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The Socioeconomic Burden of Migraine: Extending The Case To 7 Further European Countries

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List of Abbreviations

CVD	Cardiovascular diseases
DALY	Disability-adjusted life year
DM	Diabetes mellitus
FCA	Friction cost approach
GBD	Global burden of disease
GDP	Gross domestic product
GVA	Gross value added
HCA	Human capital approach
IHME	Institute for Health Metrics and Evaluation
IO	Input-output
NACE Rev. 2	Second revision of the Statistical Classification of Economic Activities in the European Community
OECD	Organization for Economic Cooperation and Development
SOB	Socioeconomic burden
USES	Unpaid substitution economic sector
YLD	Years lived with disability
YLL	Years of life lost

Summary

Background

Migraine is a highly prevalent neurovascular disorder that disproportionately affects younger women, with the highest prevalence, 27,458 per 100,000 women (27.5%), observed among those aged 40–44. According to the Global Burden of Disease study, migraine ranks as the second-highest disease-related cause of disability worldwide. While direct healthcare costs are well-documented (€1,495–€8,344 per patient annually in OECD countries), broader productivity-related costs remain understudied.

Objective

This study quantifies the socioeconomic burden (SOB) of migraine in Greece, Poland, Lithuania, Croatia, Slovakia, Slovenia, and Switzerland, capturing productivity losses in both paid and unpaid work through disability-adjusted life years (DALYs) and gross value added (GVA). The analysis includes direct, indirect, and induced economic effects using input-output modelling, and compares migraine's burden with cardiovascular disease (CVD) and diabetes mellitus (DM).

Results

From 2011 to 2024, the cumulative socioeconomic burden of migraine across the seven countries ranged from €8.43 billion in Slovenia to €141.87 billion in Switzerland, at current prices. (2024). Across the seven countries, annual losses increased from €22.32 billion (2011) to €36.64 billion (2024). In 2024, the burden ranged from 1.25% in Slovenia to 1.55% in Poland across six of the seven countries, while Greece had a comparatively higher burden of 2.35% of GDP. Disentangling this overall burden in paid and unpaid work in the time period from 2011 to 2024 shows, that paid work productivity losses accounted from €4.72 billion in Slovenia to €113.16 billion in Switzerland (in current prices), while unpaid work losses ranged from €3.71 billion in Slovenia to €44.73 billion in Poland. Migraine imposed an economic burden that is higher than both cardiovascular diseases (CVD) and diabetes mellitus (DM) in 2024 in Greece, Slovenia and Switzerland (migraine 2.35% - 1.25% of GDP vs. 1.64% - 0.65% for CVD and 1.48% - 0.76% for DM), while in the remaining four countries; Croatia, Lithuania, Poland, and Slovakia; its burden was broadly comparable to that of CVD and DM (1.30% – 1.55% vs. 1.33 – 2.03% and 0.83% – 1.99%, respectively). For a breakdown by country, see Figure 7. Compared to other European countries, the socioeconomic burden of migraine in the included countries was close to the European median of 1.50%, with only Greece scoring a considerably higher burden of 2.61% of the GDP in 2021.

Conclusions

Migraine imposes a considerable and persistent burden on Europe’s economy, predominantly affecting individuals during their peak working years. Given that migraine affects working-age populations in an ageing society, reducing its burden could enhance overall economic output, ease fiscal pressures on public budgets, and support individuals in fulfilling essential unpaid roles such as caregiving. Policymakers should consider migraine prevention and treatment as strategic investments with broad societal returns.

1 Introduction

Migraine is a neurovascular disorder that is defined by recurring moderate to severe headaches (Goadsby, 2007). Migraine is highly prevalent. Globally, it has been estimated to have a prevalence of 14% in 2019, corresponding to approximately 1.1 billion individuals affected worldwide (Amiri et al., 2022). The combined severity and frequency of migraine attacks and the high prevalence result in a substantial disease burden. According to the Global Burden of Disease (GBD) study, this disease represents the second-highest disease-related cause of disability (years lived with disability, YLD), after lower back pain (IHME, 2026). A notable observation is that this burden is increasing over time. Between 1990 and 2021, the global prevalence increased by 39.52% (Chen et al., 2024). Women, particularly in younger and middle-age groups are disproportionally affected. The global prevalence for women between the ages of 40 and 44 showed the highest prevalence of disease in 2021, equivalent to 27,458 per 100,000 women (IHME, 2026).

In Europe specifically, headache disorders remain among the leading contributors to disability. A recent systematic analysis of the Global Burden of Disease Study 2021 covering 45 European countries found that the burden of migraine slightly increased between 1990 and 2021. Women and individuals aged 30 to 44 years consistently exhibited the highest burden, particularly for migraine. Notably, higher Socio-demographic Index (SDI) scores were positively correlated with DALY rates for migraine, suggesting direct relevance to the heterogeneous group of seven economies analysed here, which spans high-income Switzerland through the smaller post-transition economies of Croatia, Lithuania, and Slovakia (Jung et al., 2025).

Due to this disease burden, migraine also results in high costs to the healthcare system. A systematic review by Eltrafi et al. (2023) estimated the costs of migraine to the healthcare system in the OECD countries. Such costs consist of costs related to physician or hospital visits and the cost of drugs. This study shows that in OECD countries, the annual estimated direct cost per patient ranges from €1,495.20 to €8,344.30 across the 13 articles identified. Applied to the tens of millions of affected individuals across Europe, per-patient costs of this magnitude aggregate into healthcare expenditure that places migraine among the most financially consequential neurological conditions for health systems.

Healthcare spending, however, captures only a fraction of the true economic footprint. The broader relationship between population health and productive capacity has been extensively documented (Bloom et al., 2019; Jamison et al., 2013; Suhrcke et al., 2005), and migraine's impact on labor supply is one of its most consequential dimensions. Several country-level studies illuminate this broader burden within the specific national contexts examined here. In Slovenia, administrative sick leave registry data combined with self-reported survey outcomes showed that productivity losses from migraine represented a measurable economic cost to the national economy (Lotrič Dolinar et al., 2020). The picture for Lithuania is similarly clear: cost-of-illness analysis estimated migraine's total cost at approximately 0.35% of national GDP, with indirect productivity losses accounting for around 70% of that figure (Lublóy, 2019). In Poland, a large-scale cross-sectional survey conducted between August 2021 and June 2022 documented high disability rates alongside pervasive underdiagnosis and inadequate access to preventive treatment (Waliszewska-Prosół et al., 2023), suggesting the true burden of migraine exceeds what health system data currently record. The same conclusion recurs across OECD settings generally: Eltrafi et al. (2023) found that existing research consistently prioritises direct healthcare costs while leaving productivity-related losses largely unquantified.

A socioeconomic burden (SOB) of disease framework addresses precisely this gap. Rather than recording what health systems spend, SOB analysis quantifies how disease erodes a population's capacity to generate economic value through its effects on both the size and the efficiency of the productive workforce. Premature mortality can reduce the labor supply and economic output. Absenteeism removes workers from the labor force episodically; presenteeism leaves them in place but at reduced capacity. Among migraine patients in Europe, both pathways occur at rates substantially above those observed in non-affected peers, extending into activity impairment beyond

the workplace (Doane et al., 2020). SOB analyses also capture productivity losses in unpaid work: caregiving, household management, and related activities that standard economic frameworks do not monetise but which constitute genuine value to households and to broader society.

The scale of these losses, even within a single country, is instructive. An earlier WifOR analysis estimated annual productivity losses from migraine in Germany at €6,493 per patient; applied to Germany's prevalence base, the aggregate figure exceeds €100 billion annually (Seddik et al., 2020).

The present report extends this line of analysis to seven European countries not previously covered by comparable SOB assessments: Croatia, Greece, Lithuania, Poland, Switzerland, Slovakia, and Slovenia. It builds directly on prior WifOR studies covering Germany, France, Spain, the Netherlands, Portugal, the Czech Republic, and Belgium (Lovera & Ubels, 2025; Lovera et al., 2026), with three specific objectives:

- Describe the SOB of migraine in each of the seven countries
- Compare the SOB of migraine with cardiovascular disease and diabetes mellitus
- Conduct a gender-specific analysis of the SOB of migraine

2 Methods

2.1 Analysis

The analysis of the socioeconomic burden (SOB) of migraine links disease burden to productivity losses and is conducted in three main steps. In step (A), the burden of migraine is quantified using disability-adjusted life years (DALYs). In step (B), this burden is converted into productivity losses, expressed as lost working time, whereby one DALY lost is interpreted as one year without productive capacity. In step (C), the resulting loss of working time is monetized using gross value added (GVA). An overview of these three steps is provided below, while the detailed calculation formulas are presented in the Annex.

In step (A), disease burden is measured using DALYs, which integrate information on both mortality and morbidity. The mortality-related component of disease burden is captured by years of life lost (YLL), representing the number of years an individual would have lived had death from a specific disease not occurred. For example, if an individual dies at age 30 due to a cardiovascular event and would otherwise have been expected to live to age 80, this corresponds to 50 YLL. Morbidity-related disease burden is expressed as years lived with disability (YLD), reflecting the loss of healthy life due to living with a condition. For instance, a person with migraine is assigned a disability weight of 0.4, implying that 80 years lived with migraine are equivalent to 48 years in full health (80 multiplied by one minus the disability weight), meaning that 32 healthy life years are lost due to disability. Together, YLL and YLD provide a common metric that allows disease burden to be aggregated. The sum of YLL and YLD constitutes the DALY.

In step (B), disease burden is translated into productivity losses by assuming that each DALY lost corresponds to one non-productive year. However, the relationship between productivity losses and YLL differs from that for YLD. For YLL, two methodological approaches are applied: the human capital approach (HCA) and the friction cost approach (FCA). Under the HCA, the death of an individual is assumed to result in a permanent loss of productivity that cannot be replaced. Under the FCA, it is assumed that organizations adjust to the loss of a worker after one year through mechanisms such as recruitment or organizational and technological changes; accordingly, mortality is assumed to lead to a productivity loss of one year. While both approaches yield identical results for migraine, they lead to different estimates for diabetes and cardiovascular disease (CVD), where mortality plays a larger role. For YLD-related DALYs, it is similarly assumed that each lost DALY represents one non-productive year. YLD is assumed to capture productivity losses arising from both presenteeism and absenteeism.

In step (C), lost productive working time is valued using GVA. Traditionally, productivity losses are monetized using wages; however, due to market imperfections, wages do not fully reflect workers' actual productivity. GVA provides a more accurate measure of economic contribution, as it represents the value created by an industry after subtracting the value of intermediate inputs used in production. Consequently, GVA reflects the net economic value added by a given sector. In SOB analyses, disease-related reductions in the productivity of employed individuals are estimated using GVA per capita. As such, the monetary valuation of disease burden captures the economic impact of reduced working capacity among productive individuals in the economy.

In addition, to assess the impact of disease burden on productivity in terms of paid work, multipliers derived from Input-Output (IO) models are applied to estimate not only direct effects, but also indirect and induced spillover effects. Direct effects represent the immediate economic impact of reduced paid work resulting from ill health. Indirect effects capture losses in intermediate consumption of goods and services that arise from reduced GVA attributable to disease, reflecting productivity losses in other sectors due to lower demand from the affected primary sector. Induced effects account for reductions in household consumption resulting from lower income generated both directly and indirectly. Together, indirect and induced effects represent spillover effects. Total productivity losses from paid work are calculated as the sum of direct, indirect, and induced costs.

In addition to paid work, the socioeconomic burden associated with unpaid work is also estimated. Unpaid work does not generate market-valued outputs, requiring its productive value to be estimated indirectly. Importantly, unpaid work differs from paid work in the nature of the activities involved, such as meal preparation, caring for household members, and household maintenance. Accordingly, the value of unpaid work is assumed to differ from that of paid work. Unpaid work is therefore valued by identifying market-based economic activities that most closely correspond to the relevant unpaid tasks. Further details on this valuation approach are provided in the Annex.
Finally, to place the SOB of migraine in a broader context, the SOB of CVDs and diabetes is also estimated using the same methodological framework described above.

2.2 Data

The Institute for Health Metrics and Evaluation (IHME) uses a range of datasets to inform the analysis (Stovner *et al.*, 2018). Estimates of disease burden, including prevalence, YLDs, YLLs, and mortality, are obtained from the GBD database for migraine, CVD, and diabetes mellitus (IHME, 2025). Data are retrieved from the latest available database (GBD 2023) and stratified by country, sex, age group, and year. Age categories are defined in five-year bands from ages 15 to 94, with a final open-ended group covering individuals aged 95 and older.

Migraine prevalence data specifically are estimated with population-based epidemiological data using DisMod-MR 2.1, a Bayesian meta-regression tool (Stovner *et al.*, 2018). Migraine cases are defined according to the International Classification of Headache Disorders (ICHD) criteria, with prevalence representing individuals who experienced at least one migraine episode in the preceding 12 months (Stovner *et al.*, 2018). Disease burden is expressed as Years Lived with Disability (YLDs), calculated by multiplying prevalence by the proportion of time spent in the symptomatic state and the disability weight for migraine (Stovner *et al.*, 2018). Since migraine is not associated with mortality, YLDs are equivalent to Disability-Adjusted Life Years (DALYs) (Stovner *et al.*, 2018).

Information on paid and unpaid working time for the different countries is sourced from the United Nations Department of Economic and Social Affairs (UN Statistics Division, 2024a), which aggregates findings from national time-use surveys conducted at different points in time. For each country, the most recent survey available was selected. Preference was given to aligning age groups between the GBD database and national time-use instruments.

Data availability varied by country, with Croatia and Slovakia having some data gaps. Croatia's paid and unpaid working hours were derived from a 2024 time-use survey recording average daily hours on all activity categories for the population aged 15 years and older, disaggregated by sex (Croatian Bureau of Statistics, 2024). For Slovakia, only unpaid work data were retrievable from a 2013 survey (Kaščáková et al., 2018) , paid work hours were sourced from Slovenia based on three structural similarities: comparable GDP per capita adjusted for purchasing power parity (Slovenia: $48,496 vs. Slovakia: $40,347), near-identical female labor force participation (Slovenia: 72.8% vs. Slovakia: 72.7%), and equivalent weekly paid work hours (both approximately 40 hours for men and 39 hours for women) (Eurostat, 2025, 2026; World Bank, 2026a).
Unpaid work is defined as the average number of hours per day devoted to unpaid domestic and care activities. These averages are calculated over the entire week, thereby accounting for differences between weekdays and weekends. Total working time comprises both paid and unpaid work and is similarly reported as average daily hours over a full week, including weekend days.

WifOR's methodological framework extends beyond conventional economic evaluation approaches by integrating productivity loss assessment with value chain analysis based on Input–Output (IO) modeling and health economic principles. The approach evaluates how investments in health contribute to economic development through improvements in population health. Earlier applications and methodological iterations have been validated across

a wide range of projects, peer-reviewed journal articles, conference presentations, and books (e.g. (Ostwald et al., 2023); a comprehensive list can be provided upon request.

On the basis of IO matrices, the analysis quantifies direct economic effects and estimates spillover impacts in related sectors as well as induced effects along value chains (Bess & Ambargis, 2011; Scholz et al., 2025). The analysis first estimates the direct economic gains that would occur if the affected population were healthier and able to remain in employment, thereby directly increasing GVA. It then estimates indirect effects arising from higher intermediate demand for goods and services from upstream suppliers, driven by the additional GVA generated. Finally, induced effects are captured by accounting for increased consumption resulting from income generated through both direct and indirect channels. Spillover effects are defined as the combined impact of indirect and induced effects.

Demographic and macroeconomic data are sourced from the World Bank (World Bank, 2026b). Demographic inputs include the population aged 16–64 and 65 years and older. Economic indicators include the labour force participation rate, gross value added, unemployment rate, employment-to-population ratio, and GDP. Results are presented in current Euros. To account for inflation, additional GVA figures expressed in constant 2015 Euros are used. All monetary values are subsequently converted into euros using nominal exchange rates from the European Central Bank data portal (European Central Bank, 2026).

3 Results

3.1 Health Burden and socioeconomic burden of migraine

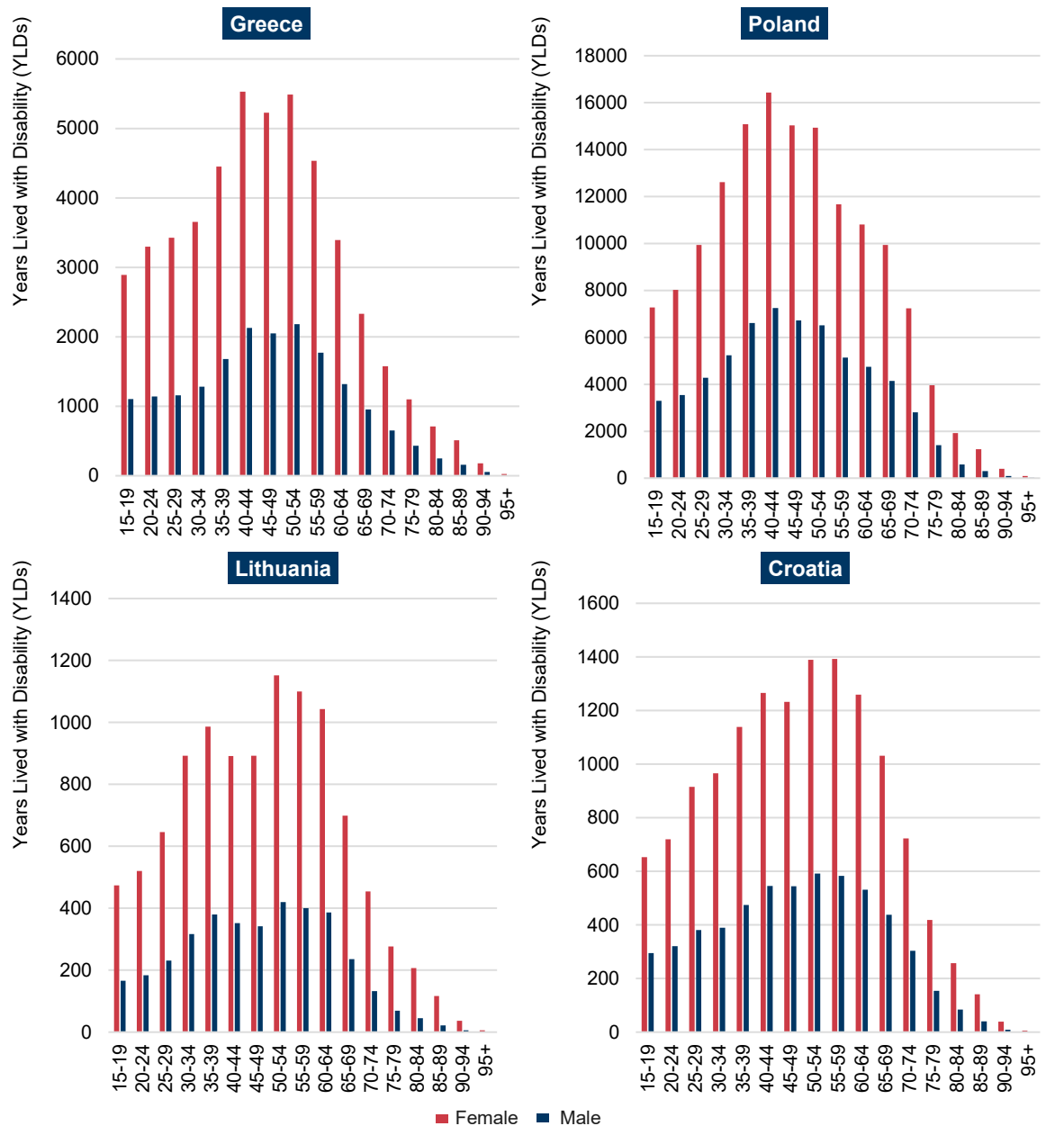

Figure 1. Years Lived with Disability (YLDs) due to Migraine in seven European countries in 2024

Source: (IHME, 2026)

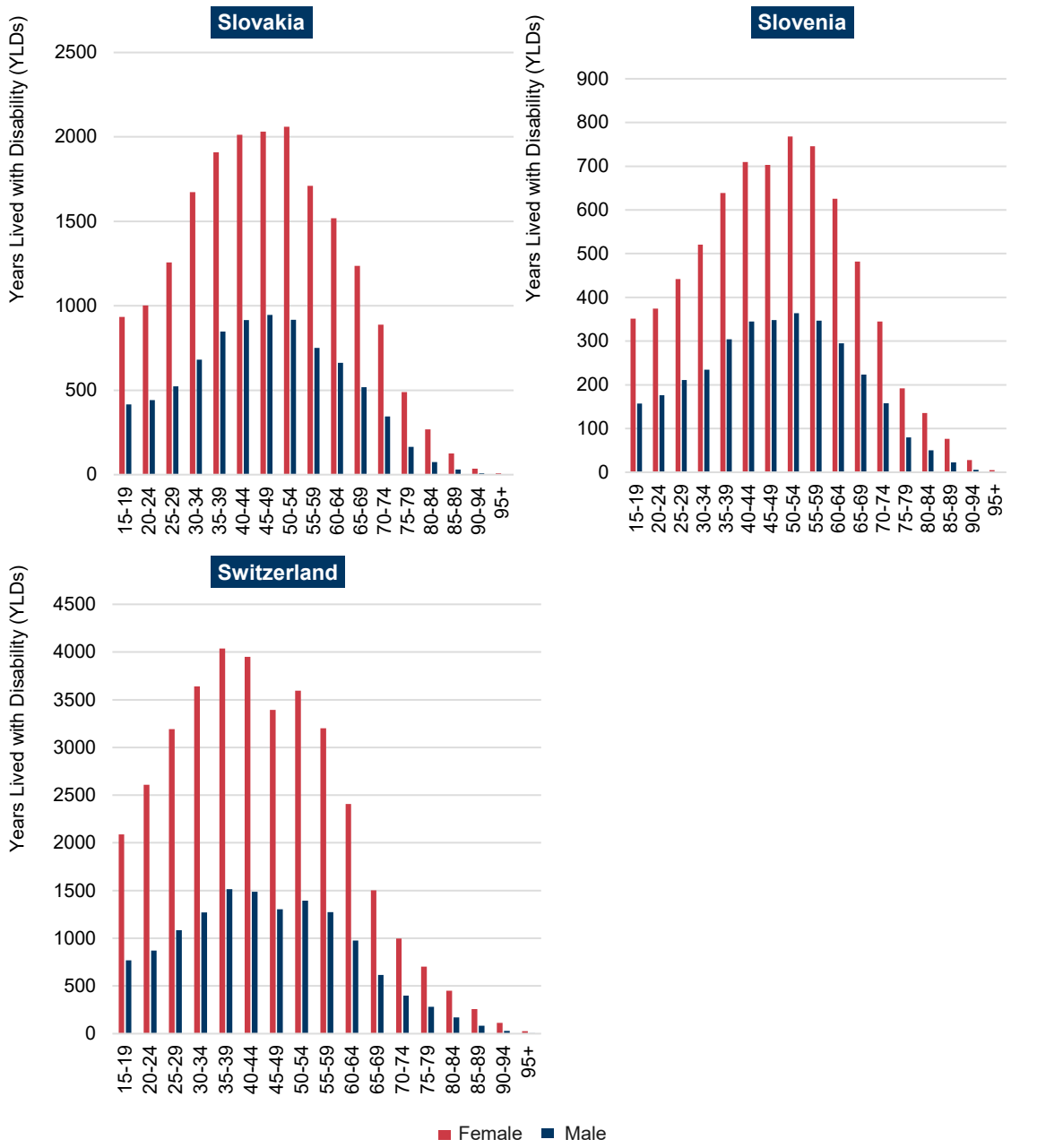

Figure 1. Years Lived with Disability (YLDs) due to Migraine in Seven European Countries, 2024

Source: (IHME, 2026)

The data in **Figure 1** reveal that in all countries, the highest disease burden occurs in individuals between 25 and 69 years of age, corresponding to the core working-age population. Beyond age 50, the burden gradually declines, reflecting both lower prevalence rates and smaller population sizes in older age groups. This concentration of disease burden in working-age individuals highlights the potential for substantial productivity and economic consequences.

The SOB of migraine represents a substantial impact on the economy. To place this burden in macroeconomic context and enable comparisons across countries and over time, **Figure 2** presents the SOB from 2011 to 2024 in terms of the total absolute productivity loss for the time period 2011 to 2024 (left), and only 2024 (right), for each country.

