis. All data on pharmaceutical specifics and total revenue was collected from each company's annual statements for the given year. Where data is not available for all twenty years, the nearest possible date to 1997 was used.

When analyzing the time period when FDA or EMA approval is granted until a pharmaceutical becomes *Top 3*, the products ranked as *top 3* in 1997 are excluded. This is because of the of lack information on revenue and sales volume prior to 1997 and thus, cannot accurately portray the accumulated years they have been a *Top 3* drug. Furthermore, certain pharmaceuticals that still hold their *Top 3* position in 2017 are excluded from averages of how many years each pharmaceutical retains its status.

FDA approval records in certain cases far outdate available data on pharmaceutical revenue and sales volume. In addition, some pharmaceuticals included were launched before the modern-day FDA was founded in 1938 and there is no data available for approvals granted prior to 1939. For example, Bayer's Aspirin was first marketed globally in 1899. The date of FDA and EMA approval used for these pharmaceuticals is set to 1939.

Certain pharmaceuticals, through licensing agreements, are distributed by more than one major company. For these cases, data is collected from both firms to show total revenues generated by the pharmaceutical and market variances. For example, both Merck & Co. and Johnson&Johnson market Remicade, one of the highest grossing pharmaceuticals in the world. It received FDA approval in 1998 and became one of Johnson&Johnson's *Top 3* pharmaceuticals in 2002 and for Merck&Co. in 2010. Until 2011, Merck&Co marketed Remicade in Canada, Central and South America, the Middle East, Africa and Asia Pacific, while Johnson&Johnson held exclusive marketing rights in Europe and the U.S. In 2011, when the global patents protecting Remicade neared their expirations, Merck&Co. relinquished its exclusive marketing rights back to Johnson&Johnson, only retaining rights to market the drug in Europe, Russia and Turkey (Merck, 2011).

In the following discussion, only FDA approval is used because pharmaceuticals tend to be launched either the same year in the U.S. and Europe or one year prior in the U.S. There are no significant differences between the effects of FDA and EMA approvals on the chosen pharmaceuticals and FDA approval is used to illustrate the trends in the market. For data regarding time from EMA approval until market launch in Europe, see Supplementary Material.

### 4.3.2 Main findings – Time to *Top 3*

The analysis reveals a clear pattern on how long it takes from when a pharmaceutical receives its initial FDA approval to becoming a *Top 3* pharmaceutical across all categories. Most pharmaceuticals do not become *Top 3* before new approvals that extend the drugs scope in both patient populations and uses are granted. For example, Pfizer's Celebrex was granted its initial FDA approval for treating adults suffering from osteoarthritis, but it does not become a *Top 3* drug until 2007, one year after FDA granted an extension to include treating signs of Juvenile Rheumatoid Arthritis in patients from the age of two or older (FDA, FDA Centennial, 2006). The average time it takes a pharmaceutical to achieve status as *Top 3,* i.e. each company's top three drugs by revenue after receiving its initial FDA approval is between six and seven years. Only the *Cancer* and *Antiviral* pharmaceuticals become *Top 3* within four and three years, respectively.

In 2018, cancer was the second leading cause of death globally, indicating an incessant need for pharmaceuticals to treat the disease. In addition, the cost of cancer drugs are exorbitantly high. Despite prices of patented cancer drugs being far greater in the US than any other country, they are generally less affordable in low and middle-income countries than high-income countries. Surprisingly, cancer drugs are the least affordable in India (Clark, et al., 2017). Both high sales volumes and prices contribute to make the period between FDA approval and becoming a top-selling drug shorter than the market average.

*Antivirals*, which also includes antiretrovirals, consists of pharmaceuticals used to treat symptoms of viruses like Hepatitis C (Hep C), HIV and AIDS. Most pharmaceuticals in the *Antiviral* class were launched within a short timespan after the increase in global awareness previously alluded to. The first antiretroviral was approved by the FDA in 1987, only two years after clinical trials were initiated. However, treatments did not show long-term effects until 1995, when antiretrovirals started being prescribed in various combinations and pharmaceuticals of this classification began receiving its status as *Top 3* drugs. This category has the shortest time from approval to becoming *Top 3* because they were the first treatments for HIV to be brought to market and there was little competition. Many of the antivirals only remain a *Top 3* for a short amount of time, the average being 3.87 years. On the other hand, pharmaceuticals in the cancer category, once achieving *Top 3* status, keep this position for an average of 6.59 years. Most of the antivirals have faced little competition from similar treatments but almost all patented pharmaceuticals in this category will have lost their market exclusivity rights after 2017. Therefore, it is likely time from FDA approval to *Top 3* for future antivirals will approach the market average.

### 4.3.3 Accumulated Time as *Top 3*

Time as *Top 3* is the range and average of how many years each pharmaceutical spends as the highest grossing product for its distributing company over the past twenty years across the pharmaceutical categories. *Cancer, Blood Medication, Statins* and *Diabetes* hold the highest averages for years spent as *Top 3.* With an average of 8.6 years, *Blood Medication* is the category with the highest average of remaining *Top 3*. By excluding the pharmaceuticals that remain *Top 3* in 2017, the average is lower at 5.18 years. The pharmaceuticals among each company's *Top 3* in 2017 have held their position for an average of 7.54 years, about a year longer than the average for

all pharmaceuticals between 1997 and 2017. Because many of these still hold exclusivity rights, it is likely they will remain *Top 3* for several years to come as they will not face significant competition from generics. Nearly 40% of the *Top 3* pharmaceuticals in 2017 have held their position ten years or more. For complete information, see Table 3.

| Categories | Years as Top 3 for all pharmaceuticals | Exclusion of 2017 Figures |
|---|---|---|
| **Blood Medication** | 8.60 | 8.31 |
| **Asthma** | 7.20 | 4.67 |
| **Antidepressants** | 7.10 | 7.78 |
| **Statins** | 7.00 | 6.17 |
| **Diabetes** | 7.00 | 3.25 |
| **Cancer** | 6.59 | 4.79 |
| **Immunosuppressants** | 5.71 | 4.80 |
| **Others** | 4.73 | 4.10 |
| **Antivirals** | 3.85 | 4.47 |
| **Antibiotics** | 3.43 | 2.43 |

*Table 3: Average years spent as Top 3 pharmaceuticals*

The *Cancer* category currently has the highest number of pharmaceuticals in *Top 3* for 2017 and nearly 26 percent of all pharmaceuticals in this category have remained *Top 3* for 10 or more years since first entering the list. For individual pharmaceuticals, cancer drug Neulasta, anemia drug Aranesp and insulin drug Lantus have topped the list of highest revenues for the longest period. Neulasta remains Amgen's second highest grossing pharmaceutical after twenty-one years on the *Top 3* list, while Aranesp from Eli Lilly and Sanofi's Lantus remain *Top 3* for their respective companies after 17 years as *Top 3* pharmaceuticals. *Asthma* is the only category that does not include one or more pharmaceuticals to only remain as *Top 3* for one year. All five *Asthma* pharmaceuticals spent three or more years as *Top 3*, with an average of 7.2 years.

### 4.3.4 Differences Across Categories

Most of the *Top 3* antiviral pharmaceuticals over the past 20 years are, or have been, marketed by Gilead Sciences. Eight out of nine *Top 3* pharmaceuticals for Gilead Sciences have

been antivirals and antiretrovirals, accounting for 98.91 percent of their total pharmaceutical revenue since 1997. Only half of the fifteen other companies have had antivirals on their top-selling pharmaceutical list, a stark contrast to the category *Cancer* where twelve out of fifteen companies have had one or more pharmaceuticals on the *Top 3* list. Celgene has eight different pharmaceuticals in which six are in the *Cancer* category. The consistent pattern of having several top-selling pharmaceuticals in the same category continues across all the fifteen companies included in the analysis. However, most typically have a more diversified portfolio than Celgene and Gilead Sciences. Pfizer and Merck & Co. contain the most diversification – each have eleven different *Top 3* pharmaceuticals in nine different categories. Figure 3 shows the number of main categories and total categories all fifteen major companies operate in.

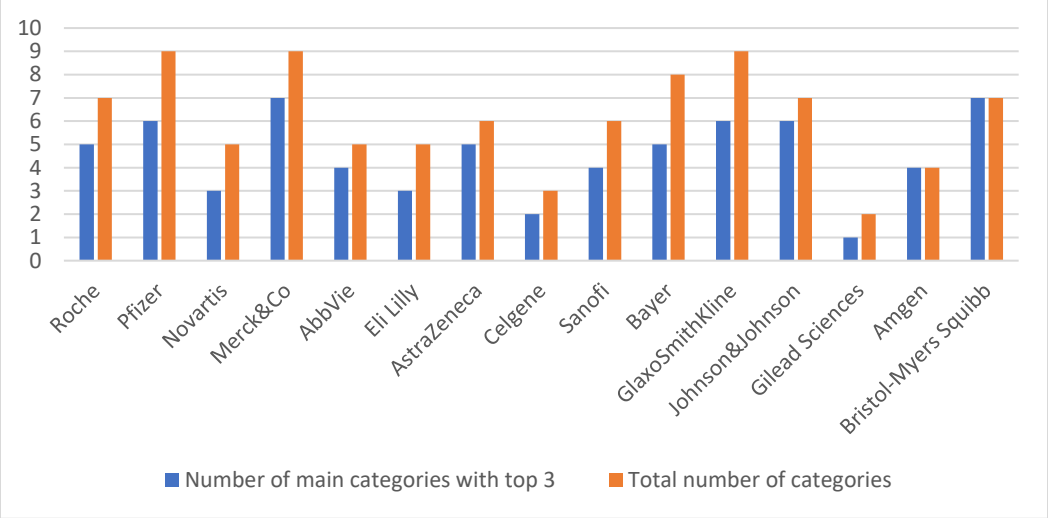


*Figure 3: Top 3 pharmaceuticals category distribution by company*

All categories except *Asthma* have one or more pharmaceuticals that only remain a *Top 3* pharmaceutical for just one year. The pharmaceuticals that are only a *Top 3* for a year often generate higher revenues for a short period because of extraordinary circumstances like pandemics, exemplified by the case of GlaxoSmithKline's Relenza during the flu pandemic in 2009 and 2010. Because Relenza's status as a *Top 3* pharmaceutical was a result of extraordinary circumstances, it does not reflect general market trends and is excluded from the analysis. Certain pharmaceuticals also enter the *Top 3* list only to lose their position after national emergencies are declared, allowing generics to enter the market prior to the brand name patent expiration. The implementation of

compulsory licenses has predominantly affected the *Antivirals* category. Eight out of nine *Antivirals* became *Top 3* within a year of initial FDA approval, yet they remain as one of the shortest *Top 3* categories. Antivirals remain *Top 3* for an average of two years, with Amgen's Infergen holding its position the longest at four years. This is a huge contrast to categories like *Blood Medication* where pharmaceuticals remain *Top 3* for over eight years on average. For further information, see Supplementary Material.

## 4.4 Revenues

This section examines pharmaceutical revenues from 1997 to 2017 for the industry's major corporations and their subsequent *Top 3* drugs. Because of limited data available, the analysis does not include information pertaining to revenue prior to 1997. For certain firms, the dataset begins later than 1997 because of a lack of publicly available data or newly established companies. For these cases, data from the nearest possible year is used.

In the following calculations, all revenue relates solely to pharmaceutical revenue, unless specified otherwise. For companies that operate in medical devices, veterinary pharmaceuticals and/or other business not directly connected to human pharmaceuticals, e.g. Johnson&Johnson, only pharmaceutical revenue is extracted from the annual statements. Other revenue is removed to enable comparable data for those firms that operate primarily in pharmaceuticals, e.g. AbbVie.

### 4.41 Total company and market revenues

Figure 2 illustrates the historical development of global revenues for the *Top 3* pharmaceuticals, accumulated revenue of the fifteen major companies and the pharmaceutical industry as a whole. Notably, the percentage increase of annual revenue is highly correlated amongst all three variables. Both *Top 3* revenue and accumulated company revenue have faced occasional decreases. These have been incremental, only occurring in four and three years for *Top 3* and company revenue, respectively. On the other hand, the global pharmaceutical industry remained extremely constant with a CAGR of 6.5 percent. From 1999-2017, the pharmaceutical industry as a whole generated revenues exceeding $14,444.5 billion, in which 43 percent was

generated by the top fifteen companies. Figure 4 shows the market revenue distributions across these three segments.

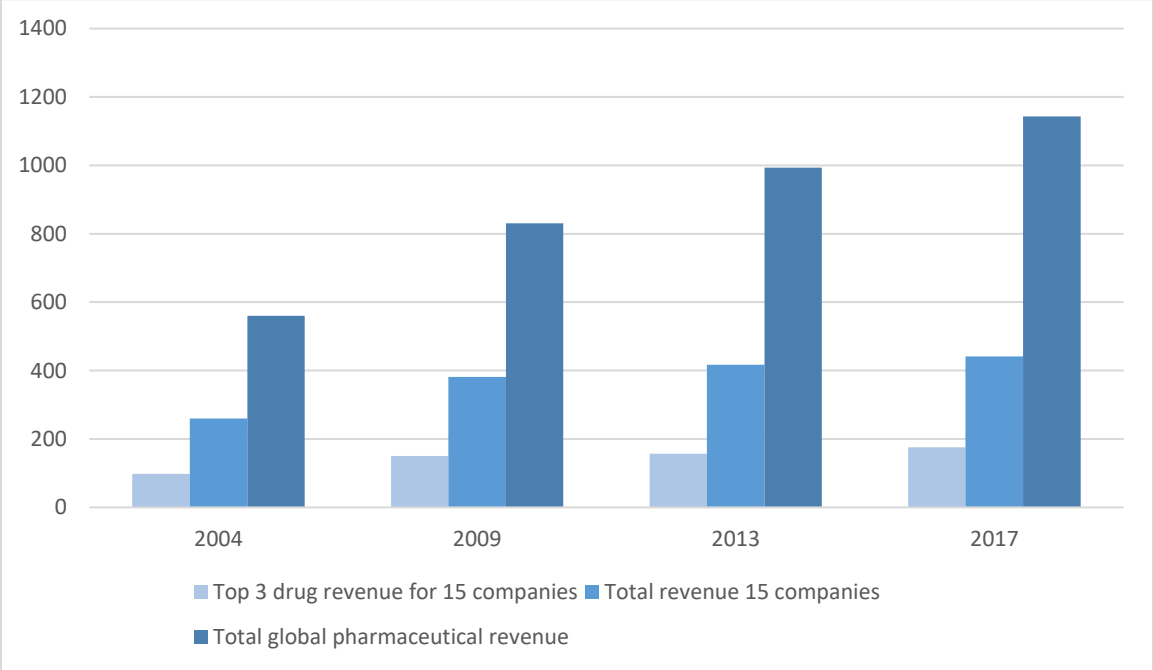


*Figure 4: Market revenue distributions*

On average, the accumulated revenue for the *Top 3* pharmaceuticals account for 36.34 percent of the fifteen companies' revenue and nearly 16 percent of total revenue for the global pharmaceutical industry. In 2013, 2009 and 2004 these drugs accounted for 15.83, 18.10 and 17.47 percent, respectively. For many companies, a major proportion of total revenue is generated by one or few blockbuster drugs. For example, 84 percent of AbbVie's revenue generated between 1997 and 2017 comes from a single *Immunosuppressant* pharmaceutical – Humira.

Minor variations occur for companies facing patent expiration dates, or patent cliffs, which occurs with the loss of several main patents protecting top pharmaceuticals. However, the variations are minor because the companies tend to have new pharmaceuticals in their pipeline. Through constant development and launches of new products, all companies are able to maintain high revenues even after major pharmaceuticals lose their status as *Top 3*.

In general, the *Top 3* pharmaceuticals generate higher revenues nearing their main patent expirations, however, exceptions to this trend occur for certain pharmaceuticals. For example, *Blood Medications* Aranesp and Procrit saw decreases in revenue after 2007, despite their exclusivity periods being valid. This was a result of new studies linking these pharmaceuticals with a higher risk of death among certain cancer patients. Due to the nature of the pharmaceutical industry, discoveries of long-term side effects often lead to market reactions such as new labelling guidelines by the FDA and hesitation to prescribe the medication from doctors. Nevertheless, these occurrences are relatively rare and generally have minor consequences for long-term revenue.

## 4.42 Revenue across categories

Revenues are shown to vary significantly across categories. Out of the ten categories identified, *Cancer* is the largest in terms of both revenue and number of pharmaceuticals that have been among the *Top 3* between 1997 and 2017. The second category in terms of revenue is *Blood Medication,* which includes pharmaceuticals to treat symptoms of anemia, high and low blood pressure and blood clots. There are twenty different pharmaceuticals in the *Blood Medication* category that generate 16 percent of the total revenues from all *Top 3* pharmaceuticals, exceeding $387 billion. The *antiviral* category also consists of twenty separate pharmaceuticals, but each generate lower revenues and only accounts for approximately 6.5 percent of total *Top 3* revenue during the timespan. Total revenues generated by *antivirals* have been $156.18 billion, an average of $7.81 billion per drug, while the cancer category generated total revenues of $487.7 billion, an average of $18.06 billion for each of the 27 pharmaceuticals. Differences in revenue can be attributed to only one third of name cancer pharmaceuticals having faced generic competition in the US market as of 2017. Figure 5 shows a breakdown of revenue as a percentage of company revenue across all ten categories.

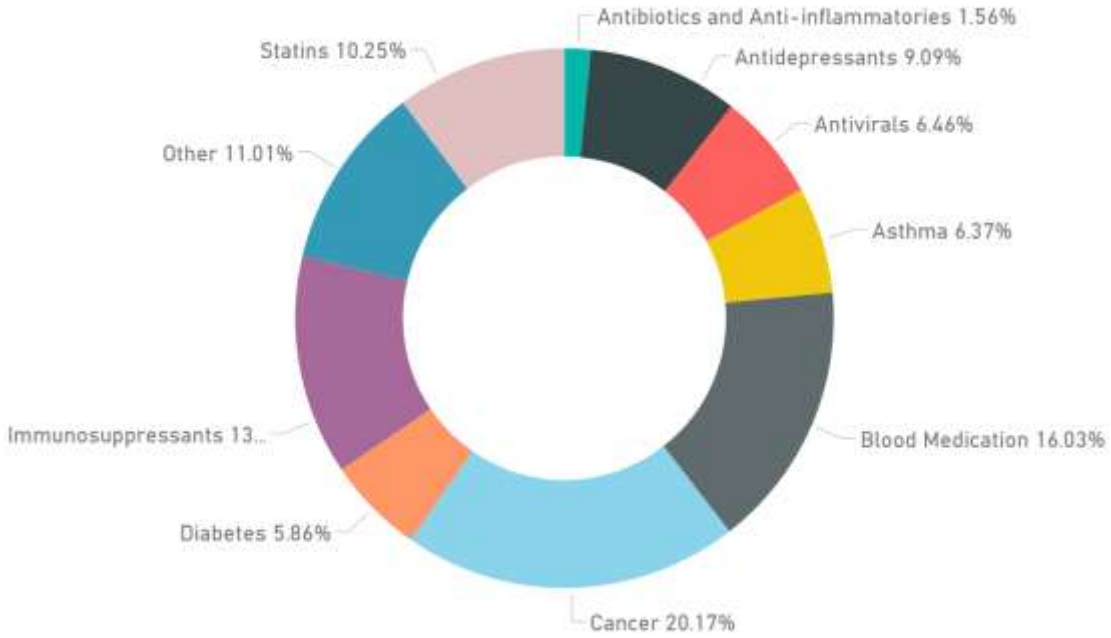


*Figure 5: Revenue from each pharmaceutical category as percentage of accumulated revenue from all 15 companies 1997-2017*

From the distribution of pharmaceuticals in each category, it becomes clear that all major companies mainly invest and develop pharmaceuticals that treat symptoms pertaining to the most common diseases in developed countries. Pharmaceuticals with the highest aggregated revenues are the ones that treat widespread diseases on a global scale. For example, both blood-related issues and viral infections are equally prevalent in advanced, developing and least developed nations. Intuitively, pharmaceuticals with a larger global market will generate higher revenues. However, due to the huge variations in sales prices for pharmaceuticals sold in different countries, investment decisions are mainly driven by demand in developed countries, most notably in the U.S, because this is where the majority of revenue for global pharmaceutical companies is generated. *Cancer* is the category generating the highest revenue per pharmaceutical, in addition to holding the highest number of pharmaceuticals brought to market. Cancer is not considered a leading cause of death in developing countries and has a limited market outside developed countries, yet 95 percent of revenue generated by Roche between 1997 and 2017 comes from its three main *Cancer* pharmaceuticals.

## 4.5 Patent Expiration and Generic Entry

Data on patent information is obtained through each company's annual statements. Data on generic approval in the U.S. and Europe is based on the FDA and EMA drug approval databases. In circumstances where generic approval is granted prior to the expiration of the brand name pharmaceuticals, the year of generic market entry is set to the same year as patent expiration due to the fact that generic manufacturers will have produced their products to be ready for commercial launch as soon as exclusivity rights expire. Dates of generic market entry are then compared to both the generic and brand name companies' press releases on generic launches. The largest generic pharmaceutical companies globally are the U.S based company Mylan Pharmaceuticals, Israeli based Teva Pharmaceuticals and Indian based Sun Pharma, Cipla, Ranbaxy Laboratories and Dr. Reddy's Laboratories. Most generics launched in the U.S., Europe and India are pharmaceuticals developed by these five companies.

Generics are copies of a small-molecule reference brand name pharmaceutical that is made from synthesized chemicals. Generics are identical in use, dosage, side effects, strength and active ingredient, i.e. it is chemically identical, to the original drug. Biologic pharmaceuticals are more complex, larger molecules derived from living cells. Because of their complex nature, most regulatory bodies have laid out stricter guidelines for producing 'generic' biologics, or so-called biosimilars. Unlike generics, biosimilars must go through several trials to prove they have similar effects and safety as the reference biologic. These processes significantly increase the cost of developing a biosimilar compared to synthesizing generics, though they are still significantly lower than developing novel pharmaceuticals (Biogen, n.d.). In the analysis, both biosimilars and generics are referred to as generics where specification is not decisive for the results.

There is limited public data on generic entry into the European market. Nevertheless, similar to brand name pharmaceuticals, it appears generics are launched within one year from U.S. launch. If they receive tentative approval prior to the brand name pharmaceuticals patent expiration, the launch date simultaneously occurs with the loss of exclusivity rights. Because of data limitation and correlation to the U.S. market, only data from India and the U.S. is utilized in the following section. A full overview of patents granted, expiration dates, generic market entry and number of years for brand name drugs to lose their *Top 3* position after generic competition is introduced in the European, U.S. and Indian markets can be found in Supplementary Material.

Total exclusivity periods vary across the pharmaceuticals and markets included in the analysis however, when exclusivity periods are longer than 20 years, this is often a result of patent extensions through evergreening. On the contrary, certain pharmaceuticals also show shorter exclusivity periods. Some pharmaceuticals have been discontinued voluntarily by the companies or had their active ingredients banned by government regulatory bodies. In these cases, the year of market ban has been used for patent expiration date because the active ingredient will not be approved by generic or other brand name manufacturers. Average exclusivity time includes estimated future expiration dates that may be subject to change through extensions or invalidations. A separate calculation includes only the patents that had already expired as of 2017. The results do not show a significant difference between both calculations. The average exclusivity time discussed in the following section therefore includes all *Top 3* products.

Data on patent grant and expiration dates in India prior to 2005 are not available, nor is data on the initial launch for brand name drugs. Therefore, this is not included in the analysis. Launch of generics on the Indian market is included to examine how generic competition affects brand name revenues.

### 4.51 Main findings

Brand name pharmaceuticals predating India's new intellectual property protection laws of 2005 face the highest generic competition in India. Numerous low-income countries rely on India for access to safe, affordable pharmaceuticals and the Indian government has faced resounding pressure from advocates to ensure the availability of generic pharmaceuticals to control major price increases after the new IP law was implemented. This is evident when looking at patent grant activity in India which grant far fewer patents than their counterparts. To achieve a successful grant, patents are required to have a more detailed scope, making evergreening and patent extensions less prevalent. The 2005 amendment states "the mere discovery of a new form of a known substance which does not result in the enhancement of the known efficacy" is not patentable (WHO, 2008). There have been many cases of patents being revoked, invalidated or narrowing of patent claims in Indian courts over the past ten years. Fewer brand name pharmaceuticals have been granted patents in India than in the U.S. and Europe, while many have had their patents revoked after generic manufacturers have challenged them in court. Pegasys was the first brand

name drug to be granted a patent under India's new laws, which was upheld by the Indian government in a 2009 litigation process. However, the patent was revoked on the grounds of uninventiveness in 2013. AbbVie's Kaletra, which holds over 75 patents worldwide, was not granted a patent by the Indian government because they deemed it non-inventive. This is not an unusual occurrence, mainly due to the lack of novelty if a generic is already in circulation. India allowed generics that were already being produced and sold prior to 2005 to continue operations even after brand name pharmaceuticals have been granted patents according to the amended IP laws. These factors have led to multiple generics being available on the Indian market for several years before the brand name pharmaceutical has lost its exclusivity rights. The societal implications of continued production have resulted in increased accessibility domestically and in developing nations abroad.

In addition. several brand name companies license to Indian generic companies to sell the brand name or generic versions in India and other developing countries while their pharmaceuticals still hold patents in the U.S. and Europe. For example, Gilead Sciences introduced generic versions of its brand names Epclusa, Harvoni and Sovaldi over ten years prior to its patent expirations. Gilead marketed the generics in the U.S. and Europe itself but licensed the drugs to Indian companies for marketing in other territories. Harvoni became a *Top 3* pharmaceutical one year after it was introduced in 2015 and despite facing generic competition, still generates the highest revenue of Gilead's pharmaceuticals in 2017. However, from 2015 to 2016 both Harvoni and Sovaldi experienced a decrease in revenue of 32 and 24 percent, respectively. In three years, Harvoni has generated a revenue of $27.32 billion worldwide. Sovaldi only remained a *Top 3* pharmaceutical for three years but within those years, had accumulated revenues of $19.56 billion and remains a high grossing drug for the company. The case of these three pharmaceuticals show that facing generic competition does not necessarily mean they cannot maintain high revenues. It is important to note that in this case, it was Gilead itself that produced and licensed its own generics and despite being lower than brand names, prices were likely kept higher than independent generic competitors.

When looking at total global revenues and the introduction of generic competition, the results shows that most brand name pharmaceuticals and their position as a *Top 3* are not affected by generics being launched in India. Furthermore, the results indicate that generic competition has

little effect on generated revenue before entry into the U.S. market. On average, generics are marketed in India 4.7 years prior to the brand name pharmaceuticals losing their U.S. and European patent protection. Most pharmaceuticals also generate the highest revenues in the years leading up to a pending patent expiration, several years after generics have been introduced in countries outside the U.S. Both Novartis' Gleevec and Eli Lilly's Alimta had generic versions launched in India within two years of market launch in the U.S. in the early 2000's, yet both brand name drugs still currently reside in the *Top 3.* Additionally, generics for GlaxoSmithKline's Valtrex were first marketed in India in 2007, the same year it became GSM's third highest earning drug. It spent its last year as a *Top 3* two years later, in 2009, which was the same year Valtrex' patents expired and generics entered the U.S. market. The results suggest this is the most common occurrence.

The majority of the *Top 3* pharmaceuticals lose their status as soon as generics enter the market in the U.S. Tentative FDA approval is often granted to generic pharmaceuticals prior to the brand names patents expire and are therefore ready to be launched immediately after patent expiration. Additionally, the first generic manufacturer to launch its product receives a 180-day exclusivity period, allowing the generic to take over a large portion of market share soon after its launch. When brand name pharmaceuticals lose their patent protection late in the year, they tend to hold their position as *Top 3* most of the following year even if a generic becomes available right after patent expiration. This can be explained by limited competition during the six-month exclusivity period. The largest revenue loss for brand name pharmaceuticals happens once this exclusivity expires and the market becomes open for all approved generics. For example, Teva secured an exclusivity period for its generic version of Pfizer's Zoloft after it lost patent protection. During those 180 days, the price of Zoloft decreased by approximately 40 percent. After the initial exclusivity, the market was flooded with other generics, including one from Pfizer itself, and Zoloft's price dropped an additional 40 percent. The excessive loss of revenue causes many companies to attempt further protection through additional patent applications.

Two of Celgene's blockbuster drugs, Revlimid and Thalomid, have dominated the *Top 3* pharmaceuticals for 12 and 13 years, respectively. Revlimid was launched in the U.S. in 2006 and generated the second highest revenue for Celgene its first year on the market and subsequently spent eleven consecutive years as the company's number one pharmaceutical. As of 2017, Revlimid had spent a total of sixteen years under patent protection in the U.S. Through

evergreening, Celgene has extended Revlimid's total exclusivity period to twenty-six years with an estimated patent expiration date in 2027. Generics of the products were launched in India in 2015, with no significant effect on revenue. The main European patent is expected to expire in 2024. One of Celgene's strategies to protect Revlimid from generic competition has been to build an impermeable fortress of patents in addition to preventing other companies from obtaining large enough quantities of the pharmaceutical to develop feasible alternatives (Williams S. , 2019). The lack of competition has allowed Celgene to charge exorbitant prices for Revlimid and the drug earned an aggregated revenue of $43.791 billion from 2006-2017. Extending monopolistic market power is not uncommon and proves the exploitative capabilities inherent in the current system. \

## 4.6 Limitations and Further Research

The research conducted has provided useful analyses but has limitations. The sample size pertaining to the top 3 drugs does not enable a complete perspective on the product line for each company. Furthermore, the analysis does not focus on the effects of specific policies but rather on recent developments in the industry as a whole. Local differences may not be reflected in the findings. Limited access to data on patent grants and expiration, generic market entry in Europe and India as well as estimations for future loss of exclusivity may contort the results. In addition, relative to the market size, the data sample is small. However, the fifteen major companies and data from the U.S. market, which dominates the industry, undoubtedly gives a good indication on general industry trends. Generic pharmaceutical companies are not analyzed, and it would be beneficial to conduct further studies into their effect on the global market. More in-depth analysis should be performed to uncover more specific effects of regional differences and other categories of pharmaceuticals. The thesis provides recommendations to counteract the imbalances and inefficiencies in the market, but further research must be done to determine feasibility and the potential impact of these changes. Because the patent system influences numerous stakeholders, successful execution will be challenging and time-consuming. Other options should be evaluated to discover the best course of action going forward.

# 5. Conclusion

The most significant finding in the company analysis is how revenue and pharmaceuticals are distributed amongst the nine main categories. Out of the 117 pharmaceuticals that have held *Top 3* positions between 1997 and 2017, only twenty-six were found outside of the main categories. When examining the categories, it becomes apparent that the predominate focus is on the Western markets. The subsequent profitability of drugs used to treat diseases prominent in industrialized countries incentivizes companies to focus their research and development efforts into these areas. As a result, it is indicative that medication for less developed countries was not prioritized, aligning with previous literature on the negligent impact of additional protection on research decisions. From an economic perspective, it is expected that pharmaceutical companies emphasize profit maximization over social welfare. This innate conundrum that is beholden on the pharmaceutical industry involves a major ethical component, namely providing global access to life-saving medication. Expecting private firms to solve a public issue is futile and unrealistic. For the pharmaceutical industry to consolidate the needs of both corporations and patients, the system regulating it must facilitate a mutually beneficial arrangement.

The analysis uncovered that introducing generic products in markets outside the U.S. had little effect on the companies aggregated revenue. In addition, the pervasive nature of counterfeit drugs in developing nations indicates an incessant need to adequately regulate manufacturing processes, mainly in India and China. Enforcing sufficient intellectual property standards can encourage licensing agreements, leading to high quality generics for developing nations. Furthermore, collaboration through partnerships and alliances between governments, non-profit organizations, regulatory authorities, multinational firms and generic manufacturers can be utilized to ensure objectives are unified and technology is protected. Enabling globalized standards allows for the allocation of resources to be optimized, creating efficiency and development opportunities for emerging nations. For this solution to be viable, several changes must be made to the current system. The obscure definitions of ‘obviousness’ create a convoluted process that has enabled the excessive granting of patents and subsequent increase in court cases. The initial grant of patents should have a narrower scope, focusing on the active ingredient or biologic of a pharmaceutical and not design, process or other frivolous claims. Companies should be able to inquire with local

patent authorities whether infringement has occurred, potentially limiting the extensive litigious process that greatly inhibits business operations.

Steps should also be made to limit patent extensions however, one imbalance is created by the patent system itself. A fixed patent term incentivizes companies to focus research efforts on pharmaceuticals that require shorter clinical trials and a quick commercialization process. Therefore, investment decisions are not based on pharmaceutical need but rather on which products will provide the longest exclusivity protection. One possible solution to rectify this issue is to implement a more flexible patent term based on the length of clinical trial processes required to develop different types of drugs. The pharmaceutical sector is unique compared to any other industry given the reliance on patent protection in business operations. Specific provisions for pharmaceutical protection are continuously incorporated into international agreements, leading to an optimistic outlook to address potential concerns.

