THE ECONOMIC IMPACT OF THE PHARMACEUTICAL INDUSTRY IN EUROPE
Comparing the innovative and generic industries

Novo Nordisk
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Novo Nordisk is a global healthcare company headquartered in Denmark. Novo Nordisk’s key contribution is to discover and develop innovative biological medicines and make them accessible to patients throughout the world.

Copenhagen Economics is a leading economics advisory firm in Europe with offices in Brussels, Copenhagen, Helsinki and Stockholm. The CE Health Care & Life Sciences team help companies and policymakers design and argue future-oriented policies. The Global Competition Review (GCR) lists Copenhagen Economics among the Top-20 economic consultancies in the world.

This report was initiated and funded by Novo Nordisk and developed by Copenhagen Economics. Copenhagen Economics is responsible for the analyses in the report, including the calculations, data processing, interpretations, and conclusions. The conclusions are exclusively those of Copenhagen Economics and do not necessarily reflect the opinions of the project’s funder.
The economic contribution from the innovative industry is larger than that from the generic industry.

The innovative and generic industries form a dynamic ecosystem.

Current measures to promote access may decrease incentives to launch in Europe.

References and appendix.
**Executive summary**

**Changes in pharmaceutical legislation create uncertainty**

For the first time in almost two decades, the EU pharmaceutical industry is facing substantial changes to the EU pharmaceutical legislation that will significantly impact incentives to develop and market both orphan and non-orphan medicines. With the revision, the European Commission (EC) is proposing measures to allow for faster access to generic medicines while at the same time incentivising the continued development and introduction to the market of innovative medicines.

One of the more controversial proposals is to reduce the baseline regulatory data protection (RDP) period from eight to six years, while providing an opportunity to extend the protection period if certain loosely specified conditions are fulfilled.

In addition to a reduction of the RDP period, the EC has proposed measures for faster access to generic medicines. These measures include the Bolar exemption, the supplementary protection certificate (SPC) manufacturing waiver, and measures to limit the problem of divisional patent applications, all of which allow generic manufacturers faster and easier access.

The proposals have been met with scepticism and criticism by the innovative industry. They are worried that the reduced baseline RDP combined with faster access from generic manufacturers will reduce the effective protection length of future medicines. This will in turn reduce incentives to develop and market innovative medicines in the EU to the detriment of patients. On the other hand, faster access to cheaper generic medicines may lead to reduced length of RDP risks making Europe a less attractive place to launch new medicines, and this will likely have negative implications for future investments. Copenhagen Economics has recently shown in a global study that more launches of innovative medicines lead to more investment in clinical trials.

**The innovative industry accounts for 80% of pharmaceutical value creation in the EU**

We find that the innovative pharmaceutical industry has a larger economic impact in terms of contribution to the EU GVA than the generic industry does. In fact, the innovative industry accounts for 80% of the pharmaceutical GVA in the EU. This effect is driven by two factors. First, the GVA contribution from each euro spent in the innovative industry is larger than the GVA contribution from each euro spent in the generic industry. The innovative industry has a larger GVA contribution due to its emphasis on research and development (R&D), more complex manufacturing processes, and higher capital returns. Second, the EU produces relatively more innovative pharmaceutical products compared to generic pharmaceutical products.

**The innovative and generic industries form a balanced pharmaceutical ecosystem**

Despite its lower GVA contribution, the generic industry is not unimportant in Europe. Rather, the generic industry plays an important role as it is linked to the innovative industry in a balanced pharmaceutical ecosystem. The pharmaceutical ecosystem is initiated by the launch of an innovative medicine and results in the entry of generic medicines, which lowers the price and induces innovation. Without the launch of innovative medicines, generic medicine developers would not have anything to base their products on. Hence, innovative medicines are a prerequisite for generic medicines; not only for their existence in the first place, but typically also because generics enter markets where they can reference an existing originator product.

**Recent measures by the EC put Europe’s competitiveness at risk**

The EC’s proposals can all achieve the aim of securing faster access to generic medicines. However, policymakers should be careful not to disincentivise innovative launches as this can put the GVA contribution from the innovative industry at risk.