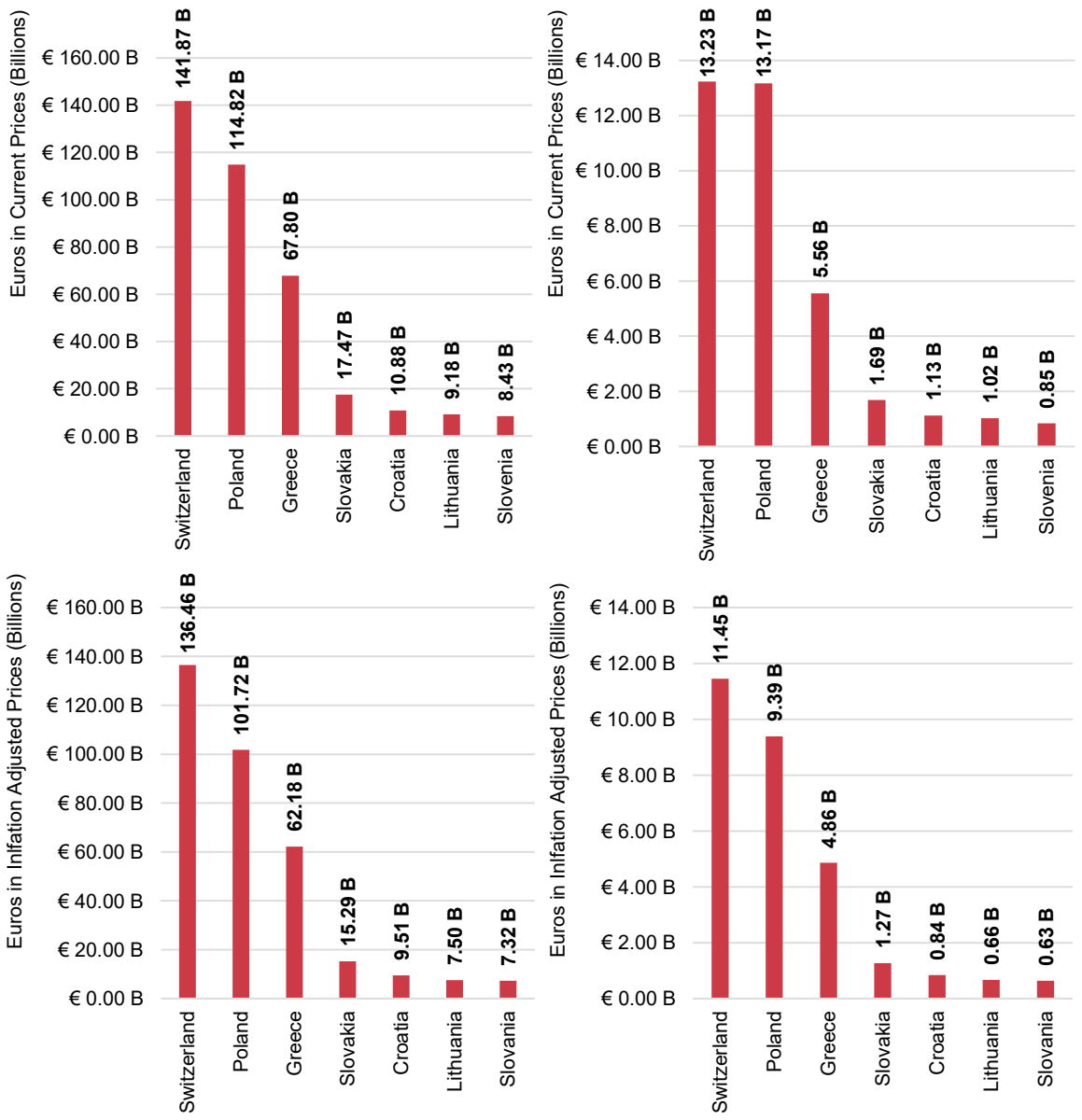

Figure 2. Total Socioeconomic Burden of Migraine, 2011–2024 (Left) and 2024 (Right): Current Prices (Upper) and Inflation-Adjusted Prices (Lower)

Source: WifOR elaboration

During the period between 2011-24, the total socioeconomic burden remained consistently high, ranging from more than 8 billion euros in Slovenia to over 141 billion Euros in Switzerland. A similar pattern emerges when only the year 2024 is taken, where the productivity losses of Slovenia are close to 1 billion Euro, and the Swiss productivity losses are more than 13 billion Euros. The reason that for the year 2024 the difference in productivity losses between Switzerland and Poland is relatively smaller than that of the time period between 2011 and 2024 is likely to reflect, amongst other factors, Poland ‘s comparatively stronger economic growth in this time period.

Figure 3 presents the total socioeconomic burden of migraine of the included countries from 2011 to 2024, expressed as a percentage of GDP. This makes a direct comparison of the burden between the countries possible.

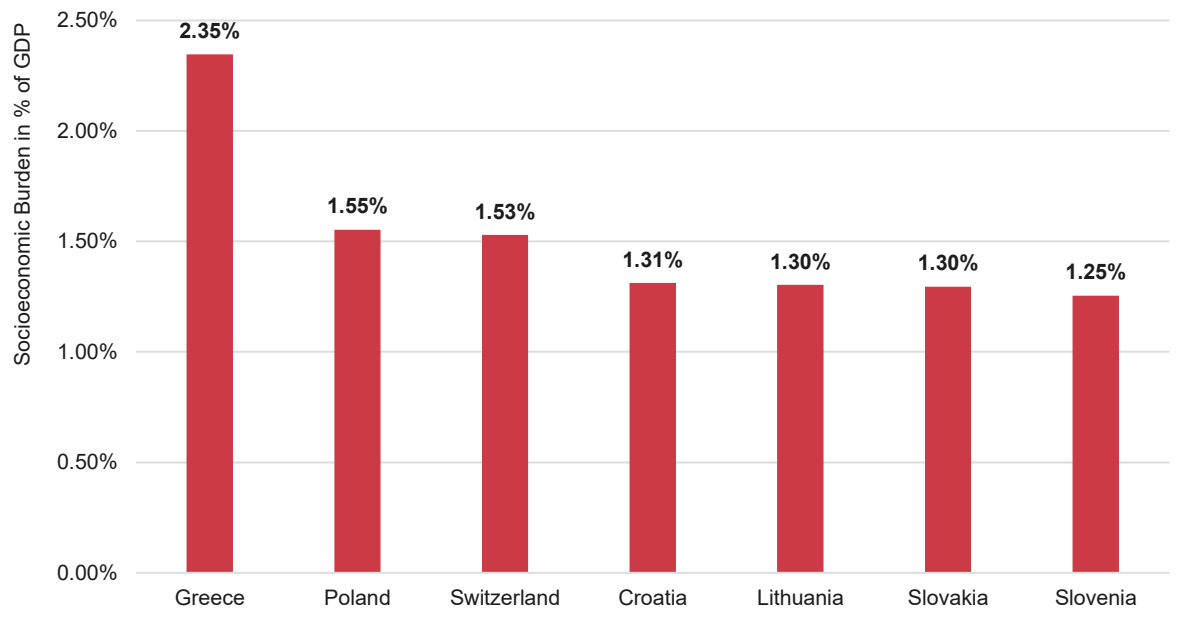

Figure 3. Overall Socioeconomic Burden of Migraine as a Percentage of GDP, 2024

Source: WifOR elaboration

In 2024, migraine imposed a substantial and persistent economic burden, driven primarily by productivity losses in both paid and unpaid work. In all countries, migraine poses a significant burden on the economy, ranging from 1.25% of the GDP in Slovenia to 2.35% of the GDP in Greece.

Figure 4 depicts the distribution of these losses between paid and unpaid work over 14 years at current prices.

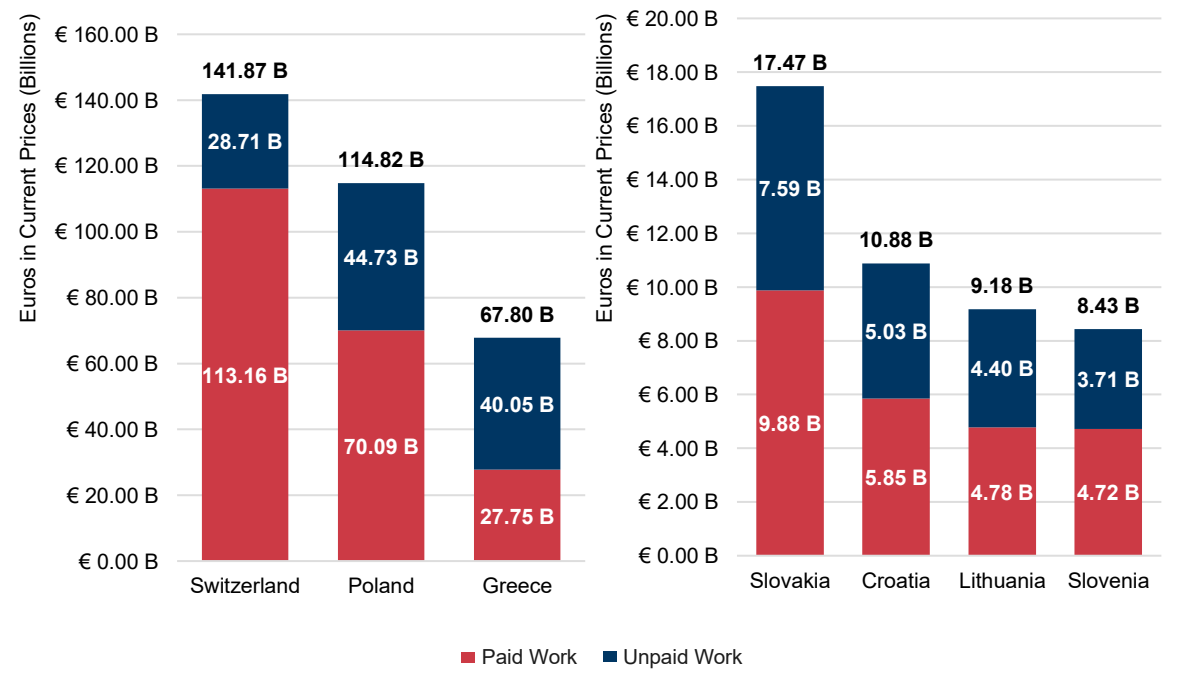

Figure 4. Overall Socioeconomic Burden of Migraine: Paid and Unpaid Productivity Losses, 2011–2024 (Current Prices)

Source: WifOR elaboration

This analysis reveals that the relative importance of unpaid work compared to paid work differs between countries, which is the result of differences in unpaid work time and the value of unpaid work compared to paid work in the different economies. Still, in most countries, almost half the productivity losses are associated with losses in unpaid work activities.

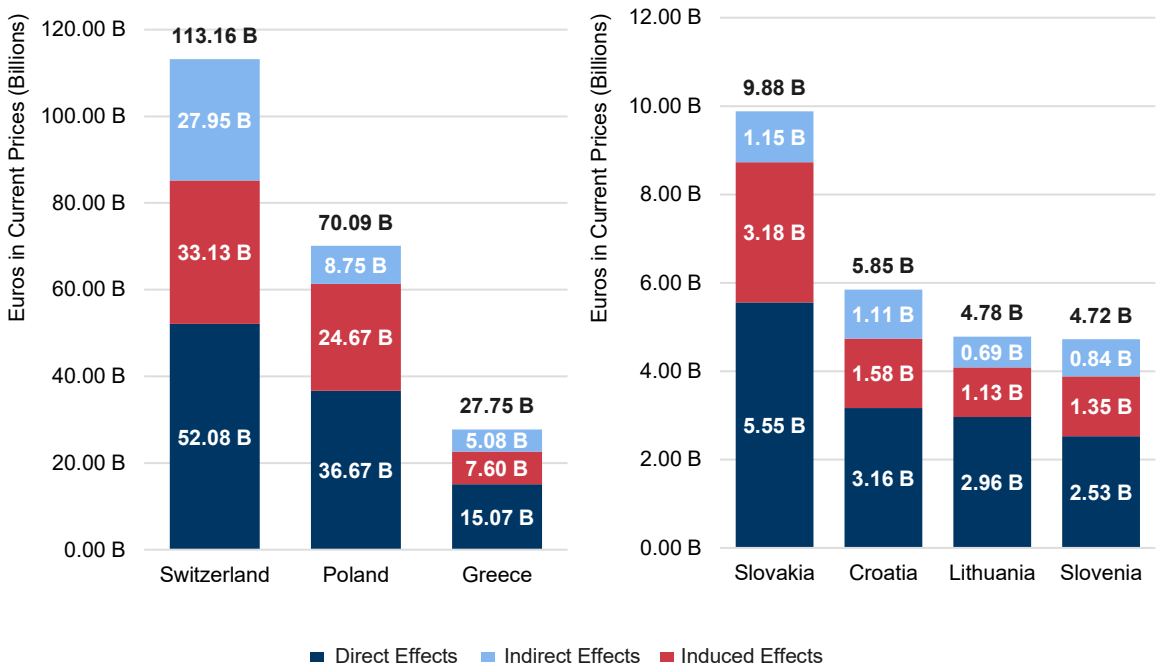

Figure 5. Paid Work Productivity Losses, Disaggregated by Direct, Indirect, and Induced Effects of Migraine on the Economy (Current Prices)

Source: WifOR elaboration

Figure 5 focuses on paid work and disaggregates these productivity losses by the productivity losses that can directly be attributed to migraine, and how these losses further spread through the economy in terms of indirect and induced effects. Although the direct effects are the highest in each country, the additional losses in terms of indirect and induced effects show that the burden of migraine further spreads throughout the economy beyond the direct impact on migraine patients.

To further contextualize these results, the additional working days required by an individual aged 15 years or older to recover migraine-related productivity losses were calculated. In 2024, each individual in Greece would need to work an additional 2.49 days to compensate for the productivity losses incurred that year, which was the highest among the seven countries. Comparable figures were observed in Lithuania and Poland, at 1.91 and 1.90 additional days respectively, and in Switzerland and Slovakia, at 1.70 and 1.69 additional days respectively. Meanwhile, Slovenia and Croatia were at the lower end, registering 1.56 and 1.54 additional days.

3.2 The socioeconomic burden of migraine compared with diabetes and cardiovascular diseases

A comparative analysis of productivity losses attributable to migraine versus those associated with diabetes and cardiovascular disease provides an additional contextual perspective. Figure 6 illustrates temporal trends for these three conditions from 2011 to 2024, utilizing the Friction Cost Approach (FCA), which assumes labor market substitution in cases of premature mortality, or in other words, that the productivity of an employee can be replaced in one year.

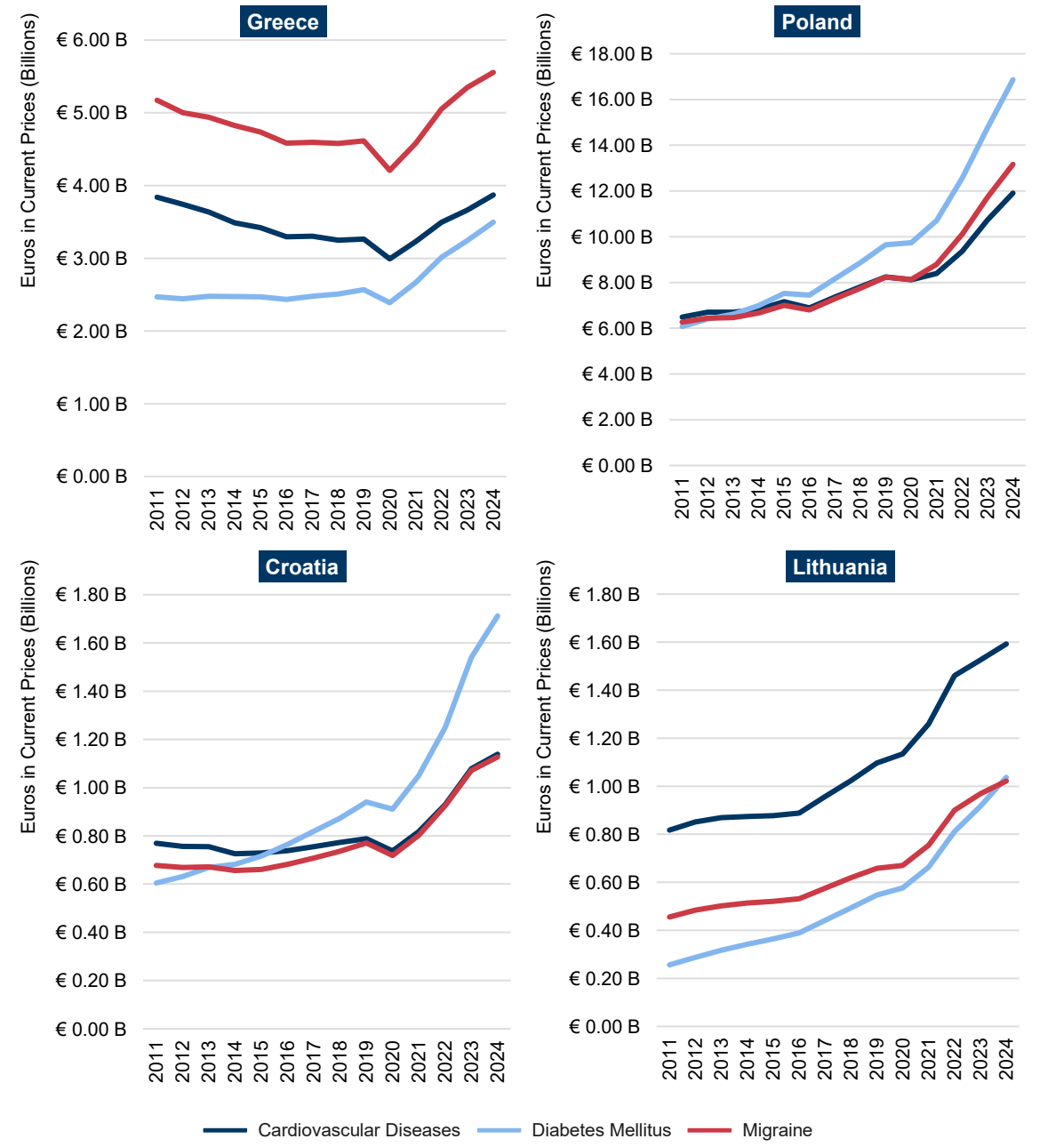

Figure 6. Time Trends in Socioeconomic Burden: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Friction Cost Approach, Assuming Substitution), 2011–2024 (Current Prices)

Source: WifOR elaboration

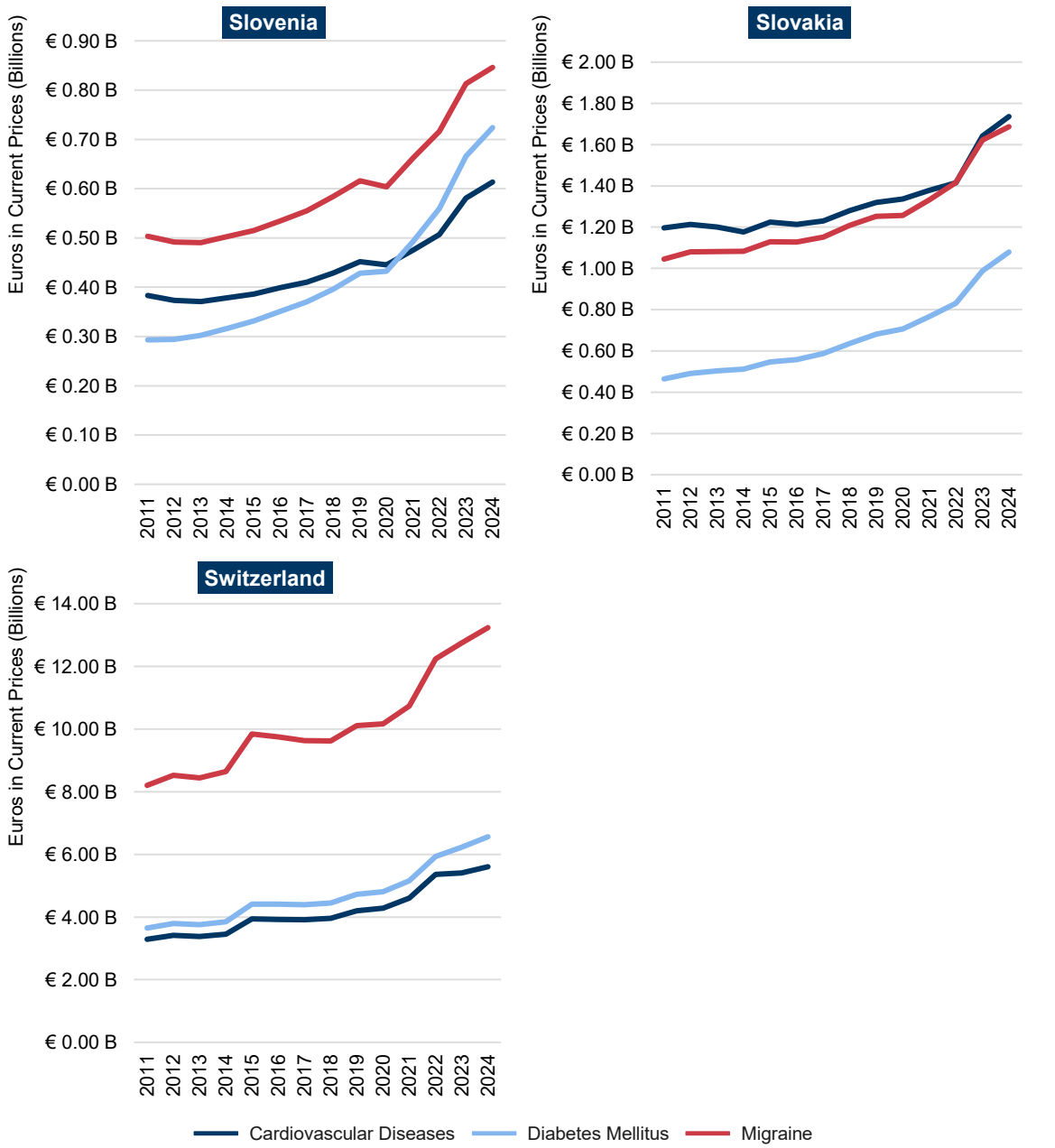

Figure 6. Time Trends in Socioeconomic Burden: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Friction Cost Approach, Assuming Substitution), 2011–2024 (Current Prices)

Source: WifOR elaboration

The data demonstrate that in all countries, the socioeconomic burden of migraine has increased between 2011 and 2024 in terms of current prices. Additionally, across the entire 14-year period, migraine imposed a substantially higher economic burden that is at least comparable, and in Greece, Slovenia, and Switzerland consistently higher, than CVD and DM. The difference in burden between migraine and CVD or DM is particularly pronounced in Switzerland, where over the entire time period the socioeconomic burden of migraine was substantially higher. In Slovakia and Slovenia, the socioeconomic burden of migraine is considerably higher than DM. In Poland and Croatia, the socioeconomic burden of migraine is very similar to that of CVD across the entire time period.

Consistent with the analytical approach applied to migraine burden in general, inter-disease comparisons were made, expressing the total socioeconomic burden relative to the country's GDP. **Figure 7** presents these results utilizing the Friction Cost Approach (FCA), with an additional disaggregation in terms of paid and unpaid work for each disease in each country.

