FREE JURA – Wissenschaftliche Grundlage

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Keine Handelsbremsen

Free Jura

Summary (DE)

Traditionelle Wirtschaftsstrategien geraten in Zeiten zunehmender geopolitischer Volatilität und wachsenden wirtschaftlichen Protektionismus vermehrt unter Druck. Diese Arbeit untersucht ein experimentelles wirtschaftspolitisches Instrument: die Einrichtung einer Sonderwirtschaftszone (SWZ) im Kanton Jura in der Schweiz. Der Jura ist historisch von strukturellen wirtschaftlichen Herausforderungen, wie einer hohen Staatsquote und Arbeitslosigkeit, geprägt. Deshalb dient er als Fallbeispiel für diese Arbeit.

Mithilfe des von Caliendo und Parro entwickelten quantitativen allgemeinen Gleichgewichtsmodells für den globalen Welthandel simuliert diese Studie kontrafaktische Szenarien einer Handelsliberalisierung zwischen dem Jura und grossen globalen Wirtschaftsblöcken, darunter die Europäische Union und die BRICS-Staaten. Die Ergebnisse zeigen, dass eine strategisch ausgerichtete SWZ die lokale Produktion erheblich steigern und potenzielle Wohlfahrtsgewinne von bis zu 6,53% erzielen könnte. Diese Resultate implizieren, dass eine SWZ das Wirtschaftswachstum und den Wohlstand des Kantons fördern könnte, ohne dabei die übergeordneten wirtschaftlichen Rahmenbedingungen der Schweiz zu beeinträchtigen.

Im Rahmen der Arbeit wurde ein flexibles, datengestütztes Modell für einzelne Regionen entwickelt, welches ermöglicht, wirtschaftliche Chancen durch individuelle Handelspolitik zu ermitteln.

Abstract

In an era of increasing geopolitical volatility and rising economic protectionism, traditional economic strategies are facing increased strain. This thesis investigates a novel policy instrument: the establishment of a Special Economic Zone (SEZ) in the Canton of Jura, Switzerland. Historically characterized by structural economic challenges, such as a high public expenditure ratio and unemployment, Jura serves as a compelling case study for regional revitalization.

By applying the quantitative general-equilibrium trade model developed by Caliendo and Parro, this research simulates counterfactual scenarios of trade liberalization between Jura and major global blocs, including the European Union and the BRICS nations. The findings reveal that a strategically oriented SEZ could substantially increase local production and yield potential welfare gains of up to 6.53%. These results suggest that such a zone could capitalize on an increasingly multipolar world, promoting economic growth and prosperity for the canton without compromising the broader Swiss economic framework.

Ultimately, this study delivers a flexible, data-driven model for individual regions to assess how to implement independent trade policies to evolve in a dynamic global economy.

Preface

The year 2025 was characterized by uniquely confusing global trade policy in Switzerland which really went into overdrive on the 2nd April, also called ”Liberation Day” on which President Donald Trump of the USA declared new ”Reciprocal” tariffs which targeted almost every country with a tariff rate of 10% or higher. Switzerland was among the countries hit the hardest by these initial tariffs, ”receiving” a tariff of 31% on ”Liberation Day”.

But ”Liberation Day” was just the start of the chaos. After conversations between the Trump administration and the Swiss government, the administration set tariffs even higher, up to 39%. This created fears among many businesses and individuals working and living in Switzerland about the economic future of the country. After long negotiation, the USA and Switzerland settled their tariff dispute with an increase of a maximum of 15% in each sector. Fast forward to Spring 2026 the tariffs have been universally declared to be unlawful by the supreme court of the USA and might be repaid to companies charged with them.

Besides the tariff disputes also other events have shown us in recent times how fragile our global supply chain can be and how crucial it is not only for politicians and economists but also for companies and individuals to have a general understanding about the forces at play in the world and how our supply chains work. An example is the 2026 closure of the Strait of Hormuz which is still ongoing and has impacted the global supply chains and also the local economy of Switzerland more severely than many people had expected. This article aims to make tools to model economies more accessible to all sorts of stakeholders by explaining the application in a more technically graspable way.

As concerned citizens and graduating students we wanted to deepen our understanding of these economic systems and apply our competences to build the knowledge to make responsible and educated decisions in our future career and life. It is therefore that we decided to make the focus of our Bachelor’s thesis about a topic which is very new to us and required a lot of effort to learn about.

The methodology and framework applied in this article are highly versatile and can be used to assess the effects of tariff changes between any group of countries for which sufficient data are available. Although this research primarily focuses on applying the model to study a potential SEZ, we developed a comprehensive pipeline supported by an extensive dataset covering all UN member states as well as Chinese Taipei.

Contents

1. Introduction

1.1. Background

In recent years, the Swiss economy has faced increasing challenges due to geopolitical uncertainty and volatile international trade policies, particularly those originating in the United States of America in 2025 [1]. As a highly open and export-oriented economy, Switzerland remains strongly exposed to shifts in the global economic environment and changes in international trade relations. Recent developments, including the imposition of substantial tariffs on Swiss exports, have highlighted the vulnerability of key industrial sectors and intensified the need for strategic economic diversification.

At the same time, public discourse has increasingly begun to question the relatively dominant position of the United States in the international economic system, while voices calling for a more "multipolar world" have gained prominence [2]. In such a setting, global economic power is expected to become more distributed across multiple economic blocs, including emerging markets and large-scale international initiatives such as the Belt and Road Initiative (BRI). These developments may fundamentally reshape trade networks and patterns of international economic cooperation.

Beyond external challenges, Switzerland is also facing growing internal fiscal pressures. The federal debt brake, introduced following the referendum of December 2, 2001, legally binds the Confederation to maintain a balanced budget over the business cycle [3]. At the same time, recent policy decisions are expected to significantly increase public expenditures. In particular, the acceptance of the "13th AHV pension" initiative in 2024 will place additional strain on the social security system, with projections indicating a negative pay-as-you-go balance from 2026 onward and a deficit of approximately 5 billion CHF by 2033 [4]. Furthermore, large-scale public investment projects, such as the procurement of F-35 fighter jets, have generated substantial unforeseen costs, adding further pressure to public finances.

These developments imply that Switzerland must either increase public revenues or identify alternative mechanisms to ensure fiscal sustainability. While raising taxes represents one option, it may negatively affect economic competitiveness. Alternatively, fostering economic growth would expand the tax base and thereby increase government revenues without requiring higher tax rates. This creates a strong incentive to explore innovative policy instruments that can stimulate economic activity while maintaining Switzerland's fiscal framework.

In light of both external and internal challenges, it is becoming increasingly important for policymakers and researchers to examine how the Swiss economy can remain agile and adapt to evolving global economic structures. Addressing these challenges requires innovative policy approaches and a thorough quantitative evaluation of potential opportunities for new forms of trade integration and economic cooperation, particularly with emerging economic regions.

One such policy instrument is the establishment of a special economic zone (SEZ) within Switzerland. The fist SEZ was established in 1959 in Shannon, Ireland and the model has gained popularity worldwide with many Asian countries, most notably China, started to rely heavily on them in the 1970's [5]. Estimates from China have shown remarkable achievements with average wages of workers working inside a SEZ raising by 8% and overall GDP rising by up to 20% [5].

This thesis estimates the economic effects of selected scenarios arising from the creation of a region with substantial autonomy over trade policy, hereafter referred to as a SEZ, in the Canton of Jura. The SEZ is conceived with a strategic orientation toward geopolitically opposing economic blocs, with the aim of positioning the Canton as a neutral hub for trade.

The underlying idea is to grant the Canton of Jura the ability to negotiate and implement its own tariff policy. This autonomy would enable Jura to pursue broad trade liberalization, thereby increasing its attractiveness for foreign investment and economic activity.

The Canton of Jura represents a particularly relevant case study in this context. Historically, Jura has exhibited a relatively high public expenditure ratio relative to its economic output, indicating structural economic challenges and a comparatively weak contribution to national GDP. In 2002, the Canton of Jura recorded the highest public expenditure ratio at 35.1% [6]. Additionally, the canton reports the third highest unemployment rate in Switzerland, which in April 2026 stood at 4.7%, significantly above the Swiss average of 3.0% [7]. This makes the canton a suitable candidate for a first case study for targeted regional economic policies aimed at stimulating growth and improving fiscal sustainability.

This article does not address the legal, social, or political implications associated with creating a SEZ in Switzerland. The purpose of this article is to establish a quantitative framework that allows the assessment of potential trade policy scenarios for Switzerland at a regional level. Particular attention is given to the Canton of Jura, which serves as the primary case study for this analysis.

To conduct this analysis, the research builds on the quantitative general-equilibrium trade model developed by Caliendo and Parro [8], which itself extends the Ricardian trade framework introduced by Eaton and Kortum [9]. The model is applied to a dataset that explicitly separates the Canton of Jura from the rest of Switzerland, allowing for a regional sectoral analysis within a global trade framework.

This structure makes it possible to simulate counterfactual scenarios involving trade liberalization between Switzerland and selected groups of economies, including countries participating in the BRI, the emerging Brazil, Russia, India, China and South Africa (BRICS) countries and countries of the European Union (EU) and the USA. By simulating these scenarios, the article aims to provide insights into how deeper trade integration with different economic blocs could affect regional production structures, sectoral trade patterns, and overall economic outcomes in the Canton of Jura.

Ultimately, this study seeks to contribute to the broader discussion on how the Cantons of Switzerland can position themselves in an increasingly multipolar global economy while simultaneously addressing domestic fiscal constraints. The proposed SEZ framework is evaluated as a potential instrument to enhance economic resilience, stimulate welfare growth, and therefore support the long-term sustainability of public finances.

1.2. Objective / Tasks / Requirements

This bachelor's thesis, titled *"Free Jura – General Equilibrium Simulation of a Potential Special Economic Zone in the Canton of Jura"*, investigates the economic implications of trade liberalization policies using a quantitative general equilibrium framework. The primary objective is to analyze how the creation of a potential special economic zone in the Canton of Jura would affect both sectoral and aggregate economic outcomes.

The theis is based on the multi-sector, multi-country trade model developed by Caliendo and Parro [8], which enables the simulation of counterfactual trade scenarios while accounting for inter dependencies across sectors and countries within global value chains. Using this framework, the thesis evaluates the impact of changes in trade costs on key economic indicators, including exports, imports, prices, real wages, employment, and value added.

The initial task description and central focus of the analysis (see subsubsection A.1) was to compare a counterfactual scenario in which trade barriers between the Canton of Jura and countries participating in the BRI are reduced or eliminated with counterfactual scenarios involving other groups of countries. The definition evolved slightly throughout the course of the project, with the BRI no longer serving as the primary focus but instead representing one counterfactual scenario among several others. A broader scope was ultimately adopted, as it yields more informative and robust insights.

The resulting effects of tariff changes are quantitatively simulated and interpreted. The outcomes are then compared with alternative liberalization scenarios in order to assess the relative effectiveness and economic consequences of various trade policy strategies.

Methodologically, the research combines economic theory with computational modeling. Existing code implementations, particularly in MATLAB, has been adapted slightly while the main contribution is a data-preparation pipeline, done in R, which enables the calculation of the scenarios for the analysis. The thesis therefore required not only a solid understanding of economic modeling principles but also skills in programming, data processing, and numerical methods.

Overall, the research is positioned at the intersection of economics, data science, and applied mathematics, with a strong emphasis on quantitative policy evaluation and model-based economic analysis.

2. Theoretical foundations

This chapter outlines the origins of the quantitative model used in this article and describes its general functionality. For a more in-depth discussion of the mathematical foundations, the reader is referred to the reference work by Caliendo and Parro [8].

2.1. General Equilibrium Models

The concept of economic equilibrium is strongly influenced by neoclassical economic assumptions, which states that economies tend toward an equilibrium state characterized by market-clearing (meaning all goods produced are also sold), perfect competition, rational agents, and effectively infinite competition. In this framework, goods are priced at their production cost (wages, circulating capital, and depreciation of fixed capital) such that no economic profit persists in equilibrium.

2.1.1. Ricardian Trade Models

Ricardian trade models build upon these neoclassical equilibrium conditions while integrating the classical "labor theory of value." Originally articulated by Adam Smith in *An Inquiry into the Nature and Causes of the Wealth of Nations* (1776) and subsequently formalized by David Ricardo in *On the Principles of Political Economy and Taxation* (1817) [10, 11], this integration synthesizes core elements of two historically distinct economic schools of thought.

General Concept

The Ricardian framework operates on the premise that the intrinsic value of goods derives entirely from human labor. Consequently, in a state of market equilibrium, the total value added through the production of a good or service is strictly equivalent to the aggregate wages compensated to the labor force.

To model market dynamics, these frameworks employ conditional functions to formalize the behavioral responses of households and producers to shifting trade policies. For instance, consumer preferences are frequently represented via a

Cobb–Douglas utility function, which dictates a constant expenditure share across goods.

Ricardian trade models are built on the foundational principle of comparative advantage, originally formalized by David Ricardo through his classic illustration of England and Portugal trading cloth and wine [11]. This seminal framework demonstrates that global production maximizes when nations specialize in the sector where they face the lowest opportunity costs.

This core intuition was substantially modernized by Eaton and Kortum [9], who developed a micro-founded, general equilibrium framework. While their model requires computational algorithms to solve, it fundamentally retains the Ricardian insight that comparative advantage dictates geographic patterns of production.

The quantitative Ricardian framework has since seen continuous refinement. A major methodological breakthrough was achieved by Caliendo and Parro [8], who introduced a multi-sector extension to the Eaton and Kortum structure [12]. By incorporating intersectoral linkages and trade in intermediate inputs, their framework has become the contemporary state-of-the-art model for evaluations of tariff shocks and trade policy counterfactuals.

Caliendo and Parro Model

This article employs the multi-sector Ricardian general equilibrium model developed by Caliendo and Parro (2014) [8]. As the model is implemented without structural modifications to its underlying theoretical mechanics, this section provides a qualitative overview of its functionality. For an exhaustive mathematical derivation, the reader is directed to the foundational paper.

The model assumes perfect labor mobility across sectors within a given country. As the labor market size is treated as an endogenous variable, the market is assumed to continuously clear (meaning labor supply always meets labor demand), explicit labor market datasets are therefore not required to solve the equilibrium.

Consistent with the core tenets of Ricardian theory, all value added is distributed as labor income. Total aggregate welfare (or national income) for a representative household in country n is defined as the total value added (which is equal to the total income of laborers), tariff revenues, and the aggregate trade deficit:

$$Welfare_n = ValueAdded_n + TariffIncome_n + Deficit_n \tag{2.1}$$

This aggregate income is subsequently allocated across goods and services from various sectors. Since sectoral demand inherently depends on aggregate national income, which is itself influenced by trade flows and production constraints, the model features highly interdependent variables, necessitating an iterative algorithmic approach to find the equilibrium.

Trade policy shocks, such as tariff adjustments, directly alter consumer choices as agents optimize for the lowest-cost goods. Assuming goods within sectors are substitutable but finite, household expenditure allocation across sectors can be represented by a Cobb–Douglas utility function:

$$u(C_n) = \prod_{j=1}^{J} \left(C_n^j\right)^{\alpha_n^j}, \quad \text{where} \quad \sum_{j=1}^{J} \alpha_n^j = 1. \tag{2.2}$$

Here, C_n^j represents the consumption of goods from sector j in country n, and α_n^j denotes the constant expenditure share of sector j relative to total consumption. Specifically, α_n^j dictates the fixed percentage of total income that consumers in a given country allocate to a particular sector to maximize their overall utility.

Sectoral consumption relies heavily on the local price index p_n^j. According to the Caliendo and Parro framework, this price level is determined by international trade conditions, specifically "iceberg" trade costs κ_{ni}^j. These costs encompass both non-tariff barriers (such as geographic distance and transportation frictions) and explicit applied tariffs. Furthermore, the final price level is a function of the unit cost of the input bundle c_i^j and the productivity parameter z_i^j in the origin country i. Rational consumers consistently select the lowest available price across all potential source countries, which can be formally defined as:

$$p_n^j(\omega^j) = \min_i \left\{ \frac{c_i^j \, \kappa_{ni}^j}{z_i^j(\omega^j)} \right\} \tag{2.3}$$

The optimization minimizes costs across all origin countries i, identifying the optimal source country i^* for country n's consumption. This mechanism captures the fundamental logic of consumer preference modeling.

Bilateral trade costs are parameterized as $\kappa_{ni}^j = (1+\tau_{ni}^j) \cdot d_{ni}^j$, where d_{ni}^j isolates the non-tariff trade costs for transporting a good from country i to country n, and τ_{ni}^j represents the applied bilateral tariff. For domestic trade ($n = i$), the factor d_{nn}^j is normalized to exactly 1. Because baseline parameters such as non-tariff trade frictions (d_{ni}^j), productivity vectors (z_i^j), and price indices (p_n^j) are notoriously difficult to estimate empirically [8, p. 11], the model circumvents these structural estimations.

Consequently, the framework employs "hat algebra," a methodology that expresses equilibrium conditions entirely in terms of relative changes rather than absolute levels, thereby drastically reducing the model's data requirements.

The model extends the trade framework developed by Eaton and Kortum (2002) [9] to accommodate multiple sectors [12], classifying them as either tradable or non-tradable. By definition, all services are categorized as non-tradable. While some recent implementations, such as those by Swiss National Bank (SNB) researcher Wicht (2020), aggregate all non-tradable sectors into a single macroeconomic “services” sector [12], this analysis adheres to the original specification by Caliendo and Parro, maintaining distinct non-tradable sectors. This structural choice is further justified in chapter 3 subsection 3.1.2.

The framework evaluates a set of countries N and sectors J. It is driven by a specified counterfactual scenario, constructed by defining a baseline tariff matrix τ^j_{in} and a counterfactual tariff matrix τ'^j_{in}. Utilizing these tariff inputs alongside baseline bilateral trade flows (detailed in Table 3.4), the model calculates the relative changes in wages, trade volumes, and expenditure.

Solving for this general equilibrium requires several specific structural parameters:

First, the bilateral expenditure share π^j_{ni}, defined as $\pi^j_{ni} = \frac{X^j_{ni}}{X^j_n}$, captures the proportion of country n's total sectoral expenditure allocated to goods imported from country i. The domestic expenditure X^j_{ni} is derived by subtracting aggregate exports from the total production of each country to find the imported volume M^j_{ni}. The expenditure value inclusive of tariffs is then calculated as $X^j_{ni} = M^j_{ni} \cdot (1 + \tau^j_{ni})$.

Second, the model requires γ^{kj}_n, which represents the cost share of intermediate consumption sourced from Input-Output (IO) tables.

Third, the value-added share per sector (γ^j_n) and the aggregate volume of value added, formulated as $\omega_n \cdot L_n$ (where L_n denotes the amount of households and ω_n the wage level) is also required.

Finally, the model requires sectoral trade elasticities (θ^j), which dictate the sensitivity of trade flows to changes in trade costs. These parameters are drawn directly from the empirical estimations provided in Section 4 of Caliendo and Parro (2014) [8].

By synthesizing these parameters, counterfactual outcomes are generated through the system of equations specified in Section 3.1.6, *Equilibrium in relative changes*, of the foundational paper [8]. The subsequent section details the specific algorithmic resolution of this equilibrium.

2.1.2. Solving an Equilibrium

To solve general equilibrium models, usually an iterative process is required which optimizes the result. This is due to the balance that needs to be struck between production and consumption while both sides, producers and consumers, have opposing interests. Consumers aim to obtain as many goods and services as they can for the lowest possible cost, while producers seek to charge the highest prices they can without losing their competitive edge. This applies not only to commodity markets but also to the labour market.

Also, production is limited due to physical constraints. Infrastructure and raw materials are needed for production which might not be available in large enough quantity given certain productivity levels.

The Caliendo and Parro model specifically follows the following logic to arrive at an equilibrium:

> [...] total expenditure, excluding tariff payments, in country n minus trade deficits equals the sum of each country's total expenditure, excluding tariff payments, on tradable goods from country n. [8, p. 11]

This sentence is mathematically noted in the paper by Caliendo and Parro in equation 9 which forms the basis of the equilibrium:

$$\underbrace{\sum_{j=1}^{J}\sum_{i=1}^{N} X_n^j \frac{\pi_{ni}^j}{1+\tau_{ni}^j}}_{\text{Sum of Imports}} - D_n = \underbrace{\sum_{j=1}^{J}\sum_{i=1}^{N} X_i^j \frac{\pi_{in}^j}{1+\tau_{in}^j}}_{\text{Sum of Exports}} \tag{2.4}$$

It means that the total expenditure of one country (consumer) needs to be equivalent to what it produces itself in value which is purchased by other countries or by consumers inside the same country. The production capabilities are itself dependent on different factors, like for example the productivity value z_j^i which has been introduced in the prior section.

The left side of the equation represents the sum of all imports of a country n in a sector j. The imports also include the goods and services which are consumed inside the country n. Then the deficit is subtracted to equalize the equation with the sum of exports of the right side of the equation. The term X_n^j is denoted as the expenditure of country n in sector j.

The calculation of the sum of imports can be interpreted as a cumulative distribution with a constant X_n^j which is calculated in each iteration of the solution algorithm and serves in this equation as a static number for each sector and country combination. For example 1 Mio. USD is spent by Switzerland in the Education sector would be $X_{CHE}^{Education} = 1$ Mio. USD. This one million is than split into parts by the term $\frac{\pi_{ni}^j}{1+\tau_{ni}^j}$ and the tariff payments are added in the same term. If the tariff is 0%, only the factor π_{ni}^j remains.

The expenditure share π_{ni}^j denotes the fraction of country n's total spending that is devoted to goods from sector j produced in country i. For instance, if n is Switzerland, j is Education, and i is Germany, then $\pi_{\text{CHE,DEU}}^{\text{Education}} = 0.2$ indicates that Switzerland allocates 20% of its Education-sector expenditure to goods from Germany.

With all these constraints in place an iterative algorithm starts by guessing a relative wage increase of 100% in all countries ($\hat{w}_n = 1; \forall n \in N$) and than checks if each constraint holds. A "deficit" D_n is calculated, which is part of Equation 2.4

and represents the remaining part of the equilibrium which is unexplained by changes in wages $\hat{w}_n$. The algorithm is run until the sum of all deficits from countries $\sum_{n \in N} |D_n|$ is reduced to a defined amount, in the Caliendo and Parro model this is $\sum_{n \in N} |D_n| \leq 1\mathrm{e}^{-7}$.

2.2. Data-sources for Global Value Chains

Applying the Caliendo and Parro model requires a data foundation, as has been described in subsubsection 2.1.1. The following section describes the core dataset type needed to calculate the model by Caliendo and Parro, namely IO-Tables.

2.2.1. Background

Modelling interlinked economies is a data-intensive and complex task. Many approaches have been made to create balanced datasets which can be used to observe world trade. The usual difficulty is to find reliable data sources for the entire world.

While data from the Organisation for Economic Co-operation and Development (OECD) nations is usually available in an acceptable quality, reliable data from other countries can be harder to get and might need to be inferred through statistical means.

Another major challenge of working with economic data is that datasets are very quickly obsolete and updating datasets requires a lot of work. Therefore the selection of an appropriate data-source which strikes a balance between actuality, data-quality and depth is key to any research in the field.

Major data-sources for international trade is the World Input-Output Database (WIOD) [13] or the Eora-Database [14, 15]. Both include a multi-country, multi-sector IO table dataset which is a combination of both measured and reported economic data, like Gross Domestic Product (GDP), and also inferred data where no reliable source is available.

The following section explains how IO tables are structured.

2.2.2. IO-Tables

IO tables constitute internally consistent datasets that combine reported trade data with imputed values. Their primary objective is to represent international trade flows as accurately as possible.

This objective is inherently challenging. Countries differ substantially in their reporting practices: some do not report data at all, while others provide incomplete or unreliable statistics. In addition, inconsistencies frequently arise between data sources. For example, reported GDP figures may not align with customs data on imports and exports. Since GDP is typically reported by institutions different from those responsible for trade statistics, such discrepancies are common.

In light of these limitations, it is important to emphasize that IO tables should not be interpreted as exact representations of reality. Rather, they provide approximate estimates in situations where data are missing or incomplete.

The general structure of IO tables is illustrated in Figure 2.1, which is provided by the authors of the Eora database [14, 15].

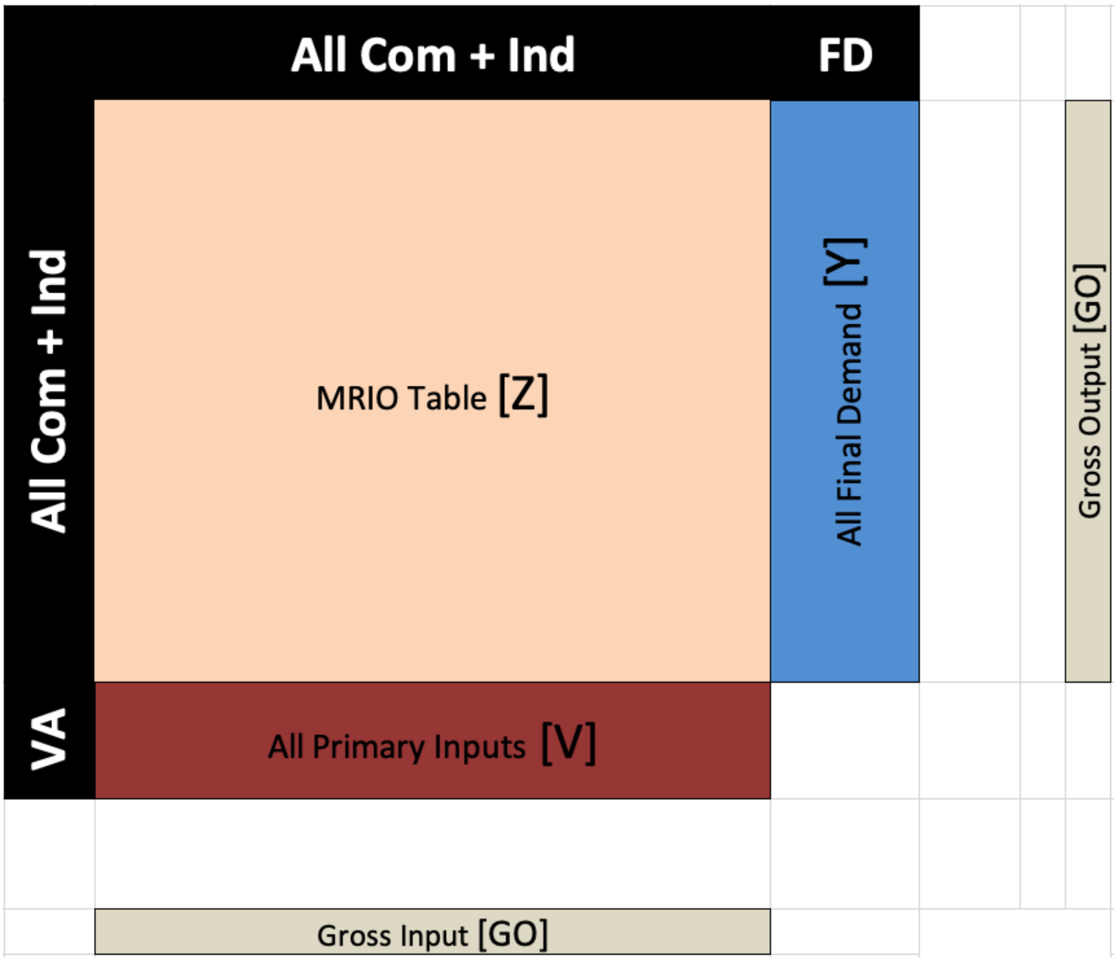

Figure 2.1.: Structure of the Eora26 input–output table VA = V = Value Added; FD = Y = Final Demand

A numerical example of an IO table is shown in Figure 2.2. The table reports trade flows from each origin sector in each origin country to each destination sector in each destination country.

For instance, the value in the fifth column of the first row of the Inter-Industry Transaction Matrix (Z) matrix is 819. This indicates a trade flow of 819,000 USD from Sector 1 in Country 1 to Sector 1 in Country 2. As the example is derived from the Eora database, values are reported in thousands of USD [14, 15].

The Value Added (VA) block, also displayed in Figure 2.2, represents the value added within each country-sector corresponding to a given column. The sum of the intermediate consumption matrix Z and the corresponding VA entries for a country yields its total Gross Output (GO). This value is balanced: summing across the rows of Z and adding the Final Demand (FD) block results in the same GO.

Although the FD block is not explicitly shown in Figure 2.2, it appears on the right-hand side of Figure 2.1. This block describes the allocation of produced output to final demand categories (i.e., consumption). A key underlying assumption of IO tables is that all produced value is ultimately absorbed through final demand, whether domestically or internationally.

Constructing balanced IO tables is a complex task due to the large number of free parameters and the limitations of the underlying data. Moreover, the simplifying assumptions inherent in these models do not fully capture real-world consumption patterns. Consequently, such datasets must be used with caution. Nevertheless, they remain a valuable and often indispensable source of information.

This research primarily relies on the Eora and WIOD datasets, while also incorporating alternative, higher-precision data sources whenever available. From a technical perspective, the Caliendo and Parro model can be solved using only IO tables and tariff data.