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1) EFPIA (2023c) / 2) Copenhagen Economics based on Eurostat table NAMA_10_A64 / 3) Copenhagen Economics (2023)
1

The economic contribution from the innovative industry is larger than that from the generic industry.
The pharmaceutical industry has great economic significance in the EU

The pharmaceutical industry is of great significance to Europe, not only because of treatments developed for the benefit of patients but also through its substantial contribution of €131bn to the Gross Value Added (GVA) across the European Union; see Figure 1. GVA encompasses the financial return generated by an industry and the sum of wages, and it serves as an indicator of an industry’s economic influence from its production. The GVA contribution presented here covers the entire pharmaceutical industry, i.e., innovative, generic, and other medicines such as veterinary medicine.

Europe is the second largest pharmaceutical market in the world, and the commercial sector exists within a broader ecosystem. However, the value created by the pharmaceutical industry is not solely attributed to its own efforts. The success of the pharmaceutical industry hinges on a range of factors outside the pharmaceutical industry, including basic research, adequate skilled labour, and reliable supply chains. These factors both support and are supported by a thriving European pharmaceutical industry.

The industry is a key driver of European research and development

A distinguishing feature of the pharmaceutical industry compared to other industries is its emphasis on research and development (R&D). The pharmaceutical industry outperforms others in R&D spending with 21.5% of all EU industrial R&D expenditure being registered within the health industry in 2021. A significant share of this is dedicated to the discovery and development of innovative medicines. These investments not only yield medical breakthroughs but also stimulate technological advancements, attract additional investments, and foster an environment of innovation within the European Union.

Large spillovers occur in job creation and throughout the supply chain

Job creation is another valuable aspect of the pharmaceutical industry’s impact. With a diverse range of activities encompassing research, manufacturing, marketing, and distribution, the industry creates a wide array of employment opportunities. In 2023, the pharmaceutical industry employed between 617,000 and 865,000 workers, depending on the industry definition. Using the lower bound of 617,000 workers ranks the pharmaceutical industry eleventh out of 15 manufacturing industries, but the value created per employee is significantly higher than that of other key R&D sectors.

Furthermore, the spillover effects of the pharmaceutical industry extend beyond its immediate boundaries through its supply chain. Local businesses that supply raw materials, packaging, and equipment experience a demand from pharmaceutical companies, leading to heightened economic activity and job creation. Moreover, the industry’s contributions extend to healthcare providers, as innovative medicines and therapies contribute to improved patient outcomes and an overall enhancement of quality of life. These effects, however, are not quantified in this report.

Figure 1: Gross value added in the pharmaceutical industry, EU27

Billion euro at current prices

Note: The figure covers only NACE Industry Code C21. In addition, the pharmaceutical industry partly overlaps with other industries. However, these overlaps are not accounted for in this report. The 2020 number is pending revision.

The innovative industry accounts for 80% of pharmaceutical GVA in the European Union

The GVA is largely driven by the innovative industry

We estimate that the innovative pharmaceutical industry accounts for 80% of the pharmaceutical GVA in medicine for human use across the European Union. The remaining 20% of GVA is created in the generic industry; see Figure 2.

These results stem from our estimation of GVA across subindustries, combining data on GVA intensity, sales shares, differences in production, and resource use across the innovative and generic industries. The approach is described in further detail in the Appendix.

Our analysis reveals two key factors driving these findings. Firstly, the GVA intensity of the innovative industry surpasses that of the generic industry by 35% due to higher remuneration of the two components of GVA, labour and capital; see Figure 3. In other words, one euro spent in the innovative industry yields a GVA contribution of 0.51 while one euro spent in the generic industry yields 0.38 in GVA contribution. Secondly, the relatively larger production share of innovative medicines compared to generic medicines in Europe contributes significantly to the overall GVA.1

R&D, investments, and high labour usage foster high-value creation for innovators

The higher GVA intensity observed in the innovative industry primarily stems from the business model employed by innovators. This business model places emphasis on R&D and complex manufacturing processes while relying to a lesser extent on intermediate inputs sourced from other sectors.2

