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Resilience of Small Open Economies to Geopolitical Shocks: The Case of Switzerland

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Resilience of Small Open Economies to Geopolitical Shocks: The Case of Switzerland^{*}

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Abstract

We extend a quantitative general equilibrium model of global trade networks to evaluate the economic impacts of various trade disruptions. Our analysis considers scenarios such as US-China trade wars, a broader Cold War 2.0 decoupling, Trump-era tariffs, and disruptions in the trade of critical inputs. We assess effects across 34 countries/regions and 38 industries, with a particular focus on Switzerland and its key sectors. We also account for second-layer effects, which can mitigate but, in most cases, amplify or considerably amplify the impacts predicted by our model. By highlighting both vulnerabilities and opportunities within the Swiss economy, we provide insights into the level of resilience of a small open economy to geopolitical shocks.

Keywords: Global trade networks, Trump tariffs, Swiss economy JEL Classification: C67, D57, F17, F41, F51

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1 Introduction

Linked global value chains characterize the economic world today and are pivotal for small open economies like Switzerland. These value chains enable small open economies to specialize in specific stages of production where they have comparative advantages. With international competition, the industries engaged in international trade are exposed to competition with leading firms from other countries, which in turn stimulates productivity growth. Moreover, global value chains can reduce the business cycle risk in domestic markets as the trade partners of firms in a country are diversified. Yet, the existing global value chains entail challenges, and there is a rapidly growing literature on these challenges.¹

More specifically, current developments in international trade display five interrelated phenomena. We refer, e.g., to Aiyar et al. (2023) and Baldwin et al. (2024, 2022, 2023) for a more detailed account: First, the global cross-border flows of goods, services, and capital strongly expanded in the second half of the 20th century but seem to have stagnated since the global financial crisis, and trade in goods has even declined somewhat. Yet, trade in services has not plateaued and is expected to grow further (Baldwin et al., 2024), and key economic indicators of global openness remain at high levels (Goldberg and Reed, 2023; Franco Bedoya, 2023; Di Sano et al., 2023).

Second, there have been stark recent structural changes in global production, now that China has become the dominant manufacturing location in the world, as illustrated in Figure 1, which displays the evolution of the shares in global manufacturing value added for China, India, Japan, USA and the Euro Area. Remarkably, China has become the world's manufacturing powerhouse in only two decades, producing roughly 30% of the world's manufacturing value added output.

Third, trade restrictions have increased significantly in recent years, as shown in data

¹See, e.g., Blackwill and Harris (2016) on how modern economic wars can be waged, Drezner et al. (2021) on how states can use their economic interdependence in value chain networks to pursue security or other geostrategic goals, or Braml and Felbermayr (2022) on how foreign trade policy may need to be considerably reformed.



Figure 1: Evolution of Manufacturing Value Added Source: World Development Indicators and authors' calculations.

from the Global Trade Alert (see, e.g., Aiyar et al. (2023)), and national security is often part of the justification for their imposition. Companies are increasingly considering near-shoring, friend-shoring, or even re-shoring.

Fourth, tensions have risen between the US and China in recent years, and each attempts to become less trade-dependent on the other, both generally and with regard to specific technologies and products. China has achieved a significant reduction in its trade dependency on the US, and China's manufacturing supply chains have been generally localizing. Meanwhile, a large fraction of US imports from manufacturing sectors continue to come from China. See Figure 2, for example, which illustrates the evolution of the US's and China's reliance on each other for manufacturing sector imports.

Yet, as shown by Baldwin et al. (2024), the rest of the world is not localizing, or only to a much lesser extent, as the share of imported intermediate goods in total intermediate goods usage continues to grow.