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# Appendix

Figure 1a

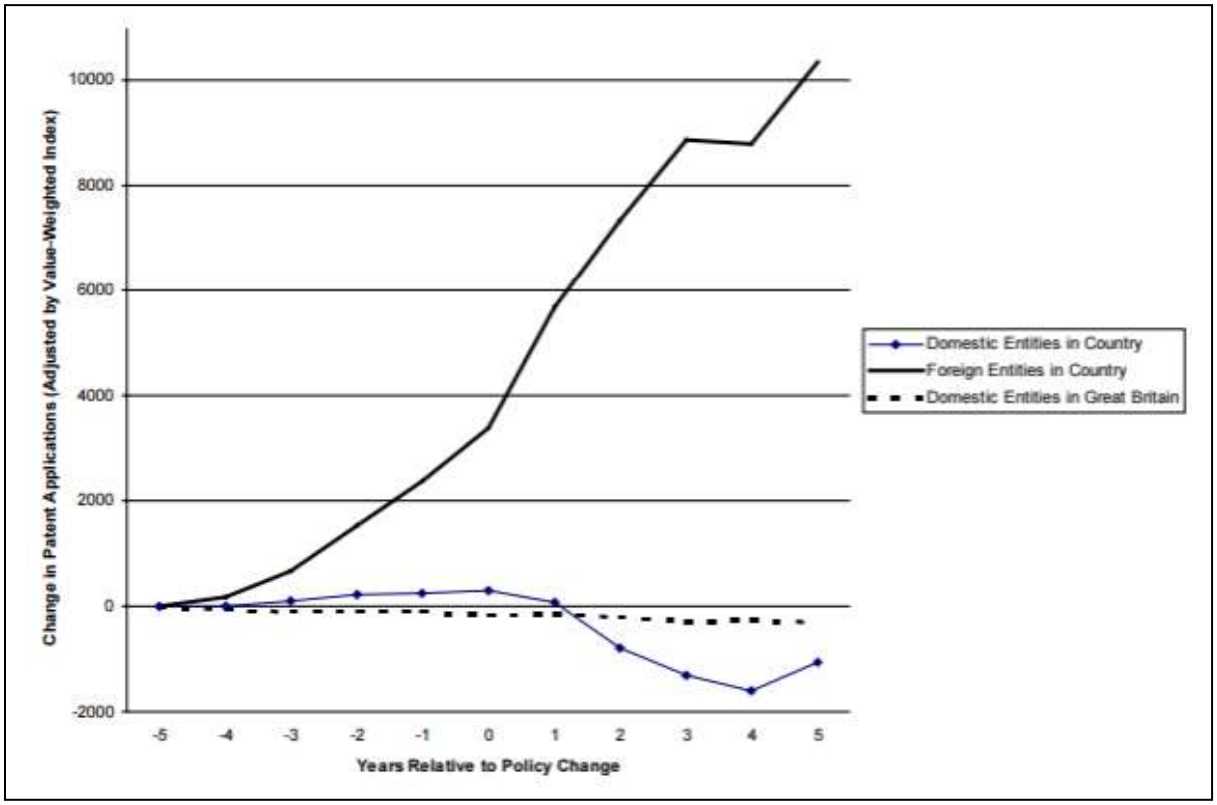



Figure 2a

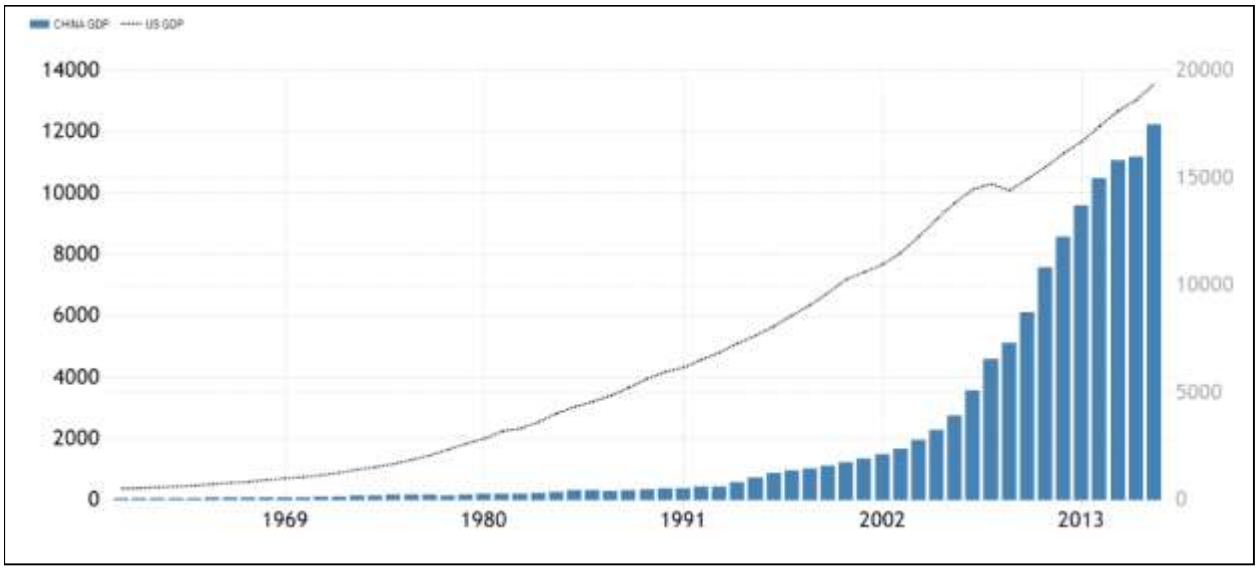


Figure 2b

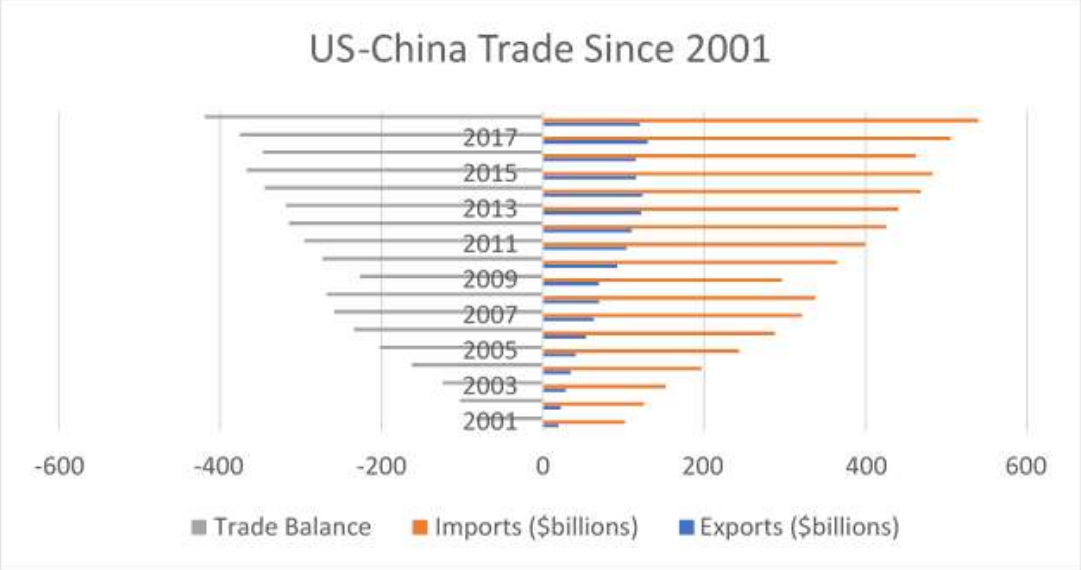



Figure 3a

| Time of Accession | Name of Convention or Treaty |
|---|---|
| June 3, 1980 | Convention Establishing the World Intellectual Property Organization (WIPO) |
| December 19, 1984 | Paris Convention |
| March 19,1985 | Paris Convention for the Protection of Industrial Property |
| June 27, 1989 | Madrid Protocol |
| February 1989 | Washington Convention |
| October 9, 1992 | Berne Convention<br>Universal copyright Convention |
| May 1, 1993 | Geneva Phongrams Convention |
| January 1, 1994 | Patent Cooperation Treaty |
| July 1, 1995 | Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purpose of Patent Procedure |
| September 19, 1996 | Locarno Agreement Establishing an International Classification for Industrial Designs |
| June 19, 1997 | Strasbourg Agreement Concerning the International Patent Classification |
| December 10, 2001 | Agreement on Trade-Related Aspects of Intellectual Property Rights |

Figure 4a

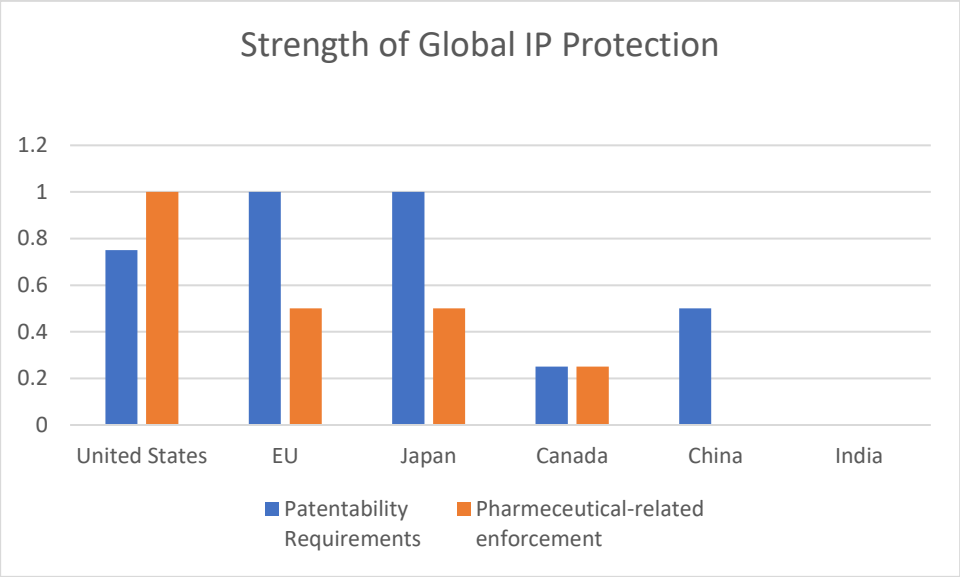



Figure 5a

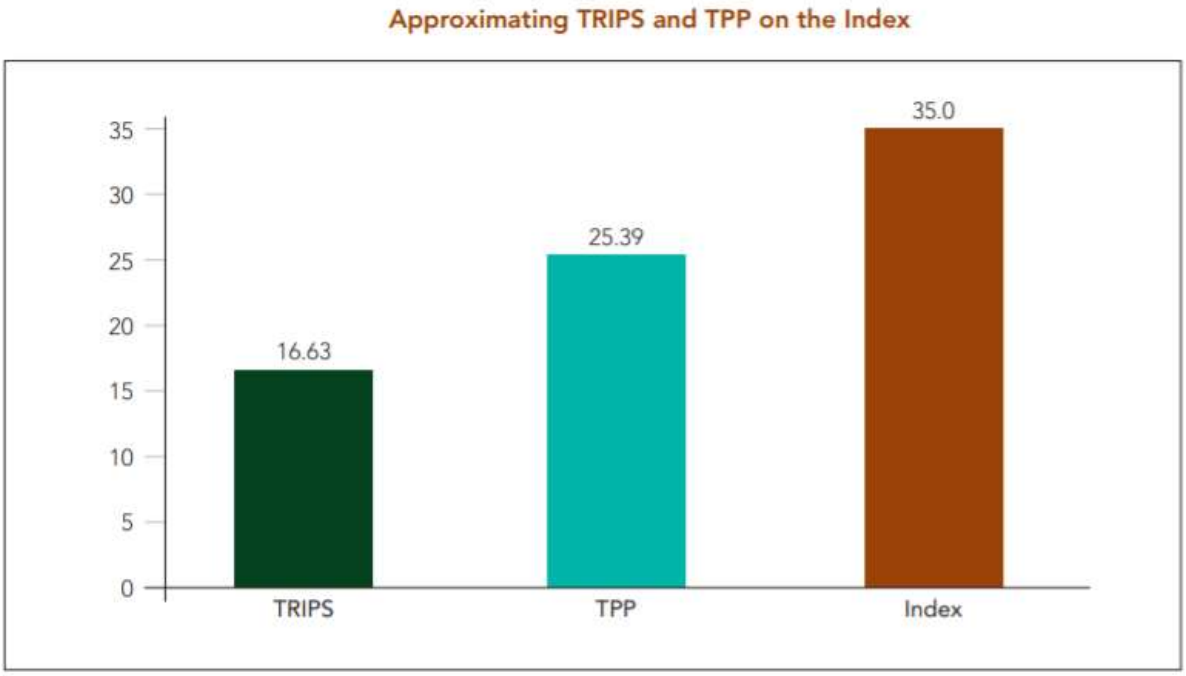


Figure 6a

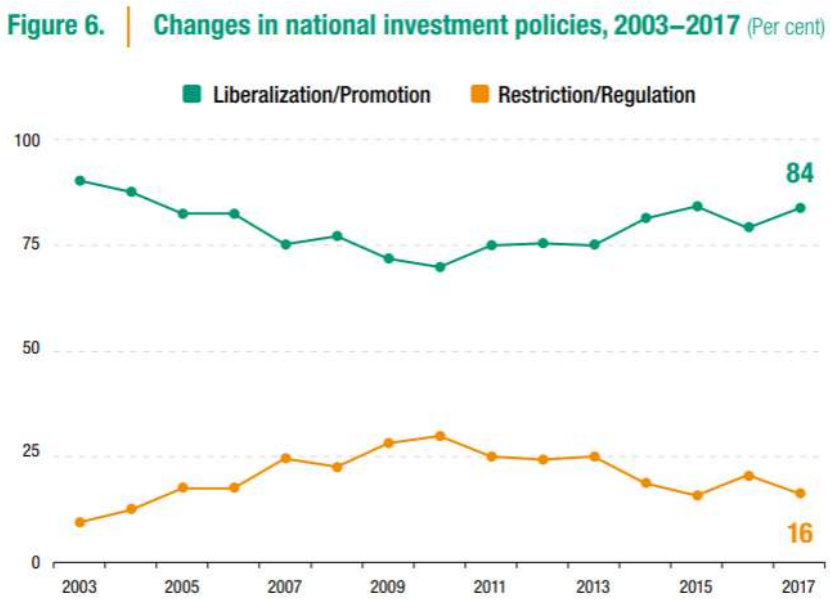



Figure 7a

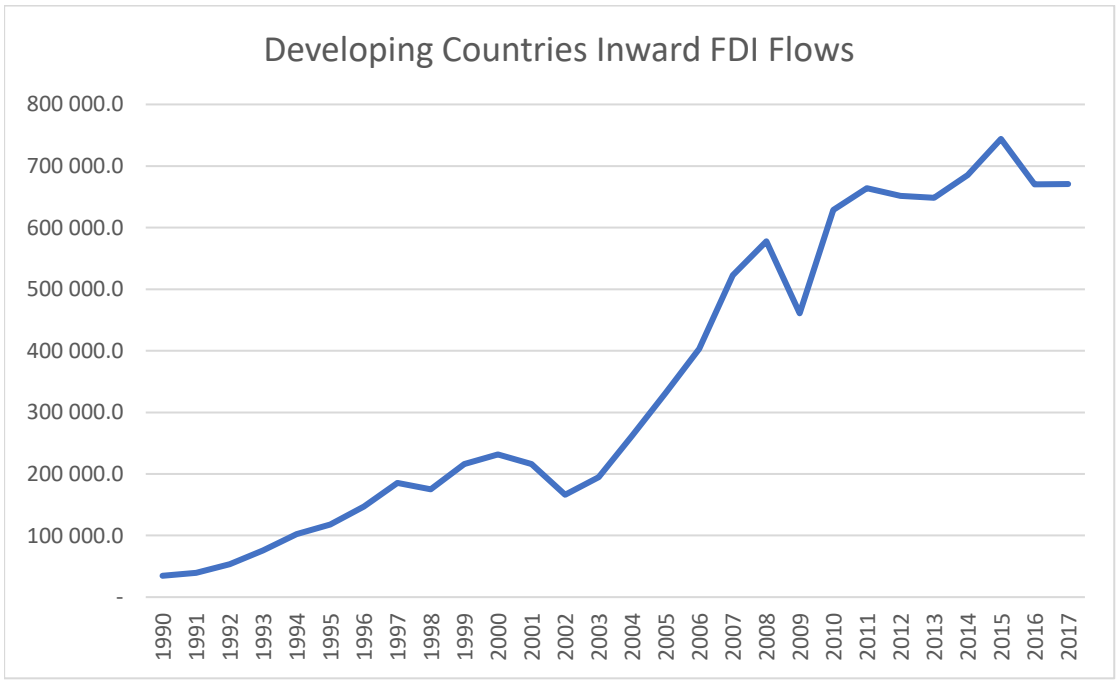


Figure 8a

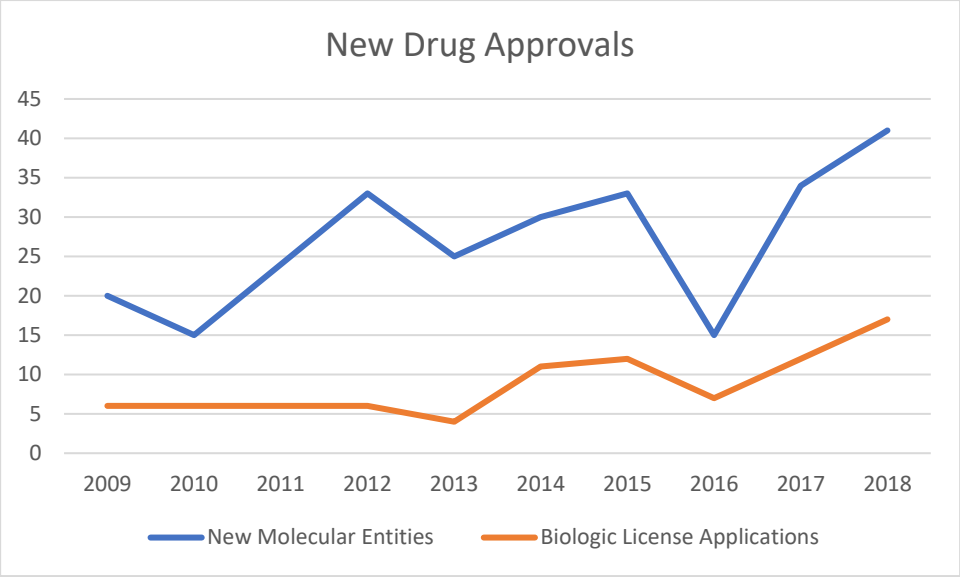



Figure 9a

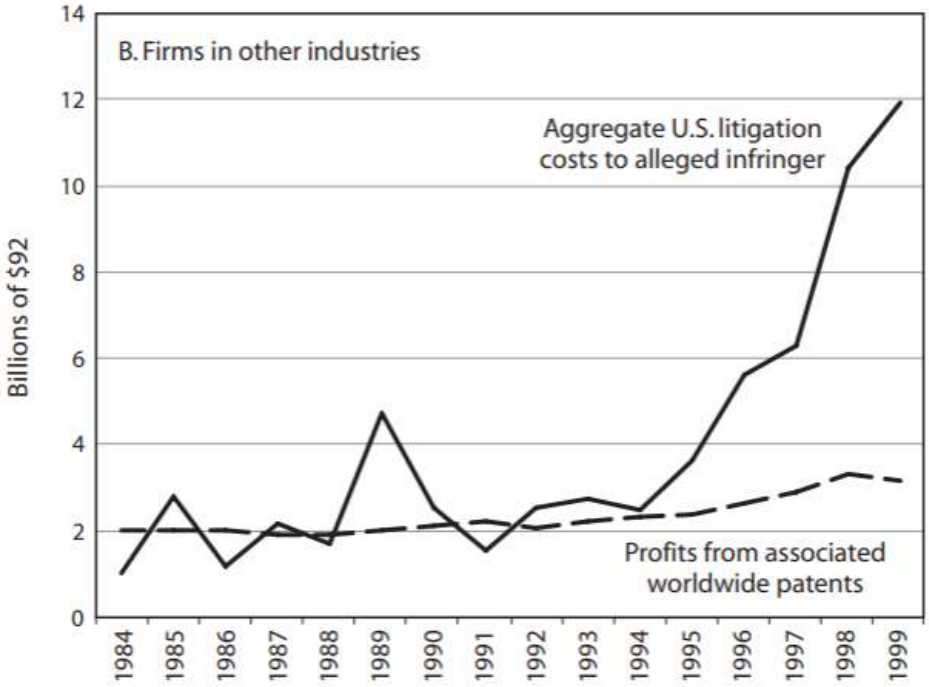


Figure 9b

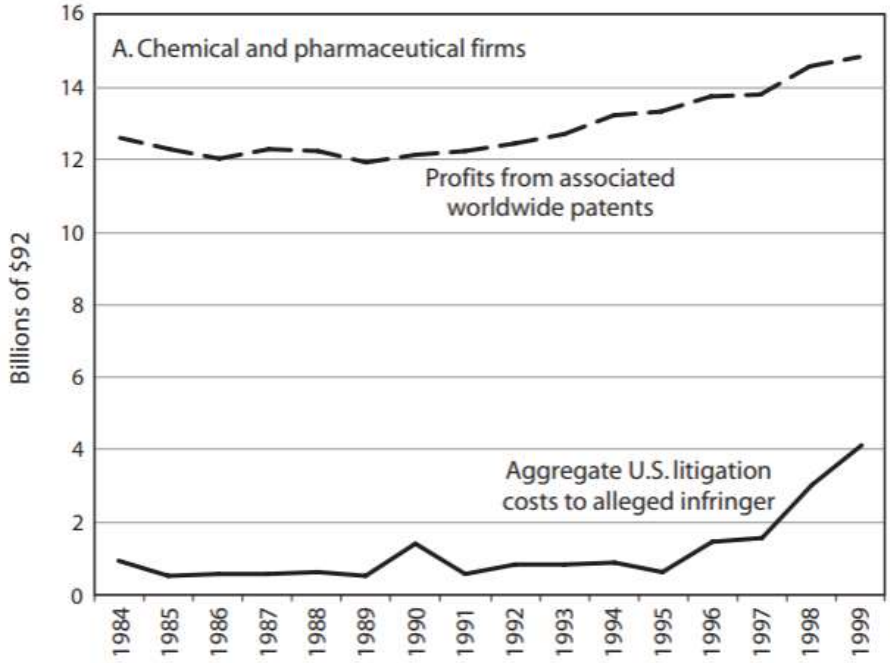



Figure 10a

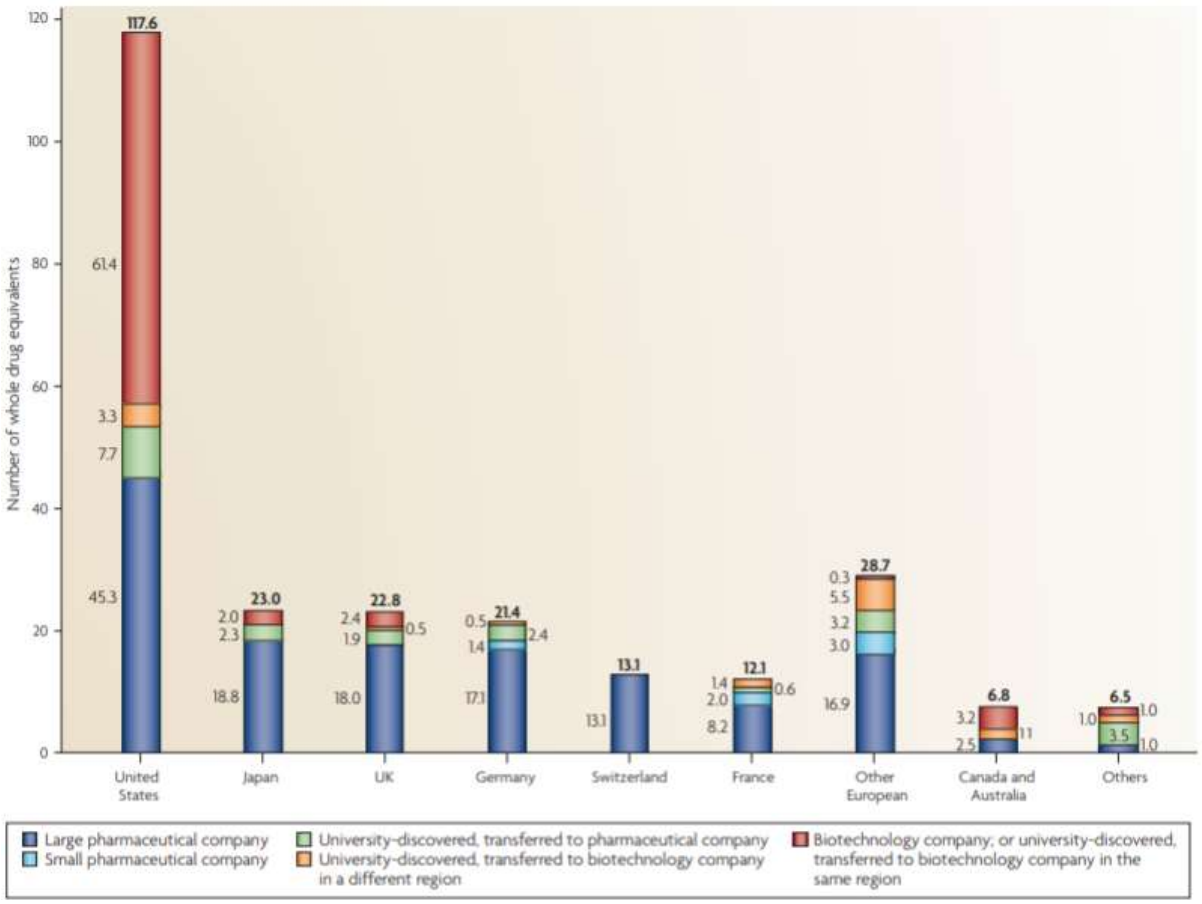


Figure 11a

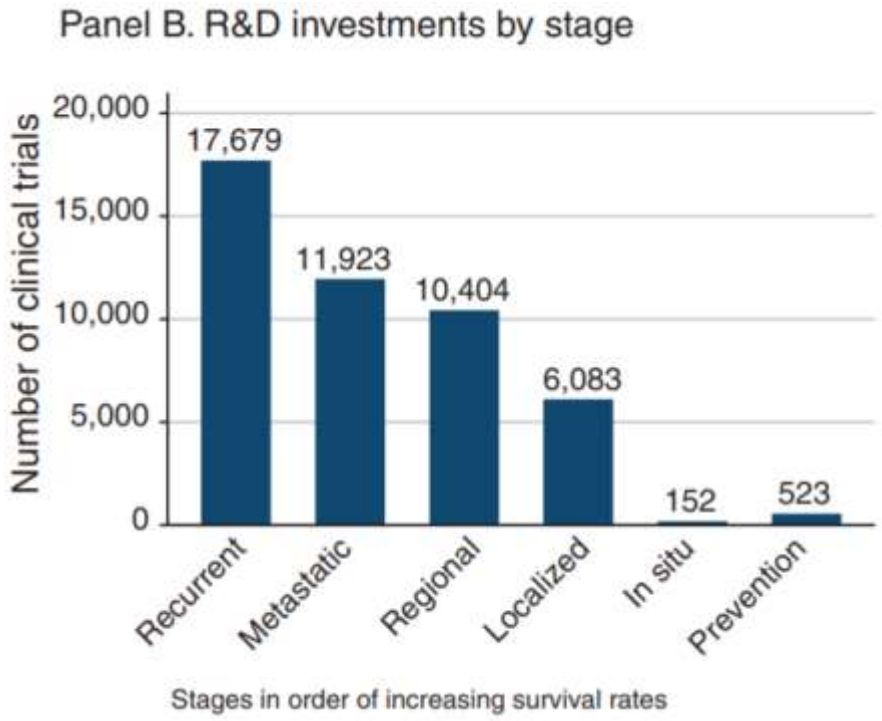
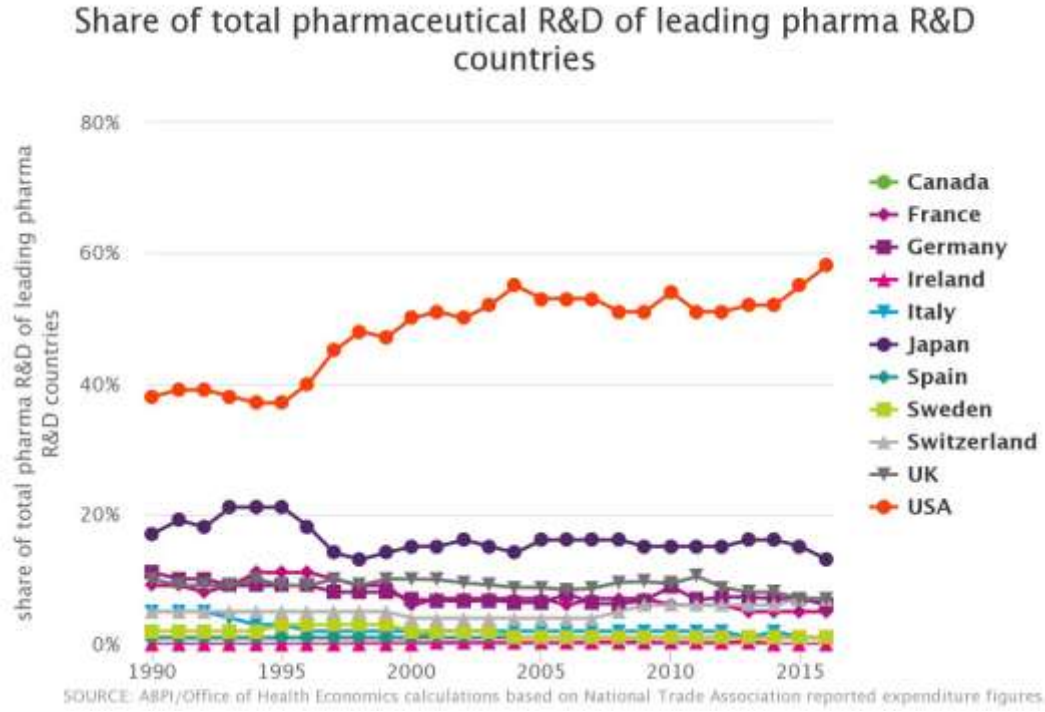



Figure 12a



# Supplementary Material

## Company overviews

| Exchange rate averages CPF-USD | Roche | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | Annual Revenue ($ billions) | Annual Revenue ($ billions) Pharmaceutical Division | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of total Revenue from top 3 drugs | % of pharmaceutical Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) |
| 1,015454 | 2017 | 54,123 | 41,837 | Rituxan | 7,502 | 13,86 % | 10,553 | 19,50 % | 39,57 % | 51,19 % | Herceptin | 7,122 | Avastin | 6,791 |
| 1,014806 | 2016 | 51,349 | 39,679 | Rituxan | 7,408 | 14,43 % | 10,047 | 19,57 % | 41,24 % | 53,36 % | Avastin | 6,883 | Herceptin | 6,882 |
| 1,036876 | 2015 | 49,874 | 38,675 | Rituxan | 7,305 | 14,65 % | 9,643 | 19,33 % | 42,14 % | 54,34 % | Avastin | 6,930 | Herceptin | 6,779 |
| 1,084623 | 2014 | 51,520 | 39,801 | Rituxan | 7,484 | 14,53 % | 9,667 | 18,76 % | 41,25 % | 53,39 % | Avastin | 6,960 | Herceptin | 6,806 |
| 1,073556 | 2013 | 50,221 | 38,974 | Rituxan | 7,462 | 14,86 % | 9,340 | 18,60 % | 41,22 % | 53,12 % | Avastin | 6,714 | Herceptin | 6,526 |
| 1,062474 | 2012 | 48,342 | 37,433 | Rituxan | 7,126 | 14,74 % | 9,004 | 18,63 % | 40,35 % | 52,11 % | Herceptin | 6,257 | Avastin | 6,124 |
| 1,113761 | 2011 | 47,369 | 36,525 | Rituxan | 6,688 | 14,12 % | 8,991 | 18,98 % | 38,91 % | 50,47 % | Avastin | 5,894 | Herceptin | 5,851 |
| 0,957983 | 2010 | 45,478 | 35,501 | Avastin | 6,190 | 13,61 % | 8,670 | 19,06 % | 38,43 % | 49,24 % | Rituxan | 6,089 | Herceptin | 5,201 |
| 0,974275 | 2009 | 47,789 | 37,993 | Avastin | 6,062 | 12,68 % | 9,620 | 20,13 % | 35,83 % | 45,07 % | Rituxan | 5,930 | Herceptin | 5,131 |
| 0,918114 | 2008 | 41,882 | 33,016 | Rituxan | 5,875 | 14,03 % | 8,121 | 19,39 % | 38,25 % | 48,52 % | Avastin | 5,155 | Herceptin | 4,989 |
| 0,800338 | 2007 | 36,922 | 29,439 | Rituxan | 4,415 | 11,96 % | 6,711 | 18,18 % | 31,37 % | 39,35 % | Herceptin | 3,883 | Avastin | 3,286 |
| 0,747482 | 2006 | 31,425 | 24,887 | Rituxan | 3,617 | 11,51 % | 4,925 | 15,67 % | 27,90 % | 35,23 % | Herceptin | 2,935 | Avastin | 2,214 |
| 0,753915 | 2005 | 26,772 | 20,558 | Rituxan | 3,132 | 11,70 % | 4,301 | 16,07 % | 24,08 % | 31,36 % | NeoRecormon/Epogii | 1,698 | Herceptin | 1,618 |
| 0,757836 | 2004 | 23,700 | 16,441 | Rituxan | 2,560 | 10,80 % | 3,860 | 16,29 % | 24,58 % | 35,43 % | NeoRecormon/Epogii | 2,082 | Pegasys+Copegus | 1,184 |
| 0,655957 | 2003 | 18,997 | 14,137 | Rituxan | 1,820 | 9,58 % | 3,044 | 16,03 % | 21,41 % | 28,77 % | NeoRecormon/Epogii | 1,345 | Rocephin | 0,902 |
| 0,445564 | 2002 | 11,827 | 8,602 | Rituxan | 1,039 | 8,79 % | 1,735 | 14,67 % | 19,11 % | 26,27 % | Rocephin | 0,690 | NeoRecormon/Epogi | 0,531 |
| 0,313068 | 2001 | 9,130 | 5,905 | Rocephin | 0,532 | 5,82 % | 1,219 | 13,35 % | 15,63 % | 24,17 % | Rituxan | 0,531 | Accutane | 0,365 |
| 0,310856 | 2000 | 8,562 | 5,498 | Accutane | 0,398 | 4,65 % | 1,218 | 14,23 % | 9,88 % | 15,38 % | CellCept | 0,246 | NeoRecormon/Epogi | 0,202 |
| 0,496159 | 1999 | 13,678 | 8,180 | Rocephin | 0,873 | 6,38 % | 1,876 | 13,72 % | 13,57 % | 22,68 % | Accutane | 0,516 | Xenical | 0,466 |
| 0,551142 | 1998 | 13,592 | 7,923 | | | | 1,878 | 13,82 % | | | | | | |
| 0,5493802 | 1997 | 10,318 | 6,636 | | | | 1,596 | 15,47 % | | | | | | |
| | Average | NB Some of the changes are bc of changes in local cu | | | | 11,72 % | | 17,38 % | 30,77 % | 40,50 % | | | | |
| | Max | 527,640 | | | | 14,86 % | | 20,13 % | 42,14 % | 54,34 % | | | | |
| | Min | | | | | 4,65 % | | 13,35 % | 9,88 % | 15,38 % | | | | |

| Pfizer | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Annual Revenue ($ billions) | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) | Pfizer worlds largest company based on pure pharma revenue (therefore pharma division not included) |
| 2017 | 52,546 | Prevnar 13 | 5,601 | 10,66 % | 7,657 | 14,57 % | 26,25 % | Lyrica | 5,065 | Ibrance | 3,126 | |
| 2016 | 52,824 | Prevnar 13 | 5,718 | 10,82 % | 7,872 | 14,90 % | 25,73 % | Lyrica | 4,966 | Enbrel | 2,909 | |
| 2015 | 48,851 | Prevnar 13 | 6,145 | 12,58 % | 7,690 | 15,74 % | 29,31 % | Lyrica | 4,839 | Enbrel | 3,333 | |
| 2014 | 49,605 | Lyrica | 5,168 | 10,42 % | 8,393 | 16,92 % | 27,18 % | Prevnar 13 | 4,464 | Enbrel | 3,850 | |
| 2013 | 51,584 | Lyrica | 4,595 | 8,91 % | 6,678 | 12,95 % | 23,93 % | Prevnar 13 | 3,974 | Enbrel | 3,774 | |
| 2012 | 58,986 | Lyrica | 4,158 | 7,05 % | 7,870 | 13,34 % | 20,08 % | Lipitor | 3,948 | Enbrel | 3,737 | |
| 2011 | 67,425 | Lipitor | 9,577 | 14,20 % | 9,112 | 13,51 % | 25,12 % | Lyrica | 3,693 | Enbrel | 3,666 | |
| 2010 | 67,809 | Lipitor | 10,733 | 15,83 % | 9,413 | 13,88 % | 25,17 % | Enbrel | 3,274 | Lyrica | 3,063 | |
| 2009 | 50,009 | Lipitor | 11,434 | 22,86 % | 7,845 | 15,69 % | 33,31 % | Lyrica | 2,840 | Celebrex | 2,383 | |
| 2008 | 48,296 | Lipitor | 12,401 | 25,68 % | 7,945 | 16,45 % | 36,16 % | Lyrica | 2,573 | Celebrex | 2,489 | |
| 2007 | 48,418 | Lipitor | 12,675 | 26,18 % | 8,089 | 16,71 % | 37,11 % | Norvasc | 3,001 | Celebrex | 2,290 | |
| 2006 | 48,371 | Lipitor | 12,886 | 26,64 % | 7,599 | 15,71 % | 41,06 % | Norvasc | 4,866 | Zoloft | 2,110 | |
| 2005 | 47,405 | Lipitor | 12,187 | 25,71 % | 7,442 | 15,70 % | 42,50 % | Norvasc | 4,706 | Zoloft | 3,256 | |
| 2004 | 48,988 | Lipitor | 10,862 | 22,17 % | 7,684 | 15,69 % | 38,14 % | Norvasc | 4,463 | Zoloft | 3,361 | |
| 2003 | 44,736 | Lipitor | 9,231 | 20,63 % | 7,487 | 16,74 % | 37,30 % | Norvasc | 4,336 | Zoloft | 3,118 | |
| 2002 | 32,373 | Lipitor | 7,972 | 24,63 % | 5,176 | 15,99 % | 44,98 % | Norvasc | 3,846 | Zoloft | 2,742 | |
| 2001 | 29,024 | Lipitor | 6,448 | 22,22 % | 4,776 | 16,46 % | 42,70 % | Norvasc | 3,581 | Zoloft | 2,365 | |
| 2000 | 29,574 | Lipitor | 5,031 | 17,01 % | 4,435 | 15,00 % | 35,62 % | Norvasc | 3,362 | Zoloft | 2,140 | |
| 1999 | 27,376 | Lipitor | 3,795 | 13,86 % | 4,036 | 14,74 % | 32,08 % | Norvasc | 2,991 | Zoloft | 1,997 | |
| 1998 | 13,544 | Novarsc | 2,575 | 19,01 % | 3,305 | 24,40 % | 40,25 % | Zoloft | 1,836 | Zithromax | 1,041 | |
| 1997 | 11,055 | Novarsc | 2,217 | 20,05 % | 1,805 | 16,33 % | 41,66 % | Zoloft | 1,507 | Diflucan | 0,881 | |
| | | | 161,409 | 17,96 % | | 15,78 % | 33,60 % | | | | | |
| | | | | 26,64 % | | 24,40 % | 44,98 % | | | | | |
| | | | | 7,05 % | | 12,95 % | 20,08 % | | | | | |

| | Novartis | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exchange rate averages CPF-USD | Year | Annual Revenue ($ billions) | Annual Revenue ($ billions) Pharmaceutical Division | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of total Revenue from top 3 drugs | % of pharmaceutical Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) |
| | 2017 | 49,109 | 43,085 | Gilenya | 3,185 | 6,49 % | 9,000 | 18,33 % | 14,66 % | 16,71 % | Cosentyx | 2,071 | Gleevec | 1,943 |
| | 2016 | 48,518 | 42,706 | Gleevec | 3,323 | 6,85 % | 9,024 | 18,60 % | 17,04 % | 19,36 % | Gilenya | 3,109 | Lucentis | 1,835 |
| | 2015 | 49,414 | 39,602 | Gleevec | 4,658 | 9,43 % | 8,900 | 18,01 % | 19,21 % | 23,97 % | Gilenya | 2,776 | Lucentis | 2,060 |
| | 2014 | 57,996 | 47,169 | Gleevec | 4,746 | 8,18 % | 9,917 | 17,10 % | 16,66 % | 20,49 % | Gilenya | 2,477 | Lucentis | 2,441 |
| | 2013 | 57,920 | 47,424 | Gleevec | 4,693 | 8,10 % | 9,846 | 17,00 % | 18,30 % | 22,35 % | Diovan | 3,524 | Lucentis | 2,383 |
| | 2012 | 56,673 | 46,448 | Gleevec | 4,675 | 8,25 % | 9,116 | 16,09 % | 20,27 % | 24,74 % | Diovan | 4,417 | Lucentis | 2,398 |
| | 2011 | 58,566 | 48,608 | Diovan | 5,665 | 9,67 % | 9,239 | 15,78 % | 21,13 % | 25,46 % | Gleevec | 4,659 | Lucentis | 2,050 |
| | 2010 | 50,624 | 48,198 | Diovan | 6,053 | 11,96 % | 8,080 | 15,96 % | 23,41 % | 24,59 % | Gleevec | 4,265 | Lucentis | 1,533 |
| | 2009 | 44,267 | 44,200 | Diovan | 6,013 | 13,58 % | 7,469 | 16,87 % | 25,81 % | 25,85 % | Gleevec | 3,944 | Zometa | 1,469 |
| | 2008 | 41,459 | 41,459 | Diovan | 5,740 | 13,85 % | 7,217 | 17,41 % | 26,03 % | 26,03 % | Gleevec | 3,670 | Zometa | 1,382 |
| Both Sand | 2007 | 39,800 | 39,800 | Diovan | 5,012 | 12,59 % | 6,430 | 16,16 % | 23,52 % | 23,52 % | Gleevec | 3,050 | Zometa | 1,297 |
| Before 200 | 2006 | 37,020 | 37,020 | Diovan | 4,223 | 11,41 % | 5,349 | 14,45 % | 21,96 % | 21,96 % | Gleevec | 2,554 | Lotrel | 1,352 |
| | 2005 | 31,212 | 31,212 | Diovan | 3,676 | 11,78 % | 4,846 | 15,53 % | 22,65 % | 22,65 % | Gleevec | 2,170 | Zometa | 1,224 |
| | 2004 | 28,247 | 28,247 | Diovan | 3,093 | 10,95 % | 4,207 | 14,89 % | 20,85 % | 20,85 % | Gleevec | 1,634 | Lamisil | 1,162 |
| | 2003 | 24,864 | 24,864 | Diovan | 2,425 | 9,75 % | 3,628 | 14,59 % | 18,39 % | 18,39 % | Gleevec | 1,128 | Neoral/Sandimmun | 1,020 |
| 0,445564 | 2002 | 14,442 | 14,442 | Diovan | 1,150 | 7,96 % | 1,933 | 13,39 % | 17,10 % | 17,10 % | Neoral/Sandimmun | 0,716 | Lamisil | 0,604 |
| 0,313068 | 2001 | 10,030 | 9,471 | Diovan | 0,589 | 5,87 % | 1,311 | 13,08 % | 16,32 % | 17,28 % | Neoral/Sandimmun | 0,573 | Cibacen/Lotensin (inc | 0,475 |
| 0,310856 | 2000 | 9,050 | 8,617 | | | N/A | 1,247 | 13,78 % | N/A | | | | | |
| 0,496159 | 1999 | 12,607 | 11,797 | | | N/A | 1,744 | 13,83 % | N/A | | | | | |
| 0,551142 | 1998 | | | | | N/A | | N/A | N/A | | | | | |
| 0,549802 | 1997 | | | | | N/A | | N/A | N/A | | | | | |
| | Average | | 654,368 | | | 9,80 % | | 15,83 % | 20,19 % | 21,84 % | | | | |
| | Max | | | | | 13,85 % | | 18,60 % | 26,03 % | 26,03 % | | | | |
| | Min | | | | | 5,87 % | | 13,08 % | 14,66 % | 16,71 % | | | | |