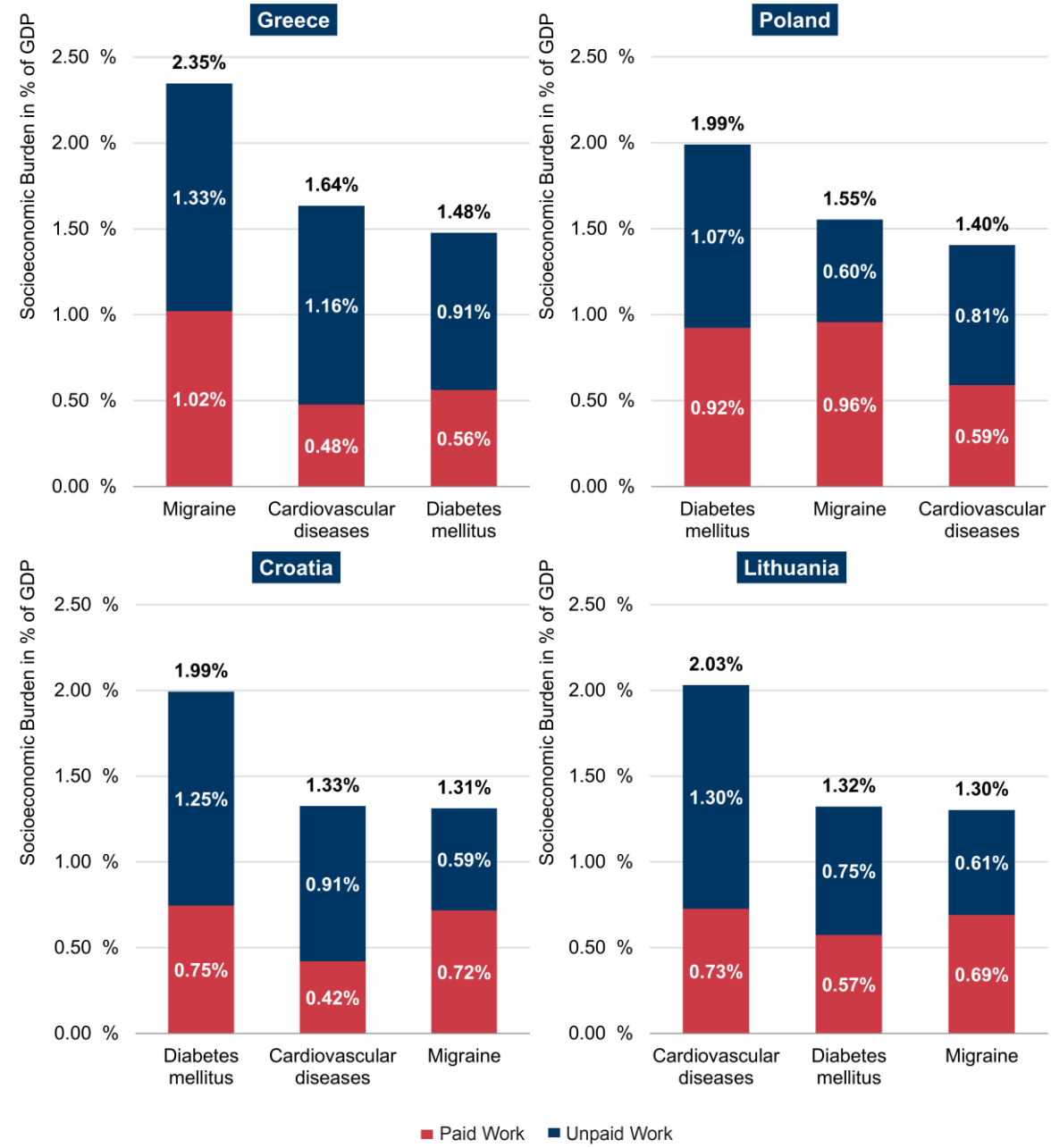

Figure 7. Overall Socioeconomic Burden of Migraine as a Percentage of GDP: Paid and Unpaid Productivity Losses, 2024 (Friction Cost Approach, Assuming Substitution)

Source: WifOR elaboration

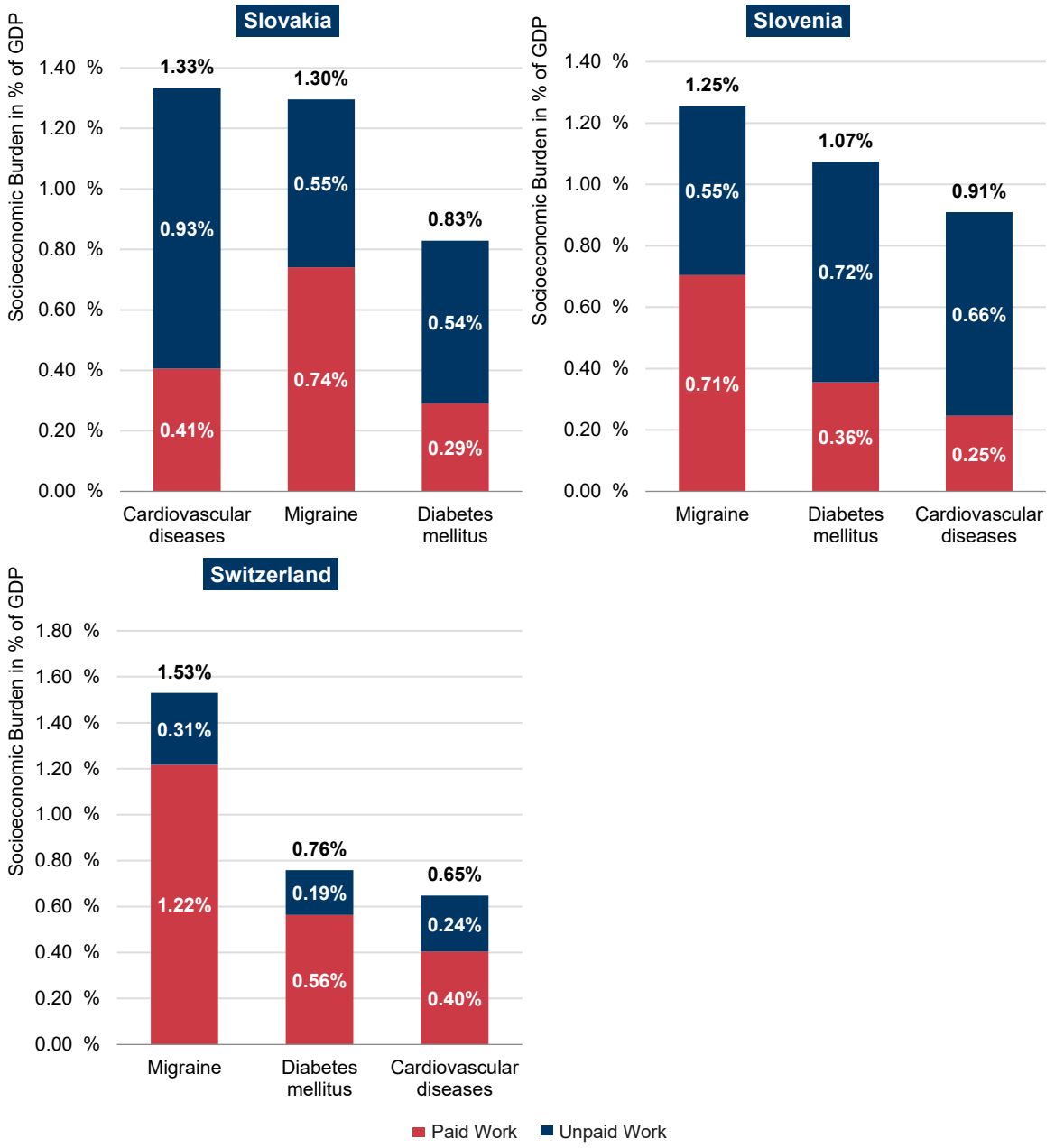

Figure 7. Overall Socioeconomic Burden of Migraine as a Percentage of GDP: Paid and Unpaid Productivity Losses, 2024 (Friction Cost Approach, Assuming Substitution)

Source: WifOR elaboration

Migraine, CVD, and DM impose a significant socioeconomic burden. As can be seen from the time trends in Figure 6, migraine poses either the highest or a very similar total socioeconomic burden when compared with CVD and DM. Zooming in on the burden in terms of paid work, this pattern becomes even stronger as can be seen in Figure 7. Besides the countries where the total socioeconomic burden of migraine was already higher than CVD and DM, additionally Poland and Slovakia show that migraine imposes a higher socioeconomic burden in terms of paid work than CVD and DM. In other countries, similar patterns can be distinguished as well, where the relative impact of migraine on paid work is relatively high.

To further elucidate the primary sources of paid work productivity losses, **Figure 8** illustrates the spillover effects across migraine, diabetes mellitus, and cardiovascular disease in all countries in 2024. These estimates, expressed as a percentage of GDP, were calculated using the FCA approach.

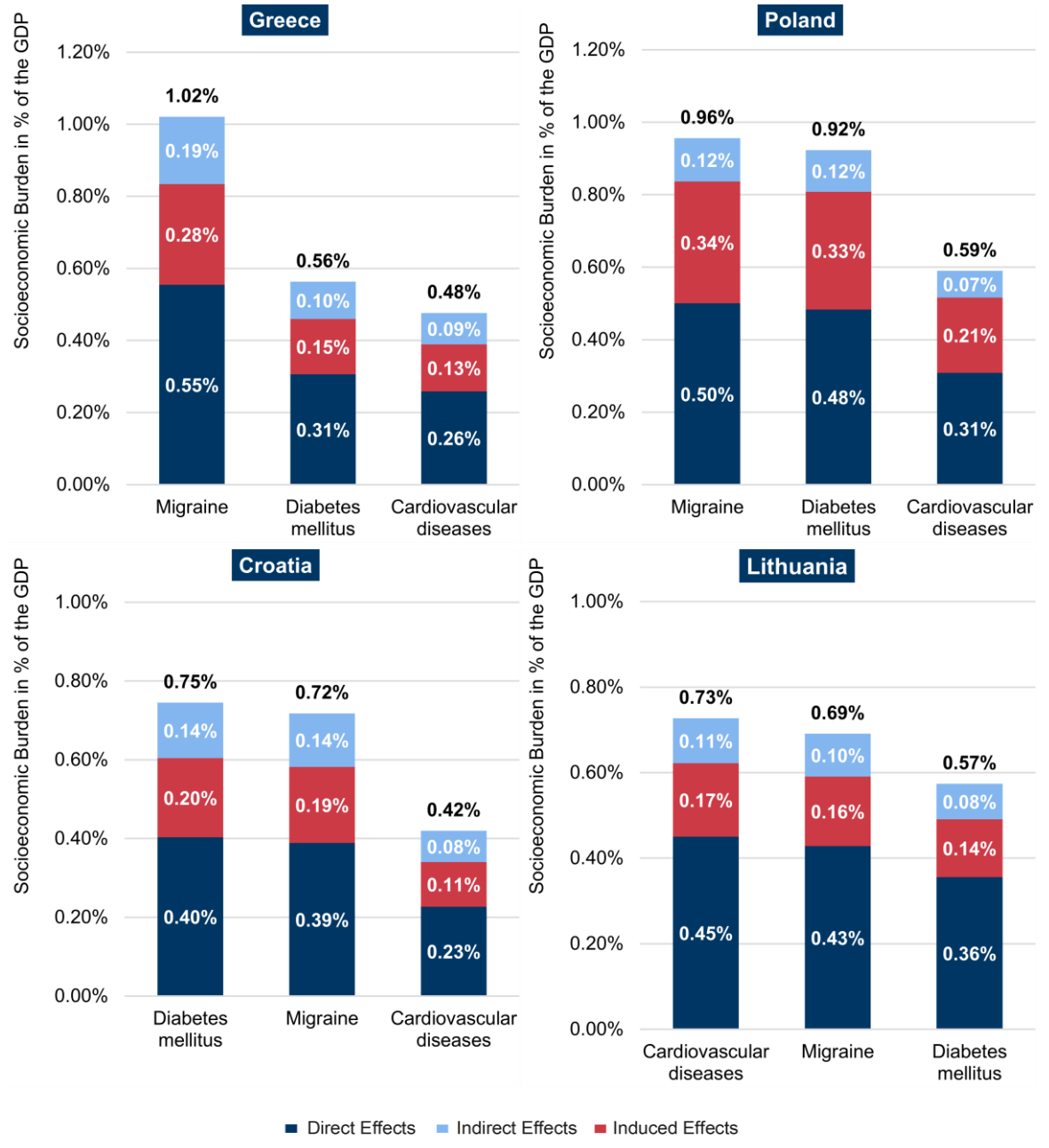

Figure 8. Overall Socioeconomic Burden of Migraine as a Percentage of GDP, 2024: Spillover Effects Across Disease Areas (Friction Cost Approach, Assuming Substitution)

Source: WifOR elaboration

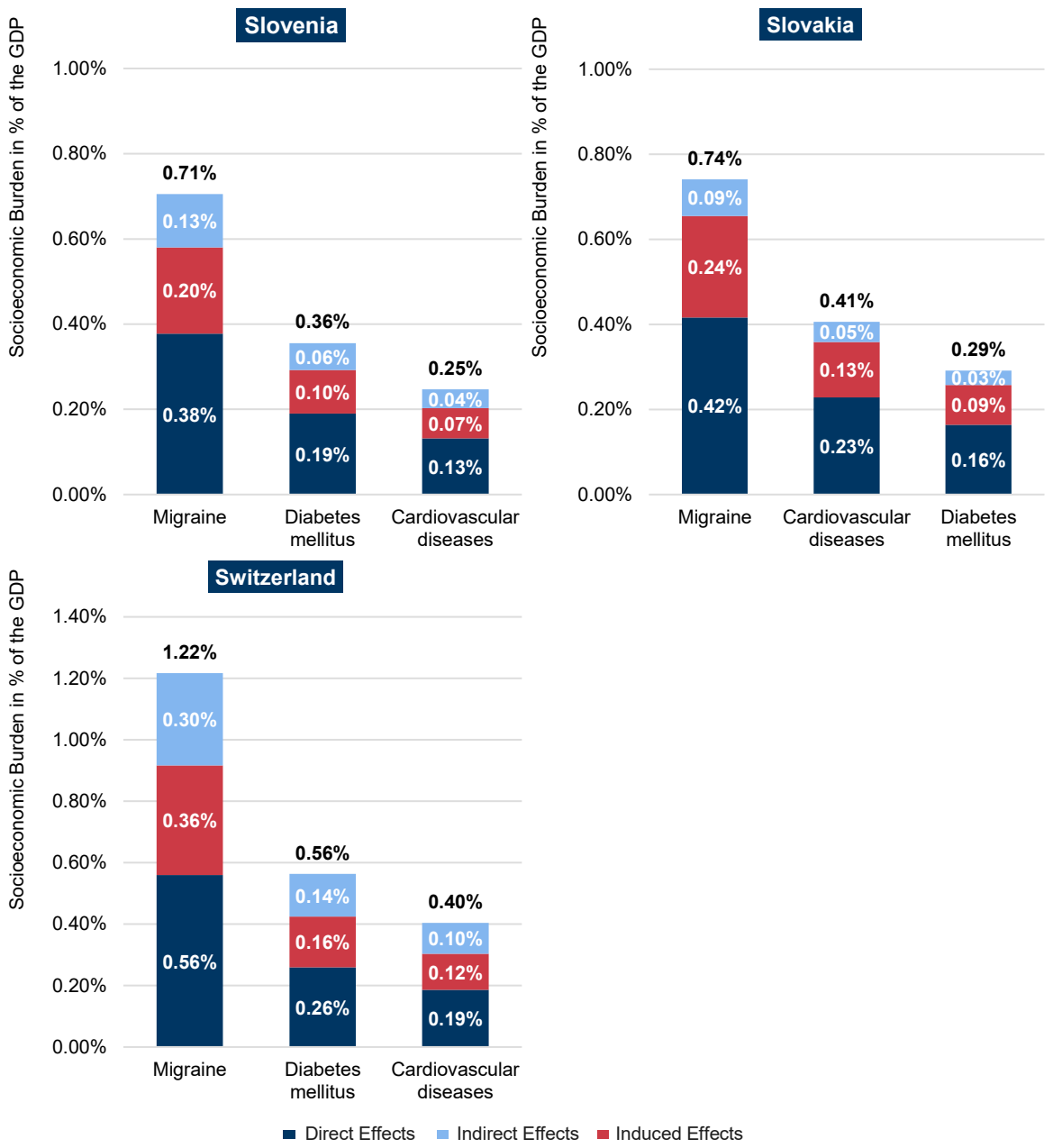

Figure 8. Overall Socioeconomic Burden of Migraine as a Percentage of GDP, 2024: Spillover Effects Across Disease Areas (Friction Cost Approach, Assuming Substitution)

Source: WifOR elaboration

The patterns show the significant effects of the burden of all the diseases as their impact ripples through the economy and affect how industry sectors get impacted beyond the direct impact of migraine. Although in all countries the direct effects show the highest impact, across all countries, indirect and induced effects together are approximately of the same magnitude as the direct paid-work effect, implying total paid-work effects of roughly twice the direct effect. can be identified through the indirect and induced effects. It should be noted that these figures focus on the formal sector. As such, in economies with significant informal sectors, the impact of migraine could be further underestimated.

3.3 Gender specific differences in the socioeconomic burden of migraine

As illustrated in Figure 1, the burden of migraine disproportionately affects younger female populations. **Figure 9** further corroborates that females account for the majority of the socioeconomic burden associated with migraine. The graph depicts productivity losses in absolute monetary terms (euros) from 2011 to 2024 and by GDP for the Year 2024 by sex. Solid bars represent productivity losses in paid work sectors, whereas faded bars indicate productivity losses in unpaid work domains.

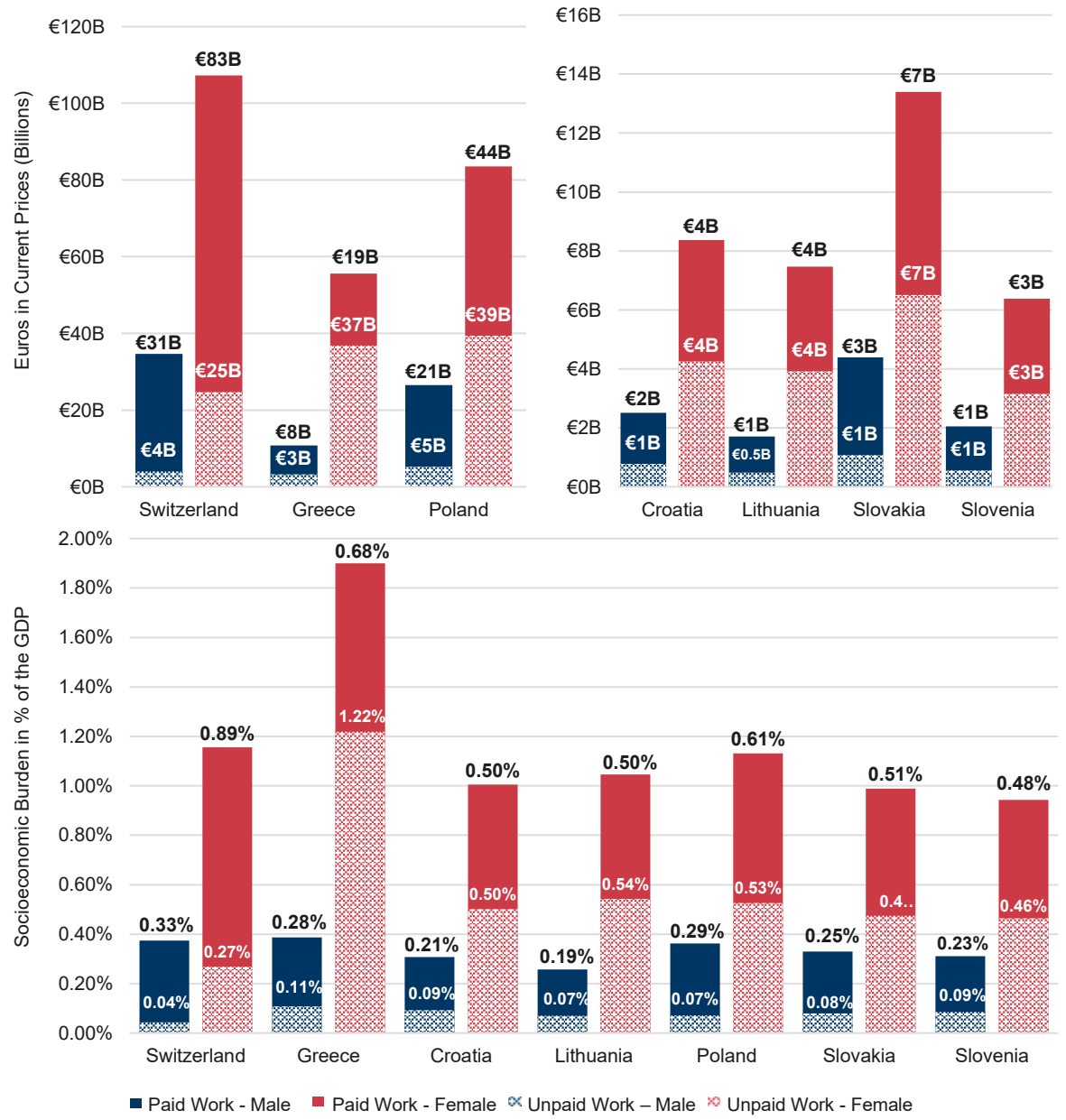

Figure 9. Comparison of the Socioeconomic Burden in Paid and Unpaid Work Between Men and Women: Current Prices, 2011–2024 (Upper) and as a Percentage of GDP, 2024 (Lower)

Source: WifOR elaboration

Across all countries examined, females experienced at least approximately twice the productivity losses of males due to migraine, with this disparity reaching approximately threefold in Switzerland and almost fivefold in Greece. Regarding productivity losses in paid work sectors, females experienced between approximately 2 and almost 3 times greater losses than males. The disparity is considerably more pronounced in unpaid work: females experienced between approximately 5 and more than 12 times greater productivity losses from unpaid work compared to males, with female-specific losses ranging from €3 billion to €39 billion. This gap reflects both the elevated disease burden among females but also from the inequitable distribution of unpaid labor (reference Table 1 in the annex for gender-based disparities in average weekly hours allocated to paid and unpaid work by country).

Figure 10 also shows how the burden of migraine affects males and females differently over time compared to other diseases.

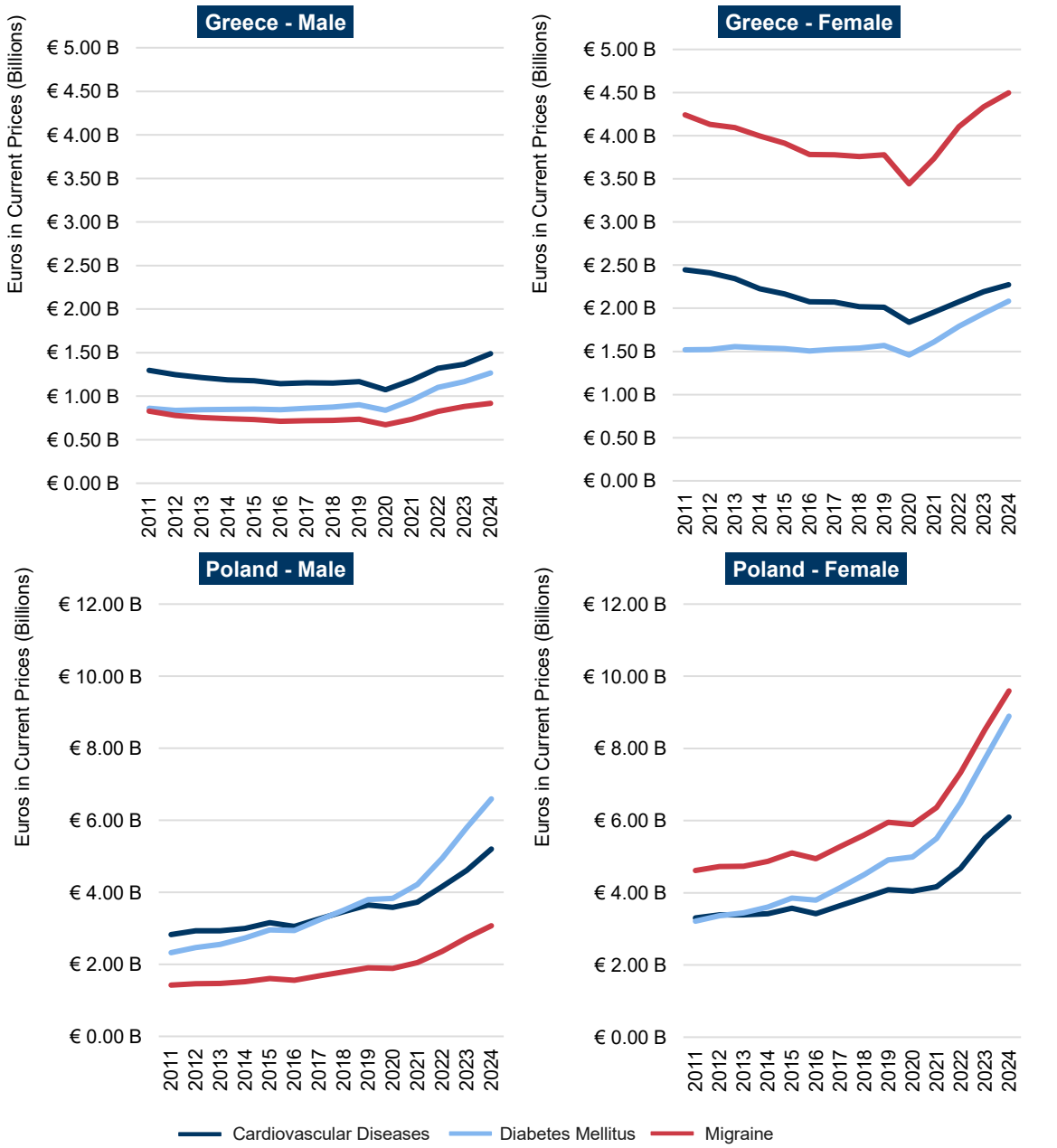

Figure 10. Time Trends in Overall Socioeconomic Burden for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Friction Cost Approach, Assuming Substitution)

Source: WifOR elaboration

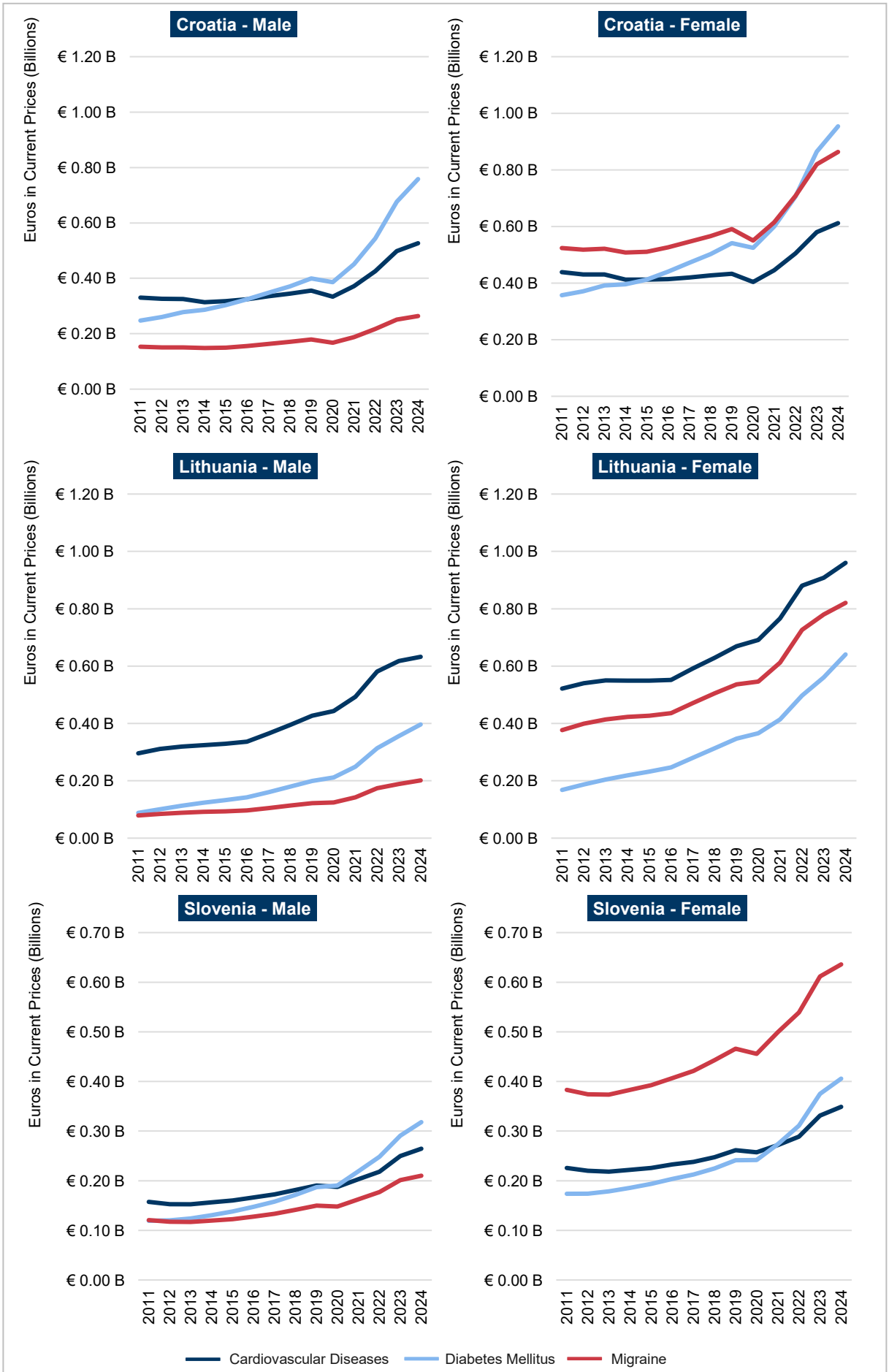

Figure 10. Time Trends in Overall Socioeconomic Burden for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Friction Cost Approach, Assuming Substitution)