	Z	Country 1 Sector 1	Country 1 Sector 2	Country 1 Sector 3	Country 1 Sector 4	Country 2 Sector 1	Country 2 Sector 2	Country 2 Sector 3	Country 2 Sector 4
Country 1	Sector 1	346	156	95	594	819	154	832	397
Country 1	Sector 2	354	443	7	908	42	92	561	839
Country 1	Sector 3	291	795	243	825	753	2	340	232
Country 1	Sector 4	637	259	289	813	500	716	947	645
Country 2	Sector 1	547	466	910	276	518	149	779	553
Country 2	Sector 2	752	936	822	638	611	496	98	924
Country 2	Sector 3	295	444	7	828	929	535	367	257
Country 2	Sector 4	113	518	791	459	79	748	254	218
Country 3	Sector 1	46	457	552	572	632	680	730	607
Country 3	Sector 2	962	96	544	96	675	113	711	337
Country 3	Sector 3	531	190	686	191	374	615	788	738
Country 3	Sector 4	857	776	897	18	915	482	308	458
VA block:									
Country 1	Value Added	1’172	1’120	1’676	1’648	-	-	-	-
Country 2	Value Added	-	-	-	-	1’019	4’730	401	471
Country 3	Value Added	-	-	-	-	-	-	-	-
Total input		**6’901**	**6’657**	**7’518**	**7’868**	**7’864**	**9’511**	**7’117**	**6’677**

Figure 2.2.: Eora26 structure with example values

2.2.3. Relevance for the Caliendo and Parro model

In theory, the Caliendo and Parro framework requires only two primary categories of data for its complete calibration and solution: a comprehensive IO–table (like WIOD or Eora) and a matrix of bilateral international tariffs. While these two components are conceptually sufficient to solve the general equilibrium model, empirical implementations often leverage supplementary data sources.

This reliance on external datasets is driven by inherent data-quality limitations within standard IO–tables. Consequently, researchers frequently incorporate specialized trade or production databases whenever available. These do not alter the underlying structural mechanics of the model, but rather substitute specific IO sub-matrices with higher-fidelity empirical observations.

For example the FD and GO block of the IO–table are often replaced with data which is considered to be more accurate, like data reported by the UN Statistics Division, the United Nations (UN) National Accounts dataset [16].

3. Methodology

This chapter outlines the data work performed to establish the database required to apply the Caliendo and Parro model to assess counterfactual scenarios of the Canton of Jura.

3.1. Application of the Caliendo and Parro Model

The following section lays out how the software providied by Caliendo and Parro is used for this article.

3.1.1. General Application

As described in chapter 2 in more details, this article applies the Ricardian general equilibrium model, which has been developed for the 2014 published paper *Estimates of the Trade and Welfare Effects of NAFTA* by Caliendo and Parro [8], to assess the impact on the Swiss economy of establishing a SEZ in the Canton of Jura that would implement its own trade policy.

The Caliendo–Parro model relies on IO tables to compute value-added shares γ_n^j (j and k denoting sectors and i and n denoting countries) and sectoral input shares γ_n^{kj}. It also requires bilateral trade flows M_{in}^j and gross output Y_n^j, which can be derived either from the IO tables or from dedicated trade datasets. The necessary input files for the model are listed in Table 3.3.

Because the Canton of Jura does not constitute an independent economic unit and therefore is not covered as such in standard IO databases, it is treated as if it were a separate country. The required data are then constructed by combining and imputing from multiple data sources.

Once all required datasets are merged, the counterfactual tariff structures examined in this article are defined, and the resulting dataset is transformed into the input format required by the software provided by Caliendo and Parro. The software is for free available for download online and is written in MATLAB [17]. This software computes the new equilibrium and the associated Hat-Algebra-based changes under the counterfactual scenarios, including, for instance, the change in welfare.

3.1.2. Sector and Elasticity definition

As established, the modeling approach in this article closely follows the trade model of Caliendo and Parro with only minimal modifications. Accordingly, the sectoral classification used by Caliendo and Parro is adopted without alteration.

Caliendo and Parro define a total of 40 sectors, of which 20 are classified as tradable and 20 as non-tradable. In contrast to more recent studies, such as Wicht (2020) [12], which aggregate the non-tradable sectors into a single “services” sector, this article retains the full disaggregation. This choice allows for a more detailed analysis of sectoral adjustments to assess how trade changes affect non-tradable sectors like construction and facilitates a closer comparison with the results reported in the original Caliendo and Parro study. The list of sectors is provided in Table 3.1.

The sectors are mapped to the standardized industry classification International Standard Industrial Classification (ISIC) Rev. 3, which enables the integration and decomposition of data from external sources into the 40-sector structure of Caliendo and Parro. The decomposition procedure is described in detail in subsection 3.2.2.

Furthermore, the computation of equilibrium requires each tradable sector to be associated with a sector-specific trade elasticity, denoted by θ^j. These elasticity values are also taken from Caliendo and Parro and are reported in Table 3.1. .

Nr	Caliendo and Parro Industry Name	ISIC Rev.3	Trade-Elasticity θ^j
1	Agriculture	1–5	9.11
2	Mining	10–14	13.53
3	Food	15–16	2.62
4	Textile	17–19	8.1
5	Wood	20	11.5
6	Paper	21–22	16.52
7	Petroleum	23	64.85
8	Chemicals	24	3.13
9	Plastic	25	1.67
10	Minerals	26	2.41
11	Basic metals	27	3.28
12	Metal products	28	6.99
13	Machinery n.e.c	29	1.45
14	Office	30	12.95
15	Electrical	31	12.91
16	Communication	32	3.95
17	Medical	33	8.71
18	Auto	34	8.22
19	Other Transport	351–359	8.22
20	Other	36–37	3.98
21	Electricity	40–41	-
22	Construction	45	-
23	Retail	50–52	-
24	Hotels	55	-
25	Land Transport	60	-
26	Water Transport	61	-
27	Air Transport	62	-
28	Aux Transport	63	-
29	Post	64	-
30	Finance	65–67	-
31	Real State	70	-
32	Renting Mach	71	-
33	Computer	72	-
34	R&D	73	-
35	Other Business	74	-
36	Public	75	-
37	Education	80	-
38	Health	85	-
39	Other services	90–93	-
40	Private	95	-

Table 3.1.: Caliendo and Parro Industry Classification with Elasticities (ISIC Rev.3)

3.1.3. Country definition

The set of countries used in this study is constructed based on a predefined core group and an extension mechanism tailored to each counterfactual scenario. Specifically, a baseline set of 30 countries is included in all simulations to ensure consistency and comparability across scenarios. This core set captures the major economies and key actors in global trade.

For each counterfactual scenario, additional countries may be incorporated if they are directly relevant to the analysis and not already part of the baseline dataset. This approach allows for flexibility while maintaining a stable reference framework.

Table 3.2 lists the baseline countries considered in this study. The category "ROW" (Rest of World) aggregates all countries not explicitly represented, while "CHE.JU" denotes the Canton of Jura as a SEZ.

United States	China	Japan	Germany
United Kingdom	France	Italy	Brazil
South Korea	Russia	Australia	Spain
Indonesia	Netherlands	Saudi Arabia	Turkey
Sweden	Poland	Belgium	Thailand
Norway	Iran	Austria	UAE
Canada	Mexico	Switzerland	Argentina
India	Canton of Jura, Switzerland	Rest of World	

Table 3.2.: Baseline set of countries included in the analysis

3.2. ISIC Matching

This section describes how trade data from different data sources with different levels of sector aggregations can be matched to each other using the ISIC sector codes.

3.2.1. Base Sector Definition

To perform the calculations for the counterfactual scenarios, multiple data sources to construct the necessary data framework are required as described in chapter 2. Besides the tariffs τ_{in}^{j}, all the other data requirements of the model developed by Caliendo and Parro [8] are constructed with economic volumes of some sort. In particular IO-Tables and other more specific datasets, like the UN national accounts dataset, which are used to calculate the Input-sector-importance γ_n^{kj}, the

Value-added-share γ_n^j, the Bilateral-trade-volume M_{in}^j and the Gross-output Y_n^j are shown in Table 3.3.

Parameter	Input-File	Data-Source
Tariffs τ_{in}^j	tariffs2019.txt	MacMap from CEPII
Input-sector-importance γ_n^{kj}	IO.txt	Eora
Value-added-share γ_n^j	B.txt	Eora
Bilateral-trade-volume M_{in}^j	xbilat.txt	BACI from CEPII
Gross-output Y_n^j	GO.txt	UN National Accounts Database
Sector-elasticities θ^j	T.txt	Caliendo and Parro

Table 3.3.: Input-Data Sources

To avoid needing to recalculate the sectoral elasticities θ^j, this article uses the same sectoral definitions and therefore the same sector-elasticities as where used by Caliendo and Parro as described in table Table 3.1.

3.2.2. ISIC Decomposition

After the ISIC sectors have been matched, a decomposition must be performed to distribute the trade volumes from a source dataset with arbitrary ISIC codes across the 40 target sectors defined by Caliendo and Parro [8].

Sectors that can be matched one-to-one, meaning that a single source sector in the dataset corresponds directly to one of the 40 target sectors used in this article, can be transferred straightforwardly by renaming the rows and columns associated with the respective source sector.

The process becomes more complex when a sector in the dataset is associated with multiple target sectors among the 40 sectors used in this article. In this case, an association assumption is required. Specifically, the distribution across multiple target sectors is assumed to be proportional to the trade volume of each target sector relative to the sum of the trade volumes of all associated target sectors, as shown in Equation 3.1.

$$\pi_i^{mk} = \frac{\sum_{n,j} Z_{in}^{kj}}{\sum_{k' \in K_m} \sum_{n,j} Z_{in}^{k'j}} \tag{3.1}$$

Here, the variables are defined as follows:

- m is the original source sector being decomposed.

- K_m denotes the set of all disaggregated target sectors associated with source sector m.
- $k \in K_m$ is a specific target sector within that set.
- Z_{in}^{kj} represents the trade volume originating from sector k in source country i, directed to destination sector j in destination country n.

The parameter π_i^{mk} represents the trade-weighted share used to decompose the source sector m into the target sector k. To illustrate, suppose the WIOD source sector is C29 (ISIC Rev.4), which must be split into the target sectors "Office" and "Medical" (ISIC Rev.3 sectors 30 and 33). In this scenario, m = C29 and $K_m = \{\text{Office}, \text{Medical}\}$ (see subsection A.2.2).

By specifying the source country i in Equation 3.1, the trade shares are calculated exclusively using that single country's export data. This country-specific decomposition is particularly relevant for constructing the data for the Canton of Jura, as detailed in Section 3.3.

It should be noted that if a global trade share is required instead of a country-specific one, the formula can be adjusted to sum over all source countries i in both the numerator and denominator, yielding a global share π^{mk} with this adjusted equation:

$$\pi^{mk} = \frac{\sum_{i,n,j} Z_{in}^{kj}}{\sum_{k' \in K_m} \sum_{i,n,j} Z_{in}^{k'j}} \tag{3.2}$$

The trade volume data for each target sector are taken from the already decomposed WIOD tables [13]. Consequently, the WIOD tables must be decomposed before any other decomposition is carried out. As they form the basis for all subsequent decompositions, they are explained further in the following section.

3.2.3. WIOD ISIC Matching and Decomposition

In this article the data from the 2016 Version of the WIOD database was used. This dataset provides IO–tables for 44 countries and 56 sectors which ISIC Rev. 4 specification [13]. The sectors used in this article are equivalent to the sector specification used by Caliendo and Parro and follow the ISIC Rev.3 format.

The decomposed WIOD tables form the basis for all the other decompositions done in this article. This is due to the convenient way the WIOD sectors can be aggregated. With other aggregations one source sector could correspond to more than one, potentially non-tradable, target sector. The WIOD tables do also have a double association, namely the sector "Manufacture of computer, electronic and optical products" which is matched to both "Medical" and "Office". But both sector ”Medical” and ”Office” are tradable sectors. Therefore, the sector shares π^{mk} as explained in Equation 3.1, can be calculated using the bilateral trade data from 1993 provided by Caliendo and Parro [8].

The double association of the source sector ”Manufacture of computer, electronic and optical products” (C26) to target sectors ”Medical” (ISIC Rev.3 Nr. 30) and ”Office” (ISIC Rev.3 Nr. 33) which are each a subsection (ISIC Rev.4 Nr. C26), are specifically explained in this setion to clarify how the decomposition works.

To correctly distribute the data from the WIOD source table into the 40 sectors used in this article, a adapted version of the trade-weighted-distribution-share π^{mk} has been calculated from the data used by Caliendo and Parro which is assessed using the global trade distribution share Equation 3.5. The adaptation is nessesary because the bilateral trade data from 1993 isn't a Z-table as it is used in the Equation 3.1 but a 3-dimensional bilateral trade matrix specifying only the origin sector k. The destination sector j is not specified and is therefore excluded. The explicit application for the decomposition can be seen in Equation 3.3. In the equation, $X_{in}^{Medical}$ is the bilateral trade volume in sector ”Medical” worldwide that is replacing the Z_{in}^{kj} in Equation 3.1 which is taken from the Z-table generated from the WIOD data.

$$\pi^{\text{C26, Medical}} = \frac{\sum_{i,n} X_{in}^{\text{Medical}}}{\sum_{k \in \{\text{Medical, Office}\}} \sum_{i,n} X_{in}^{k}} \tag{3.3}$$

The trade-weighted-distribution-shares π^{mk} are then used to split the WIOD sector ”Manufacture of computer, electronic and optical products” into the sectors ”Medical” and ”Office” in relation to their trade-weighted-distribution-share calculated from the data provided by Caliendo and Parro [8].

3.2.4. Production and Consumption differentiation

The default generation of the π_i^{mk} factor is calculated using the production side of the Z matrix, meaning the share of intermediate outputs or ”producingSector” (rows of the $J \times J$ matrix are used to calculate the shares which each sector takes up in an economy). This can also be applied to the columns of the sector to sector matrix by calculating the shares of the intermediate inputs into sectors which is methodically summing over the ”consumingSector” in the data vector of the Z matrix. The matrix indexes can be seen in the following statement:

$$Z[\text{originCountry, destinationCountry, producingSector, consumingSector}] \tag{3.4}$$

Depending on the situation, calculating shares using the inputs might be more logically suitable, for example if specifically a consumption dataset should be decomposed into other sectors.

The adjusted formula for the consumption oriented π_i^{mk} can be calculated by adjusting the formula Equation 3.1 as follows (switch j and k):

$$\pi^{mk} = \frac{\sum_{i,n,j} Z_{in}^{jk}}{\sum_{k' \in K_m} \sum_{i,n,j} Z_{in}^{jk'}} \tag{3.5}$$

3.3. Generating the REICO of the Canton of Jura

Since the Canton of Jura does not determine an independent trade policy and does not publish separate IO tables, the required dataset must be constructed by dis-aggregating existing national data sources.

3.3.1. Production in Jura

To implement the model developed by Caliendo and Parro at the regional level, this study follows the procedure proposed by Felbermayr et al. [18], who compiled a regional dataset at the Nomenclature of Territorial Units for Statistics (NUTS) 2 level.

As Switzerland is a member of the European Free Trade Association (EFTA), its territorial units are assigned a NUTS classification. The Canton of Jura is classified at the NUTS3 level (CH025), whereas the Regionalized Inter-Country Input–Output (REICO) analysis conducted by Felbermayr et al. is based on NUTS2 regions [18]. Consequently, no existing dataset directly represents the Canton of Jura. For this reason, a dedicated dataset is constructed for the present analysis, following the structure of the REICO tables developed by Felbermayr et al. [18].

According to the methodology proposed by Felbermayr et al. [18], the regional input side of Z and VA matrices can be approximated by allocating national values according to the sectoral contribution share $\pi_{n'}^{k}$ of each sector k in region n' relative to the national total of country n:

$$\pi_{n'}^{k} = \frac{VA_{n'}^{k}}{\sum_{n'} VA_{n'}^{k}} \tag{3.6}$$

Here, n' denotes the set of regions within a country, and $VA_{n'}^{k}$ represents the sectoral VA for region n'. For Switzerland, these data are provided by the Federal Statistical Office (FSO), which publishes canton-level VA statistics disaggregated into eight sectors according to ISIC Rev.4 [19].

Using the ISIC sectoral decomposition defined in Equation 3.1, with country i set to "CHE" (Switzerland), the regional contribution share for each sector k of the Canton of Jura, $\pi_{CHE.JU}^{k}$, can be calculated. The resulting sectoral distribution indicates that the Canton of Jura exhibits a comparatively strong specialization in agriculture, contributing a disproportionately large share to Switzerland's total VA relative to other sectors (see Figure 3.1).

It can also be observed from Figure 3.1 that several sectors display identical shares of the Swiss economy. This outcome results from the high level of aggregation in the sectoral data provided by the FSO. Each source sector is mapped to a distinct set of target sectors, and these mappings do not overlap across source sectors. Consequently, the ISIC sectoral decomposition is not strictly required for calculating the regional shares of the Swiss economy, as the same contribution share can be applied directly to each associated target sector without first decomposing trade volumes.

The final production data for the Canton of Jura are constructed for each relevant dataset, namely Z, GO, VA and `xbilat` (see Table 3.4), by scaling the corresponding Swiss values using the sector-specific production shares (see Figure 3.1).

For the case of Z, the Jura entries are defined as:

$$Z[\text{originCountry, destinationCountry, producingSector, consumingSector}] \tag{3.7}$$

$$\begin{aligned} Z[\text{CHE.JU}, \ , k, \ ] &= \pi^k_{\text{CHE.JU}} \cdot Z[\text{CHE}, \ , k, \ ], \\ Z[\text{CHE}, \ , k, \ ] &= (1 - \pi^k_{\text{CHE.JU}}) \cdot Z[\text{CHE}, \ , k, \ ] \end{aligned} \tag{3.8}$$

In other words, all exports from the production sectors in the Canton of Jura are calculated as a proportional fraction of total Swiss exports. The corresponding amount is then subtracted from the Switzerland entry in the dataset to avoid counting the Canton of Jura twice.

In terms of looking at the Z matrix it can be thought of it as the row of the Z matrix representing Switzerland is taken and each producing sector row of the country is one by one copied into the Jura row's producing sectors in proportion to the factor $\pi^k_{\text{CHE.JU}}$.

The same approach is also used with other necessary data which can be logically associated with consumption. This is namely the GO, FD and the `xbilat` values of Jura. Particularly `xbilat` includes some core assumptions, namely that the imports to the Canton of Jura follow the consumption share while the Exports follow the production share.

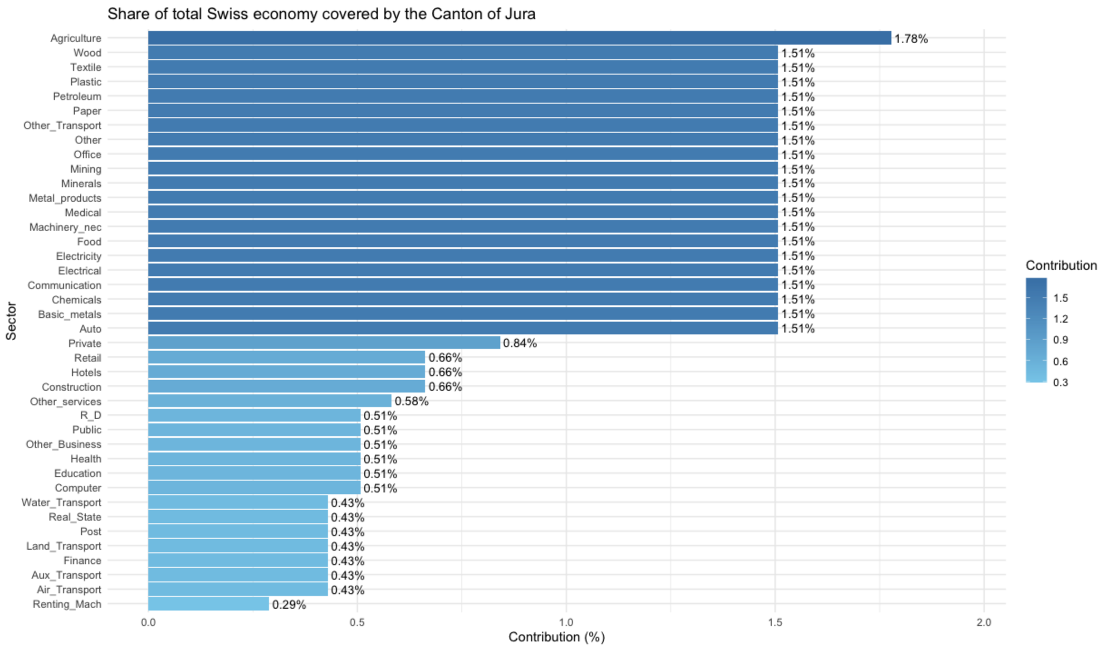

Figure 3.1.: The chart shows the percentage contribution of the production in the Canton of Jura to the total VA of Switzerland based on the 40 sectors used in this article

3.3.2. Consumption in Jura

As noted earlier in the description of the Canton of Jura, the canton exhibits variations in the proportions of certain sectors (for instance, the "Agriculture" sector is overrepresented). Therefore the same construction method can't be applied for the consumption side of Jura.

For this article the consumption side follows a simple assumption the Canton of Jura consumes the same way as the rest of Switzerland. Therefore the consumption in the Canton of Jura is the share of the population of Switzerland living in Jura times the consumption in Switzerland. The population data is provided by FSO. The article uses data from the year 2019 [20].

The consumption share is therefore:

$$\pi = \frac{PopulationJura}{PopulationSwitzerland} \tag{3.9}$$

$$Z[\text{originCountry, destinationCountry, producingSector, consumingSector}] \tag{3.10}$$

$$
\begin{aligned}
Z[, \text{CHE.JU}, , j] &= \pi \cdot Z[, \text{CHE}, , j], \\
Z[, \text{CHE}, , j] &= (1 - \pi) \cdot Z[, \text{CHE}, , j]
\end{aligned}
\tag{3.11}
$$

The logic of the approach is identical to the production side of the data transformation. The only difference is that now the columns are copied from the column representing Switzerland in proportion to the factor π. Technically the whole column could be copied and sector by sector copying with the parameter j would not be necessary as π is the same number for each sector. In order to make the production and consumption approach more intuitive and expand the possibility to also make the consumption side dynamic the implementation has been done in the same way.

The same approach is also used with other necessary data which can be logically associated with consumption. As mentioned in the prior subsection, the dataset FD is considered to be a consumption based dataset and the imports to the Canton of Jura in the `xbilat` data are also handled as consumption values.

3.3.3. Inner Switzerland Trade

Another data transformation is necessary to generate the data for the trade which is done between the Canton of Jura and the rest of Switzerland. The trade volumes inside Switzerland, namely the imports and exports from and to the Canton of Jura as well as the trade inside the Canton itself can be derived from the data of Switzerland with the same sector shares as has been described in the sections above.

The difference with the inner Switzerland trade is that not a whole row is copied but only the $J \times J$ submatrix representing the trade inside Switzerland. First the export from Jura is calculated by copying the trade matrix from Switzerland sector by sector with the shares $\pi^k_{\text{CHE.JU}}$ into the submatrix representing trade from Jura to Switzerland. Next for the imports to Jura the same submatrix of Switzeland is again taken and copied into the submatrix representing the trade from Switzerland to Jura but this time with the consumption factor π. In the end the submatrix of Switzerland is scaled down by reducing it by $(\pi^k_{\text{CHE.JU}} + \pi)$.

3.3.4. Inner Jura Trade

Intracantonal trade within the Canton of Jura was assumed to be negligible and therefore set to zero. This assumption is justified by the canton's small geographical and economic scale, which implies limited availability of production inputs, particularly primary inputs such as raw materials. In addition, accurately quantifying the share of intermediate inputs used by industries in the Canton of Jura that are actually produced within the canton would require highly detailed data that are not readily accessible or reliable. Consequently, the internal trade flows of the Canton of Jura are omitted from the analysis.

3.4. Data Sources

The following section describes the used data-sources in more details.

3.4.1. General Information

The Caliendo–Parro model requires several bilateral and national input datasets, all of which are constructed for the reference year 2019. Table 3.3 provides an overview of all required input files, the parameters they contain, and the data sources from which they are derived. The following subsections describe each data source in detail, including the construction steps and methodological choices made. Table 3.4 additionally lists the primary datasets used to construct the bilateral trade flow and tariff matrices.

An important characteristic of these sources is that the tariff data follows the HS 2007 classification, whereas BACI is based on HS 2017. While the two versions are largely equivalent at the six-digit level, isolated code discrepancies can occur and may lead to minor matching losses in the product-level merge described in subsection 3.4.4. This limitation is acknowledged but is not expected to materially affect results, as the affected categories account for a negligible share of aggregate trade volume.

3.4.2. Bilateral Trade Flows

Bilateral trade flows are sourced from the BACI database (version HS17, release 2026), developed by CEPII [21]. BACI provides harmonised trade statistics at the HS6 product level by reconciling the systematic asymmetry between importer- and exporter-reported data drawn from UN COMTRADE. Values are originally reported in thousands of USD and are converted to full USD in the data pipeline.

A relevant limitation of BACI is the absence of Chinese Taipei, referred to Taiwan (Chinese Taipei (Taiwan) (TWN)) in this article. Since Taiwan is a major supplier of computer chips the territory could potentially be impactful and relevant for further research. The separate construction of Taiwan as an economic entity was therefore decided for the model. Because Taiwan is not a UN member state, its trade is not reported in UN COMTRADE and consequently does not appear in BACI. To address this gap, bilateral trade data for Taiwan are obtained separately from the WTO Tariff Download Facility [23], where Taiwan is registered. Import and export flows are appended to the BACI dataset after removing any residual

Parameter / Dataset	**Symbol (File)**	**Provider**	**Year**	**Description**
Bilateral trade volume (BACI HS17)	M_{in}^{j} (`xbilat.txt`)	CEPII [21]	2019	Bilateral trade flows at HS6 level, values in USD
Tariffs (MacMap HS6)	τ_{in}^{j} (`tariffs2019.txt`)	CEPII [22]	2019	Bilateral applied AVE tariff rates (HS 2007)
Taiwan trade & tariffs (Tariff Download)	–	WTO [23]	2019	Taiwan bilateral trade flows and applied MFN tariffs per HS6
Input-sector importance	γ_{n}^{kj} (`IO.txt`)	Eora	–	Intermediate input cost shares
Value-added share	γ_{n}^{j} (`B.txt`)	Eora	2017	Value-added share of gross output
Gross output	Y_{n}^{j} (`GO.txt`)	UN National Accounts	2019	Total gross output per sector
Sector elasticities	θ^{j} (`T.txt`)	Caliendo and Parro	2015	Trade elasticity parameters
Sector concordance	–	World Bank WITS [24]	–	HS6 $\rightarrow$ ISIC Rev. 3 mapping for Caliendo–Parro sectors

Table 3.4.: Summary of model parameters, required input files, and primary data sources.

Taiwan observations from the latter. Where the same trade pair appears in both the import and the export file, values are summed to avoid double counting.

Following the assembly of the trade flow dataset, HS6 product codes are mapped to the 20 tradeable sectors of Caliendo and Parro via the concordance provided by the World Bank WITS [24], which maps HS6 codes to ISIC Rev. 3 ranges as defined in [8]. The remaining 20 non-tradable sectors do not appear in bilateral trade data and are therefore derived exclusively from the IO tables. Products that cannot be matched to a tradable sector are dropped. Within each exporter–importer–sector cell, trade values are summed to yield the bilateral trade flow matrix M_{in}^{j} required as input to the model.

Countries that appear in the BACI data but are not needed for computing a counterfactual scenario are combined into a single composite Rest of World (ROW)-level aggregate. Where a non-scenario exporter trades with an importer part of the scenario, the exporter is relabeled `ROW` and flows are summed. Where a scenario exporter trades with a non-scenario importer, the importer is relabeled

ROW and flows are summed. Where both trading partners are absent from the scenario country list, both are relabeled ROW and the resulting ROW → ROW diagonal is subsequently removed, since the model does not account for domestic trade within the ROW aggregate.

3.4.3. Tariff Rates

General Source

Applied bilateral tariff rates are taken from the MacMap HS6 dataset for 2019 [22], accessed via CEPII. The dataset reports AVE rates at the HS6 level for bilateral importer–exporter pairs. To keep the data processing tractable, only those observations that correspond to actually observed trade pairs in the BACI data are loaded and processed.

Chinese Taipei Tariffs

The main tariff file does not contain observations for Chinese Taipei. Although TWN is not specifically needed for the counterfactual scenarios presented in this article, the integration was done to ensure a high data availability and model flexibility for potential future policy research involving TWN as a major producer of silicone computer-chips.

Two approaches are applied to integrate TWN which are dependant on the direction of trade. For *exports from TWN* to third countries, no bilateral TWN-specific tariff data are available in the MFN dataset. As a proxy, the average applied tariff of the respective importing country at the HS6 level is computed across all non-TWN exporters and assigned to the TWN export pair.

EU Tariff Harmonisation

The EU operates a Common External Tariff (CET), meaning that all member states apply identical tariff rates to imports from third countries. Without explicit harmonisation, the raw data may contain minor reporting differences across EU member states for the same exporter–product pair. To enforce consistency, two rules are applied. First, all intra-EU tariff rates are set to zero, reflecting the internal market. Second, for each exporter–HS6 combination involving a non-EU exporter, the tariff rate is set to the simple average across all EU member states for which an observation exists, thereby approximating the CET. The list of EU member states used for 2019 includes the United Kingdom (GBR), since the reference year predates the effective end of the Brexit transition period on 31 December 2020.

A further harmonisation is applied on the *exporter* side. MacMap does not provide bilateral tariff observations for all EU member states as exporters to non-EU countries; Belgium (BEL), Luxembourg (LUX), and Romania (ROU) are absent entirely. Since the EU operates a common commercial policy, third countries apply equivalent tariff rates to all EU exporters regardless of their member state of origin. Missing EU-exporter observations are therefore imputed by computing the simple average tariff charged by each importing country across all EU member states for which an observation exists, at the HS6 level.

Sector-Level Tariff Aggregation

Within each exporter–importer–sector cell, the sector-level tariff rate $\dot{\tau}_{in}^{j}$ is computed as a trade-value-weighted average of the underlying HS6 tariff rates:

$$\dot{\tau}_{in}^{j} = \frac{\sum\limits_{h \in H^j} v_{in}^{h} \cdot \tau_{in}^{h}}{\sum\limits_{h \in H^j} v_{in}^{h}}, \tag{3.12}$$

where H^j is the set of HS6 codes mapped to sector j, v_{in}^{h} is the bilateral trade value of product h from country i to country n, and τ_{in}^{h} is the corresponding tariff rate. This trade-value-weighted aggregation is standard in the literature and is also employed by Caliendo and Parro [8].