**Merck and Co.**

| Year | Annual Revenue ($ billions) | Annual Revenue ($ billions) Pharmaceutical Division | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of total Revenue from top 3 drugs | % of pharmaceutical Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | 40,122 | 35,390 | Januvia | 5,896 | 14,70 % | 10,208 | 25,44 % | 29,94 % | 33,94 % | Keytruda | 3,809 | Gardasil | 2,308 |
| 2016 | 39,807 | 35,151 | Januvia | 6,109 | 15,35 % | 10,124 | 25,43 % | 30,10 % | 34,09 % | Zetia/Vytorin | 3,701 | Gardasil | 2,173 |
| 2015 | 39,498 | 34,782 | Januvia | 3,863 | 9,78 % | 6,705 | 16,98 % | 21,62 % | 24,55 % | Zetia | 2,526 | Janumet | 2,151 |
| 2014 | 42,237 | 36,042 | Januvia | 3,931 | 9,31 % | 7,180 | 17,00 % | 21,20 % | 24,84 % | Zetia | 2,650 | Remicade | 2,372 |
| 2013 | 44,033 | 37,437 | Januvia | 4,004 | 9,09 % | 7,503 | 17,04 % | 20,29 % | 23,86 % | Zetia | 2,658 | Remicade | 2,271 |
| 2012 | 47,267 | 40,601 | Januvia | 4,086 | 8,64 % | 8,168 | 17,28 % | 16,73 % | 19,48 % | Remicade | 2,076 | Zetia | 1,747 |
| 2011 | 48,047 | 41,289 | Singulair | 5,479 | 11,40 % | 8,467 | 17,62 % | 23,87 % | 27,78 % | Januvia | 3,324 | Remicade | 2,667 |
| 2010 | 45,987 | 39,811 | Singulair | 4,987 | 10,84 % | 10,991 | 23,90 % | 21,93 % | 25,33 % | Remicade | 2,714 | Januvia | 2,385 |
| 2009 | 27,428 | 25,237 | Singulair | 4,669 | 17,02 % | 5,845 | 21,31 % | 37,01 % | 40,23 % | Cozaar/Hyzaar | 3,561 | Januvia | 1,922 |
| 2008 | 23,850 | 23,620 | Singulair | 4,337 | 18,18 % | 4,805 | 20,15 % | 39,61 % | 40,00 % | Cozaar/Hyzaar | 3,558 | Fosamax | 1,553 |
| 2007 | 24,198 | 23,939 | Singulair | 4,266 | 17,63 % | 4,883 | 20,18 % | 44,55 % | 45,03 % | Cozaar/Hyzaar | 3,350 | Fosamax | 3,163 |
| 2006 | 22,363 | 22,080 | Singulair | 4,358 | 19,49 % | 4,783 | 21,39 % | 47,14 % | 47,74 % | Cozaar/Hyzaar | 3,049 | Fosamax | 3,134 |
| 2005 | 22,012 | 21,825 | Zocor | 4,382 | 19,91 % | 3,848 | 17,48 % | 48,20 % | 48,61 % | Fosamax | 3,191 | Cozaar/Hyzaar | 3,037 |
| 2004 | 22,937 | 22,715 | Zocor | 5,197 | 22,66 % | 4,010 | 17,48 % | 48,75 % | 49,22 % | Fosamax | 3,160 | Cozaar/Hyzaar | 2,824 |
| 2003 | 22,486 | 22,257 | Zocor | 5,011 | 22,28 % | 3,280 | 14,59 % | 45,53 % | 45,99 % | Fosamax | 2,677 | Vioxx | 2,549 |
| 2002 | 51,790 | 18,867 | Zocor | 5,600 | 10,81 % | 2,700 | 5,21 % | 19,89 % | 54,59 % | Vioxx | 2,500 | Fosamax | 2,200 |
| 2001 | 47,716 | 17,792 | Zocor | 5,264 | 11,03 % | 2,500 | 5,24 % | 19,31 % | 51,80 % | Vioxx | 2,358 | Fosamax | 1,594 |
| 2000 | 40,363 | 16,058 | Zocor | 2,207 | 5,47 % | 2,300 | 5,70 % | 10,97 % | 27,58 % | Vioxx | 1,518 | Fosamax | 0,704 |
| 1999 | 32,714 | 15,661 | | | | 2,068 | 6,32 % | | | | | | |
| 1998 | 26,898 | 13,985 | | | | 1,812 | 6,74 % | | | | | | |
| 1997 | 23,637 | 14,197 | | | | 1,684 | 7,12 % | | | | | | |
| Average | | 558,736 | | | 14,09 % | | 15,70 % | 30,37 % | 36,93 % | | | | |
| Max | | | | | 22,66 % | | 25,44 % | 48,75 % | 54,59 % | | | | |
| Min | | | | | 5,47 % | | 5,21 % | 10,97 % | 19,48 % | | | | |

| AbbVie | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Annual Revenue ($ billions) | Annual Revenue ($ billions) Pharmaceutical Division | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) |
| 2017 | 28,216 | Operates only i | Humira | 18,427 | 65,31 % | 4,982 | 17,66 % | 77,36 % | Imbruvica | 2,573 | Lupron | 0,829 |
| 2016 | 25,638 | | Humira | 16,078 | 62,71 % | 4,366 | 17,03 % | 75,79 % | Imbruvica | 1,832 | Viekira | 1,522 |
| 2015 | 22,859 | | Humira | 14,012 | 61,30 % | 4,285 | 18,75 % | 72,08 % | Viekira | 1,639 | Lupron | 0,826 |
| 2014 | 19,960 | | Humira | 12,543 | 62,84 % | 3,297 | 16,52 % | 71,88 % | AndroGel | 0,934 | Kaletra | 0,870 |
| 2013 | 18,790 | | Humira | 10,659 | 56,73 % | 2,855 | 15,19 % | 67,35 % | AndroGel | 1,035 | Kaletra | 0,962 |
| 2012 | 18,012 | | Humira | 9,265 | 51,44 % | 2,778 | 15,42 % | 63,93 % | AndroGel | 1,152 | TriCor/Tril | 1,098 |
| 2011 | 17,022 | | Humira | 7,932 | 46,60 % | 2,618 | 15,38 % | 61,53 % | TriCor/Trilipix | 1,372 | Kaletra | 1,170 |
| 2010 | 19,894 | | Humira | 6,508 | 32,71 % | 2,495 | 12,54 % | 45,67 % | TriCor/Trilipix | 1,355 | Kaletra | 1,223 |
| 2009 | 16,486 | | Humira | 5,500 | 33,36 % | 1,707 | 10,35 % | 33,36 % | | | | |
| 2008 | 16,708 | | Humira | 4,500 | 26,93 % | | | 26,93 % | | | | |
| 2007 | 14,630 | | Humira | 3,000 | 20,51 % | | | | | | | |
| | Information prior to 2007 not possible to obtain for pharmaceuticals | | | | | | | | | | | |
| Average | 218,215 | | | | 47,31 % | | 15,43 % | 59,59 % | | | | |
| Max | | | | | 65,31 % | | 18,75 % | 77,36 % | | | | |
| Min | | | | | 20,51 % | | 10,35 % | 26,93 % | | | | |

| Eli Lilly & Co. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Annual Revenue ($ billions) | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) |
| 2017 | 22,871 | Humalog | 2,865 | 12,53 % | 5,282 | 23,09 % | 32,67 % | Cialis | 2,323 | Alimta | 2,283 |
| 2016 | 21,222 | Humalog | 2,842 | 13,39 % | 5,244 | 24,71 % | 36,03 % | Alimta | 2,493 | Cialis | 2,311 |
| 2015 | 19,959 | Humalog | 2,842 | 14,24 % | 4,796 | 24,03 % | 38,31 % | Alimta | 2,493 | Cialis | 2,311 |
| 2014 | 19,616 | Alimta | 2,792 | 14,23 % | 4,734 | 24,13 % | 40,11 % | Humalog | 2,785 | Cialis | 2,291 |
| 2013 | 23,113 | Cymbalta | 5,084 | 22,00 % | 5,531 | 23,93 % | 44,99 % | Alimta | 2,703 | Humalog | 2,611 |
| 2012 | 22,603 | Cymbalta | 4,994 | 22,09 % | 5,278 | 23,35 % | 43,77 % | Alimta | 2,594 | Humalog | 2,306 |
| 2011 | 24,287 | Zyprexa | 4,622 | 19,03 % | 5,021 | 20,67 % | 46,30 % | Cymbalta | 4,162 | Alimta | 2,461 |
| 2010 | 23,076 | Zyprexa | 5,026 | 21,78 % | 4,884 | 21,17 % | 46,34 % | Cymbalta | 3,459 | Alimta | 2,209 |
| 2009 | 21,836 | Zyprexa | 4,916 | 22,51 % | 4,327 | 19,81 % | 45,56 % | Cymbalta | 3,075 | Humalog | 1,959 |
| 2008 | 20,378 | Zyprexa | 4,696 | 23,04 % | 3,841 | 18,85 % | 44,80 % | Cymbalta | 2,697 | Humalog | 1,736 |
| 2007 | 18,634 | Zyprexa | 4,761 | 25,55 % | 3,487 | 18,71 % | 45,38 % | Cymbalta | 2,103 | Gemzar | 1,592 |
| 2006 | 15,691 | Zyprexa | 4,364 | 27,81 % | 3,129 | 19,94 % | 45,17 % | Gemzar | 1,408 | Cymbalta | 1,316 |
| 2005 | 14,645 | Zyprexa | 4,202 | 28,69 % | 3,026 | 20,66 % | 45,98 % | Gemzar | 1,335 | Humalog | 1,198 |
| 2004 | 13,858 | Zyprexa | 4,420 | 31,89 % | 2,691 | 19,42 % | 48,61 % | Gemzar | 1,214 | Humalog | 1,102 |
| 2003 | 12,583 | Zyprexa | 4,277 | 33,99 % | 2,305 | 18,32 % | 50,54 % | Humulin | 1,060 | Gemzar | 1,022 |
| 2002 | 11,078 | Zyprexa | 3,689 | 33,30 % | 2,149 | 19,40 % | 50,26 % | Humulin | 1,004 | Gemzar | 0,875 |
| 2001 | 11,543 | Zyprexa | 3,087 | 26,74 % | 2,235 | 19,36 % | 53,18 % | Prozac | 1,990 | Humulin | 1,061 |
| 2000 | 10,862 | Prozac | 2,574 | 23,69 % | 2,019 | 18,58 % | 55,59 % | Zyprexa | 2,350 | Humulin | 1,115 |
| 1999 | 10,003 | Prozac | 2,613 | 26,13 % | 1,784 | 17,83 % | 49,53 % | Zyprexa | 1,885 | Gemzar | 0,456 |
| 1998 | 9,237 | Prozac | 2,812 | 30,44 % | 1,739 | 18,83 % | 50,58 % | Zyprexa | 1,443 | Axid | 0,418 |
| 1997 | 8,158 | Prozac | 2,559 | 31,37 % | 1,382 | 16,94 % | 46,77 % | Zyprexa | 0,730 | Axid | 0,527 |
| Average | 355,250 | | | 24,02 % | | 20,56 % | 45,74 % | | | | |
| Max | | | | 33,99 % | | 24,71 % | 55,59 % | | | | |
| Min | | | | 12,53 % | | 16,94 % | 32,67 % | | | | |

| | Astra Zeneca | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exchange rate averages SEK-USD | Year | Annual Revenue ($ billions) | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) |
| | 2017 | 22,465 | Symbicort | 2,803 | 12,48 % | 5,757 | 25,63 % | 31,69 % | Crestor | 2,365 | Nexium | 1,952 |
| | 2016 | 23,002 | Crestor | 3,401 | 14,79 % | 5,890 | 25,61 % | 36,61 % | Symbicort | 2,989 | Nexium | 2,032 |
| | 2015 | 24,708 | Crestor | 5,017 | 20,31 % | 5,997 | 24,27 % | 44,14 % | Symbicort | 3,394 | Nexium | 2,496 |
| | 2014 | 26,095 | Crestor | 5,512 | 21,12 % | 5,579 | 21,38 % | 49,70 % | Symbicort | 3,801 | Nexium | 3,655 |
| | 2013 | 25,711 | Crestor | 5,622 | 21,87 % | 4,821 | 18,75 % | 50,47 % | Nexium | 3,872 | Symbicort | 3,483 |
| | 2012 | 27,973 | Crestor | 6,253 | 22,35 % | 5,243 | 18,74 % | 47,87 % | Nexium | 3,944 | Symbicort | 3,194 |
| | 2011 | 33,591 | Crestor | 6,622 | 19,71 % | 5,523 | 16,44 % | 50,25 % | Seroquel | 5,828 | Nexium | 4,429 |
| | 2010 | 33,269 | Crestor | 5,691 | 17,11 % | 5,318 | 15,98 % | 47,98 % | Seroquel | 5,302 | Nexium | 4,969 |
| | 2009 | 32,804 | Nexium | 4,959 | 15,12 % | 4,409 | 13,44 % | 43,67 % | Seroquel | 4,866 | Crestor | 4,502 |
| | 2008 | 31,601 | Nexium | 5,200 | 16,46 % | 5,179 | 16,39 % | 41,93 % | Seroquel | 4,452 | Crestor | 3,597 |
| | 2007 | 29,559 | Nexium | 5,216 | 17,65 % | 5,162 | 17,46 % | 40,73 % | Seroquel | 4,027 | Crestor | 2,796 |
| | 2006 | 26,475 | Nexium | 5,182 | 19,57 % | 3,902 | 14,74 % | 40,14 % | Seroquel | 3,416 | Crestor | 2,028 |
| | 2005 | 23,950 | Nexium | 4,633 | 19,34 % | 3,379 | 14,11 % | 38,12 % | Seroquel | 2,761 | Seloken/Toprol-XL | 1,735 |
| | 2004 | 21,426 | Nexium | 3,883 | 18,12 % | 3,803 | 17,75 % | 36,67 % | Seroquel | 2,027 | Losec/Prilosec | 1,947 |
| | 2003 | 18,849 | Nexium | 3,302 | 17,52 % | 3,451 | 18,31 % | 39,02 % | Losec/Prilosec | 2,565 | Seroquel | 1,487 |
| | 2002 | 17,841 | Losec/Prilosec | 4,623 | 25,91 % | 3,069 | 17,20 % | 43,42 % | Nexium | 1,978 | Seroquel | 1,145 |
| | 2001 | 16,480 | Losec/Prilosec | 5,684 | 34,49 % | 2,687 | 16,30 % | 45,85 % | Zestril | 1,097 | Pulmicort | 0,775 |
| | 2000 | 15,804 | Losec/Prilosec | 6,260 | 39,61 % | 2,616 | 16,55 % | 51,77 % | Zestril | 1,188 | Zoladex | 0,734 |
| | 1999 | 18,445 | Losec/Prilosec | 5,909 | 32,04 % | 2,454 | 13,30 % | 42,61 % | Zestril | 1,221 | Pulmicort | 0,730 |
| 0,12698 | 1998 | 7,262 | Losec/Prilosec | 4,015 | 55,29 % | 1,346 | 18,54 % | 71,12 % | Pulmicort | 0,697 | Seloken/Toprol-XL | 0,453 |
| | 1997 | 5,702 | Losec/Prilosec | 2,733 | 47,94 % | 1,112 | 19,51 % | 65,94 % | Pulmicort | 0,625 | Seloken/Toprol-XL | 0,402 |
| | Average | 483,012 | | | 24,23 % | | 18,11 % | 45,70 % | | | | |
| | Max | | | | 55,29 % | | 25,63 % | 71,12 % | | | | |
| | Min | | | | 12,48 % | | 13,30 % | 31,69 % | | | | |

| Celgene | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Annual Revenue ($ billions) | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of Revenue from top 3 | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) |
| 2017 | 13,003 | Revlimid | 8,187 | 62,96 % | 5,915 | 45,49 % | 85,21 % | Pomalyst | 1,614 | Otezla | 1,279 |
| 2016 | 11,229 | Revlimid | 6,974 | 62,10 % | 4,470 | 39,81 % | 82,83 % | Pomalyst | 1,311 | Otezla | 1,017 |
| 2015 | 9,256 | Revlimid | 5,801 | 62,67 % | 3,697 | 39,94 % | 83,75 % | Pomalyst | 0,983 | Abraxane | 0,968 |
| 2014 | 7,670 | Revlimid | 4,980 | 64,92 % | 2,431 | 31,69 % | 84,84 % | Abraxane | 0,848 | Pomalyst | 0,680 |
| 2013 | 6,494 | Revlimid | 4,280 | 65,91 % | 2,226 | 34,28 % | 88,27 % | Vidaza | 0,803 | Abraxane | 0,649 |
| 2012 | 5,507 | Revlimid | 3,767 | 68,40 % | 1,724 | 31,31 % | 91,10 % | Vidaza | 0,823 | Abraxane | 0,427 |
| 2011 | 4,842 | Revlimid | 3,208 | 66,25 % | 1,600 | 33,05 % | 88,79 % | Vidaza | 0,705 | Abraxane | 0,386 |
| 2010 | 3,626 | Revlimid | 2,469 | 68,10 % | 1,128 | 31,12 % | 93,57 % | Vidaza | 0,534 | Thalomid | 0,390 |
| 2009 | 2,690 | Revlimid | 1,706 | 63,44 % | 0,795 | 29,55 % | 94,08 % | Thalomid | 0,437 | Vidaza | 0,387 |
| 2008 | 2,255 | Revlimid | 1,325 | 58,75 % | 0,931 | 41,30 % | 90,30 % | Thalomid | 0,505 | Vidaza | 0,207 |
| 2007 | 1,406 | Revlimid | 0,774 | 55,05 % | 0,399 | 28,35 % | 92,08 % | Thalomid | 0,447 | Alkeran | 0,074 |
| 2006 | 0,899 | Thalomid | 0,433 | 48,17 % | 0,259 | 28,77 % | 89,43 % | Revlimid | 0,321 | Alkeran | 0,050 |
| 2005 | 0,537 | Thalomid | 0,388 | 72,22 % | 0,191 | 35,53 % | 82,28 % | Alkeran | 0,050 | Focalin | 0,004 |
| 2004 | 0,378 | Thalomid | 0,309 | 81,75 % | 0,161 | 42,61 % | 97,30 % | Alkeran | 0,017 | Focalin | 0,042 |
| 2003 | 0,271 | Thalomid | 0,224 | 82,40 % | 0,123 | 45,20 % | 97,75 % | Alkeran | 0,018 | Focalin | 0,024 |
| 2002 | 0,136 | Thalomid | 0,012 | 8,77 % | 0,085 | 62,54 % | 37,20 % | Focalin | 0,039 | N/A | 0,000 |
| 2001 | 0,114 | Thalomid | 0,082 | 71,78 % | 0,068 | 59,26 % | 73,70 % | Focalin | 0,002 | N/A | 0,000 |
| 2000 | 0,084 | Thalomid | 0,062 | 73,59 % | 0,053 | 62,57 % | 73,59 % | N/A | 0,000 | N/A | 0,000 |
| 1999 | 0,026 | Thalomid | 0,024 | 91,98 % | 0,020 | 74,81 % | 91,98 % | N/A | 0,000 | N/A | 0,000 |
| 1998 | 0,004 | Thalomid | 0,003 | 78,95 % | 0,020 | 521,05 % | 78,95 % | N/A | 0,000 | N/A | 0,000 |
| 1997 | 0,001 | N/A | N/A | N/A | 0,017 | 1553,6 % | N/A | N/A | 0,000 | N/A | 0,000 |
| Average | 70,427 | | | 65,41 % | | 136,75 % | 84,85 % | | | | |
| Max | | | | 91,98 % | | 1553,6 % | 97,75 % | | | | |
| Min | | | | 8,77 % | | 28,35 % | 37,20 % | | | | |
| | | | | | *Average R&* | *41,96 %* | | | | | |
| | | | | | *MaxR&D to* | *74,81 %* | | | | | |

| Sanofi | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Annual Revenue ($ billions) | Annual Revenue ($ billions) Pharmaceutical Division | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of total Revenue from top 3 drugs | % of pharmaceutical Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) | Exchange rate averages EUR-USD |
| 2017 | 39,611 | 28,387 | Lantus | 5,223 | 13,18 % | 6,183 | 15,61 % | 22,15 % | 30,91 % | Lovenox | 1,780 | Aubagio | 1,771 | 1,13 |
| 2016 | 37,437 | 32,371 | Lantus | 6,325 | 16,89 % | 5,725 | 15,29 % | 26,30 % | 30,41 % | Lovenox | 1,811 | Plavix | 1,709 | 1,1069 |
| 2015 | 41,019 | 33,064 | Lantus | 7,090 | 17,29 % | 5,639 | 13,75 % | 27,15 % | 33,69 % | Plavix | 2,140 | Lovenox | 1,907 | 1,1096 |
| 2014 | 44,856 | 36,820 | Lantus | 8,427 | 18,79 % | 6,408 | 14,28 % | 29,33 % | 35,73 % | Plavix | 2,473 | Lovenox | 2,257 | 1,3283 |
| 2013 | 43,777 | 36,203 | Lantus | 7,593 | 17,34 % | 6,337 | 14,48 % | 28,15 % | 34,04 % | Plavix | 2,467 | Lovenox | 2,263 | 1,3285 |
| 2012 | 44,936 | 37,123 | Lantus | 6,378 | 14,19 % | 6,329 | 14,08 % | 25,52 % | 30,89 % | Plavix | 2,657 | Lovenox | 2,434 | 1,2858 |
| 2011 | 46,495 | 38,837 | Lantus | 5,453 | 11,73 % | 6,699 | 14,41 % | 24,16 % | 28,92 % | Lovenox | 2,940 | Plavix | 2,841 | 1,3925 |
| 2010 | 42,923 | 35,244 | Lantus | 4,655 | 10,84 % | 6,030 | 14,05 % | 26,07 % | 31,75 % | Lovenox | 3,721 | Taxotere | 2,814 | 1,3262 |
| 2009 | 40,876 | 36,018 | Lantus | 4,296 | 10,51 % | 6,392 | 15,64 % | 29,81 % | 33,83 % | Lovenox | 4,232 | Plavix | 3,659 | 1,3948 |
| 2008 | 40,557 | 36,348 | Lovenox | 4,028 | 9,93 % | 6,731 | 16,60 % | 28,28 % | 31,56 % | Plavix | 3,838 | Lantus | 3,604 | 1,4712 |
| 2007 | 38,466 | 34,656 | Lovenox | 3,582 | 9,31 % | 6,221 | 16,17 % | 25,19 % | 27,96 % | Plavix | 3,324 | Lantus | 2,785 | 1,3712 |
| 2006 | 35,658 | 32,475 | Lovenox | 3,060 | 8,58 % | 5,567 | 15,61 % | 23,58 % | 25,89 % | Plavix | 2,801 | Stilnox/Ambien | 2,546 | 1,2568 |
| 2005 | 33,979 | 31,413 | Lovenox | 2,666 | 7,85 % | 5,031 | 14,81 % | 21,16 % | 22,88 % | Plavix | 2,521 | Taxotere | 2,002 | 1,2441 |
| 2004 | 18,496 | 17,647 | Lovenox | 2,368 | 12,80 % | 2,971 | 16,06 % | 34,29 % | 35,95 % | Plavix | 2,107 | Allegra | 1,868 | 1,2438 |
| 2003 | 9,113 | 8,800 | Stilnox/Ambien | 1,523 | 16,71 % | 1,490 | 16,35 % | 43,41 % | 44,96 % | Plavix | 1,500 | Eloxatin | 0,933 | 1,1324 |
| 2002 | 7,048 | 6,760 | Stilnox/Ambien | 1,348 | 19,12 % | 1,153 | 16,35 % | 39,92 % | 41,62 % | Plavix | 0,934 | Aprovel | 0,532 | 0,9463 |
| 2001 | 5,812 | 5,679 | Stilnox/Ambien | 0,704 | 12,11 % | 0,924 | 15,89 % | 29,50 % | 30,19 % | Plavix | 0,632 | Aprovel | 0,379 | 0,8959 |
| 2000 | 5,505 | 5,114 | Stilnox/Ambien | 0,537 | 9,76 % | 0,872 | 15,85 % | 22,12 % | 23,81 % | Plavix | 0,403 | Aprovel | 0,277 | 0,9232 |
| 1999 | 5,700 | 5,027 | Stilnox/Ambien | 0,421 | 7,38 % | 0,971 | 17,03 % | 16,62 % | 18,84 % | Aprovel | 0,314 | Plavix | 0,212 | 1,0654 |
| 1998 | | | | | | | | | | | | | | |
| 1997 | | | | | | R&D includes both pharma and diagnostic | | | | | | | | |
| Average | | 497,987 | | | 12,86 % | | 15,39 % | 27,51 % | 31,25 % | | | | | |
| Max | | | | | 19,12 % | | 17,03 % | 43,41 % | 44,96 % | | | | | |
| Min | | | | | 7,38 % | | 13,75 % | 16,62 % | 18,84 % | | | | | |

| Bayer | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Annual Revenue ($ billions) | Annual Revenue ($ billions) Pharmaceutical Division | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of total Revenue from top 3 drugs | % of total Pharmaceutical Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) | Exchange rate averages EUR-USD |
| 2017 | 39,566 | 19,037 | Xarelto | 3,727 | 9,42 % | 5,089 | 12,86 % | 18,00 % | 37,42 % | Eylea | 2,124 | Mirena | 1,272 | 1,13 |
| 2016 | 51,769 | 18,176 | Xarelto | 3,241 | 6,26 % | 5,165 | 9,98 % | 12,23 % | 34,83 % | Eylea | 1,799 | Kogenate | 1,291 | 1,1069 |
| 2015 | 51,400 | 15,251 | Xarelto | 2,499 | 4,86 % | 4,742 | 9,23 % | 10,01 % | 33,72 % | Eylea | 1,363 | Kogenate | 1,282 | 1,1096 |
| 2014 | 56,105 | 16,008 | Xarelto | 2,230 | 3,97 % | 4,747 | 8,46 % | 8,54 % | 29,93 % | Kogenate | 1,473 | Mirena | 1,088 | 1,3283 |
| 2013 | 53,351 | 14,864 | Kogenate | 1,597 | 2,99 % | 4,238 | 7,94 % | 7,94 % | 28,50 % | Betaferon | 1,379 | Xarelto | 1,261 | 1,3285 |
| 2012 | 51,125 | 12,901 | Betaferon | 1,564 | 3,06 % | 3,874 | 7,58 % | 8,66 % | 34,32 % | Kogenate | 1,520 | YAZ/Yasmin | 1,344 | 1,2858 |
| 2011 | 50,866 | 13,854 | Betaferon | 1,555 | 3,06 % | 4,083 | 8,03 % | 8,93 % | 32,79 % | Kogenate | 1,497 | YAZ/Yasmin | 1,490 | 1,3925 |
| 2010 | 46,532 | 14,466 | Betaferon | 1,599 | 3,44 % | 4,049 | 8,70 % | 9,46 % | 30,45 % | YAZ/Yasmin | 1,473 | Kogenate | 1,331 | 1,3262 |
| 2009 | 43,473 | 14,599 | YAZ/Yasmin | 1,783 | 4,10 % | 3,830 | 8,81 % | 10,84 % | 32,29 % | Betaferon | 1,693 | Kogenate | 1,239 | 1,3948 |
| 2008 | 48,428 | 15,747 | YAZ/Yasmin | 1,798 | 3,71 % | 3,903 | 8,06 % | 9,76 % | 30,03 % | Betaferon | 1,683 | Kogenate | 1,248 | 1,4712 |
| 2007 | 44,407 | 14,078 | YAZ/Yasmin | 1,429 | 3,22 % | 3,535 | 7,96 % | 8,92 % | 28,13 % | Betaferon | 1,410 | Kogenate | 1,122 | 1,3712 |
| 2006 | 36,391 | 9,398 | Kogenate | 0,989 | 2,72 % | 2,887 | 7,93 % | 6,83 % | 26,46 % | Adalat | 0,826 | Betaferon | 0,672 | 1,2568 |
| 2005 | 34,068 | 5,060 | Ascensia | 0,883 | 2,59 % | 2,346 | 6,89 % | 7,42 % | 49,96 % | Kogenate | 0,825 | Adalat | 0,820 | 1,2441 |
| 2004 | 37,012 | 5,458 | Ciprobay | 1,041 | 2,81 % | 2,621 | 7,08 % | 7,17 % | 48,63 % | Adalat | 0,833 | Ascensia | 0,780 | 1,2438 |
| 2003 | 32,349 | 5,373 | Ciprobay | 1,598 | 4,94 % | 2,734 | 8,45 % | 9,38 % | 56,48 % | Adalat | 0,765 | Ascensia | 0,672 | 1,1324 |
| 2002 | 28,034 | 4,511 | Ciprobay | 1,335 | 4,76 % | 2,439 | 8,70 % | 9,45 % | 58,74 % | Adalat | 0,757 | Aspirin | 0,557 | 0,9463 |
| 2001 | 27,122 | 4,286 | Ciprobay | 1,759 | 6,49 % | 2,293 | 8,45 % | 12,10 % | 76,55 % | Adalat | 0,873 | Aspirin | 0,648 | 0,8959 |
| 2000 | 28,592 | 5,668 | Ciprobay | 1,648 | 5,76 % | 2,209 | 7,73 % | 11,55 % | 58,24 % | Adalat | 1,066 | Lipobay/Baycol | 0,587 | 0,9232 |
| 1999 | 29,108 | 5,327 | Ciprobay | 1,618 | 5,56 % | 2,399 | 8,24 % | 11,42 % | 62,40 % | Adalat | 1,088 | Aspirin | 0,618 | 1,0654 |
| 1998 | 31,213 | 4,828 | Ciprobay | 1,404 | 4,50 % | 2,229 | 7,14 % | 9,73 % | 62,92 % | Adalat | 1,045 | Aspirin | 0,589 | 1,0902 |
| 1997 | 31,282 | 4,774 | | | | 2,205 | 7,05 % | N/A | | | | | | 1,2594 |
| Average | | 223,665 | | | 4,41 % | | 8,35 % | 9,92 % | 42,64 % | | | | | |
| Max | | | | | 9,42 % | | 12,86 % | 18,00 % | 76,55 % | | | | | |
| Min | | | | | 2,59 % | | 6,89 % | 6,83 % | 26,46 % | | | | | |
| | | | | | | R&D includes pharma and crop | | Revenue lower % of revenue than others. Big Crop sciences segment | | | | | | |

| GlaxoSmithKline | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Annual Revenue ($ billions) | Annual Revenue ($ billions) Pharmaceutical Division | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of total Revenue from top 3 drugs | % of pharmaceutical Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) | Exchange rate averages EUR-USD |
| 2017 | 38,906 | 28,917 | Advair/Seretide | 4,034 | 10,37 % | 5,769 | 14,83 % | 23,17 % | 31,18 % | Triumeq | 3,172 | Tivicay | 1,810 | 1,2889 |
| 2016 | 37,650 | 27,939 | Advair/Seretide | 4,705 | 12,50 % | 4,898 | 13,01 % | 22,13 % | 29,83 % | Triumeq | 2,342 | Tivicay | 1,287 | 1,35 |
| 2015 | 36,559 | 27,237 | Advair/Seretide | 5,625 | 15,39 % | 5,440 | 14,88 % | 21,50 % | 28,86 % | Infanrix/Pediarix | 1,120 | Triumeq | 1,116 | 1,5282 |
| 2014 | 37,919 | 30,773 | Advair/Seretide | 6,970 | 18,38 % | 5,131 | 13,53 % | 25,48 % | 31,40 % | Infanrix/Pediarix | 1,365 | Avodart | 1,327 | 1,6482 |
| 2013 | 41,464 | 33,349 | Advair/Seretide | 8,251 | 19,90 % | 5,319 | 12,83 % | 26,38 % | 32,80 % | Infanrix/Pediarix | 1,348 | Avodart | 1,341 | 1,5644 |
| 2012 | 41,899 | 33,798 | Advair/Seretide | 7,999 | 19,09 % | 5,507 | 13,14 % | 25,01 % | 31,01 % | Avodart | 1,252 | Infanrix/Pediarix | 1,229 | 1,5852 |
| 2011 | 43,915 | 35,585 | Advair/Seretide | 8,115 | 18,48 % | 6,273 | 14,28 % | 23,97 % | 29,58 % | Flixotide | 1,304 | Infanrix/Pediarix | 1,106 | 1,60351 |
| 2010 | 43,871 | 36,130 | Advair/Seretide | 7,941 | 18,10 % | 6,125 | 13,96 % | 25,13 % | 30,51 % | Relenza | 1,842 | Flixotide | 1,242 | 1,5452 |
| 2009 | 44,449 | 37,157 | Advair/Seretide | 7,798 | 17,54 % | 6,434 | 14,47 % | 25,22 % | 30,17 % | Valtrex | 2,028 | Relenza | 1,384 | 1,56686 |
| 2008 | 45,144 | 37,783 | Advair/Seretide | 7,669 | 16,99 % | 6,824 | 15,12 % | 25,70 % | 30,71 % | Valtrex | 2,215 | Lamictal | 1,717 | 1,85383 |
| 2007 | 45,480 | 38,507 | Advair/Seretide | 7,005 | 15,40 % | 6,661 | 14,65 % | 24,34 % | 28,75 % | Lamictal | 2,196 | Valtrex | 1,870 | 2,00211 |
| 2006 | 42,789 | 36,991 | Advair/Seretide | 6,104 | 14,26 % | 6,369 | 14,88 % | 24,58 % | 28,43 % | Avandia | 2,578 | Lamictal | 1,835 | 1,84239 |
| 2005 | 39,403 | 33,948 | Advair/Seretide | 5,463 | 13,86 % | 5,705 | 14,48 % | 23,11 % | 26,83 % | Avandia | 2,099 | Lamictal | 1,544 | 1,81917 |
| 2004 | 37,311 | 31,423 | Advair/Seretide | 4,510 | 12,09 % | 5,203 | 13,94 % | 22,79 % | 27,06 % | Avandia | 2,045 | Seroxat/Paxil | 1,948 | 1,83265 |
| 2003 | 35,041 | 29,714 | Advair/Seretide | 3,618 | 10,33 % | 4,561 | 13,02 % | 23,53 % | 27,74 % | Seroxat/Paxil | 3,068 | Welbutrin | 1,558 | 1,63432 |
| 2002 | 31,879 | 27,044 | Seroxat/Paxil | 3,088 | 9,69 % | 4,358 | 13,67 % | 22,99 % | 27,10 % | Advair/Seretide | 2,451 | Augmentin | 1,790 | 1,50286 |
| 2001 | 29,504 | 24,775 | Seroxat/Paxil | 2,674 | 9,06 % | 3,679 | 12,47 % | 20,46 % | 24,37 % | Augmentin | 2,046 | Flixotide/Flovent | 1,318 | 1,44001 |
| 2000 | 28,906 | 23,376 | Seroxat/Paxil | 2,348 | 8,12 % | 3,789 | 13,11 % | 19,13 % | 23,65 % | Augmentin | 1,847 | Flixotide/Flovent | 1,333 | 1,51506 |
| 1999 | 26,151 | 22,032 | | | | 3,697 | 14,14 % | | | | | | | 1,61788 |
| 1998 | 24,754 | 20,819 | | | | 3,434 | 13,87 % | | | | | | | 1,65714 |
| 1997 | | | | | | | | | | | | | | |
| Average | 752,997 | 617,297 | | | 14,42 % | | 13,91 % | 23,59 % | 28,89 % | | | | | |
| Max | | | | | 19,90 % | | 15,12 % | 26,38 % | 32,80 % | | | | | |
| Min | | | | | 8,12 % | | 12,47 % | 19,13 % | 23,65 % | | | | | |