Source: WifOR elaboration

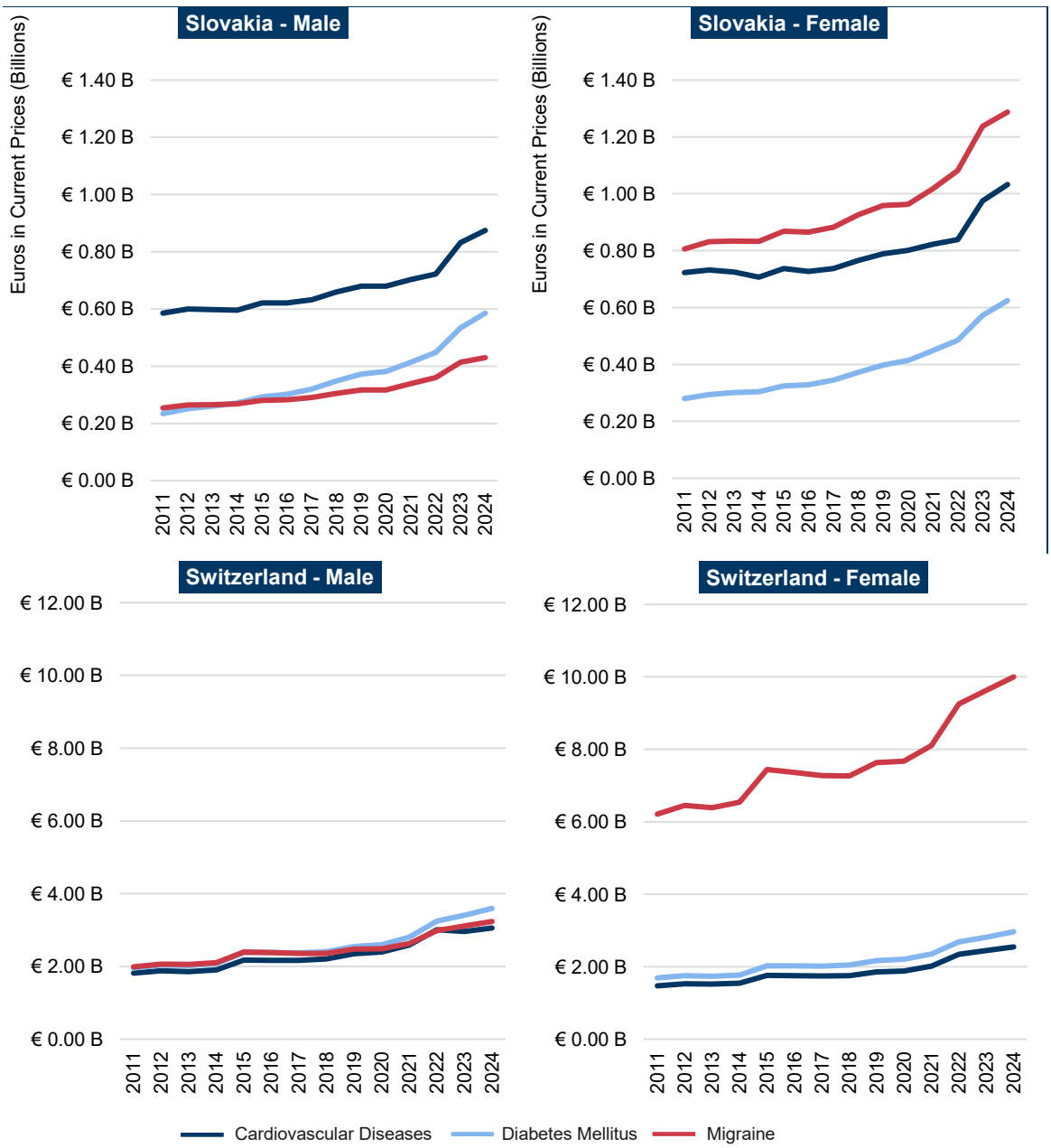

Figure 10. Time Trends in Overall Socioeconomic Burden for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Friction Cost Approach, Assuming Substitution)

Source: WifOR elaboration

In this figure, it becomes clear that migraine is particularly relevant for women. In almost all countries, the socioeconomic burden of migraine is consistently higher than that of CVD and DM over time. Only in Lithuania and Croatia is the socioeconomic burden of migraine comparable to that of diabetes mellitus in recent years (Croatia) or is consistently slightly lower than cardiovascular diseases (Lithuania). Even more striking is how across the countries, in absolute terms, the burden of migraine is growing more rapidly in females than males. This is due to the already high base level of burden in women that further increases over time.

3.4 Comparison with other European countries

Similar studies have been published by WifOR showing the impact of Migraine in seven European countries: Belgium, Germany, France, Spain, the Netherlands, Portugal, and the Czech Republic (Lovera & Ubels, 2025) (Lovera et al., 2026). This section presents the results of the analyses carried out in these seven countries as well as the results of the analyses carried out in the current report, thus enabling a comparison of the burden of migraine in all fourteen European countries studied to date. Accordingly, Figure 11 below displays the SOB of the fourteen countries aggregated over the years 2011 – 2021 and as a percentage of the relative country GDP in 2021

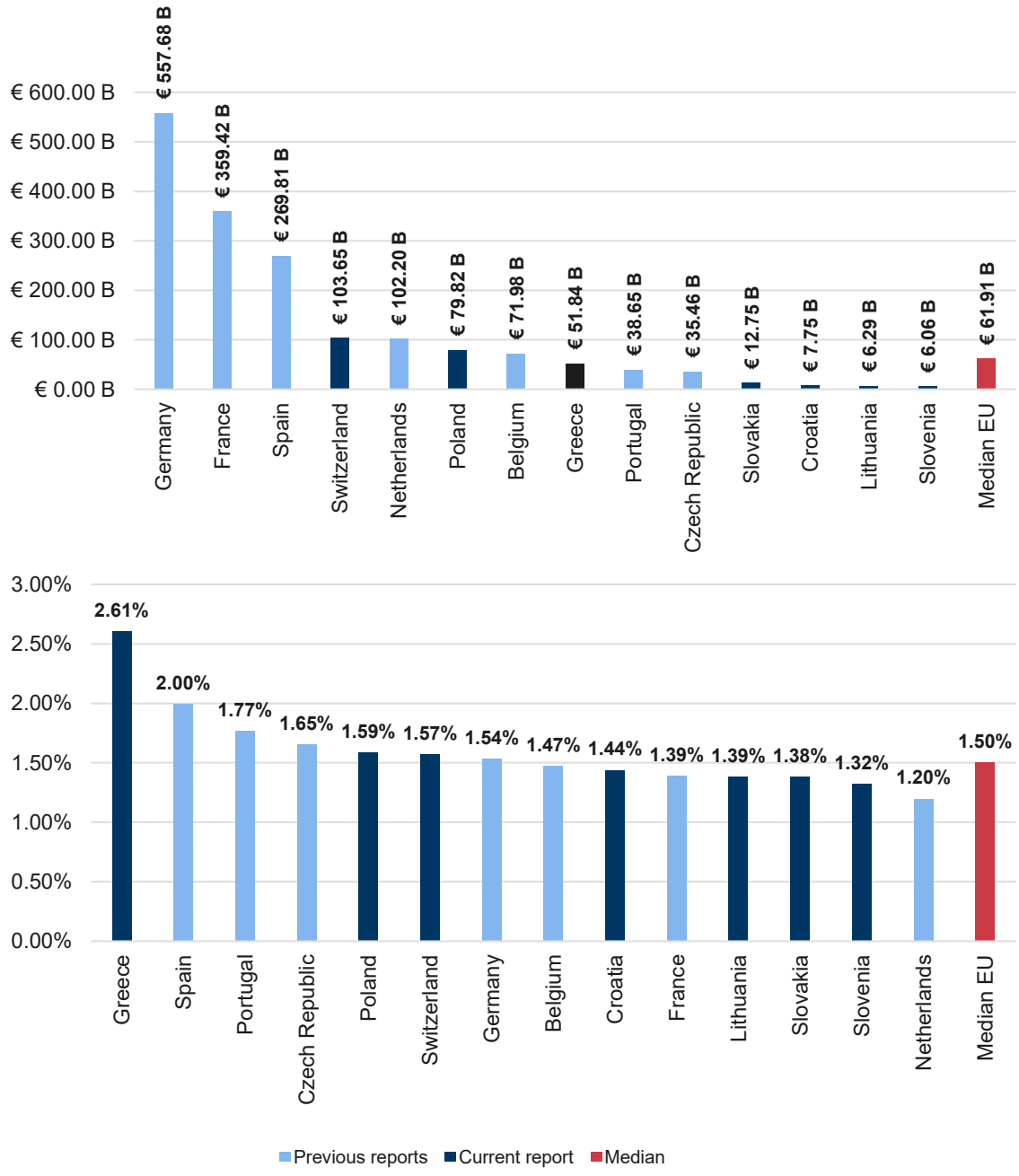

Figure 11. Total Socioeconomic Burden of Migraine: Current Prices, 2011–2021 (Upper) and as a Percentage of GDP, 2021 (Lower)

Source: WifOR elaboration

Analysis of data from 2011 to 2021, encompassing productivity losses from both paid and unpaid work, reveals that these losses ranged from €558 billion in Germany to €6 billion in Slovenia, when current prices were considered. The European median burden at this time was close to €62 billion.

When examining socioeconomic burden as a percentage of GDP in 2021, estimates ranged from 1.20% to 2.00%, with a median of 1.50%. Among these countries, Spain and Portugal showed the highest relative burdens. When the countries analysed in the present study are considered alongside these earlier estimates, most fall within a similar range. Greece represents a notable exception, with an estimated socioeconomic burden of 2.61% of GDP in 2021, exceeding the range observed in the previously analysed countries.

Aggregated across the 14 EU countries studied to date, migraine-related productivity losses in paid and unpaid work amounted to an estimated €169.7 billion in 2021 (current prices). This corresponds to approximately 1.54% of their combined GDP, or more than €320,000 for every minute of the year.

It is important to note that this analysis used GBD 2023 data for Belgium, while the European report used GBD 2021 data. Therefore, some differences in socioeconomic burden between the countries for which new estimates were created in this study and other European countries could be attributed to methodological differences between the datasets rather than actual differences in disease burden. However, these methodological differences are likely minimal. To illustrate, when comparing the two datasets for Belgium (for which the country assessment took place during the publication of the updated data by the IHME), the socioeconomic burden as a percentage of GDP was 1.50% in 2021 and 1.47% in 2023: a difference of only 0.03 percentage points. This close alignment across GBD data vintages, together with the overall pattern of results observed in this analysis, suggests that the findings presented here are broadly consistent with those of the earlier six-country and Belgium reports.

4 Discussion

The Socioeconomic Burden imposed by migraine represents a substantial economic impact across Europe. Over the 14-year period from 2011 to 2024, this cumulative burden ranged from €8.34 billion in Slovenia to €141.87 billion in Switzerland in current prices. Adjusted for the inflation that occurred in this period, the cumulative burden was €7.32 billion in Slovenia and €136.46 billion in Switzerland. When this socioeconomic burden is expressed relative to GDP, the data indicates that migraine represents a structurally significant economic burden relative to all the countries' overall economic capacity. In 2024, migraine's socioeconomic burden ranged from 1.25% of the GDP of Slovenia to 2.35% of the GDP of Greece.

When comparing the results of the countries included in this study with additional countries from earlier studies (Belgium, France, Germany, Spain, the Czech Republic, the Netherlands and Portugal), it becomes clear that only Greece has a significantly higher burden, compared to other countries (2.61% for Greece, next highest is France with 2.00%). The burden in the other countries included falls within the range of 1.32% to 1.59% of their respective GDPs, which is essentially the range around which all the countries cluster. The high burden of Greece is driven by both its relatively high burden in terms of paid work (only behind Switzerland) and its high unpaid work productivity losses in women (highest amongst the included countries). Specifically, in Greece, women account for 72% of the total hours of unpaid work performed by both sexes. This signifies the relatively high burden of migraine in Greece, particularly in women. Here, it is also important to note that additional productivity losses in the informal sector are not quantified, and as such, the real productivity losses due to migraine could be higher.

In terms of paid work, the burden of migraine has a significant impact beyond the direct productivity losses – the indirect and induced effects are similar and, in one case, Switzerland, even higher than the direct productivity losses. These spillover effects highlight that the economic consequences of migraine extend beyond affected individuals and propagate across economic sectors through reduced demand and consumption. Consequently, preventing or reducing the burden of migraine could have far-reaching positive effects across the economy.

In addition to the paid work losses outlined above, an additional burden is also caused by losses in unpaid work, which is in many countries even higher than that of paid work. Although unpaid activities are typically not monetized, they generate goods and services essential to society. Given that migraine predominantly affects individuals of working age, it is particularly important in an ageing society to reduce the burden of this condition and support affected individuals in fulfilling unpaid roles, such as caregiving, that might otherwise remain unmet. Without such intervention, the social systems are further pressured to address this gap between unpaid labor supply and demand.

A comparative analysis of the SOB of migraine relative to diabetes mellitus and cardiovascular diseases provides further contextual perspective on these findings. The data demonstrate that across the entire 14-year period, migraine imposed a similar or higher economic burden than both cardiovascular disease and diabetes mellitus in the countries in this analysis. Particularly for women, the burden of migraine is significantly higher than that of cardiovascular diseases and diabetes mellitus. This can be explained by the fact that migraine, unlike CVD and DM, does not cause mortality; therefore, the loss of productivity is accumulated throughout the entire working life, while for CVD and DM, according to the friction-cost approach, the period of working time loss is limited to the period before death. In addition, since migraine predominantly affects women of working age, its impact on health is especially significant for this population group, given the long duration of the disease.

Studies show that workplace interventions can reduce the burden of migraine and improve functioning in affected employees (Begasse de Dhaem et al., 2021). Key modifiable factors include fostering autonomy, social support, and job satisfaction, while minimizing environmental triggers such as bright light, noise, odors, and poor air quality, and ensuring adequate restroom access. Additionally, managing quantitative demands (e.g., workload,

work hours, schedule flexibility) and emotional demands (e.g., stressful work atmosphere) are important. Furthermore, targeted interventions, such as workplace migraine education programs, not only improve employee wellbeing but can also increase productivity by 29-36% (Begasse de Dhaem et al., 2021). These findings suggest that investments in migraine prevention, diagnosis, and management may generate economic benefits alongside health improvements.
Healthcare-system interventions may also offer an alternative approach to reduce the socioeconomic burden of migraine. Such measures might include enhancing the recognition and management of migraine in primary care, shortening the time to initiation of preventive therapy, optimizing referral patterns, and improving access to and use of evidence-based preventive and chronic migraine treatments. In a European economic modelling analysis, the introduction of headache services (through healthcare professional education and consumer self-management resources) was associated with substantial health gains and cost savings versus treatment as usual. The intervention was considered cost-effective even when assuming that only 20% of migraine-related lost productivity would be regained (Tinelli et al., 2021).
Together, these findings suggest that interventions operating both within and outside the healthcare system may help mitigate the socioeconomic consequences of migraine by reducing disability, improving functioning, and limiting productivity losses.
Despite comparable or higher disease burden, migraine has historically received disproportionately lower public health investment relative to conditions such as CVD and DM (Gillum et al., 2011; Schwedt & Shapiro, 2009) . This mismatch between disease burden and health system investment underscores the case for reprioritizing migraine within national health policy agendas.

Several methodological limitations should be acknowledged. The economic and demographic parameters applied in this study- such as multipliers for direct, indirect, and induced effects - are derived from aggregated databases that lack detailed information on occupational or sector-specific distributions of disease prevalence. Migraine, cardiovascular disease, and type 2 diabetes mellitus may have different implications across the workforce because their demographic and occupational patterns differ. Migraine is associated with physically demanding work and shift or night-shift work, while cardiovascular-health profiles and type 2 diabetes incidence also vary substantially across occupational groups (Affatato et al., 2021; Bauer et al., 2025; Shockey et al., 2016). Future analyses should explore how these demographic and occupational patterns influence the broader economic ripple effects of various diseases across industrial sectors.

Moreover, this study does not incorporate the economic consequences of informal caregiving associated with migraine, diabetes mellitus, or cardiovascular disease. Informal caregiving refers to unpaid care provided by relatives, friends, or community members to individuals with chronic illnesses, disabilities, or age-related health conditions. Such care frequently falls on women and can lead to reduced working hours, career disruptions, or withdrawal from the labor force, resulting in substantial but often overlooked economic costs. Understanding how disease burden interacts with caregiving responsibilities and labor market participation represents a critical direction for future research.

With respect to the GBD framework, it is important to note its dependence on country-reported data. While advanced statistical adjustments mitigate some inconsistencies, residual reporting biases may remain, potentially influencing the reliability of cross-country comparisons.

In conclusion, migraine imposes a considerable burden on both paid and unpaid productivity in all the European countries analyzed. This disease predominantly affects individuals during their peak working years. As a result, migraines represent not only a public health challenge but also a macroeconomic issue, affecting labor supply, economic output, and societal functioning. Reducing the burden of migraine could therefore generate substantial economic and societal benefits, alongside improvements in health outcomes, particularly where investment supports prevention, earlier diagnosis, and improved access to treatment, thereby reducing pressure on public healthcare budgets.

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Annex

4.1 Additional results - Current price

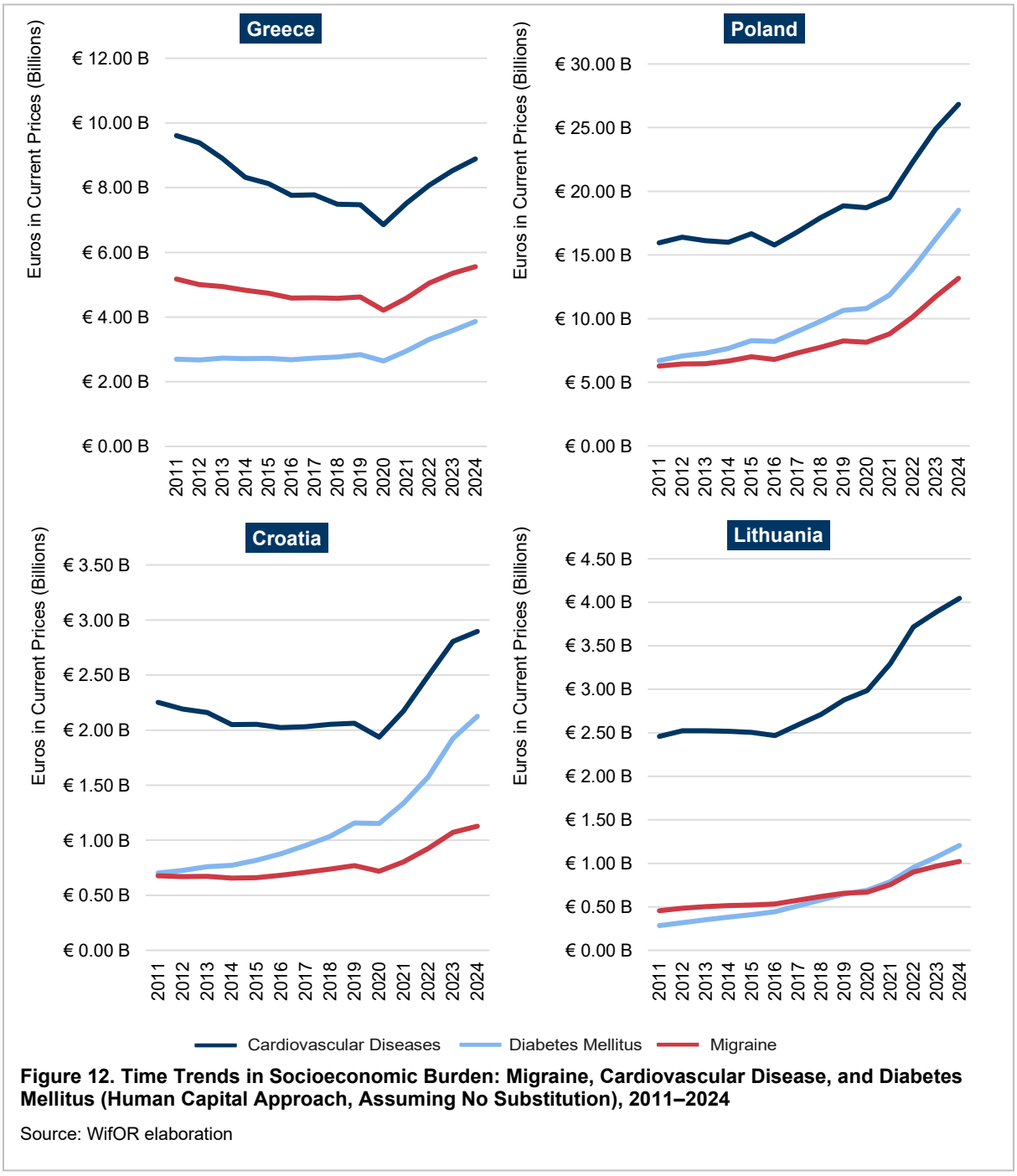

Figure 12. Time Trends in Socioeconomic Burden: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Human Capital Approach, Assuming No Substitution), 2011–2024

Source: WifOR elaboration

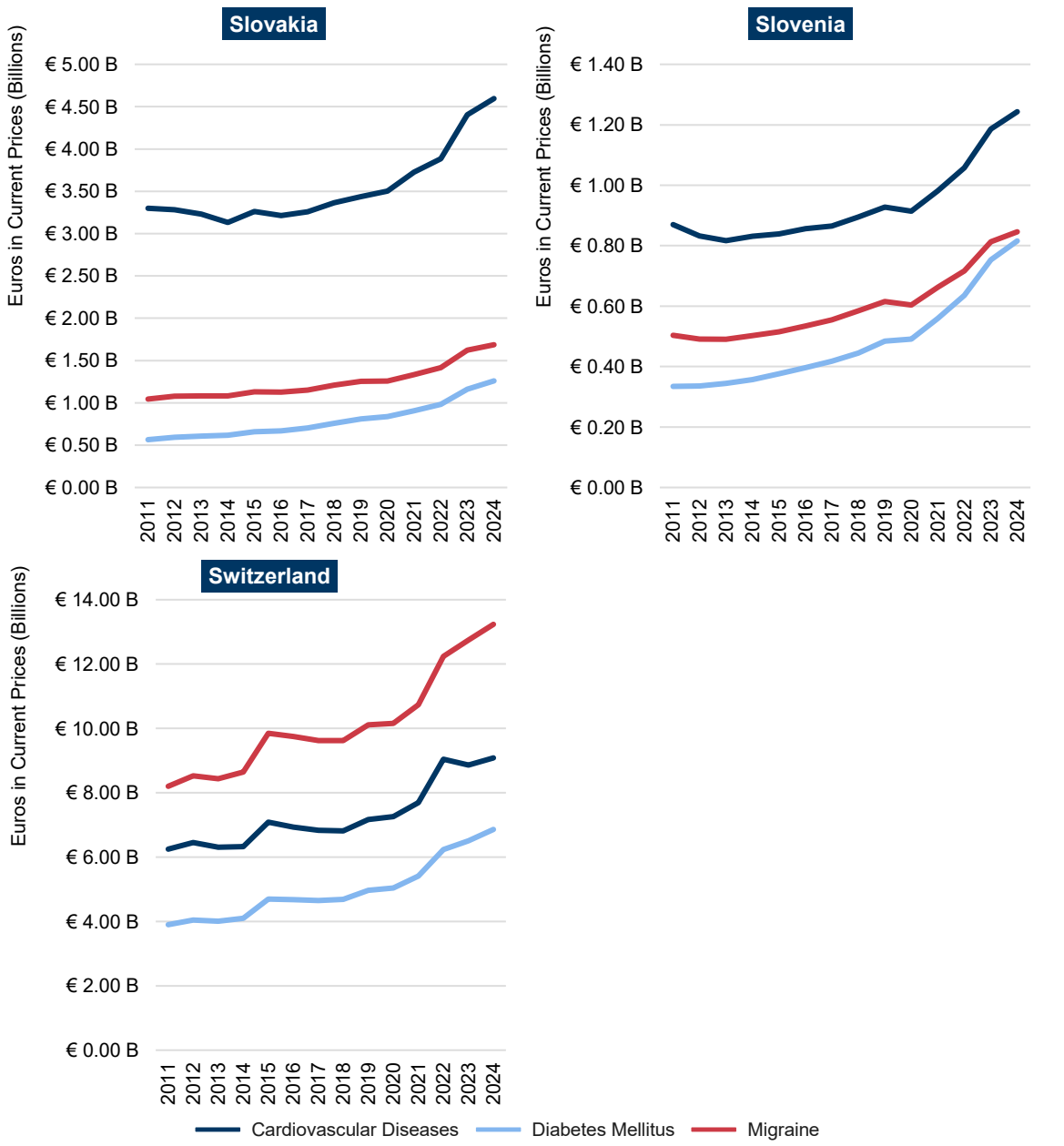

Figure 12. Time Trends in Socioeconomic Burden: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Human Capital Approach, Assuming No Substitution), 2011–2024