It is important to acknowledge a known bias inherent to this weighting scheme. High tariffs suppress import volumes, so heavily protected products receive a small weight in the average, causing a downward bias in the estimated sector-level tariff rate relative to the true protective effect. This is not a coding error but a structural limitation shared by all import-weighted aggregation approaches. As an illustration, the Swiss "Food" sector (sector 3) displays a weighted average tariff of approximately 55 %, a figure that likely still *understates* the true degree of agricultural protection. Tariff rates within each ROW cell are re-aggregated using the same trade-value-weighted formula.

3.4.4. Merging Trade Flows and Tariffs

Trade flows and tariff rates are joined at the HS6 level using a *left join* on the triple (exporter, importer, HS6 code), after which the merged data are aggregated to the sector level as described above. Trade pairs for which no tariff observation is available receive an imputed tariff rate of zero (i.e. $\tau = 1$), which is consistent with the treatment of preferential agreements such as the Generalised System of Preferences or Everything But Arms, where the effective applied tariff is zero but no explicit entry appears in the MFN-based tariff file.

Of the 11’327’428 bilateral HS6-level observations retained after the left join, 3’861’987 (34.1 %) were matched to a tariff observation in MacMap, covering trade flows worth USD 4’500 Mrd. (23.5 % of total trade value). The remaining 65.9 % of observations, representing 76.5 % of total trade value (USD 14’500 Mrd.), received an imputed tariff rate of zero. Importantly, the left join ensures that *no trade flow is lost*: the bilateral trade volume is preserved in full, and only the tariff assignment is imputed where data are missing.

The final step assembles two three-dimensional arrays with dimensions $N \times N \times J$, where N is the number of countries (including `CHE.JU` and `ROW`) and $J = 20$ is the number of tradeable sectors. The first array, $\mathbf{X}_{in}^{j}$, contains the bilateral trade flow from country i to country n in sector j, expressed in USD. The second, $\boldsymbol{\tau}_{in}^{j}$, contains the corresponding trade-weighted average applied tariff rate in ad-valorem decimal form. The diagonal of both arrays, representing own-country trade, is set to zero, consistent with the convention in Caliendo and Parro [8].

For compatibility with the MATLAB solver software provided by Caliendo and Parro [17], the three-dimensional arrays, produced by applying the methodology described in this chapter, are exported in a stacked format of $(J \cdot N) \times N$ matrices, where each block of N rows corresponds to one sector. The tariff matrix is multiplied by 100 before export to convert from decimal to percentage points, as required by the solver. The Canton of Jura (`CHE.JU`) receives the same tariff profile as Switzerland (`CHE`) in the baseline calibration, reflecting the fact that Jura is currently part of the Swiss customs territory. The counterfactual scenarios then modify these rates to simulate an independent trade policy for the Canton.

For transparency, Table 3.5 summarizes the main limitations of the data construction procedure described in this section.

Issue	Description	Expected Impact
Left join on tariff merge	Missing tariff rates set to zero (tariff-free). Of USD 14,511 Mrd. total BACI trade volume, USD 13'916 Mrd. (95.9 %) could be matched to a tariff rate; the remaining USD 595 Mrd. (4.1 %) are assigned zero.	Small; less than 5 % of trade volume affected
EU exporter harmonisation	MacMap contains no bilateral tariff entries for BEL, LUX and ROU as exporters to non-EU countries. The EU common external tariff is approximated by averaging the rates of the remaining EU member states at HS6 level.	Negligible; EU CET is harmonised by regulation
TWN export tariff proxy	No bilateral TWN export tariffs available in the dataset; the average MFN rate of the importing country at HS6 level is used as a proxy across all non-TWN exporters.	Small; limited to TWN export pairs only
Import-weighting bias	High tariffs suppress import volumes, causing downward bias in the trade-weighted average applied rate.	Systematic underestimation of protection; shared by all studies using trade-weighted tariffs
HS classification mismatch	Tariff data in HS 2007, BACI in HS 2017; minor code differences at HS6 level.	Negligible

Table 3.5.: Summary of data limitations and their expected impact.

3.4.5. Gross Output

Gross Output is defined as the intermediate consumption (Z) plus the value added (VA) in a country. This data could technically be constructed using the WIOD or Eora data only but since these data sources have a lot of imputed data, they are not representative of the real economical output of countries and represent only an estimation (see chapter 2). As has been done by Caliendo and Parro [8], the software for this analysis is using actual reported data from the UN "National Accounts Database" of the year 2019. [16]

The UN database offers data for the gross output of 7 ISIC Rev.3 sectors which can be matched to the sectors used in this analysis by doing a ISIC-Matching as described in section 3.2.

3.4.6. Value Added Shares

The Value Added Shares, γ_i^n, which are located in file "B.txt", are calculated using the data from Eora. The more accurate data of Gross Output which is calculated using actual reported data from the UN National Accounts dataset, can't be used for the calculation as it doesn't have reliable Value Added data. Also, the Value Added data from the INDSTAT dataset, as has been used by Caliendo and Parro, can't be used as it is missing many key ISIC sectors. Caliendo and Parro handled this issue by combining different datasets, like OECD STAN, with the INDSTAT dataset to cover all 40 sectors. The problem with the OECD STAN dataset is that it only covers OECD nations which would mean the data for this research which covers many non-OECD countries, like the BRICS countries, would need to be imputed using inaccurate data sources like Eora regardless. So the most reliable way is to directly use all the data from Eora.

3.4.7. Input-Sector-Importance

The Input-Sector-Importance γ_n^{kj} measures the partial contribution of output from industry k across all countries to industry j in country n. In other words, γ_n^{kj} represents the share of total intermediate inputs used by industry j in country n that originates from industry k. It can be interpreted as the percentage of intermediate expenditures of industry j in country n that is directed toward inputs from industry k. For example, it describes how much of the expenses of the automotive industry in Germany go to metal production.

The data used for this calculation also comes from Eora, depending on the scenario, although the scenarios presented in this article all rely on the Eora dataset. Since the two datasets vary a lot due to their data imputation methods, the resulting Input-Sector-Importances are very dependent on the dataset used. Because WIOD only covers a small sample of countries and many that are relevant for this article, namely the BRI-countries are often not represented, Eora is used in more scenarios. Due to the fact that Eora has more assumptions in it, WIOD is used whenever it is possible.

When computing the equilibrium, the choice of data source has a substantial impact on computational performance. In particular, the linear system `DD1 = OM \ Vb`, which is located in the *expenditure.m* script, exhibits significantly different execution times depending on the underlying Input Sector Importance matrix OM.

This difference is linked to the numerical properties of OM. While WIOD produces a well-conditioned matrix with a condition number of approximately 9, Eora results in a substantially more ill-conditioned matrix with a condition number of around 150. A higher condition number is associated with increased numerical difficulty in solving linear systems, which can slow down the backslash operation and amplify sensitivity to rounding errors.

As a result, the computation of `DD1 = OM \ Vb` is noticeably slower for the Eora-based system compared to the WIOD case. This difference propagates to the overall runtime of the equilibrium solution procedure implemented in the *expenditure.m* script.

3.5. Technological implementation

This section specifies the technologies used for this thesis. The technical architecture of the quantitative analysis relies primarily on the programming languages R and MATLAB, as well as version control tools.

3.5.1. Data Preparation and Analysis Pipeline in R

The central productive output of the thesis is the development of a comprehensive data pipeline based on R. R was primarily used for processing, cleaning, and merging the high-dimensional international trade and tariff databases (such as BACI and MacMap). Key programming steps included ISIC matching, aggregation of sectors, construction of input-output data for the Canton of Jura, and transforming the processed data into stacked matrices which can be interpreted by the software of Caliendo and Parro [17] in MATLAB.

3.5.2. Quantitative General Equilibrium Model in MATLAB

The actual numerical solution of the general equilibrium model according to Caliendo and Parro was executed in MATLAB [8]. The original code by Caliendo and Parro was adopted and only modified to be able to dynamically process a non-static amount of countries. Instead of manually running the data through isolated single scripts, an automated pipeline was created, allowing for an efficient computation of welfare effects in a single continuous run. More details about the changes to the

MATLAB code can be found in the Appendix under section A.4.

3.5.3. Version Control with Git

To ensure traceability and simplify collaboration, the entire R and MATLAB codebase is version-controlled using Git. The corresponding code repository is hosted and managed on GitHub.

3.6. Output Analytics

After the model of Caliendo and Parro is applied to the dataset constructed in this chapter, different scenarios are analyzed, with particular focus on the region of Jura. The analytical strategy used by Caliendo and Parro focuses on welfare gains and decomposes these gains into the **volume of trade** and the **terms of trade**. These metrics are important to understand the causes of welfare changes. The **volume of trade** describes how welfare changes due to increasing imports, denoted by M, or due to higher tariff revenues generated from these imports. The **terms of trade** describe whether tariff changes create a relative price advantage for a country. This advantage occurs when the price level of imported goods decreases relative to the export price level, which improves the value obtained per unit traded [8].

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Specifically, the overall change in welfare, $d \ln W_n$, for a given region n can be formally expressed by decomposing these effects:

$$d \ln W_n = \frac{1}{I_n} \sum_{j=1}^{J} \sum_{i=1}^{N} \underbrace{\left(E_{ni}^j d \ln c_n^j - M_{ni}^j d \ln c_i^j \right)}_{\text{Terms of trade}} + \frac{1}{I_n} \sum_{j=1}^{J} \sum_{i=1}^{N} \underbrace{\tau_{ni}^j M_{ni}^j \left(d \ln M_{ni}^j - d \ln c_i^j \right)}_{\text{Volume of trade}}, \tag{16}$$

In this expression, I_n represents the total income of the region. The summations over N trading partners and J sectors aggregate the effects across the entire economy.

- The **terms of trade** component captures the net change in value driven by shifts in unit production costs (c_n^j for the domestic region and c_i^j for foreign regions), weighted by initial exports E_{ni}^j and imports M_{ni}^j.
- The **volume of trade** component measures the welfare impact generated when changes in the quantity of imports M_{ni}^j interact with existing bilateral tariffs τ_{ni}^j.

These metrics form the main analytical framework in the study by Caliendo and Parro, where the focus lies on a detailed analysis of a single counterfactual scenario. The study examines the effects of the NAFTA trade agreement, which reduced tariffs between the United States, Canada, and Mexico, on the economies of these countries [8]. In contrast, this article focuses on the analysis of multiple counterfactual scenarios. This broader perspective requires additional analytical approaches compared to the reference study.

To gain detailed insights into the effects of a scenario and to evaluate tariff reductions applied to a specified group of countries, a standardized representation of scenarios is defined. The analysis focuses on the Canton of Jura as a system consisting of stocks and flows. In this framework, consumption within the canton represents the stock, while imports and exports represent the flows.

Due to the use of hat algebra, the results of the model are expressed in relative changes. The model outputs an expenditure matrix $X_n^{j'}$, which is calculated based on relative wage changes $\hat{w}$. This matrix represents an index of expenditures in a counterfactual scenario and is implemented in the function `expenditure.m`, as described in the appendix of Caliendo and Parro [8]. From this expenditure index, a counterfactual index of bilateral trade flows, denoted as *xbilat*, is calculated using trade shares, following the same procedure [8].

Import and export changes are derived by aggregating the bilateral trade matrix. Imports for a given country are calculated by summing over the corresponding column of *xbilat* across all partner countries. Exports are calculated by summing over the corresponding row. After obtaining the indices for the baseline and the counterfactual scenario, percentage changes are computed using:

$$exportChange = 100 \left(\frac{export^{CF}}{export^{B}} - 1 \right).$$

The method is likewise used to determine variations in imports.

The same concept is applied to gross output (GO). In this case, sectoral detail is important to identify which sectors of the Canton of Jura benefit from tariff changes. The gross output matrix is derived from the expenditure matrix by aggregating all expenditures of a country. An example of the implementation is provided in the replication code of Caliendo and Parro in the file `script.m`. [8] After computing both baseline and counterfactual gross output, percentage changes are calculated using the same method as for imports and exports. These results are used to generate the figures presented in chapter 4.

3.7. Scenario Definition

In chapter 4 the simulation results for each free trade scenario between the Canton of Jura (`CHE.JU`) and its respective partner countries are presented. In this context, "free trade" refers to a situation in which zero tariffs are applied across all sectors, both on imports from the respective countries to the Canton of Jura and on exports from the Canton of Jura to these countries. Meaning $\tau^k_{i,\text{ CHE.JU}} = 0$ for all countries $i \in Scenario$. Scenario countries refers not to all countries in a scenario but to the countries in the scenario to which free trade is arranged. For example in the BRICS scenario this would be the BRICS countries.

An example of how tariffs are adjusted in the counterfactual scenarios is shown in Figure 3.2, where baseline tariffs (left heatmap), taken from the MacMap HS6 dataset for 2019 [22], are compared with the tariffs under the BRI counterfactual scenario (right heatmap). The counterfactual changes occur in the CHE.JU row and column, where a large number of tariff entries are set to zero.

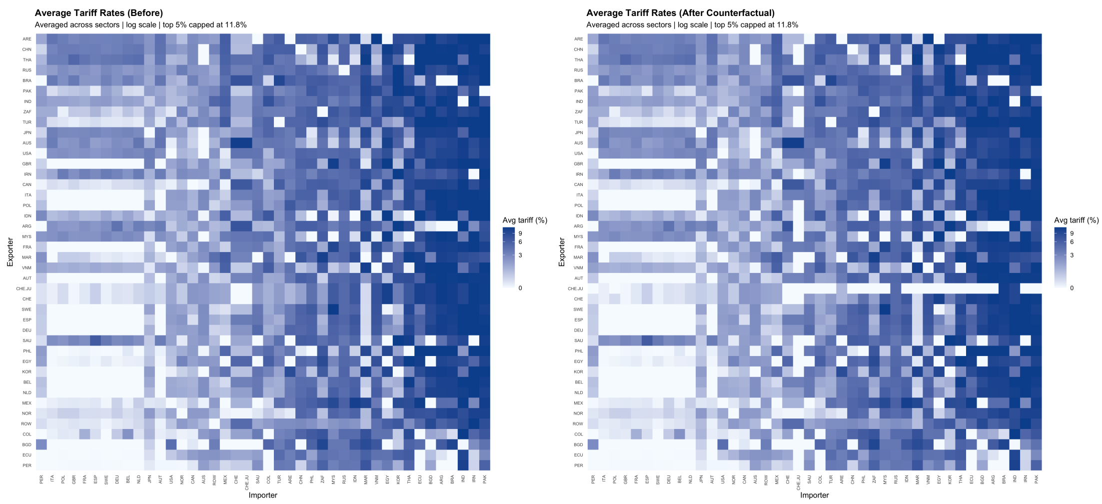

Figure 3.2.: Baseline Tariff Heatmap compared to the BRI-Counterfactual

For each scenario, the primary variables of interest are the relative change in welfare, as well as the absolute and relative changes in imports to, exports from, and gross output within the Canton of Jura. In addition, to obtain deeper insights into sectoral dynamics and international spillover effects, changes in gross output are also analyzed at the global level, disaggregated by industry.

To maintain a more concise presentation in the results chapter and to focus on welfare effects and absolute changes within the Canton of Jura, the relative changes as well as the global gross output results are moved to the appendix (section A.5).

To further improve understanding of the model behavior based on the dataset constructed using the methodology described in this article, an additional scenario is considered in which all global tariffs are set to zero. Moreover, a stepwise scenario involving the BRICS countries is introduced. In this sequential setup, China and India are first analyzed individually, as they represent the largest economies within the group; subsequently, both countries are combined into a joint scenario; finally, the full set of BRICS countries is included and evaluated as a single bloc. This incremental approach enables the assessment of the marginal contributions of individual countries and subgroups within the BRICS framework.

A total of six scenarios are presented in the chapter 4, including one build-up scenario (BRICS) including four sub-scenarios. The scenarios are chosen based on a selection of economic entities which are very relevant for Switzerland, namely the EU and the USA, and, to reflect the opportunities resulting from a multipolar focus, major emerging economic blocks have been chosen to be assessed in the counterfactual scenarios, namely the BRI and BRICS countries, which include many of the most important emerging markets.

To ensure comparability across simulations, an identical set of graphical representations is produced and reported for each scenario. The two most relevant graphs for each scenario are shown in chapter 4, the remaining graphs can be found in the section A.5.

4. Results

The following chapter presents the results of the investigated scenarios. Each scenario is structured identically to facilitate systematic comparison. To limit the extent of this chapter, only the most relevant diagrams are included, while additional figures are provided in the Appendix section A.5.

4.1. Overall Scenario Results

This section summarizes all the scenarios main effects, namely the welfare gains and the stock- and flow values (import, export GO).

4.1.1. Welfare

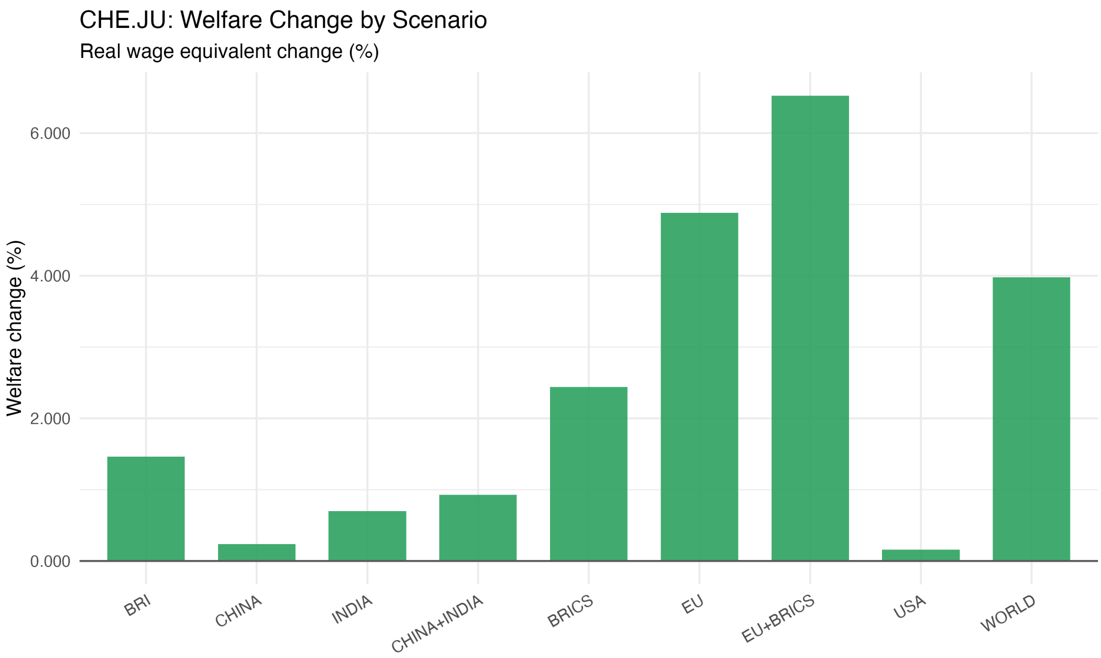

Figure 4.1.: CHE.JU welfare change compared across all scenarios.

Scenario	Amount of countries with 0 tariff	Welfare increase in Jura
BRI	20	+1.46%
China only	1	+0.23%
India only	1	+0.7%
China + India	1	+0.93%
BRICS	5	+2.44%
EU	27	+4.88%
EU + BRICS	32	+6.53%
USA	1	+0.16%
World	30 + ROW	+3.98%

Table 4.1.: Welfare gains and amount of countries involved

The Figure 4.1 shows the welfare in the Canton of Jura gains among all scenarios. The highest welfare effect can be seen in the EU + BRICS scenario which reports a welfare gain of around 6.53% (see section 4.5 for more details).

The BRICS scenario is listed as four individual scenarios in the graphic as it is a build-up scenario in which the biggest member countries by GDP, namely China and India, are first looked at individually and are then combined to first a two country block and finally with all the defined BRICS countries. In Table 4.1 it can be seen that welfare gains are partially dependent on the amount of countries set to zero tariffs in a scenario as the EU + BRICS scenario has the most countries with zero tariffs involved and also reports the highest welfare gain.

4.1.2. Import, Export and GO

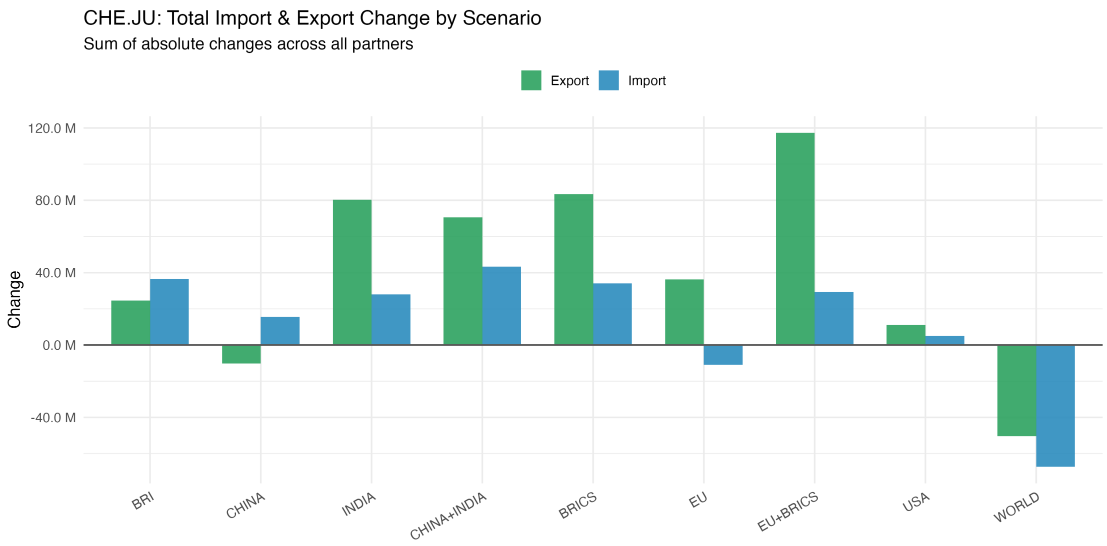

Figure 4.2.: Total absolute import and export change of CHE.JU compared across all scenarios.

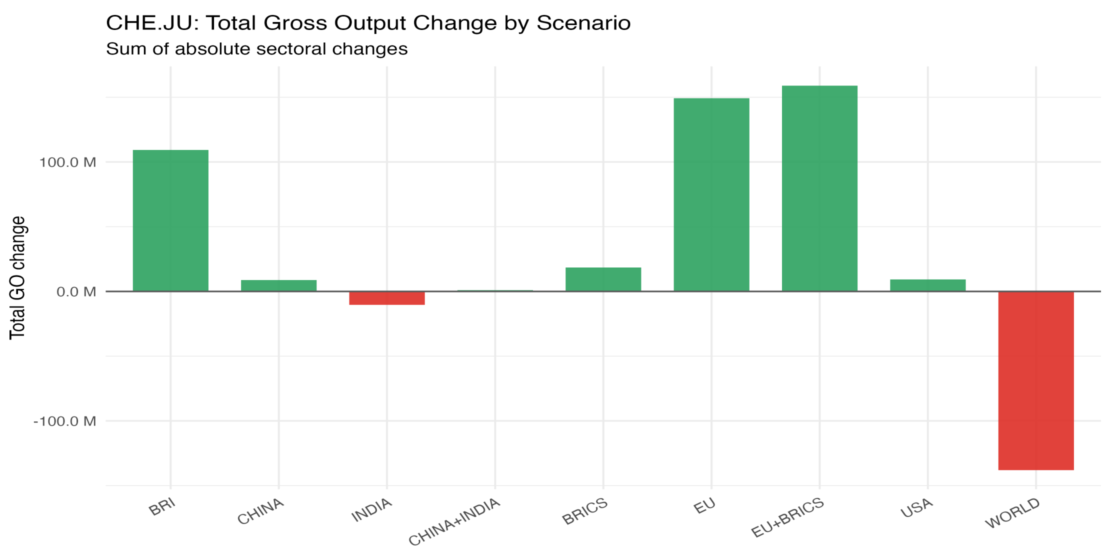

Figure 4.3.: Total absolute gross output change of CHE.JU compared across all scenarios.

In Figure 4.2 and Figure 4.3 it can be seen that even though welfare gains take place in scenarios like the China only or World scenario, the GO or import and export volumes can still decline overall. This is because welfare, as defined by Caliendo and Parro, does not only result from increased ”volume of trade” but also if a country has an advantage in prices, meaning their ”terms of trade” (see Equation 16 for comparison) is better [8].

4.2. BRI Scenario

4.2.1. Scenario Description

The BRI scenario represents a simulated free trade agreement between the Canton of Jura and a subset of the 20 largest BRI countries measured by GDP (see Table 4.2 for details). BRI countries are defined as those states that are active signatories of the Memorandum of Understanding underpinning the BRI. Information on membership status is provided by Shanghai Fudan University [25]. The “Green Finance & Development Center” makes available an Excel dataset listing all signatory countries, on the basis of which the sample is constructed. Specifically, those countries for which the column “Likely date of exit” contains no entry are classified as BRI countries.

Although the set of countries that would have a free trade relationship with the Canton of Jura is relatively large in this counterfactual, the bilateral trade volume between most of the countries, with notable exceptions such as China, is fairly small; tariff changes could therefore have only a minor impact.

Countries				
China	Indonesia	South Korea[1]	Turkey	Iran
Saudi Arabia	Poland	Argentina	Thailand	Ecuador
Philippines	Vietnam	Bangladesh	Malaysia	Peru
Egypt	Colombia	South Africa	Pakistan	Morocco

Table 4.2.: List of BRI countries included in the analysis.

[1]South Korea’s official status within the BRI is sometimes debated, but they are included here based on their signing of a Memorandum of Understanding (MoU) on May 1, 2018.

4.2.2. Figures

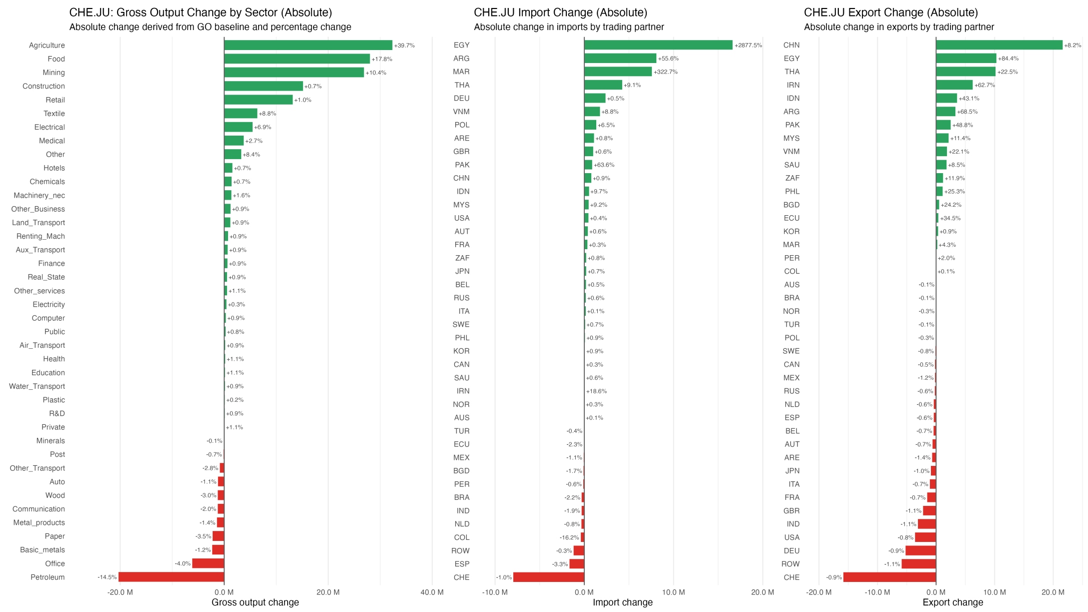

Figure 4.4.: Absolute changes in gross output, imports, and exports by sector and trading partner — BRI scenario.

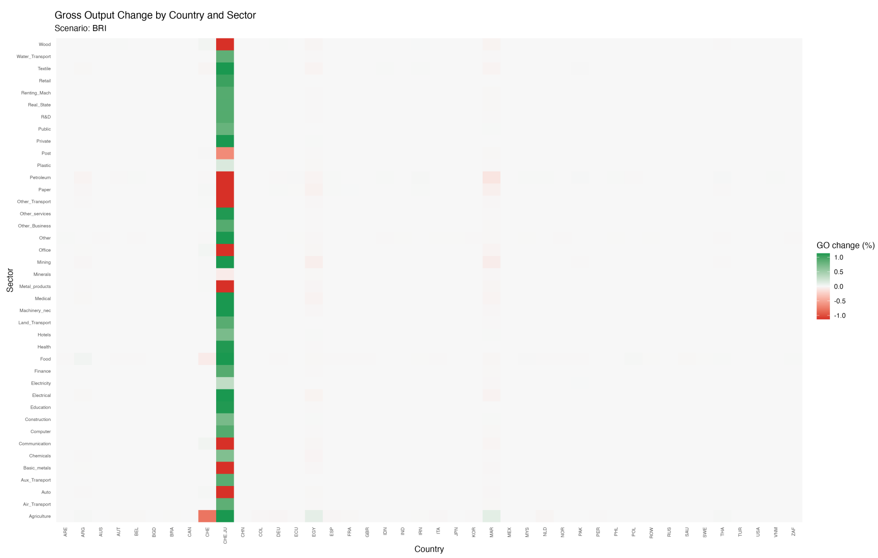

Figure 4.5.: Gross output change heatmap across countries and sectors — BRI scenario.