| Johnson & Johnson | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Annual Revenue ($ billions) | Annual Revenue ($ billions) Pharmaceutical Division | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending on pharmaceuticals ($ billions) | R&D to Revenue | % of Revenue from top 3 drugs | % of pharmaceutical Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) |
| 2017 | 75,450 | 36,256 | Remicade | 6,315 | 8,37 % | 8,360 | 23,06 % | 17,09 % | 35,57 % | Stelara | 4,011 | Trevicta | 2,569 |
| 2016 | 71,890 | 33,464 | Remicade | 6,966 | 9,69 % | 6,967 | 20,82 % | 17,33 % | 37,23 % | Stelara | 3,232 | Zytiga | 2,260 |
| 2015 | 70,074 | 31,430 | Remicade | 6,561 | 9,36 % | 6,821 | 21,70 % | 16,08 % | 35,84 % | Stelara | 2,474 | Zytiga | 2,231 |
| 2014 | 74,331 | 32,313 | Remicade | 6,868 | 9,24 % | 6,213 | 19,23 % | 15,35 % | 35,30 % | Olysio/Sovriad | 2,302 | Zytiga | 2,237 |
| 2013 | 71,312 | 28,125 | Remicade | 6,673 | 9,36 % | 5,810 | 20,66 % | 14,08 % | 35,71 % | Zytiga | 1,698 | Prezista | 1,673 |
| 2012 | 67,224 | 25,351 | Remicade | 6,139 | 9,13 % | 5,362 | 21,15 % | 13,54 % | 35,90 % | Velcade | 1,500 | Procrit/Eprex | 1,462 |
| 2011 | 65,030 | 24,368 | Remicade | 5,492 | 8,45 % | 5,138 | 21,09 % | 13,38 % | 35,69 % | Procrit/Eprex | 1,623 | Risperdal/Consta | 1,583 |
| 2010 | 61,587 | 22,396 | Remicade | 4,610 | 7,49 % | 4,432 | 19,79 % | 13,06 % | 35,92 % | Procrit/Eprex | 1,934 | Risperdal/Consta | 1,500 |
| 2009 | 61,897 | 22,520 | Remicade | 4,304 | 6,95 % | 4,591 | 20,39 % | 13,08 % | 35,96 % | Procrit/Eprex | 2,245 | Levaquin/Floxin | 1,550 |
| 2008 | 63,747 | 24,567 | Remicade | 3,748 | 5,88 % | 5,095 | 20,74 % | 14,02 % | 36,39 % | Topamax | 2,731 | Procrit/Eprex | 2,460 |
| 2007 | 61,095 | 24,886 | Remicade | 3,327 | 5,45 % | 5,276 | 21,20 % | 14,18 % | 34,82 % | Procrit/Eprex | 2,885 | Topamax | 2,453 |
| 2006 | 53,324 | 23,267 | Risperdal/Consta | 4,183 | 7,84 % | 4,956 | 21,30 % | 19,46 % | 44,60 % | Procrit/Eprex | 3,180 | Remicade | 3,013 |
| 2005 | 50,514 | 22,322 | Risperdal/Consta | 3,552 | 7,03 % | 4,442 | 19,90 % | 18,63 % | 42,16 % | Procrit/Eprex | 3,324 | Remicade | 2,535 |
| 2004 | 47,348 | 22,128 | Procrit/Eprex | 3,589 | 7,58 % | 3,629 | 16,40 % | 18,55 % | 39,70 % | Risperdal | 3,050 | Remicade | 2,145 |
| 2003 | 41,862 | 19,517 | Procrit/Eprex | 3,984 | 9,52 % | 3,201 | 16,40 % | 19,65 % | 42,14 % | Risperdal | 2,512 | Remicade | 1,729 |
| 2002 | 36,298 | 17,151 | Procrit/Eprex | 4,269 | 11,76 % | 2,693 | 15,70 % | 21,25 % | 44,97 % | Risperdal | 2,146 | Remicade | 1,297 |
| 2001 | 32,317 | 14,849 | Procrit/Eprex | 3,426 | 10,60 % | | | | | | | | |
| 2000 | 29,172 | 12,659 | | | | | | | | | | | |
| 1999 | 27,357 | 11,232 | | | | | | | | | | | |
| 1998 | 23,811 | | | | | | | | | | | | |
| 1997 | 22,522 | | | | | | | | | | | | |
| Average | | 448,801 | | | 8,45 % | | 19,97 % | 16,17 % | 37,99 % | | | | |
| Max | | | | | 11,76 % | | 23,06 % | 21,25 % | 44,97 % | | | | |
| Min | | | | | 5,45 % | | 15,70 % | 13,06 % | 34,82 % | | | | |

| Gilead Sciences | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Annual Revenue ($ billions) | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) |
| 2017 | 26,107 | Harvoni | 4,370 | 16,74 % | 3,734 | 14,30 % | 44,26 % | Genvoya | 3,674 | Epclusa | 3,510 |
| 2016 | 30,390 | Harvoni | 9,081 | 29,88 % | 5,098 | 16,78 % | 54,78 % | Sovaldi | 4,001 | Truvada | 3,566 |
| 2015 | 32,639 | Harvoni | 13,864 | 42,48 % | 3,014 | 9,23 % | 69,24 % | Sovaldi | 5,276 | Truvada | 3,459 |
| 2014 | 24,890 | Sovaldi | 10,283 | 41,31 % | 2,854 | 11,47 % | 68,67 % | Atripla | 3,470 | Truvada | 3,340 |
| 2013 | 11,202 | Atripla | 3,648 | 32,57 % | 2,120 | 18,93 % | 69,12 % | Truvada | 3,136 | Viread | 0,959 |
| 2012 | 9,703 | Atripla | 3,574 | 36,84 % | 1,760 | 18,14 % | 78,37 % | Truvada | 3,181 | Viread | 0,849 |
| 2011 | 8,385 | Atripla | 3,225 | 38,45 % | 1,229 | 14,66 % | 81,54 % | Truvada | 2,875 | Viread | 0,738 |
| 2010 | 7,949 | Atripla | 2,927 | 36,82 % | 1,073 | 13,50 % | 79,36 % | Truvada | 2,650 | Viread | 0,732 |
| 2009 | 7,011 | Truvada | 2,490 | 35,51 % | 0,940 | 13,41 % | 79,00 % | Atripla | 2,382 | Viread | 0,668 |
| 2008 | 5,336 | Truvada | 2,107 | 39,48 % | 0,722 | 13,53 % | 80,59 % | Atripla | 1,572 | Viread | 0,621 |
| 2007 | 4,230 | Truvada | 1,589 | 37,57 % | 0,591 | 13,97 % | 73,40 % | Atripla | 0,903 | Viread | 0,612 |
| 2006 | 3,026 | Truvada | 1,194 | 39,47 % | 0,384 | 12,68 % | 69,04 % | Viread | 0,689 | Atripla | 0,206 |
| 2005 | 2,028 | Viread | 0,779 | 38,39 % | 0,278 | 13,69 % | 77,27 % | Truvada | 0,568 | AmBisome | 0,221 |
| 2004 | 1,325 | Viread | 0,783 | 59,10 % | 0,224 | 16,88 % | 80,21 % | AmBisome | 0,212 | Truvada | 0,068 |
| 2003 | 0,868 | Viread | 0,566 | 65,27 % | 0,165 | 19,00 % | 88,13 % | AmBisome | 0,198 | N/A | |
| 2002 | 0,467 | Viread | 0,226 | 48,38 % | 0,135 | 28,87 % | 88,15 % | AmBisome | 0,186 | N/A | |
| 2001 | 0,234 | AmBisome | 0,165 | 70,38 % | 0,186 | 79,39 % | 77,05 % | Viread | 0,016 | N/A | |
| 2000 | 0,196 | AmBisome | 0,141 | 72,15 % | 0,132 | 67,30 % | N/A | N/A | | N/A | |
| 1999 | 0,169 | AmBisome | 0,129 | 76,46 % | 0,110 | 65,22 % | N/A | N/A | | N/A | |
| 1998 | 0,033 | Vestide | 0,006 | 18,71 % | 0,075 | 230,98 % | N/A | N/A | | N/A | |
| 1997 | 0,040 | Vestide | 0,012 | 29,25 % | 0,059 | 148,00 % | N/A | N/A | | N/A | |
| Average | 176,227 | | | 43,11 % | | 40,00 % | 74,01 % | | | | |
| Max | | | | 76,46 % | | 230,98 % | 88,15 % | | | | |
| Min | | | | 16,74 % | | 9,23 % | 44,26 % | | | | |
| | | | | | R&D total (cant differentiate) | | | | | | |

| Amgen | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Annual Revenue ($ billions) | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) |
| 2017 | 22,849 | Enbrel | 5,433 | 23,78 % | 3,562 | 15,59 % | 52,61 % | Neulasta/Neupc | 4,534 | Aranesp | 2,053 |
| 2016 | 22,991 | Enbrel | 5,965 | 25,94 % | 3,840 | 16,70 % | 55,27 % | Neulasta/Neupc | 4,648 | Aranesp | 2,093 |
| 2015 | 21,662 | Enbrel | 5,364 | 24,76 % | 4,070 | 18,79 % | 55,54 % | Neulasta/Neupc | 4,715 | Aranesp | 1,951 |
| 2014 | 20,063 | Neulasta/Neupogen | 5,755 | 28,68 % | 4,297 | 21,42 % | 58,14 % | Enbrel | 4,688 | Xgeva | 1,221 |
| 2013 | 18,676 | Neulasta/Neupogen | 5,790 | 31,00 % | 4,083 | 21,86 % | 65,60 % | Enbrel | 4,551 | Aranesp | 1,911 |
| 2012 | 17,265 | Neulasta/Neupogen | 5,352 | 31,00 % | 3,380 | 19,58 % | 67,35 % | Enbrel | 4,236 | Aranesp | 2,040 |
| 2011 | 15,295 | Neulasta/Neupogen | 5,212 | 34,08 % | 3,167 | 20,71 % | 73,33 % | Enbrel | 3,701 | Aranesp | 2,303 |
| 2010 | 15,053 | Neulasta/Neupogen | 4,844 | 32,18 % | 2,894 | 19,23 % | 72,42 % | Enbrel | 3,534 | Epogen | 2,524 |
| 2009 | 14,351 | Neulasta/Neupogen | 4,643 | 32,35 % | 2,864 | 19,96 % | 75,17 % | Enbrel | 3,493 | Aranesp | 2,652 |
| 2008 | 15,003 | Neulasta/Neupogen | 4,659 | 31,05 % | 3,030 | 20,20 % | 75,94 % | Enbrel | 3,598 | Aranesp | 3,137 |
| 2007 | 14,771 | Neulasta/Neupogen | 4,277 | 28,96 % | 3,266 | 22,11 % | 75,29 % | Aranesp | 3,614 | Enbrel | 3,230 |
| 2006 | 14,268 | Aranesp | 4,121 | 28,88 % | 3,366 | 23,59 % | 73,98 % | Neulasta/Neupc | 3,923 | Epogen | 2,511 |
| 2005 | 12,430 | Neulasta/Neupogen | 3,504 | 28,19 % | 2,314 | 18,62 % | 75,22 % | Aranesp | 3,273 | Enbrel | 2,573 |
| 2004 | 10,550 | Epogen | 2,601 | 24,65 % | 2,028 | 19,22 % | 66,10 % | Aranesp | 2,473 | Enbrel | 1,900 |
| 2003 | 8,356 | Neulasta/Neupogen | 2,522 | 30,18 % | 1,655 | 19,81 % | 77,79 % | Epogen | 2,435 | Aranesp | 1,544 |
| 2002 | 5,523 | Epogen | 2,261 | 40,93 % | 1,117 | 20,22 % | 81,83 % | Neulasta/Neupc | 1,843 | Aranesp | 0,416 |
| 2001 | 4,016 | Epogen | 2,005 | 49,93 % | 0,865 | 21,54 % | 93,77 % | Neupogen | 1,346 | Aranesp | 0,415 |
| 2000 | 3,629 | Epogen | 1,963 | 54,09 % | 0,845 | 23,28 % | 91,81 % | Neupogen | 1,224 | Infergen | 0,145 |
| 1999 | 3,340 | Epogen | 1,759 | 52,66 % | 0,823 | 24,64 % | 98,13 % | Neupogen | 1,257 | Infergen | 0,262 |
| 1998 | 2,718 | Epogen | 1,382 | 50,85 % | 0,663 | 24,39 % | 99,37 % | Neupogen | 1,161 | Infergen | 0,158 |
| 1997 | 2,401 | Epogen | 1,161 | 48,34 % | 0,631 | 26,28 % | 93,73 % | Neupogen | 1,056 | Infergen | 0,034 |
| Average | 265,210 | | | 34,88 % | | 20,84 % | 75,16 % | | | | |
| Max | | | | 54,09 % | | 26,28 % | 99,37 % | | | | |
| Min | | | | 23,78 % | | 15,59 % | 52,61 % | | | | |

| Bristol-Myers Squibb | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Annual Revenue ($ billions) | Top-selling drug | Annual Revenue ($ billions) | % of Revenue from top-selling drug | R&D Spending ($ billions) | R&D to Revenue | % of Revenue from top 3 drugs | Name of 2 | Revenue ($ billions) | Name of 3 | Revenue ($ billions) |
| 2017 | 20,776 | Opdivo | 4,948 | 23,82 % | 6,411 | 30,86 % | 59,20 % | Eliquis | 4,872 | Orencia | 2,479 |
| 2016 | 19,427 | Opdivo | 3,774 | 19,43 % | 4,940 | 25,43 % | 48,29 % | Eliquis | 3,343 | Orencia | 2,265 |
| 2015 | 16,560 | Orencia | 1,885 | 11,38 % | 5,920 | 35,75 % | 32,40 % | Eliquis | 1,860 | Sprycel | 1,620 |
| 2014 | 15,879 | Abilify | 2,020 | 12,72 % | 5,434 | 34,22 % | 32,53 % | Orencia | 1,652 | Sprycel | 1,493 |
| 2013 | 15,879 | Abilify | 2,289 | 14,42 % | 4,535 | 28,56 % | 34,35 % | Sustiva | 1,614 | Reyataz | 1,551 |
| 2012 | 17,621 | Abilify | 2,827 | 16,04 % | 3,904 | 22,16 % | 39,16 % | Plavix | 2,547 | Sustiva | 1,527 |
| 2011 | 21,244 | Plavix | 7,087 | 33,36 % | 3,839 | 18,07 % | 53,73 % | Abilify | 2,758 | Reyataz | 1,569 |
| 2010 | 19,484 | Plavix | 6,666 | 34,21 % | 3,566 | 18,30 % | 54,97 % | Abilify | 2,565 | Reyataz | 1,479 |
| 2009 | 18,808 | Plavix | 6,146 | 32,68 % | 3,647 | 19,39 % | 53,91 % | Abilify | 2,592 | Reyataz | 1,401 |
| 2008 | 20,597 | Plavix | 5,603 | 27,20 % | 3,585 | 17,41 % | 43,93 % | Abilify | 2,153 | Reyataz | 1,292 |
| 2007 | 19,348 | Plavix | 4,755 | 24,58 % | 3,282 | 16,96 % | 39,38 % | Abilify | 1,660 | Avapro/Avalide | 1,204 |
| 2006 | 17,915 | Plavix | 3,257 | 18,18 % | 3,067 | 17,12 % | 32,02 % | Abilify | 1,282 | Pravachol | 1,197 |
| 2005 | 19,207 | Plavix | 3,823 | 19,90 % | 2,746 | 14,30 % | 36,76 % | Pravachol | 2,256 | Avapro/Avalide | 0,982 |
| 2004 | 19,380 | Plavix | 3,327 | 17,17 % | 2,500 | 12,90 % | 35,88 % | Pravachol | 2,635 | Taxol | 0,991 |
| 2003 | 20,894 | Pravachol | 2,827 | 13,53 % | 2,279 | 10,91 % | 29,81 % | Plavix | 2,467 | Taxol | 0,934 |
| 2002 | 18,119 | Pravachol | 2,266 | 12,51 % | 2,218 | 12,24 % | 27,72 % | Plavix | 1,900 | Taxol | 0,857 |
| 2001 | 19,423 | Pravachol | 2,173 | 11,19 % | 2,259 | 11,63 % | 28,69 % | Glucophage | 2,049 | Plavix | 1,350 |
| 2000 | 18,216 | Pravachol | 1,817 | 9,97 % | 1,939 | 10,64 % | 28,22 % | Glucophage | 1,732 | Taxol | 1,592 |
| 1999 | 20,222 | Pravachol | 1,704 | 8,43 % | 1,843 | 9,11 % | 22,26 % | Taxol | 1,481 | Glucophage | 1,317 |
| 1998 | 18,284 | Pravachol | 1,643 | 8,99 % | 1,577 | 8,63 % | 21,80 % | Taxol | 1,481 | Glucophage | 0,862 |
| 1997 | 16,701 | Pravachol | 1,437 | 8,60 % | 1,385 | 8,29 % | 17,71 % | Taxol | 0,941 | Glucophage | 0,579 |
| Average | 393,984 | | | 18,01 % | | 18,23 % | 36,80 % | | | | |
| Max | | | | 34,21 % | | 35,75 % | 59,20 % | | | | |
| Min | | | | 8,43 % | | 8,29 % | 17,71 % | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | Average R&D to revenue | | | | |
| 2017 | 25,59 % | | | 22,53 % | |
| 2016 | 20,97 % | | | 21,87 % | |
| 2015 | 25,90 % | | | 22,49 % | |
| 2014 | 19,07 % | | | 18,87 % | |
| 2013 | 26,25 % | | | 17,69 % | |
| 2012 | 17,97 % | | | 17,62 % | |
| 2011 | 17,51 % | | | 16,98 % | |
| 2010 | 17,41 % | | | 17,41 % | |
| 2009 | 17,28 % | | | 23,47 % | |
| 2008 | 29,35 % | | | 29,35 % | |
| 2007 | 23,47 % | | | 17,28 % | |
| 2006 | 17,41 % | | | 17,41 % | |
| 2005 | 16,98 % | | | 17,51 % | |
| 2004 | 17,62 % | | | 17,97 % | |
| 2003 | 17,69 % | | | 26,25 % | |
| 2002 | 18,87 % | | | 19,07 % | |
| 2001 | 22,49 % | | | 25,90 % | |
| 2000 | 21,87 % | | | 20,97 % | |
| 1999 | 22,53 % | | | 25,59 % | |
| | | | | | |
| max | 29,35 % | | | | |
| min | 16,98 % | | | | |
| | | | | | |
| | Average R&D to revenue all years | | | | 26,15 % |

## Revenue and R&D 1999-2017

2017

| Company | Total company rev | R&D Expend | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 41,837 | 10,553 | 21,416 |
| Pfizer | 52,546 | 7,657 | 13,792 |
| Sanofi | 28,387 | 6,138 | 8,773 |
| Bayer | 19,037 | 5,089 | 7,123 |
| GlaxoSmithKline | 28,917 | 5,769 | 9,016 |
| Johnson&Johnson | 36,256 | 8,36 | 12,895 |
| Merck & Co. | 35,39 | 10,208 | 12,013 |
| Novartis | 43,085 | 9 | 7,199 |
| AbbVie | 28,216 | 4,982 | 21,829 |
| Eli Lilly | 22,871 | 5,282 | 7,472 |
| Amgen | 22,849 | 3,562 | 12,02 |
| Gilead Siences | 26,107 | 3,734 | 11,554 |
| Bristol Meyers Squibb | 20,776 | 6,411 | 12,299 |
| Celgene | 13,003 | 5,915 | 11,08 |
| Astra Zeneca | 22,465 | 5,757 | 7,12 |
| | 441,742 | 98,417 | 175,601 |

2016

| Company | Total company reven | R&D Expend | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 39,679 | 10,047 | 21,174 |
| Pfizer | 52,824 | 7,872 | 13,593 |
| Sanofi | 32,371 | 5,725 | 9,845 |
| Bayer | 18,176 | 5,165 | 6,330 |
| GlaxoSmithKline | 27,939 | 0,898 | 8,333 |
| Johnson&Johnson | 33,460 | 6,967 | 12,458 |
| Merck & Co. | 35,151 | 10,124 | 11,983 |
| Novartis | 42,706 | 9,024 | 8,267 |
| AbbVie | 25,638 | 4,366 | 19,432 |
| Eli Lilly | 21,222 | 5,244 | 7,646 |
| Amgen | 22,991 | 3,840 | 12,706 |
| Gilead Siences | 30,390 | 5,098 | 16,646 |
| Bristol Meyers Squibb | 19,427 | 4,940 | 9,382 |
| Celgene | 11,229 | 4,470 | 9,302 |
| Astra Zeneca | 23,002 | 8,422 | 5,890 |
| | 436,205 | 92,202 | 147,039 |

2015

| Company | Total company rev | R&D Expend | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 38,074 | 9,340 | 20,702 |
| Pfizer | 51,584 | 6,678 | 12,343 |
| Sanofi | 36,203 | 6,337 | 12,322 |
| Bayer | 14,864 | 4,238 | 4,237 |
| GlaxoSmithKline | 33,349 | 5,319 | 10,94 |
| Johnson&Johnson | 28,125 | 5,81 | 10,044 |
| Merck & Co. | 37,437 | 7,503 | 8,933 |
| Novartis | 57,82 | 9,846 | 10,6 |
| AbbVie | 18,79 | 2,855 | 12,656 |
| Eli Lilly | 23,113 | 5,531 | 10,398 |
| Amgen | 18,676 | 4,083 | 12,252 |
| Gilead Siences | 11,202 | 2,12 | 7,743 |
| Bristol Meyers Squibb | 15,879 | 4,535 | 5,454 |
| Celgene | 6,494 | 2,226 | 5,732 |
| Astra Zeneca | 25,711 | 4,821 | 12,977 |
| | 417,421 | 81,242 | 157,333 |

2014

| Company | Total company reven | R&D Expend | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 37,433 | 9,004 | 19,507 |
| Pfizer | 58,986 | 7,870 | 11,843 |
| Sanofi | 37,123 | 6,329 | 11,468 |
| Bayer | 12,901 | 3,874 | 4,427 |
| GlaxoSmithKline | 33,798 | 5,507 | 10,480 |
| Johnson&Johnson | 25,351 | 5,362 | 9,101 |
| Merck & Co. | 40,601 | 8,168 | 7,909 |
| Novartis | 46,448 | 9,116 | 11,490 |
| AbbVie | 18,012 | 2,778 | 11,515 |
| Eli Lilly | 22,603 | 5,278 | 9,894 |
| Amgen | 17,265 | 3,380 | 11,628 |
| Gilead Siences | 9,703 | 1,760 | 7,600 |
| Bristol Meyers Squibb | 17,621 | 3,904 | 6,901 |
| Celgene | 5,507 | 1,724 | 5,017 |
| Astra Zeneca | 27,973 | 5,243 | 13,391 |
| | 411,325 | 70,293 | 152,171 |

2013

| Company | Total company rev | R&D Expend | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 37,993 | 9,620 | 17,123 |
| Pfizer | 50,009 | 7,845 | 16,857 |
| Sanofi | 36,018 | 6,392 | 12,186 |
| Bayer | 14,599 | 3,830 | 4,714 |
| GlaxoSmithKline | 37,157 | 6,434 | 11,209 |
| Johnson&Johnson | 22,52 | 4,591 | 8,099 |
| Merck & Co. | 25,237 | 5,845 | 10,162 |
| Novartis | 44,2 | 7,469 | 11,426 |
| AbbVie | 16,486 | 17,07 | 5,5 |
| Eli Lilly | 21,836 | 4,327 | 9,949 |
| Amgen | 14,351 | 2,864 | 10,788 |
| Gilead Siences | 7,011 | 0,94 | 5,539 |
| Bristol Meyers Squibb | 18,808 | 3,647 | 10,139 |
| Celgene | 2,69 | 0,795 | 2,531 |
| Astra Zeneca | 32,804 | 4,409 | 14,327 |
| | 381,719 | 86,078 | 150,339 |

2012

| Company | Total company reven | R&D Expend | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 33,016 | 8,121 | 16,019 |
| Pfizer | 48,296 | 7,945 | 17,463 |
| Sanofi | 36,348 | 6,731 | 11,471 |
| Bayer | 15,747 | 3,903 | 4,728 |
| GlaxoSmithKline | 37,783 | 6,824 | 11,601 |
| Johnson&Johnson | 24,567 | 5,095 | 8,939 |
| Merck & Co. | 23,260 | 4,805 | 9,448 |
| Novartis | 41,459 | 7,217 | 10,732 |
| AbbVie | 16,708 | | 4,500 |
| Eli Lilly | 20,378 | 3,841 | 9,129 |
| Amgen | 15,003 | 3,030 | 11,394 |
| Gilead Siences | 5,336 | 0,722 | 0,300 |
| Bristol Meyers Squibb | 20,597 | 3,585 | 9,048 |
| Celgene | 2,255 | 0,931 | 2,036 |
| Astra Zeneca | 31,601 | 5,179 | 13,249 |
| | 372,354 | 67,929 | 140,117 |

2015

| Company | Total company re | R&D Expe | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 38,675 | 9,643 | 21,014 |
| Pfizer | 48,851 | 7,690 | 14,317 |
| Sanofi | 33,064 | 5,639 | 11,138 |
| Bayer | 15,251 | 4,742 | 5,143 |
| GlaxoSmithKline | 27,237 | 5,440 | 7,861 |
| Johnson&Johnson | 31,430 | 6,821 | 11,266 |
| Merck & Co. | 34,782 | 6,705 | 8,540 |
| Novartis | 39,602 | 8,900 | 9,494 |
| AbbVie | 22,859 | 4,285 | 16,477 |
| Eli Lilly | 19,959 | 4,796 | 7,646 |
| Amgen | 21,662 | 4,070 | 12,030 |
| Gilead Siences | 32,639 | 3,014 | 22,599 |
| Bristol Meyers Squibb | 16,560 | 5,920 | 5,365 |
| Celgene | 9,256 | 3,697 | 7,752 |
| Astra Zeneca | 24,708 | 5,997 | 10,907 |
| | 416,535 | 87,359 | 171,549 |

2014

| Company | Total company reven | R&D Expen | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 39,801 | 9,667 | 21,25 |
| Pfizer | 49,605 | 8,393 | 13,482 |
| Sanofi | 26,820 | 6,408 | 13,157 |
| Bayer | 16,008 | 4,747 | 4,791 |
| GlaxoSmithKline | 30,773 | 5,131 | 9,662 |
| Johnson&Johnson | 32,313 | 6,213 | 11,070 |
| Merck & Co. | 36,042 | 7,180 | 8,953 |
| Novartis | 47,169 | 9,917 | 9,664 |
| AbbVie | 19,960 | 3,297 | 14,347 |
| Eli Lilly | 19,616 | 4,730 | 7,868 |
| Amgen | 20,063 | 4,297 | 11,664 |
| Gilead Siences | 24,890 | 2,854 | 17,093 |
| Bristol Meyers Squibb | 15,879 | 5,434 | 5,165 |
| Celgene | 7,670 | 2,431 | 6,508 |
| Astra Zeneca | 26,095 | 5,579 | 12,968 |
| | 412,704 | 86,278 | 167,642 |

2011

| Company | Total company re | R&D Expe | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 36,525 | 8,991 | 18,433 |
| Pfizer | 67,425 | 9,112 | 16,963 |
| Sanofi | 38,837 | 6,699 | 11,233 |
| Bayer | 13,854 | 4,083 | 4,542 |
| GlaxoSmithKline | 35,585 | 6,273 | 10,525 |
| Johnson&Johnson | 24,368 | 5,138 | 8,698 |
| Merck & Co. | 41,289 | 8,467 | 11,470 |
| Novartis | 48,608 | 9,239 | 12,374 |
| AbbVie | 17,022 | 2,618 | 10,474 |
| Eli Lilly | 24,287 | 5,021 | 11,245 |
| Amgen | 15,295 | 3,167 | 11,216 |
| Gilead Siences | 8,385 | 1,229 | 6,838 |
| Bristol Meyers Squibb | 21,244 | 3,839 | 11,414 |
| Celgene | 4,842 | 1,600 | 4,299 |
| Astra Zeneca | 33,591 | 5,523 | 16,879 |
| | 431,157 | 80,999 | 166,603 |

2010

| Company | Total company reven | R&D Expen | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 35,501 | 8,67 | 17,479 |
| Pfizer | 67,809 | 9,413 | 17,070 |
| Sanofi | 35,244 | 6,03 | 11,19 |
| Bayer | 14,466 | 4,049 | 4,404 |
| GlaxoSmithKline | 36,130 | 6,125 | 11.025 |
| Johnson&Johnson | 22,396 | 4,320 | 8,044 |
| Merck & Co. | 39,811 | 10,991 | 10,086 |
| Novartis | 48,198 | 8,080 | 11,851 |
| AbbVie | 19,894 | 2,495 | 9,086 |
| Eli Lilly | 23,076 | 4,884 | 10,694 |
| Amgen | 15,053 | 2,894 | 10,902 |
| Gilead Siences | 7,949 | 1,073 | 6,309 |
| Bristol Meyers Squibb | 19,484 | 3,566 | 10,710 |
| Celgene | 3,626 | 1,128 | 3,393 |
| Astra Zeneca | 22,269 | 5,318 | 15,962 |
| | 410,906 | 79,036 | 147,18 |

2007

| Company | Total company re | R&D Expe | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 29,439 | 6,711 | 11.584 |
| Pfizer | 48,418 | 8,089 | 17,966 |
| Sanofi | 34,656 | 6,221 | 9,69 |
| Bayer | 14,078 | 3,535 | 3,960 |
| GlaxoSmithKline | 38,507 | 6,661 | 11,072 |
| Johnson&Johnson | 24,886 | 5,276 | 8,665 |
| Merck & Co. | 23,939 | 4,883 | 10,779 |
| Novartis | 39,800 | 6,430 | 9,359 |
| AbbVie | 14,630 | | 3,000 |
| Eli Lilly | 18,634 | 3.487 | 8,456 |
| Amgen | 14,771 | 3,266 | 11,121 |
| Gilead Siences | 4,230 | 0,591 | 3,105 |
| Bristol Meyers Squibb | 19,348 | 7,619 | 3,282 |
| Celgene | 1,406 | 0,399 | 1,295 |
| Astra Zeneca | 29,559 | 5,162 | 12,039 |
| | 356,301 | 64,843 | 113,789 |

2006

| Company | Total company reven | R&D Expen | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 24,887 | 4,925 | 8,766 |
| Pfizer | 48,371 | 7,559 | 19,862 |
| Sanofi | 32,475 | 5,567 | 8,408 |
| Bayer | 9,398 | 2,887 | 2,487 |
| GlaxoSmithKline | 36,991 | 6,369 | 10,516 |
| Johnson&Johnson | 23,267 | 4,956 | 10,376 |
| Merck & Co. | 22,080 | 4,783 | 10,541 |
| Novartis | 37,020 | 5,349 | 8,129 |
| Eli Lilly | 15,691 | 3,129 | 7,088 |
| Amgen | 14,268 | 10,555 | 3,366 |
| Gilead Siences | 3,026 | 0,384 | 2,089 |
| Bristol Meyers Squibb | 17,915 | 3,067 | 5,736 |
| Celgene | 0,899 | 0,259 | 0,804 |
| Astra Zeneca | 26,475 | 3,902 | 10,626 |
| | 312,763 | 63,691 | 108,794 |

2005

| Company | Total company rev | R&D Expend | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 20,558 | 4,301 | 6,447 |
| Pfizer | 47,405 | 7,442 | 29,159 |
| Sanofi | 31,413 | 5,031 | 7,189 |
| Bayer | 5,060 | 2,360 | 2,528 |
| GlaxoSmithKline | 33,948 | 5,705 | 9,107 |
| Johnson&Johnson | 22,322 | 4,442 | 9,411 |
| Merck & Co. | 21,825 | 3,848 | 10,610 |
| Novartis | 31,212 | 4,846 | 7,070 |
| Eli Lilly | 14,645 | 3,016 | 6,734 |
| Amgen | 12,430 | 2,314 | 9,350 |
| Gilead Siences | 2,028 | 0,278 | 1,567 |
| Bristol Meyers Squibb | 19,207 | 2,746 | 7,061 |
| Celgene | 0,537 | 0,191 | 0,442 |
| Astra Zeneca | 23,950 | 3,379 | 9,129 |
| | 286,54 | 49,899 | 115,804 |

2004

| Company | Total company reven | R&D Expend | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 16,441 | 3,86 | 5,826 |
| Pfizer | 48,988 | 7,684 | 18,686 |
| Sanofi | 17,647 | 2,971 | 6,343 |
| Bayer | 5,458 | 2,621 | 2,654 |
| GlaxoSmithKline | 31,423 | 5,203 | 8,504 |
| Johnson&Johnson | 22,128 | 3,629 | 8,784 |
| Merck & Co. | 22,715 | 4,01 | 11,181 |
| Novartis | 28,247 | 4,207 | 5,889 |
| Eli Lilly | 13,858 | 2,691 | 6,736 |
| Amgen | 10,55 | 2,028 | 6,974 |
| Gilead Siences | 1,325 | 0,224 | 1,062 |
| Bristol Meyers Squibb | 19,38 | 2,5 | 6,953 |
| Celgene | 0,378 | 0,161 | 0,367 |
| Astra Zeneca | 21,426 | 3,803 | 7,857 |
| | 259,964 | 45,592 | 97,816 |

2001

| Company | Total company rev | R&D Expend | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 5,905 | 1,219 | 1,427 |
| Pfizer | 29,024 | 4,776 | 12,394 |
| Sanofi | 5,679 | 0,924 | 1,715 |
| Bayer | 4,286 | 2,293 | 3,281 |
| GlaxoSmithKline | 24,775 | 3,679 | 6,038 |
| Johnson&Johnson | 14,849 | | |
| Merck & Co. | 17,792 | 2,500 | 9,216 |
| Novartis | 9,471 | 1,311 | 1,636 |
| Eli Lilly | 11,543 | 2,235 | 6,138 |
| Amgen | 4,016 | 0,865 | 3,766 |
| Gilead Siences | 0,234 | 0,186 | 0,180 |
| Bristol Meyers Squibb | 19,423 | 2,259 | 5,572 |
| Celgene | 0,114 | 0,068 | 0,080 |
| Astra Zeneca | 16,800 | 2,687 | 7,556 |
| | 163,911 | 25,002 | 58,999 |

2000

| Company | Total company reven | R&D Expend | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 5,498 | 1,218 | 0,846 |
| Pfizer | 29,574 | 4,435 | 10,533 |
| Sanofi | 5,114 | 0,872 | 1,218 |
| Bayer | 5,668 | 2,209 | 3,301 |
| GlaxoSmithKline | 23,476 | 3,789 | 5,528 |
| Johnson&Johnson | 12,659 | | |
| Merck & Co. | 16,058 | 2,300 | 4,429 |
| Novartis | 8,617 | 1,247 | |
| Eli Lilly | 10,862 | 2,019 | 6,038 |
| Amgen | 3,629 | 0,845 | 3,332 |
| Gilead Siences | 0.196 | 0,132 | 0,141 |
| Bristol Meyers Squibb | 18,216 | 1,939 | 5,141 |
| Celgene | 0,084 | 0,062 | 0,053 |
| Astra Zeneca | 15,804 | 2,616 | 8,182 |
| | 155,259 | 23,683 | 48,742 |

2003

| Company | Total company re | R&D Expe | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 14,137 | 3,044 | 4,068 |
| Pfizer | 44,736 | 7,487 | 16,685 |
| Sanofi | 8,800 | 1,490 | 3,957 |
| Bayer | 5,373 | 2,734 | 3,035 |
| GlaxoSmithKline | 29,714 | 4,561 | 8,243 |
| Johnson&Johnson | 19,517 | 3,201 | 8,225 |
| Merck & Co. | 22,257 | 3,280 | 10,237 |
| Novartis | 24,864 | 3,628 | 4,573 |
| Eli Lilly | 12,583 | 2,305 | 6,359 |
| Amgen | 8,356 | 1,655 | 6,500 |
| Gilead Siences | 0.868 | 0,165 | 0,765 |
| Bristol Meyers Squibb | 20,894 | 2,279 | 6,228 |
| Celgene | 0,271 | 0,123 | 0,265 |
| Astra Zeneca | 18,849 | 3,451 | 7,354 |
| | 230,351 | 39,403 | 86,494 |

2002

| Company | Total company reven | R&D Expen | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 8,602 | 1,735 | 2,26 |
| Pfizer | 32,373 | 5,176 | 14,560 |
| Sanofi | 6,760 | 1,153 | 2,813 |
| Bayer | 4,511 | 2,439 | 2,650 |
| GlaxoSmithKline | 27,044 | 4,358 | 7,329 |
| Johnson&Johnson | 17,151 | 2,693 | 7,712 |
| Merck & Co. | 18,867 | 2,700 | 10,300 |
| Novartis | 14,442 | 1,933 | 2,469 |
| Eli Lilly | 11,078 | 2,149 | 5,568 |
| Amgen | 5,523 | 1,117 | 4,519 |
| Gilead Siences | 0.467 | 0,135 | 0,411 |
| Bristol Meyers Squibb | 18,119 | 2,218 | 5,023 |
| Celgene | 0,136 | 0,085 | 0,051 |
| Astra Zeneca | 17,841 | 3,069 | 7,746 |
| | 182,447 | 30,960 | 73,411 |