An R&D-intensive pharmaceutical industry contributes significantly to the economy by generating highly skilled and well-paying jobs. For example, recent estimations by Copenhagen Economics reveal that in the United States and Switzerland, both markets with a thriving R&D-intensive pharmaceutical industry, productivity in the pharmaceutical industry is higher than that of the overall economy. Specifically, productivity measured in terms of total value added per full-time employee is more than 2.5 and 4 times higher in the pharmaceutical industry compared to the overall economy in the United States and Switzerland, respectively.3 The focus on R&D processes in the innovative industry can also lead both to cooperation with local European universities and international cooperation with, for example, the United States and China. These cooperations can result in knowledge spillovers between the parties involved, as the researchers from the universities and the researchers employed by the innovative industry learn from one another.

Another important characteristic of the innovative industry is its high capital return. This characteristic stems from the risky investments in the development of novel treatments undertaken by the industry. Basic investment theory states that the higher the risk of an investment, the higher the required return on capital.4 As innovative investments are characterised by high risk, the required return on capital is also high. As the generic industry does not conduct risky investments to the same extent, the industry is not characterised by high returns on capital. As the return on capital generates economic value, the innovative industry also creates economic value through its investments.

Figure 2: The majority of GVA stems from the innovative industry

<table>
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<th>Share of pharmaceutical GVA by subindustry (%)</th>
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<tr>
<td>Innovative industry</td>
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<tr>
<td>80%</td>
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<tr>
<td>Generic industry</td>
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<tr>
<td>20%</td>
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Note: We categorise all human medicine as either generic or innovative. All results reported here stem from our estimation. See the Appendix for details.

Source: Copenhagen Economics estimate based on Eurostat (2022), McKinsey (2017), and US Census Bureau (2020).

Figure 3: The innovative industry boasts the highest GVA intensity

<table>
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<tr>
<th>GVA per EUR production by subindustry (EUR)</th>
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<tr>
<td>Innovative industry</td>
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<td>0.51</td>
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<tr>
<td>Generic industry</td>
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<tr>
<td>0.38</td>
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</table>

Note: We categorise all human medicine as either generic or innovative. All results reported here stem from our estimation. See the Appendix for details.

Source: Copenhagen Economics estimate based on Eurostat (2022), McKinsey (2017), and US Census Bureau (2020).

1) See the Appendix for the methodology and further details / 2) When sourcing inputs from other sectors, value creation happens only indirectly through the mediating sector, as compared to utilising labour or capital directly. See the Appendix for a breakdown of the use in production among innovators and generic manufacturers / 3) Copenhagen Economics (2023) / 4) Sharpe (1964)
THE INNOVATIVE AND GENERIC INDUSTRIES FORM A DYNAMIC ECOSYSTEM
The innovative and generic industries are closely linked in a balanced pharmaceutical ecosystem

The innovative and generic industries are both part of a pharmaceutical ecosystem

The innovative and generic industries are not independent parties but two dependent parts of a balanced pharmaceutical ecosystem; see Figure 4.

The ecosystem is initiated by innovative medicine developers’ efforts to bring new treatments to the market through a long, costly, and risky development process. Once an innovative medicine is launched and sold on the market it will be sold exclusively for a period due to regulatory protection. Periods of exclusivity (patent or regulatory protection) allow the developer to make a return on its previous investment and justify the risk of new investments. Future investments will be influenced by the period of exclusivity available.

Once the exclusivity period expires, generic (or biosimilar) manufacturers can seek marketing authorisation for their versions of the medicine based in full or in part on the data package created and submitted by the innovator showing that the medicine is safe and effective. Hence, the entry of generics creates competition. Given that generic manufacturers incur fewer costs and risks to launch their products as they e.g., do not have to conduct clinical trials in a development phase, they can sell their products at a lower price to the benefit of patients and healthcare budgets.

In 2021, 26% of the pharmaceutical sales market value in the EU were generic medicines. The average covers a wide range from 4% in Luxembourg to 56% in Poland. This wide range indicates that the prescription use of generics and the approval of innovative medicines varies substantially across Member States.