4.2.3. Scenario Results

Establishing a free trade agreement with the 20 largest BRI countries yields an estimated welfare increase of 1.46% for the Canton of Jura. Although this constitutes a significant gain compared to the 1.31% maximum welfare increase calculated by Caliendo and Parro [8] for Mexico under North American Free Trade Agreement (NAFTA), the magnitude is somewhat subdued considering the scale of the 20-nation bloc. The relative weakness of these gains is further underscored when compared to the EU scenario (see section 4.4).

Even though the welfare gains are not groundbreaking, individual sector in the Canton of Jura still experience major growth. As can be seen in Figure 4.4, the Canton of Jura experiences major growth in the Agriculture, Food, and Mining sectors, which all grow substantially by 20–30 million USD from their original value.

The Canton of Jura was officially reported to have a GDP of around 6 billion CHF in 2022 [26]. If the exchange rate of CHF to USD in 2022 from 03.01.2022, which was 1.0888 USD per CHF [27], is applied, this is equivalent to approximately 6.53 billion USD. Using the methodology explained in section 3.3 to construct the data for the Canton of Jura, the total GO amounts to 6.68 billion USD. Taking this into account, it can be seen that a 30 million USD change in one sector is not very influential for the overall economy, but it still represents substantial growth for the individual sector, which in the case of Agriculture has a yearly output of around 815 million USD.

Further, focusing on the trading partners, it can be seen that imports from Egypt to the Canton of Jura grow by over 15 million USD. This marks a significant increase since Egypt originally accounted for only 577'029 USD and therefore represents an increase of almost 3000%. Due to the nature of the Caliendo and Parro model, the dimensions of the sectors of the goods imported cannot be derived from the model; this needs to be assumed based on the increases and decreases in GO worldwide. When analyzing Figure 4.5, it can be seen that the Agriculture sector of Egypt also grows, as does that of Morocco. The remainder of Switzerland, subsequently called "Mainland Switzerland", takes a hit in its respective Agriculture sector, which is flooded by cheaper imports that are first imported to the Canton of Jura and then, following the zero-tariff regime between Mainland Switzerland and the Canton of Jura, subsequently imported into Switzerland. The Islamic Republic of Iran and Pakistan report slight increases in the Petroleum sector. Both countries, especially the Islamic Republic of Iran, are already major energy exporters; therefore, the relative increase is not large, but it is fairly impactful for the Petroleum sector of the Canton of Jura. Although the Canton of Jura has no oil industry, it does have biogas production facilities such as the company "Bio-energ'etique", which could be impacted by this policy, as the sector experiences losses of over 20 million USD.

China poses the highest potential for growth in the export market, with a predicted increase of more than 20 million USD in equilibrium. Besides China, Egypt and Thailand also present themselves as new opportunities for exports of goods from the Canton of Jura. Not only imports from, but also exports to, Mainland Switzerland take a hit and shrink by over 15 million USD.

All in all, even though twenty countries in total were included in the free trade scenario, the overall welfare gains were not that substantial. Certain sectors experience large shifts, while most do not change significantly.

4.3. BRICS Build-up Scenarios

4.3.1. Scenario Description

To understand the individual contribution of countries within the BRICS bloc, a build-up approach is used: starting with China alone, then India alone, then combining China and India, and finally including all BRICS members.

The comprehensive BRICS scenario models the implementation of a free trade agreement between the Canton of Jura and all founding BRICS member states. The term "founding countries" denotes the founding members of the bloc, namely Brazil, Russia, India, China, and South Africa, which are treated as the only BRICS countries within this framework. Subsequent signatories to the grouping, such as Egypt, Ethiopia, or the United Arab Emirates (ARE) as well as observer states like Kazakhstan, are not classified as BRICS members for the purposes of the present analysis.

4.3.2. Figures

China Only

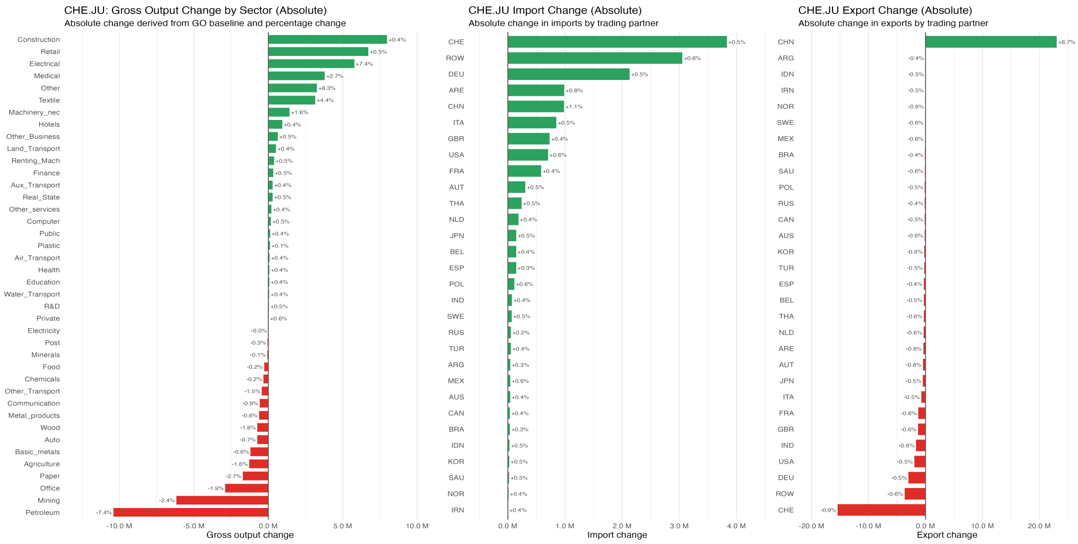

Figure 4.6.: Absolute changes in gross output, imports, and exports by sector and trading partner — China scenario.

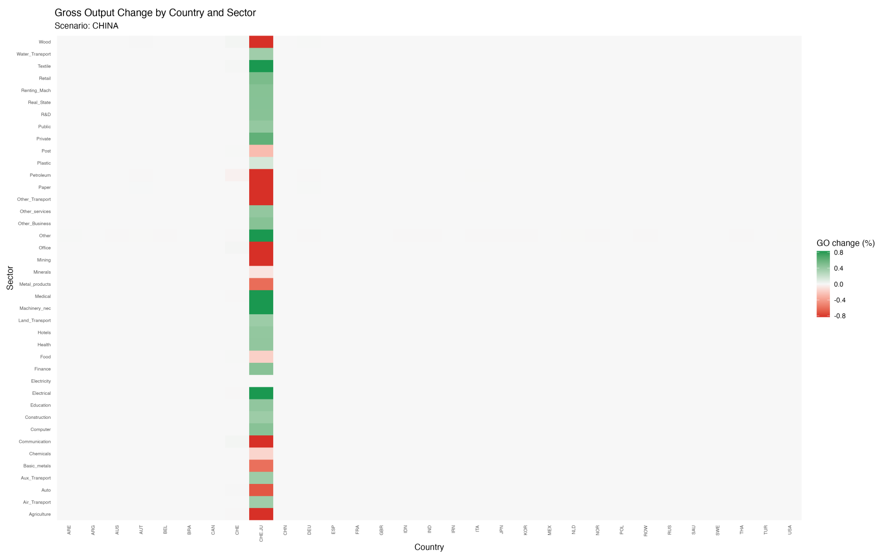

Figure 4.7.: Gross output change heatmap across countries and sectors — China scenario.

India Only

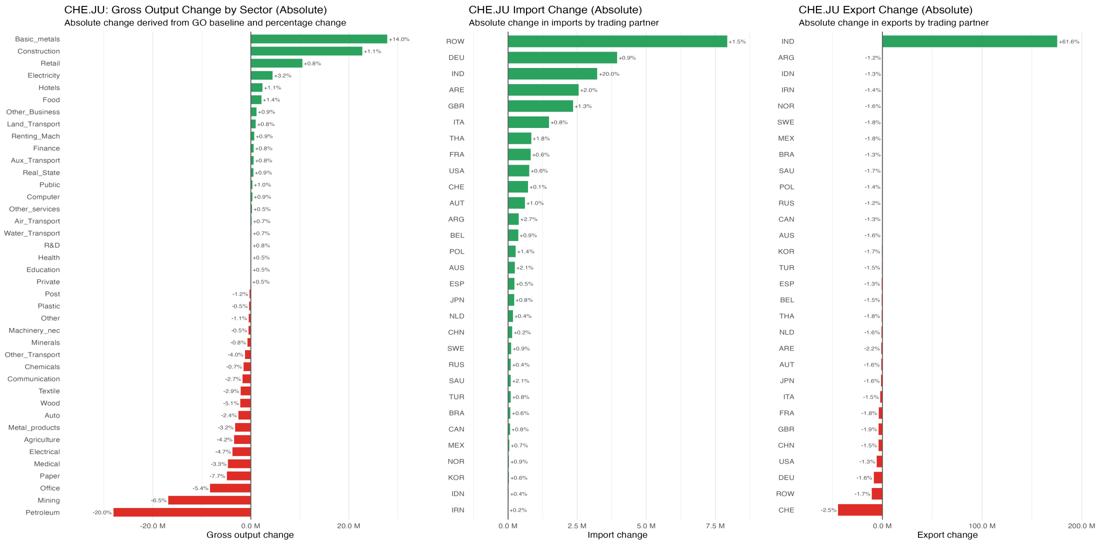

Figure 4.8.: Absolute changes in gross output, imports, and exports by sector and trading partner — India scenario.

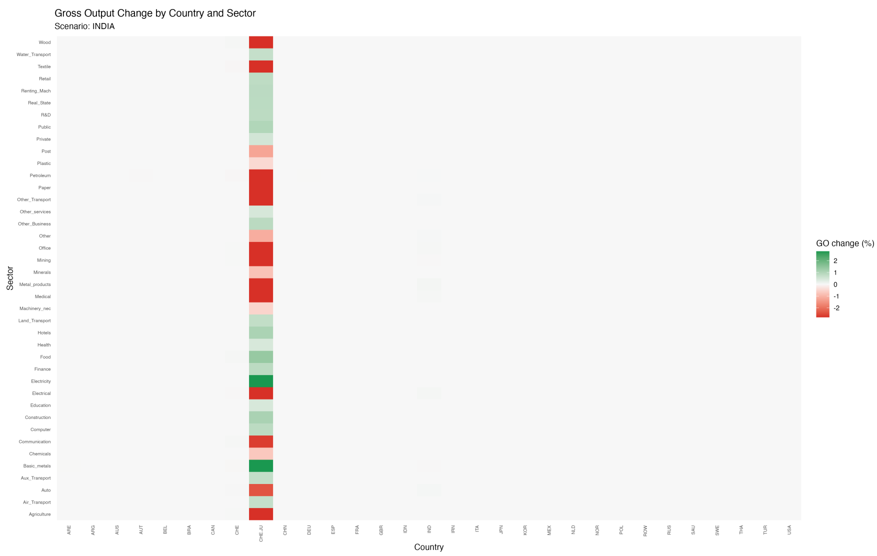

Figure 4.9.: Gross output change heatmap across countries and sectors — India scenario.

China and India

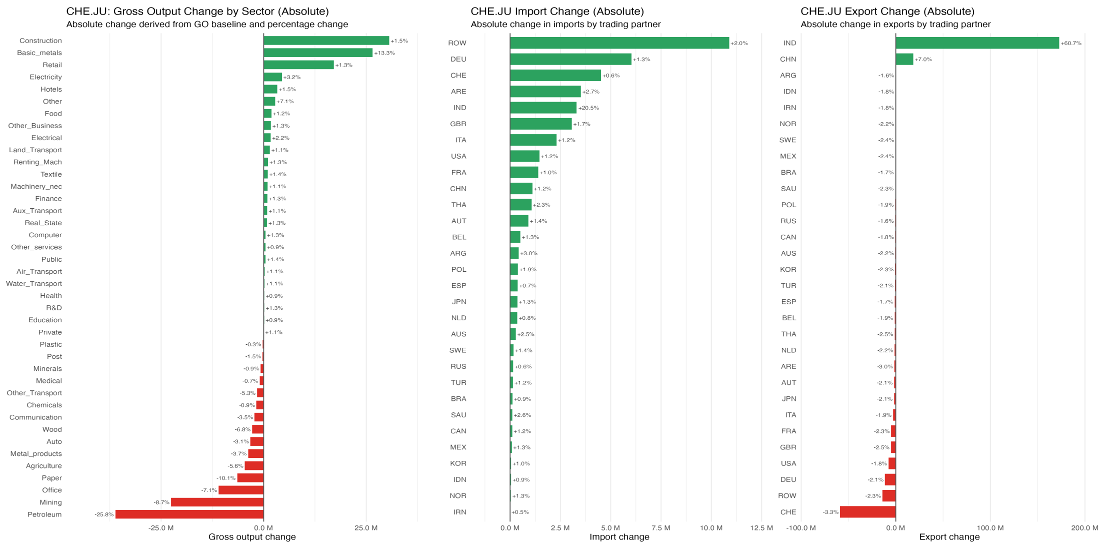

Figure 4.10.: Absolute changes in gross output, imports, and exports by sector and trading partner — China and India scenario.

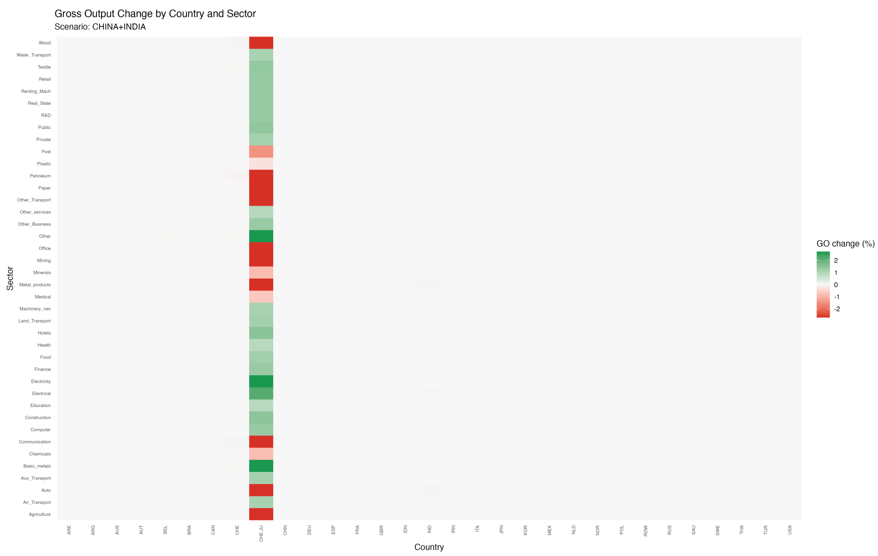

Figure 4.11.: Gross output change heatmap across countries and sectors — China and India scenario.

Full BRICS

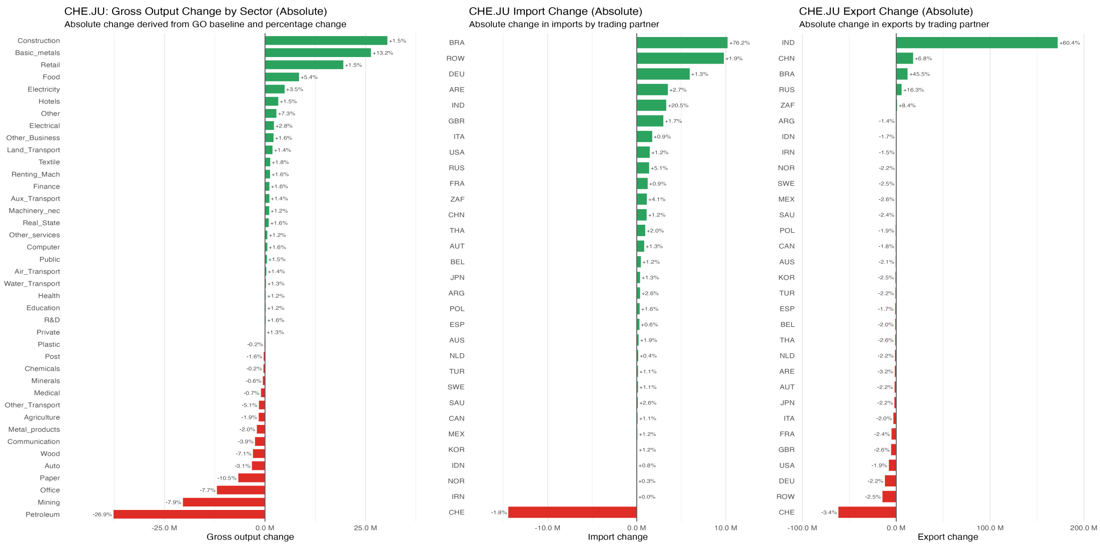

Figure 4.12.: Absolute changes in gross output, imports, and exports by sector and trading partner — full BRICS scenario.

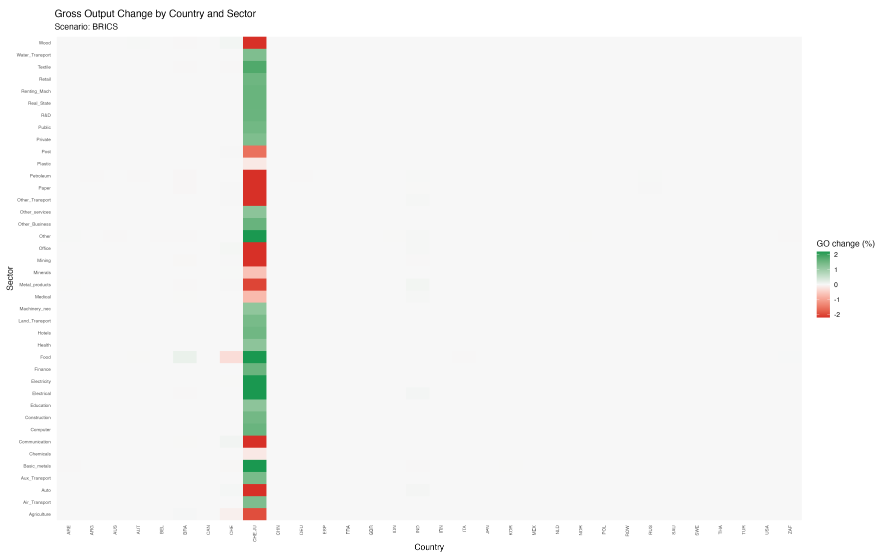

Figure 4.13.: Gross output change heatmap across countries and sectors — full BRICS scenario.

4.3.3. Scenario Results

China Only

Welfare gains in the China-only scenario for the Canton of Jura amount to 0.23% and could be considered negligible. This presents an important insight into the trade integration that the Canton of Jura already has with China and suggests that an equilibrium following the free trade agreement between Switzerland and China in 2014 has most likely already been reached, with only certain potentials in highly protected sectors remaining.

Focusing on gross output in Figure 4.6, it can be observed that the Construction sector experiences slight growth of around 5%, or approximately 7.5 million USD. One possible explanation for this growth might be cheaper building materials imported from China. The Retail sector also grows slightly, which could be due to increased access to consumer products from China.

Imports from Mainland Switzerland grow by around 3.5 million USD per year and mark the largest increase in growth. Comparing this with Figure 4.7, it can be assumed that the imports mostly originate from the Computer, Office, and Wood sectors, as they all report decreases in the Canton of Jura alongside simultaneous increases in Mainland Switzerland.

Changes in exports from the Canton of Jura are directed exclusively toward China, which imports more than 20 million USD in additional goods from the Canton of Jura. This is a substantial increase of over 7.5%, but it results in only a slight impact on the overall welfare gains for the Canton.

India Only

Welfare gains resulting from a free trade agreement between the Canton of Jura and India are substantially larger than in the scenario with China, resulting in relative welfare growth in the Canton of around 0.7%. Since the data basis for this article is from the year 2019, when Switzerland and India had not yet signed the industrial free trade agreement of 2024, this scenario not only serves as a further case study into how region-specific trade policies could impact welfare, but also to assess how existing free trade policy has affected these regions and how trade liberalization could further impact them. In comparison to the China-only scenario, in which a substantial free trade agreement was already in force, the India-only scenario shows the regional potential that the new trade policy from 2024 will have for the Canton.

The gross output of the Canton, shown in Figure 4.8, experiences large sectoral growth in the Basic Metals sector as well as in Construction, while the Petroleum industry contracts.

Imports barely shift; the Canton imports around 7.5 million USD more from all countries combined into the "Rest of World" category. India only ranks third in import increases, with around 3 million USD in growth. This is the highest relative (+ 20.0%), but it remains an overall negligible absolute amount, leading to the conclusion that imports from India are not a major factor in the welfare increase.

The source of the welfare increase results from growing exports to India, where exports increase by about 175 million USD, representing an increase of over 60%. It can be assumed that the exports partly originate from primary metal production, as the "Basic Metals" sector grows by 14% and represents ISIC sector 27, which covers the production of metals such as aluminum, steel, or copper. India does subsequently report a slight increase in the sector "Metal products" (see Figure 4.9) which would support the assumption.

While the result is plausible, the Canton of Jura currently does not have large industries associated with this sector. Due to the broad categorization and the highly aggregated data used to construct the Canton of Jura, the sector is most likely overestimated in the data, receiving 1.51% of the total production of Switzerland according to Figure 3.1.

China and India

Combining China and India into a single scenario shows the build-up effect and how model outputs change when adding two countries within the same scenario instead of observing them individually.

The total welfare gain for the Canton of Jura amounts to 0.93%, which is exactly the sum of the welfare effects from the China-only (0.23%) and India-only (0.7%) scenarios. This shows that welfare effects are sometimes additive, although this assumption cannot be made in all cases. In this instance, the interactions between the economies of India and China through the Canton of Jura are negligible; therefore, an increase in one does not result in a decrease in the other. This could be different if more interconnected economies, such as Germany and France, were linked through a shared node like the Canton of Jura.

As can be seen in Figure 4.10, the Construction sector is the major beneficiary, as it already profits substantially in both the China-only and India-only scenarios. The increase is not simply the sum of the two single-country scenarios, however, as the increase amounts to around 7.5 million USD in the China-only scenario and 25 million USD in the India-only scenario, while the two countries combined result in the same increase as the India-only scenario of 25 million USD, showing that it is not an additive measure. Basic Metals and Retail are also beneficiaries, as can be expected from the two individual scenarios. The Petroleum sector again suffers significantly, as was already observed in both the India-only and China-only scenarios.

The India-only scenario is clearly more dominant, also in terms of imports, as the same importing "country" (Rest of World) marks the highest increase in import volume to Jura.

The exports paint a clear, almost additive, picture of the increases in export volumes to China and India, almost exactly mirroring the results from the single-country scenarios, with India importing up to 175 million USD more and China around 25 million USD more from Jura. There are slight changes, however, as the export volume to India decreases slightly compared to the single-country scenario.

The worldwide gross output changes seen in Figure 4.11 largely resembles the one from the India only scenario Figure 4.9 with slight growth of the "Metal products" sector in India.

Full BRICS

Now, adding all the defined BRICS countries (Brazil, Russia, India, China, and South Africa) into one scenario and extracting the results, the outcomes can be interpreted with additional context.

Welfare makes a sudden jump from 0.93% in the China and India scenario to 2.44%. This implies that there could be at least one country within the set that has a larger impact on overall welfare than the two largest economic units of the bloc, China and India.

For gross output, no unexpected changes occur. Construction and Basic Metals remain the dominant sectors in which growth takes place, while Petroleum and Mining decline as can be seen in Figure 4.12. The magnitude of change also remains roughly in the same range as in the previous scenarios.

Imports to Jura show a potentially large source of the welfare change. The highest increase in imports originates from Brazil, with over 10 million USD in additional trade. This represents almost an 80% increase. The other increases largely reflect those observed in the prior scenarios, except for the ARE, which now also appears among the import increases, most likely due to the decline in the Petroleum sector and the subsequent increase in imports.

Exports are also similar to the two prior scenarios, with India and China remaining the main export markets. However, Brazil, Russia, and South Africa now also appear with slight increases in export volumes. Exports to Mainland Switzerland decline by 3.4% which accounts for a large absolute amount of over 50 million USD.

This is also reflected in the worldwide GO change (Figure 4.13) where clear decreases in the gross output of certain sectors of Mainland Switzerland can be seen as well as increases in the Food sector of Brazil.

4.4. EU Scenario

4.4.1. Scenario Description

The EU scenario simulates a free trade agreement between the Canton of Jura and all European Union member countries. The scenario includes the most countries of the single block scenarios, 27 in total, and is therefore likely to yield a high total welfare gain.

4.4.2. Figures

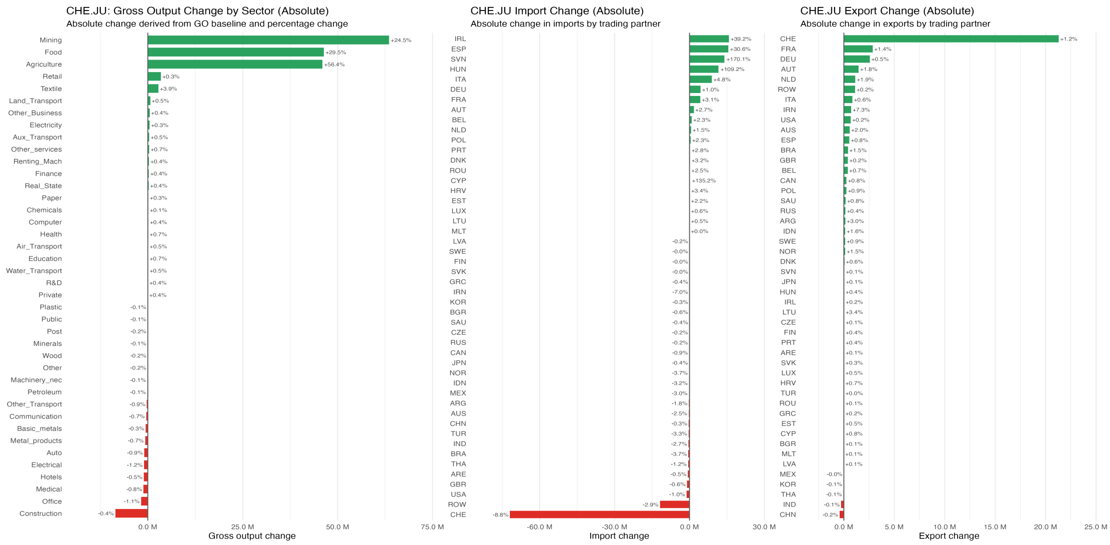

Figure 4.14.: Absolute changes in gross output, imports, and exports by sector and trading partner — EU scenario.

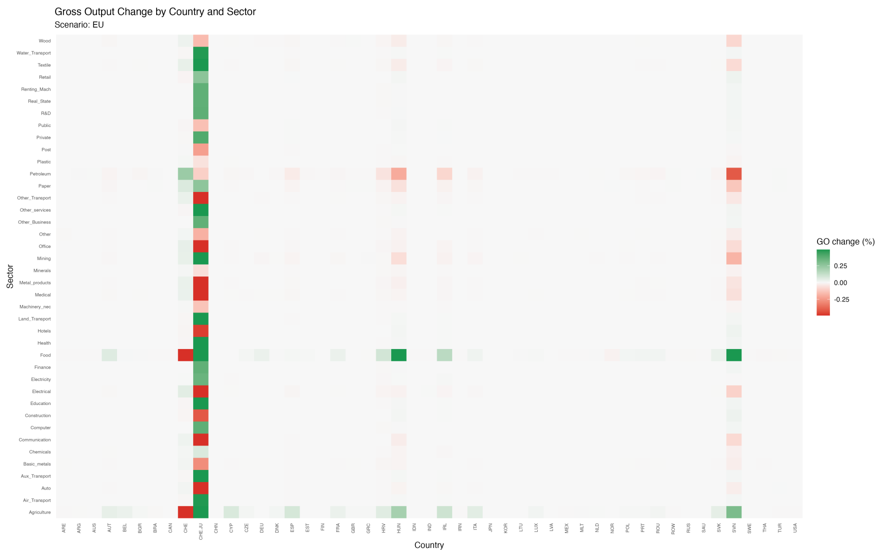

Figure 4.15.: Gross output change heatmap across countries and sectors — EU scenario.

4.4.3. Scenario Results

The EU scenario delivers by far the highest results of all the scenarios considered so far, with a relative welfare increase of 4.88%.

In this scenario, the Canton of Jura can leverage its position in the local market with neighboring countries substantially and act as a bridge, allowing goods to flow from the EU market into Mainland Switzerland through the Canton of Jura.

Gross output in Figure 4.14 in the canton grows substantially. In percentage terms, the Agriculture sector grows the most, reporting an increase of over 50%, with Food following second at around 30%. In absolute terms, the Mining sector gains the most, increasing its yearly output by over 60 million USD, which corresponds to a relative increase of around 25%. Companies operating in the ISIC sectors associated with the "Mining" sector in the Canton of Jura are mostly concrete and limestone producing firms such as "Lachat SA". An increase in gross output in this industry is plausible, as nearby countries are likely to purchase raw materials such as concrete if prices are low. Shipping concrete or other commodities with low value density only makes sense to very close markets, as transporting these products over long distances would not be economically viable. Since the Canton of Jura does not possess high-value raw materials, it is consistent that the previous scenarios did not show major increases in gross output in this sector, as the countries in the BRICS as well as the BRI scenario are geographically distant.

The absolute import growth to the canton is majorly distributed among four major countries, namely Ireland, Spain, Slovenia, and Hungary, all increasing by around 12–15 million USD. Slovenia also reports the highest relative increase at almost 175%, and Cyprus the second highest at over 125% but the absolute value of Cyprus doesn't grow noticeably since the trade volume is negigable from the beginning. Imports from Mainland Switzerland contract by around 70 million USD, leading to a net decrease in import volume overall for the canton.