Fifth, in recent years, the EU, the US, and China have launched large-scale industrial



Figure 2: US/China Bilateral Manufacturing Imports Source: OECD TiVa-Datenbank 2023.

subsidy programs to reduce external dependencies by widening the possibilities for domestic sourcing, with the goal of achieving self-sufficiency in key technologies. Examples are the Green Deal Industrial Plan (GDIP) of the EU,² the Inflation Reduction Act (IRA)³ or the Chips Act,⁴ and a series of recent policy initiatives in China.⁵ While productivity, growth, and job creation are part of the motivation for such programs, alleviating climate change, geopolitical concerns, and reducing dependence on potentially less reliable trading partners are also major reasons for these policies (Hausmann, 2023).

Switzerland is largely a bystander to these developments but nevertheless faces the challenging task of operating in a less rule-based and more uncertain policy environment. So far the impact of these developments on Switzerland appears to remain quite

²Green Deal Industrial Plan, https://ec.europa.eu/commission/presscorner/detail/en/ip _23_510 (accessed June 17, 2024).

³Inflation Reduction Act of 2022, https://www.govinfo.gov/content/pkg/PLAW-117publ169/uslm/PLAW-117publ169.xml (accessed July 27, 2023).

⁴CHIPS and Science Act, https://www.nist.gov/chips (accessed July 27, 2023).

⁵E.g., Made in China (MIC) 2025, https://en.wikipedia.org/wiki/Made_in_China_2025 (accessed June 17, 2024).

limited, and there have not been major new trade barriers Switzerland is facing. Recent studies suggest that there are several channels through which the Swiss economy can be affected by the new wave of industrial policies.⁶ Yet, the aggregate impact of the IRA and the GDIP, for instance, on the Swiss economy appears small, with potential welfare losses around 0.06% of the Swiss GDP (Meyer et al., 2024). However, there is also considerable uncertainty about the short-term and long-term impacts of such initiatives (see, e.g., Evenett and Fritz (2021)).

In 2025, the US presidency of Donald Trump brings new and escalating disruptions in the global trade network. Switzerland and many other countries face potential risks from both new direct trade barriers, as well as spillovers from external trade wars or spillovers from sanctions related to political and military conflicts.

Swiss political authorities have made significant efforts to assess the dependencies of the Swiss economy in international trade by (i) analyzing the concentration of imports and exports according to country of origin and destination, (ii) examining which substitution possibilities exist nationally and internationally, and (iii) defining a set of goods with heightened and potentially critical dependency in international supply chains (Bundesrat, 2024).

In this paper, we provide complementary evidence on how particular shocks in international trade might impact the Swiss economy and explore the economy's resilience. Our objectives are to provide a quantitative assessment of the effects of shocks to trading relationships, to point to particular vulnerabilities and economic security risks, and to identify opportunities for bouncing back after trade shocks. In short, we assess the resilience of the Swiss economy to trade shocks and attempt to inform open questions in the resilience assessment of the Swiss economy. Along the way, we provide a quantitative assessment of the effects of trade shocks for 33 other countries and regions, including the major trade partners of Switzerland.

Our quantitative model for resilience analysis is inspired by the approach of Baqaee

⁶See Meyer et al. (2024).

and Farhi (2024) employed in Bachmann et al. (2024) and Baqaee et al. (2024), as well as the work of Çakmaklı et al. (2021). We describe this global general equilibrium trade model in Section 4. Full details on using the model to compute the effects of shocks are provided in Appendix A. We calibrate the model for 34 countries/regions and 38 industries using 2019 input-output data from the OECD (see Section 5).

We provide a series of scenarios for trade conflicts. We stress that these are examples, and we do not make predictions regarding the likelihood that an individual scenario will be realized. Moreover, many more scenarios are conceivable and could be examined with our framework.

Specifically, we consider 4 sets of scenarios described and analyzed in detail in Section 6: (1) a Cold War 2.0 scenario in which there is a breakdown of trade between a Russia/China block and a US/EU sphere of influence (including Switzerland), (2) variations on Trump tariffs and US/China trade wars, (3) a pharmaceutical supply chain shock, and (4) a disruption in the global supply of critical inputs from China. We show results for different trade barrier sizes, and we differentiate between shortrun and long-run effects. We focus our analysis on Switzerland and some of its critical industries, but we also show results for the other countries and regions.