1999

| Company | Total company re | R&D Expe | Top 3 drugs revenue |
|---|---|---|---|
| Roche | 13,678 | 1,876 | 1,856 |
| Pfizer | 27,376 | 4,036 | 8,783 |
| Sanofi | 5,027 | 0,971 | 0,947 |
| Bayer | 5,327 | 2,399 | 3,772 |
| GlaxoSmithKline | 22,032 | 3,697 | |
| Johnson&Johnson | 27,357 | | |
| Merck & Co. | 15,661 | 2,068 | |
| Novartis | 11,797 | 1,744 | |
| Eli Lilly | 10,003 | 1,784 | 4,954 |
| Amgen | 3,34 | 0,823 | 3,278 |
| Gilead Siences | 0,169 | 0,11 | |
| Bristol Meyers Squibb | 20,222 | 1,843 | 4,502 |
| Celgene | 0,026 | 0,02 | 0,024 |
| Astra Zeneca | 18,445 | 2,454 | 7,86 |
| | 180,460 | 23,825 | 35,976 |

| | Top 3 drug revenue for 15 companies | Change from previous year | % of total for 15 companies | % of total in | Total revenue 15 companies | Change from previous year | % of total industry revenue | Total global pharmaceutical revenue | Change from previous year | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 35,976 | | 19,94 % | 9,68 % | 180,46 | | 48,56 % | 371,6 | | | | | |
| 2000 | 48,742 | 35,48 % | 31,39 % | 12,63 % | 155,259 | -13,96 % | 40,22 % | 386 | 3,88 % | | top 3 | companies | market |
| 2001 | 58,999 | 21,04 % | 35,99 % | 15,12 % | 163,911 | 5,57 % | 42,01 % | 390,2 | 1,09 % | 2009 | 9,47 % | 8,06 % | 8,24 % |
| 2002 | 73,411 | 24,43 % | 40,24 % | 17,17 % | 182,447 | 11,31 % | 42,67 % | 427,6 | 9,58 % | 2013 | 1,46 % | 2,39 % | 4,64 % |
| 2003 | 86,494 | 17,82 % | 37,55 % | 17,37 % | 230,351 | 26,26 % | 46,26 % | 498 | 16,46 % | 2017 | 3,51 % | 1,45 % | 3,59 % |
| 2004 | 97,816 | 13,09 % | 37,63 % | 17,47 % | 259,964 | 12,86 % | 46,43 % | 559,9 | 12,43 % | | | | |
| 2005 | 115,804 | 18,39 % | 40,41 % | 19,26 % | 286,54 | 10,22 % | 47,66 % | 601,2 | 7,38 % | | | | |
| 2006 | 108,794 | -6,05 % | 34,78 % | 16,77 % | 312,763 | 9,15 % | 48,21 % | 648,7 | 7,90 % | | | | |
| 2007 | 113,789 | 4,59 % | 31,94 % | 15,66 % | 356,301 | 13,92 % | 49,05 % | 726,4 | 11,98 % | | | | |
| 2008 | 140,117 | 23,14 % | 37,64 % | 17,54 % | 372,254 | 4,48 % | 46,59 % | 799 | 9,99 % | | | | |
| 2009 | 150,339 | 7,30 % | 39,38 % | 18,10 % | 381,719 | 2,54 % | 45,96 % | 830,6 | 3,95 % | | | | |
| 2010 | 147,18 | -2,10 % | 35,05 % | 16,57 % | 419,906 | 10,00 % | 47,28 % | 888,2 | 6,93 % | | | | |
| 2011 | 166,603 | 13,20 % | 38,64 % | 17,30 % | 431,157 | 2,68 % | 44,76 % | 963,2 | 8,44 % | | | | |
| 2012 | 152,171 | -8,66 % | 37,00 % | 15,78 % | 411,325 | -4,60 % | 42,65 % | 964,4 | 0,12 % | | | | |
| 2013 | 157,333 | 3,39 % | 37,69 % | 15,83 % | 417,421 | 1,48 % | 42,00 % | 993,8 | 3,05 % | | | | |
| 2014 | 167,642 | 6,55 % | 40,62 % | 15,76 % | 412,704 | -1,13 % | 38,80 % | 1063,6 | 7,02 % | | | | |
| 2015 | 171,549 | 2,33 % | 41,18 % | 15,99 % | 416,535 | 0,93 % | 38,82 % | 1073,1 | 0,89 % | | | | |
| 2016 | 147,039 | -14,29 % | 33,71 % | 13,18 % | 436,205 | 4,72 % | 39,10 % | 1115,7 | 3,97 % | | | | |
| 2017 | 175,601 | 19,42 % | 39,75 % | 15,36 % | 441,742 | 1,27 % | 38,64 % | 1143,3 | 2,47 % | | | | |
| AVG | | 9,95 % | | | | 5,43 % | 43,98 % | | 6,53 % | | | | |
| Max | | 35,48 % | | | | 26,26 % | 49,05 % | | 16,46 % | | | | |
| Min | | -14,29 % | | | | -13,96 % | 38,64 % | | 0,12 % | | | | |

| | Total R&D spend 15 companies | % of total global R&D in pharma | Total global pharma R&D spend | Total US pharma R&D | % of total global spend all industries |
|---|---|---|---|---|---|
| 1999 | 23,825 | 56,73 % | 42 | 22,7 | 54,05 % |
| 2000 | 23,683 | 52,63 % | 45 | 26 | 57,78 % |
| 2001 | 25,002 | 49,02 % | 51 | 29,8 | 58,43 % |
| 2002 | 30,960 | 45,53 % | 68 | 31 | 45,59 % |
| 2003 | 39,403 | 50,52 % | 78 | 34,5 | 44,23 % |
| 2004 | 45,592 | 53,01 % | 86 | 37 | 43,02 % |
| 2005 | 49,899 | 53,08 % | 94 | 39,9 | 42,45 % |
| 2006 | 63,691 | 60,66 % | 105 | 43 | 40,95 % |
| 2007 | 64,843 | 55,42 % | 117 | 47,9 | 40,94 % |
| 2008 | 67,929 | 53,91 % | 126 | 47,4 | 37,62 % |
| 2009 | 86,078 | 69,42 % | 124 | 46,4 | 37,42 % |
| 2010 | 79,036 | 61,27 % | 129 | 50,7 | 39,30 % |
| 2011 | 80,999 | 59,12 % | 137 | 48,6 | 35,47 % |
| 2012 | 70,293 | 51,69 % | 136 | 49,6 | 36,47 % |
| 2013 | 81,242 | 58,87 % | 138 | 51,6 | 37,39 % |
| 2014 | 86,278 | 59,92 % | 144 | 53,3 | 37,01 % |
| 2015 | 87,359 | 58,63 % | 149 | 59,6 | 40,00 % |
| 2016 | 92,202 | 57,99 % | 159 | 65,5 | 41,19 % |
| 2017 | 98,417 | 59,65 % | 165 | 71,4 | 43,27 % |
| AVG | | 56,16 % | | | 42,77 % |
| Max | | 69,42 % | | | 58,43 % |
| Min | | 45,53 % | | | 35,47 % |

| | Total R&D spend 15 companies | Change from previous year | Total global pharma R&D spend | | Total US pharma R&D | % of total global spend all industries |
|---|---|---|---|---|---|---|
| 1999 | 23,825 | | 42 | | 22,7 | |
| 2000 | 23,683 | -0,60 % | 45 | 7,14 % | 26 | 14,54 % |
| 2001 | 25,002 | 5,57 % | 51 | 13,33 % | 29,8 | 14,62 % |
| 2002 | 30,960 | 23,83 % | 68 | 33,33 % | 31 | 4,03 % |
| 2003 | 39,403 | 27,27 % | 78 | 14,71 % | 34,5 | 11,29 % |
| 2004 | 45,592 | 15,71 % | 86 | 10,26 % | 37 | 7,25 % |
| 2005 | 49,899 | 9,45 % | 94 | 9,30 % | 39,9 | 7,84 % |
| 2006 | 63,691 | 27,64 % | 105 | 11,70 % | 43 | 7,77 % |
| 2007 | 64,843 | 1,81 % | 117 | 11,43 % | 47,9 | 11,40 % |
| 2008 | 67,929 | 4,76 % | 126 | 7,69 % | 47,4 | -1,04 % |
| 2009 | 86,078 | 26,72 % | 124 | -1,59 % | 46,4 | -2,11 % |
| 2010 | 79,036 | -8,18 % | 129 | 4,03 % | 50,7 | 9,27 % |
| 2011 | 80,999 | 2,48 % | 137 | 6,20 % | 48,6 | -4,14 % |
| 2012 | 70,293 | -13,22 % | 136 | -0,73 % | 49,6 | 2,06 % |
| 2013 | 81,242 | 15,58 % | 138 | 1,47 % | 51,6 | 4,03 % |
| 2014 | 86,278 | 6,20 % | 144 | 4,35 % | 53,3 | 3,29 % |
| 2015 | 87,359 | 1,25 % | 149 | 3,47 % | 59,6 | 11,82 % |
| 2016 | 92,202 | 5,54 % | 159 | 6,71 % | 65,5 | 9,90 % |
| 2017 | 98,417 | 6,74 % | 165 | 3,77 % | 71,4 | 9,01 % |
| AVG | | 8,14 % | | | | 6,71 % |
| Max | | 27,64 % | | 33,33 % | | 14,62 % |
| Min | | -13,22 % | | -1,59 % | | -4,14 % |

## Category overviews

**Cancer**

| | Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling |
|---|---|---|---|---|---|
| 1 | Roche | Rituxan | 85,983 | Still no 1 | 17 |
| 2 | Roche | Avastin | 69,204 | Still no 3 | 12 |
| 3 | Roche | Herceptin | 69,981 | Still no 2 | 13 |
| 4 | Pfizer | Ibrance | 3,126 | Still no 3 | 1 |
| 5 | Novartis | Gleevec | 51,112 | Still no 3 | 15 |
| 6 | Novartis | Zometa | 5,372 | 3 | 5 |
| 7 | Merck & Co. | Keytruda | 3,809 | Still no 2 | 1 |
| 8 | AbbVie | Imbruvica | 4,405 | Still no 2 | 3 |
| 9 | AbbVie | Lupron | 1,655 | Still no 3 | 2 |
| 10 | Eli Lilly | Alimta | 20,028 | Still no 3 | 8 |
| 11 | Eli Lilly | Gemzar | 7,902 | 3 | 9 |
| 12 | AstraZeneca | Zoladex | 0,734 | 3 | 1 |
| 13 | Celgene | Revlimid | 43,791 | Still no 1 | 12 |
| 14 | Celgene | Pomalyst | 4,587 | Still no 2 | 4 |
| 15 | Celgene | Vidaza | 3,459 | 2 | 6 |
| 16 | Celgene | Thalomid | 3,314 | 3 | 13 |
| 17 | Celgene | Abraxane | 3,277 | 2 | 5 |
| 18 | Celgene | Alkeran | 0,208 | 2 | 5 |
| 19 | Sanofi | Taxotere | 4,816 | 3 | 6 |
| 20 | Sanofi | Eloxatin | 0,933 | 3 | 1 |
| 21 | Johnson & Johnson | Zytiga | 8,426 | 3 | 4 |
| 22 | Johnson & Johnson | Velcade | 1,500 | 2 | 1 |
| 23 | Amgen | Neulasta | 67,987 | Still no 2 | 21 |
| 24 | Amgen | Xgeva | 1,221 | 3 | 1 |
| 25 | Bristol-Myers Squibb | Opdivo | 8,722 | Still no 1 | 2 |
| 26 | Bristol-Myers Squibb | Taxol | 8,277 | 3 | 8 |
| 27 | Bristol-Myers Squibb | Sprycel | 3,113 | 3 | 2 |
| | Total revenue | | 486,942 | | For all |
| | Average | | 18,035 | | 6,59 |
| | Max | | 85,983 | | 21 |
| | Min | | 0,208 | | 1 |

**Antidepressants and antipsychotics**

| | Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling | |
|---|---|---|---|---|---|---|
| 1 | Eli Lilly | Zyprexa | 54,467 | 1 | 15 | |
| 2 | AstraZeneca | Seroquel | 35,311 | 3 | 10 | |
| 3 | Johnson & Johnson | Risperdal | 28,686 | 3 | 7 | |
| 4 | Johnson & Johnson | Trevicta/Invega | 2,569 | 3 | 1 | |
| 5 | Bristol-Myers Squibb | Abilify | 20,146 | 1 | 9 | |
| 6 | Eli Lilly | Cymbalta | 26,890 | 1 | 8 | |
| 7 | Eli Lilly | Prozac | 12,548 | 2 | 5 | |
| 8 | Pfizer | Zoloft | 24,432 | 3 | 10 | |
| 9 | GlaxoSmithKline | Seroxat(EU)/Pa | 13,127 | 3 | 5 | |
| 10 | GlaxoSmithKline | Welbutrin XL | 1,558 | 3 | 1 | |
| | Total revenue | | 219,734 | | For all | For no longer top |
| | Average | | 21,973 | | 7,10 | 7,777778 |
| | Max | | 54,467 | | 15,00 | 15 |
| | Min | | 1,558 | | 1,00 | 1 |

**Asthma**

| | Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling | |
|---|---|---|---|---|---|---|
| 1 | Merck & Co. | Singulair | 28,096 | 1 | 6 | |
| 2 | AstraZeneca | Symbicort | 19,664 | Still no 1 | 6 | |
| 3 | AstraZeneca | Pulmicort | 2,827 | 3 | 5 | |
| 4 | GlaxoSmithKline | Advair(US)/Ser | 98,260 | Still no 1 | 16 | |
| 5 | GlaxoSmithKline | Flixotide/Flove | 5,197 | 2 | 3 | |
| | Total revenue | | 154,044 | | For all | For no longer top |
| | Average | | 30,809 | | 7,20 | 4,666667 |
| | Max | | 98,260 | | 16,00 | 6 |
| | Min | | 2,827 | | 3,00 | 3 |

**Antivirals (including Antiretrovirals)**

| | | Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling |
|---|---|---|---|---|---|---|
| Antivirals | | Roche | Pegasys+Copegus | 1,184 | 3 | 1 |
| *revenue* | | AbbVie | Viekira | 3,161 | 3 | 2 |
| | *60,874* | GlaxoSmithKline | Relenza | 3,225 | 2 | 2 |
| *average* | | Johnson & Johnson | Olysio/Sovriad | 2,302 | 2 | 1 |
| | *6,764* | Gilead Sciences | Harvoni | 27,315 | Still no 1 | 3 |
| *max* | | Gilead Sciences | Sovaldi | 19,560 | 2 | 3 |
| | 27,315 | Gilead Sciences | Epclusa | 3,510 | Still no 3 | 1 |
| *min* | | Gilead Sciences | Vistide | 0,018 | 1 | 2 |
| | 0,018 | Amgen | Infergen | 0,599 | 3 | 4 |
| Antiretrovirals | | Abbvie | Kaletra | 4,225 | 3 | 5 |
| *revenue* | | GlaxoSmithKline | Triumeq | 6,63 | Still no 2 | 3 |
| | *95,308* | GlaxoSmithKline | Valtrex | 6,113 | 2 | 3 |
| *average* | | GlaxoSmithKline | Tivicay | 3,096 | Still no 3 | 2 |
| | *8,664* | Johnson & Johnson | Prezista | 1,673 | 3 | 1 |
| *max* | | Gilead Sciences | Truvada | 30,223 | 3 | 13 |
| | 30,223 | Gilead Sciences | Atripla | 21,004 | 2 | 9 |
| *min* | | Gilead Sciences | Viread | 8,237 | 3 | 13 |
| | 1,673 | Gilead Sciences | Genvoya | 3,674 | Still no 2 | 1 |
| | | Bristol-Myers Squibb | Reyataz | 7,292 | 3 | 6 |
| | | Bristol-Myers Squibb | Sustiva | 3,141 | 2 | 2 |
| | | Total revenue | | 156,182 | | For all |
| | | Average | | 7,8091 | | 3,85 |
| | | Max | | 30,223 | | 13 |
| | | Min | | 0,018 | | 1 |

**Blood medication (including medication for blood pressure, blo**

| | | Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling |
|---|---|---|---|---|---|---|
| Anemia | 1 | Roche | NeoRecormon | 5,858 | 2 | 6 |
| *revenue 9* | 2 | Johnson & Johnsen | Procrit/Eprex | 30,955 | 3 | 11 |
| *avg22,852* | 3 | Amgen | Aranesp | 33,995 | Still no 3 | 17 |
| *max 33,99* | 4 | Amgen | Epogen | 20,601 | 3 | 16 |
| Anticoagule | 5 | Sanofi | Plavix | 36,218 | 3 | 17 |
| *revenue 13* | 6 | Bristol-Myers Squibb | Plavix | 48,928 | 2 | 12 |
| *avg 24,785* | 7 | Bristol-Myers Squibb | Eliquis | 10,075 | Still no 2 | 3 |
| *max 48,928* | 8 | Bayer | Kogenate | 15,412 | 3 | 12 |
| *min 10,075* | 9 | Bayer | Xarelto | 12,957 | Still no 1 | 5 |
| Blood press | 10 | Pfizer | Norvasc | 39,944 | 2 | 11 |
| *revenue* | 11 | Novartis | Diovan | 54,579 | 2 | 13 |
| *133,587* | 12 | Novartis | Lotrel | 1,352 | 3 | 1 |
| *average* | 13 | Novartis | Cibacen/Loten | 0,475 | 3 | 1 |
| *13,359* | 14 | Merck & Co. | Cozaar/Hyzaar | 19,379 | 2 | 6 |
| *max* | 15 | AstraZeneca | Zestril | 3,506 | 2 | 3 |
| 54,579 | 16 | AstraZeneca | Seloken/Topro | 2,590 | 3 | 9 |
| *min* | 17 | Sanofi | Aprovel | 1,502 | 3 | 4 |
| 0,475 | 18 | Bayer | Adalat | 8,074 | 2 | 9 |
| | 19 | Bristol-Myers Squibb | Avapro | 2,186 | 3 | 2 |
| Blood thinn | 20 | Sanofi | Lovenox | 39,048 | Still no 2 | 14 |
| | | Total revenue | | 387,634 | | For all |
| | | Average | | 19,382 | | 8,60 |
| | | Max | | 54,579 | | 17,00 |
| | | Min | | 0,475 | | 1,00 |

| | | Antibiotics and anti inflammatories | | | | |
|---|---|---|---|---|---|---|
| | | Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling |
| Antibiotics | | Roche | Rocephin | 2,997 | 3 | 5 |
| *revenue* | | Pfizer | Zithromax | 1,041 | 3 | 2 |
| | 21,675 | Bayer | Ciprobay | 10,404 | 1 | 7 |
| *average* | | GlaxoSmith Kline | Augmentin | 5,683 | 3 | 3 |
| | 4,335 | Johnson & Johnson | Levaquin/Floxin | 1,55 | 3 | 1 |
| Anti-inflammatory | | Pfizer | Celebrex | 7,162 | 3 | 3 |
| | | Merck & Co. | Vioxx | 8,925 | 3 | 3 |
| | | Total revenue | | 37,762 | | For all |
| | | Average | | 5,395 | | 3,429 |
| | | Max | | 10,404 | | 1,000 |
| | | Min | | 1,041 | | 1,000 |

| Diabetes | | | | |
|---|---|---|---|---|
| Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling |
| Merck & Co. | Januvia | 35,520 | Still no 1 | 9 |
| Merck & Co. | Janumet | 2,151 | 3 | 1 |
| Eli Lilly | Humalog | 22,245 | Still no 1 | 10 |
| Eli Lilly | Humulin | 4,240 | 2 | 4 |
| Sanofi | Lantus | 61,828 | Still no 1 | 17 |
| GlaxoSmithKline | Avandia | 6,722 | 2 | 3 |
| Bristol-Myers Squibb | Glucophage | 6,539 | 2 | 5 |
| Total revenue | | 139,245 | | For all |
| Average | | 19,892 | | 7,000 |
| Max | | 61,828 | | 17,000 |
| Min | | 2,151 | | 1,000 |

| Others | | | | |
|---|---|---|---|---|
| Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling |
| Pfizer | Lyrica | 40,960 | Still no 2 | 10 |
| GlaxoSmithKline | Lamictal | 7,292 | 3 | 4 |
| Johnson & Johnson | Topamax | 5,184 | 2 | 2 |
| Pfizer | Prevnar 13 | 20,184 | Still no 1 | 5 |
| Merck & Co. | Gardasil | 4,481 | Still no 3 | 2 |
| GlaxoSmithKline | Infanrix/Pediari | 6,168 | 2 | 5 |
| Pfizer | Diflucan | 0,881 | 3 | 1 |
| Novartis | Lamicil | 1,766 | 3 | 3 |
| Gilead Sciences | AmBisome | 1,251 | 3 | 7 |
| Bayer | Yaz/Yasmin | 9,316 | 3 | 6 |
| Bayer | Mirena | 2,360 | Still no 3 | 2 |
| AstraZeneca | Nexium | 61,702 | Still no 3 | 16 |
| AstraZeneca | Losec/Prilosec | 33,736 | 3 | 8 |
| Novartis | Lucentis | 14,700 | 3 | 7 |
| Bayer | Eylea | 5,286 | Still no 2 | 3 |
| Merck & Co. | Fosamax | 21,376 | 3 | 9 |
| AbbVie | AndroGel | 3,121 | 2 | 3 |
| Eli Lilly | Cialis | 9,236 | Still no 2 | 4 |
| Eli Lilly | Axid | 0,945 | 3 | 2 |
| Celgene | Focalin | 0,111 | 3 | 5 |
| Sanofi | Stilnox/Ambier | 7,079 | 3 | 6 |
| Sanofi | Allegra | 1,868 | 3 | 1 |
| Bayer | Aspirin | 2,412 | 3 | 5 |
| GlaxoSmithKline | Avodart | 3,920 | 3 | 3 |
| Roche | Accutane | 1,279 | 3 | 3 |
| Roche | Xenical | 0,466 | 3 | 1 |
| Total revenue | | 267,080 | | For all |
| Average | | 10,272 | | 4,731 |
| Max | | 61,702 | | 16,000 |
| Min | | 0,111 | | 1,000 |

| Immunosuppressants | | | | |
|---|---|---|---|---|
| Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling |
| Roche | CellCept | 0,246 | 2 | 1 |
| Pfizer | Enbrel | 24,543 | 3 | 7 |
| Amgen | Enbrel | 52,266 | Still no 1 | 14 |
| Novartis | Gilenya | 11,547 | Still no 1 | 4 |
| Novartis | Neoral/Sandimmun | 2,309 | 3 | 3 |
| Novartis | Cosentyx | 2,071 | Still no 2 | 1 |
| Merck & Co. | Remicade | 12,100 | 3 | 5 |
| Johnson & Johnson | Remicade | 71,722 | Still no 1 | 16 |
| Johnson & Johnson | Stelara | 9,717 | Still no 2 | 3 |
| AbbVie | Humira | 108,424 | Still no 1 | 11 |
| Celgene | Otezla | 2,296 | Still no 3 | 2 |
| Sanofi | Aubagio | 1,771 | Still no 3 | 1 |
| Bayer | Betaferon | 11,556 | 2 | 8 |
| Bristol-Myers Squibb | Orencia | 8,281 | Still no 3 | 4 |
| Total revenue | | 318,849 | | For all |
| Average | | 22,775 | | 5,714 |
| Max | | 108,424 | | 16,000 |
| Min | | 0,246 | | 1,000 |

| Statins (cholesterol medication) | | | | |
|---|---|---|---|---|
| Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling |
| Pfizer | Lipitor | 129,180 | 2 | 14 |
| Merck & Co. | Zocor | 27,661 | 1 | 6 |
| Merck & Co. | Zetia | 13,282 | 2 | 5 |
| AbbVie | TriCor/Trilipix | 3,825 | 3 | 1 |
| AstraZeneca | Crestor | 53,406 | Still no 2 | 12 |
| Bristol-Myers Squibb | Pravachol | 19,955 | 3 | 10 |
| Bayer | Lipobay/Bayco | 0,587 | 3 | 1 |
| Total revenue | | 247,896 | | For all |
| Average | | 35,414 | | 7,000 |
| Max | | 129,180 | | 14,000 |
| Min | | 0,587 | | 1,000 |
| | | | | |
| | | | | |
| Average revenue all pharmaceuticals | | | | 19,176 |

**Roche**

| Exchange rate averages CPF- | Year | Top-selling drug | Annual Revenue ($ billions) | Classification | Name of 2 | Revenue ($ billions) | Classification | Name of 3 | Revenue ($ billions) | Classification | Top 3 drugs through 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,0155 | 2017 | Rituxan | 7,502 | Cancer and Autoimmune disease | Herceptin | 7,122 | Cancer | Avastin | 6,791 | Cancer | Rituxan | Cancer (blood, lymohnodes), Autoimmune disease (e.g.rheumatoid arthritis) |
| 1,0148 | 2016 | Rituxan | 7,408 | Cancer and Autoimmune disease | Avastin | 6,883 | Cancer | Herceptin | 6,882 | Cancer | Avastin | Cancer (lung, kidney, ovarian, cervical cancer, glioblastoma/brain) |
| 1,0369 | 2015 | Rituxan | 7,305 | Cancer and Autoimmune disease | Avastin | 6,930 | Cancer | Herceptin | 6,779 | Cancer | Herceptin | Cancer (breast) |
| 1,0846 | 2014 | Rituxan | 7,484 | Cancer and Autoimmune disease | Avastin | 6,960 | Cancer | Herceptin | 6,806 | Cancer | Rocephin | Antibiotic |
| 1,0736 | 2013 | Rituxan | 7,462 | Cancer and Autoimmune disease | Avastin | 6,714 | Cancer | Herceptin | 6,526 | Cancer | NeoRecormon/Epogi | Anemia |
| 1,0625 | 2012 | Rituxan | 7,126 | Cancer and Autoimmune disease | Herceptin | 6,257 | Cancer | Avastin | 6,124 | Cancer | CellCept | Immunosuppressant (Lupus) |
| 1,1138 | 2011 | Rituxan | 6,688 | Cancer and Autoimmune disease | Avastin | 5,894 | Cancer | Herceptin | 5,851 | Cancer | Pegasys+Copegus | Antiviral (Hep C) |
| 0,958 | 2010 | Avastin | 6,190 | Cancer | Rituxan | 6,089 | Cancer and Autoimmune disea | Herceptin | 5,201 | Cancer | Accutane | Severe acne |
| 0,9743 | 2009 | Avastin | 6,062 | Cancer | Rituxan | 5,930 | Cancer and Autoimmune disea | Herceptin | 5,131 | Cancer | Xenical | Dietary |
| 0,9181 | 2008 | Rituxan | 5,875 | Cancer and Autoimmune disease | Avastin | 5,155 | Cancer | Herceptin | 4,989 | Cancer | | |
| 0,8003 | 2007 | Rituxan | 4,415 | Cancer and Autoimmune disease | Herceptin | 3,883 | Cancer | Avastin | 3,286 | Cancer | | |
| 0,7475 | 2006 | Rituxan | 3,617 | Cancer and Autoimmune disease | Herceptin | 2,935 | Cancer | Avastin | 2,214 | Cancer | | |
| 0,7539 | 2005 | Rituxan | 3,132 | Cancer and Autoimmune disease | NeoRecormon/Epogi | 1,698 | Anaemia | Herceptin | 1,618 | Cancer | | |
| 0,7578 | 2004 | Rituxan | 2,560 | Cancer and Autoimmune disease | NeoRecormon/Epogi | 2,082 | Anaemia | Pegasys+Copegus | 1,184 | Antiviral | | |
| 0,656 | 2003 | Rituxan | 1,820 | Cancer and Autoimmune disease | NeoRecormon/Epogi | 1,345 | Anaemia | Rocephin | 0,902 | Antibiotic | | |
| 0,4456 | 2002 | Rituxan | 1,039 | Cancer and Autoimmune disease | Rocephin | 0,690 | Antibiotic | NeoRecormon/Epogi | 0,531 | Anaemia | | |
| 0,3131 | 2001 | Rocephin | 0,532 | Antibiotic | Rituxan | 0,531 | Cancer and Autoimmune disea | Accutane | 0,365 | Severe acne | | |
| 0,3109 | 2000 | Accutane | 0,398 | Severe acne | CellCept | 0,246 | Immunosuppressant | NeoRecormon/Epogi | 0,202 | Anaemia | | |
| 0,4962 | 1999 | Rocephin | 0,873 | Antibiotic | Accutane | 0,516 | Severe acne | Xenical | 0,466 | Dietary | | |
| | | | | 16 of 19 cancer (14 of these also autoimmune diseases) | | | 13 of 19 cancer, 3 of 19 anemia | | | 13 of 19 cancer, 2 anaemia | | |

**Pfizer**

| Year | Top-selling drug | Annual Revenue ($ billions) | Classification | Name of 2 | Revenue ($ billions) | Classification | Name of 3 | Revenue ($ billions) | Classification | Top 3 drugs through 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | Prevnar 13 | 5,601 | Vaccine | Lyrica | 5,065 | Anticonvulsant | Ibrance | 3,126 | Cancer | Prevnar 13 | Vaccine (pneumococcal bacteria) |
| 2016 | Prevnar 13 | 5,718 | Vaccine | Lyrica | 4,966 | Anticonvulsant | Enbrel | 2,909 | Autoimmune disease | Lipitor | Statin (cholesterol) |
| 2015 | Prevnar 13 | 6,145 | Vaccine | Lyrica | 4,839 | Anticonvulsant | Enbrel | 3,333 | Autoimmune disease | Norvasc | Blood pressure |
| 2014 | Lyrica | 5,168 | Anticonvulsant | Prevnar 13 | 4,464 | Vaccine | Enbrel | 3,850 | Autoimmune disease | Enbrel | Immunosuppressant (e.g.rheumatoid arthritis) |
| 2013 | Lyrica | 4,595 | Anticonvulsant | Prevnar 13 | 3,974 | Vaccine | Enbrel | 3,774 | Autoimmune disease | Ibrance | Cancer (breast) |
| 2012 | Lyrica | 4,158 | Anticonvulsant | Lipitor | 3,948 | Statin | Enbrel | 3,737 | Autoimmune disease | Celebrex | Anti-inflamatory |
| 2011 | Lipitor | 9,577 | Statin | Lyrica | 3,693 | Anticonvulsant | Enbrel | 3,666 | Autoimmune disease | Zoloft | Antidepressant |
| 2010 | Lipitor | 10,733 | Statin | Enbrel | 3,274 | Autoimmune disease | Lyrica | 3,063 | Anticonvulsant | Lyrica | Anticonvulsant (seizures) |
| 2009 | Lipitor | 11,434 | Statin | Lyrica | 2,840 | Anticonvulsant | Celebrex | 2,383 | Anti-inflamatory | Zithromax | Antibiotic |
| 2008 | Lipitor | 12,401 | Statin | Lyrica | 2,573 | Anticonvulsant | Celebrex | 2,489 | Anti-inflamatory | Diflucan | Antifungal |
| 2007 | Lipitor | 12,675 | Statin | Norvasc | 3,001 | Blood pressure | Celebrex | 2,290 | Anti-inflamatory | | |
| 2006 | Lipitor | 12,886 | Statin | Norvasc | 4,866 | Blood pressure | Zoloft | 2,110 | Antidepressant | | |
| 2005 | Lipitor | 12,187 | Statin | Norvasc | 4,706 | Blood pressure | Zoloft | 3,256 | Antidepressant | | |
| 2004 | Lipitor | 10,862 | Statin | Norvasc | 4,463 | Blood pressure | Zoloft | 3,361 | Antidepressant | | |
| 2003 | Lipitor | 9,231 | Statin | Norvasc | 4,336 | Blood pressure | Zoloft | 3,118 | Antidepressant | | |
| 2002 | Lipitor | 7,972 | Statin | Norvasc | 3,846 | Blood pressure | Zoloft | 2,742 | Antidepressant | | |
| 2001 | Lipitor | 6,448 | Statin | Norvasc | 3,581 | Blood pressure | Zoloft | 2,365 | Antidepressant | | |
| 2000 | Lipitor | 5,031 | Statin | Norvasc | 3,362 | Blood pressure | Zoloft | 2,140 | Antidepressant | | |
| 1999 | Lipitor | 3,795 | Statin | Norvasc | 2,991 | Blood pressure | Zoloft | 1,997 | Antidepressant | | |
| 1998 | Norvasc | 2,575 | Blood pressure | Zoloft | 1,836 | Antidepressant | Zithromax | 1,041 | Antibiotic | | |
| 1997 | Norvasc | 2,217 | Blood pressure | Zoloft | 1,507 | Antidepressant | Diflucan | 0,881 | Antifungal | | |

**Novartis**

| Year | Top-selling drug | Annual Revenue ($ billions) | Classification | Name of 2 | Revenue ($ billions) | Classification | Name of 3 | Revenue ($ billions) | Classification | Top 3 drugs through 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | Gilenya | 3,185 | Immunosuppressant | Cosentyx | 2,071 | Immunosuppressant | Gleevec | 1,943 | Cancer | Gilenya | Immunosuppressant (Multiple Sclerosis) |
| 2016 | Gleevec | 3,323 | Cancer | Gilenya | 3,109 | Immunosuppressant | Lucentis | 1,835 | Eye disease | Cosentyx | Immunosuppressant (Psoriasis) |
| 2015 | Gleevec | 4,658 | Cancer | Gilenya | 2,776 | Immunosuppressant | Lucentis | 2,060 | Eye disease | Neoral/Sandimmun | Immunosuppressant (Psoriasis, prevent organ rejection, rheumatoid arthritis) |
| 2014 | Gleevec | 4,746 | Cancer | Gilenya | 2,477 | Immunosuppressant | Lucentis | 2,441 | Eye disease | Gleevec | Cancer (blood, stomach/gastrointestinal) |
| 2013 | Gleevec | 4,693 | Cancer | Diovan | 3,524 | Blood pressure | Lucentis | 2,383 | Eye disease | Zometa | Cancer (manage side affects) |
| 2012 | Gleevec | 4,675 | Cancer | Diovan | 4,417 | Blood pressure | Lucentis | 2,398 | Eye disease | Diovan | Blood pressure |
| 2011 | Diovan | 5,665 | Blood pressure | Gleevec | 4,659 | Cancer | Lucentis | 2,050 | Eye disease | Lotrel | Blood pressure |
| 2010 | Diovan | 6,053 | Blood pressure | Gleevec | 4,265 | Cancer | Lucentis | 1,533 | Eye disease | Cibacen/Lotensin | Blood pressure |
| 2009 | Diovan | 6,013 | Blood pressure | Gleevec | 3,944 | Cancer | Zometa | 1,469 | Cancer | Lucentis | Eye disease |
| 2008 | Diovan | 5,740 | Blood pressure | Gleevec | 3,670 | Cancer | Zometa | 1,382 | Cancer | Lamicil | Anti fungal |
| 2007 | Diovan | 5,012 | Blood pressure | Gleevec | 3,050 | Cancer | Zometa | 1,297 | Cancer | | |
| 2006 | Diovan | 4,223 | Blood pressure | Gleevec | 2,554 | Cancer | Lotrel | 1,352 | Blood pressure | | |
| 2005 | Diovan | 3,676 | Blood pressure | Gleevec | 2,170 | Cancer | Zometa | 1,224 | Cancer | | |
| 2004 | Diovan | 3,093 | Blood pressure | Gleevec | 1,634 | Cancer | Lamisil | 1,162 | Antifungal | | |
| 2003 | Diovan | 2,425 | Blood pressure | Gleevec | 1,128 | Cancer | Neoral/Sandimmun | 1,020 | Immunosuppressant | | |
| 2002 | Diovan | 1,150 | Blood pressure | Neoral/Sandimmun | 0,716 | Immunosuppressant | Lamisil | 0,604 | Antifungal | | |
| 2001 | Diovan | 0,589 | Blood pressure | Neoral/Sandimmun | 0,573 | Immunosuppressant | Cibacen/Lotensin (inc | 0,475 | Blood pressure | | |

**Merck and Co.**

| Year | Top-selling drug | Annual Revenue ($ billions) | Classification | Name of 2 | Revenue ($ billions) | Classification | Name of 3 | Revenue ($ billions) | Classification | Top 3 drugs through 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | Januvia | 5,896 | Diabetes | Keytruda | 3,809 | Cancer | Gardasil | 2,308 | Vaccine (HPV) | Januvia | Diabetes |
| 2016 | Januvia | 6,109 | Diabetes | Zetia/Vytorin | 3,701 | Statin | Gardasil | 2,173 | Vaccine (HPV) | Janumet | Diabetes |
| 2015 | Januvia | 3,863 | Diabetes | Zetia | 2,526 | Statin | Janumet | 2,151 | Diabetes | Singulair | Asthma and allergies |
| 2014 | Januvia | 3,931 | Diabetes | Zetia | 2,650 | Statin | Remicade | 2,372 | Autoimmune disease | Zocor | Statin (Cholesterol) |
| 2013 | Januvia | 4,004 | Diabetes | Zetia | 2,658 | Statin | Remicade | 2,271 | Autoimmune disease | Keytruda | Cancer (lung, skin, lymphnodes) |
| 2012 | Januvia | 4,086 | Diabetes | Remicade | 2,076 | Autoimmune disease | Zetia | 1,747 | Statin | Zetia | Statin (cholesterol) |
| 2011 | Singulair | 5,479 | Asthma and allergies | Januvia | 3,324 | Diabetes | Remicade | 2,667 | Autoimmune disease | Remicade | Immunosuppressant (e.g.rheumatoid arthritis) |
| 2010 | Singulair | 4,987 | Asthma and allergies | Remicade | 2,714 | Autoimmune disease | Januvia | 2,385 | Diabetes | Cozaar/Hyzaar | Blood pressure |
| 2009 | Singulair | 4,669 | Asthma and allergies | Cozaar/Hyzaar | 3,561 | Blood pressure | Januvia | 1,922 | Diabetes | Fosamax | Osteoporosis |
| 2008 | Singulair | 4,337 | Asthma and allergies | Cozaar/Hyzaar | 3,558 | Blood pressure | Fosamax | 1,553 | Osteoporosis | Vioxx | Anti-inflamatory |
| 2007 | Singulair | 4,266 | Asthma and allergies | Cozaar/Hyzaar | 3,350 | Blood pressure | Fosamax | 3,163 | Osteoporosis | Gardasil | Vaccine (HPV) |
| 2006 | Singulair | 4,358 | Asthma and allergies | Cozaar/Hyzaar | 3,049 | Blood pressure | Fosamax | 3,134 | Osteoporosis | | |
| 2005 | Zocor | 4,382 | Statin | Fosamax | 3,131 | Osteoporosis | Cozaar/Hyzaar | 3,037 | Blood pressure | | |
| 2004 | Zocor | 5,197 | Statin | Fosamax | 3,160 | Osteoporosis | Cozaar/Hyzaar | 2,824 | Blood pressure | | |
| 2003 | Zocor | 5,011 | Statin | Fosamax | 2,677 | Osteoporosis | Vioxx | 2,549 | Anti-inflamatory | | |
| 2002 | Zocor | 5,600 | Statin | Vioxx | 2,500 | Anti-inflamatory | Fosamax | 2,200 | Osteoporosis | | |
| 2001 | Zocor | 5,264 | Statin | Vioxx | 2,358 | Anti-inflamatory | Fosamax | 1,594 | Osteoporosis | | |
| 2000 | Zocor | 2,207 | Statin | Vioxx | 1,518 | Anti-inflamatory | Fosamax | 0,704 | Osteoporosis | | |

**AbbVie**

| Year | Top-selling drug | Annual Revenue ($ billions) | | Name of 2 | Revenue ($ billions) | | Name of 3 | Revenue ($ billions) | | Top 3 drugs through 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | Humira | 18,427 | Autoimmune disease | Imbruvica | 2,573 | Cancer | Lupron | 0,829 | Cancer | Humira | Immunosuppressant (e.g.rheumatoid arthritis) |
| 2016 | Humira | 16,078 | Autoimmune disease | Imbruvica | 1,832 | Cancer | Viekira | 1,522 | Antiviral | Imbruvica | Cancer (blood) |
| 2015 | Humira | 14,012 | Autoimmune disease | Viekira | 1,639 | Antiviral | Lupron | 0,826 | Cancer | Viekira | Antiviral (Hep C) |
| 2014 | Humira | 12,543 | Autoimmune disease | AndroGel | 0,934 | Androgen | Kaletra | 0,870 | Antiretroviral | Kaletra | Antiretroviral (HIV) |
| 2013 | Humira | 10,659 | Autoimmune disease | AndroGel | 1,035 | Androgen | Kaletra | 0,962 | Antiretroviral | AndroGel | Androgen (testosterone) |
| 2012 | Humira | 9,265 | Autoimmune disease | AndroGel | 1,152 | Androgen | TriCor/Trilipix | 1,098 | Statin | TriCor/Trilipix | Statin (cholesterol) |
| 2011 | Humira | 7,932 | Autoimmune disease | TriCor/Trilipix | 1,372 | Statin | Kaletra | 1,170 | Antiretroviral | Lupron | Cancer (prostate) |
| 2010 | Humira | 6,508 | Autoimmune disease | TriCor/Trilipix | 1,355 | Statin | Kaletra | 1,223 | Antiretroviral | | |
| 2009 | Humira | 5,500 | Autoimmune disease | | | | | | | | |
| 2008 | Humira | 4,500 | Autoimmune disease | | | | | | | | |
| 2007 | Humira | 3,000 | Autoimmune disease | | | | | | | | |