Exports from Jura to Mainland Switzerland, in turn, grow substantially by over 20 million USD. In particular, the "Food" and "Agriculture" sectors appear to be partially substituted from Mainland Switzerland, as they shrink there while simultaneously growing in the Canton of Jura, as can be seen in Figure 4.15. Other EU countries also report growth in the "Food" and "Agriculture" sectors, namely Hungary and Slovenia, suggesting that these sectors in Mainland Switzerland are being supplied with cheaper imports from Jura while Jura itself shifts supply to import more from Hungary and Slovenia in turn. This highlights an important effect of how a SEZ could affect the domestic market: even though highly protected sector tariffs for Agriculture and Food within Mainland Switzerland remain unchanged, changes in sectoral tariffs within a potential SEZ could circumvent local legislation and enable liberalization without domestic tariff adjustments.

4.5. EU and BRICS Scenario

4.5.1. Scenario Description

The EU and BRICS scenario simulates a free trade agreement between the Canton of Jura and both blocs simultaneously, as they are the most influential based on the prior scenarios.

This scenario reflects the true potential for the Canton as an entity that can bridge gaps in an increasingly multipolar world and maintain beneficial trade relations with sometimes opposing geopolitical blocs.

As has already been discussed in section 4.3, trade liberalizations scale to some degree with the number of partners involved and can sometimes be approximated as additive. Therefore, the scenario combining both blocs, BRICS and the EU, could produce a similar effect for the Canton of Jura and would reflect a multi-polar position.

4.5.2. Figures

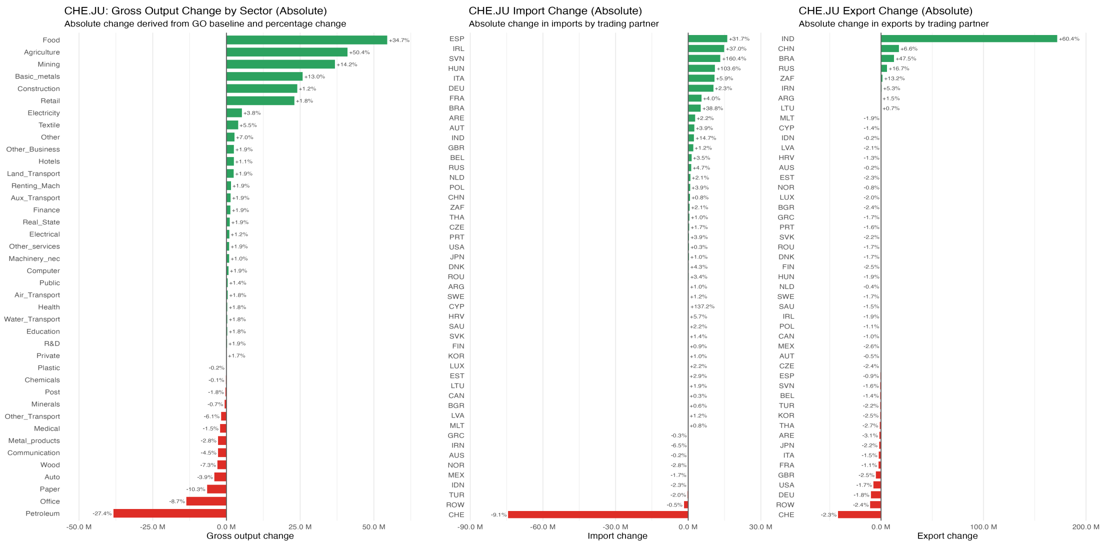

Figure 4.16.: Absolute changes in gross output, imports, and exports by sector and trading partner — EU and BRICS scenario.

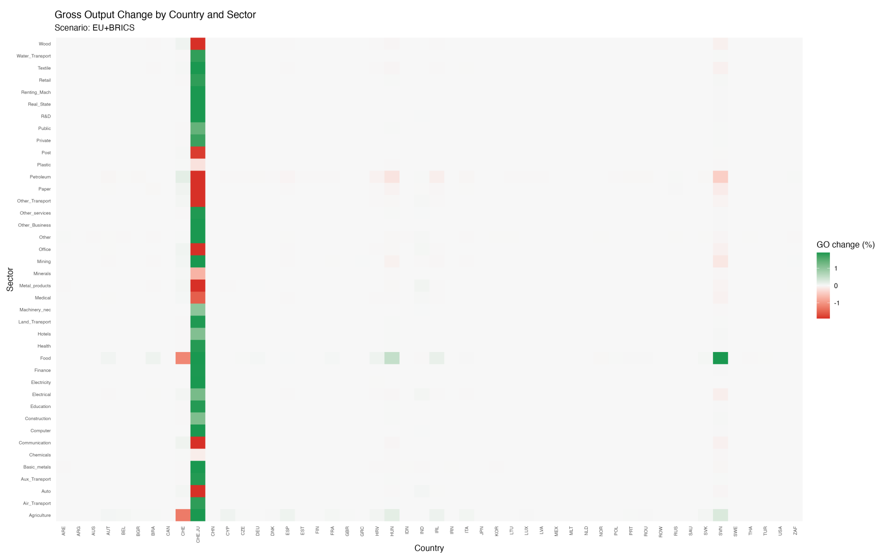

Figure 4.17.: Gross output change heatmap across countries and sectors — EU and BRICS scenario.

4.5.3. Scenario Results

The results reflect expectations, but overall welfare gains do not scale additively and amount to around a 6.53% increase, which is less than the sum of the BRICS and EU scenarios (2.44% (BRICS) + 4.88% (EU) = 7.32%). This again confirms, as already discussed in section 4.3, that although a certain degree of additivity exists, it cannot be assumed to be strictly additive when more interlinked economies are involved in a scenario.

Gross output, which can be seen in Figure 4.16, is still dominated by the same sectors as in the EU scenario, although the Mining sector no longer holds the top position and is surpassed by the Food and Agriculture sectors. The BRICS scenario also shows its impact, pushing the Basic Metals, Retail, and Construction sectors further up in the ranking, which were not as prominent in the EU-only scenario. Growth in the mentioned sectors ranges from over 20 million USD in the Retail sector to almost 55 million USD in the Food sector. Agriculture experiences the highest relative growth of over 50%, with Food following at around 35%.

Imports to the Canton of Jura almost exactly reflect the EU scenario, with only slight changes, such as Spain overtaking Ireland in absolute import growth and imports from Germany and Italy increasing slightly more. Import volumes also mirror the EU scenario, with Mainland Switzerland again experiencing a decline in exports to the Canton of Jura by almost 75 million USD, and a relatively even increase in imports from Spain, Ireland, Slovenia, Hungary, Italy, and Germany, ranging from around 10 million USD (Germany) to around 13 million USD (Spain).

The export situation changes drastically compared to the EU scenario and more closely reflects the BRICS scenario, with exports to India growing by almost 175 million USD, followed by China with around 20 million USD. The strong export growth to Mainland Switzerland observed in the EU scenario completely disappears, with Mainland Switzerland instead experiencing a decrease in imports from Jura of around 40 million USD. This contraction in exports to Mainland Switzerland is most likely due to more attractive export opportunities in Indian markets. Even though a beneficial market situation would arise for goods traded via the Canton of Jura to Mainland Switzerland, exports to Indian markets are even more advantageous according to the Cobb-Douglas consumer preference function used in the Caliendo and Parro model [8].

The scenario shows a advantageous combination of countries for the Canton of Jura with the BRICS countries mostly generating additional demand for exports while the EU countries accounting for most of the import increases.

The worldwide GO changes (see Figure 4.17) mostly happen in the EU countries with some changes in the "Metal products" sector in India as has also been observed in the India only scenario.

It could be assumed that, based on these decreases in both imports from and exports to Mainland Switzerland, the welfare of Mainland Switzerland would be negatively impacted by this policy. This is not the case, however, as Mainland Switzerland experiences no significant welfare loss, while the Canton of Jura experiences a welfare increase of over 6.53%, as can be seen in Figure A.32.

4.6. USA Scenario

4.6.1. Scenario Description

The USA scenario simulates a free trade agreement between the Canton of Jura and the United States. As the USA, according to the FSO, was the largest export market of Switzerland [28], a scenario involving only the USA was also included in this article to assess if there is further potential in this market or whether the equilibrium given the agreements in 2019 (before the tariff shocks in 2025) had already been nearly reached and further liberalization would not have a substantial impact.

4.6.2. Figures

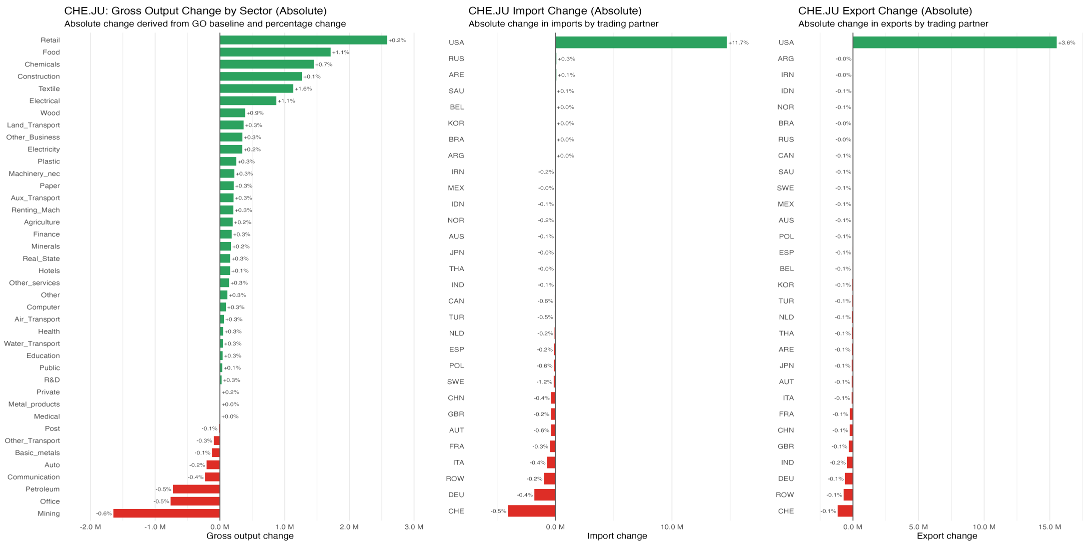

Figure 4.18.: Absolute changes in gross output, imports, and exports by sector and trading partner — USA scenario.

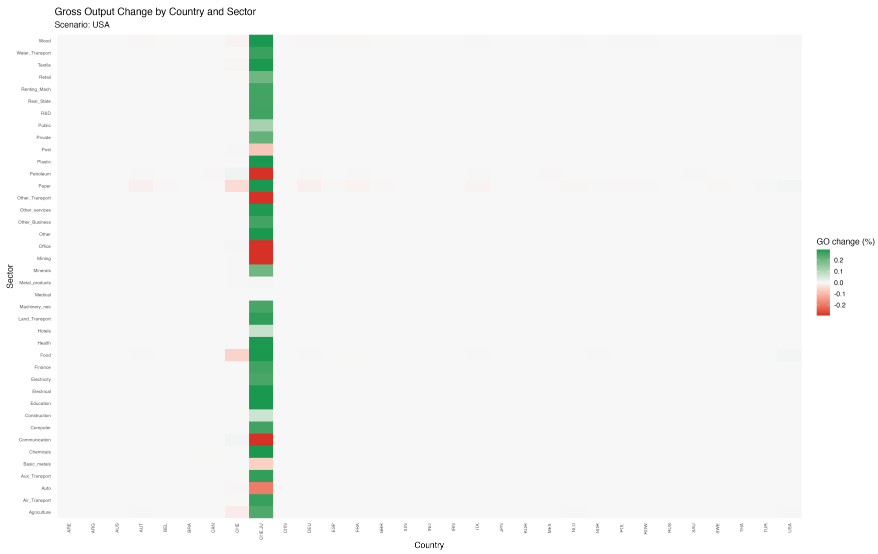

Figure 4.19.: Gross output change heatmap across countries and sectors — USA scenario.

4.6.3. Scenario Results

The results suggest an almost equilibrium-like market situation between the Canton of Jura and the USA, with only a slight welfare gain of 0.16% for the Canton of Jura resulting from further liberalization.

Sectors of growth in the canton, as seen in Figure 4.18, include Retail, with around 2.5 million USD of growth, as well as Food and Chemicals, each increasing by around 1.5 million USD. The Mining sector is negatively affected, reporting a contraction of approximately 1.5 million USD.

Imports from the USA grow by over 10%, or almost 15 million USD, while imports from Mainland Switzerland slightly decrease by around 3 million USD.

The USA also increases in importance as an export market, accounting for over 15 million USD of additional exports, corresponding to growth of around 3.5%. Exports to Mainland Switzerland, in contrast, decline by around 1%.

In a worldwide perspective it can be seen that the sector "Paper" is shrinking in many European countries while it slightly rises in the USA (see Figure 4.19) leading to the assumption that large parts of the increased imports from the USA are from this sector.

4.7. World Scenario

4.7.1. Scenario Definition

The World scenario simulates a global free trade agreement in which all tariffs between all countries are set to zero.

This scenario provides a reference point for assessing how far welfare gains from trade liberalization can extend and whether the effects on relative welfare in the Canton of Jura would disappear if further trade liberalization occurred worldwide. Setting all tariffs to zero implies that there are no longer any global trade restrictions from tariffs, and goods flow completely freely to wherever it is most economically beneficial for market participants.

4.7.2. Figures

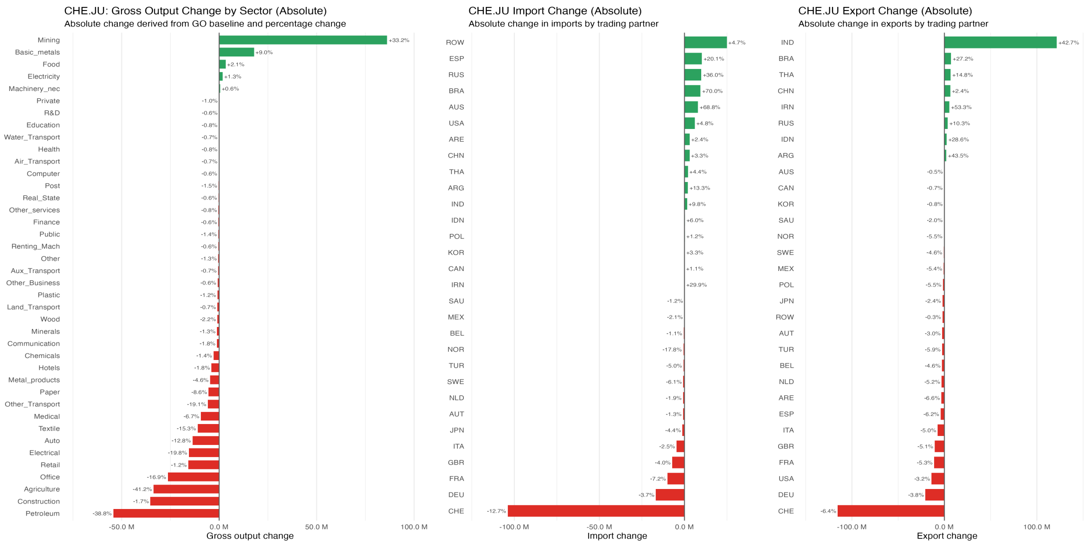

Figure 4.20.: Absolute changes in gross output, imports, and exports by sector and trading partner — World scenario.

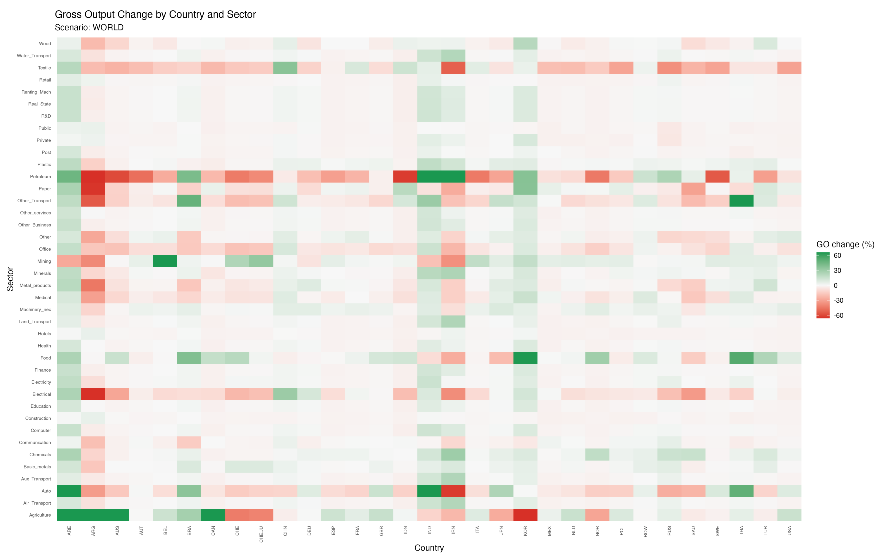

Figure 4.21.: Gross output change heatmap across countries and sectors — World scenario.

4.7.3. Scenario Results

In a world with no tariffs at all welfare in all observed countries rises, with an average increase of 1.74%. The Canton of Jura experiences an above-average increase of 3.98%, although this remains significantly lower than the 6.53% increase in the EU+BRICS scenario. This indicates that the Canton of Jura would benefit most specifically in a world where countries are more protective in trade, allowing the Canton to leverage its unique position in the market.

While Korea would derive the largest gains from a fully liberalized global trading system, with an estimated relative welfare increase of approximately 15%, both the Canton of Jura and Mainland Switzerland also rank comparatively highly. Jura alone appears among the top three beneficiaries, while Mainland Switzerland occupies the 8th position. These results indicate that, although the largest welfare gains are realized in a fully liberalized world, Switzerland as a whole is, in any case, a substantial beneficiary of free trade policies.

In the fully liberalized world, the Mining sector of the Canton grows the most, by over 75 million USD, as was also the case in the EU scenario, leading to the hypothesis that Mining may represent a potential underexplored market in the Canton of Jura today (see Figure 4.20). Losses can be found in the Petroleum sector, which is mostly composed of biogas production and declines by over 50 million USD.

Imports from Mainland Switzerland again suffer, collapsing by over 100 million USD, while imports from all countries in the "Rest of World" (ROW) category increase by over 20 million USD. Second place is taken by Spain, consistent with the EU scenario.

Familiar patterns to other scenarios, namely the BRICS scenario, can be observed in exports, where India again dominates the export market of the Canton of Jura, accounting for almost 150 million USD in increased export volume. This suggests that BRICS trade liberalization already captures most of the potential export market growth of the Canton of Jura, while the EU scenario primarily boosts more affordable imports.

Overall, there is a substantial net decrease in gross output volume in this scenario of almost 150 million USD. Import and export volumes also decrease by 40–60 million USD, yet welfare gains are still generated. This clearly indicates that welfare gains in this scenario do not arise from higher economic output (trade volume), but from terms of trade, as explained in section 3.6. This is further supported by Figure A.41, which shows volume-of-trade changes and where it can be seen that the Canton of Jura experiences increases at all. Therefore, welfare must originate from improved terms of trade, meaning the Canton can obtain more favorable trade prices for imports relative to the prices of its exports.

If a broader perspective is taken, the Figure 4.21 gives a good insight into which countries industries could benefit a lot from trade liberalization worldwide. The United Arab Emirates (ARE) report GO growth in every sector except "Mining". Also India and Korea appear to be a countries with untapped potential for industrial output growth.

5. Discussion and outlook

This chapter presents the discussion and conclusion drawn from the results and gives an outlook for future research that could be done using the model and data presented in this article.

5.1. Discussion and Conclusion

The results from the model suggest a significant opportunities for the Canton of Jura if a SEZ would be established inside the Canton with potential relative welfare gains of $\tilde{6}.53\%$ if extensive free trade agreements with a diversified group of countries (EU and BRICS), reflecting both a multi-polarity as well as regional integration, would be established.

This result suggest a significantly higher potential of welfare gains than have been found in other studies over trade deals. Compared to the findings of the reference papers, the notably big impact for the Canton can be quantified. For example compared to the reference paper by Caliendo and Parro which found welfare gains of 1.31% at most for Mexico from the NAFTA trade agreement while some welfare levels, like the one of Canada, even declined (-0.06%) [8]. Also the paper released by SNB researcher Wicht found that a dissolution of all free trade agreements would contract the economy of Switzerland by only -0.58% [12].

The goals therefore, as defined in section 1.2, have been reached and a quantitative framework to model tariff changes to different groups of countries, including the BRI countries, have been established and interpreted.

However, these results are strongly conditioned by the assumptions of the Caliendo and Parro model and the methodologies applied to construct the Canton of Jura. In particular, the assumption of perfectly flexible labor and the absence of adjustment frictions imply that resources can be reallocated across sectors without cost. In reality, such adjustments are often associated with transition costs, including unemployment, skill mismatches, and regional disparities. As a result, the short- to medium-term effects of trade liberalization may differ substantially from the long-run equilibrium outcomes reported in this study. The model therefore provides an upper-bound estimate of efficiency gains rather than a complete picture of real-world adjustment dynamics.

Additionally, simplifications in the construction of the Canton of Jura, such as the omission of inner-cantonal trade and the consumption share being proportional to the rest of Switzerland lead to distortions in the results although minor ones. In the realization phase many different approaches to construct the Canton of Jura have been implemented, ranging from simply taking the constant proportional share for both the production as well as the consumption part have been tried ranging until the more complex solution which was used to generate the results of this article. The welfare effects barely differ from the construction methods as the trade volumes are equally large, only the sectoral changes do vary slightly depending on the method. It can therefore be assumed that the omission of the inner-cantonal trade does not lead to great distortions in the results.

Other relevant findings are that already existing free trade agreements or otherwise already largely liberalized markets seem to have almost reached equilibrium in the year 2019. Both the scenarios involving only China as well as the one only involving the USA have produced relatively small welfare gains, suggesting that these markets are already almost at equilibrium.

Also, a fully liberalized world does not necessarily bring the most welfare to individual countries. Having a more balanced approach and selectively choosing countries or economic blocks to strike bilateral deals with makes a large difference. This also shows that trade deals should be made based on economic potential. A trade deal with India implies large potential for the Canton of Jura and should be prioritized over more specified deals with China as the potential additional gains are much smaller.

The welfare is not the only metric on which a scenario can be judged though. The Figure 4.2 and the Figure 4.3 presented in the beginning of the chapter 4 show the absolute change in gross output, import and export volume in the Canton of Jura for each scenario. It can be seen that the total volume mostly rises but there are also scenarios, most notably the World scenario, in which the physical economy actually shrinks. It could be strategically decided to opt for a growing size of the economy instead of optimizing for welfare gains as it would mean more industries are established and thus more jobs are created even though they might not pay as much as in another scenario.

When assessing the economic impact beyond welfare changes sectoral changes should also be taken into account. Figure 5.1 provides a overview as to which industries would be affected by which scenario. Even though welfare values might increase or not differ much from one scenario to another, sectoral impacts can be very large. A sector which is often negatively affected is the Petroleum sector, represented mostly by biogas producers in the Canton of Jura like for example the company "Bio-energ'etique". Other sectors often suffering are Paper, Wood, Communication and Other transport. All the scenarios involving geopolitically non-western countries paint a similar picture in the effect on sectors while the EU scenario is an outlier.

Figure 5.1.: Gross output change of CHE.JU by sector and scenario.

Food and Agriculture have the highest global average tariffs (see Figure A.6) therefore high gains in these sectors are not unexpected. The large increase in the Mining sector under the EU scenario is more surprising due to its comparatively low tariffs. Nevertheless, the proximity of the EU market and the correspondingly low iceberg trade costs κ_{ni}^{j} explain why Mining benefits so much from a more integrated trade arrangement.

In conclusion it can be said that converting the Canton of Jura into a SEZ focused on establishing a neutral economic zone in an increasingly multipolar world could be a beneficial policy to be adopted by the Canton, rising the welfare by up to 6.53% in the analyzed scenarios. Further, there would be no significant impact on the economy of the rest of Switzerland. It would give the Canton a strategic advantage and could potentially transform Jura into a global economic hub and change it's standing as a peripheral economy with one of the highest public expenditure ratio's [6] and unemployment quotas [7] in Switzerland.

5.2. Limitations

The limitations of the approach applied in this article stem primarily from two sources: data quality and modeling constraints.

The data-quality limitations arise mainly from the strong dependence on Eora [14, 15] and WIOD, both of which are IO-tables that incorporate numerous underlying assumptions, as outlined in subsection 2.2.2. Additional data-quality concerns result from certain datasets, especially the one used to determine the sectoral shares of the Canton of Jura (see Figure A.1), being available only in a highly aggregated form. This required the ISIC decomposition to rely heavily on the WIOD table to allocate these aggregated values across the 40 sectors needed for this study, as discussed in subsection 3.2.2.

Data quality is further affected by the relatively old reference year of the available data. To maintain consistency, data from 2019 was used throughout the thesis whenever possible, since combining data from different years would substantially distort the results. However, this also implies that the significant economic events of the COVID-19 pandemic in 2020 and the tariff shock in 2024, when the contemporary US administration substantially raised import tariffs, are not captured in this analysis.

The modeling limitations, previously discussed, mainly concern the assumptions embedded in the Ricardian trade model of Caliendo and Parro [8], in particular the assumption of a perfectly flexible labour market. Furthermore, the modeling strategy used to construct the dataset for the Canton of Jura has its own shortcomings, most notably the omission of the inter-cantonal trade flow.

5.3. Outlook

The primary output of this study is the development of a comprehensive R-based analytical pipeline. This framework applies the Ricardian trade model established by Caliendo and Parro [8] to a dynamic dataset, enabling the simulation of regionally independent trade policies within a global general equilibrium context.

While the current analysis focuses on assessing trade policy implications for a potential SEZ in the Canton of Jura, the model is architected to evaluate any counterfactual scenario involving the broad set of countries compiled for this study. Although the initial dataset was designed to reflect the full scope of BRI nations, the computational complexity associated with high-dimensional matrices necessitated a focus on the 20 largest economies. Nevertheless, a robust dataset encompassing nearly all widely recognized countries and territories has been established and remains available for future counterfactual modeling.

Furthermore, the methodology used to construct the regional economic profile for the Canton of Jura is readily transferable to other Swiss cantons using the existing software framework. The Canton of Jura mearly serves as a first case study and rational first choice due to the structural challenges but similar policies could be potentially beneficial for other cantons and regions as well. While regional analyses of other nations currently lack a comparable data basis, they could be synthesized by applying the same logic and decomposition methods developed for this research.

Future research could expand upon this work by exploring "de-globalization" scenarios, specifically modeling the dissolution of historic trade agreements and the imposition of higher tariffs between specific economic blocs. As this research utilized 2019 tariff levels, which was a period of relative stability prior to major global trade shocks, such a comparison would provide valuable insights into modern economic resilience.

Also, the regional modeling could be refined to address existing limitations, such as the omission of intra-cantonal trade. Improving this aspect of the model would require the acquisition of more granular, high-precision regional data.

Additionally, as this article does not address them, the potential legal, societal, and political implications should be examined, as they may lead to the conclusion that an SEZ, as defined here, is either not legally compatible with the current Swiss law or not politically feasible.

Finally, given the persistent geopolitical tensions in the Middle East and the associated disruptions to global supply chains, the model could be reoriented to examine regional effects through counterfactual volume-based shocks instead of tariff variations. By directly modifying bilateral trade flows and sectoral production levels, this framework would allow researchers to measure the specific economic consequences of targeted disturbances, such as constraints on energy supplies, on both regional and national economies. Comparable work is currently being undertaken at the Kiel Institute for the World Economy, as documented in the paper released in March 2026, *"The Cost of Closing the Strait of Hormuz: Energy Bottlenecks and Global Food Security"* by Hinz et al., where counterfactual scenarios are generated not by altering tariffs but by adjusting trade elasticities [29].

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Acronyms

ARE United Arab Emirates. 43, 50, 62, 74

AVE Ad-Valorem Equivalent. 26, 27, 74

BACI Base pour l'Analyse du Commerce International. 25–27, 30, 32, 74

BRI Belt and Road Initiative. 1, 3, 31, 35, 36, 38, 40, 42, 53, 63, 66, 74

BRICS Brazil, Russia, India, China and South Africa. 3, 31, 35, 36, 38, 43, 47, 50, 53, 54, 56, 61, 63, 74, 89

CEPII Centre d'Études Prospectives et d'Informations Internationales. 25–27, 74

CET Common External Tariff. 27, 30, 74

EFTA European Free Trade Association. 21, 74

EU European Union. 3, 27, 28, 30, 38, 51, 56, 63, 74

FD Final Demand. 12, 13, 22, 24, 74

FSO Federal Statistical Office. 21–23, 57, 74, 86

GDP Gross Domestic Product. 10, 11, 38, 40, 42, 74

GO Gross Output. 12, 13, 22, 34, 37, 39, 42, 50, 56, 62, 74

HS Harmonized System. 25–27, 29, 30, 74

IO Input-Output. 8, 10–14, 17, 19, 21, 26, 66, 74

ISIC International Standard Industrial Classification. 15–22, 26, 31, 32, 49, 53, 66, 74, 86

MFN Most Favoured Nation. 26–28, 30, 74

NAFTA North American Free Trade Agreement. 42, 63, 74

NUTS Nomenclature of Territorial Units for Statistics. 21, 74

OECD Organisation for Economic Co-operation and Development. 10, 74

REICO Regionalized Inter-Country Input–Output. 21, 74

ROW Rest of World. 26–28, 74

SEZ special economic zone. 2, 3, 14, 17, 53, 63, 65–67, 74

SNB Swiss National Bank. 7, 63, 74

SQL Structured Query Language. 74

TWN Chinese Taipei (Taiwan). 25, 27, 30, 74

UN United Nations. 13, 17, 25, 31, 74

VA Value Added. 12, 21–23, 30, 71, 74

WIOD World Input-Output Database. 10, 12, 13, 19, 20, 30–32, 66, 74

WITS World Integrated Trade Solution. 26, 74

WTO World Trade Organization. 25, 26, 74

Z Inter-Industry Transaction Matrix. 12, 20–22, 30, 74

A.1.6. Methodology and Engineering Approach

From the outset, the project team agreed on a structured, engineering-oriented approach. The key methodological decisions and procedures are documented below:

- **Model selection:** After evaluating several approaches, the quantitative general equilibrium model of Caliendo & Parro (2015) was chosen as the theoretical foundation, as it captures multi-sector trade effects together with input-output linkages.
- **Data source:** WIOD has a faster execution time than Eora as the conditionality ($\approx$ 8.5 vs. $\approx$ 140) is lower, resulting in more stable algorithmic convergence. Due to limited data availability of WIOD, Eora was nontheless preferred for the generation of the scenarios.
- **Tariff data:** BACI trade flows (HS6 level, year 2019) were merged with WITS tariff data and aggregated to the 20 tradeable CP sectors (HS6 $\rightarrow$ ISIC $\rightarrow$ CP).
- **Canton of Jura:** The Canton of Jura was modelled by splitting it out from Switzerland (`CHE` $\rightarrow$ `CHE` + `CHE.JU`) using cantonal value-added data from the Federal Statistical Office (FSO) and population shares.
- **Version control:** All code (R and MATLAB) was version-controlled using Git and managed on GitHub to ensure traceability and effective collaboration.
- **Reproducibility:** All scenarios were documented with saved intermediate results (RDS files), enabling plots to be reproduced without re-running MATLAB.