Despite variations in the use of generics across Europe, the use of generic medicines leads to estimated savings on medicines of approximately €100bn. These savings are important in the pharmaceutical ecosystem, as they can be re-invested into new innovative medicines, used to broaden access to more patients, or a mix of the two.

However, lower prices are not the only effect of generic entry as it also pushes innovation, provided a sufficient return on investment for innovation remains available. In the wake of generic entry, innovative companies will divert their efforts away from therapeutic areas already well-served by generic medicines and instead shift their R&D activity towards areas not served by generic medicines. The innovative industry may also continue to innovate in a disease area where generic medicines exist but where the innovator hopes to develop a more effective medicine meeting a remaining unmet medical need for people living with that disease.

When we talk about the innovative industry, we often think of the value added stemming solely from the development of new categories of treatments. However, as just mentioned, the innovative industry also dedicates efforts to discovering more effective and potentially cost-saving treatments in areas where other treatments already exist. It holds for some treatments that first in class is not best in class as improvements to treatments might lead to fewer side effects, different routes of administration, and more effective and long-term effects. A push to innovation might therefore not result in a completely new category of products; it might be incremental innovation building on top of an already existing product.

As the ecosystem illustrates, the generic and innovative pharmaceutical industries influence one another. On the one hand, the innovative industry is a prerequisite for a thriving generic industry. On the other hand, competition from the generic industry can encourage innovation from the innovative industry, provided a sufficient return on investment is available for the development of new products, which present a high level of financial risk. In the ecosystem illustrated, the steps from launch to competition are certain, defined by periods of exclusivity and competition. But the successful development of a new medicine is never certain. Fundamentally, remaining unmet medical needs cannot be met without innovation, and thus the stimulus for innovation from competition must be carefully set to also allow sufficient time for return on investment.

Figure 4: Illustration of the pharmaceutical ecosystem

Source: Copenhagen Economics.
CURRENT MEASURES TO PROMOTE ACCESS MAY DECREASE INCENTIVES TO LAUNCH IN EUROPE
The European Commission is putting forward measures to promote faster access to generic medicines in Europe

The European Commission (EC) has at its core to ensure that patients have access to high-quality, effective, and safe medicines. However, in doing so policymakers have to strike the right balance between promoting and rewarding innovation, ensuring access to medicines, and sustaining the viability of health systems, which is a delicate balancing act.

**Current measures to promote earlier access to generics**

Recently, the EC published its proposal for the revision of the General Pharmaceutical Legislation (GPL), which also tries to strike this balance. Specifically, the revision aims to:

- Make sure that all patients across the EU have timely and equitable access to safe, effective, and affordable medicines.
- Enhance the security of supply and ensure medicines are available to patients, regardless of where they live in the EU.
- Continue to offer an attractive and innovation-friendly environment for research, development, and the production of medicines in Europe.
- Make medicines more environmentally sustainable.
- Address antimicrobial resistance (AMR) and the presence of pharmaceuticals in the environment through a One Health approach.

In its proposal, the EC specifically proposes to broaden the scope of the Bolar exemption and harmonise its application in all Member States. With the Bolar exemption, studies for subsequent regulatory approval of generics and biosimilars can be carried out during the patent or supplementary protection certificate (SPC) period. In other words, generic manufacturers can frontload some of their efforts to market a generic medicine making sure that the generic version of a medicine reaches the market faster.

The Bolar exemption, however, is not the only measure introduced by the EC to promote faster access to generics. In recent years, the EC has also introduced the SPC manufacturing waiver, allowing for manufacturing for stockpiling or exporting to non-EU Member States during the last six months of the protection period and efforts to limit the problem of divisional patent applications. In total, the EC has put forward at least three different measures to promote faster access to generics.

**Reducing regulatory data protection will negatively affect the innovative industry**

In addition to the three above-mentioned measures to promote faster access to generics, the EC has also proposed to reduce the baseline regulatory data protection (RDP) period. During the RDP period, governments prevent disclosure of the comprehensive test data compiled through all phases of the pharmaceutical R&D process that the medicinal producer must generate and deliver to the government in the marketing authorisation process. For innovative producers, these regulatory data have been generated through extensive research and scientific study at substantial cost, effort, and risk. Once the RDP period ends, generic producers can reference the original data package submitted by the innovator in their production process and hence do not need to replicate the data.