**Eli Lilly & Co.**

| Year | Top-selling drug | Annual Revenue ($ billions) | | Name of 2 | Revenue ($ billions) | | Name of 3 | Revenue ($ billions) | | Top 3 drugs through 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | Humalog | 2,865 | Diabetes | Cialis | 2,323 | Erectile dysfunction | Alimta | 2,283 | Cancer | Gemzar | Cancer (breast, lung, ovarian, pancreatic) |
| 2016 | Humalog | 2,842 | Diabetes | Alimta | 2,493 | Cancer | Cialis | 2,311 | Erectile dysfunction | Alimta | Cancer (lung) |
| 2015 | Humalog | 2,842 | Diabetes | Alimta | 2,493 | Cancer | Cialis | 2,311 | Erectile dysfunction | Cymbalta | Anti depressant |
| 2014 | Alimta | 2,792 | Cancer | Humalog | 2,785 | Diabetes | Cialis | 2,291 | Erectile dysfunction | Zyprexa | Atypical antipsychotic (schizophrenia, bipolar disorder) |
| 2013 | Cymbalta | 5,084 | Anti-depressant | Alimta | 2,703 | Cancer | Humalog | 2,611 | Diabetes | Prozac | Anti-depressant |
| 2012 | Cymbalta | 4,994 | Anti-depressant | Alimta | 2,594 | Cancer | Humalog | 2,306 | Diabetes | Cialis | Erectile dysfunction |
| 2011 | Zyprexa | 4,622 | Atypical antipsychotic | Cymbalta | 4,162 | Anti-depressant | Alimta | 2,461 | Cancer | Humalog | Diabetes |
| 2010 | Zyprexa | 5,026 | Atypical antipsychotic | Cymbalta | 3,459 | Anti-depressant | Alimta | 2,209 | Cancer | Humulin | Diabetes |
| 2009 | Zyprexa | 4,916 | Atypical antipsychotic | Cymbalta | 3,075 | Anti-depressant | Humalog | 1,959 | Diabetes | Axid | H2 blocker (ulcers) |
| 2008 | Zyprexa | 4,696 | Atypical antipsychotic | Cymbalta | 2,697 | Anti-depressant | Humalog | 1,736 | Diabetes | | |
| 2007 | Zyprexa | 4,761 | Atypical antipsychotic | Cymbalta | 2,103 | Anti-depressant | Gemzar | 1,592 | Cancer | | |
| 2006 | Zyprexa | 4,364 | Atypical antipsychotic | Gemzar | 1,408 | Cancer | Cymbalta | 1,316 | Anti depressant | | |
| 2005 | Zyprexa | 4,202 | Atypical antipsychotic | Gemzar | 1,335 | Cancer | Humalog | 1,198 | Diabetes | | |
| 2004 | Zyprexa | 4,420 | Atypical antipsychotic | Gemzar | 1,214 | Cancer | Humalog | 1,102 | Diabetes | | |
| 2003 | Zyprexa | 4,277 | Atypical antipsychotic | Humulin | 1,060 | Diabetes | Gemzar | 1,022 | Cancer | | |
| 2002 | Zyprexa | 3,689 | Atypical antipsychotic | Humulin | 1,004 | Diabetes | Gemzar | 0,875 | Cancer | | |
| 2001 | Zyprexa | 3,087 | Atypical antipsychotic | Prozac | 1,990 | Anti-depressant | Humulin | 1,061 | Diabetes | | |
| 2000 | Prozac | 2,574 | Anti-depressant | Zyprexa | 2,350 | Atypical antipsychotic | Humulin | 1,115 | Diabetes | | |
| 1999 | Prozac | 2,613 | Anti-depressant | Zyprexa | 1,885 | Atypical antipsychotic | Gemzar | 0,456 | Cancer | | |
| 1998 | Prozac | 2,812 | Anti-depressant | Zyprexa | 1,443 | Atypical antipsychotic | Axid | 0,418 | H2 blocker | | |
| 1997 | Prozac | 2,559 | Anti-depressant | Zyprexa | 0,730 | Atypical antipsychotic | Axid | 0,527 | H2 blocker | | |

| Astra Zeneca | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Top-selling drug | Annual Revenue ($ billions) | | Name of 2 | Revenue ($ billions) | | Name of 3 | Revenue ($ billions) | | Top 3 drugs through 20 years | |
| 2017 | Symbicort | 2,803 | Asthma (Corticosteroid) | Crestor | 2,365 | Statin | Nexium | 1,952 | Proton pump inhibitors | Symbicort | Asthma (Corticosteroid) |
| 2016 | Crestor | 3,401 | Statin | Symbicort | 2,989 | Asthma | Nexium | 2,032 | Proton pump inhibitors | Pulmicort | Asthma (Corticosteroid) |
| 2015 | Crestor | 5,017 | Statin | Symbicort | 3,394 | Asthma | Nexium | 2,496 | Proton pump inhibitors | Nexium | Proton pump inhibitors (antacid) |
| 2014 | Crestor | 5,512 | Statin | Symbicort | 3,801 | Asthma | Nexium | 3,655 | Proton pump inhibitors | Losec/Prilosec | Proton pump inhibitors (antacid) |
| 2013 | Crestor | 5,622 | Statin | Nexium | 3,872 | Proton pump inhibitors | Symbicort | 3,483 | Asthma | Crestor | Statin (cholesterol) |
| 2012 | Crestor | 6,253 | Statin | Nexium | 3,944 | Proton pump inhibitors | Symbicort | 3,194 | Asthma | Seroquel | Atypical antipsychotic (schizophrenia, bipolar disorder) |
| 2011 | Crestor | 6,622 | Statin | Seroquel | 5,828 | Atypical antipsychotic | Nexium | 4,429 | Proton pump inhibitor | Zestril | Blood pressure |
| 2010 | Crestor | 5,691 | Statin | Seroquel | 5,302 | Atypical antipsychotic | Nexium | 4,969 | Proton pump inhibitor | Seloken/Toprol-XL | Blood pressure |
| 2009 | Nexium | 4,959 | Proton pump inhibitors | Seroquel | 4,866 | Atypical antipsychotic | Crestor | 4,502 | Statin | Zoladex | Cancer (Breast and prostate) |
| 2008 | Nexium | 5,200 | Proton pump inhibitors | Seroquel | 4,452 | Atypical antipsychotic | Crestor | 3,597 | Statin | | |
| 2007 | Nexium | 5,216 | Proton pump inhibitors | Seroquel | 4,027 | Atypical antipsychotic | Crestor | 2,796 | Statin | | |
| 2006 | Nexium | 5,182 | Proton pump inhibitors | Seroquel | 3,416 | Atypical antipsychotic | Crestor | 2,028 | Statin | | |
| 2005 | Nexium | 4,633 | Proton pump inhibitors | Seroquel | 2,761 | Atypical antipsychotic | Seloken/Toprol-XL | 1,735 | Blood pressure | | |
| 2004 | Nexium | 3,883 | Proton pump inhibitors | Seroquel | 2,027 | Atypical antipsychotic | Losec/Prilosec | 1,947 | Proton pump inhibitors | | |
| 2003 | Nexium | 3,302 | Proton pump inhibitors | Losec/Prilosec | 2,565 | Proton pump inhibitors | Seroquel | 1,487 | Atypical antipsychotic | | |
| 2002 | Losec/Prilosec | 4,623 | Proton pump inhibitors | Nexium | 1,978 | Proton pump inhibitors | Seroquel | 1,145 | Atypical antipsychotic | | |
| 2001 | Losec/Prilosec | 5,684 | Proton pump inhibitors | Zestril | 1,097 | Blood pressure | Pulmicort | 0,775 | Asthma | | |
| 2000 | Losec/Prilosec | 6,260 | Proton pump inhibitors | Zestril | 1,188 | Blood pressure | Zoladex | 0,734 | Cancer | | |
| 1999 | Losec/Prilosec | 5,909 | Proton pump inhibitors | Zestril | 1,221 | Blood pressure | Pulmicort | 0,730 | Asthma | | |
| 1998 | Losec/Prilosec | 4,015 | Proton pump inhibitors | Pulmicort | 0,697 | Asthma | Seloken/Toprol-XL | 0,453 | Blood pressure | | |
| 1997 | Losec/Prilosec | 2,733 | Proton pump inhibitors | Pulmicort | 0,625 | Asthma | Seloken/Toprol-XL | 0,402 | Blood pressure | | |

| Celgene | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Top-selling drug | Annual Revenue ($ billions) | | Name of 2 | Revenue ($ billions) | | Name of 3 | Revenue ($ billions) | | Top 3 drugs through 20 years | |
| 2017 | Revlimid | 8,187 | Cancer | Pomalyst | 1,614 | Cancer | Otezla | 1,279 | Immunosuppressant | Revlimid | Cancer (bone marrow, mantle cell lymphoma-MCL) |
| 2016 | Revlimid | 6,974 | Cancer | Pomalyst | 1,311 | Cancer | Otezla | 1,017 | Immunosuppressant | Thalomid | Cancer (bone marrow) |
| 2015 | Revlimid | 5,801 | Cancer | Pomalyst | 0,983 | Cancer | Abraxane | 0,968 | Cancer | Pomalyst | Cancer (bone marrow, who has already received 2 other drugs) |
| 2014 | Revlimid | 4,980 | Cancer | Abraxane | 0,848 | Cancer | Pomalyst | 0,680 | Cancer | Vidaza | Cancer (blood, bone marrow) |
| 2013 | Revlimid | 4,280 | Cancer | Vidaza | 0,803 | Cancer | Abraxane | 0,643 | Cancer | Abraxane | Cancer (Breast, pancreas, lungs) |
| 2012 | Revlimid | 3,767 | Cancer | Vidaza | 0,823 | Cancer | Abraxane | 0,427 | Cancer | Alkeran | Cancer (Bone marrow, breast, ovarian, neurosarcoma |
| 2011 | Revlimid | 3,208 | Cancer | Vidaza | 0,705 | Cancer | Abraxane | 0,386 | Cancer | Focalin | ADHD |
| 2010 | Revlimid | 2,469 | Cancer | Vidaza | 0,534 | Cancer | Thalomid | 0,390 | Cancer | Otezla | Immunosuppressant (psoriasis, psoriatic arthritis) |
| 2009 | Revlimid | 1,706 | Cancer | Thalomid | 0,437 | Cancer | Vidaza | 0,387 | Cancer | | |
| 2008 | Revlimid | 1,325 | Cancer | Thalomid | 0,505 | Cancer | Vidaza | 0,207 | Cancer | | |
| 2007 | Revlimid | 0,774 | Cancer | Thalomid | 0,447 | Cancer | Alkeran | 0,074 | Cancer | | |
| 2006 | Thalomid | 0,433 | Cancer | Revlimid | 0,321 | Cancer | Alkeran | 0,050 | Cancer | | |
| 2005 | Thalomid | 0,388 | Cancer | Alkeran | 0,050 | Cancer | Focalin | 0,004 | ADHD | | |
| 2004 | Thalomid | 0,309 | Cancer | Alkeran | 0,017 | Cancer | Focalin | 0,042 | ADHD | | |
| 2003 | Thalomid | 0,224 | Cancer | Alkeran | 0,018 | Cancer | Focalin | 0,024 | ADHD | | |
| 2002 | Thalomid | 0,012 | Cancer | Focalin | 0,039 | ADHD | | | | | |
| 2001 | Thalomid | 0,082 | Cancer | Focalin | 0,002 | ADHD | | | | | |
| 2000 | Thalomid | 0,062 | Cancer | | | | | | | | |
| 1999 | Thalomid | 0,024 | Cancer | | | | | | | | |
| 1998 | Thalomid | 0,003 | Cancer | | | | | | | | |

**Sanofi**

| Year | Top-selling drug | Annual Revenue ($ billions) | | Name of 2 | Revenue ($ billions) | | Name of 3 | Revenue ($ billions) | | Top 3 drugs through 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | Lantus | 5,223 | Diabetes | Lovenox | 1,780 | Blood thinner | Aubagio | 1,771 | Immunosuppressant | Lantus | Diabetes |
| 2016 | Lantus | 6,325 | Diabetes | Lovenox | 1,811 | Blood thinner | Plavix | 1,709 | Anticoagulent | Lovenox | Blood thinner |
| 2015 | Lantus | 7,090 | Diabetes | Plavix | 2,140 | Anticoagulent | Lovenox | 1,907 | Blood thinner | Aprovel | Blood pressure |
| 2014 | Lantus | 8,427 | Diabetes | Plavix | 2,473 | Anticoagulent | Lovenox | 2,257 | Blood thinner | Plavix | Anticoagulent (prevents clotting, increased blood flow) |
| 2013 | Lantus | 7,593 | Diabetes | Plavix | 2,467 | Anticoagulent | Lovenox | 2,263 | Blood thinner | Stilnox/Ambien | Insomnia |
| 2012 | Lantus | 6,378 | Diabetes | Plavix | 2,657 | Anticoagulent | Lovenox | 2,434 | Blood thinner | Aubagio | Immunosupprassant (Multiple sclerosis) |
| 2011 | Lantus | 5,453 | Diabetes | Lovenox | 2,940 | Blood thinner | Plavix | 2,841 | Anticoagulent | Taxotere | Cancer (breast, lung, prostate, stomach, head/neck) |
| 2010 | Lantus | 4,655 | Diabetes | Lovenox | 3,721 | Blood thinner | Taxotere | 2,814 | Cancer | Eloxatin | Cancer (colon, rectum) |
| 2009 | Lantus | 4,296 | Diabetes | Lovenox | 4,232 | Blood thinner | Plavix | 3,659 | Anticoagulent | Allegra | Antihistamine (allergies) |
| 2008 | Lovenox | 4,028 | Blood thinner | Plavix | 3,838 | Anticoagulent | Lantus | 3,604 | Diabetes | | |
| 2007 | Lovenox | 3,582 | Blood thinner | Plavix | 3,324 | Anticoagulent | Lantus | 2,785 | Diabetes | | |
| 2006 | Lovenox | 3,060 | Blood thinner | Plavix | 2,801 | Anticoagulent | Stilnox/Ambien | 2,546 | Insomnia | | |
| 2005 | Lovenox | 2,666 | Blood thinner | Plavix | 2,521 | Anticoagulent | Taxotere | 2,002 | Cancer | | |
| 2004 | Lovenox | 2,368 | Blood thinner | Plavix | 2,107 | Anticoagulent | Allegra | 1,868 | Antihistamine | | |
| 2003 | Stilnox/Ambien | 1,523 | Insomnia | Plavix | 1,500 | Anticoagulent | Eloxatin | 0,933 | Cancer | | |
| 2002 | Stilnox/Ambien | 1,348 | Insomnia | Plavix | 0,934 | Anticoagulent | Aprovel | 0,532 | Blood pressure | | |
| 2001 | Stilnox/Ambien | 0,704 | Insomnia | Plavix | 0,632 | Anticoagulent | Aprovel | 0,379 | Blood pressure | | |
| 2000 | Stilnox/Ambien | 0,537 | Insomnia | Plavix | 0,403 | Anticoagulent | Aprovel | 0,277 | Blood pressure | | |
| 1999 | Stilnox/Ambien | 0,421 | Insomnia | Aprovel | 0,314 | Blood pressure | Plavix | 0,212 | Anticoagulent | | |

**Bayer**

| Year | Top-selling drug | Annual Revenue ($ billions) | | Name of 2 | Revenue ($ billions) | | Name of 3 | Revenue ($ billions) | | Top 3 drugs through 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | Xarelto | 3,727 | Anticoagulent | Eylea | 2,124 | Eye disease | Mirena | 1,272 | Contraceptive | Xarelto | Anticoagulent (prevents clotting) |
| 2016 | Xarelto | 3,241 | Anticoagulent | Eylea | 1,799 | Eye disease | Kogenate | 1,291 | Blood clots | Kogenate | Blood clots (aids blood clots, stop bleadings) |
| 2015 | Xarelto | 2,499 | Anticoagulent | Eylea | 1,363 | Eye disease | Kogenate | 1,282 | Blood clots | Adalat | Blood pressure |
| 2014 | Xarelto | 2,230 | Anticoagulent | Kogenate | 1,473 | Blood clots | Mirena | 1,088 | Contraceptive | Betaferon | Immunosupprassant (Multiple sclerosis) |
| 2013 | Kogenate | 1,597 | Blood clots | Betaferon | 1,379 | Immunosuppressant | Xarelto | 1,261 | Anticoagulent | Ciprobay | Antibiotic |
| 2012 | Betaferon | 1,564 | Immunosuppressant | Kogenate | 1,520 | Blood clots | YAZ/Yasmin | 1,344 | Contraceptive | Yaz/Yasmin | Contraceptive |
| 2011 | Betaferon | 1,555 | Immunosuppressant | Kogenate | 1,497 | Blood clots | YAZ/Yasmin | 1,490 | Contraceptive | Mirena | Contraceptive |
| 2010 | Betaferon | 1,599 | Immunosuppressant | YAZ/Yasmin | 1,473 | Contraceptive | Kogenate | 1,331 | Blood clots | Ascensia | Diabetes |
| 2009 | YAZ/Yasmin | 1,783 | Contraceptive | Betaferon | 1,693 | Immunosuppressant | Kogenate | 1,239 | Blood clots | Eylea | Eye disease |
| 2008 | YAZ/Yasmin | 1,798 | Contraceptive | Betaferon | 1,683 | Immunosuppressant | Kogenate | 1,248 | Blood clots | Aspirin | Pain relief |
| 2007 | YAZ/Yasmin | 1,429 | Contraceptive | Betaferon | 1,410 | Immunosuppressant | Kogenate | 1,122 | Blood clots | Lipobay/Baycol | Statin (cholesterol) |
| 2006 | Kogenate | 0,989 | Blood clots | Adalat | 0,826 | Blood pressure | Betaferon | 0,672 | Immunosuppressant | | |
| 2005 | Ascensia | 0,883 | Diabetes | Kogenate | 0,825 | Blood clots | Adalat | 0,820 | Blood pressure | | |
| 2004 | Ciprobay | 1,041 | Antibiotic | Adalat | 0,833 | Blood pressure | Ascensia | 0,780 | Diabetes | | |
| 2003 | Ciprobay | 1,538 | Antibiotic | Adalat | 0,765 | Blood pressure | Ascensia | 0,672 | Diabetes | | |
| 2002 | Ciprobay | 1,335 | Antibiotic | Adalat | 0,757 | Blood pressure | Aspirin | 0,557 | Pain relief | | |
| 2001 | Ciprobay | 1,759 | Antibiotic | Adalat | 0,873 | Blood pressure | Aspirin | 0,648 | Pain relief | | |
| 2000 | Ciprobay | 1,648 | Antibiotic | Adalat | 1,066 | Blood pressure | Lipobay/Baycol | 0,587 | Statin | | |
| 1999 | Ciprobay | 1,618 | Antibiotic | Adalat | 1,088 | Blood pressure | Aspirin | 0,618 | Pain relief | | |
| 1998 | Ciprobay | 1,404 | Antibiotic | Adalat | 1,045 | Blood pressure | Aspirin | 0,589 | Pain relief | | |

**GlaxoSmithKline**

| Year | Top-selling drug | Annual Revenue ($ billions) | | Name of 2 | Revenue ($ billions) | | Name of 3 | Revenue ($ billions) | | Top 3 drugs through 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | Advair/Seretide | 4,034 | Asthma | Triumeq | 3,172 | Antiretroviral | Tivicay | 1,810 | Antiretroviral | Advair/Seretide | Asthma (corticosteroid) |
| 2016 | Advair/Seretide | 4,705 | Asthma | Triumeq | 2,342 | Antiretroviral | Tivicay | 1,287 | Antiretroviral | Flixotide | Asthma (corticosteroid) |
| 2015 | Advair/Seretide | 5,625 | Asthma | Infanrix/Pediarix | 1,120 | Vaccine | Triumeq | 1,116 | Antiretroviral | Augmentin | Antibiotic (penicilin) |
| 2014 | Advair/Seretide | 6,970 | Asthma | Infanrix/Pediarix | 1,365 | Vaccine | Avodart | 1,327 | Benign prostatic hyperplasi | Relenza | Antiviral (flu pandemic) |
| 2013 | Advair/Seretide | 8,251 | Asthma | Infanrix/Pediarix | 1,348 | Vaccine | Avodart | 1,341 | Benign prostatic hyperplasi | Triumeq | Antiretroviral (HIV) |
| 2012 | Advair/Seretide | 7,999 | Asthma | Avodart | 1,252 | Benign prostatic hyperplasi | Infanrix/Pediarix | 1,229 | Vaccine | Tivicay | Antiretroviral (HIV) |
| 2011 | Advair/Seretide | 8,115 | Asthma | Flixotide | 1,304 | Asthma | Infanrix/Pediarix | 1,106 | Vaccine | Valtrex | Antiretroviral (genital herpes, cold sores, shingles) |
| 2010 | Advair/Seretide | 7,941 | Asthma | Relenza | 1,842 | Antiviral | Flixotide | 1,242 | Asthma | Seroxat/Paxil | Antidepressant |
| 2009 | Advair/Seretide | 7,798 | Asthma | Valtrex | 2,028 | Antiretroviral | Relenza | 1,384 | Antiviral | Welbutrin | Antidepressant |
| 2008 | Advair/Seretide | 7,669 | Asthma | Valtrex | 2,215 | Antiretroviral | Lamictal | 1,717 | Anticonvulsant | Lamictal | Anticonvulsant |
| 2007 | Advair/Seretide | 7,005 | Asthma | Lamictal | 2,196 | Anticonvulsant | Valtrex | 1,870 | Antiretroviral | Avandia | Diabetes |
| 2006 | Advair/Seretide | 6,104 | Asthma | Avandia | 2,578 | Diabetes | Lamictal | 1,835 | Anticonvulsant | Infanrix/Pediarix | Vaccine (combination toddlers) |
| 2005 | Advair/Seretide | 5,463 | Asthma | Avandia | 2,099 | Diabetes | Lamictal | 1,544 | Anticonvulsant | Avodart | Benign prostatic hyperplasia |
| 2004 | Advair/Seretide | 4,510 | Asthma | Avandia | 2,045 | Diabetes | Seroxat/Paxil | 1,948 | Antidepressant | | |
| 2003 | Advair/Seretide | 3,618 | Asthma | Seroxat/Paxil | 3,068 | Antidepressant | Welbutrin | 1,558 | Antidepressant | | |
| 2002 | Seroxat/Paxil | 3,088 | Antidepressant | Advair/Seretide | 2,451 | Asthma | Augmentin | 1,790 | Antibiotic | | |
| 2001 | Seroxat/Paxil | 2,674 | Antidepressant | Augmentin | 2,046 | Antibiotic | Flixotide/Flovent | 1,318 | Asthma | | |
| 2000 | Seroxat/Paxil | 2,348 | Antidepressant | Augmentin | 1,847 | Antibiotic | Flixotide/Flovent | 1,333 | Asthma | | |

**Johnson & Johnson**

| Year | Top-selling drug | Annual Revenue ($ billions) | | Name of 2 | Revenue ($ billions) | | Name of 3 | Revenue ($ billions) | | Top 3 drugs through 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | Remicade | 6,315 | Autoimmune disease | Stelara | 4,011 | Immunosuppressant | Trevicta | 2,569 | Atypical antipsychotic | Remicade | Autoimmune disease (e.g.rheumatoid arthritis) |
| 2016 | Remicade | 6,966 | Autoimmune disease | Stelara | 3,232 | Immunosuppressant | Zytiga | 2,260 | Cancer | Risperdal | Atypical antipsychotics (Schizofrenia, bipolar disease etc) |
| 2015 | Remicade | 6,561 | Autoimmune disease | Stelara | 2,474 | Immunosuppressant | Zytiga | 2,231 | Cancer | Trevicta | Atypical antipsychotic (schizofrenia) |
| 2014 | Remicade | 6,868 | Autoimmune disease | Olysio/Sovriad | 2,302 | Antiviral | Zytiga | 2,237 | Cancer | Procrit/Eprex | Anemia |
| 2013 | Remicade | 6,673 | Autoimmune disease | Zytiga | 1,698 | Cancer | Prezista | 1,673 | Antretroiviral | Stelara | Immunosuppressant (Psoriasis) |
| 2012 | Remicade | 6,139 | Autoimmune disease | Velcade | 1,500 | Cancer | Procrit/Eprex | 1,462 | Anemia | Olysio/Sovriad | Antiviral (Hep C) |
| 2011 | Remicade | 5,492 | Autoimmune disease | Procrit/Eprex | 1,623 | Anemia | Risperdal/Consta | 1,583 | Atypical antipsychotic | Prezista | Antiretroviral (HIV) |
| 2010 | Remicade | 4,610 | Autoimmune disease | Procrit/Eprex | 1,934 | Anemia | Risperdal/Consta | 1,500 | Atypical antipsychotic | Levaquin/Floxin | Antibiotic |
| 2009 | Remicade | 4,304 | Autoimmune disease | Procrit/Eprex | 2,245 | Anemia | Levaquin/Floxin | 1,550 | Antibiotic | Zytiga | Cancer (Prostate) |
| 2008 | Remicade | 3,748 | Autoimmune disease | Topamax | 2,731 | Anticonvulsant | Procrit/Eprex | 2,460 | Anemia | Velcade | Cancer (bone marrow, lymphnodes) |
| 2007 | Remicade | 3,327 | Autoimmune disease | Procrit/Eprex | 2,885 | Anemia | Topamax | 2,453 | Anticonvulsant | Topamax | Anticonvulsant (seizure) |
| 2006 | Risperdal/Consta | 4,183 | Atypical antipsychotic | Procrit/Eprex | 3,180 | Anemia | Remicade | 3,013 | Autoimmune disease | | |
| 2005 | Risperdal/Consta | 3,552 | Atypical antipsychotic | Procrit/Eprex | 3,324 | Anemia | Remicade | 2,535 | Autoimmune disease | | |
| 2004 | Procrit/Eprex | 3,589 | Anemia | Risperdal | 3,050 | Atypical antipsychotic | Remicade | 2,145 | Autoimmune disease | | |
| 2003 | Procrit/Eprex | 3,984 | Anemia | Risperdal | 2,512 | Atypical antipsychotic | Remicade | 1,729 | Autoimmune disease | | |
| 2002 | Procrit/Eprex | 4,269 | Anemia | Risperdal | 2,146 | Atypical antipsychotic | Remicade | 1,297 | Autoimmune disease | | |
| 2001 | Procrit/Eprex | | | | | | | | | | |

**Gilead Sciences**

| Year | Top-selling drug | Annual Revenue ($ billions) | | Name of 2 | Revenue ($ billions) | | Name of 3 | Revenue ($ billions) | | Top 3 drugs through 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | Harvoni | 4,370 | Antiviral | Genvoya | 3,674 | Antiretroviral | Epclusa | 3,510 | Antiviral | Harvoni | Antiviral (Hep C) |
| 2016 | Harvoni | 9,081 | Antiviral | Sovaldi | 4,001 | Antiviral | Truvada | 3,566 | Antiretroviral | Sovaldi | Antiviral (Hep C) |
| 2015 | Harvoni | 13,864 | Antiviral | Sovaldi | 5,276 | Antiviral | Truvada | 3,459 | Antiretroviral | Epclusa | Antiviral (Hep C) |
| 2014 | Sovaldi | 10,283 | Antiviral | Atripla | 3,470 | Antiretroviral | Truvada | 3,340 | Antiretroviral | Vistide | Antiviral (treats eye disease in AIDS patients) |
| 2013 | Atripla | 3,648 | Antiretroviral | Truvada | 3,136 | Antiretroviral | Viread | 0,959 | Antiretroviral | Atripla | Antiretroviral (HIV) |
| 2012 | Atripla | 3,574 | Antiretroviral | Truvada | 3,181 | Antiretroviral | Viread | 0,849 | Antiretroviral | Truvada | Antiretroviral (HIV) |
| 2011 | Atripla | 3,225 | Antiretroviral | Truvada | 2,875 | Antiretroviral | Viread | 0,738 | Antiretroviral | Viread | Antiretroviral (HIV) |
| 2010 | Atripla | 2,927 | Antiretroviral | Truvada | 2,650 | Antiretroviral | Viread | 0,732 | Antiretroviral | Genvoya | Antiretroviral (HIV) |
| 2009 | Truvada | 2,490 | Antiretroviral | Atripla | 2,382 | Antiretroviral | Viread | 0,668 | Antiretroviral | AmBisome | Antifungal |
| 2008 | Truvada | 2,107 | Antiretroviral | Atripla | 1,572 | Antiretroviral | Viread | 0,621 | Antiretroviral | | |
| 2007 | Truvada | 1,589 | Antiretroviral | Atripla | 0,903 | Antiretroviral | Viread | 0,612 | Antiretroviral | | |
| 2006 | Truvada | 1,194 | Antiretroviral | Viread | 0,689 | Antiretroviral | Atripla | 0,206 | Antiretroviral | | |
| 2005 | Viread | 0,779 | Antiretroviral | Truvada | 0,568 | Antiretroviral | AmBisome | 0,221 | Antifungal | | |
| 2004 | Viread | 0,783 | Antiretroviral | AmBisome | 0,212 | Antifungal | Truvada | 0,068 | Antiretroviral | | |
| 2003 | Viread | 0,566 | Antiretroviral | AmBisome | 0,198 | Antifungal | | | | | |
| 2002 | Viread | 0,226 | Antiretroviral | AmBisome | 0,186 | Antifungal | | | | | |
| 2001 | AmBisome | 0,165 | Antifungal | Viread | 0,016 | Antiretroviral | | | | | |
| 2000 | AmBisome | 0,141 | Antifungal | | | | | | | | |
| 1999 | AmBisome | 0,129 | Antifungal | | | | | | | | |
| 1998 | Vistide | 0,006 | Antiviral | | | | | | | | |
| 1997 | Vistide | 0,012 | Antiviral | | | | | | | | |

**Amgen**

| Year | Top-selling drug | Annual Revenue ($ billions) | | Name of 2 | Revenue ($ billions) | | Name of 3 | Revenue ($ billions) | | Top 3 drugs through 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | Enbrel | 5,433 | Autoimmune disease | Neulasta/Neupogen | 4,534 | Cancer | Aranesp | 2,053 | Anemia | Enbrel | Autoimmune disease (e.g.rheumatoid arthritis) |
| 2016 | Enbrel | 5,965 | Autoimmune disease | Neulasta/Neupogen | 4,648 | Cancer | Aranesp | 2,093 | Anemia | Neulasta/Neupogen | Cancer (stimulte white bloodcells in bone marrow after Chemo) |
| 2015 | Enbrel | 5,364 | Autoimmune disease | Neulasta/Neupogen | 4,715 | Cancer | Aranesp | 1,951 | Anemia | Aranexp | Anemia |
| 2014 | Neulasta/Neupogen | 5,755 | Cancer | Enbrel | 4,688 | Autoimmune disease | Xgeva | 1,221 | Cancer | Epogen | Anemia |
| 2013 | Neulasta/Neupogen | 5,790 | Cancer | Enbrel | 4,551 | Autoimmune disease | Aranesp | 1,911 | Anemia | Xgeva | Cancer (bone marrow, bone) |
| 2012 | Neulasta/Neupogen | 5,352 | Cancer | Enbrel | 4,236 | Autoimmune disease | Aranesp | 2,040 | Anemia | Infergen | Antiviral (Hep C) |
| 2011 | Neulasta/Neupogen | 5,212 | Cancer | Enbrel | 3,701 | Autoimmune disease | Aranesp | 2,303 | Anemia | | |
| 2010 | Neulasta/Neupogen | 4,844 | Cancer | Enbrel | 3,534 | Autoimmune disease | Epogen | 2,524 | Anemia | | |
| 2009 | Neulasta/Neupogen | 4,643 | Cancer | Enbrel | 3,493 | Autoimmune disease | Aranesp | 2,652 | Anemia | | |
| 2008 | Neulasta/Neupogen | 4,659 | Cancer | Enbrel | 3,598 | Autoimmune disease | Aranesp | 3,137 | Anemia | | |
| 2007 | Neulasta/Neupogen | 4,277 | Cancer | Aranesp | 3,614 | Anemia | Enbrel | 3,230 | Autoimmune disease | | |
| 2006 | Aranesp | 4,121 | Anemia | Neulasta/Neupogen | 3,923 | Cancer | Epogen | 2,511 | Anemia | | |
| 2005 | Neulasta/Neupogen | 3,504 | Cancer | Aranesp | 3,273 | Anemia | Enbrel | 2,573 | Autoimmune disease | | |
| 2004 | Epogen | 2,601 | Anemia | Aranesp | 2,473 | Anemia | Enbrel | 1,900 | Autoimmune disease | | |
| 2003 | Neulasta/Neupogen | 2,522 | Cancer | Epogen | 2,435 | Anemia | Aranesp | 1,544 | Anemia | | |
| 2002 | Epogen | 2,261 | Anemia | Neulasta/Neupogen | 1,843 | Cancer | Aranesp | 0,416 | Anemia | | |
| 2001 | Epogen | 2,005 | Anemia | Neupogen | 1,346 | Cancer | Aranesp | 0,415 | Anemia | | |
| 2000 | Epogen | 1,963 | Anemia | Neupogen | 1,224 | Cancer | Infergen | 0,145 | Antiviral | | |
| 1999 | Epogen | 1,759 | Anemia | Neupogen | 1,257 | Cancer | Infergen | 0,262 | Antiviral | | |
| 1998 | Epogen | 1,382 | Anemia | Neupogen | 1,161 | Cancer | Infergen | 0,158 | Antiviral | | |
| 1997 | Epogen | 1,161 | Anemia | Neupogen | 1,056 | Cancer | Infergen | 0,034 | Antiviral | | |

Enbrel; most revenue to Amgen but partner with Pfizer who sells it outside US (and Pfizer partner with Takeda in Japan)

| Bristol-Myers Squibb | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Top-selling drug | Annual Revenue ($ billions) | | Name of 2 | Revenue ($ billions) | | Name of 3 | Revenue ($ billions) | | Top 3 drugs through 20 years | |
| 2017 | Opdivo | 4,948 | Cancer | Eliquis | 4,872 | Anticoagulent | Orencia | 2,479 | Autoimmune disease | Opdivo | Cancer (skin, lung, renal, lymphnode, head/neck, colon, liver, urinary) |
| 2016 | Opdivo | 3,774 | Cancer | Eliquis | 3,343 | Anticoagulent | Orencia | 2,265 | Autoimmune disease | Orencia | Autoimmune disease (rheumatoid arthritis) |
| 2015 | Orencia | 1,885 | Autoimmune disease | Eliquis | 1,860 | Anticoagulent | Sprycel | 1,620 | Cancer | Abilify | Atypical antipsychotic (schizophrenia, bipolar disorder, Tourettes, autism) |
| 2014 | Abilify | 2,020 | Atypical antipsychotic | Orencia | 1,652 | Autoimmune disease | Sprycel | 1,493 | Cancer | Plavix | Anticoagulent (prevents clotting, increased blood flow) |
| 2013 | Abilify | 2,289 | Atypical antipsychotic | Sustiva | 1,614 | Antiretroviral | Reyataz | 1,551 | Antiretroviral | Eliquis | Anticoagulent |
| 2012 | Abilify | 2,827 | Atypical antipsychotic | Plavix | 2,547 | Anticoagulent | Sustiva | 1,527 | Antiretroviral | Pravachol | Statins (cholesterol) |
| 2011 | Plavix | 7,087 | Anticoagulent | Abilify | 2,758 | Atypical antipsychotic | Reyataz | 1,569 | Antiretroviral | Sustiva | Antiretroviral (HIV) |
| 2010 | Plavix | 6,666 | Anticoagulent | Abilify | 2,565 | Atypical antipsychotic | Reyataz | 1,479 | Antiretroviral | Reyataz | Antiretroviral (HIV) |
| 2009 | Plavix | 6,146 | Anticoagulent | Abilify | 2,592 | Atypical antipsychotic | Reyataz | 1,401 | Antiretroviral | Glucophage | Diabetes |
| 2008 | Plavix | 5,603 | Anticoagulent | Abilify | 2,153 | Atypical antipsychotic | Reyataz | 1,292 | Antiretroviral | Taxol | Cancer (ovarian, breast, lung, skin, lymph nodes, cervical, pancreatic |
| 2007 | Plavix | 4,755 | Anticoagulent | Abilify | 1,660 | Atypical antipsychotic | Avapro/Avalide | 1,204 | Blood pressure | Sprycel | Cancer (blood/leukemia) |
| 2006 | Plavix | 3,257 | Anticoagulent | Abilify | 1,282 | Atypical antipsychotic | Pravachol | 1,197 | Statins | Avapro | Blood pressure |
| 2005 | Plavix | 3,823 | Anticoagulent | Pravachol | 2,256 | Statins | Avapro/Avalide | 0,982 | Blood pressure | | |
| 2004 | Plavix | 3,327 | Anticoagulent | Pravachol | 2,635 | Statins | Taxol | 0,991 | Cancer | | |
| 2003 | Pravachol | 2,827 | Statins | Plavix | 2,467 | Anticoagulent | Taxol | 0,934 | Cancer | | |
| 2002 | Pravachol | 2,266 | Statins | Plavix | 1,900 | Anticoagulent | Taxol | 0,857 | Cancer | | |
| 2001 | Pravachol | 2,173 | Statins | Glucophage | 2,049 | Diabetes | Plavix | 1,350 | Anticoagulent | | |
| 2000 | Pravachol | 1,817 | Statins | Glucophage | 1,732 | Diabetes | Taxol | 1,592 | Cancer | | |
| 1999 | Pravachol | 1,704 | Statins | Taxol | 1,481 | Cancer | Glucophage | 1,317 | Diabetes | | |
| 1998 | Pravachol | 1,643 | Statins | Taxol | 1,481 | Cancer | Glucophage | 0,862 | Diabetes | | |
| 1997 | Pravachol | 1,437 | Statins | Taxol | 0,941 | Cancer | Glucophage | 0,579 | Diabetes | | |