A.2. ISIC Matching

A.2.1. UN National Accounts

Nr	Caliendo Parro Industry Name	Caliendo Parro ISIC Rev.3	Caliendo_Parro_ISIC_Rev3	UN National Accounts Sector
1	Agriculture	1–5	1–5	Agriculture, hunting, forestry, fishing (ISIC A-B)
2	Mining	10–14	10–14	Mining, Manufacturing, Utilities (ISIC C-E)
3	Food	15–16	15–16	Manufacturing (ISIC D)
4	Textile	17–19	17–19	Manufacturing (ISIC D)
5	Wood	20	20	Manufacturing (ISIC D)
6	Paper	21–22	21–22	Manufacturing (ISIC D)
7	Petroleum	23	23	Manufacturing (ISIC D)
8	Chemicals	24	24	Manufacturing (ISIC D)
9	Plastic	25	25	Manufacturing (ISIC D)
10	Minerals	26	26	Manufacturing (ISIC D)
11	Basic metals	27	27	Manufacturing (ISIC D)
12	Metal products	28	28	Manufacturing (ISIC D)
13	Machinery n.e.c	29	29	Manufacturing (ISIC D)
14	Office	30	30	Manufacturing (ISIC D)
15	Electrical	31	31	Manufacturing (ISIC D)
16	Communication	32	32	Manufacturing (ISIC D)
17	Medical	33	33	Manufacturing (ISIC D)
18	Auto	34	34	Manufacturing (ISIC D)
19	Other Transport	351–359	351–359	Manufacturing (ISIC D)
20	Other	36–37	36–37	Manufacturing (ISIC D)
21	Electricity	40–41	40–41	Mining, Manufacturing, Utilities (ISIC C-E)
22	Construction	45	45	Construction (ISIC F)
23	Retail	50–52	50–52	Wholesale, retail trade, restaurants and hotels (ISIC G-H)
24	Hotels	55	55	Wholesale, retail trade, restaurants and hotels (ISIC G-H)
25	Land Transport	60	60	Transport, storage and communication (ISIC I)
26	Water Transport	61	61	Transport, storage and communication (ISIC I)
27	Air Transport	62	62	Transport, storage and communication (ISIC I)
28	Aux Transport	63	63	Transport, storage and communication (ISIC I)
29	Post	64	64	Transport, storage and communication (ISIC I)
30	Finance	65–67	65–67	Other Activities (ISIC J-P)
31	Real State	70	70	Other Activities (ISIC J-P)
32	Renting Mach	71	71	Other Activities (ISIC J-P)
33	Computer	72	72	Other Activities (ISIC J-P)
34	R&D	73	73	Other Activities (ISIC J-P)
35	Other Business	74	74	Other Activities (ISIC J-P)
36	Public	75	75	Other Activities (ISIC J-P)
37	Education	80	80	Other Activities (ISIC J-P)
38	Health	85	85	Other Activities (ISIC J-P)
39	Other services	90–93	90–93	Other Activities (ISIC J-P)
40	Private	95	95	Other Activities (ISIC J-P)

A.2.2. WIOD

Nr	Caliendo Parro Industry Name	Caliendo Parro ISIC Rev.3	WIOD ISIC Rev.3 Converted	WIOD ISIC Rev.4	WIOD Nr.	WIOD Industry Name
1	Agriculture	1–5	1–5	A01/A02/A03	1/2/3	Crop and animal production, hunting and related service activities / Forestry and logging / Fishing and aquaculture
2	Mining	10–14	10–14	B	4	Mining and quarrying
3	Food	15–16	15–16	C10-C12	5	Manufacture of food products, beverages and tobacco products
4	Textile	17–19	17–19	C13-C15	6	Manufacture of textiles, wearing apparel and leather products
5	Wood	20	20	C16	7	Manufacture of wood and of products of wood and cork, except furniture
6	Paper	21–22	21–22	C17/C18	8/9	Manufacture of paper and paper products / Printing and reproduction of recorded media
7	Petroleum	23	23	C19	10	Manufacture of coke and refined petroleum products
8	Chemicals	24	24	C20/C21	11/12	Manufacture of chemicals and chemical products / Manufacture of basic pharmaceutical products
9	Plastic	25	25	C22	13	Manufacture of rubber and plastic products
10	Minerals	26	26	C23	14	Manufacture of other non-metallic mineral products
11	Basic metals	27	27	C24	15	Manufacture of basic metals
12	Metal products	28	28	C25	16	Manufacture of fabricated metal products, except machinery and equipment
13	Machinery n.e.c	29	29	C28	19	Manufacture of machinery and equipment n.e.c.
14	Office	30	30	C26	17	Manufacture of computer, electronic and optical products
15	Electrical	31	31	C27	18	Manufacture of electrical equipment
16	Communication	32	32	J61	39	Telecommunications
17	Medical	33	33	C26	17	Manufacture of computer, electronic and optical products
18	Auto	34	34	C29	20	Manufacture of motor vehicles, trailers and semi-trailers
19	Other Transport	351–359	35	C30	21	Manufacture of other transport equipment
20	Other	36–37	36–37	C31_C32/C33	22/23	Manufacture of furniture and other manufacturing / Repair and installation of machinery
21	Electricity	40–41	40–41	D/E36	24/25	Electricity, gas, steam and air conditioning supply / Water collection, treatment and supply
22	Construction	45	45	F	27	Construction
23	Retail	50–52	50–52	G45/G46/G47	28/29/30	Wholesale and retail trade and repair of motor vehicles / Wholesale trade / Retail trade
24	Hotels	55	55	I	36	Accommodation and food service activities
25	Land Transport	60	60	H49	31	Land transport and transport via pipelines
26	Water Transport	61	61	H50	32	Water transport
27	Air Transport	62	62	H51	33	Air transport
28	Aux Transport	63	63	H52	34	Warehousing and support activities for transportation
29	Post	64	64	H53	35	Postal and courier activities
30	Finance	65–67	65–67	K64/K65/K66	41/42/43	Financial service activities / Insurance and pension funding / Auxiliary financial activities
31	Real State	70	70	L	44	Real estate activities
32	Renting Mach	71	71	N	50	Rental and leasing activities, employment and support services
33	Computer	72	72	J58/J62_J63	37/40	Publishing activities / Computer programming, consultancy and information services
34	R&D	73	73	M72	47	Scientific research and development
35	Other Business	74	74	M69_M70/M71/M73/M74_M75	45/46/48/49	Legal and accounting activities / Engineering activities / Advertising and market research / Other professional activities
36	Public	75	75	O	51	Public administration and defence; compulsory social security
37	Education	80	80	P	52	Education
38	Health	85	85	Q	53	Human health and social work activities
39	Other services	90–93	90–93	E37-E39/J59_J60/R-S/U	26/38/54/56	Waste management / Motion picture and entertainment / Arts recreation and personal services / Extraterritorial organisations
40	Private	95	95	T	55	Activities of households as employers

A.2.3. Eora

Nr	Caliendo Parro Industry Name	Caliendo Parro ISIC Rev.3	Eora ISIC Rev.3 Converted	Eora ISIC Rev.4	Eora Nr.	Eora Industry Name
1	Agriculture	1–5	1–5	A01	1	Agriculture
2	Mining	10–14	10–14	A03	2	Fishing
3	Food	15–16	15–16	B	3	Mining and Quarrying
4	Textile	17–19	17–19	C10/C11/C12	4	Food and Beverages
5	Wood	20	20	C13/C14/C15	5	Textiles and Wearing Apparel
6	Paper	21–22	21–22	C16	6	Wood
7	Petroleum	23	23	C17/C18	7	Paper
8	Chemicals	24	24	C19	8	Petroleum
9	Plastic	25	25	C20/C21	9	Chemicals
10	Minerals	26	26	C22	10	Rubber and Plastic
11	Basic metals	27	27	C23	11	Non-Metallic Mineral Products
12	Metal products	28	28	C24	12	Basic Metals
13	Machinery n.e.c	29	29	C25	13	Fabricated Metal Products
14	Office	30	30	C28	14	Machinery n.e.c.
15	Electrical	31	31	C26	15	Computer/Electronic/Optical Equipment
16	Communication	32	32	J61	21	Post and Telecommunications
17	Medical	33	33	C26	15	Computer/Electronic/Optical Equipment
18	Auto	34	34	C29	16	Motor Vehicles
19	Other Transport	351–359	351–359	C30	17	Other Transport Equipment
20	Other	36–37	36–37	C31/C32/C33	18	Other Manufacturing/Repair
21	Electricity	40–41	40–41	D35/E36	19/20	Electricity/Gas/Water
22	Construction	45	45	F	21	Construction
23	Retail	50–52	50–52	G45/G46/G47	22/23/24	Wholesale/Retail Trade and Repair
24	Hotels	55	55	I	25	Hotels and Restaurants
25	Land Transport	60	60	H49	26	Land Transport
26	Water Transport	61	61	H50	27	Water Transport
27	Air Transport	62	62	H51	28	Air Transport
28	Aux Transport	63	63	H52	29	Warehousing and Support Activities
29	Post	64	64	H53	30	Postal and Courier Activities
30	Finance	65–67	65–67	K64/K65/K66	31/32/33	Financial Services/Insurance/Auxiliary Financial Activities
31	Real State	70	70	L	34	Real Estate Activities
32	Renting Mach	71	71	N	35	Rental and Leasing Activities
33	Computer	72	72	J58/J62/J63	36/37	Publishing/Computer Programming and Information Services
34	R&D	73	73	M72	38	Research and Development
35	Other Business	74	74	M69/M70/M71/M73/M74/M75	39/40/41/42/43/44	Professional and Technical Activities
36	Public	75	75	O	45	Public Administration
37	Education	80	80	P	46	Education
38	Health	85	85	Q	47	Human Health and Social Work
39	Other services	90–93	90–93	R/S/U	48/49/50	Arts/Recreation/Other Services
40	Private	95	95	T	51	Private Households

A.2.4. FSO Dataset (Swiss Economic Data)

Nr	Caliendo Parro Industry Name	Caliendo Parro ISIC Rev.3	BFS ISIC Rev.3 Converted	BFS ISIC Rev.4	BFS Industry Name
1	Agriculture	1–5	1–5	A	Landwirtschaft
2	Mining	10–14	10–14	BCF	Bergbau und Gewinnung von Steinen und Erden
3	Food	15–16	15–16	BCF	Bergbau und Gewinnung von Steinen und Erden
4	Textile	17–19	17–19	BCF	Bergbau und Gewinnung von Steinen und Erden
5	Wood	20	20	BCF	Bergbau und Gewinnung von Steinen und Erden
6	Paper	21–22	21–22	BCF	Bergbau und Gewinnung von Steinen und Erden
7	Petroleum	23	23	BCF	Bergbau und Gewinnung von Steinen und Erden
8	Chemicals	24	24	BCF	Bergbau und Gewinnung von Steinen und Erden
9	Plastic	25	25	BCF	Bergbau und Gewinnung von Steinen und Erden
10	Minerals	26	26	BCF	Bergbau und Gewinnung von Steinen und Erden
11	Basic metals	27	27	BCF	Bergbau und Gewinnung von Steinen und Erden
12	Metal products	28	28	BCF	Bergbau und Gewinnung von Steinen und Erden
13	Machinery n.e.c	29	29	BCF	Bergbau und Gewinnung von Steinen und Erden
14	Office	30	30	BCF	Bergbau und Gewinnung von Steinen und Erden
15	Electrical	31	31	BCF	Bergbau und Gewinnung von Steinen und Erden
16	Communication	32	32	BCF	Bergbau und Gewinnung von Steinen und Erden
17	Medical	33	33	BCF	Bergbau und Gewinnung von Steinen und Erden
18	Auto	34	34	BCF	Bergbau und Gewinnung von Steinen und Erden
19	Other Transport	351–359	351–359	BCF	Bergbau und Gewinnung von Steinen und Erden
20	Other	36–37	36–37	BCF	Bergbau und Gewinnung von Steinen und Erden
21	Electricity	40–41	40–41	DEPQ	Energieversorgung
22	Construction	45	45	BCF	Bergbau und Gewinnung von Steinen und Erden
23	Retail	50–52	50–52	GHIJ	Handel und Reparatur von Fahrzeugen
24	Hotels	55	55	GHIJ	Handel und Reparatur von Fahrzeugen
25	Land Transport	60	60	GHIJ	Handel und Reparatur von Fahrzeugen
26	Water Transport	61	61	GHIJ	Handel und Reparatur von Fahrzeugen
27	Air Transport	62	62	GHIJ	Handel und Reparatur von Fahrzeugen
28	Aux Transport	63	63	GHIJ	Handel und Reparatur von Fahrzeugen
29	Post	64	64	GHIJ	Handel und Reparatur von Fahrzeugen
30	Finance	65–67	65–67	K	Erbringung von Finanzdienstleistungen und Versicherungen
31	Real State	70	70	LMNRS	Grundstücks- und Wohnungswesen
32	Renting Mach	71	71	LMNRS	Grundstücks- und Wohnungswesen
33	Computer	72	72	LMNRS	Grundstücks- und Wohnungswesen
34	R&D	73	73	LMNRS	Grundstücks- und Wohnungswesen
35	Other Business	74	74	LMNRS	Grundstücks- und Wohnungswesen
36	Public	75	75	O	Öffentliche Verwaltung
37	Education	80	80	DEPQ	Energieversorgung
38	Health	85	85	DEPQ	Energieversorgung
39	Other services	90–93	90–93	LMNRS	Grundstücks- und Wohnungswesen
40	Private	95	95	T	Private Haushalte als Hersteller

A.3. Input Data Analytics

A.3.1. Input and Output Data Canton Jura

To gain more insights into the output of the model, analyzing and understanding the model-input data is very relevant. Of particular interest is the result of the data of the Canton of Jura which has been prepared through the steps described in the chapter 3 (Methodology). In Figure A.1, which is a supply-side view (Inputs) of the sectors in the Canton of Jura, can be observed which sectors are how relevant for the sectors in Jura. This diagram was constructed by adding together all the inputs with destination Jura from all countries grouped by the sectors using mainly the data from Eora.

It can be seen which sectors are how important for each sector in Jura. Also a "proof-of-concept" can be done by comparing the figure of Jura, which has been constructed with the described calculations using the economic data of the FSO, to the non-changed diagram of the whole of Switzerland which can be seen in Figure A.2.

Since the inputs (consumption) in Jura is just a scaled version of Switzerland it should look identical on this graphic which it does.

Besides the inputs, the outputs of the Canton of Jura should also be looked at to understand its function in the model. To do the analysis the Figure 3.1 should be taken into account. According to this distribution, we can expect Jura to have a larger proportional share of Agriculture in their exports. Due to the fact that Agriculture is not a sector with a large trade volume to begin with the influence of the sector compared to the rest of the trade volumes is still small.

Another expected phenomena in the data of the Canton of Jura should be the impact of the relatively large watch manufacturing industry which is represented in the sector "Medical" in the sectors used for this article. It covers the ISIC sector 33 which is associated with the watch manufacturing.

The mentioned effects can be observed in the Figure A.3. The Agriculture sector in both Switzerland and Jura is relatively small but the contribution share is notably higher in Jura with Agriculture making up 1.2% of the total while in case of Switzerland by itself its only 0.2%.

To assess the importance of trading partners for the Canton of Jura an analysis of import and export volume to and from Jura by country was also made. This can be seen in Figure A.4.

From this figure it can be seen that Mainland-Switzerland is by far the most important trading partner of the Canton of Jura. This is also reflected in the results which show that slight variations in the relative change in import or export to and from Switzerland result in large absolute changes in the trade volume and quickly lead to welfare gains or losses. Additionally, the importance of Germany, France

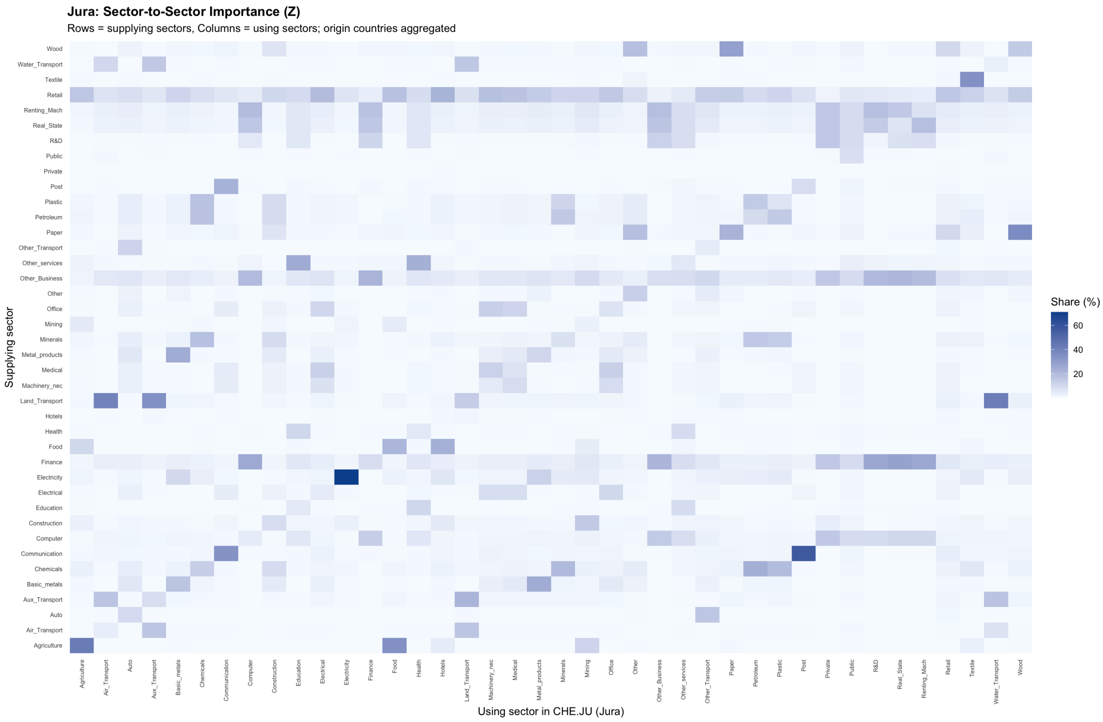


Figure A.1.: Sector-Input Importance of Jura constructed from Eora

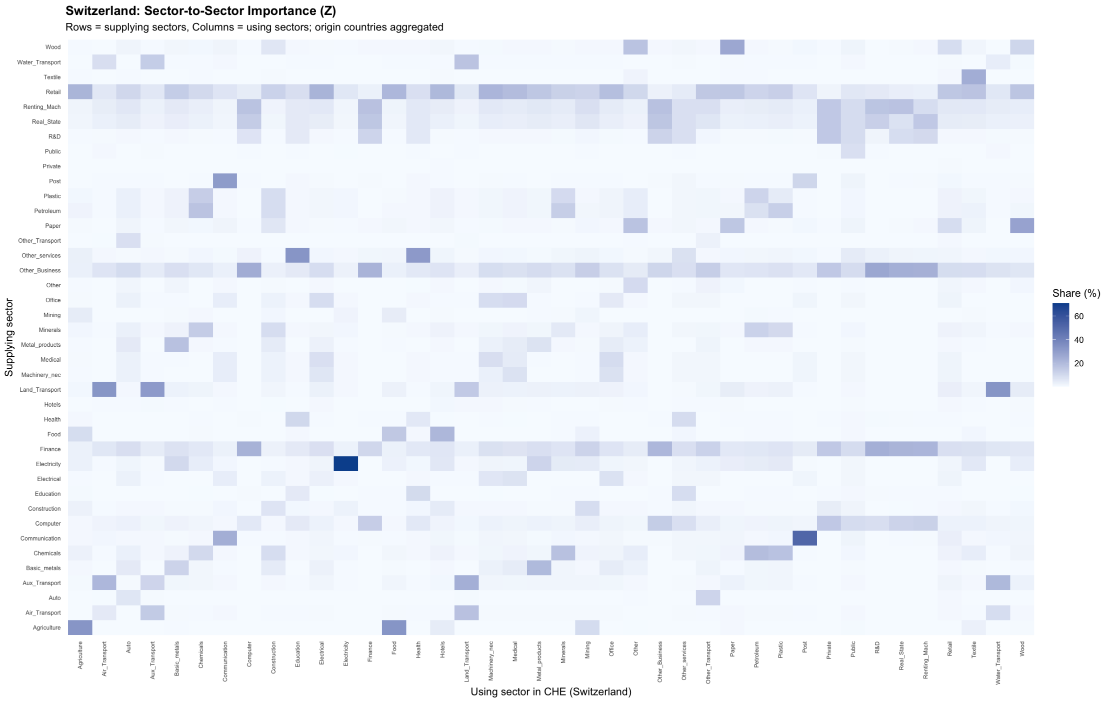
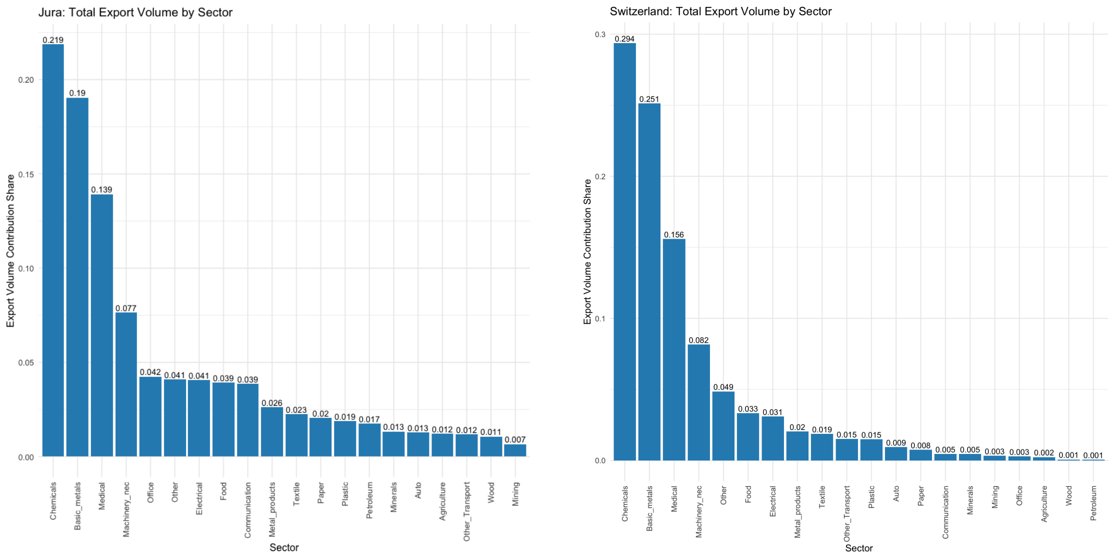


Figure A.2.: Sector-Input Importance of Switzerland using Eora Data



(a) Jura (b) Switzerland

Figure A.3.: Export Volume Contribution Share comparison between Jura and Switzerland

and the USA but also India as a member of the BRICS countries is notable.

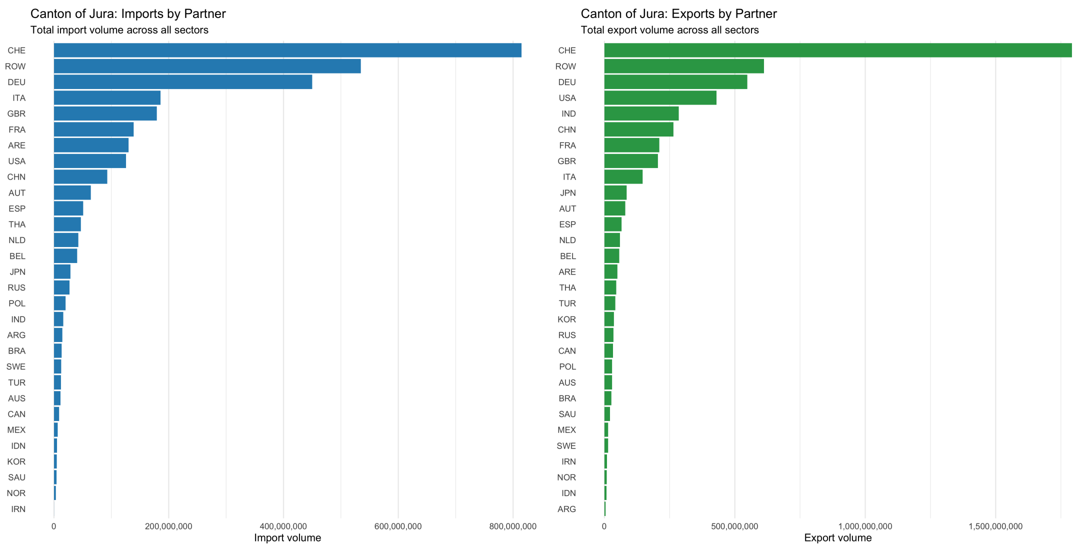


Figure A.4.: Total trade volume of Jura in 2019 by country (import and export)

A.3.2. Tariff Data

The tariff-data is the core data to calculate the counterfactual scenarios. To make educated guesses which places could benefit from lower tariffs it is crucial to gain an understanding which countries charge high average tariffs between each other and in which sectors the tariffs are mostly located.

In the Figure A.5 the average tariffs countries charge between each other is shown. Patterns which are directly obvious are for example the european countries which dont charge tariffs between each other. Other notable effects are the comparatively high average tariffs that are charged from Argentina, Brazil, India and the Islamic Republic of Iran.

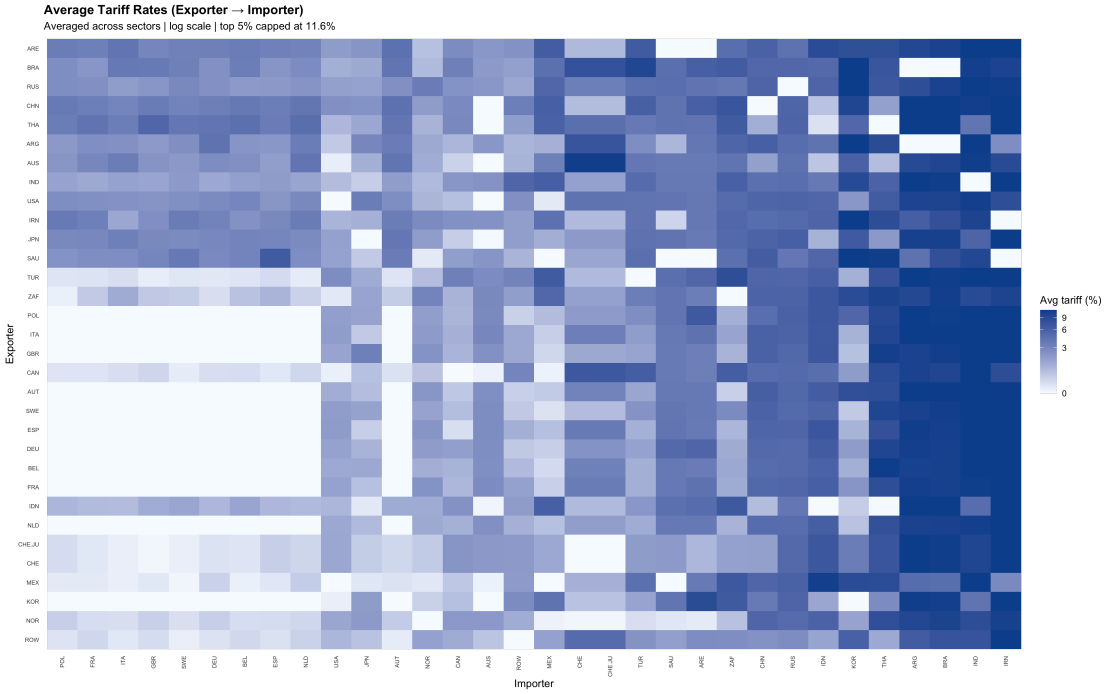


Figure A.5.: Average Tariff-Rate countries charge (Log-Scale)

To analyze which sectors are highly tariffed the Figure A.6 can be observed. The "Food" sector is tariffed disproportionally high in the world with an average tariff rate of 14%, followed by Agriculture and Textile and Auto which are also highly protected.

This gives insight into why these sectors have such a high impact on the result if the tariffes are removed from them. This explains the Results in chapter 4.