Currently, innovators benefit from eight years of RDP in the EU, after which generic or biosimilar manufacturers can file applications to produce with the EMA. The innovator also benefits from two additional years of market exclusivity before the generic version of the medicine can be launched. This set-up is often referred to as the “8+2”-year period. In its proposal, the EC proposes to reduce the RDP period by two years, implying that the exclusivity period will be reduced to “6+2” years. According to the proposal, the RDP period remains competitive after a reduction given what other regions offer.

In the proposal, the RDP period can also be extended by two years if the medicinal product is released in all 27 EU Member States, six months when the product addresses an unmet medical need, six months if comparative trials are conducted, and one year for additional therapeutic indications.

In total, an innovative medicinal product can theoretically gain regulatory protection (RDP and market exclusivity) for up to 12 years under the proposed measures. This is more than the current maximum of 11 years. However, this may not be available in practice as for example, the respective criteria for incentives for unmet medical need and comparative trials may be mutually exclusive, and the feasibility of being able to launch in all member states has been strongly questioned by the innovative sector.

**The proposal increases uncertainty and may lead to fewer launches in Europe**

Despite the increase in the maximum length of RDP and other measures set out to increase access to affordable medicine in the GPL, the innovative industry has met the proposal with scepticism and criticism, stating that “…(it) manages to undermine research and development in Europe while failing to address access to medicines for patients.”

One of the main reasons for this scepticism is that the sum of the proposed measures will increase uncertainty in the development process. For example, despite the potentially longer regulatory protection period, the requirements to fulfil the conditions granting 12 years of regulatory protection are unpredictable, and this induces uncertainty. Therefore, many consider the protection period as being reduced in practice from 8+2 to 6+2. This decrease in the protection period risks making Europe a less attractive market to launch new products in, all things being equal.

Sources: 1) European Commission (2020) / 2) European Commission (2023a) / 3) Ibid. / 4) This holds for general pharmaceuticals. For orphan medicinal product, the length of data and market exclusivity is longer / 5) European Commission (2023b) / 6) EFPIA (2023b)
4
REFERENCES AND APPENDIX
References (1/2)


disparagement/


References (2/2)


U.S. Census Bureau (2020), in collaboration with the National Science Foundation, Business Enterprise Research and Development Survey (BERD), https://www.census.gov/programs-surveys/berd.html


Our estimation of GVA differences between the innovative and the generic industries

We use a three-step process to separate the GVA from the innovative and the generic industry
The pharmaceutical industry is heterogeneous, and its various types of products and subindustries include the innovative and generic industries. However, detailed data about the individual subindustries are not readily available as data are generally presented in an aggregated form covering the total pharmaceutical industry. This makes it challenging to gain specific insights into the GVA of subindustries.

This data constraint holds particularly for the detailed national accounts and input-output (IO) tables traditionally used when estimating the economic impact of industries. For the same reason, almost all previous work on the pharmaceutical industry, e.g., EFPIA and PwC (2019), treats the pharmaceutical sector as one.

To arrive at the estimates presented in this report on GVA differences between the innovative and the generic industries, we use a novel estimation method aimed at combining various data sources to arrive at a single, internally consistent estimate. This is done using a three-step process, described on the right and in more detail on the following pages.

Note that our process only considers the market for traditional human medicine, which we split into generics and innovative products. We disregard other pharmaceutical products, which IMS Health in WifOR (2015) suggests cover 12% of the market. Thus, we effectively assume that the production of other medicinal products follows the same distribution of innovative and generic medicines as human medicines. However, as our estimation process is independent of the absolute market size, this assumption does not affect the results we obtain.

STEP 1
We source detailed production and GVA data for the pharmaceutical industry and for differences in production between innovative and generic medicines.

STEP 2
We reconcile the structure of the data points to create a unified data arrangement suitable for estimating the GVA for each subindustry.