Plavix & Avapro also Sanofi (Sanofi teamed up with BMS becaus BMS cardio specialist 1993 to develop 2 drugs) BMS pays royalties to Sanofi

BMS returns rights to Plavix and Avapro to Sanofi in 2013 after exclusivity loss, but will receive royalties for sales outside US and Puerto Rico (worldwide for Avapro) until 2018

| Cancer | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Roche | Pfizer | Novartis | Merck&Co | AbbVie | Eli Lilly | AstraZeneca | Celgene | Sanofi | Bayer | GlaxoSmithKline | Johnson&Johnson | Gilead | Amgen | Bristol-Myers Squibb | Accumulated |
| Number of drugs in category | 3 | 1 | 2 | 1 | 2 | 2 | 1 | 6 | 2 | 0 | 0 | 2 | 0 | 2 | 3 | **27** |
| Number of drugs total | 9 | 11 | 10 | 11 | 7 | 9 | 9 | 8 | 9 | 11 | 13 | 11 | 9 | 6 | 12 | 145 |
| Total revenue in the category | 225,168 | 3,126 | 56,484 | 3,809 | 6,06 | 27,93 | 0,734 | 58,636 | 5,749 | 0 | 0 | 9,926 | 0 | 69,208 | 20,112 | **486,942** |
| Total revenue total top 3 | 237,198 | 291,453 | 145,283 | 176,78 | 128,816 | 158,501 | 213,476 | 61,043 | 155,063 | 52,33 | 166,991 | 164,284 | 114,792 | 176,669 | 146,655 | 2389,334 |
| Category revenue as share of all top 3 | 94,93 % | 1,07 % | 38,88 % | 2,15 % | 4,70 % | 17,62 % | 0,34 % | 96,06 % | 3,71 % | 0,00 % | 0,00 % | 6,04 % | 0,00 % | 39,17 % | 13,71 % | 20,38 % |
| Total revenue company | 527,64 | 161,409 | 654,368 | 558,736 | 218,215 | 355,25 | 483,012 | 70,427 | 497,987 | 223,665 | 617,297 | 448,801 | 176,227 | 265,21 | 393,984 | **5652,228** |
| Category share of total revenue | 42,67 % | 1,94 % | 8,63 % | 0,68 % | 2,78 % | 7,86 % | 0,15 % | 83,26 % | 1,15 % | 0,00 % | 0,00 % | 2,21 % | 0,00 % | 26,10 % | 5,10 % | 8,62 % |

| Blood Medication | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Roche | Pfizer | Novartis | Merck&Co | AbbVie | Eli Lilly | AstraZeneca | Celgene | Sanofi | Bayer | GlaxoSmithKline | Johnson&Johnson | Gilead | Amgen | Bristol-Myers Squibb | Accumulated |
| Number of drugs in category | 1 | 1 | 3 | 1 | 0 | 0 | 2 | 0 | 3 | 3 | 0 | 1 | 0 | 2 | 3 | 20 |
| Number of drugs total | 9 | 11 | 10 | 11 | 7 | 9 | 9 | 8 | 9 | 11 | 13 | 11 | 9 | 6 | 12 | 145 |
| Total revenue in the category | 5,858 | 39,944 | 56,406 | 19,379 | 0 | 0 | 35,311 | 0 | 76,768 | 8,074 | 0 | 30,955 | 0 | 54,596 | 61,189 | 388,48 |
| Total revenue total top 3 | 237,198 | 291,453 | 145,283 | 176,78 | 128,816 | 158,501 | 213,476 | 61,043 | 155,063 | 52,33 | 166,991 | 164,284 | 114,792 | 176,669 | 146,655 | 2389,334 |
| Category revenue as share of all top 3 | 2,47 % | 13,71 % | 38,82 % | 10,96 % | 0,00 % | 0,00 % | 16,54 % | 0,00 % | 49,51 % | 15,43 % | 0,00 % | 18,84 % | 0,00 % | 30,90 % | 41,72 % | 16,26 % |
| Total revenue company | 527,64 | 161,409 | 654,368 | 558,736 | 218,215 | 355,25 | 483,012 | 70,427 | 497,987 | 223,665 | 617,297 | 448,801 | 176,227 | 265,21 | 393,984 | **5652,228** |
| Category share of total revenue | 1,11 % | 24,75 % | 8,62 % | 3,47 % | 0,00 % | 0,00 % | 7,31 % | 0,00 % | 15,42 % | 3,61 % | 0,00 % | 6,90 % | 0,00 % | 20,59 % | 15,53 % | 6,87 % |

| Immunosuppressants | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Roche | Pfizer | Novartis | Merck&Co | AbbVie | Eli Lilly | AstraZeneca | Celgene | Sanofi | Bayer | GlaxoSmithKline | Johnson&Johnson | Gilead | Amgen | Bristol-Myers Squibb | Accumulated |
| Number of drugs in category | 1 | 1 | 3 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 2 | 0 | 1 | 1 | 14,000 |
| Number of drugs total | 9 | 11 | 10 | 11 | 7 | 9 | 9 | 8 | 9 | 11 | 13 | 11 | 9 | 6 | 12 | 145 |
| Total revenue in the category | 0,246 | 24,543 | 15,927 | 12,1 | 108,424 | 0 | 0 | 2,296 | 1,771 | 11,556 | 0 | 81,439 | 0 | 52,266 | 8,281 | 318,849 |
| Total revenue total top 3 | 237,198 | 291,453 | 145,283 | 176,78 | 128,816 | 158,501 | 213,476 | 61,043 | 155,063 | 52,33 | 166,991 | 164,284 | 114,792 | 176,669 | 146,655 | 2389,334 |
| Category revenue as share of all top 3 | 0,10 % | 8,42 % | 10,96 % | 6,84 % | 84,17 % | 0,00 % | 0,00 % | 3,76 % | 1,14 % | 22,08 % | 0,00 % | 49,57 % | 0,00 % | 29,58 % | 5,65 % | 13,34 % |
| Total revenue company | 527,64 | 161,409 | 654,368 | 558,736 | 218,215 | 355,25 | 483,012 | 70,427 | 497,987 | 223,665 | 617,297 | 448,801 | 176,227 | 265,21 | 393,984 | **5652,228** |
| Category share of total revenue | 0,05 % | 15,21 % | 2,43 % | 2,17 % | 49,69 % | 0,00 % | 0,00 % | 3,26 % | 0,36 % | 5,17 % | 0,00 % | 18,15 % | 0,00 % | 19,71 % | 2,10 % | 5,64 % |

| Statins | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Roche | Pfizer | Novartis | Merck&Co | AbbVie | Eli Lilly | AstraZeneca | Celgene | Sanofi | Bayer | GlaxoSmithKline | Johnson&Johnson | Gilead | Amgen | Bristol-Myers Squibb | Accumulated |
| Number of drugs in category | 0 | 1 | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 7 |
| Number of drugs total | 9 | 11 | 10 | 11 | 7 | 9 | 9 | 8 | 9 | 11 | 13 | 11 | 9 | 6 | 12 | **145** |
| Total revenue in the category | 0 | 129,18 | 0 | 40,943 | 3,825 | 0 | 53,406 | 0 | 0 | 0,587 | 0 | 0 | 0 | 0 | 19,955 | **247,896** |
| Total revenue total top 3 | 237,198 | 291,453 | 145,283 | 176,78 | 128,816 | 158,501 | 213,476 | 61,043 | 155,063 | 52,33 | 166,991 | 164,284 | 114,792 | 176,669 | 146,655 | 2389,334 |
| Category revenue as share of all top 3 | 0,00 % | 44,32 % | 0,00 % | 23,16 % | 2,97 % | 0,00 % | 25,02 % | 0,00 % | 0,00 % | 1,12 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 13,61 % | 10,38 % |
| Total revenue company | 527,64 | 161,409 | 654,368 | 558,736 | 218,215 | 355,25 | 483,012 | 70,427 | 497,987 | 223,665 | 617,297 | 448,801 | 176,227 | 265,21 | 393,984 | **5652,228** |
| Category share of total revenue | 0,00 % | 80,03 % | 0,00 % | 7,33 % | 1,75 % | 0,00 % | 11,06 % | 0,00 % | 0,00 % | 0,26 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 5,06 % | 4,39 % |

| Antidepressants | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Roche | Pfizer | Novartis | Merck&Co | AbbVie | Eli Lilly | AstraZeneca | Celgene | Sanofi | Bayer | GlaxoSmithKline | Johnson&Johnson | Gilead | Amgen | Bristol-Myers Squibb | Accumulated |
| Number of drugs in category | 0 | 1 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 1 | 10 |
| Number of drugs total | 9 | 11 | 10 | 11 | 7 | 9 | 9 | 8 | 9 | 11 | 13 | 11 | 9 | 6 | 12 | 145 |
| Total revenue in the category | 0 | 24,432 | 0 | 0 | 0 | 93,905 | 35,311 | 0 | 0 | 0 | 14,685 | 31,255 | 0 | 0 | 20,146 | 219,734 |
| Total revenue total top 3 | 237,198 | 291,453 | 145,283 | 176,78 | 128,816 | 158,501 | 213,476 | 61,043 | 155,063 | 52,33 | 166,991 | 164,284 | 114,792 | 176,669 | 146,655 | 2389,334 |
| Category revenue as share of all top 3 | 0,00 % | 8,38 % | 0,00 % | 0,00 % | 0,00 % | 59,25 % | 16,54 % | 0,00 % | 0,00 % | 0,00 % | 8,79 % | 19,02 % | 0,00 % | 0,00 % | 13,74 % | 9,20 % |
| Total revenue company | 527,64 | 161,409 | 654,368 | 558,736 | 218,215 | 355,25 | 483,012 | 70,427 | 497,987 | 223,665 | 617,297 | 448,801 | 176,227 | 265,21 | 393,984 | **5652,228** |
| Category share of total revenue | 0,00 % | 15,14 % | 0,00 % | 0,00 % | 0,00 % | 26,43 % | 7,31 % | 0,00 % | 0,00 % | 0,00 % | 2,38 % | 6,96 % | 0,00 % | 0,00 % | 5,11 % | 3,89 % |

| Antivirals | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Roche | Pfizer | Novartis | Merck&Co | AbbVie | Eli Lilly | AstraZeneca | Celgene | Sanofi | Bayer | GlaxoSmithKline | Johnson&Johnson | Gilead | Amgen | Bristol-Myers Squibb | Accumulated |
| Number of drugs in category | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 8 | 1 | 2 | **20** |
| Number of drugs total | 9 | 11 | 10 | 11 | 7 | 9 | 9 | 8 | 9 | 11 | 13 | 11 | 9 | 6 | 12 | 145 |
| Total revenue in the category | 1,184 | 0 | 0 | 0 | 7,386 | 0 | 0 | 0 | 0 | 0 | 19,064 | 3,975 | 113,541 | 0,599 | 10,433 | **156,182** |
| Total revenue total top 3 | 237,198 | 291,453 | 145,283 | 176,78 | 128,816 | 158,501 | 213,476 | 61,043 | 155,063 | 52,33 | 166,991 | 164,284 | 114,792 | 176,669 | 146,655 | 2389,334 |
| Category revenue as share of all top 3 | 0,50 % | 0,00 % | 0,00 % | 0,00 % | 5,73 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 11,42 % | 2,42 % | 98,91 % | 0,34 % | 7,11 % | 6,54 % |
| Total revenue company | 527,64 | 161,409 | 654,368 | 558,736 | 218,215 | 355,25 | 483,012 | 70,427 | 497,987 | 223,665 | 617,297 | 448,801 | 176,227 | 265,21 | 393,984 | **5652,228** |
| Category share of total revenue | 0,22 % | 0,00 % | 0,00 % | 0,00 % | 3,38 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 3,09 % | 0,89 % | 64,43 % | 0,23 % | 2,65 % | 2,76 % |

Asthma

| | Roche | Pfizer | Novartis | Merck&Co | AbbVie | Eli Lilly | AstraZeneca | Celgene | Sanofi | Bayer | GlaxoSmithKline | Johnson&Johnson | Gilead | Amgen | Bristol-Myers Squibb | Accumulated |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of drugs in category | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 5 |
| Number of drugs total | 9 | 11 | 10 | 11 | 7 | 9 | 9 | 8 | 9 | 11 | 13 | 11 | 9 | 6 | 12 | 145 |
| Total revenue in the category | 0 | 0 | 0 | 28,096 | 0 | 0 | 22,491 | 0 | 0 | 0 | 103,457 | 0 | 0 | 0 | 0 | 154,044 |
| Total revenue total top 3 | 237,198 | 291,453 | 145,283 | 176,78 | 128,816 | 158,501 | 213,476 | 61,043 | 155,063 | 52,33 | 166,991 | 164,284 | 114,792 | 176,669 | 146,655 | 2389,334 |
| Category revenue as share of all top 3 | 0,00 % | 0,00 % | 0,00 % | 15,89 % | 0,00 % | 0,00 % | 10,54 % | 0,00 % | 0,00 % | 0,00 % | 61,95 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 6,45 % |
| Total revenue company | 527,64 | 161,409 | 654,368 | 558,736 | 218,215 | 355,25 | 483,012 | 70,427 | 497,987 | 223,665 | 617,297 | 448,801 | 176,227 | 265,21 | 393,984 | **5652,228** |
| Category share of total revenue | 0,00 % | 0,00 % | 0,00 % | 5,03 % | 0,00 % | 0,00 % | 5 % | 0,00 % | 0,00 % | 0,00 % | 16,76 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 2,73 % |

Diabetes

| | Roche | Pfizer | Novartis | Merck&Co | AbbVie | Eli Lilly | AstraZeneca | Celgene | Sanofi | Bayer | GlaxoSmithKline | Johnson&Johnson | Gilead | Amgen | Bristol-Myers Squibb | Accumulated |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of drugs in category | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 8,000 |
| Number of drugs total | 9 | 11 | 10 | 11 | 7 | 9 | 9 | 8 | 9 | 11 | 13 | 11 | 9 | 6 | 12 | 145 |
| Total revenue in the category | 0 | 0 | 0 | 37,671 | 0 | 26,485 | 0 | 0 | 61,828 | 2,335 | 6,722 | 0 | 0 | 0 | 6,539 | 141,580 |
| Total revenue total top 3 | 237,198 | 291,453 | 145,283 | 176,78 | 128,816 | 158,501 | 213,476 | 61,043 | 155,063 | 52,33 | 166,991 | 164,284 | 114,792 | 176,669 | 146,655 | 2389,334 |
| Category revenue as share of all top 3 | 0,00 % | 0,00 % | 0,00 % | 21,31 % | 0,00 % | 16,71 % | 0,00 % | 0,00 % | 39,87 % | 4,46 % | 4,03 % | 0,00 % | 0,00 % | 0,00 % | 4,46 % | 5,93 % |
| Total revenue company | 527,64 | 161,409 | 654,368 | 558,736 | 218,215 | 355,25 | 483,012 | 70,427 | 497,987 | 223,665 | 617,297 | 448,801 | 176,227 | 265,21 | 393,984 | **5652,228** |
| Category share of total revenue | 0,00 % | 0,00 % | 0,00 % | 6,74 % | 0,00 % | 7,46 % | 0,00 % | 0,00 % | 12,42 % | 1,04 % | 1,09 % | 0,00 % | 0,00 % | 0,00 % | 1,66 % | 2,50 % |

Antibiotics and anti-inflammatories

| | Roche | Pfizer | Novartis | Merck&Co | AbbVie | Eli Lilly | AstraZeneca | Celgene | Sanofi | Bayer | GlaxoSmithKline | Johnson&Johnson | Gilead | Amgen | Bristol-Myers Squibb | Accumulated |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of drugs in category | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | **7** |
| Number of drugs total | 9 | 11 | 10 | 11 | 7 | 9 | 9 | 8 | 9 | 11 | 13 | 11 | 9 | 6 | 12 | 145 |
| Total revenue in the category | 2,997 | 8,203 | 0 | 8,925 | 0 | 0 | 0 | 0 | 0 | 10,404 | 5,683 | 1,55 | 0 | 0 | 0 | **37,762** |
| Total revenue total top 3 | 237,198 | 291,453 | 145,283 | 176,78 | 128,816 | 158,501 | 213,476 | 61,043 | 155,063 | 52,33 | 166,991 | 164,284 | 114,792 | 176,669 | 146,655 | 2389,334 |
| Category revenue as share of all top 3 | 1,26 % | 2,81 % | 0,00 % | 5,05 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 19,88 % | 3,40 % | 0,94 % | 0,00 % | 0,00 % | 0,00 % | 1,58 % |
| Total revenue company | 527,64 | 161,409 | 654,368 | 558,736 | 218,215 | 355,25 | 483,012 | 70,427 | 497,987 | 223,665 | 617,297 | 448,801 | 176,227 | 265,21 | 393,984 | **5652,228** |
| Category share of total revenue | 0,57 % | 5,08 % | 0,00 % | 1,60 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 4,65 % | 0,92 % | 0,35 % | 0,00 % | 0,00 % | 0,00 % | 0,67 % |

**Antibiotics and anti inflammatories**

| Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling drug | Year entered the market US | Original patent granted US | Main patent expiry US | Total years under exclusivity US | Years from FDA approval to top selling | Year generics launched US | Years from generics approved US to no longer top selling | Year entered the market Europe | Original patent granted Europe | Original patent expiry Europe | Total years under exclusivity Europe | Years from EC approval to top selling | Year generics launched Europe | Years from generics approved Europe to no longer top selling | Years from brand drug is launched US to generics enter market | Year generics launched India | Years from generics approved India to no longer top selling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roche | Rocephin | 2,937 | 3 | 5 | 1984 | 1985 | 2005 | 20 | 15 | 2005 | -2 | 2011 | 1984 | N/A | N/A | -12 | 2004 | -1 | N/A | N/A | N/A |
| Pfizer | Zithromax | 1,041 | 3 | 2 | 1991 | 1991 | 2005 | 24 | 7 | 2005 | -7 | 1991 | N/A | N/A | N/A | 7 | 2005 | -7 | 5 | 1996 | -2 |
| Bayer | Ciprobay | 10,404 | 1 | 7 | 1987 | 1980 | 2004 | 24 | 11 | 2003 | 1 | 1987 | 1988 | 2003 | 15 | 11 | 2005 | -1 | 16 | 2003 | -1 |
| GlaxoSmith Kline | Augmentin | 5,683 | 3 | 3 | 1984 | 1984 | 2002 | 8 | 16 | 2002 | 0 | 1984 | 1995 | 2002 | 7 | 16 | N/A | N/A | 16 | 2000 | -2 |
| Johnson & Johnson | Levaquin/Floxin | 1,55 | 3 | 1 | 1996 | 1995 | 2011 | 16 | 13 | 2011 | -2 | N/A | 1996 | N/A | N/A | N/A | 2015 | -6 | N/A | N/A | N/A |
| Pfizer | Celebrex | 7,162 | 3 | 3 | 1998 | 1994 | 2014 | 20 | 9 | 2014 | -5 | 1999 | 1995 | 2014 | 13 | 8 | N/A | N/A | 16 | 2014 | 5 |
| Merck & Co. | Vioxx | 8,925 | 3 | 3 | 1999 | 1995 | 2004 | 9 | 2 | banned | N/A | 1999 | 1997 | 2004 | 7 | 2 | N/A | N/A | 3 | 2002 | -1 |
| Total revenue | | 37,762 | | For all | | | | | | | | | | | | | | | | | |
| Average | | 5,395 | | 3,429 | | | | 17,286 | 9,667 | | -2,500 | | | | 11,000 | 7,500 | | -3,750 | 11,2 | | -0,2 |
| Max | | 10,404 | | 1,000 | | | | 24,000 | 13,000 | | 1,000 | | | | 13,000 | 8,000 | | -1,000 | 16,0 | | 5,0 |
| Min | | 1,041 | | 1,000 | | | | 8,000 | 7,000 | | -7,000 | | | | 7,000 | 7,000 | | -7,000 | 3,0 | | -2,0 |

**Statins (cholesterol medication)**

| Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling drug | Year entered the market US | Original patent granted US | Main patent expiry US | Total years under exclusivity US | Years from FDA approval to top selling | Year generics launched US | Years from generics approved US to no longer top selling | Year entered the market Europe | Original patent granted Europe | Original patent expiry Europe | Total years under exclusivity Europe | Years from EC approval to top selling | Year generics launched Europe | Years from generics approved Europe to no longer top selling | Years from brand drug is launched US to generics enter market | Year generics launched India | Years from generics approved India to no longer top selling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pfizer | Lipitor | 129,180 | 2 | 14 | 1996 | 1992 | 2011 | 19 | 3 | 2011 | 1 | 1996 | 1995 | 2012 | 17 | 3 | 2012 | 0 | 9 | 2005 | -7 |
| Merck & Co. | Zocor | 27,661 | 1 | 6 | 1991 | 1986 | 2006 | 20 | 9 | 2006 | -1 | 1989 | 1987 | 2005 | 18 | 11 | 2013 | -8 | 11 | 2002 | -3 |
| Merck & Co. | Zetia | 13,282 | 2 | 5 | 2001 | 1996 | 2017 | 21 | 11 | 2017 | -1 | 2003 | 1992 | 2018 | 26 | 9 | N/A | N/A | 9 | 2010 | -6 |
| AbbVie | TriCor/Trilipix | 3,825 | 3 | 1 | 1998 | 1995 | 2014 | 19 | 17 | 2013 | -1 | N/A | 1992 | 2012 | 20 | N/A | 2013 | -1 | N/A | N/A | N/A |
| AstraZeneca | Crestor | 53,406 | Still no 2 | 12 | 2003 | 1994 | 2016 | 22 | 3 | 2016 | Not Relevant | 2002 | 2000 | 2020 | 20 | 4 | N/A | Top after generics | 6 | 2009 | Top after generics |
| Bristol-Myers Squib | Pravachol | 19,355 | 3 | 10 | 1991 | 1989 | 2006 | 17 | 6 | 2006 | 0 | 1990 | 1988 | 2005 | 17 | 7 | 2005 | 1 | 7 | 1998 | -8 |
| Bayer | Lipobay/Baycol | 0,587 | 3 | 1 | 1997 | 1993 | 2001 | 8 | 3 | None | N/A | 1997 | 1991 | 2001 | 10 | 3 | banned | N/A | N/A | N/A | N/A |
| Total revenue | | 247,896 | | For all | For all no longer top | | | | | | | | | | | | | | | | |
| Average | | 35,414 | | 7,000 | 6,167 | | | 18,000 | 7,400 | | -0,400 | | | | 18,286 | 4,750 | | -2,000 | 8,400 | | -6,000 |
| Max | | 129,180 | | 14,000 | 14,000 | | | 22,000 | 17,000 | | 1,000 | | | | 26,000 | 9,000 | | 1,000 | 11,000 | | -3,000 |
| Min | | 0,587 | | 1,000 | 1,000 | | | 8,000 | 3,000 | | -1,000 | | | | 10,000 | 3,000 | | -8,000 | 6,000 | | -8,000 |

**Diabetes**

| Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling drug | Year entered the market US | Original patent granted US | Main patent expiry US | Total years under exclusivity US | Years from FDA approval to top selling | Year generics launched US | Years from generics approved US to no longer top selling | Year entered the market Europe | Original patent granted Europe | Original patent expiry Europe | Total years under exclusivity Europe | Years from EC approval to top selling | Year generics launched Europe | Years from generics approved Europe to no longer top selling | Years from brand drug is launched US to generics enter market | Year generics launched India | Years from generics approved India to no longer top selling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Merck & Co. | Januvia | 35,520 | Still no 1 | 3 | 2006 | 2003 | 2022 | 13 | 3 | None | Not relevant | 2007 | 2004 | 2022 | 18 | 2 | None | Not relevant | N/A | N/A | No data |
| Merck & Co. | Janumet | 2,151 | 3 | 1 | 2007 | 2003 | 2022 | 13 | 8 | None | N/A | 2008 | 2004 | 2023 | 13 | 7 | None | N/A | 4 | 2011 | -4 |
| Eli Lilly | Humalog | 22,245 | Still no 1 | 10 | 1996 | 1993 | 2014 | 21 | 8 | None | Not relevant | 1996 | 1996 | 2013 | 17 | 8 | None | Not relevant | 8 | 2004 | Top after generic |
| Eli Lilly | Humulin | 4,240 | 2 | 4 | 1983 | 1972 | 2000 | 28 | 18 | N/A | N/A | 1982 | 1980 | N/A | N/A | 18 | N/A | #VERDI! | 12 | 1995 | -8 |
| Sanofi | Lantus | 61,828 | Still no 1 | 17 | 2000 | 2000 | 2031 | 31 | 1 | None | Not relevant | 2000 | 2000 | 2028 | 28 | 1 | None | Not relevant | 4 | 2004 | Top after generic |
| GlaxoSmithKline | Avandia | 6,722 | 2 | 3 | 1999 | 1999 | 2026 | 27 | 5 | 2012 | -6 | 2000 | 2004 | 2024 | 20 | 4 | None | #VERDI! | 4 | 2003 | -3 |
| Bristol-Myers Squib | Glucophage | 6,539 | 2 | 5 | 1995 | 1976 | 2003 | 27 | 2 | 2017 | -16 | 1997 | 1986 | N/A | N/A | 0 | | 2001 | N/A | N/A | N/A |
| Total revenue | | 133,245 | | For all | For all no longer top | | | | | | | | | | | | | | | | |
| Average | | 19,832 | | 7,000 | 3,250 | | | 24,57 | 7,167 | | -11,000 | | | | 20,4 | 6,667 | | #VERDI! | 6,400 | | -5,000 |
| Max | | 61,828 | | 17,000 | 5,000 | | | 31,00 | 18,000 | | -6,000 | | | | 28,0 | 18,000 | | #VERDI! | 12,000 | | -3,000 |
| Min | | 2,151 | | 1,000 | 1,000 | | | 13,00 | 1,000 | | -16,000 | | | | 17,0 | 1,000 | | #VERDI! | 4,000 | | -8,000 |

**Immunosuppressants**

| Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling drug | Year entered the market US | Original patent granted US | Main patent expiry US | Total years under exclusivity US | Years from FDA approval to top selling | Year generics launched US | Years from generics approved US to no longer top selling | Year entered the market Europe | Original patent granted Europe | Original patent expiry Europe | Total years under exclusivity Europe | Years from EC approval to top selling | Year generics launched Europe | Years from generics approved Europe to no longer top selling | Years from brand drug is launched US to generics enter market | Year generics launched India | Years from generics approved India to no longer top selling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roche | CellCept | 0,246 | 2 | 1 | 1995 | 1993 | 2013 | 20 | 5 | 2013 | -13 | 1996 | 1997 | N/A | N/A | 4 | 2008 | -8 | N/A | N/A | N/A |
| Pfizer | Enbrel | 24,543 | 3 | 7 | 1998 | 2000 | 2028 | 28 | 12 | None | N/A | 2000 | 1999 | 2015 | 16 | 10 | 2016 | 0 | 9 | 2007 | -9 |
| Amgen | Enbrel | 52,266 | Still no 1 | 14 | 1998 | 2000 | 2028 | 28 | 6 | None | Not relevant | 2000 | 1999 | 2015 | 16 | 4 | 2016 | Not relevant | 9 | 2007 | Top after generic |
| Novartis | Gilenya | 11,547 | Still no 1 | 4 | 2010 | 2008 | 2027 | 19 | 4 | None | Not relevant | 2011 | 2008 | 2027 | 19 | 3 | None | Not relevant | N/A | N/A | Top after generic |
| Novartis | Neoral/Sandimmun | 2,309 | 3 | 3 | 1995 | 1978 | 1996 | 18 | 6 | 2000 | 3 | 1983 | 1984 | N/A | N/A | 18 | N/A | N/A | N/A | N/A | N/A |
| Novartis | Cosentyx | 2,071 | Still no 2 | 1 | 2015 | 2010 | 2031 | 21 | 2 | None | Not relevant | 2015 | 2012 | 2031 | 19 | 2 | None | Not relevant | N/A | N/A | No data |
| Merck & Co. | Remicade | 12,100 | 3 | 5 | 1998 | 2000 | 2018 | 18 | 12 | 2016 | -2 | 1999 | 2004 | 2015 | 11 | 11 | 2015 | -1 | 7 | 2005 | -9 |
| Johnson & Johnson | Remicade | 11,722 | Still no 1 | 16 | 1998 | 2000 | 2018 | 18 | 4 | 2016 | Not relevant | 1999 | 2004 | 2015 | 11 | 3 | 2015 | Not relevant | 5 | 2003 | Top after generic |
| Johnson & Johnson | Stelara | 3,717 | Still no 2 | 3 | 2009 | 2003 | 2023 | 20 | 6 | None | Not relevant | 2009 | 2005 | 2024 | 19 | 6 | None | Not relevant | 3 | 2012 | Top after generic |
| AbbVie | Humira | 108,424 | Still no 1 | 11 | 2002 | 2004 | 2023 | 19 | 5 | None | Not relevant | 2003 | 2002 | 2018 | 16 | 4 | None | Not relevant | 12 | 2014 | Top after generic |
| Celgene | Otezla | 2,296 | Still no 3 | 2 | 2014 | 2016 | 2024 | 8 | 2 | None | Not relevant | 2015 | 2013 | 2028 | 3 | 1 | None | Not relevant | N/A | N/A | No data |
| Sanofi | Aubagio | 1,771 | Still no 3 | 1 | 2012 | N/A | 2019 | N/A | 5 | | Not relevant | 2013 | N/A | 2016 | N/A | 4 | 2016 | Not relevant | N/A | N/A | No data |
| Bayer | Betaferon | 11,556 | 2 | 8 | 1993 | 1990 | 2007 | 17 | 13 | 2009 | 4 | 1995 | 1993 | N/A | N/A | 11 | 2009 | 4 | 7 | 2000 | -13 |
| Bristol-Myers Squib | Orencia | 8,261 | Still no 3 | 4 | 2005 | 2006 | 2013 | 13 | 3 | None | Not relevant | 2007 | 2009 | 2017 | 8 | 7 | None | Not relevant | N/A | N/A | No data |
| Total revenue | | 318,843 | | For all | For no longer top | | | | | | | | | | | | | | | | |
| Average | | 22,775 | | 5,714 | 4,800 | | | 18,333 | 6,750 | | -2,000 | | | | | 5,583 | | -1,250 | 7,429 | | -10,333 |
| Max | | 108,424 | | 16,000 | 8,000 | | | 20,000 | 13,000 | | 4,000 | | | | | 11,000 | | 4,000 | 12,000 | | -9,000 |
| Min | | 0,246 | | 1,000 | 1,000 | | | 17,000 | 2,000 | | -13,000 | | | | | 1,000 | | -8,000 | 3,000 | | -13,000 |

NB we can say how many years from generic enter market to no longer top selling, but cant prove correlation only indicate Rituxan: India launched generic 2007, before patent expiration

**Cancer**

| Company | Drug | Total global revenue | Position leaves top 3 from | Total years as top selling drug | Year entered the market US | Original patent granted US | Main patent expiry US | Total years under exclusivity US | Years from FDA approval to top selling | Year generics launched US | Years from generics approved US to no longer top selling | Year entered the market Europe | Original patent granted Europe | Original patent expiry Europe | Total years under exclusivity Europe | Years from EC approval to top selling | Year generics launched Europe | Years from generics approved Europe to no longer top selling | Year launched India | Years from brand drug is launched US to generics enter market | Years from brand drug is launched India to generics enter market | Year generics launched India | Years from generics approved India to no longer top selling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roche | Rituxan | 85,983 | Still no 1 | 17 | 1997 | 1995 | 2018 | 23 | 4 | N/A | N/A | 1998 | 1996 | 2013 | 17 | 3 | 2017 | Top after generics | 2000 | 10 | 7 | 2007 | Top after generics |
| Roche | Avastin | 69,204 | Still no 3 | 12 | 2004 | 2003 | 2020 | 17 | 2 | N/A | N/A | 2005 | 2005 | 2022 | 17 | 1 | N/A | N/A | 2005 | 13 | 12 | 2017 | Top after generics |
| Roche | Herceptin | 69,981 | Still no 2 | 13 | 1998 | 2002 | 2019 | 17 | 7 | 2017 | Top after generics | 2001 | 2008 | 2014 | 6 | 4 | 2017 | Top after generics | 2000 | 15 | 13 | 2012 | Top after generics |
| Pfizer | Ibrance | 3,126 | Still no 3 | 1 | 2015 | 2015 | 2023 | 8 | 2 | N/A | N/A | 2016 | 2016 | 2023 | 7 | 1 | N/A | N/A | 2017 | N/A | N/A | N/A | No data |
| Novartis | Gleevec | 51,112 | Still no 3 | 15 | 2001 | 1996 | 2022 | 26 | 2 | 2016 | Top after generics | 2001 | 1997 | 2016 | 19 | 2 | 2012 | Top after generics | 2003 | 2 | 0 | 2003 | Top after generics |
| Novartis | Zometa | 5,372 | 3 | 5 | 2007 | 1986 | 2012 | 26 | 4 | 2013 | -4 | 2001 | 2007 | N/A | N/A | 4 | 2014 | -5 | 2007 | 6 | 6 | 2013 | 4 |
| Merck & Co. | Keytruda | 3,809 | Still no 2 | 1 | 2014 | 2007 | 2028 | 21 | 3 | N/A | N/A | 2015 | 2008 | 2028 | 20 | 2 | N/A | N/A | 2015 | N/A | N/A | N/A | No data |
| AbbVie | Imbruvica | 4,405 | Still no 2 | 3 | 2013 | 2005 | 2026 | 21 | 2 | N/A | N/A | 2014 | 2006 | 2026 | 20 | 1 | N/A | N/A | 2014 | N/A | N/A | N/A | No data |
| AbbVie | Lupron | 1,655 | Still no 3 | 2 | 1986 | 1989 | 2014 | 25 | 5 | N/A | N/A | 1986 | 1990 | 2012 | 22 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | No data |
| Eli Lilly | Alimta | 20,028 | Still no 3 | 8 | 2004 | 2001 | 2022 | 21 | 6 | None | N/A | 2004 | 2003 | 2021 | 18 | 6 | 2018 | Top after generics | 2004 | 2 | 2 | 2006 | Top after generics |
| Eli Lilly | Gemzar | 7,902 | 3 | 9 | 1996 | 1983 | 2010 | 27 | 3 | 2010 | -3 | 1995 | 1997 | 2009 | 12 | 4 | 2009 | -2 | 1996 | 15 | 15 | 2011 | 4 |
| AstraZeneca | Zoladex | 0,724 | 3 | 1 | 1996 | 1990 | 2021 | 31 | 11 | N/A | N/A | 1996 | 1992 | 2010 | 18 | 4 | 2016 | -16 | 2002 | 20 | 14 | 2016 | 16 |
| Celgene | Revlimid | 43,791 | Still no 1 | 12 | 2006 | 2001 | 2027 | 26 | 1 | N/A | N/A | 2007 | 2007 | 2024 | 17 | -1 | N/A | N/A | N/A | 9 | N/A | 2015 | Top after generics |
| Celgene | Pamalyst | 4,587 | Still no 2 | 4 | 2013 | 2000 | 2024 | 24 | 2 | N/A | N/A | 2013 | 2013 | 2023 | 10 | 1 | N/A | N/A | N/A | 4 | N/A | 2017 | Top after generics |
| Celgene | Vidaza | 2,459 | 2 | 6 | 2004 | 1986 | 2011 | 25 | 4 | 2013 | 0 | 2008 | 1997 | 2018 | 21 | 0 | 2019 | -6 | N/A | 9 | N/A | 2012 | 0 |
| Celgene | Thalamid | 3,314 | 3 | 13 | 1998 | 2001 | 2023 | 22 | 0 | N/A | N/A | 1957 | N/A | N/A | N/A | -10 | N/A | N/A | 2000 | N/A | N/A | N/A | N/A |
| Celgene | Abraxane | 3,277 | 2 | 5 | 2005 | 2007 | 2034 | 27 | 6 | N/A | N/A | 2008 | 2009 | 2022 | 13 | 3 | N/A | N/A | 2007 | 6 | 4 | 2011 | -4 |
| Celgene | Alkeran | 0,208 | 2 | 5 | 2001 | 2002 | 2023 | 21 | 2 | 2011 | -10 | 1995 | 2006 | N/A | N/A | N/A | N/A | N/A | N/A | 16 | N/A | 2017 | 14 |
| Sanofi | Taxotere | 4,016 | 3 | 6 | 1996 | 1993 | 2010 | 17 | 6 | 2011 | -1 | 1995 | 1996 | 2010 | 14 | 10 | 2010 | 0 | 1996 | 4 | 4 | 2000 | -10 |
| Sanofi | Elaxatin | 0,933 | 3 | 1 | 2002 | 1996 | 2016 | 20 | 1 | 2012 | -9 | 1996 | 1994 | 2008 | 14 | 7 | 2014 | -11 | N/A | 7 | N/A | 2009 | 5 |
| Janssen & Johnson | Zytiga | 3,424 | 3 | 4 | 2011 | 1998 | 2018 | 20 | 2 | 2018 | -2 | 2011 | 2000 | 2021 | 21 | 2 | N/A | N/A | N/A | 4 | N/A | 2015 | -1 |
| Janssen & Johnson | Velcade | 1,500 | 2 | 1 | 2003 | 1995 | 2017 | 22 | 9 | 2018 | -6 | 2004 | 2007 | 2019 | 12 | 8 | 2015 | -3 | 2003 | 3 | 3 | 2006 | -6 |
| Amgen | Nevlarta | 67,987 | Still no 2 | 21 | 1991 | 2004 | 2015 | 11 | 6 | 2018 | N/A | 2002 | 2007 | 2017 | 10 | -5 | 2018 | N/A | 2002 | 20 | 9 | 2011 | Top after generics |
| Amgen | Xgeva | 1,221 | 3 | 1 | 2010 | 2004 | 2025 | 21 | 5 | N/A | N/A | 2011 | 2008 | 2022 | 14 | 4 | N/A | N/A | 2015 | N/A | N/A | N/A | N/A |
| Bristol-Myers Squib | Opdivo | 8,722 | Still no 1 | 2 | 2014 | 2013 | 2027 | 14 | 2 | N/A | N/A | 2015 | 2010 | 2026 | 16 | 8 | N/A | N/A | N/A | N/A | N/A | N/A | No data |
| Bristol-Myers Squib | Taxol | 8,277 | 3 | 8 | 1992 | 1996 | 2015 | 19 | 5 | 2001 | 3 | 2005 | 1996 | 2013 | 17 | -5 | N/A | N/A | 1995 | 15 | 12 | 2007 | 3 |
| Bristol-Myers Squib | Sprycel | 3,113 | 3 | 2 | 2006 | 2006 | 2025 | 19 | 8 | N/A | N/A | 2006 | N/A | 2027 | N/A | 4 | N/A | N/A | 2006 | 6 | 6 | 2012 | -3 |
| Total revenue | | 486,942 | | For all | For all no longer top | | | | | | | | | | | | | | | | | | |
| Average | | 18,035 | | 6,59 | 4,786 | | | 21,3 | 4,25 | | -4 | | | | | 14,9 | 3,55 | -6,143 | | 9,3 | 7,6 | | 1,917 |
| Max | | 85,983 | | 21 | 13,000 | | | 27,0 | 11,00 | | 3 | | | | | 22,0 | 10 | 0 | | 20,0 | 15,0 | | 16 |
| Min | | 0,208 | | 1 | 1,000 | | | 11,0 | 1,00 | | -10 | | | | | 6,0 | -1 | -16 | | 2,0 | 0,0 | | -10 |