Additionally, Section 6.2.5 and Appendix Table 6 show the scenarios we provided for the recent March 26, 2025 KOF forecast (Abberger et al., 2025), although we provide a less detailed description of the second-layer effects for these scenarios.⁷

The next section (2) provides a short overview of the Swiss economy to set the stage for our analysis, Section 3 previews our results and takeaways, Section 4 describes the model, Section 5 discusses the data and calibration, and Section 6 presents our full scenario analysis. Further specifics regarding the model, computational algorithm, calibration, and countries/industries are in Appendices A and B.

⁷More detailed assessments of second-layer effects for these scenarios are available upon request. In Section 3, we define "second-layer" effects as possible or likely mitigating or amplifying factors that have to be combined with the results of our model for an comprehensive assessment.

2 The Swiss Economy

The Swiss economy has characteristics typical of advanced small open economies, in addition to several distinguishing features. The services sector is the largest contributor to Switzerland's GDP and employment. It encompasses a wide range of industries such as tourism, healthcare, education, retail, and financial and other professional services. The financial industries, in particular, play a significant role, with Switzerland being a global financial hub and with firms operating at the global level in both the banking and the insurance industries. The information/communication industries and commodity trade also play a significant role in value added creation. Moreover, Switzerland's central location makes it a key transit point for goods moving across the continent, and Swiss transportation networks are well-developed.

Switzerland has a strong and R&D-intensive manufacturing sector that engages widely in international trade and includes the production of machinery, pharmaceuticals, chemicals, precision instruments, watches, and food products. In particular, Switzerland is a global leader in pharmaceuticals and biotechnology, hosting several major pharmaceutical companies that contribute significantly to both the manufacturing sector and to R&D. Compared to other countries, Switzerland has retained a comparatively large manufacturing sector, as shown in Figure 3.

Switzerland has a highly globalized economy. This is evident in Figure 4, which shows the evolution of trade in goods and services (exports plus imports) divided by GDP for a variety of industrialized economies with sizes similar to or larger than Switzerland's.

Figures 5 and 6 show Swiss export and import shares by industry and country, according to the 2019 OECD, Inter-Country Input-Output Tables, which is the dataset we employ in quantifying our model. For these graphs, we have combined some industries and countries into aggregates, but otherwise we display the raw data. Full details on our processing of the data are in Section 5 and Appendix B. Note that these figures include trade in goods *and* services. We see that pharmaceuticals, financial services, precision devices (including watches), machinery, and wholesale/retail trade



Figure 3: **Relative Size of Manufacturing Sector** Source: World Development Indicators.



Figure 4: Trade Share (Goods and Services) to GDP Source: World Development Indicators.

(sale without transformation) play a dominant role in exports of Switzerland. The largest share of Swiss exports goes to the US, and around 50% of Swiss exports go to the US, Germany, France, China, Italy, and Japan alone. The story is different with respect to Swiss imports, for which services related to information, media, science, and education are very important. Other key import sectors include wholesale/retail trade, cars and trucks, precision devices, and pharmaceuticals. Germany is by far the largest import source for Switzerland, and the majority of Swiss imports come from Europe (especially Italy and France). But after Germany, the US is the biggest source of Swiss imports, and imports from China are just behind those from France.

Overall, Switzerland sustains a large current account surplus, which stood at around 6% of GDP in 2023⁸, and the accumulation of current account surpluses has led Switzerland to have one of the larger net international investment positions in the world (close to 1 trillion US dollars in 2024).⁹



Figure 5: Share of Swiss Exports & Imports by Industry Source: 2019 OECD, Inter-Country Input-Output Tables. See Section 5 and Appendix B for further details.