STEP 3
We apply an optimisation algorithm to determine the most probable combination of innovative and generic GVA given the aggregated GVA for the entire pharmaceutical industry.
Our estimation of GVA differences between the innovative and the generic industries

To estimate the GVA in the pharmaceutical industry, we rely on country-level resource use within the pharmaceutical industry from the FIGARO (2022 ed.) IO-tables developed by Eurostat. We aggregate these into three groups: inputs, labour, and capital. The former includes all intermediate inputs sourced from other industries, while the latter two comprise GVA; see the column to the left in Figure A1. We use data on this split for all 27 EU countries for the most recent reference year, 2020; see Figure A2.

The provided cost split for the pharmaceutical industry allows us to understand the overall GVA generated by the total industry. However, it does not provide insights into the relative impact of the two subindustries examined here, namely the innovative and the generic industries.

To quantify differences in the production of innovative and generic medicines, we rely on McKinsey (2017), which presents a detailed cost breakdown of production by different types of medicine. See the grey columns in Figure A1. The data stem from an analysis of the global pharmaceutical industry. We assume that the cost split also holds for European producers. The latest available reference year is 2014.

McKinsey (2017) divides the costs of production into four categories: cost of goods, administrative costs, R&D, and EBITDA. The cost breakdown shows immediate differences between innovative and generic manufacturers, as innovative manufacturers have larger cost shares of R&D and EBITDA, while generic manufacturers have a relatively large share of cost of goods. While these help us understand the differences in cost of production, they are not immediately informative about GVA. For this reason, Step 2 of our process focuses on reconciling these data differences.

1) When sourcing inputs from other sectors, value creation happens only indirectly through the mediating sector, as compared to utilizing labour or capital directly, which adds value that would otherwise not arise. This follows standard IO-modelling practice, see e.g. Miller and Blair (2009). 2) We collect EBIT and depreciation and amortisation into EBITDA, though reported separately.

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### Figure A1: Cost split for the pharmaceutical industry and subindustries

<table>
<thead>
<tr>
<th>Type</th>
<th>Total pharmaceutical industry (EU 27)</th>
<th>Innovative manufacturers</th>
<th>Generic manufacturers</th>
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<tbody>
<tr>
<td>Inputs</td>
<td>56%</td>
<td>19%</td>
<td>36%</td>
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<tr>
<td>Labour</td>
<td>13%</td>
<td>19%</td>
<td>19%</td>
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<tr>
<td>Capital</td>
<td>31%</td>
<td>36%</td>
<td>26%</td>
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<tr>
<td>GVA</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
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<tr>
<td>Cost of goods</td>
<td>41%</td>
<td>36%</td>
<td>67%</td>
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<tr>
<td>Administrative</td>
<td>26%</td>
<td>19%</td>
<td>19%</td>
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<tr>
<td>R&amp;D</td>
<td>27%</td>
<td>13%</td>
<td>26%</td>
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<tr>
<td>EBITDA</td>
<td>6%</td>
<td>6%</td>
<td>7%</td>
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### Figure A2: Cost split for the pharmaceutical industry across EU Member States

<table>
<thead>
<tr>
<th>Country</th>
<th>Inputs</th>
<th>Labour</th>
<th>Capital</th>
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<td>AT</td>
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<td>SE</td>
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While the cost breakdown for each subindustry provides valuable insights into industry differences, it is not immediately apparent how this correlates with GVA. To facilitate a meaningful comparison of the categories from the IO-tables, we divide administrative and R&D costs into two categories: labour and intermediate inputs. According to the US Census Bureau (2020), labour compensation in the form of salaries accounts for 40% of R&D costs in US pharmaceutical companies. This falls within the range of results from similar surveys conducted in Europe. However, data from Europe is not applicable to this analysis as only a small number of countries perform R&D cost surveys specifically for the pharmaceutical industry. For the same reason, no EU-wide estimate exists, and we instead use the US estimate.

Based on the above, we assume that 40% of R&D costs are labour costs, while the remaining 60% is categorized as intermediate inputs, which encompasses e.g. laboratory expenses, building and storage costs, and other non-salary costs.