Source: WifOR elaboration

Figure 13. Overall Socioeconomic Burden of Migraine as a Percentage of GDP: Paid and Unpaid Productivity Losses, 2024 (Human Capital Approach, Assuming No Substitution)

Source: WifOR elaboration

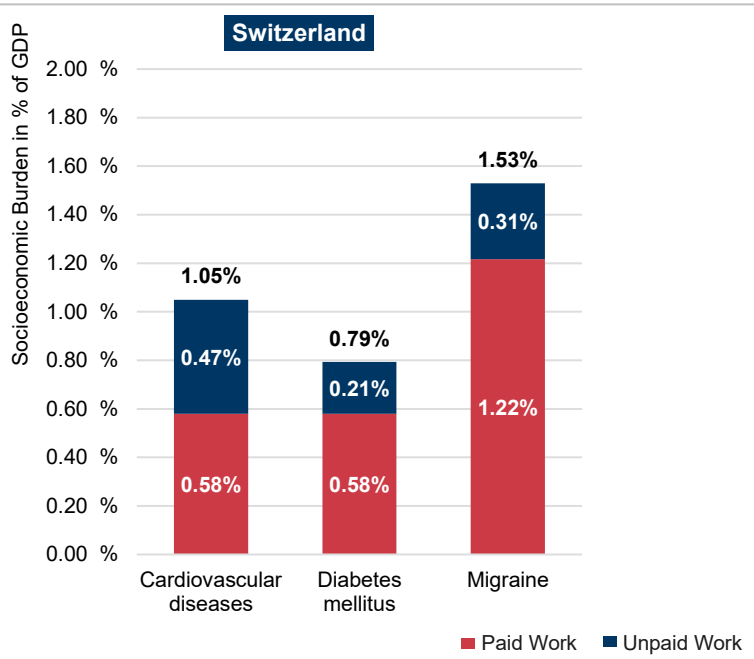

Figure 13. Overall Socioeconomic Burden of Migraine as a Percentage of GDP: Paid and Unpaid Productivity Losses, 2024 (Human Capital Approach, Assuming No Substitution)

Source: WifOR elaboration

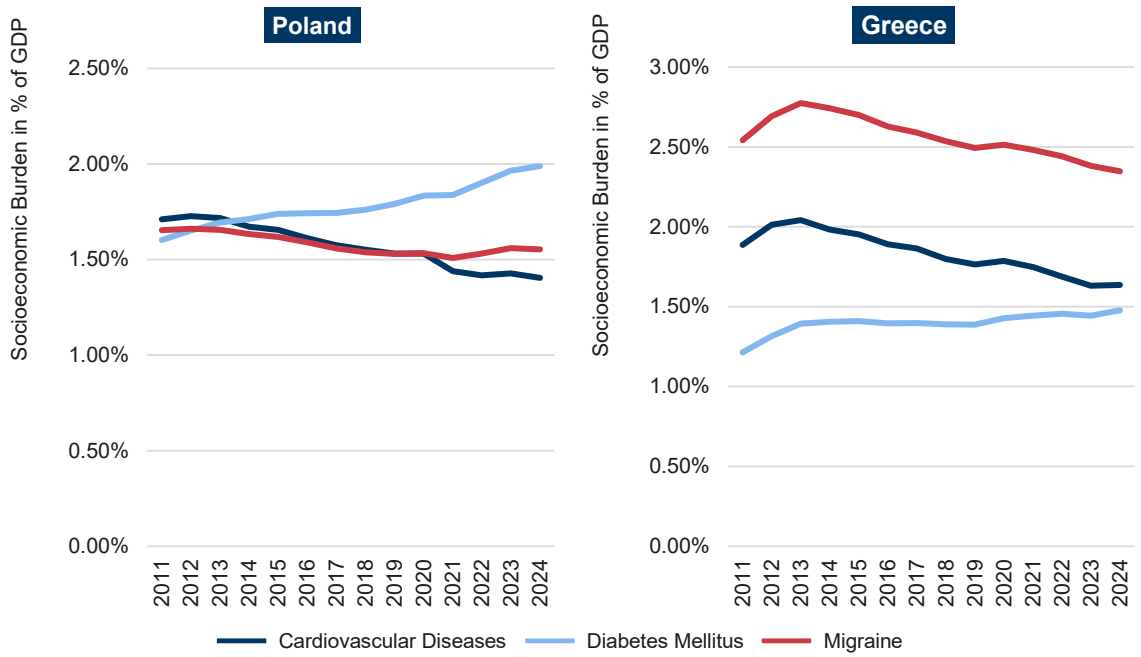

Figure 14. Time Trends in Socioeconomic Burden as a Percentage of GDP: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Friction Cost Approach, Assuming Substitution)

Source: WifOR elaboration

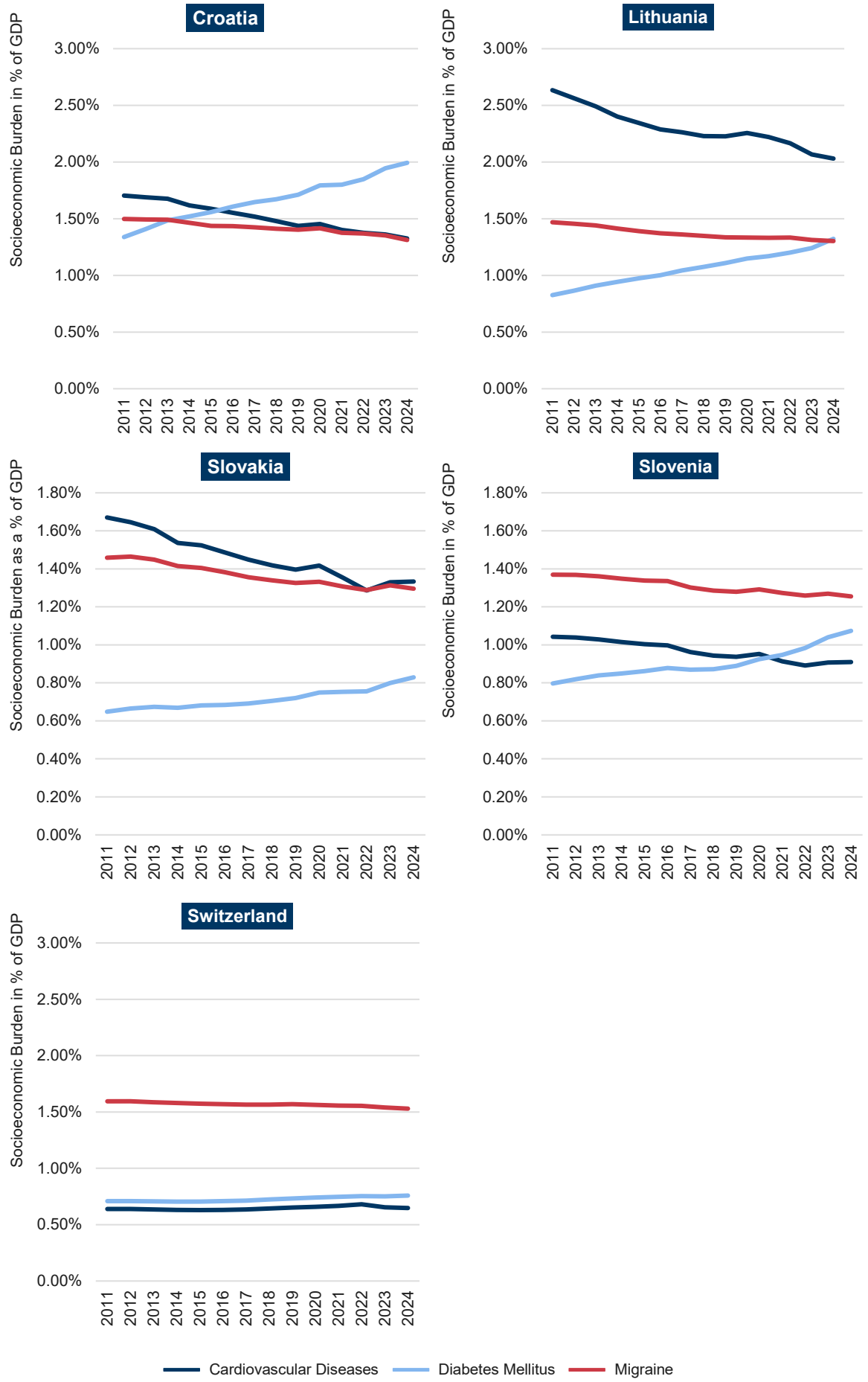

Figure 14. Time Trends in Socioeconomic Burden as a Percentage of GDP: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Friction Cost Approach, Assuming Substitution)

Source: WifOR elaboration

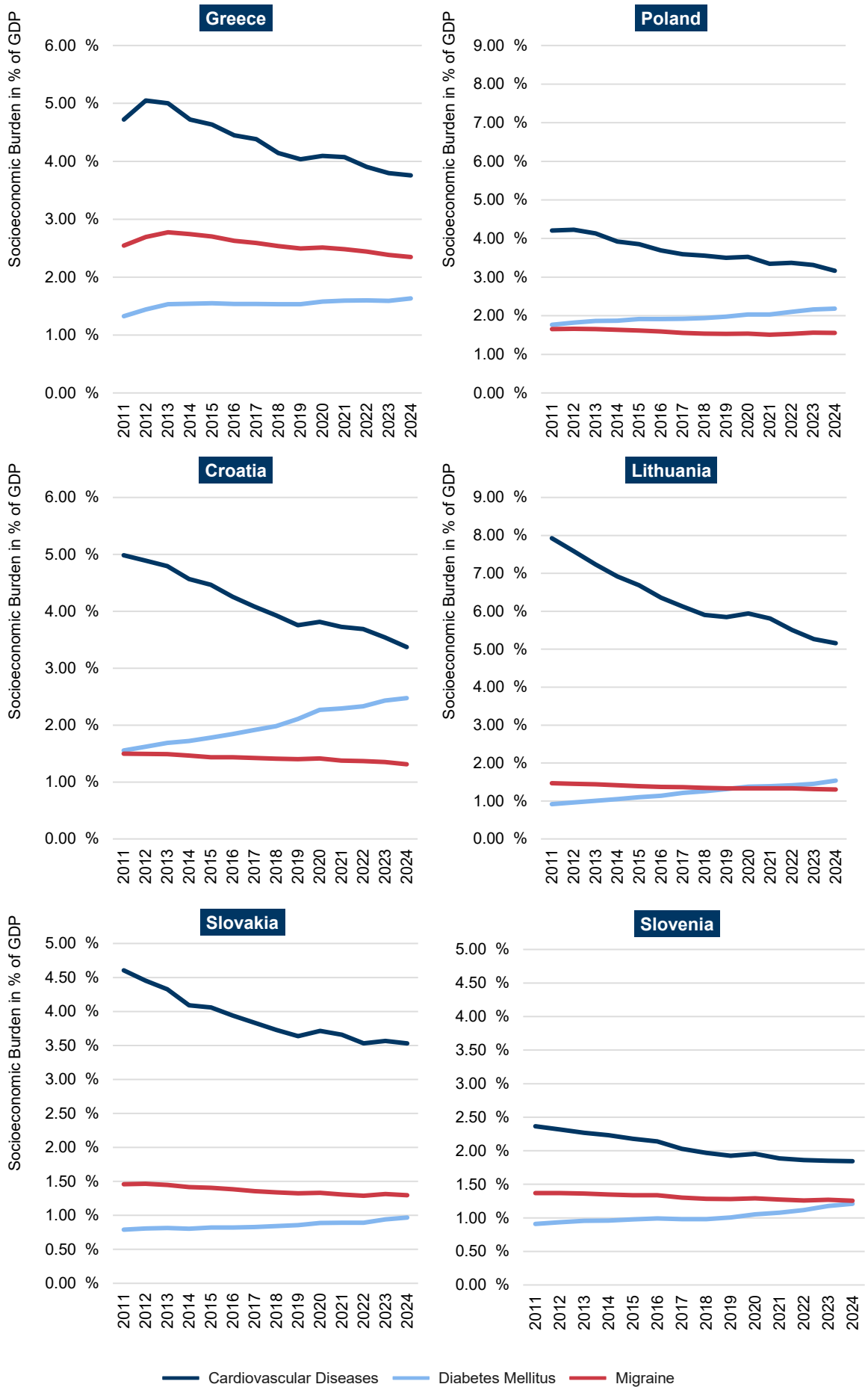

Figure 15. Time Trends in Socioeconomic Burden as a Percentage of GDP: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Human Capital Approach, Assuming No Substitution)

Source: WifOR elaboration

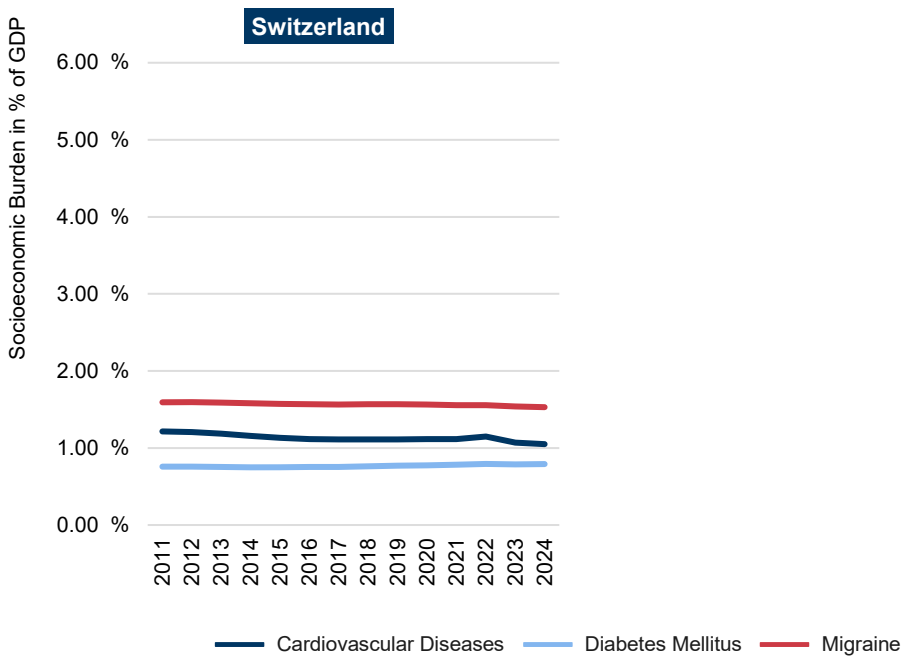

Figure 15. Time Trends in Socioeconomic Burden as a Percentage of GDP: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Human Capital Approach, Assuming No Substitution)

Source: WifOR elaboration

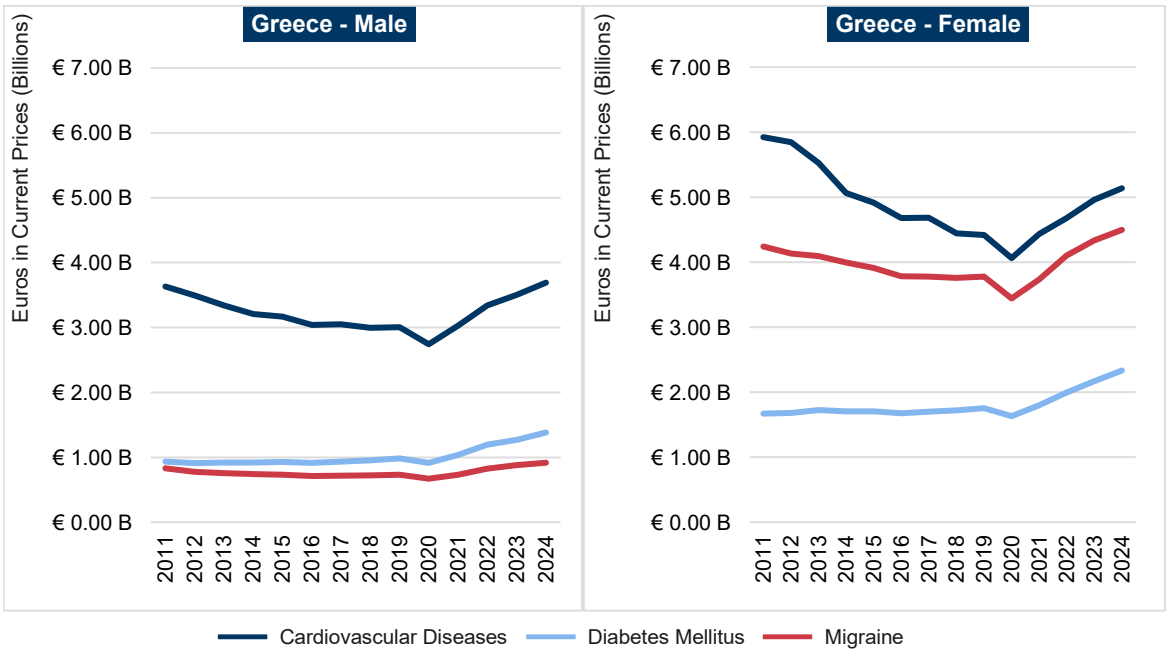

Figure 16. Time Trends in Overall Socioeconomic Burden for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Human Capital Approach, Assuming No Substitution)

Source: WifOR elaboration

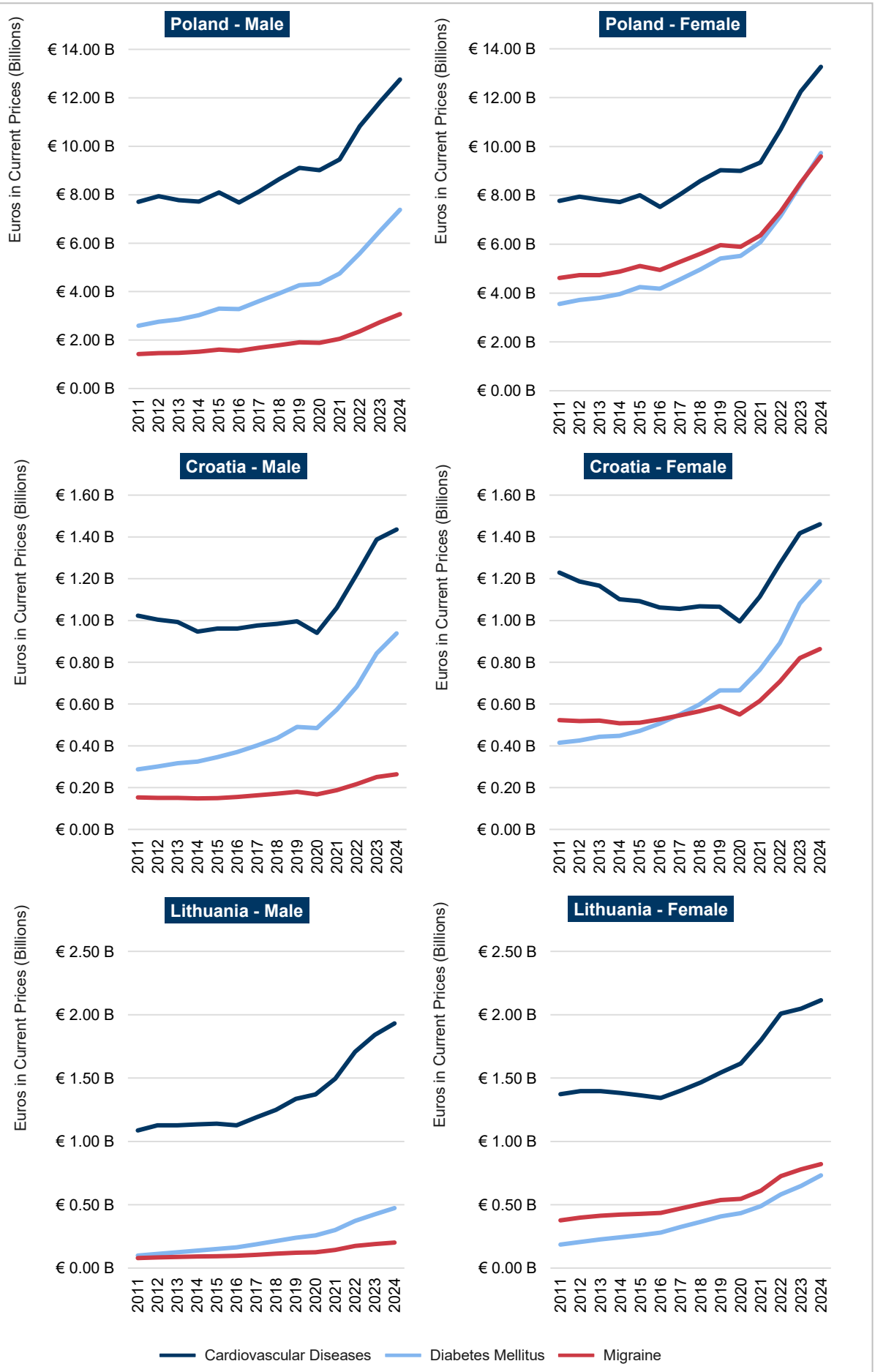

Figure 16. Time Trends in Overall Socioeconomic Burden for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Human Capital Approach, Assuming No Substitution)

Source: WifOR elaboration

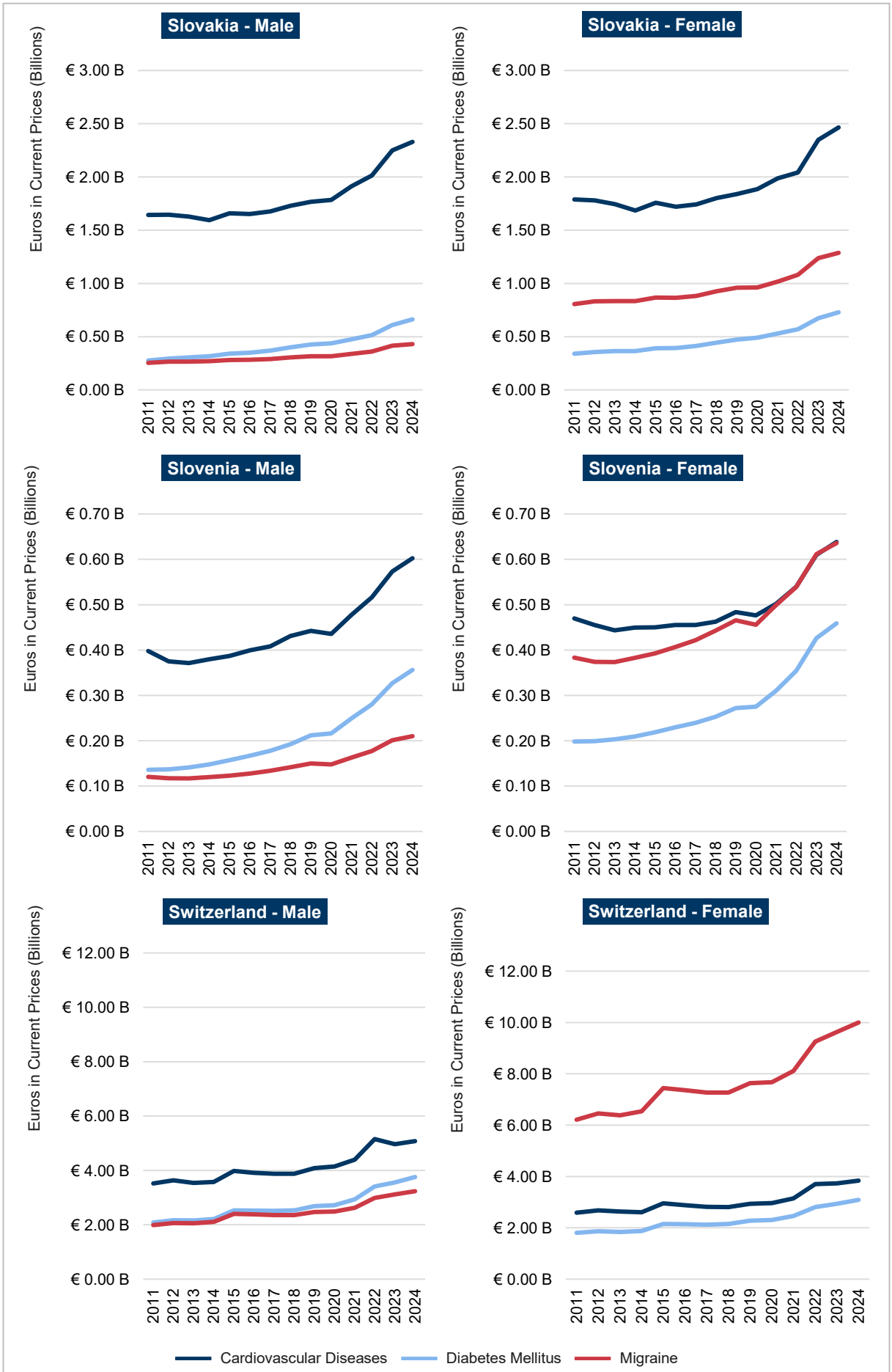

Figure 16. Time Trends in Overall Socioeconomic Burden for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Human Capital Approach, Assuming No Substitution)