⁸See, for example, the KOF 2024 winter forecast (https://doi.org/10.3929/ethz-b-0007106 52).

⁹See SNB, "Swiss balance of payments and international investment position: Q3 2024," https://www.snb.ch/public/publication/en/www-snb-ch/publications/communication/press-rel eases/2024/pre_20241220/0_en/pre_20241220.en.pdf.



Figure 6: Share of Swiss Exports & Imports by Counterparty Source: 2019 OECD, Inter-Country Input-Output Tables. "ROE" means Rest-of-EU, "LAA" is a subset of Latin American economies, "EEA" is a subset of east Asian economies, "AFR" is a subset of African economies, and "ROW" means Rest-of-World. See Section 5 and Appendix B for further details.

3 Summary of Results

Throughout our analysis, we distinguish between what we call "first-layer" and "secondlayer" effects. The first-layer effects are the ones confined to our quantitative trade model. They are the theoretical impacts of trade barriers on production, output, consumption, welfare, and prices in general equilibrium. These first-layer effects are important to consider because they represent an attempt at objectivity from the perspective of recent trade theory.

But trade policies can involve or trigger other effects beyond the scope of current quantitative trade theory. Such effects could considerably amplify the impacts of trade shocks or, in some cases, alleviate them. Therefore, we accompany our purely modelbased analysis with discussions of "second-layer" effects. The second layer is informed by data, empirical research, and qualitative theory but more difficult to include in a fully-specified quantitative general equilibrium model.

3.1 First-Layer Effects

On net, according to our model, Switzerland has a relatively resilient economy if we only consider first-layer effects. Across our scenarios, there are never catastrophic losses for Switzerland in terms of real income. General US tariffs of 20% against all countries including Switzerland would lead to a real income loss of over 200 CHF per capita each year.

A Cold War 2.0 scenario could lead to first-layer real income losses in excess of 1%, and broad and reciprocated Trump tariffs could also take more than 1% off Swiss real income (if an EU retaliation applies also to Switzerland). Thus, in these cases, real income losses per capita can be around 1000 CHF per year.

Such losses are not trivial in absolute terms, but many other economies stand to lose more from breakdowns in global trade. In our scenarios that do not directly apply to Switzerland, the net effect on the Swiss economy is positive but near zero, and a severe disruption of Chinese critical exports to the rest of the world could potentially increase Swiss real income by almost 0.5%, largely due to gains in precision devices and chemicals.

But net effects on the economy mask substantial sectoral heterogeneity, and we discuss this in detail below. To attempt to generalize, global trade disruptions could benefit Switzerland's precision devices sector and, to a lesser extent, the Swiss chemicals industry. In contrast, Swiss pharma and machinery appear to be more exposed. But overall, we find that the impact on key Swiss industries, which also include finance and food products, depends on the specifics of the scenario.

For the US, the tariff scenarios we consider lead to sizable real income losses. For example, the model suggests that the US could easily lose upwards of 1.5% of real income, depending on the time frame considered and the response of other countries. EU countries are also significantly negatively affected in some of the scenarios, and if the EU responds to US trade barriers with tariffs against the US *and* other countries, losses are also above 1% of real income, e.g. in Germany.

3.2 Second-Layer Effects

The model captures the effects of relative price and demand changes caused by trade shocks, how companies respond to these changes in their production of goods and services, and the spillover effects on all market participants resulting from these changes. However, a number of further-reaching effects (so-called "second-layer" effects) are not included. Depending on the scenario, these second-layer effects can have a small, moderate, or significant impact and must therefore be considered for a comprehensive assessment of a scenario.

These second-layer effects are more difficult to quantify than the first-layer ones. Here, we outline potential second-layer effects and provide an assessment – brief or detailed – of their possible magnitude when we discuss each scenario.

The first-layer effects do not account for two classic sources of downturn amplification.