We are unable to locate a similar estimate on the breakdown of administrative costs. Instead, we also allocate 40% of costs to labour costs, mirroring the distribution for R&D expenditures. This roughly brings us in line with the overall labour utilisation across the industry in the EU.

These assumptions result in a structurally consistent cost breakdown for the EU, see Figure A3. This breakdown allows for a direct comparison of the differences in the GVA drivers for each subindustry.

For each country, the total pharmaceutical industry cost split will differ due to country-specific variation in the IO tables, but we assume the cost split by type of industry is constant across countries.

Step 2

Our estimation of GVA differences between the innovative and the generic industries

Figure A3: Cost split for the pharmaceutical industry and subindustries
Share of spending by type of production cost (%)

Note: This shows the final cost splits. See the previous page for details on the original numbers.
Source: Copenhagen Economics based on Eurostat (2022), McKinsey (2017), and US Census Bureau (2020).
Our estimation of GVA differences between the innovative and the generic industries

In the final step, we aim to determine the most likely share of production and GVA for the two subindustries, based on the nine data points estimated in Step 2. See Figure A3 on the previous page.

Intuitively, our objective is to assign weights to a weighted average of the innovative and generic industries that mimics the resource use from the total industry as closely as possible. However, given the differences in data sources, generally, no linear combination of production shares exactly resembles the total pharmaceutical industry for each country. Instead, we set up an optimisation problem that aims at getting as close as possible to each of the data points simultaneously.

Using the nine data points identified in Step 2 (e.g., 18% of costs in the innovative industry are to labour), we get nine equations for each of the 27 Member States, as illustrated on the right. In addition, we consider the marginal impact of each country’s production split on the aggregate EU production split. This gives us a total of 11 equations, shown on the right, to satisfy simultaneously in our optimisation process. We carry out the optimisation iteratively country by country as an ordinary sum of least square minimisation problem using a numerical solver.

Finally, we sum our estimates of capital and labour usage for each subindustry across all Member States to obtain our internally consistent EU-wide estimate of the GVA split from the innovative and generic industries.

Figure A4: Illustration of optimisation problem
The process is repeated for each given country, with a country-specific total industry column

1) When including the impact on the EU-wide production split (implicitly estimated to be 75% innovative and 25% generic) in the optimisation for a single country, the result for any given country is impacted by the result of other countries as well, introducing path-dependancy into our estimation. For this reason, we repeat the iterative estimation until reaching convergence.
Sensitivity analysis

A central parameter in our estimation is the global innovative production share set to 82% in our core estimate, following McKinsey (2017). The following repeats our estimation with a 65% innovative share (low case) and 90% share (high case).

<table>
<thead>
<tr>
<th>Core estimate</th>
<th>Low innovative share estimate</th>
<th>High innovative share estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pharmaceutical GVA by subindustry</strong>&lt;br&gt;Share of total GVA from each type of medicine</td>
<td><strong>Pharmaceutical GVA by subindustry</strong>&lt;br&gt;Share of total GVA from each type of medicine</td>
<td><strong>Pharmaceutical GVA by subindustry</strong>&lt;br&gt;Share of total GVA from each type of medicine</td>
</tr>
<tr>
<td>Innovative industry</td>
<td>Generic industry</td>
<td>Innovative industry</td>
</tr>
<tr>
<td>80.0%</td>
<td>20.0%</td>
<td>69.8%</td>
</tr>
<tr>
<td><strong>GVA intensity by subindustry</strong>&lt;br&gt;GVA per EUR production by each type of medicine</td>
<td><strong>GVA intensity by subindustry</strong>&lt;br&gt;GVA per EUR production by each type of medicine</td>
<td><strong>GVA intensity by subindustry</strong>&lt;br&gt;GVA per EUR production by each type of medicine</td>
</tr>
<tr>
<td>Innovative industry</td>
<td>Generic industry</td>
<td>Innovative industry</td>
</tr>
<tr>
<td>0.509</td>
<td>0.377</td>
<td>0.499</td>
</tr>
</tbody>
</table>
THE ECONOMIC IMPACT OF THE PHARMACEUTICAL INDUSTRY IN EUROPE
Comparing the innovative and generic industries

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