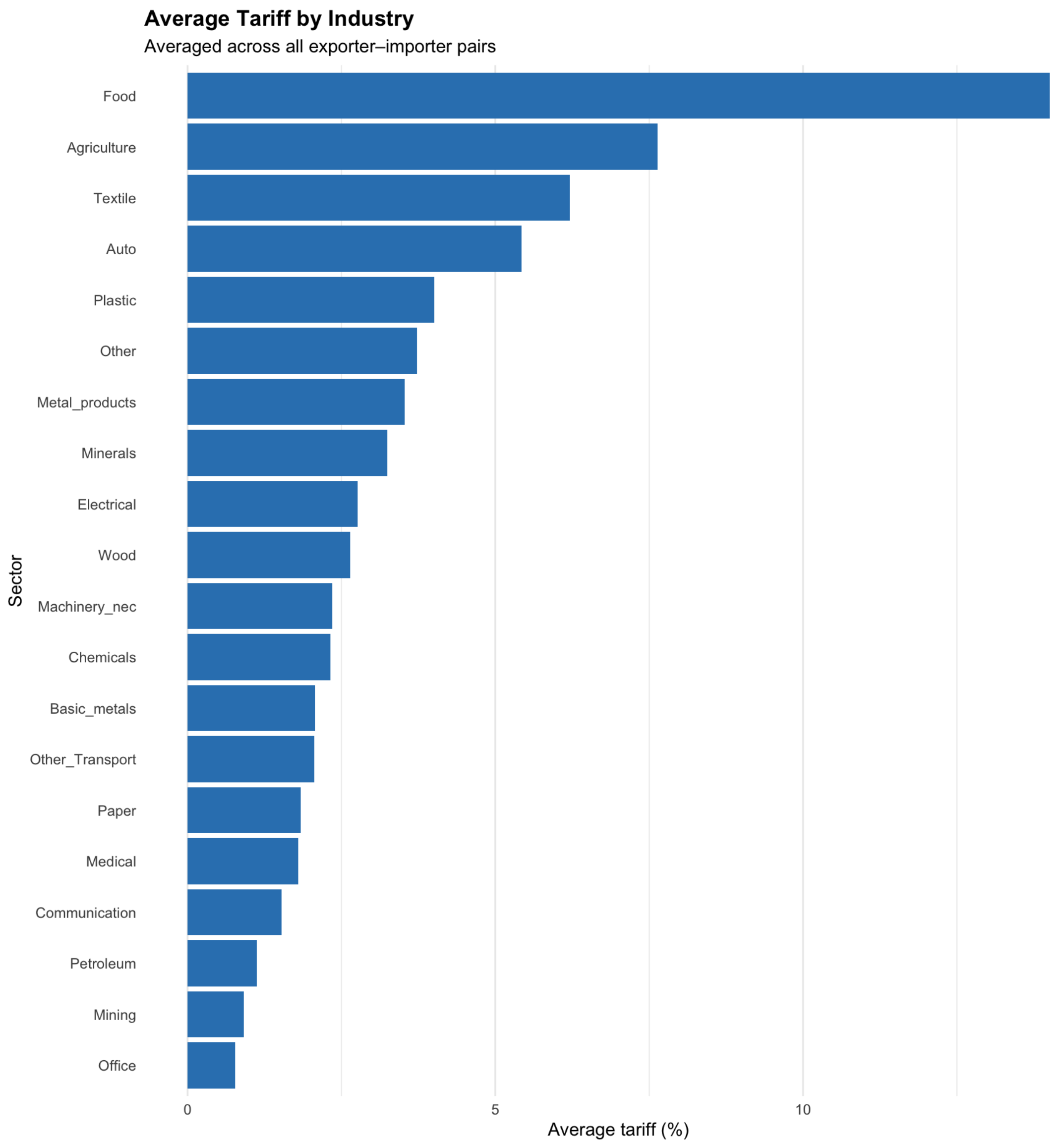


Figure A.6.: Average tariff rates in each industry

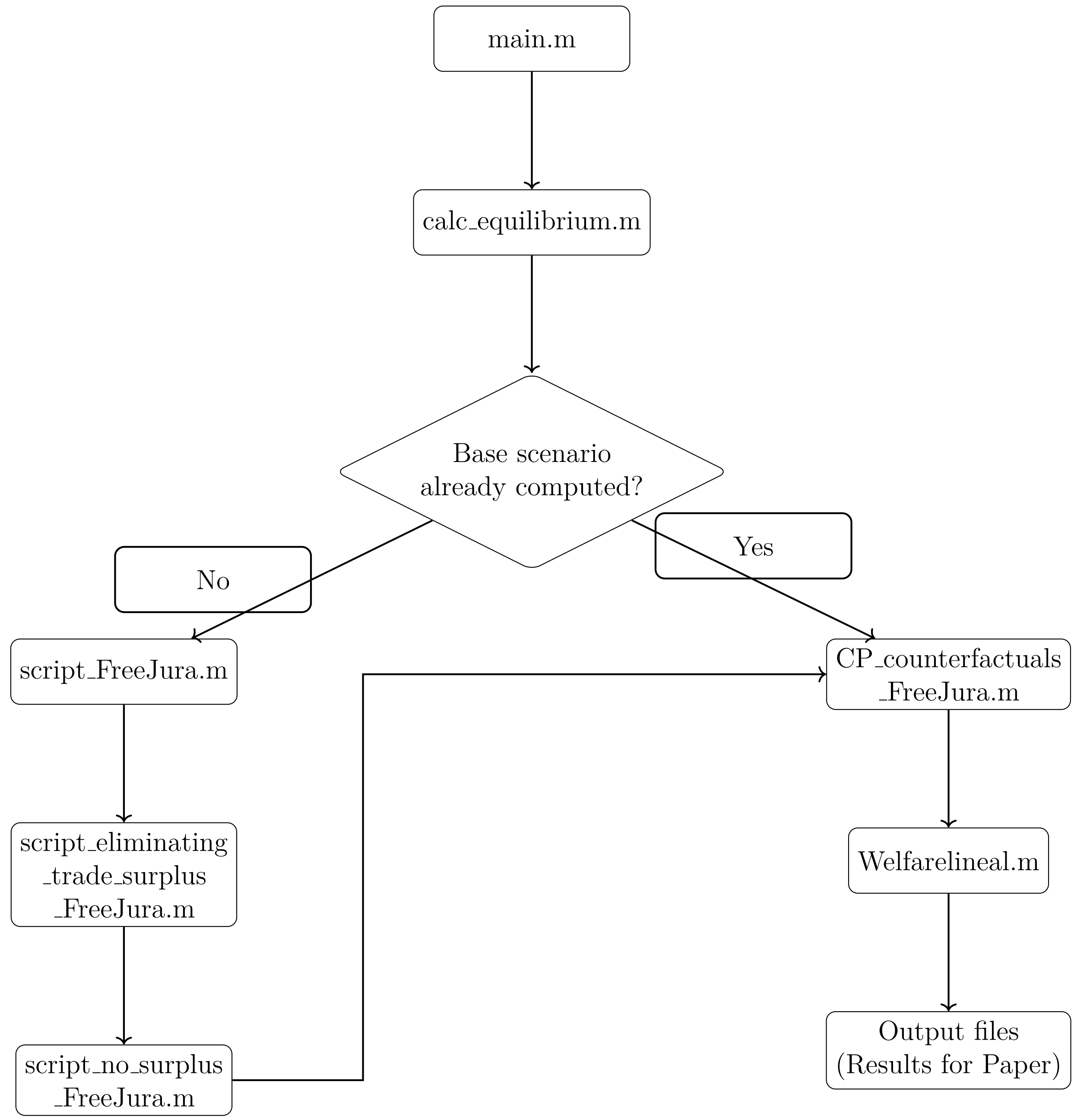
A.4. Changes in the code from Caliendo and Parro

To achieve a high degree of comparability as few changes as possible where made to the software which is provided by Caliendo and Parro. Some minor changes had to be made to accompany more countries and make the code dynamic to a variable amount of countries.

Additionally, some further changes where made to simplify the whole pipeline of calculating a scenario from the ground up with one single function. In the provided code multiple scripts need to be run after each other every time a new dataset (except if its the counterfactual tariffs) is used. This is not a issue in the way the model is used by Caliendo and Parro since they are not changing the set of countries in the counterfactual scenarios but only the tariffs. In the case of this article the other files, (xbilat, IO, B, GO...) are changed with every scenario. Therefore a more efficient and simple pipeline to get from the data to a result was needed.

To assess if the performed changes didn't interfere with the models output, the function of the model was tested by running the new pipeline with the dataset which was used by Caliendo and Parro and comparing the outputs of both the original model and the one from this article. The outputs from both models are identical, therefore correct execution of the model can be confirmed.

The main change is the combination of the functions that need to be run one after the other for the calculation of a counterfactual scenario in the Caliendo and Parro code into one pipeline which executes the code as follows:


main.m
calc_equilibrium.m
Base scenario already computed?
No
Yes
script_FreeJura.m
script_eliminating_trade_surplus_FreeJura.m
script_no_surplus_FreeJura.m
CP_counterfactuals_FreeJura.m
Welfarelineal.m
Output files (Results for Paper)

A.5. Additional Graphics

A.5.1. BRI Scenario

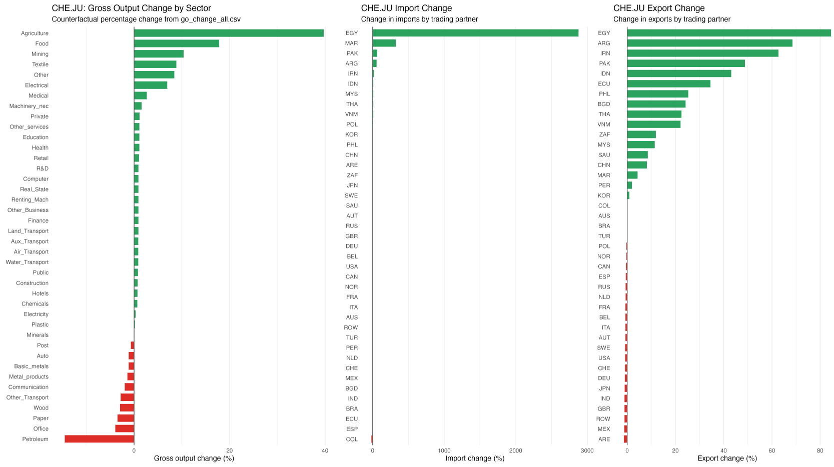


Figure A.7.: Relative changes in gross output, imports, and exports — BRI scenario.

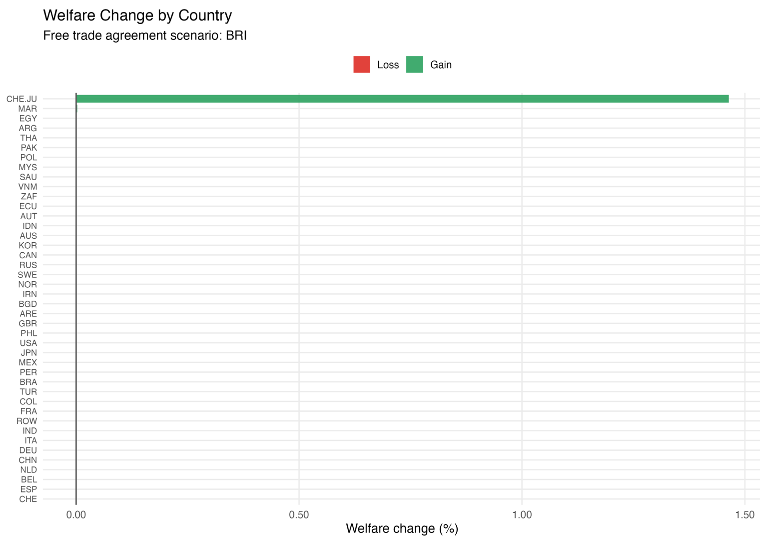


Figure A.8.: Welfare change by country — BRI scenario.

Figure A.9.: Volume of Trade change heatmap across countries and sectors — BRI scenario.

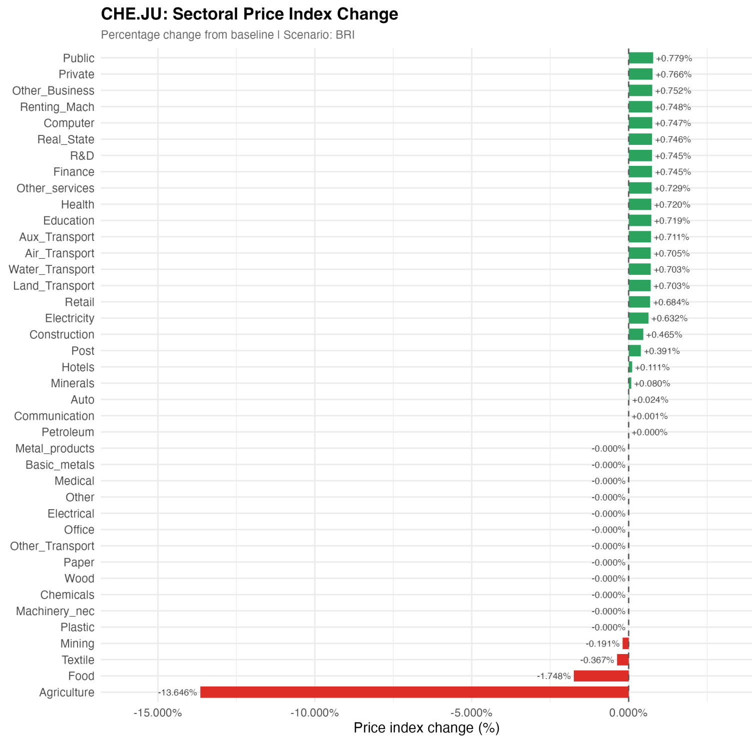


Figure A.10.: Sectoral price index change for CHE.JU — BRI scenario.

A.5.2. China Scenario

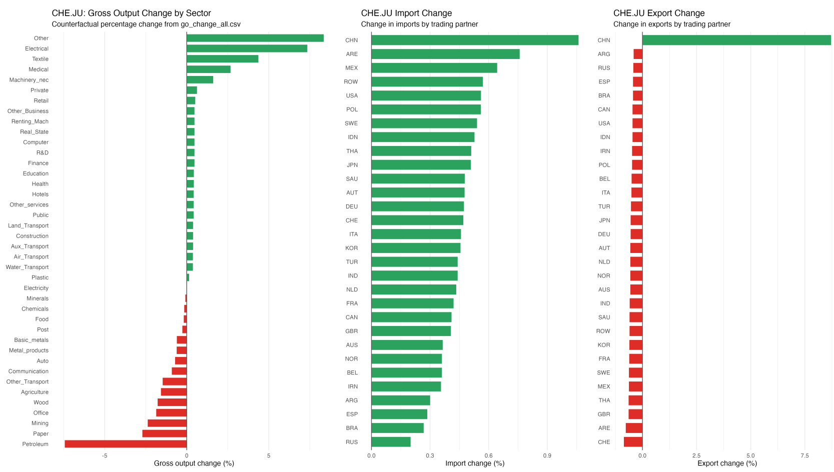


Figure A.11.: Relative changes in gross output, imports, and exports — China scenario.

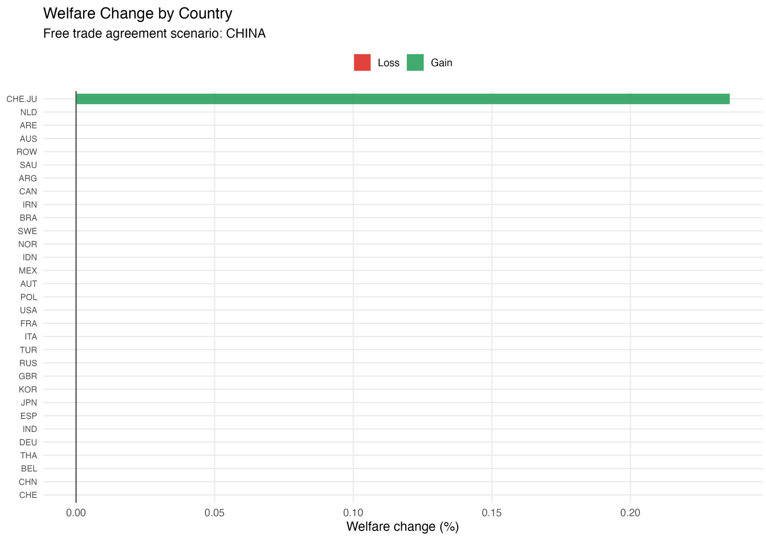


Figure A.12.: Welfare change by country — China scenario.

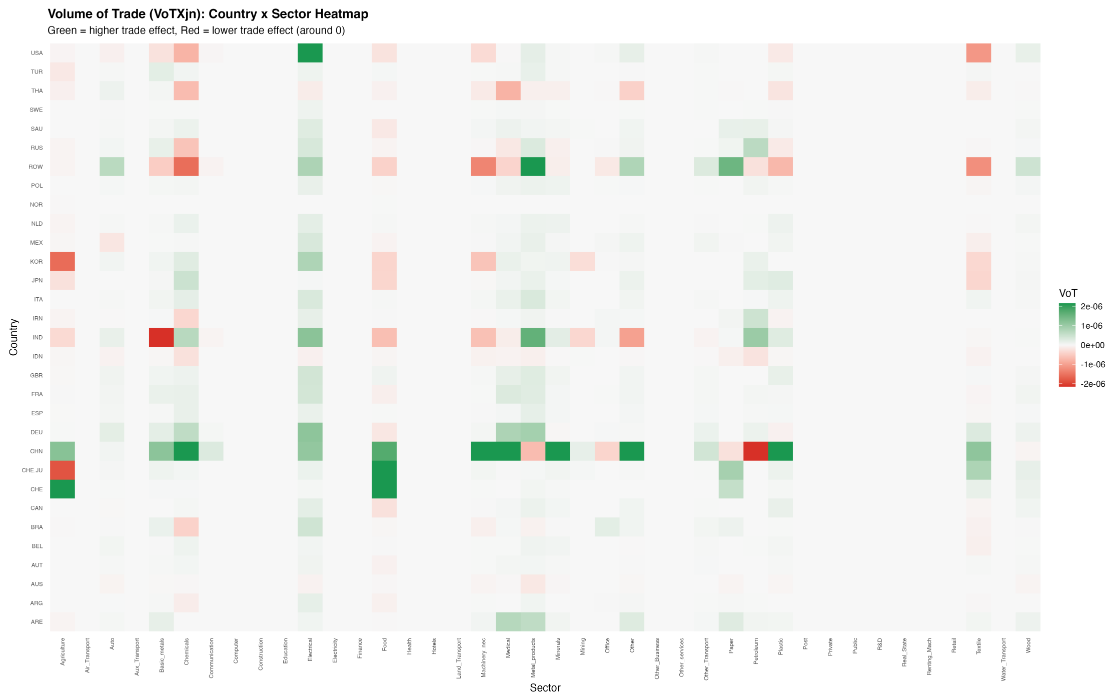


Figure A.13.: Volume of Trade change heatmap across countries and sectors — China scenario.

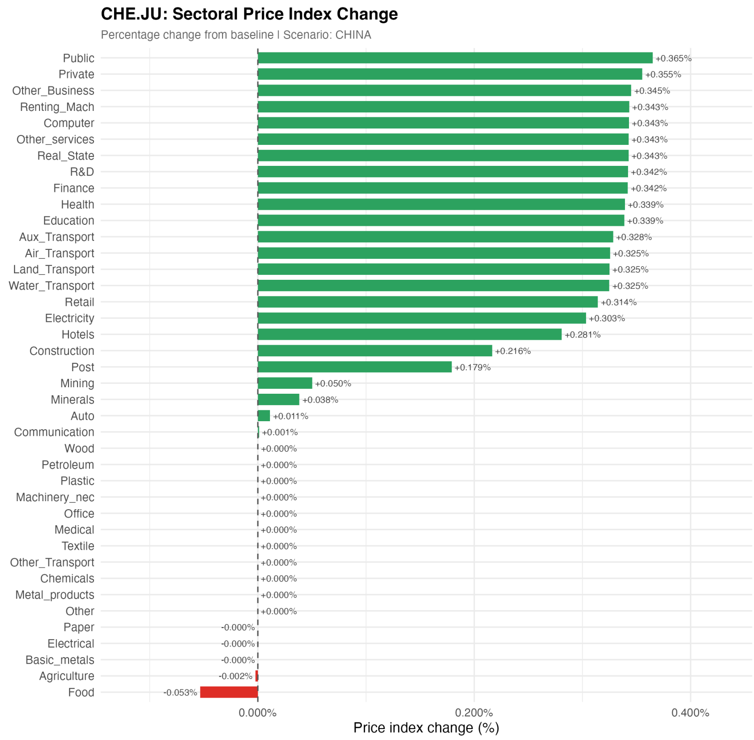


Figure A.14.: Sectoral price index change for CHE.JU — China scenario.

A.5.3. India Scenario

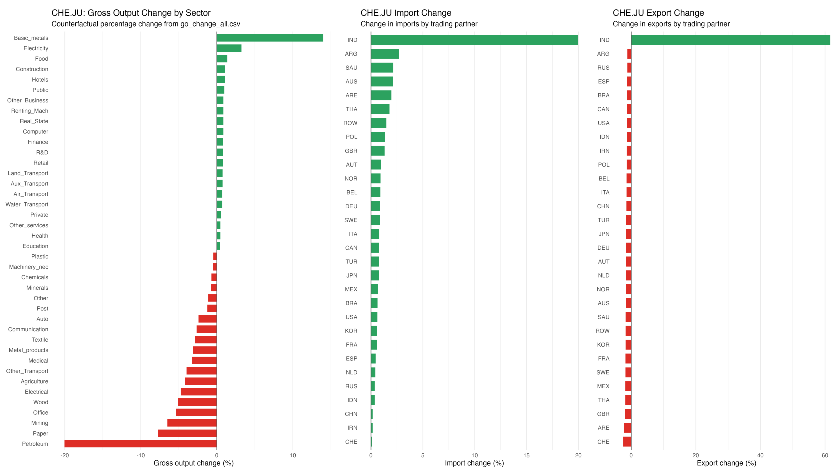


Figure A.15.: Relative changes in gross output, imports, and exports — India scenario.

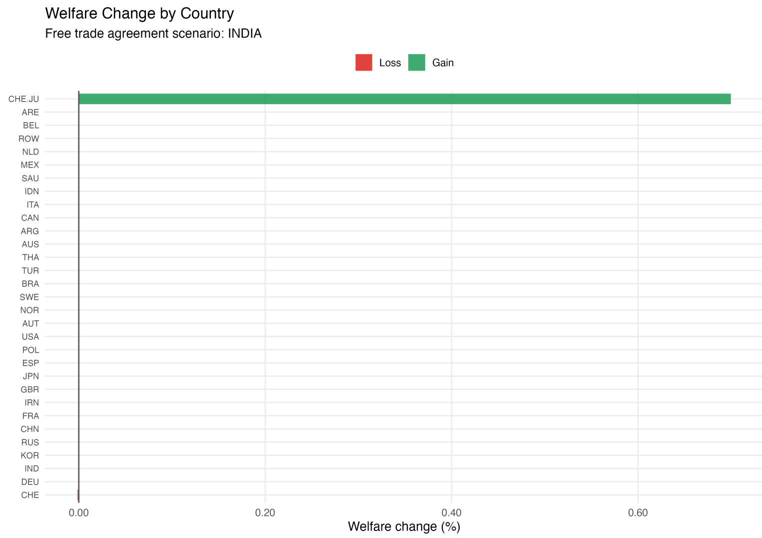


Figure A.16.: Welfare change by country — India scenario.

Figure A.17.: Volume of Trade change heatmap across countries and sectors — India scenario.

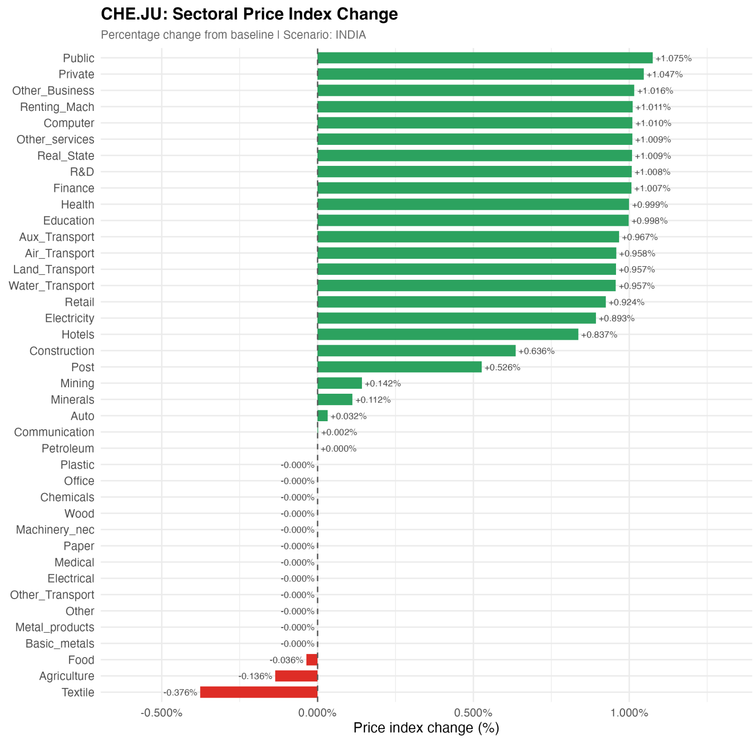


Figure A.18.: Sectoral price index change for CHE.JU — India scenario.

A.5.4. China and India Scenario

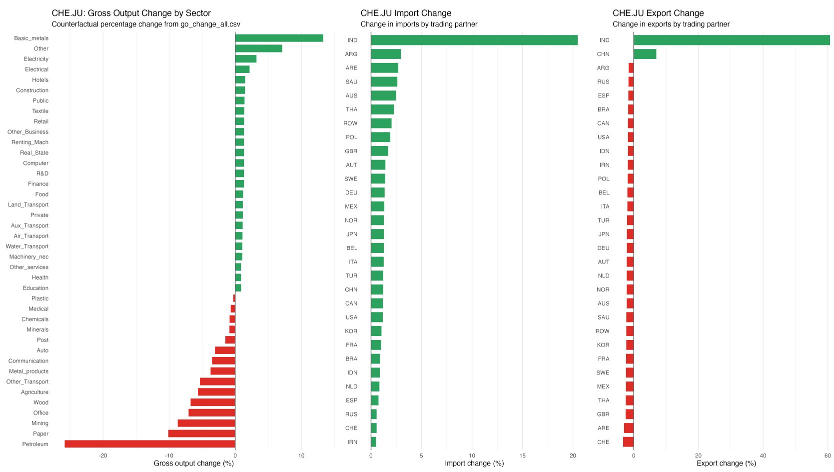


Figure A.19.: Relative changes in gross output, imports, and exports — China and India scenario.

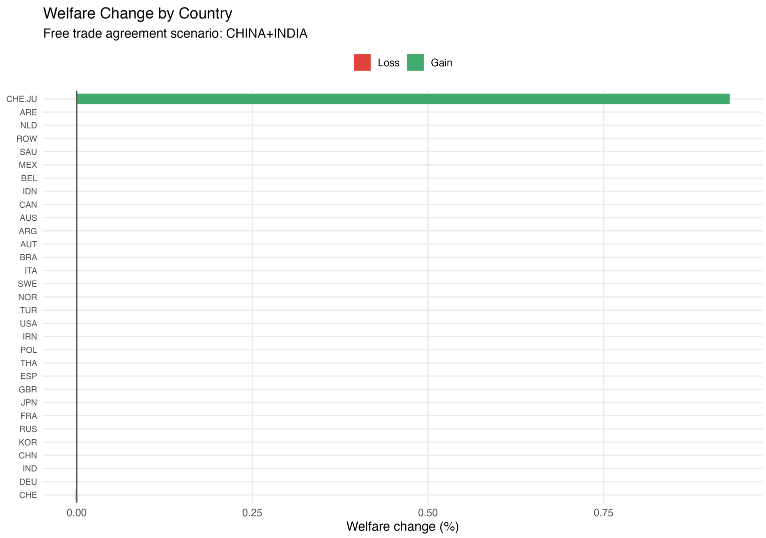


Figure A.20.: Welfare change by country — China and India scenario.

Figure A.21.: Volume of Trade change heatmap across countries and sectors — China and India scenario.

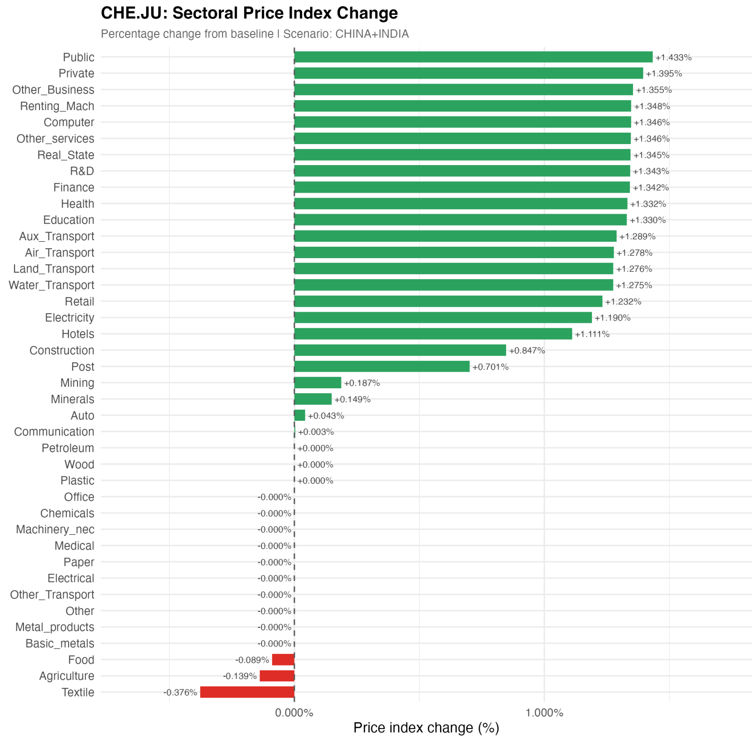


Figure A.22.: Sectoral price index change for CHE.JU — China and India scenario.