First, there are feedbacks on production and employment according to standard Keynesian reasoning in the presence of nominal rigidities. Higher prices for imports due to trade barriers reduce overall consumer spending, which in turn dampens production and employment, leading to further declines in consumption and reinforcing the output decline. Second, financial frictions can also amplify economic downturns if first-layer losses cause firms to cut back on investments in the face of credit constraints.

The second second-layer effect is the potential movement of exchange rates, beyond the change we capture in our model, when a country imposes tariffs on other countries. In our model, the implied exchange rate adjusts such that trade balances remain constant. Yet, already, Mundell (1961) stressed that tariffs could worsen the trade balance and employment because of currency appreciation. There has been an entire strand of literature since then shedding light on the foundations and empirical relevance of such currency changes and how tariffs are partially offset by a currency appreciation in the tariff-imposing country or by a depreciation in the tariff-imposed country. Recent studies point to small effects of tariffs on trade balances (see, e.g., Furceri et al. (2021)), but the relationship between tariffs and exchange rates is complex and depends on the trade disruption and the size of countries (see, e.g., the overview of Eichengreen (2019) and recent work by Jeanne and Son (2024) suggesting that the offset can be more substantial than minimal).

Further important potential second-layer effects are supply chain disruptions (or even supplier defaults or exits) due to critical raw material or semiconductor deficiencies that are not captured by our trade model. In a Cold War 2.0 scenario, for instance, such supply chain disruptions will play a central role.

The second-layer effects include also the impact of tariff revenues on the government budget and government actions, as our modeling of international trade distortions through iceberg trade costs does not account for these revenues. A related secondlayer effect works through the change in the market structure. In our model, we have perfect competition and thus changes in the market structure are not a factor. In other trade models that incorporate, for example, monopolistic competition and entry barriers, there are differences between modeling trade barriers via iceberg costs or tariffs that go beyond accounting for government revenues. The reason is that tariffs may have different consequences for firm profits and entry than do iceberg trade costs. Therefore, in such theoretical environments the elasticity of trade flows and welfare assessments may differ between iceberg trade costs and tariffs (see, e.g., Felbermayr et al. (2015) in the context of the Arkolakis et al. (2012) model).

Finally, tariffs or other trade restrictions can impact innovation and investment decisions of firms, as in the famous tariff jumping logic for example, and may affect the savings and investment balances of countries with consequences for the capital account and current account.

Moreover, all of the second-layer factors could affect, and in particular dampen, growth. And if disruptions are massive, countries may impose capital controls. With very large disruptions, we also have to take into account asset revaluations, and defaults of firms relying strongly on debt/loan financing may trigger crises with further repercussions in financial/banking markets. Moreover, it cannot be excluded that foreign funding of investments in the US could decline if growth prospects or productivity gains from technologies are lower than expected. In an extreme case, a US debt crisis could emerge, significantly amplifying the first-layer effects and negatively impacting all major trading partners and US asset holders.

Taking this broader perspective allows us to suggest whether our first-layer effects from the model represent lower or upper bounds on potential losses from trade shocks. In the Swiss case, for example, we argue below that the model likely significantly understates the negative effects of shocks that put barriers between China and Switzerland.

4 The Model

To perform quantitative counterfactual exercises, we follow the approach of Baqaee and Farhi (2024) employed in Bachmann et al. (2024) and Baqaee et al. (2024), as well as the analysis of Çakmaklı et al. (2021). There are C countries and N industries linked together with a nested constant elasticity of substitution (CES) structure. In what follows, for variables related to cross-border trade, superscripts refer to destinations and subscripts refer to sources. Each country $c \in C$ is endowed with a fixed supply of labor L^{kc} in each industry $k \in N$, which it inelastically supplies to the local industry at wage w^{kc} . The representative consumer in country c solves the maximization problem