Source: WifOR elaboration

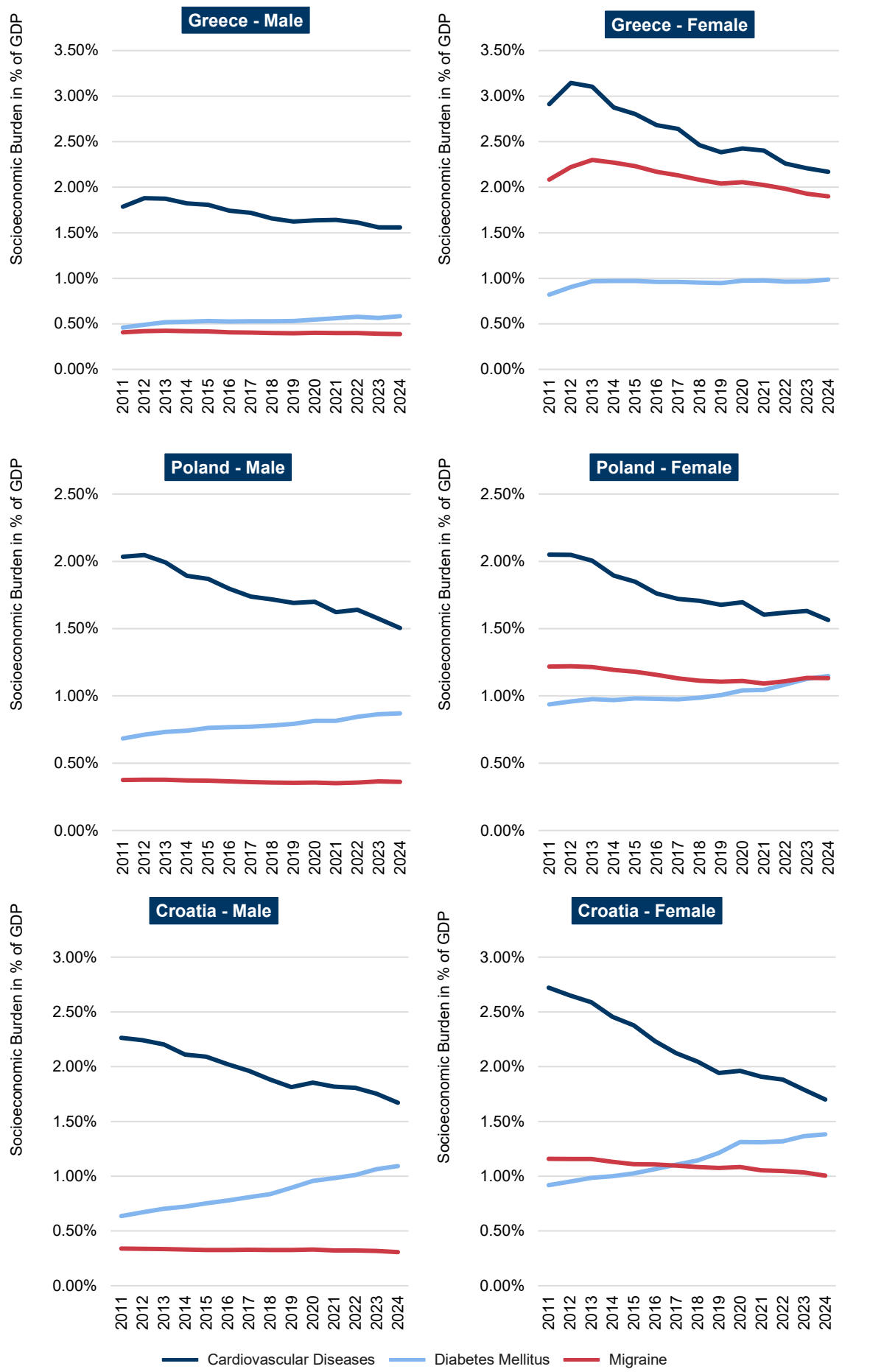

Figure 17. Time Trends in Socioeconomic Burden as a Percentage of GDP for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Human Capital Approach, Assuming No Substitution)

Source: WifOR elaboration

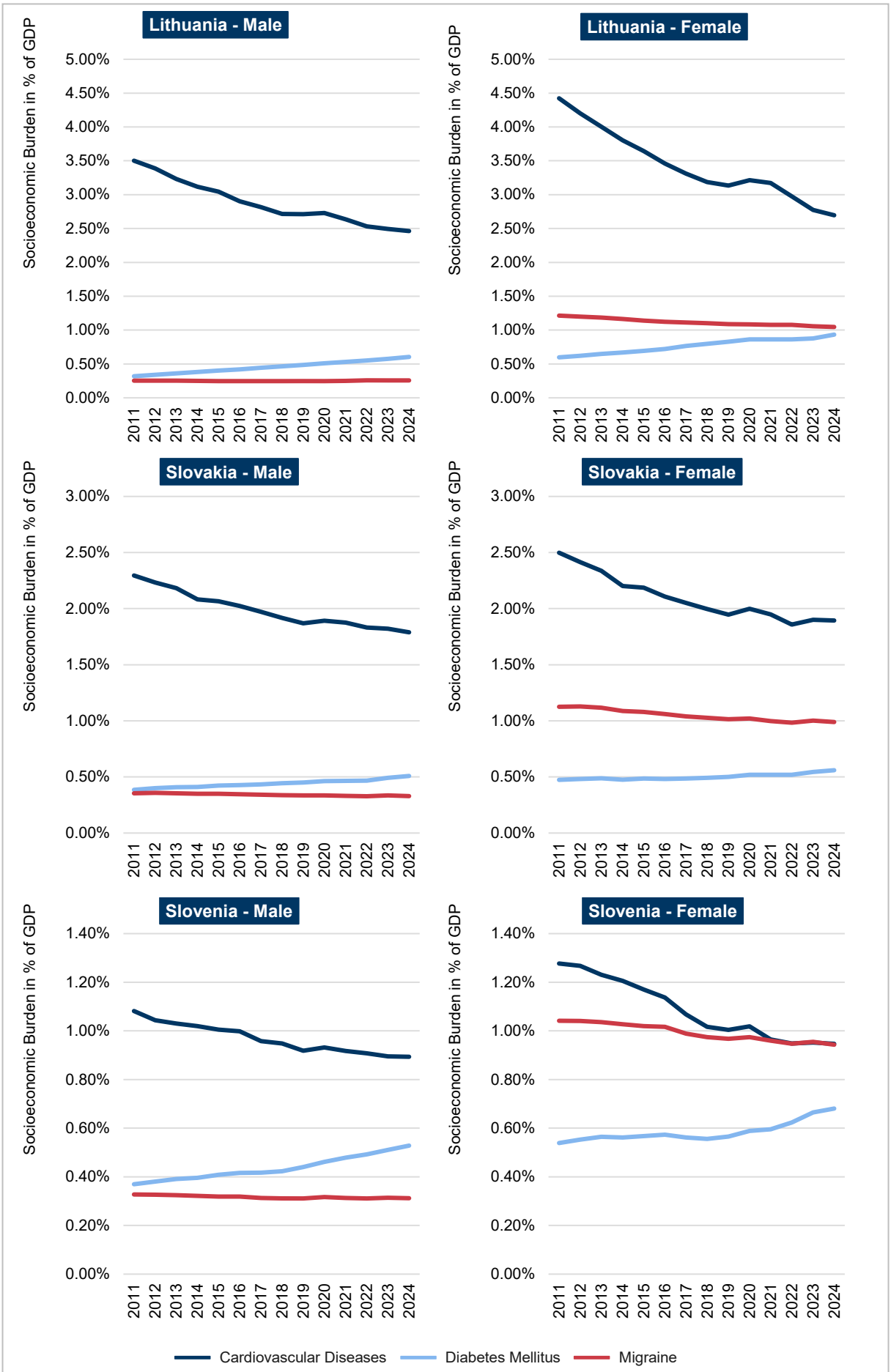

Figure 17. Time Trends in Socioeconomic Burden as a Percentage of GDP for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Human Capital Approach, Assuming No Substitution)

Source: WifOR elaboration

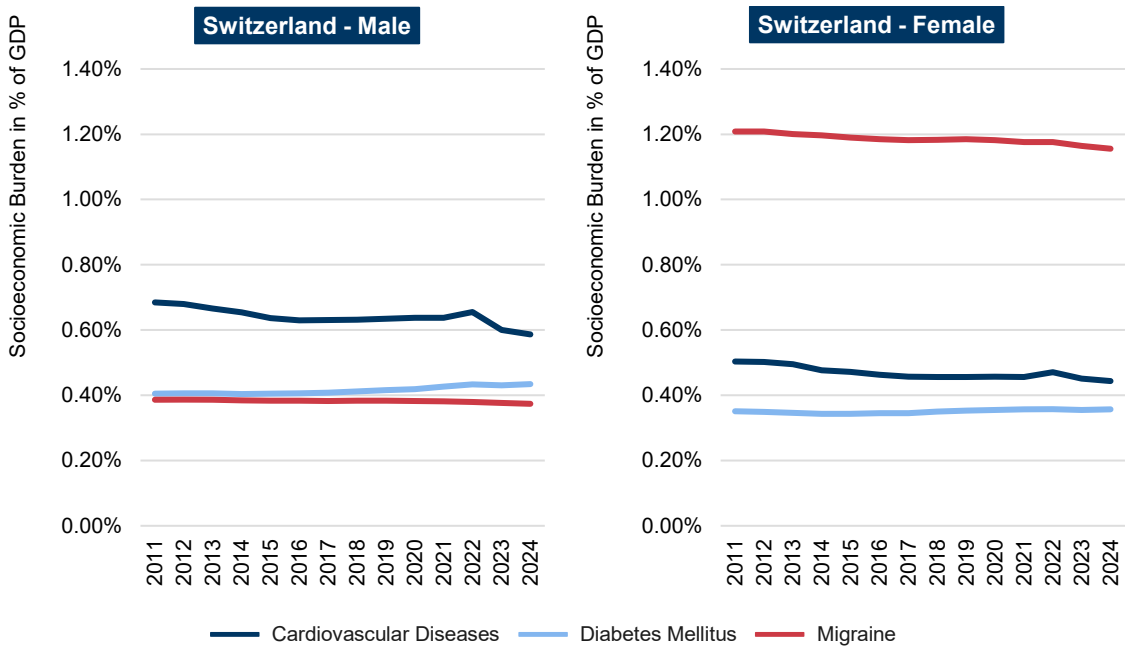

Figure 17. Time Trends in Socioeconomic Burden as a Percentage of GDP for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Human Capital Approach, Assuming No Substitution)

Source: WifOR elaboration

4.2 Additional results - Adjusted prices

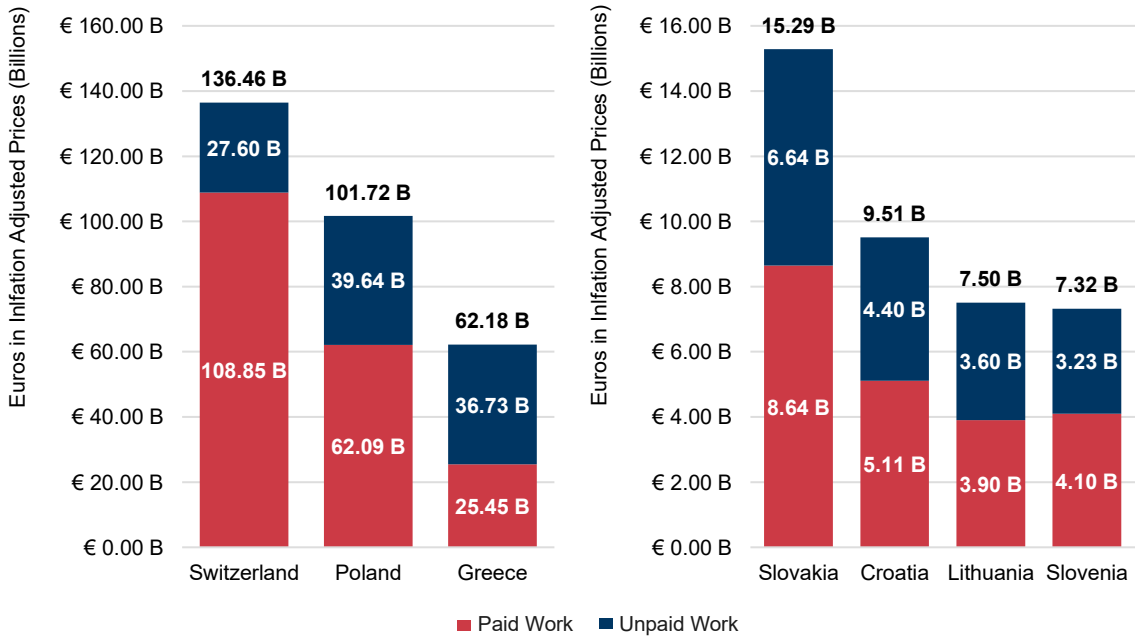

Figure 18. Overall Socioeconomic Burden of Migraine: Paid and Unpaid Productivity Losses, 2011–2024 (Adjusted Prices)

Source: WifOR elaboration

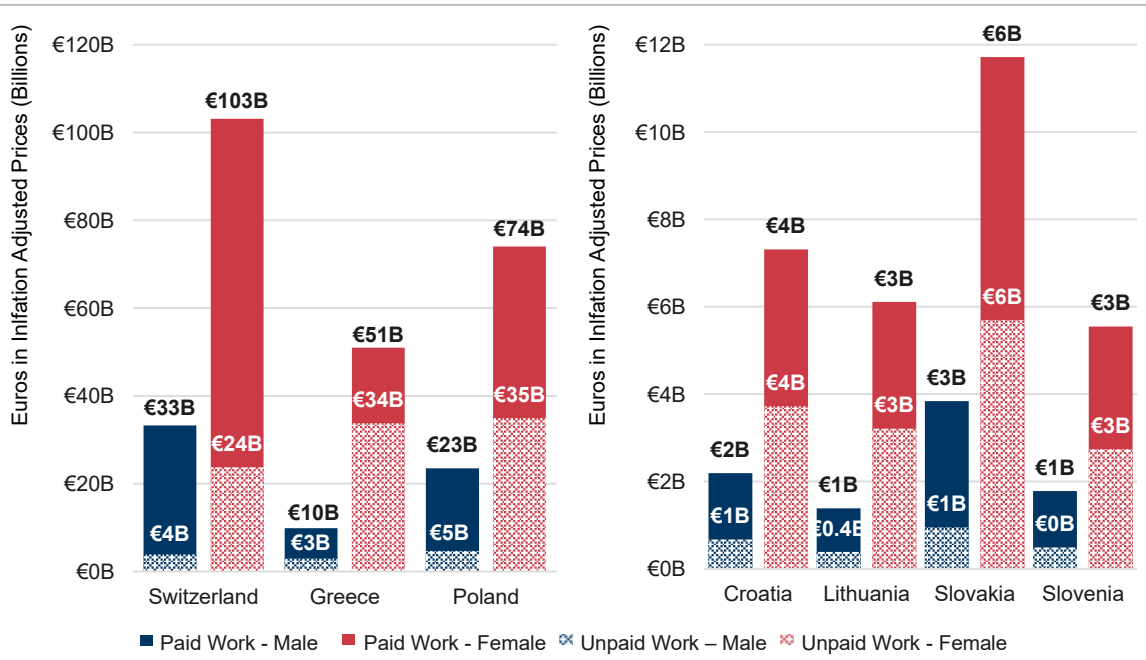

Figure 19. Comparison of the Socioeconomic Burden in Paid and Unpaid Work Between Men and Women, 2011–2024 (Adjusted Prices)

Source: WifOR elaboration

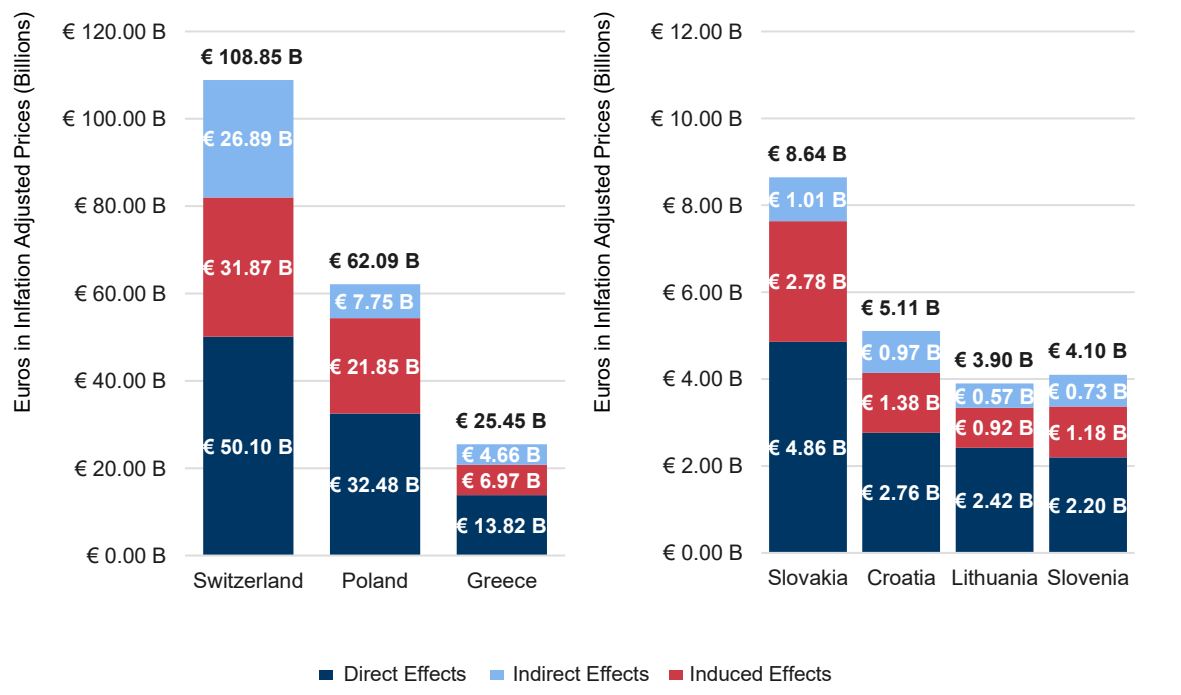

Figure 20. Paid Work Productivity Losses, Disaggregated by Direct, Indirect, and Induced Effects of Migraine on the Economy (Adjusted Prices)

Source: WifOR elaboration

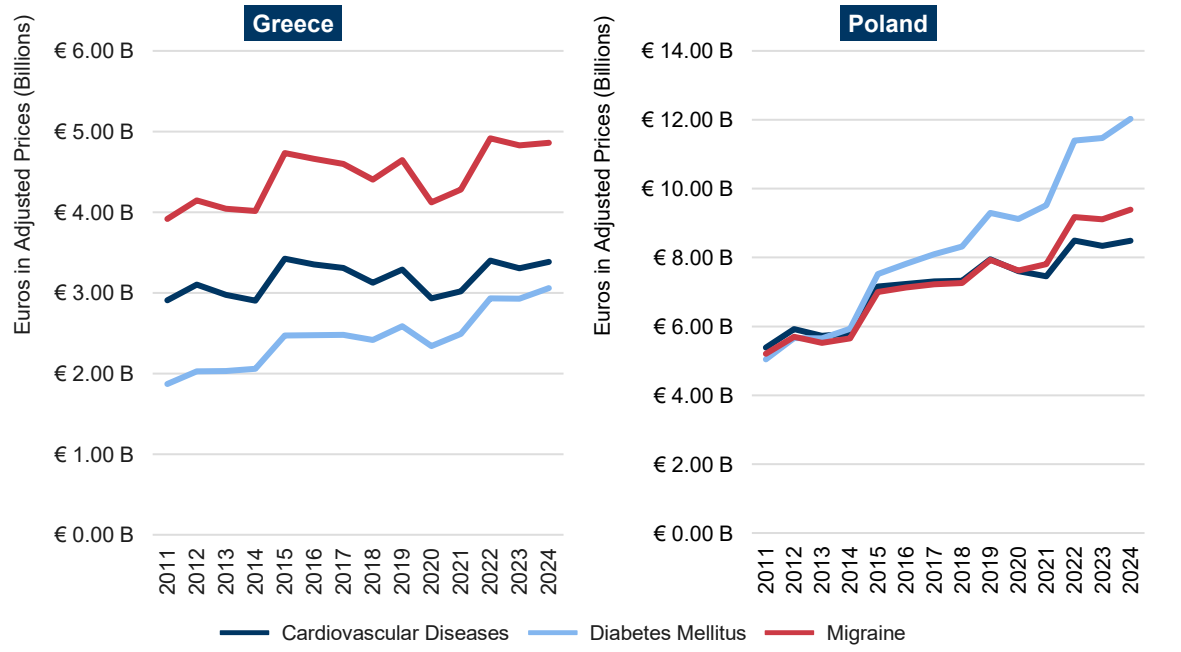

Figure 21. Time Trends in Socioeconomic Burden: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Friction Cost Approach, Assuming Substitution), 2011–2024 (Adjusted Prices)

Source: WifOR elaboration

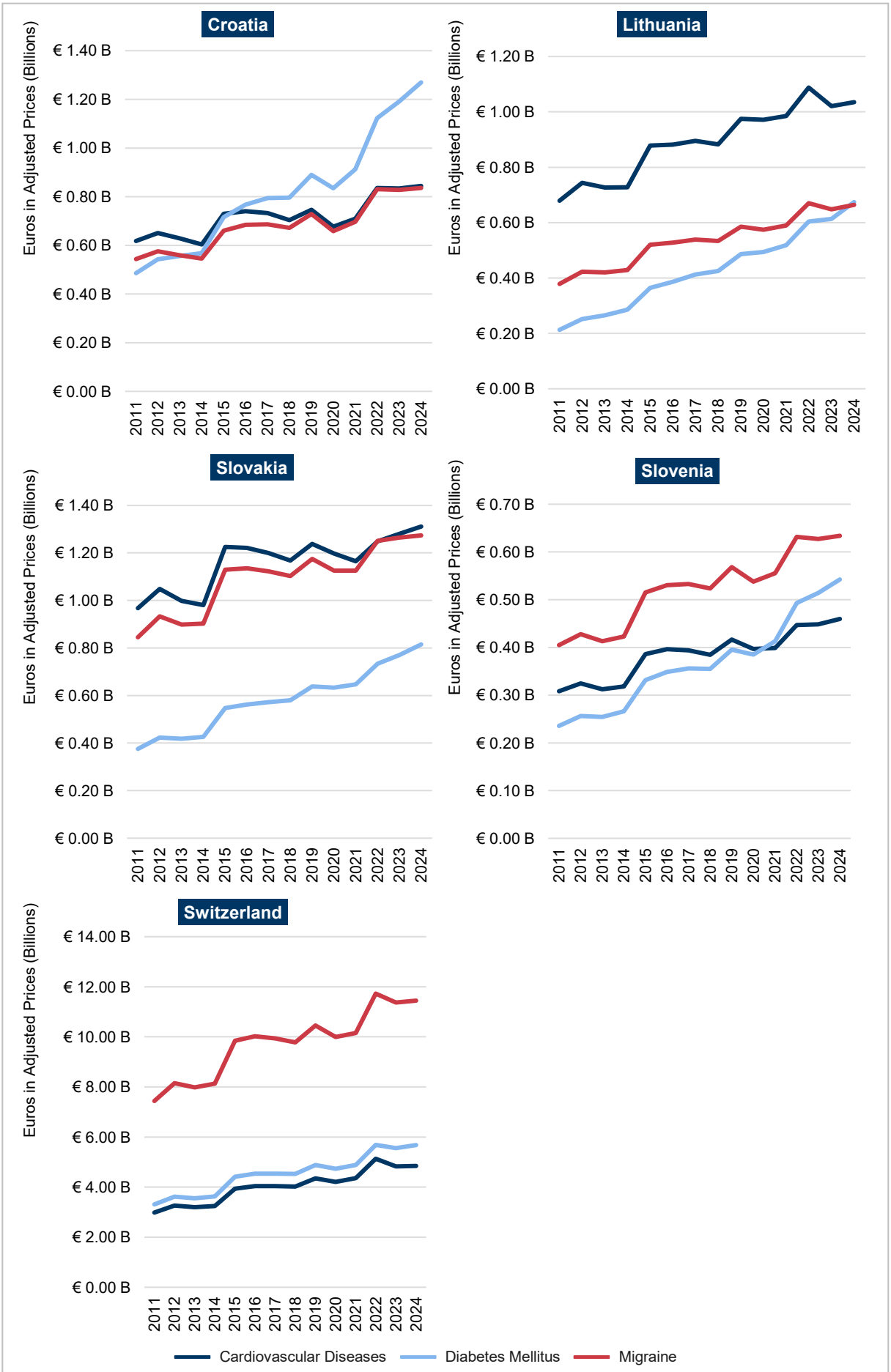

Figure 21. Time Trends in Socioeconomic Burden: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Friction Cost Approach, Assuming Substitution), 2011–2024 (Adjusted Prices)