A.5.5. Full BRICS Scenario

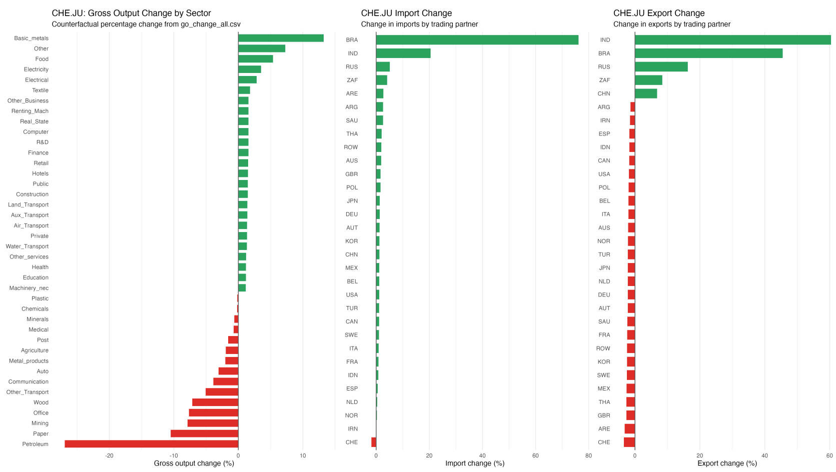


Figure A.23.: Relative changes in gross output, imports, and exports — full BRICS scenario.

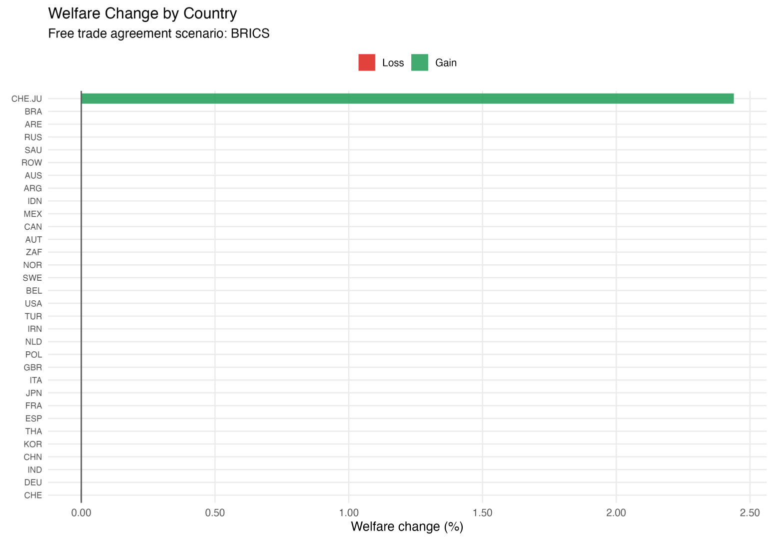


Figure A.24.: Welfare change by country — full BRICS scenario.

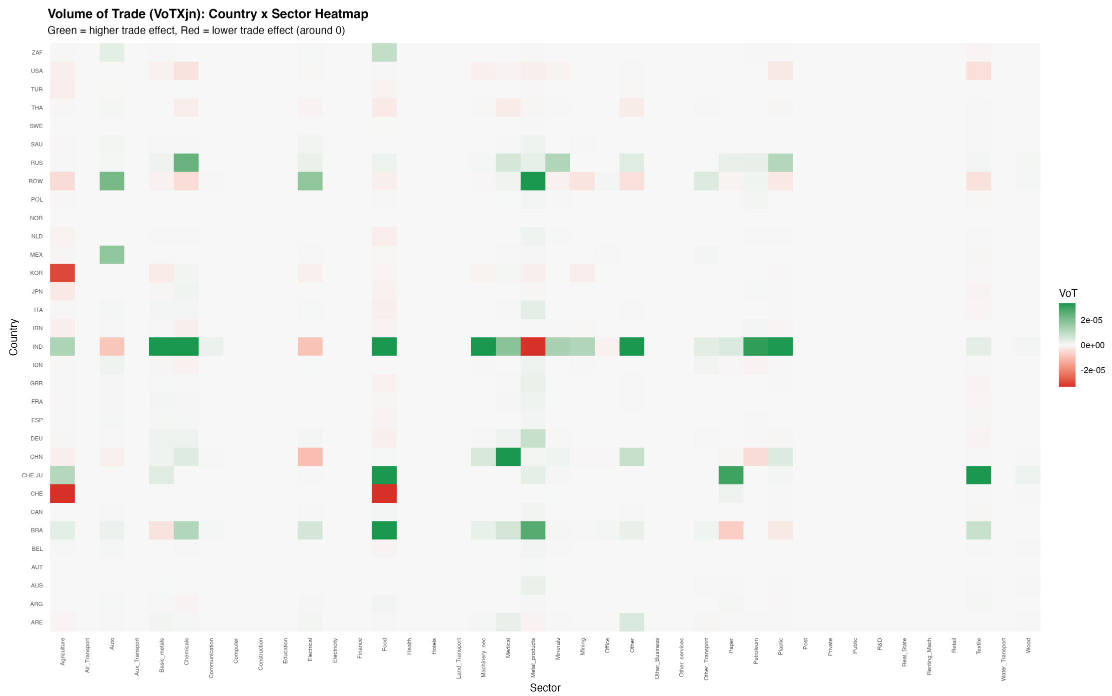


Figure A.25.: Volume of Trade change heatmap across countries and sectors — full BRICS scenario.

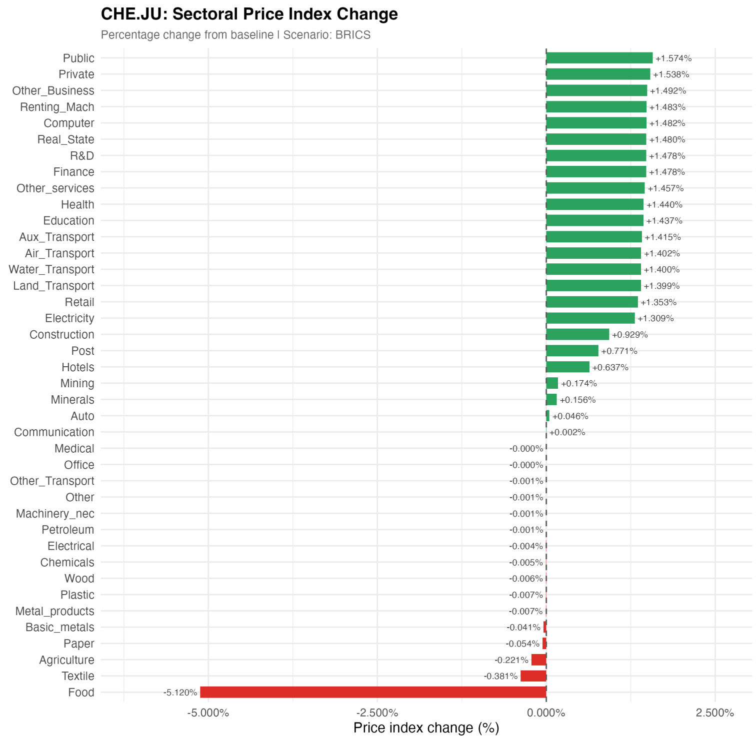


Figure A.26.: Sectoral price index change for CHE.JU — full BRICS scenario.

A.5.6. EU Scenario

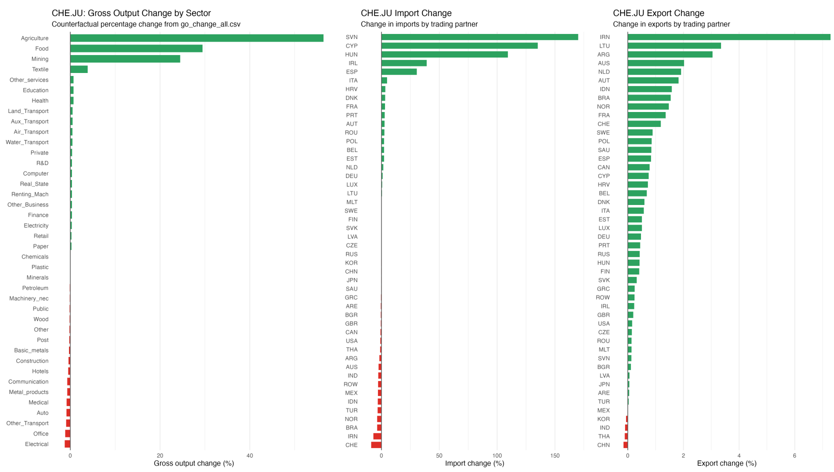


Figure A.27.: Relative changes in gross output, imports, and exports — EU scenario.

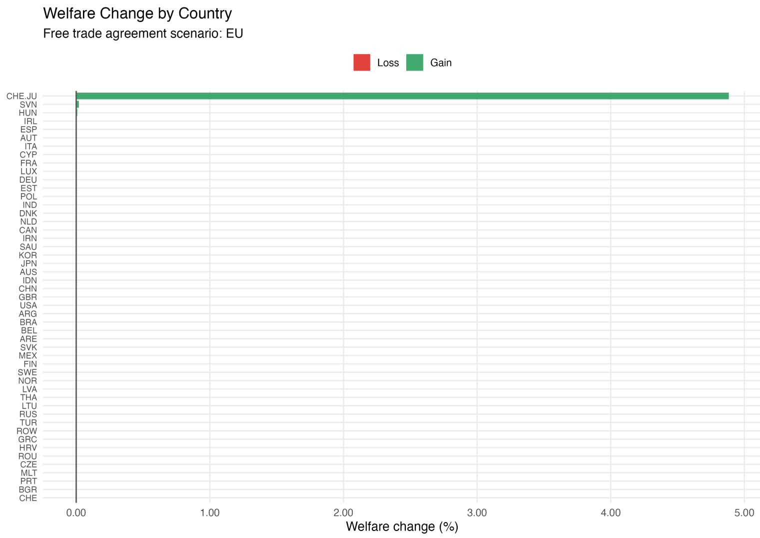


Figure A.28.: Welfare change by country — EU scenario.

Figure A.29.: Volume of Trade change heatmap across countries and sectors — EU scenario.

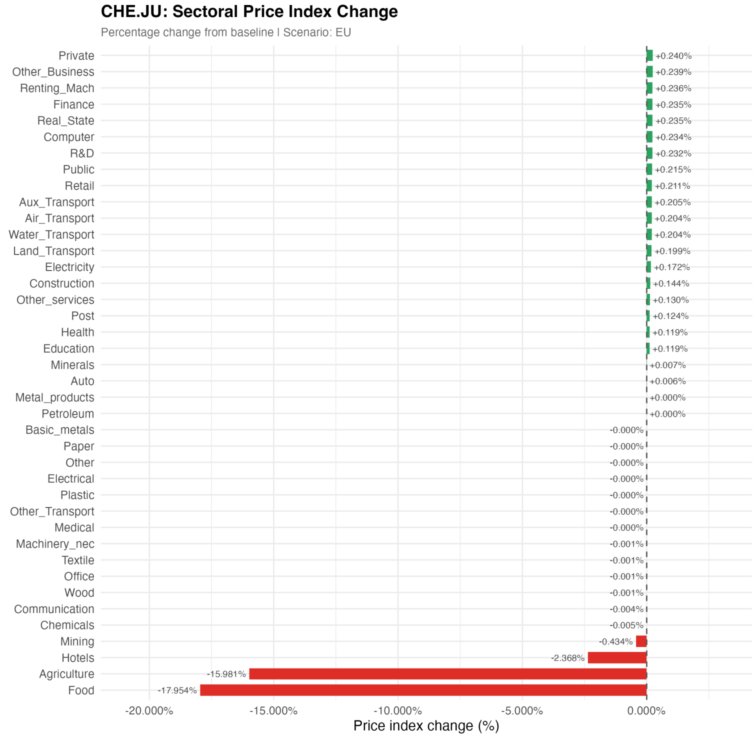


Figure A.30.: Sectoral price index change for CHE.JU — EU scenario.

A.5.7. EU and BRICS Scenario

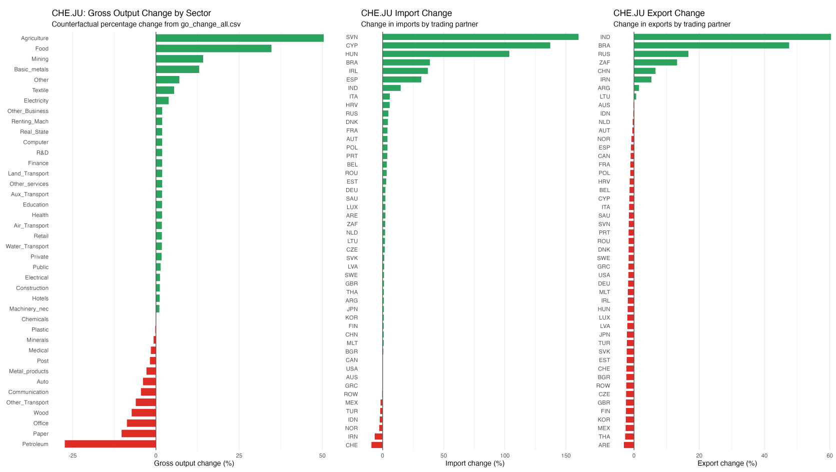


Figure A.31.: Relative changes in gross output, imports, and exports — EU and BRICS scenario.

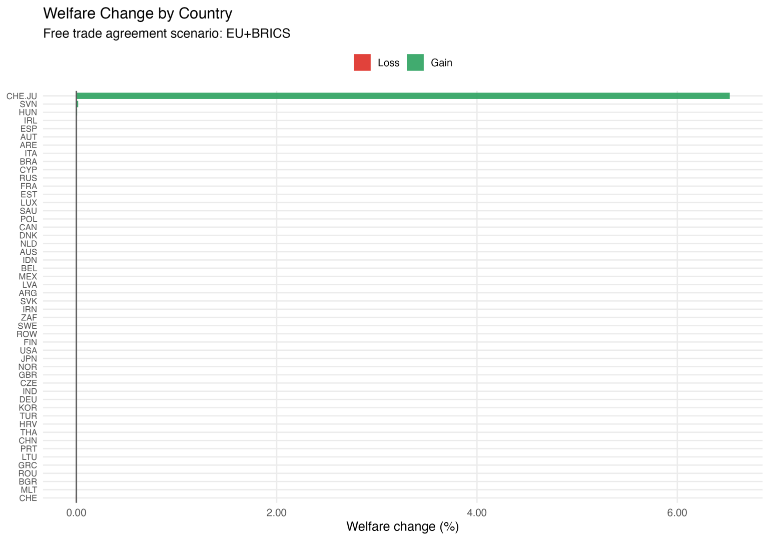


Figure A.32.: Welfare change by country — EU and BRICS scenario.

Figure A.33.: Volume of Trade change heatmap across countries and sectors — EU and BRICS scenario.

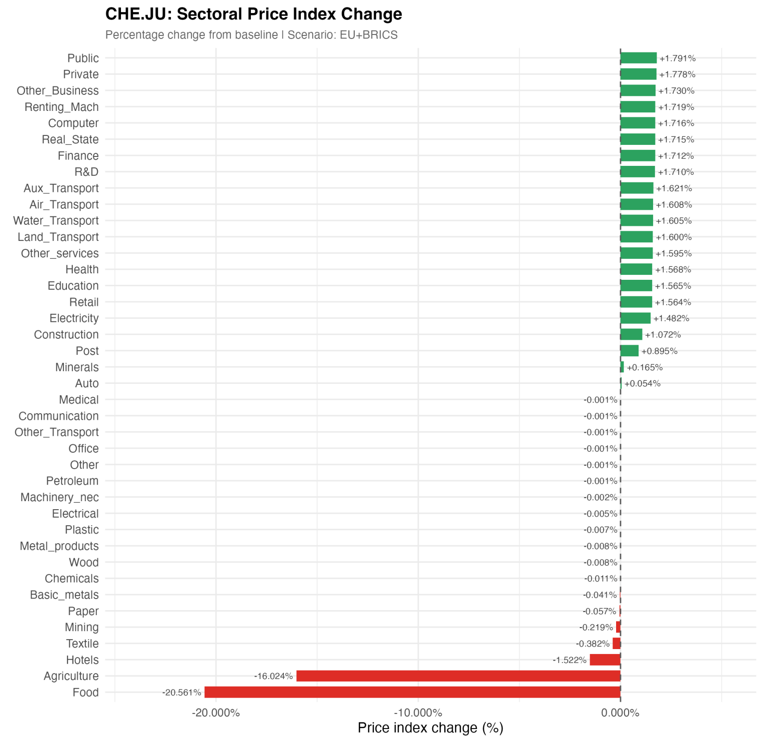


Figure A.34.: Sectoral price index change for CHE.JU — EU and BRICS scenario.

A.5.8. USA Scenario

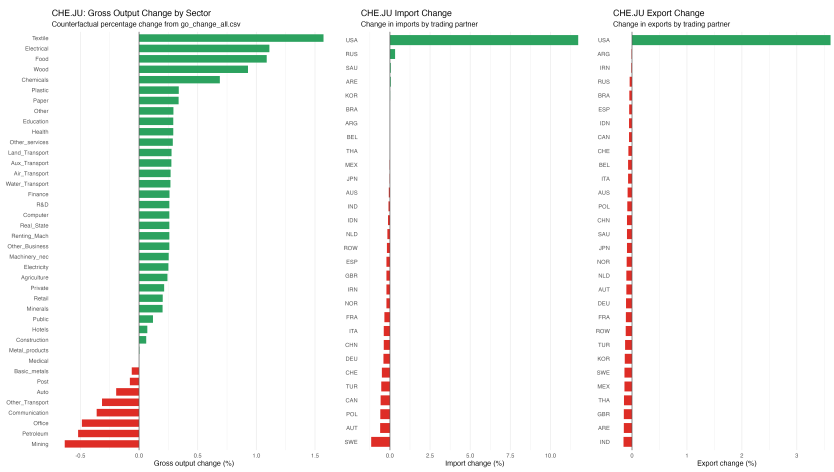


Figure A.35.: Relative changes in gross output, imports, and exports — USA scenario.

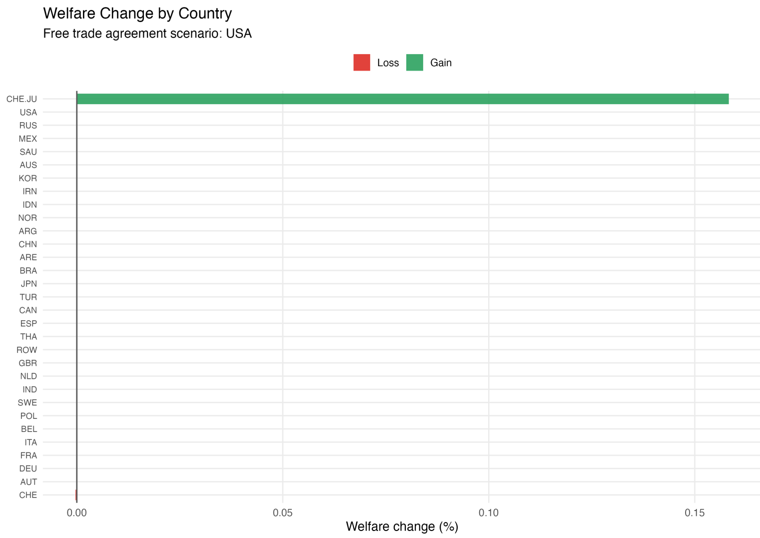


Figure A.36.: Welfare change by country — USA scenario.

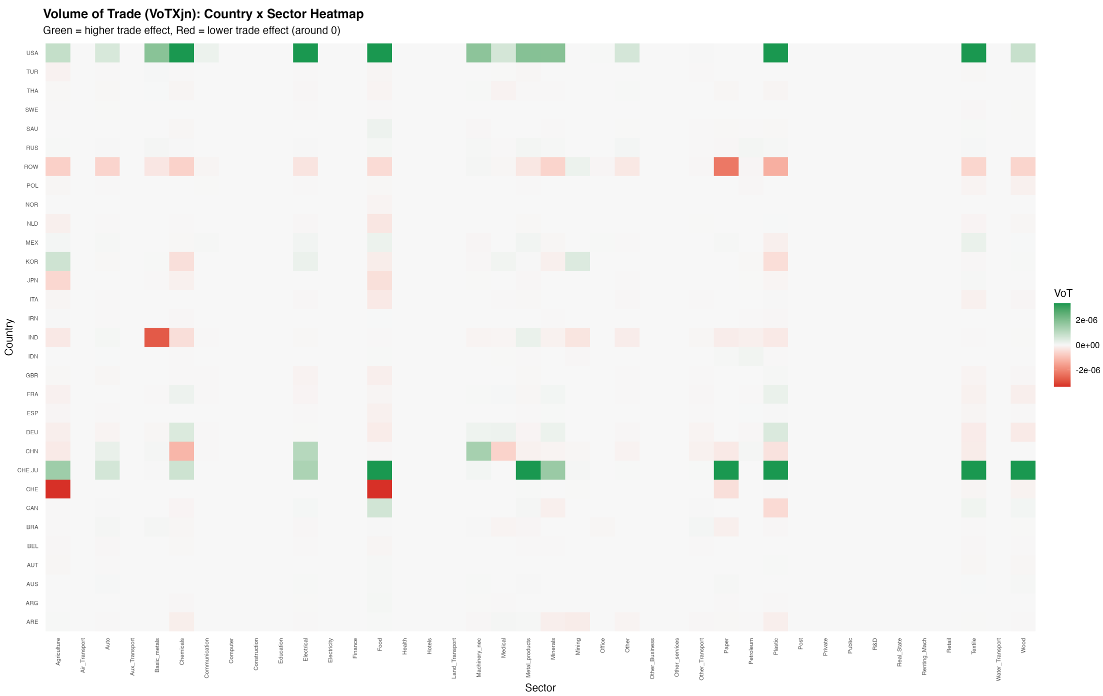


Figure A.37.: Volume of Trade change heatmap across countries and sectors — USA scenario.

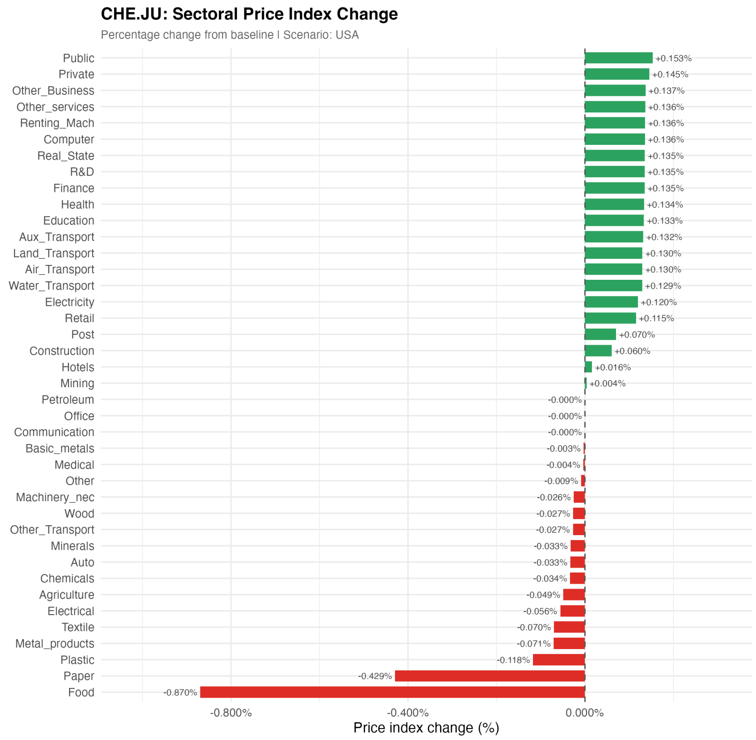


Figure A.38.: Sectoral price index change for CHE.JU — USA scenario.

A.5.9. World Scenario

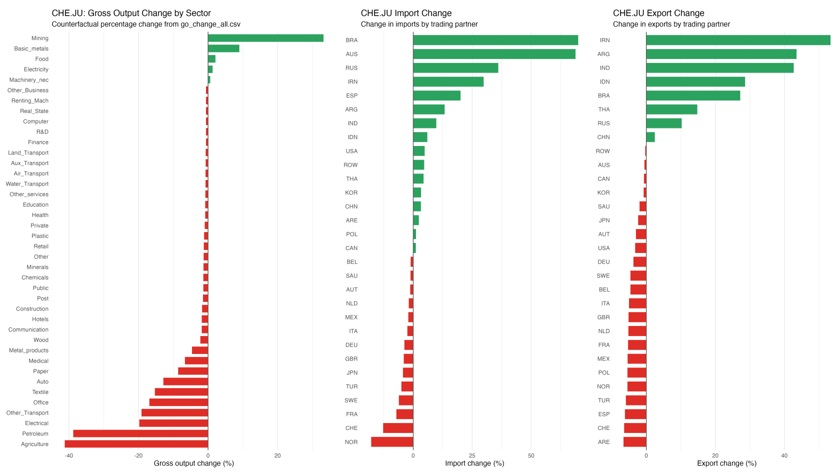


Figure A.39.: Relative changes in gross output, imports, and exports — World scenario.

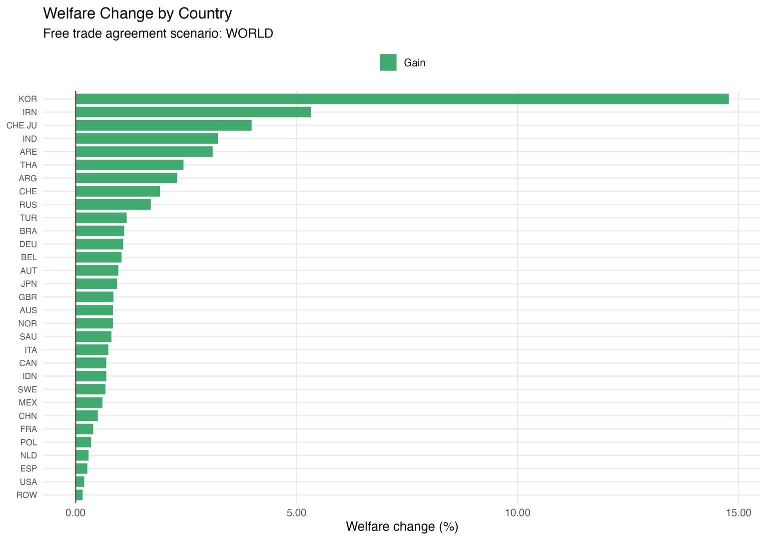


Figure A.40.: Welfare change by country — World scenario.

Figure A.41.: Volume of Trade change heatmap across countries and sectors — World scenario.

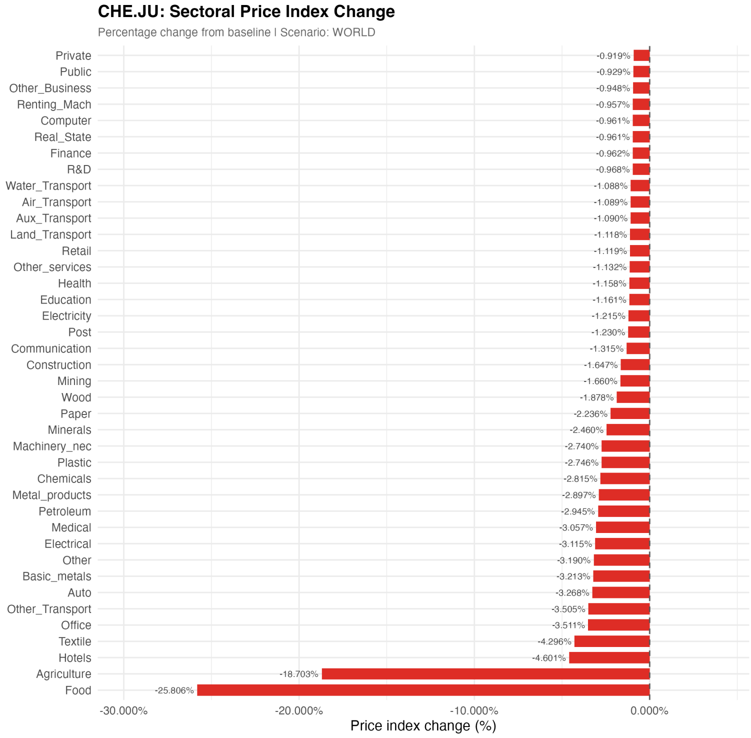


Figure A.42.: Sectoral price index change for CHE.JU — World scenario.

Declaration of the Use of Generative AI Systems

In accordance with the ZHAW guideline “Richtlinie zur Verwendung generativer KI-Systeme bei Leistungsnachweisen” (Version 3.0.0, gültig ab 01.03.2025), and its official English translation “Guidelines on the use of AI systems in assessments”, I declare the following:

Generative AI tools were used exclusively to support writing, text improvement, and code suggestion. The conceptual work, scientific argumentation, methodology design, implementation of the prototype, data analysis, and interpretation of results were carried out independently by the authors.

Specifically, the following AI systems were used:

- **ChatGPT (OpenAI)** – for improving clarity of sentences, grammar refinement, rephrasing of text passages, and assisting in the transformation of German/English text.
- **Claude (Anthropic)** – for code review, explanation, and suggestions to improve readability and efficiency.

All generated outputs were manually reviewed, verified and adapted by the authors. No AI-generated text, code or analysis was used without critical evaluation. No confidential or personal data were uploaded to any AI system.

The scientific responsibility for the correctness, originality and integrity of all content remains fully with the authors.