**Antivirals (including Antiretrovirals)**

| Company | Drug | Total global revenue | Position in year top 3 from | Total years on top selling drug | Year entered the market US | Original patent granted US | Main patent expiry US | Total years under exclusivity US | Years from FDA approval to top selling | Year generics launched US | Years from generics approved US to no longer top selling | Year entered the market Europe | Original patent granted Europe | Original patent expiry Europe | Total years under exclusivity Europe | Years from EC approval to top selling | Year generics launched Europe | Years from generics approved Europe to no longer top selling | Year launched India | Years from brand drug in launched US to generics enter market India | Years from brand drug in launched India to generics enter market | Year generics launched India | Years from generics approved India to no longer top selling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roche | Pegasys+Copegus | 1,184 | 3 | 1 | 2002 | 2002 | 2018 | 16 | 2 | 2004 | 0 | 2002 | 1997 | 2017 | 20 | 2 | 2000 | 4 | 2005 | 7 | 4 | 2009 | 5 |
| AbbVie | Viekira | 3,151 | 3 | 2 | 2014 | 2010 | 2032 | 22 | 1 | None | N/A | 2015 | 2011 | 2029 | 18 | 0 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| GlaxoSmithKline | Relenza | 3,225 | 2 | 2 | 1999 | 1990 | 2016 | 26 | 10 | N/A | N/A | N/A | 2005 | 2014 | 9 | N/A | N/A | N/A | 2009 | 10 | 0 | 2009 | -1 |
| Johnson & Johnson | Olysio/Sovriad | 2,202 | 2 | 1 | 2013 | 2012 | 2026 | 13 | 1 | None | N/A | 2014 | 2009 | 2018 | 9 | 0 | N/A | N/A | 2015 | N/A | N/A | N/A | N/A |
| Gilead Sciences | Harvoni | 27,315 | Still no 1 | 3 | 2014 | 2014 | 2032 | 18 | 1 | None | N/A | 2014 | 2008 | 2028 | 20 | 1 | N/A | N/A | 2014 | 1 | 1 | 2015 | Top after generics |
| Gilead Sciences | Sovaldi | 19,560 | 2 | 3 | 2013 | 2013 | 2030 | 17 | 1 | None | N/A | 2014 | 2014 | 2024 | 10 | 0 | N/A | N/A | 2012 | 2 | 2 | 2015 | -1 |
| Gilead Sciences | Epclusa | 3,510 | Still no 3 | 1 | 2016 | 2016 | 2032 | 16 | 1 | 2019 | N/A | 2016 | N/A | 2030 | N/A | 1 | N/A | N/A | 2016 | 1 | 1 | 2017 | Top after generics |
| Gilead Sciences | Virtide | 0,018 | 1 | 2 | 1996 | 1993 | 2010 | 17 | 1 | 2013 | -15 | 1997 | 1997 | 2012 | 15 | 0 | N/A | N/A | 2014 | 17 | -1 | 2012 | 15 |
| Amgen | Infergen | 0,599 | 3 | 4 | 1997 | 1993 | 2009 | 16 | 1 | N/A | N/A | 1999 | 1999 | N/A | N/A | -1 | N/A | N/A | 1998 | N/A | N/A | N/A | N/A |
| Abbvie | Kaletra | 4,225 | 3 | 5 | 2000 | 2000 | 2024 | 24 | 10 | 2017 | -3 | 2001 | 1996 | 2017 | 21 | 9 | 2017 | -3 | 2001 | 7 | 6 | 2007 | -7 |
| GlaxoSmithKline | Triumeq | 6,63 | Still no 2 | 3 | 2014 | 2009 | 2029 | 20 | 1 | None | N/A | 2014 | 2014 | 2035 | 21 | 1 | N/A | N/A | N/A | N/A | N/A | N/A | No data |
| GlaxoSmithKline | Valtrex | 6,113 | 2 | 3 | 1995 | 1987 | 2009 | 22 | 12 | 2009 | 0 | 2010 | 1988 | 2008 | 20 | -3 | 2009 | 0 | 2010 | 12 | -3 | 2007 | -2 |
| GlaxoSmithKline | Tivicay | 3,096 | Still no 3 | 2 | 2013 | 2012 | 2027 | 15 | 3 | None | N/A | 2014 | 2014 | N/A | N/A | 2 | N/A | N/A | 2014 | 3 | 2 | 2016 | Top after generics |
| Johnson & Johnson | Prezista | 1,673 | 3 | 1 | 2006 | 2006 | 2027 | 21 | 7 | 2017 | -4 | 2007 | 2006 | 2019 | 13 | 6 | 2017 | -4 | N/A | 3 | N/A | 2009 | -4 |
| Gilead Sciences | Truvada | 30,223 | 3 | 13 | 2004 | 2004 | 2021 | 17 | 0 | None | N/A | 2005 | 2004 | 2017 | 13 | -1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Gilead Sciences | Atripla | 21,004 | 2 | 9 | 2006 | 1995 | 2021 | 26 | 0 | None | N/A | 2006 | N/A | 2018 | N/A | 0 | 2017 | -3 | 2006 | 0 | 0 | 2006 | -8 |
| Gilead Sciences | Viread | 8,237 | 3 | 13 | 2001 | 1996 | 2018 | 22 | 0 | 2017 | -4 | 2002 | 1997 | 2017 | 20 | -1 | 2017 | -4 | 2006 | 6 | 1 | 2007 | -6 |
| Gilead Sciences | Genvoya | 3,674 | Still no 2 | 1 | 2015 | 2008 | 2032 | 24 | 2 | None | N/A | 2015 | 2015 | N/A | N/A | 2 | N/A | N/A | 2015 | N/A | N/A | N/A | No data |
| Bristol-Myers Squibb | Reyataz | 7,292 | 3 | 6 | 2003 | 2001 | 2017 | 16 | 5 | 2017 | -4 | 2004 | 2002 | 2019 | 17 | 4 | 2019 | -6 | N/A | 6 | N/A | 2009 | -4 |
| Bristol-Myers Squibb | Sustiva | 3,141 | 2 | 2 | 1998 | 1997 | 2017 | 20 | 14 | 2017 | -4 | 1999 | 1997 | 2013 | 16 | 13 | 2013 | 0 | N/A | 7 | N/A | 2005 | -8 |
| Total revenue | | 156,182 | | For all | For all no longer top | | | | | | | | | | | | | | | | | | |
| Average | | 7,8091 | | 3,85 | 4,47 | | | 19 | 3,4 | | -4,25 | | | | 16,75 | 1,94 | | -2 | | 5,86 | 1,18 | | -1 |
| Max | | 30,223 | | 13 | 13 | | | 26 | 14 | | 0 | | | | 21 | 13 | | 4 | | 17 | 6 | | 15 |
| Min | | 0,018 | | 1 | 1 | | | 16 | 0 | | -15 | | | | 9 | -3 | | -6 | | 0 | -3 | | -8 |

## *Top 3* pharmaceuticals

**Roche**

| | Drug | Type | Total years in t | Years as | Years a | Years a | Total revenue | Year became top 3 | Year stopped being top 3, and tren |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Rituxan | Cancer (blood, lymphnodes), Autoimmune disease (e.g.rheumatoid arthrit | 17 of 21 | 14 | 3 | 0 | 85.983 | 2001, as no 2 | Still top 2017, no 1(went 2,1,2,1) |
| 2 | Avastin | Cancer (lung, kidney, ovarian, cervical cancer, glioblastomal brain) | 12 of 19 | 2 | 6 | 4 | 63.204 | 2005, as no 3 | Still top 2017, no 3(went 3, 2,1,2,3,2,3) |
| 3 | Herceptin | Cancer (breast) | 13 of 19 | 0 | 4 | 9 | 63.561 | 2005, as no 3 | Still top 2017, no 2(went 3,2,3,2,3,2) |
| 4 | Rocephin | Antibiotic | 4 of 19 | 2 | 1 | 1 | 2.997 | already top 1999, no 1 | 2003, as no 3 (went 1,2,3,) |
| 5 | NeoRecormon/Epoge | Anemia | 5 of 19 | 0 | 3 | 2 | 5.858 | 2000, as no 3 | 2005, as no 2 (went 3, not, 3,2) |
| 6 | CellCept | Immunosuppressant (Lupus) | 1 of 19 | 0 | 1 | 0 | 0.246 | 2000, as no 2 | 2000, as no 2 (only no 2) |
| 7 | Pegasys+Copegus | Antiviral (Hep C) | 1 of 19 | 0 | 0 | 1 | 1.184 | 2004, as no 3 | 2004, as (only no 3) |
| 8 | Accutane | Severe acne | 3 of 19 | 1 | 1 | 1 | 1.229 | already top 1999, no 1 | 2001, as no 3 (went 2,1,3) |
| 9 | Xenical | Dietary | 1 of 19 | 0 | 0 | 1 | 0.466 | already top 1999, no 3 | 1999, as no 3 (only no 3) |

**Pfizer**

| | Drug | Type | Total years in t | Years as | Years a | Years a | Total revenue | Year became top 3 | Year stopped being top 3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | Prevnar 13 | Vaccine (pneumococcal bacteria) | 5 of 21 | 3 | 2 | 0 | 20.184 | 2013, as no 2 | still top 2017, no 1(went 2,1) |
| 3 | Lipitor | Statin (cholesterol) | 14 of 21 | 13 | 1 | 0 | 129.180 | 1999, as no 1 | 2012, as no 2 (went 1,only one year 2) |
| 4 | Norvasc | Blood pressure | 11 of 21 | 2 | 9 | 0 | 39.944 | already top 1997, no 1 | 2007, as no 2 (went 1,2) |
| 5 | Enbrel | Immunosuppressant (e.g.rheumatoid arthritis) | 7 of 21 | 0 | 1 | 6 | 24.543 | 2010, as no 2 | last year top 2016, no 3 (went one year 2,ne |
| 6 | Ibrance | Cancer (breast) | 1 of 21 | 0 | 0 | 1 | 3.126 | 2017, as no 3 | still top 2017, (only 3) |
| 7 | Celebrex | Anti-inflamatory | 3 of 21 | 0 | 0 | 3 | 7.162 | 2007, as no 3 | 2009, as no 3 (only 3) |
| 8 | Zoloft | Antidepressant | 10 of 21 | 0 | 2 | 8 | 24.432 | already top 1997, no 2 | 2006, as no 3 (went 2 two years, 3 rest) |
| 9 | Lyrica | Anticonvulsant (seizures) | 10 of 21 | 3 | 6 | 1 | 40.960 | 2008, as no 2 | still top 2017, no 2 (went 2,3,2,1,2) |
| 10 | Zithromax | Antibiotic | 1 of 21 | 0 | 0 | 1 | 1.041 | 1998, as no 3 | 1998, as no 3 (only 3) |
| 11 | Diflucan | Antifungal | 2 of 21 | 0 | 0 | 1 | 0.881 | already top 1997, no 3 | 1997, as no 3 (only 3) |

**Novartis**

| | Drug | Type | Total years in t | Years as | Years a | Years a | Total revenue | Year became top 3 | Year stopped being top 3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Gilenya | Immunosuppressant (Multiple Sclerosis) | 4 of 17 | 1 | 3 | 0 | 11.547 | 2014, as no 1 | still top 2017, no 1(went 1 a year, 2 rest |
| 2 | Cosentyx | Immunosuppressant (Psoriasis) | 1 of 17 | 0 | 1 | 0 | 2.071 | 2017, as no 2 | still top 2017, only 2 |
| 3 | Neoral/Sandimmun | Immunosuppressant (Psoriasis, prevent organ rejection, rheumatoid arthri | 3 of 17 | 0 | 2 | 1 | 2.309 | already top 2001, no 2 | 2003, as no 3 (went 2,3) |
| 4 | Gleevec | Cancer (blood, stomach/gastrointestinal) | 15 of 17 | 5 | 9 | 1 | 51.112 | 2003, as no 2 | still top 2017, no 3 (went 2,1,3 one year) |
| 5 | Zometa | Cancer (manage side affects) | 4 of 17 | 0 | 0 | 4 | 5.372 | 2005, as no 3 | 2009, as no 3 (all 3) |
| 6 | Diovan | Blood pressure | 13 of 17 | 11 | 2 | 0 | 54.579 | already top 2001, no 1 | 2013, as no 2 (went 1, 2 last 2 years) |
| 7 | Lotrel | Blood pressure | 1 of 17 | 0 | 0 | 1 | 1.352 | 2006, as no 3 | 2006, as no 3 (only 3) |
| 8 | Clbacen/Lotensin | Blood pressure | 1 of 17 | 0 | 0 | 1 | 0.475 | already top 2001, no 3 | 2001, as no 3 (only 3) |
| 9 | Lucentis | Eye disease | 7 of 17 | 0 | 0 | 7 | 14.700 | 2010, as no 3 | 2016, as no 3 (all 3) |
| 10 | Lamisil | Anti fungal | 2 of 17 | 0 | 0 | 2 | 1.766 | 2002, as no 2 | 2004, as no 2 (all 2) |

**Merck and Co.**

| | Drug | Type | Total years in t | Years as | Years a | Years a | Total revenue ye | Year became top 3 | Year stopped being top 3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Januvia | Diabetes | 5 of 18 | 4 | 1 | 2 | 35.520 | 2009, as no 3 | still top 2017, no 1(went 3,2,1) |
| 2 | Janumet | Diabetes | 1 of 18 | 0 | 0 | 1 | 2.151 | 2015, as no 3 | 2015, as no 3 (only 3) |
| 3 | Singulair | Asthma and allergies | 8 of 18 | 6 | 0 | 0 | 28.039 | 2006, as no 1 | 2011, as no 1(all 1) |
| 4 | Zocor | Statin (Cholesterol) | 6 of 18 | 6 | 0 | 0 | 27.661 | already top 2000, no 1 | 2005, as no 1(all 1) |
| 5 | Keytruda | Cancer (lung, skin, lymphnodes) | 1 of 18 | 0 | 1 | 0 | 3.809 | 2017, as no 2 | still top 2017, no 2 (only 2) |
| 6 | Zetia | Statin (cholesterol) | 5 of 18 | 0 | 4 | 1 | 10.282 | 2012, as no 3 | 2016, as no 2 (one year 3, rest 2) |
| 7 | Remicade | Immunosuppressant (e.g.rheumatoid arthritis) | 5 of 18 | 0 | 2 | 3 | 12.100 | 2010, as no 2 | 2014, as no 3 (went 2,3,2,3) |
| 8 | Cozaar/Hyzaar | Blood pressure | 6 of 18 | 0 | 4 | 2 | 19.379 | 2004, as no 3 | 2009,as no 2 (went 3,2) |
| 9 | Fosamax | Osteoporosis | 9 of 18 | 0 | 3 | 6 | 21.376 | already top 2000, no 3 | 2006, as no 3 (went 3,2,3) |
| 10 | Vytorin | Anti-inflamatory | 4 of 18 | 0 | 3 | 1 | 8.325 | already top 2001, no 2 | 2003, as no 3 (went 2,last year 3) (NB trivialized/danger?) |
| 11 | Gardasil | Vaccine (HPV) | 2 of 18 | 0 | 0 | 2 | 4.481 | 2016, as no 3 | still top 2017, no 3 (both 3) |

**AbbVie**

| | Drug | Type | Total years in t | Years as | Years a | Years a | Total revenue ye | Year became top 3 | Year stopped being top 3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Humira | Immunosuppressant (e.g.rheumatoid arthritis) | 11 of 11 | 11 | 0 | 0 | 106.424 | 2007, as no 1 | still top 2017, no 1(all 1) |
| 2 | Imbruvica | Cancer (blood) | 2 of 7 | 0 | 2 | 0 | 4.405 | 2016, as no 2 | still top 2017, no 2 (all 2) |
| 3 | Viekira | Antiviral (Hep C) | 2 of 7 | 0 | 1 | 1 | 3.161 | 2015, as no 2 | 2016, as no 3 (went 2,3 a year each) |
| 4 | Kaletra | Antiretroviral (HIV) | 4 of 7 | 0 | 0 | 4 | 4.225 | 2010, as no 3 | 2014, as no 3 (all 3) |
| 5 | AndroGel | Androgen (testosterone) | 3 of 7 | 0 | 3 | 0 | 3.121 | 2012, as no 2 | 2014, as no 2 (all 2) |
| 6 | TriCor/Trilipix | Statin (cholesterol) | 3 of 7 | 0 | 2 | 1 | 3.825 | 2010, as no 2 | 2012, as no 3 (went 2, last year 3) |
| 7 | Lupron | Cancer (prostate) | 2 of 7 | 0 | 0 | 2 | 1.695 | 2015, no 3 | still top 2017, no 3 (all 3) |

**Eli Lilly & Co.**

| | Drug | Type | Total years in t | Years as | Years a | Years a | Total revenue ye | Year became top 3 | Year stopped being top 3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Gemzar | Cancer (breast, lung, ovarian, pancreatic) | 7 of 21 | 0 | 3 | 4 | 7.902 | 1999, as no 3 | 2007, as no 3 (were one year 3, no year not, 3,2,3) |
| 2 | Alimta | Cancer (lung) | 8 of 21 | 1 | 4 | 3 | 20.028 | 2010, as no 3 | still top 2017, no 3 (went 3,2,1,2,3) |
| 3 | Cymbalta | Anti depressant | 8 of 21 | 2 | 5 | 1 | 26.890 | 2006, as no 3 | 2013, as no 1(went 3,2,1) |
| 4 | Zyprexa | Atypical antipsychotic (schizophrenia, bipolar disorder) | 15 of 21 | 11 | 4 | 0 | 54.467 | already top 1997, no 2 | 2011, as no 1(went 2,1) |
| 5 | Prozac | Anti-depressant | 5 of 21 | 4 | 1 | 0 | 12.548 | already top 1997, no 1 | 2001, as no 2 (went 1,2 last year) |
| 6 | Cialis | Erectile dysfunction | 4 of 21 | 0 | 1 | 3 | 9.236 | 2014, as no 3 | still top 2017, no 2 (went 3, 2) |
| 7 | Humalog | Diabetes | 10 of 21 | 3 | 1 | 6 | 22.245 | 2006, as no 3 | still top 2017, no 1 (went 2 year 3, two year not, two year 3, two year not, 2 year 3, 2, 1) |
| 8 | Humulin | Diabetes | 4 of 21 | 0 | 2 | 2 | 4.240 | 2000, as no 3 | 2003,as no 2 (went 3,2) |
| 9 | Axid | H2 blocker (ulcers) | 2 of 21 | 0 | 0 | 2 | 0.945 | already top 1997, no 3 | 1998, as no 3 (all 3) |

**AstraZeneca**

| | Drug | Type | Total years in t | Years as | Years a | Years a | Total revenue ye | Year became top 3 | Year stopped being top 3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Symbicort | Asthma (Corticosteroid) | 6 of 21 | 1 | 3 | 2 | 19.884 | 2012, as no 3 | still top 2017, no 1(went 3,2,1) |
| 2 | Pulmicort | Asthma (Corticosteroid) | 4 of 21 | 0 | 2 | 2 | 2.827 | already top 1997, no 2 | 2001, as no 3 (went 2, a year 3, a year not, a year 3) |
| 3 | Nexium | Proton pump inhibitors (antacid) | 16 of 21 | 7 | 3 | 6 | 61.702 | 2002, as no 2 | still top 2017, no 3 (went a year 2, 1, 3,2,3) |
| 4 | Losec/Prilosec | Proton pump inhibitors (antacid) | 8 of 21 | 6 | 1 | 1 | 33.736 | already top 1997, no 1 | 2004, as no 3 (went 1,2,3) |
| 5 | Crestor | Statin (cholesterol) | 12 of 21 | 7 | 1 | 4 | 53.406 | 2006, as no 3 | still stop 2017, no 2 (went 3,1,2) |
| 6 | Seroquel | Atypical antipsychotic (schizophrenia, bipolar disorder) | 10 of 21 | 0 | 8 | 2 | 35.311 | 2002, as no 3 | 2011,as no 2(went 3,2) |
| 7 | Zestril | Blood pressure | 3 of 21 | 0 | 3 | 0 | 3.506 | 1999, as no 2 | 2001, as no 2 (only 2) |
| 8 | Seloken/Toprol-XL | Blood pressure | 3 of 21 | 0 | 0 | 3 | 2.590 | already top 1997, no 3 | 2005, as no 3 (all 3) |
| 9 | Zoladex | Cancer (Breast and prostate) | | 0 | 0 | 1 | 0.734 | 2000, as no 3 | 2000, as no 3 (only 3) |

**Celgene**

| | Drug | Type | Total years in t | Years as | Years a | Years a | Total revenue ye | Year became top 3 | Year stopped being top 3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Revlimid | Cancer (bone marrow, mantle cell lymphoma-MCL) | 12 of 19 | 11 | 1 | 0 | 43.791 | 2006, as no 2 | still top 2017, no 1(went 2,1) |
| 2 | Thalomid | Cancer (bone marrow) | 13 of 20 | 9 | 3 | 1 | 3.314 | already top 1998, no 1 | 2010, as no 3 (went 1,2,3) |
| 3 | Pomalyst | Cancer (bone marrow, who has already received 2 other drugs) | 4 of 19 | 0 | 3 | 1 | 4.587 | 2014, as no 3 | Still top 2017, as 2 (went 3,2) |
| 4 | Vidaza | Cancer (blood, bone marrow) | 6 of 19 | 0 | 4 | 2 | 3.459 | 2008, as no 3 | 2013, as no 2 (went 3,2) |
| 5 | Abraxane | Cancer (Breast, pancreas, lungs) | 5 of 19 | 0 | 1 | 4 | 3.277 | 2011, as no 3 | 2015, as no 2 (went 3,2) |
| 6 | Abraxan | Cancer (Bone marrow, breast, ovarian, neuroscarcoma, | 5 of 19 | 0 | 3 | 2 | 0.208 | 2003, as no 2 | 2007,as no 3 (went 2,3) |
| 7 | Focalin | ADHD | 5 of 19 | 0 | 2 | 3 | 0.1806 | 2001, as no 2 | 2005, as no 3 (went 2,3) |
| 8 | Otezla | Immunosuppressant (psoriasis, psoriatic arthritis) | 2 of 19 | 0 | 0 | 2 | 2.296 | 2016, as no 3 | still top 2017, no 3 (both 3) |

**Sanofi**

| | Drug | Type | Total years in t | Years as | Years a | Years a | Total revenue ye | Year became top 3 | Year stopped being top 3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Lantus | Diabetes | 11 of 19 | 9 | 0 | 2 | 61.828 | 2001, as no 3 | still top 2017, no 1(went 3,1) |
| 2 | Lovenox | Blood thinner | 14 of 19 | 5 | 5 | 4 | 39.048 | 2004, as no 1 | still top 2017, no 2 (went 1,2,3,2) |
| 3 | Aprovel | Blood pressure | 4 of 19 | 0 | 1 | 3 | 1.502 | already 1999, no 2 | 2002, as no 3 (went 2,3) |
| 4 | Plavix | Anticoagulent (prevents clotting, increased blood flow) | 17 of 19 | 0 | 13 | 4 | 36.218 | already 1999, no 3 | 2016, as no 3 (went 3,2,3, one year not, 3, 2,3) |
| 5 | Stilnox/Ambien | Insomnia | 6 of 19 | 5 | 0 | 1 | 7.079 | already 1999, no 1 | 2006, as no 3 (went 1, 2 year not, 3) |
| 6 | Aubagio | Immunosuppressant (Multiple sclerosis) | 1 of 19 | 0 | 0 | 1 | 1.771 | 2017,as no 3 | still top 2017, no 3 (only 3) |
| 7 | Taxotere | Cancer (breast, lung, prostate, stomach, head/neck) | 2 of 19 | 0 | 0 | 2 | 4.816 | 2005, as no 3 | 2010, as no 3 (both 3) |
| 8 | Eloxatin | Cancer (colon, rectum) | 1 of 19 | 0 | 0 | 1 | 0.933 | 2003, as no 3 | 2003, as no 3 (only 3) |
| 9 | Allegra | Antihistamine (allergies) | 1 of 19 | 0 | 0 | 1 | 1.668 | 2004, as no 3 | 2004, as no 3 (only 3) |

**Bayer**

| | Drug | Type | Total years in t | Years as | Years a | Years a | Total revenue ye | Year became top 3 | Year stopped being top 3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Xarelto | Anticoagulent (prevents clotting) | 5 of 20 | 4 | 0 | 1 | 12.957 | 2013, as no 3 | still top 2017, no 1(went 3,1) |
| 2 | Kogenate | Blood clots (aids blood clots, stop bleadings) | 12 of 20 | 2 | 4 | 6 | 15.412 | 2005, as no 3 | 2016, as no 3 (went 3,2,1,3) |
| 3 | Adalat | Blood pressure | 9 of 20 | 0 | 8 | 1 | 8.074 | already top 1998, no 2 | 2006, as no 2 (went 2,3,2 last year) |
| 4 | Betaferon | Immunosuppressant (Multiple sclerosis) | 8 of 20 | 3 | 4 | 1 | 11.558 | 2006, as no 3 | 2013, as no 2 (went 3,2,1,2 last year) |
| 5 | Ciprobay | Antibiotic | 7 of 20 | 7 | 0 | 0 | 10.404 | already top 1998, no 1 | 2004, as no 1 (all 1) |
| 6 | YazlYasmin | Contraceptive | 6 of 20 | 3 | 1 | 2 | 9.316 | 2007, as no 1 | 2012, as no 3 (went 1,2,3) |
| 7 | Mirena | Contraceptive | 2 of 20 | 0 | 0 | 2 | 2.360 | 2014, as no 3 | still top 2017, no 3 (3, 2 year not, 3) |
| 8 | Ascensia | Diabetes | 3 of 20 | 1 | 0 | 2 | 2.335 | 2003, as no 3 | 2005, as no 1(went 3,1) |
| 9 | Eylea | Eye disease | 3 of 20 | 0 | 3 | 0 | 5.286 | 2015, as no 2 | still top 2017, no 2 (all 2) |
| 10 | Aspirin | Pain relief | 4 of 20 | 0 | 0 | 4 | 2.412 | already top 1998, no 3 | 2002, as no 3 (only 3) |
| 11 | Lipobay/Baycol | Statin (cholesterol) | 1 of 20 | 0 | 0 | 1 | 0.587 | 2000, as no 3 | 2000, as no 3 (only 3) |

**GlaxoSmithKline**

| | Drug | Type | Total years in t | Years as | Years a | Years a | Total revenue ye | Year became top 3 | Year stopped being top 3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Advair/Seretide | Asthma (corticosteroid) | 16 of 18 | 15 | 1 | 0 | 98.260 | 2002, as no 2 | still top 2017, no 1(went 2,1) |
| 2 | Flixotide | Asthma (corticosteroid) | 4 of 18 | 0 | 1 | 3 | 5.197 | already top 2000, no 3 | 2011, as no 2 (went 3, 8 year not, a year 3, 2) |
| 3 | Augmentin | Antibiotic (penicilin) | 3 of 18 | 0 | 2 | 1 | 5.683 | already top 2000, no 2 | 2002, as no 3 (went 2,3) |
| 4 | Relenza | Antiviral (flu pandemic) | 2 of 18 | 0 | 1 | 1 | 3.225 | 2009, as no 3 | 2010, as no 2 (bc of flu pandemic) |
| 5 | Trumeq | Antiretroviral (HIV) | 3 of 18 | 0 | 2 | 1 | 6.630 | 2015, as no 3 | still top 2017, no 2 (went 3,2) |
| 6 | Tivicay | Antiretroviral (HIV) | 2 of 18 | 0 | 0 | 2 | 3.036 | 2015, as no 3 | still top 2017, no 3 (both 3) |
| 7 | Valtrex | Antiretroviral (genital herpes, cold sores, shingles) | 3 of 18 | 0 | 2 | 1 | 6.113 | 2007, as no 3 | 2009, as no 2 (went 3,2) |
| 8 | Seroxat/Paxil | Antidepressant | 5 of 18 | 3 | 1 | 1 | 13.127 | already top 2000, no 1 | 2004, as no 3 (went 1,2,3) |
| 9 | Wellbutrin | Antidepressant | 1 of 18 | 0 | 0 | 1 | 1.558 | 2003, as no 3 | 2003, as no 3 (only 3) |
| 10 | Lamictal | Anticonvulsant | 4 of 18 | 0 | 1 | 3 | 7.292 | 2005, as no 2 | 2008, as no 3 (went 3,2,3 last year) |
| 11 | Avandia | Diabetes | 3 of 18 | 0 | 3 | 0 | 6.722 | 2004, as no 2 | 2006, as no 2 (all 2) |
| 12 | Infanrix/Pediarix | Vaccine (combination toddlers) | 5 of 18 | 0 | 3 | 2 | 6.168 | 2011, as no 3 | 2015, as no 2 (went 3,2) |
| 13 | Avodart | Benign prostatic hyperplasia | 3 of 18 | 0 | 1 | 2 | 3.920 | 2012, as no 2 | 2014, as no 3 (went 2,3) |

| | Johnson & Johnson | | From year of launch to present | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Drug | Type | Total years in t | Years as | Years as | Years as | Total revenue ye | Year became top 3 | Year stopped being top 3 |
| 1 | Remicade | Immunosuppressant (e.g rheumatoid arthritis) | 16 of 16 | 11 | 0 | 5 | 71.722 | already 2002, no 3 | still top 2017, no 1(went 3, 1) |
| 2 | Stelara | Immunosuppressant (Psoriasis) | 3 of 16 | 0 | 3 | 0 | 9.717 | 2015, as no 2 | still top 2017, no 2 (all 2) |
| 3 | Risperdal | Atypical antipsychotics (Schizofrenia, bipolar disease etc) | 7 of 16 | 2 | 3 | 2 | 28.686 | already 2002, no 2 | 2011, as no 3 (went 2, 1, 3 years not, 3) |
| 4 | Trevicta | Atypical antipsychotic (schizofrenia) | 1 of 16 | 0 | 0 | 1 | 2.569 | 2017, as no 3 | still top 2017, no 3 (only 2017) |
| 5 | Procrit/Epreo | Anemia | 11 of 16 | 3 | 6 | 2 | 30.955 | already 2002, no 1 | 2012, as no 3 (went 1,2,3,2,3) |
| 6 | Olysio/Sovriad | Antiviral (Hep C) | 1 of 16 | 0 | 1 | 0 | 2.302 | 2014, as no 2 | 2014, as no 2 (only 2) |
| 7 | Prezista | Antiretroviral (HIV) | 1 of 16 | 0 | 0 | 1 | 1.673 | 2013, as no 3 | 2013, as no 3 (only 3) |
| 8 | Levaquin/Floxin | Antibiotic | 1 of 16 | 0 | 0 | 1 | 1.550 | 2009, as no 3 | 2009, as no 3 (only 3) |
| 9 | Zytiga | Cancer (Prostate) | 4 of 16 | 0 | 1 | 3 | 8.426 | 2013, as no 2 | 2016, as no 3 (went 2,3) |
| 10 | Velcade | Cancer (bone marrow, lymphnodes) | 1 of 16 | 0 | 1 | 0 | 1.500 | 2012, as no 2 | 2012, as no 2 (only 2) |
| 11 | Topamax | Anticonvulsant (seizure) | 2 of 16 | 0 | 1 | 1 | 5.184 | 2007, as no 3 | 2008, as no 2 |

| | Gilead Sciences | | From year of launch to present | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Drug | Type | Total years in t | Years as | Years as | Years as | Total revenue ye | Year became top 3 | Year stopped being top 3 |
| 1 | Harvoni | Antiviral (Hep C) | 3 of 21 | 3 | 0 | 0 | 27.375 | 2015, as no 1 | still top 2017, no 1(all 1) |
| 2 | Sovaldi | Antiviral (Hep C) | 3 of 21 | 1 | 2 | 0 | 13.560 | 2014, as no 1 | 2016, as no 2 (went 1,2) |
| 3 | Epclusa | Antiviral (Hep C) | 1 of 21 | 0 | 0 | 1 | 3.510 | 2017, as no 3 | still top 2017, no 3 (only 3) |
| 4 | Viriide | Antiviral (treats eye disease in AIDS patients) | 2 of 21 | 2 | 0 | 0 | 0.018 | already top 1997, no 1 | 1998, as no 1(both 1) |
| 5 | Atripla | Antiretroviral (HIV) | 9 of 21 | 4 | 4 | 1 | 21.004 | first 2006, no 3 | 2014, as no 2 (went 3,2,1,2) |
| 6 | Truvada | Antiretroviral (HIV) | 13 of 21 | 4 | 5 | 4 | 30.223 | 2004, as no 3 | 2016, as no 3 (went 3,2,1,2,3) |
| 7 | Viread | Antiretroviral (HIV) | 13 of 21 | 4 | 2 | 7 | 8.237 | 2001, no 2 (first year with t | 2013, as no 3 (went 2,1,2,3) |
| 8 | Genvoya | Antiretroviral (HIV) | 1 of 21 | 0 | 1 | 0 | 3.674 | 2017, as no 2 | still top 2017, no 2 (only 2) |
| 9 | AmBisome | Antifungal | 7 of 13 | 3 | 3 | 1 | 1.251 | 1999, as no 1 | 2005, as no 3 (went 1, 2, 3) |

| | Amgen | | From year of launch to present | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Drug | Type | Total years in t | Years as | Years as | Years as | Total revenue ye | Year became top 3 | Year stopped being top 3 |
| 1 | Enbrel | Immunosuppressant (e.g rheumatoid arthritis) | 12 of 21 | 3 | 7 | 3 | 52.266 | 2004, as no 3 | still top 2017, no 1(went 3, 2, 1) |
| 2 | Neulasta/Neupogen | Cancer (stimulte white bloodcells in bone marrow after Chemo) | 20 of 21 | 10 | 10 | 0 | 67.987 | already top 1997, no 2 | still top 2017, no 2 (went 2, 1,2,1,2) |
| 3 | Aranesp | Anemia | 15 of 21 | 1 | 3 | 11 | 33.995 | 2001, as no 3 | still top 2017, no 3 (went 3, 2,1,2,3) |
| 4 | Epogen | Anemia | 10 of 21 | 7 | 1 | 2 | 20.601 | already top 1997, no 1 | 2012, as no 3 (went 1,2,1,3) |
| 5 | Xgeva | Cancer (bone marrow, bone) | 1 of 21 | 0 | 0 | 1 | 1.221 | 2015, as no 3 | 2015, as no 3 (only 3) |
| 6 | Infergen | Antiviral (Hep C) | 4 of 21 | 0 | 0 | 4 | 0.539 | 1998, as no3 | 2001, as no 3 (all years no 3) |

| | Bristol-Myers Squibb | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Drug | Type | Total years in t | Years as | Years as | Years as | Total revenue ye | Year became top 3 | Year stopped being top 3 |
| 1 | Opdivo | Cancer (skin, lung, renal, lymphnode, headneck, colon, liver, urinary) | 2 of 21 | 2 | 0 | 0 | 8.722 | 2016, as no 1 | still top 2017, no 1 |
| 2 | Orencia | Immunosuppressant (rheumatoid arthritis) | 4 of 21 | 1 | 1 | 2 | 8.281 | 2014, as no 2 | still top 2017, no 3 (went 2, 1, 3) |
| 3 | Abilify | Atypical antipsychotic (schizophrenia, bipolar disorder, Tourettes, autism) | 9 of 21 | 3 | 6 | 0 | 20.146 | 2006, as no 2 | 2014, as no 1(went 2,1) |
| 4 | Plavix | Anticoagulent (prevents clotting, increased blood flow) | 12 of 21 | 8 | 3 | 1 | 48.928 | 2001, as no 3 | 2012, as no 2 (went 3,2,1,2) |
| 5 | Eliquis | Anticoagulent | 3 of 21 | 0 | 3 | 0 | 10.075 | 2015, as no 2 | still top 2017, no 2 (all no 2) |
| 6 | Pravachol | Statins (cholesterol) | 10 of 21 | 7 | 2 | 1 | 19.355 | Already top 1997, no 1 | 2006, as no 3 (went 1,2,3) |
| 7 | Sustiva | Antiretroviral (HIV) | 2 of 21 | 0 | 1 | 1 | 3.141 | 2012, as no 3 | 2013, as no 2 (went 3,2) |
| 8 | Reyataz | Antiretroviral (HIV) | 5 of 21 | 0 | 0 | 5 | 7.292 | 2008, no 3 | 2013, as no 3 (all no3, one year not top) |
| 9 | Glucophage | Diabetes | 5 of 21 | 0 | 2 | 3 | 6.539 | already top 1997, no 3 | 2001, as no 2 (went 3,2) |
| 10 | Taxol | Cancer (ovarian, breast, lung, skin, lymph nodes, cervical, pancreatic | 7 of 21 | 0 | 3 | 4 | 8.277 | already top 1997, no 3 | 2004, as no 3 (went 2,3,one year not top) |
| 11 | Sprycel | Cancer (blood/leukemia) | 2 of 21 | 0 | 0 | 2 | 3.113 | 2014, as no 3 | 2015, as no 3 (all no 3) |
| 12 | Avapro | Blood pressure | 3 of 21 | 0 | 0 | 2 | 2.186 | 2005, as no 3 | 2007, as no 3 (not top 2006) |