Source: WifOR elaboration

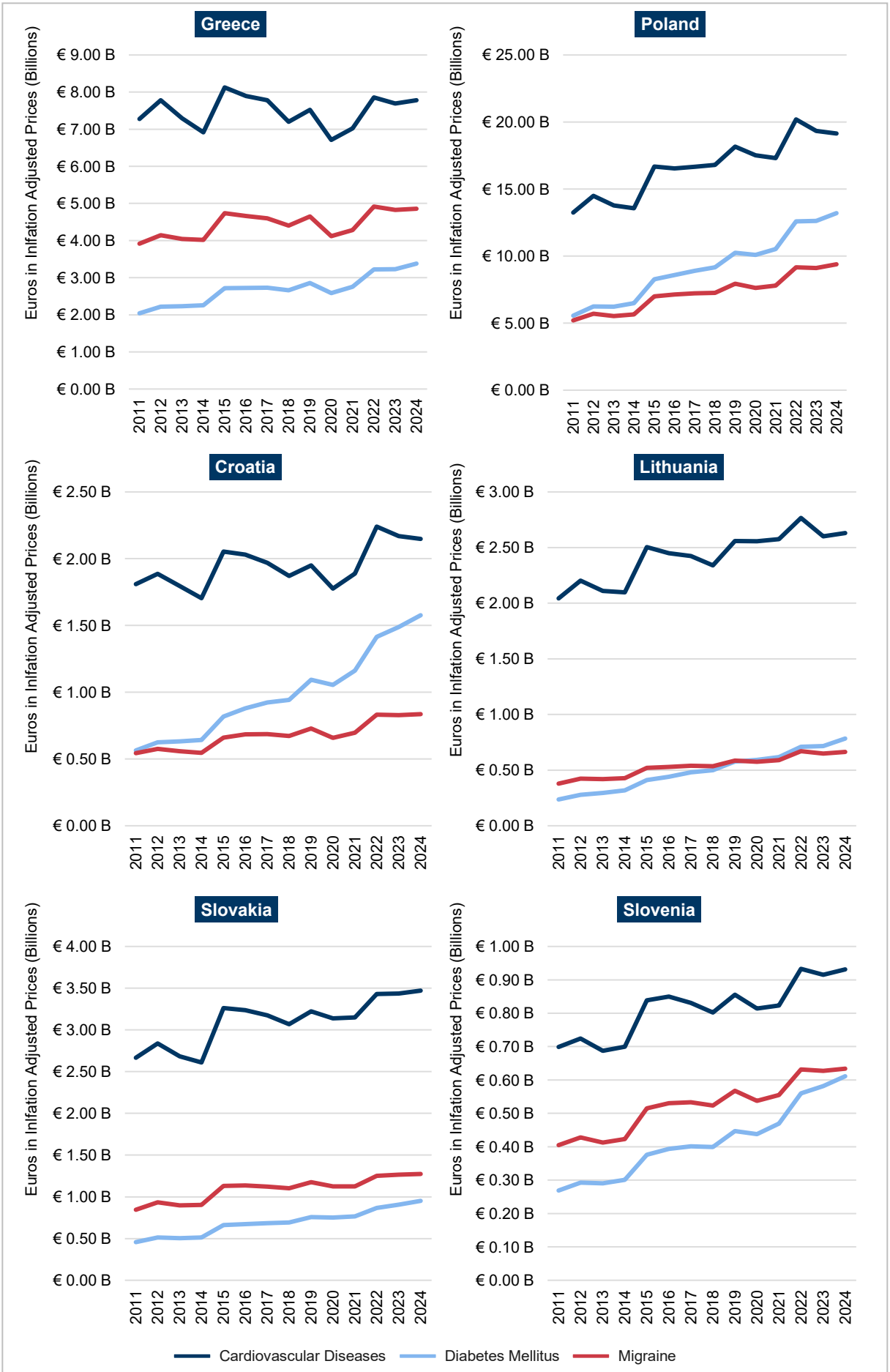

Figure 22. Time Trends in Socioeconomic Burden: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Human Capital Approach, Assuming No Substitution), 2011–2024 (Adjusted Prices)

Source: WifOR elaboration

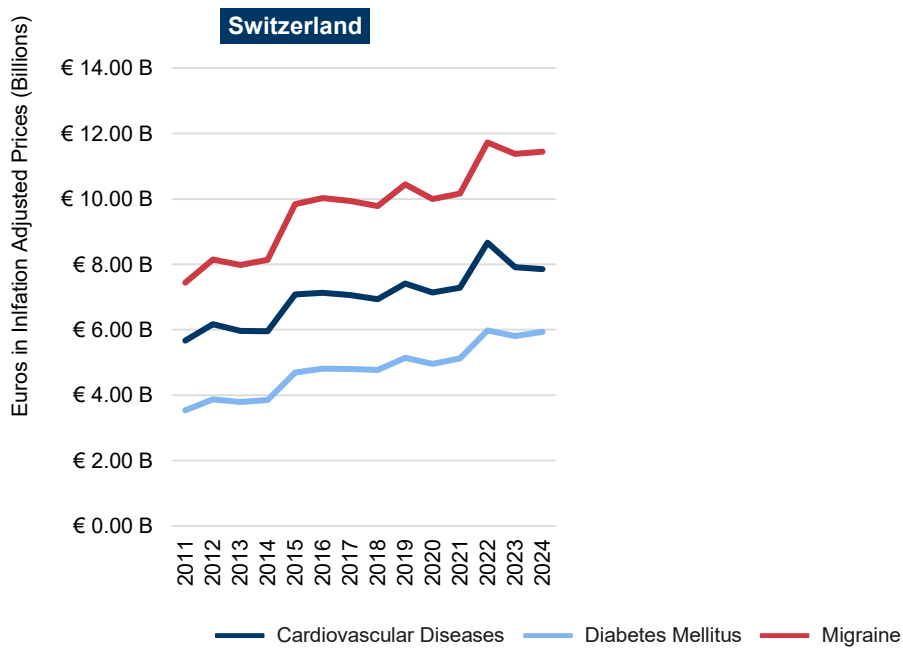

Figure 22. Time Trends in Socioeconomic Burden: Migraine, Cardiovascular Disease, and Diabetes Mellitus (Human Capital Approach, Assuming No Substitution), 2011–2024 (Adjusted Prices)

Source: WifOR elaboration

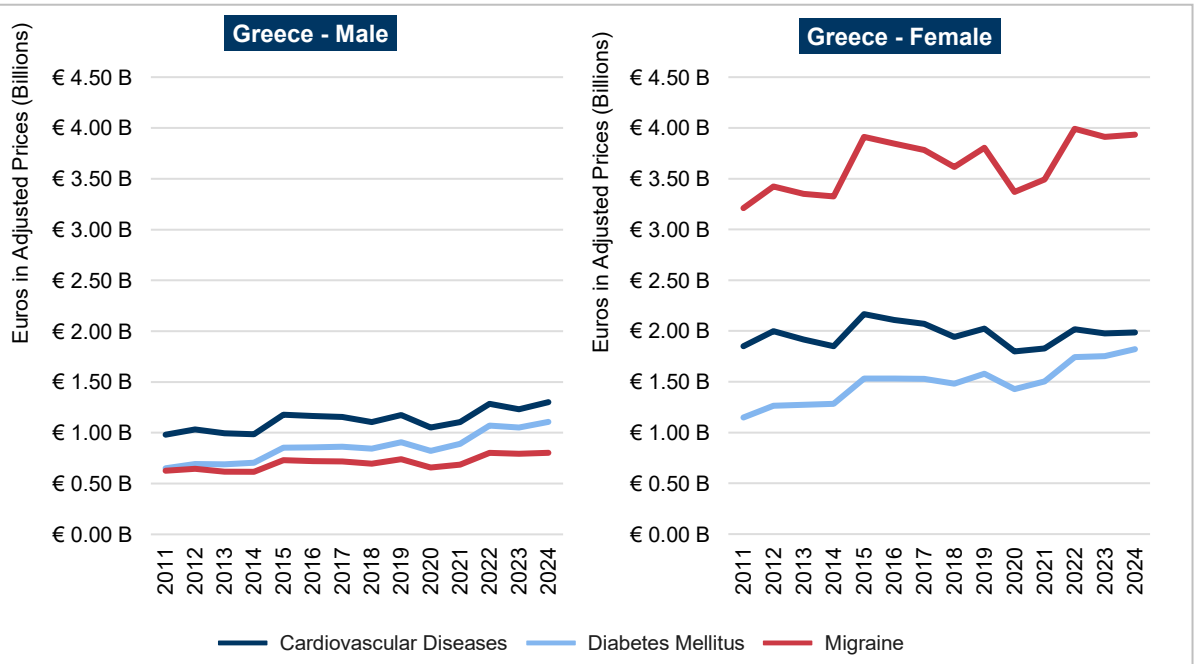

Figure 23. Time Trends in Overall Socioeconomic Burden for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Friction Cost Approach, Assuming Substitution) (Adjusted Prices)

Source: WifOR elaboration

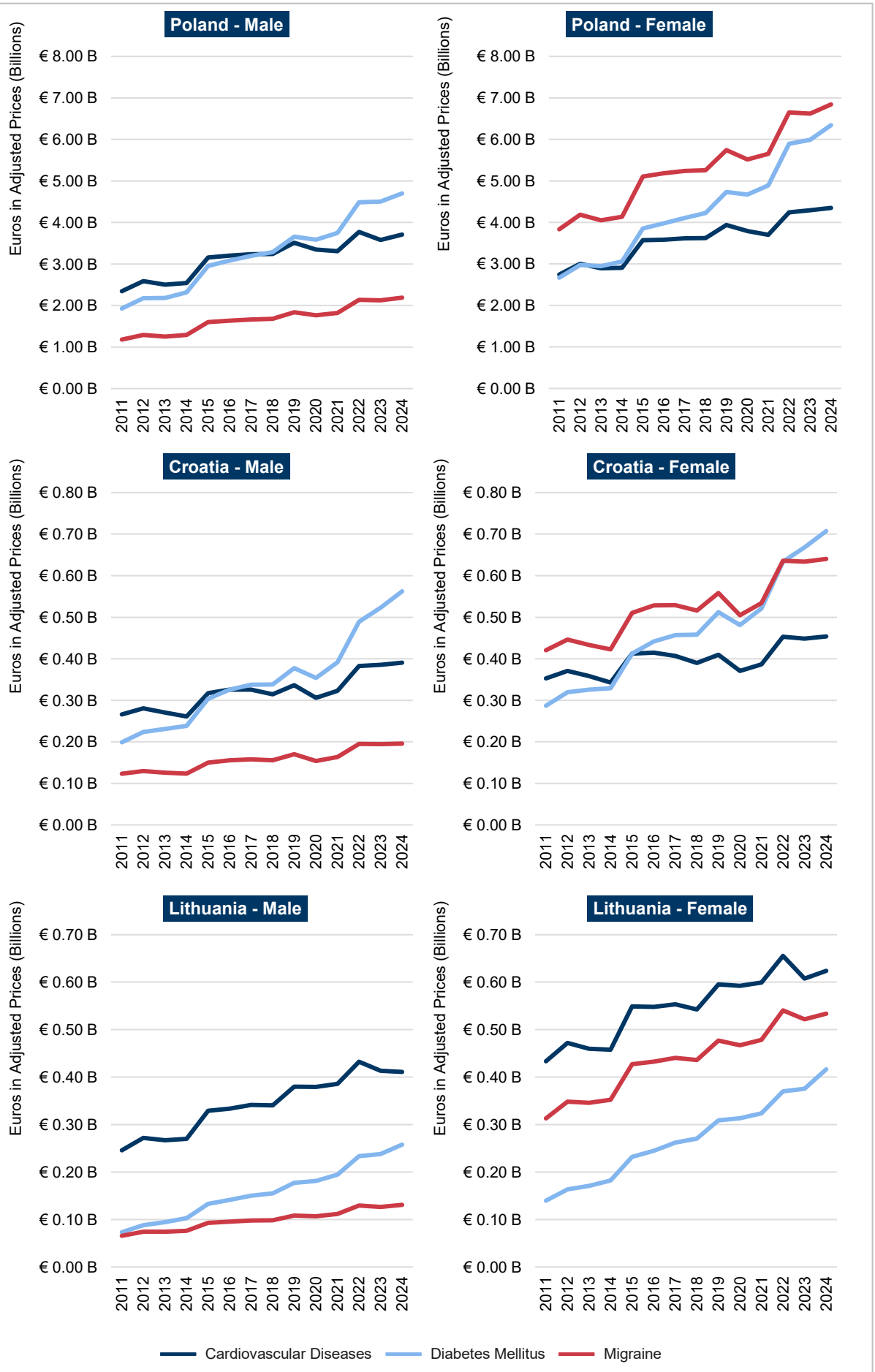

Figure 23. Time Trends in Overall Socioeconomic Burden for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Friction Cost Approach, Assuming Substitution) (Adjusted Prices)

Source: WifOR elaboration

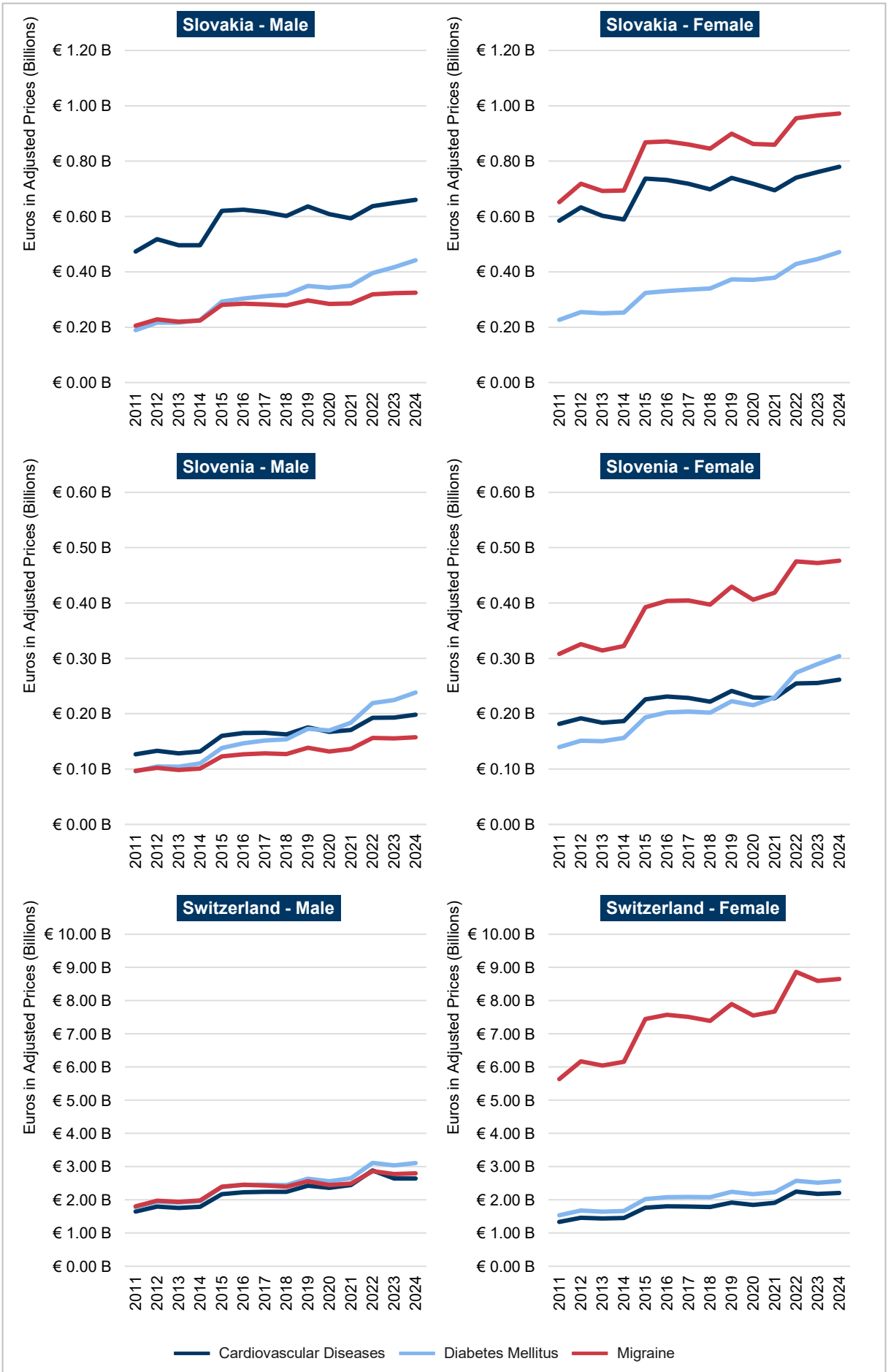

Figure 23. Time Trends in Overall Socioeconomic Burden for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Friction Cost Approach, Assuming Substitution) (Adjusted Prices)

Source: WifOR elaboration

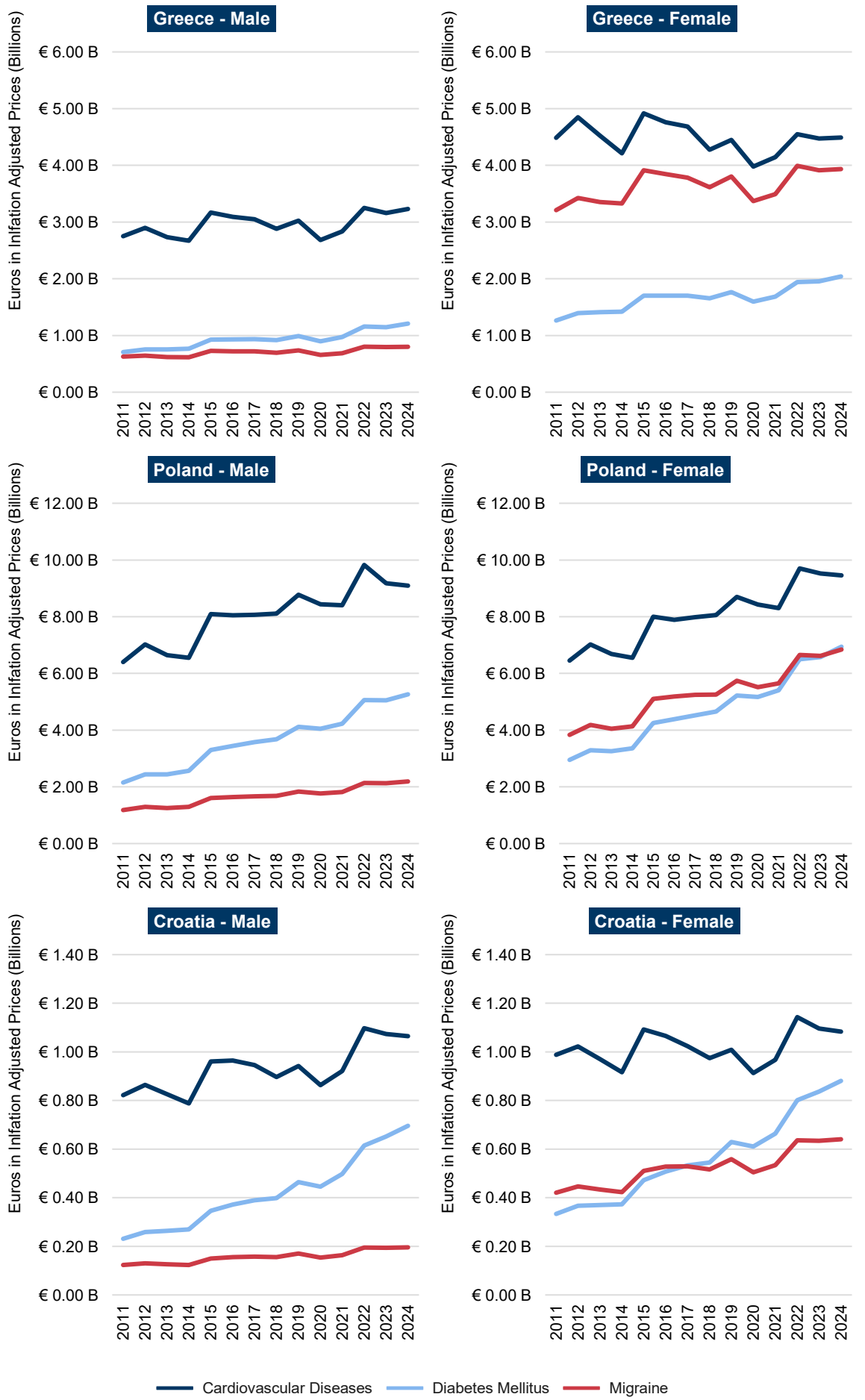

Figure 24.Time Trends in Overall Socioeconomic Burden for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Human Capital Approach, Assuming No Substitution) (Adjusted Prices)

Source: WifOR elaboration

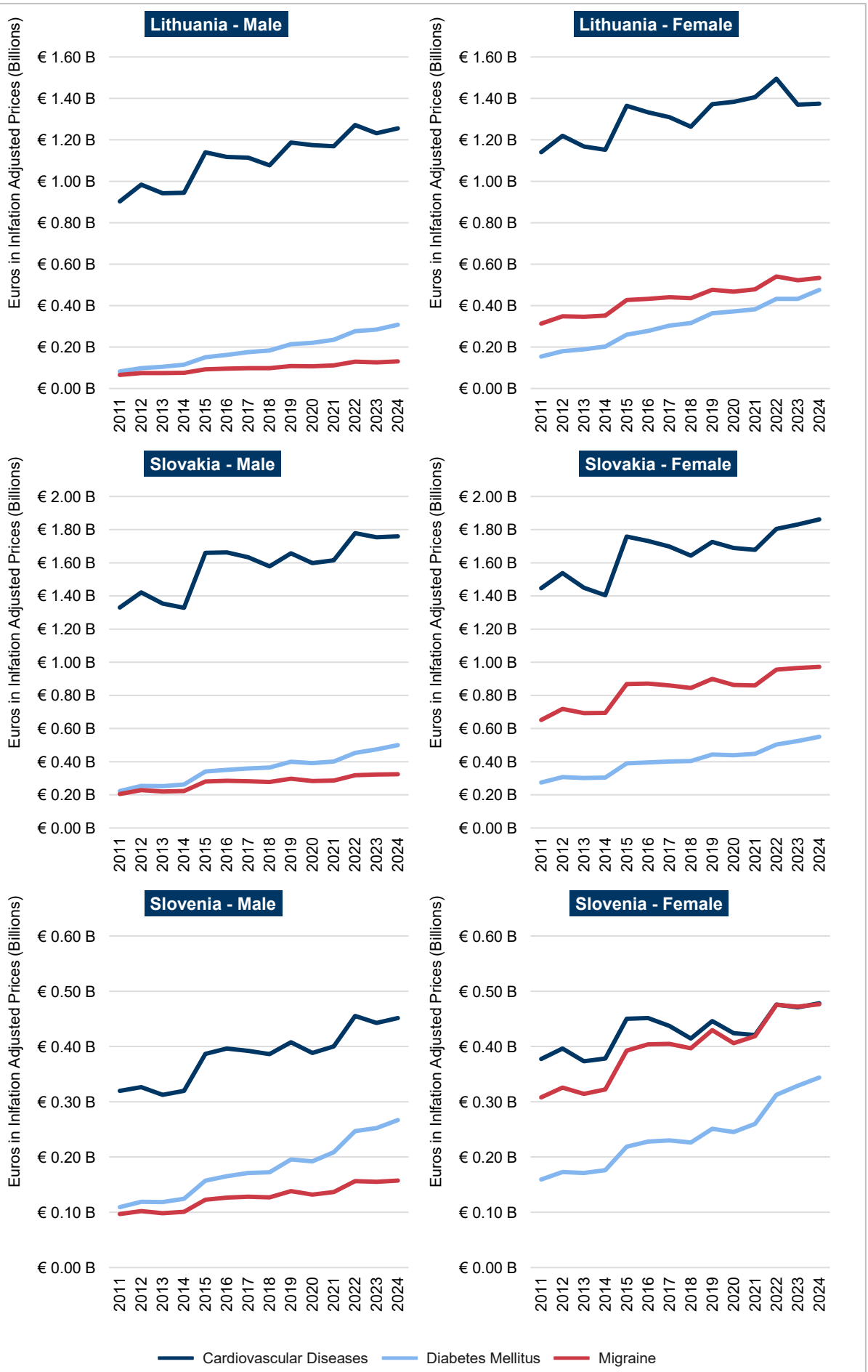

Figure 24.Time Trends in Overall Socioeconomic Burden for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Human Capital Approach, Assuming No Substitution) (Adjusted Prices)

Source: WifOR elaboration

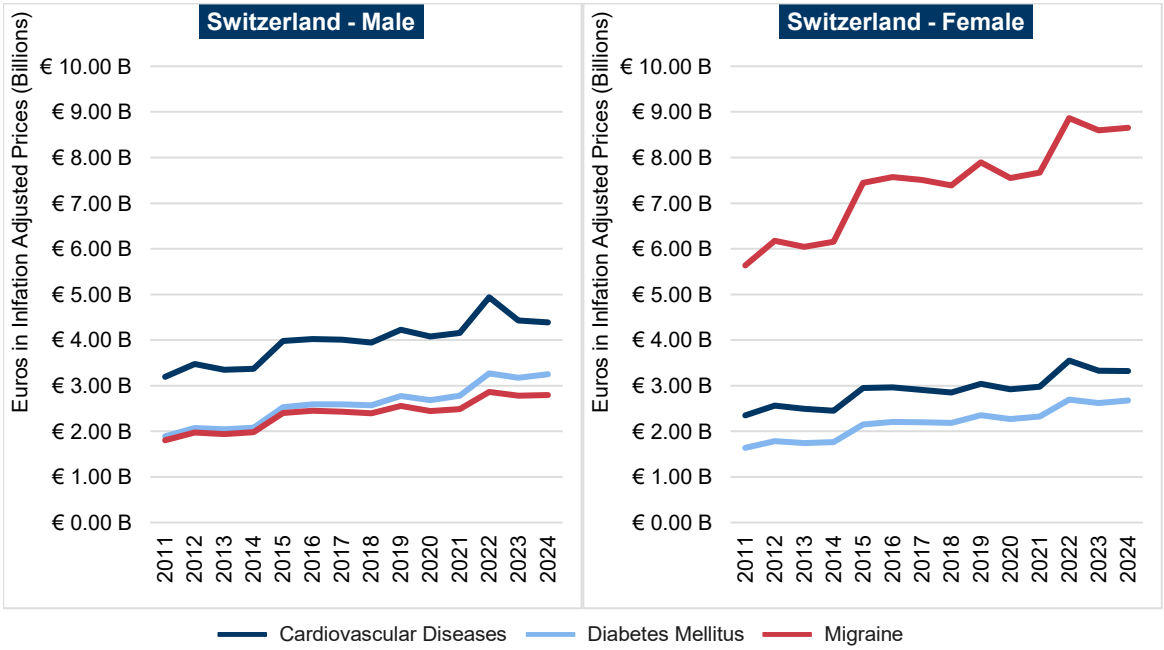

Figure 24. Time Trends in Overall Socioeconomic Burden for Migraine, Cardiovascular Disease, and Diabetes Mellitus, by Country and Gender (Human Capital Approach, Assuming No Substitution) (Adjusted Prices)

Source: WifOR elaboration

4.3 Methodology

This section will provide a more detailed overview of the methodology that is used in this report. Large parts of this section have been published before in earlier publications. Table 1 presents time use data for the included countries sourced from the UN database, describing paid and unpaid working hours, while Table 2, provided at the end of this annex, offers an overview of the indicators employed, their identification approach, and the terminology adopted throughout this manuscript.