$$U^{c} = \max_{x_{k}^{c}} \left(\sum_{k \in N} (b_{k}^{c})^{\frac{1}{\sigma}} (x_{k}^{c})^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \text{ subject to}$$
(1)
$$\sum_{k \in N} P_{k}^{c} x_{k}^{c} = \sum_{\substack{k \in N \\ I^{c}}} w^{kc} L^{kc},$$

where x_k^c is the country's composite consumption intermediate in industry $k \in N$ and P_k^c is its price. $\sigma > 0$, common across countries, is the consumption elasticity of substitution. The constants $b_k^c \ge 0$, which sum to one, are exogenous taste parameters that correspond to the Cobb-Douglas shares in the $\sigma = 1$ limit. I^c is national income (and, as we discuss below, GDP). By the standard CES argument, maximized utility is equal to real income:

$$U^c = \frac{I^c}{P^c} \tag{2}$$

$$P^{c} = \left(\sum_{k \in N} b_{k}^{c} \left(P_{k}^{c}\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}},\tag{3}$$

where P^c is the natural consumer price index. We assume that world GDP,

$$Y = \sum_{c \in C} \sum_{k \in N} w^{kc} L^{kc},$$

is the numeraire and normalize it to one.

The composite consumption intermediates are produced by competitive local importers

(one for each industry) that minimize the cost of meeting demand x_k^c :

$$\min_{y_{kc'}^c} \sum_{c' \in C} \tau_{kc'}^c p_{kc'} y_{kc'}^c \quad \text{subject to}$$

$$x_k^c = \left(\sum_{c' \in C} \left(\delta_{kc'}^c \right)^{\frac{1}{\theta_k}} \left(y_{kc'}^c \right)^{\frac{\theta_k - 1}{\theta_k}} \right)^{\frac{\theta_k}{\theta_k - 1}},$$
(4)

where $p_{kc'}$ is the "raw" price of the industry k good in country c' and $y_{kc'}^c$ is the quantity purchased. The composite consumption producer bundles together industry k goods from around the world according to trade elasticity $\theta_k > 0$ (which depends on the industry but is common across countries) and exogenous weights $\delta_{kc'}^c$ that sum to one.¹⁰ The exogenous "icebergs" $\tau_{kc'}^c \ge 1$, which depend on the source, destination, and industry, are the representation of trade barriers: buying one unit of $y_{kc'}^c$ requires the purchase of $\tau_{kc'}^c$ units (and $\tau_{kc'}^c - 1$ are destroyed).¹¹ The composite consumption producers price at marginal cost, which by CES implies

$$P_{k}^{c} = \left(\sum_{c' \in C} \delta_{kc'}^{c} \left(\tau_{kc'}^{c} p_{kc'}\right)^{1-\theta_{k}}\right)^{\frac{1}{1-\theta_{k}}}.$$
(5)

The raw, traded goods are produced in each country by firms (one for each industry) that hire local labor and solve:

$$\min_{l^{kc}, X^{kc}} w^{kc} l^{kc} + P^{kc} X^{kc} \quad \text{subject to}$$

$$y_{kc} = A^{kc} \left(\left(\alpha^{kc} \right)^{\frac{1}{\theta}} \left(l^{kc} \right)^{\frac{\theta-1}{\theta}} + \left(1 - \alpha^{kc} \right)^{\frac{1}{\theta}} \left(X^{kc} \right)^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}},$$

$$(6)$$

where A^{kc} is (exogenous) productivity, l^{kc} is labor demand, α^{kc} is the labor share, and $\theta > 0$ is the production elasticity. X^{kc} is a bundle of intermediate inputs specific to industry k in country c, and P^{kc} is the corresponding intermediate input cost index. The raw production firms also price at marginal cost, yielding a price p_{kc} with the standard CES form analogous to (5).

¹⁰Following Caliendo and Parro (2015), this formulation can be microfounded in a Ricardian fashion by assuming a continuum of sub-goods in each industry and Fréchet distributed productivies.