4.3.1 Overview of key assumption

For the analysis that is reported in this study, various methodological assumptions had to be made due to data availability and to facilitate the conduct of this study. The first key assumption is related to the use of YLD to estimate productivity losses. Here, it should be noted that DALY equals the loss of one year in full health. The loss of one year in full health is translated into a loss of one year of average working capability for both paid and unpaid work activities. With respect to YLDs, this means that any DALYs lost due to YLDs are assumed to result into a loss of one year of average working capability. However, it assumes a uniform relationship between DALYs and lost working capability across conditions, which may not fully capture disease-specific differences in how disability manifests over time.

The second key assumption is that YLLs and YLDs are having the same effect on productivity. With respect to YLLs, it is possible that particularly in light of the FCA there are differences between countries in the speed to which workers can be replaced. Similarly, also with respect to YLDs, it is possible that there are national differences in how disease affects the productivity of workers, due to difference in presenteeism and absenteeism patterns.

The third key assumption is that the prevalence as reported by the IHME is a good reflection of the national disease prevalence estimates. Of course, on a national level, many methodologies exist to estimate the prevalence of disease. This could mean that there are deviations between national estimates and estimates by the IHME. We opted to use the IHME due to the benefits of using a uniform methodology to estimate prevalence in various countries, which directly results in the possibility to make cross country comparisons of the socioeconomic burden of disease.

4.3.2 Inputs regarding burden of disease

Data from the GBD study was used to evaluate the SOB of migraine, cardiovascular diseases, and diabetes. Specifically, the analysis utilized disease burden data, in terms of mortality and YLD, categorized by 5-year age groups (ranging from 15 to 95+ years), gender (combined), and country. This data covered the period from 2011 to 2024.

4.3.3 Economic inputs

The comprehensive assessment of the economic effects of disease in terms of direct and spillover effects is based on Input-Output (IO) modelling (Conway, 2022). The essential underlying principle of IO models is that the economy

consists of interconnected economic sectors. This means that an increase in production in one sector leads to an increased demand in (intermediate) inputs, the production of which results in additional productivity in other sectors.

To calculate these effects, we utilized an established algorithm from WifOR, which used WIOD (Timmer et al., 2015) and EORA databases (Lenzen et al., 2013). Essentially, for each country, a specific Leontief inverse of the IO matrix is calculated (Leontief, 1986). This represents how change in a unit of output in one sector results in changes in output of all the other industrial sectors of a country. Through the introduction of quotes of each sector that represent the gross value added and the employment needed for a unit of output in each sector, we estimate the indirect effect of how adjacent sectors affect each other's creation of value and the contribution of employment. Additionally, through incorporating household consumption in the Leontief inverse, we account for how changes in productivity of a sector result in changes in demand by households, which leads to an estimation of the induced effects of changes in the productivity of a country.

The analysis is conducted per country, which means that any international effects are not accounted for. Industrial sectors are defined according to the NACE Rev.2 classification (Eurostat, 2008).

For each country, the following multipliers from IO analysis are derived and used to calculate direct, indirect, and induced effects.

- Direct multiplier per revenue increase (hereafter DirMult.Rev): this multiplier reflects the increase in GVA by each sector, for every additional 1 million USD in revenue (i.e. gross output, total value of sales, production value).
- Indirect multiplier per revenue increase (hereafter IndirMult.Rev): this multiplier reflects the effect of an increase in 1 million USD sector revenue on GVA.
- Induced multiplier per revenue increase (hereafter InducMult.Rev): this multiplier reflects the effect increased expenditures due to increases in directly or indirectly generated income due to an increase in 1 million USD sector revenue on GVA.
- GVA per economic sector (million USD) (hereafter GVA.PSector): this is an estimation of GVA generated per economic sector, that is based on the IO matrices of a country.
- Employees per economic sector (million of people) (hereafter EMP.PSector): an estimation of the number of employees per economic sector, based on IO matrices of a country.

4.3.4 GVA effects from paid work

Understanding how disease burden impacts individual productivity requires estimating the GVA generated per person. In the case of paid work, this is further narrowed down as the GVA generated by an employed person. The World Bank defines an employed person as "persons of working age who, during a short reference period, were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period (i.e., who worked in a job for at least one hour) or not at work due to temporary absence from a job, or to working-time arrangements" (World Bank, 2024).

In order to study the impact of disease on the GVA of paid work, three different effects are assessed:

- Direct effects: these effects reflect the immediate impact of a decrease in paid work due to disease.
- Indirect effects: these effects reflect the decrease in GVA due to a decrease in intermediate consumption.
- Induced effects: these effects reflect the decrease in GVA due to a decrease in expenditures by households.

The three multipliers introduced in the previous section (DirMult.Rev, InderMult. Rev and InducMult.Rev) are needed to evaluate these three different effects from paid work (direct, indirect and induced effects), as well as the estimation for the GVA per economic sector (GVA.PSector).

Direct effects:

To estimate direct effects, a monetization of the average GVA per employee is calculated. For each country (c) and year (t), this is estimated by dividing the total GVA of a country (GVA.2015Pr) by the number of employed individuals in a population aged 15 years or older (Employees.15m), with the following equation:

$$DirectEffect.PerEmployee_{c,t} = GVA.2015Pr.PerEmployee_{c,t} = \frac{GVA.2015Pr_{c,t}}{Employees.15m_{c,t}}$$

Indirect effects:

To estimate indirect effects, we account for the interconnections between economic sectors. The indirect effect of disease therefore assesses the losses in productivity that are a consequence of a loss of demand for intermediate goods and services. Here, we again estimate indirect effects in terms of GVA per person. To do so, the input IndirMult.Rev (indirect multiplier per revenue increase) is transformed into IndirMult.GVA (indirect multiplier per GVA increase), by making use of the input DirMult.Rev (direct multiplier per revenue increase). For this, the following formula is used for each country (c) and economic sector (s):

$$IndirMult.GVA_{c,s} = \frac{IndirMult.Rev_{c,s} - DirMult.Rev_{c,s}}{DirMult.Rev_{c,s}}$$

To comprehensively capture the indirect multiplicative effects across all sectors, we applied the indirect total economy-wide average multiplier (TAv.MultIndir.GVA) for each country (c). This multiplier is calculated by dividing the total indirect GVA effects across the economy (i.e., the sum of indirect effects by economic sector, or GVA.Psector*IndirMult.GVA) by the total GVA. The latter is obtained from the sum of GVA generated by each economic sector (GVA.Psector), based on IO analysis.

$$TAv.MultIndir.GVA_c = sum_{s=1}^{S}(GVA.Psector_{c,s} * IndirMult.GVA_{c,s}) / sum_{s=1}^{S}(GVA.PSector_{c,s})$$

Since only cross-sectional data, not time series data, is available for multipliers and GVA per sector, we assume that both the multipliers and the sectoral GVA distribution remain constant over time. As a result, we applied the average indirect GVA multiplier (TAv.MultIndir.GVA) to the direct effects derived from the time series data provided by the World Bank (DirectEffect). The indirect effects were then calculated by multiplying the average indirect GVA multiplier with the direct GVA effects in the economy.

$$IndirectEffect_{c,t} = DirectEffect.PerEmployee_{c,t} * TAv.MultIndir.GVA_c$$

Induced effects:

Direct and indirect effects occur across multiple sectors, generating induced effects throughout different parts of the value chain. Therefore, we need to estimate the induced effect multiplier per additional dollar of GVA (InducMult.GVA), rather than per additional dollar of sector revenue increase. This is obtained from dividing the induced effect multiplier per revenue increase (InducMult.Rev) by the direct multiplier per revenue increase (DirMult.Rev):

$$InducMult.GVA_{c,s} = \frac{InducMult.Rev_{c,s}}{DirMult.Rev_{c,s}}$$

To comprehensively capture the multiplicative effects across all sectors, we applied the induced total economy-wide average multiplier (TAv.MultInduc.GVA) for each country (c). Similarly as before, this multiplier is calculated by dividing the total induced GVA effects the economy (GVA.Psector*InducMult.GVA) by the total GVA.

$$TAvMultInduc.GVA_c = sum_{s=1}^{S}\left(GVA.Psector_{c,s} * InducMult.GVA_{c,s}\right)/sum_{s=1}^{S}(GVA.PSector)$$

As in the case of the indirect effects, we assume that these multipliers and the GVA distribution per sector remain constant over time. As a result, the induced effects are calculated by multiplying the average induced GVA multiplier (TVaMultInduc.GVA) with the direct GVA effects in the economy (DirectEffect):

$$InducedEffect_{c,t} = DirectEffect_{c,t} * TAvMultInduc.GVA_c$$

Total paid work effects:

The average effect of disease on reducing paid work (PaidW.PerEmployee) is then equal to the sum of the three calculated effects (DirectEffect, IndirectEffect and InducedEffect).

$$PaidW.PerEmployee_{c,t} = DirectEffect_{c,t} + IndirectEffect_{c,t} + InducedEffect_{c,t}$$

4.3.5 GVA effects from unpaid work

Given the nature of unpaid work, an indirect estimation of its productivity in monetary terms is necessary. To do so, several issues must be considered. First, it is important to account for the differences in productivity between countries. These differences are the result of different factors, such as the level of investment in the human or physical capital, or institutional and governmental policies (Hall & Jones, 1999). Second, due to the nature of unpaid work (e.g. preparation of meals, household upkeep, care taking of family), it is likely that there is a difference in the value of the productivity of unpaid work as compared to paid productivity in other sectors. To address this difference, we use data from a sector that is similar to unpaid work. To illustrate this, we assume that the value of household upkeep by an unpaid worker is similar to the productivity of hired household help.

To account for the differences between countries, the general approach is to start our estimation of the value of unpaid work of a certain country by calculating the relationship between time spent on paid and unpaid work for the different countries. Then, we initially assumed the same level of productivity in terms of GVA for both paid and unpaid work. After “anchoring” the value of unpaid work to the GVA of paid work of a country, we adjust the value of unpaid work with information about the value of productivity in terms of GVA of a sector that produces similar output as paid work. Following the second revision of the Statistical Classification of Economic Activities in the European Community (NACE Rev. 2), we assume that the sector with output most similar to unpaid work is “Sector T”, which reflect the output of “households as employers; undifferentiated goods- and services-producing activities of households for own use” (Eurostat, 2008). For simplicity, we call this sector Unpaid Substitution Economic Sector (USES) from here onwards.

In more detail, we used a combination of time-use survey data, data from the IO analysis and data from the World Bank. With time-use survey data, we calculate the ratio of time spent on unpaid work per hour to time spent on paid work per individual.

As already explained in the method section, this data presents time use across different specific categories, such as time used on having meals, commuting, or work. These categories were reclassified to paid and unpaid work according to the International Classification of Activities for Time Use Statistics 2016 (United Nations Statistics Division, 2017). Consequently, the time spent on work was used as an indicator for paid work, and time spent on housework, taking care of family, educating children, shopping or errands as indicators for time spent on unpaid work. This resulted in the following parameter inputs:

Table 1. Paid and unpaid working hours - (United Nations Statistics Division, 2026)

Country	Gender	Paid work hours	Unpaid work hours
Croatia*	Male	3.78	2.43
	Female	2.77	4.07
Greece	Male	3.12	1.60
	Female	1.90	4.20
Lithuania	Male	3.38	2.00
	Female	2.47	4.02
Poland	Male	4.32	2.38
	Female	2.50	4.38
Slovakia	Male	4.49	2.53
	Female	3.38	4.70
Slovenia*	Male	4.35	2.67
	Female	3.15	4.93
Switzerland	Male	3.82	2.75
	Female	2.52	4.16

*See section 1.2 in the full text regarding data adaptations – these are not solely informed by UN Statistics division.

These inputs were used to calculate work time ratios, with the following formulas:

$$WorkTimeRatio_{c,t} = UnpaidHours_c / PaidHours_{c,t}$$

Where UnpaidHours is the number of unpaid hours worked, PaidHours is the number of hours spent on paid work by country (c) and year (t).

Then, per employee, an estimation is made regarding the value of their unpaid work in terms of GVA. This is done with the following formula:

$$UnpaidWork.PerEmployee_{c,t} = (GVA.2015Pr_{c,t} * WorkTimeRatio_{c,t}) / Employees.15m_{c,t}$$

With GVA.2015Pr being the GVA of a country in 2015 USD, WorkTimeRatio the ratio calculated in equation 9, and Employees.15m the number of paid workers 15 years and older, by country (c), and year (t). This value essentially represents the value of unpaid work activities in terms of the average GVA produced in a country. However, as mentioned, this value needs further adjustment to more closely resemble the real value of unpaid work. This adjustment is explained in the next steps.

With data from the IO analysis, an estimation is made about the proportion of GVA that is contributed by USES relative to the output of all economic sectors. Assuming that this proportion remains stable over time, the annual

GVA figures from the World Bank are multiplied by this proportion, to estimate the yearly contribution of USES to GVA over time. Following this, we calculate the proportion of individuals working in USES relative to all employees in all sectors and use this proportion to calculate the annual number of workers in USES over time. Then, we estimate the productivity per employee working in USES per year (GVA.2015Pr.PerEmployee.USES) by dividing the estimated contribution to GVA per year by the estimated number of employees working in USES. These steps are summarized in the following equation:

$$GVA.2015Pr.PerEmployee.USES_{c,t} = \left(\frac{GVA.PSector.USES_{c,USES}}{sum_{s=1}^{S}(GVA.PSector_{c,s})}\right) * GVA.2015Pr_{c,t} / \left(\frac{EMP.PSector.USES_{c,USES}}{sum_{s=1}^{S}(EMP.PSector_{c,s})}\right) * Employees.15m_{c,t}$$

Where GVA.PSector.USES corresponds to the GVA in the USES sector, EMP.PSector.USES to the number of people employed in the USES sector by country (c). It should be noted that there are deviations in both the GVA and number of employees between the World Bank and IO analysis, due to differences in the exact way that these numbers are estimated.

With the estimated GVA per person for employees in the USES sector, a ratio is calculated which represents the productive value of an employee working in this sector relative to the productive value of an employee in the general population (GVA.Unpaid.AdjRatio). This ratio is calculated by dividing the per person GVA added of an employee in the USES sector by the general per person GVA of an employed individual, with the following formula:

$$GVA.Unpaid.AdjRatio_{c,t} = GVA.2015PR.PerEmployee.USES_{c,t} / GVA.2015Pr.PerEmployee_{c,t}$$

This ratio is then finally used to adjust the value of unpaid work calculated earlier (UnpaidWork.PerEmployee), using the following formula:

$$UnpaidWork.Adj.PerEmployee_{c,g,t} = UnpaidWork.PerEmployee_{c,g,t} * GVA.Unpaid.AdjRatio_{c}$$

4.3.6 Health outcome metrics and the SOB of disease

For the SOB of disease analysis, we assume on a general level that individuals contribute to society in terms of paid and unpaid work throughout the year, and that years lost due to morbidity or mortality lead to losses in productivity. To calculate these lost years, we use the Disability Adjusted Life Year (DALY) concept by the GBD of disease study (IHME, 2026). DALYs are calculated on the basis of Years Lived with Disability (YLDs) and Years of Life Lost (YLL). These metrics have been developed to make it possible to compare morbidity and mortality across diseases.

In order to evaluate the impact of disease in terms of YLD and YLL on productivity, we need to establish the maximum age that individual can stay productive. In other words, the maximum productive age needs to be established. For paid work, the effective retirement age was considered to be the most appropriate measure. The effective retirement age represents the average age at which individuals cease employment, in contrast to the official retirement age established by government policy. The latest OECD report, "Pensions at a Glance 2025", provides effective retirement age data divided by sex for the included countries (OECD, 2025).

For unpaid work instead, we assume that people remain productive until the age of 85. Combined, the value of both paid and unpaid work is comprehensively assessed.

To evaluate the effect of morbidity on productivity, we use YLDs. YLDs represent the burden of disease on those living with a disease. This burden is reflected as the "health" that is lost living with disease. Through the way that this health loss is estimated, this burden reflects years lost. To illustrate, if a disease results in a burden of 0.5, then two years of living with this disease is equal to living 1 year in complete health, or in other words, over a period of 2 years, someone living with a disease with a burden of 0.5 "loses" 1 year of life. In relation to productivity, we assume that these losses reflect lost time in productivity due to absenteeism and presenteeism. To monetize this loss in productivity (MVal.YLD.UnpaidW.PerEmployee and MVal.YLD.PaidW.PerEmployee), the country- and year-specific YLD of a disease (YLD) is multiplied with the country- and year average paid and unpaid work productivity (UnpaidWork.Adj.PerEmployee and PaidW.PerEmployee).

For unpaid work, the following formula is used:

$$MVal.YLD.UnpaidW.PerEmployee_{c,t} = UnpaidWork.Adj.PerEmployee_{c,t} * YLD_{c,g,t}$$

Where (c) represents the country and (t) represents the year.

For paid work, we use the following formula, which also account for the proportion of individuals who is employed with the variable EmplToPop.15m.T.Per:

$$MVal.YLD.PaidW.PerEmployee_{c,t} = PaidW.PerEmployee_{c.t} * EmplToPop.15m.T.Per_{c,t} * YLD_{c,t}$$

Where again (c) represents country, and (t) represents year.

The total monetary value of the lost productivity due to the morbidity of a disease for a specific country and year (MVal.YLD.PerEmployee) is then calculated by the sum of productivity losses in paid and unpaid work with the following formula, by (t) year and (c) country:

$$MVal.YLD.PerEmployee_{c,t} = MVal.YLD.UnpaidW.PerEmployee_{c,t} + MVal.YLD.PaidW.PerEmployee_{c,t}$$

To evaluate the effect of mortality on productivity, we calculate an adapted version of YLL. Where in the original GBD study YLL represents the life years lost in relation to life expectancy, we are interested in productive YLL lost, thus related at productive life expectancy. To calculate our adapted YLL, we use mortality estimated from the GBD study by age group, country, and year. To monetize the productivity losses related to YLL lost, we use two approaches: the FCA and the HCA.

For the FCA, we assume that the productivity of an individual can be replaced by another individual. To illustrate, if a company loses an employee through disease, then the company might hire a substitute, or might innovate, or conduct further adaptation to the production process to substitute the loss of an employee. This, of course, takes time. In this report, we therefore assume that the loss in productivity due to mortality is one year, or in other words, we assume that per deceased person, one year of productive work is lost.

Productive years of life lost are therefore the sum of all the deaths by country (c), year (t), and age group (a) as follows:

$$YLLFCA_{c,t} = sum_{a=1}^{A}(Deaths_{c,t,a})$$

Where the oldest age group for unpaid work is 80 to 84, the oldest age group for paid work depends on the effective retirement age of different countries as previously mentioned. In our analysis, we used a report from the OECD (OECD, 2025), in which the following effective retirement ages by sex were identified: Croatian men and women 63, Greek men 64, Greek women 62, Lithuanian men and women 64, Polish men 64, Polish women 61, Slovakian men 63, Slovakian women 61, Slovenian men 61, Slovenian women 60, Swiss men 65, Swiss women 64. The monetized loss of these years is calculated with the following formula for unpaid work:

$$MVal.YLLFCA.UnpaidW.PerEmployee_{c,t} = UnpaidWork.Adj.PerEmployee_{c,t} * YLLFCA_{c,t}$$

Where UnpaidWork.Adj.PerEmployee refers to the earlier estimated monetary value of one year of an individual's unpaid productivity for a specific (c) country, and (t) year. For paid work, the following formula is used:

$$MVal.YLLFCA.PaidW.PerEmployee_{c,t} = PaidW.PerEmployee_{c,t} * EmplToPop.15m.T.Per_{c,t*}YLLFCA_{c,g,t}$$

Where PaidW.PerEmployee refers to the earlier estimated monetary value of the individual's productivity of paid work, and EmplToPop.15m.T.Per refers to the proportion of employed people by (c) country, and (t) year. The total loss in productivity due to mortality in terms of FCA is then calculated by summing the loss in productivity of paid and unpaid work with the following formula, by (c) country, and (t) year:

$$MVal.YLLFCA.PerEmployee_{c,g,t} = MVal.YLLFCA.UnpaidW.PerEmployee_{c,t} + MVal.YLLFCA.PaidW.PerEmployee_{c,t}$$

For the HCA, it is assumed that an individual's death during her or his productive years results in a loss of productivity that cannot be replaced. Here, it is important to recall that productive years are defined according to effective retirement age for paid work and 84 years for unpaid work. Given that we have mortality data by age groups, we conduct the following steps to calculate the years of productive life that are lost:

- From the GBD study, the smallest range available for age groups are selected, which is mortality by 5-years (e.g. mortality in the age group of 15 to 19 years old, mortality in the age group of 20 to 24 years old etc.).
- On average, we assume that the average age of death within an age group is the midpoint of that age group. To illustrate, in the age group 20 to 24, we assume that the average of death is 22.5.
- To calculate the productive years of life lost for an age group, we then subtract the maximum productive age of paid and unpaid work from the average mentioned in the last step. For example, for the age group of 20 to 24, we subtract as follows: 84-22.5 = 61.5 productive years of unpaid work lost if an individual dies within this age group.
- To calculate the full number of years of life lost due to the number of deaths, we multiply the number of deaths per age group with the age specific value of productive years lost (e.g. number of deaths in age group 20-24 multiplied by 61.5 for unpaid work). For paid and unpaid work, these are referred to as YLLpaid and YLLunpaid.
- To value future productivity losses to the respective year that an individual dies, a discount rate of 3.5% is applied.

These steps above can be summarized by the following formulas:

$$MVal.YLLHCA.UnpaidW.PerEmployee_{c,g,t} = sum_{a=1}^{A}\left[sum_{i=1}^{YLLunpaid}\left[Deaths_{a,c,t} * UnpaidWork.Adj.PerEmployee_{c,t} * \frac{1}{(1+DiscRate)^{i}}\right]\right]$$

Where a = age group, i= each year of productive life lost (i= 1…YLLunpaid or YLLpaid), c= country, t = to the evaluated year, and DiscRate = 3.5%.

The monetary value of SOB of disease due to mortality calculated with the HCA is the sum of paid and unpaid productivity losses, which is calculated with the following formula:

$$MVal.YLLHCA.PerEmployee_{c,g,t} = MVal.YLLHCA.UnpaidW.PerEmployee_{c,t} + MVal.YLLHCA.PaidW.PerEmployee_{c,t}$$

It should be noted that there are extensive debates in health economic literature whether the FCA or HCA should be used, see for example (Brouwer & Koopmanschap, 2005) and (Targoutzidis, 2018). In this report, we refrain from making a judgement in this debate but do consider the FCA the conservative approach for estimating productivity losses. We therefore mainly report FCA based estimates throughout this study.

The complete SOB of disease, due to both mortality and morbidity, is then the sum of the productivity losses calculated with YLD and productivity losses calculated with life years lost (according to the HCA and the FCA). For this, the following formula is used, by (c) country, and (t) year:

$$MVal.Total.PerEmployee_{c,t} = MVal.YLD.Total.PerEmployee_{c,t} + MVal.YLL.Total.PerEmployee_{c,t}$$

Name in formulas	Name in data source	Reference
Disease parameters		
YLD*	YLD	(IHME, 2026)
Deaths	Mortality	(IHME, 2026)
Economic parameters		
GVA.2015Pr	GVA 2015 US$†	(World Bank, 2026b)
GVA.CurrPr	GVA current US$	(World Bank, 2026b)
GDP.2015Pr	GDP 2015 US$	(World Bank, 2026b)
GDP.CurrPr	GDP current US$	(World Bank, 2026b)
EXR.A.USD.EUR.SP00.A	Exchange rates Euro/US dollar 2011-2021	(European Central Bank, 2026)
IndirMult.Rev	Not applicable, not public	WifOR's input/output model

Name in formulas	Name in data source	Reference
InducMult.Rev	Not applicable, not public	WifOR's input/output model
GVA.PSector.USES	Not applicable, not public	WifOR's input/output model
GVA.PSector	Not applicable, not public	WifOR's input/output model
EMP.PSector.USES	Not applicable, not public	WifOR's input/output model
EMP.PSector	Not applicable, not public	WifOR's input/output model
Effective retirement age	Retirement Age Men/Women	(OECD, 2025)
Time use		
UnpaidHours	Total time spent on unpaid domestic and care work	(United Nations Statistics Division, 2026)
PaidHours	See explanation in the annex	(United Nations Statistics Division, 2026)
Demographic		
Pop.1564.T	Population ages 15-64, total	(World Bank, 2026b)
Pop.60m.T	Population ages 65 and above, total	(World Bank, 2026b)
EmplToPop.15m.T.Per	Employment to population ratio, 15+, total (%) (modeled ILO estimate)	(World Bank, 2026b)

*Table 2. Variables and data sources. *YLD: years lived with disability, †GVA: gross value added*

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