¹¹As we will discuss below, we can use icebergs less than than one to represent productivity shocks.

There are two other sets of CES bundling firms on the production side of the economy. We describe their notation below but omit the optimization problems because they are analogous to the ones already presented. First, the industry-specific input bundle X^{kc} , analogous to the consumption aggregate (Problem 1), is formed via CES with inputs x_i^{kc} from all industries j and cross-industry elasticity ϵ and industry-specific weights $(\sum_{i \in N} \omega_i^{kc} = 1)$. We call these the aggregate intermediate firms. The industry-specific inputs into the aggregate intermediate firms are bundles created by composite intermediate producers, analogous to the composite consumption intermediates in Problem 4. These N^2 production-side importers use the trade elasticity θ_k from before but face distinct weights $\sum_{c' \in C} \delta_{kc'}^{jc} = 1$ and icebergs $\tau_{kc'}^{jc}$ that can depend on the source industry/country kc' and the destination industry/country jc. Their imports are denoted $y_{kc'}^{jc}$ (in contrast with imports destined for final consumption, which were denoted $y_{kc'}^{c}$). In summary, each of the C countries has N firms who use industry-specific labor and intermediates to produce "raw" goods for export (and domestic use). These are the only "value added" firms, and their goods can ultimately be used both for final consumption as well as inputs into production. The intermediate inputs of the raw firms are produced by industry-specific aggregate intermediate firms (N in each country). The aggregate intermediate firms use input bundles from all industries, which they buy from composite intermediate firms. Each composite intermediate firm is specialized in a particular industry, so there are N for each industry and a total of N^2 in each country. These are one set of the importers of the economy, and we assume that they have to pay for the icebergs (i.e., icebergs are at the entry port). The other set of importers are the consumption composite intermediate firms, who have weights and icebergs separate from the importers on the production side of the economy. The consumption composite intermediate producers (N per country) sell industry bundles to the representative consumer in each country, which creates and consumes the final consumption good.¹² The representative consumer in each country pays for industry bundles by renting its industry-specific labor to the raw firms.

¹²Note that in our quantitative analysis, we interpret final consumption as domestic "absorption," that is, the sum of final consumption and investment by consumers, firms, and governments.

While the model exhibits a rich global trade network, the model is static and net trade is balanced: in each country, final consumption expenditure equals national income, which is also equal to GDP: since profits are zero and the factors of production are owned locally, national income is the sum of domestic value added (the local wages). In total, there are $\mathcal{N} = C \times (1 + N + N^2 + N)$ CES agents in the world economy. Figure 7 visualizes the model's optimizing agents and the structure of trade.

Given productivities and icebergs, competitive equilibrium consists of wages, production y_{kc} , labor demands, and the various CES demands and price indexes, such that given prices and wages (i) the demands solve the consumer problems and minimize firm costs, (ii) prices equal marginal costs, and (iii) the labor and raw goods markets clear:

$$l^{kc} = L^{kc}$$
$$y_{kc} = \sum_{c' \in C} \tau_{kc}^{c'} y_{kc}^{c'} + \sum_{jc' \in N \times C} \tau_{kc}^{jc'} y_{kc}^{jc'}$$

for all $k, c \in N \times C$.¹³

In our various scenarios, we investigate how prices, trade, and welfare change in response to iceberg and productivity shocks. Despite the richness of the model, Baqaee and Farhi (2024) show that calibrating and solving the model is much more straightforward than it might at first seem. To compute *log changes* in the model with respect to icebergs, one need not know the initial productivities A^{kc} , labor supplies, taste parameters, or production weights. Baqaee and Farhi (2024) prove that observing the

¹³Note that when the labor and raw intermediates markets clear and all agents are optimizing/costminimizing, the aggregate and composite intermediate markets also clear. To see this, suppose the raw intermediate firms are optimally supplying y_{kc} . This induces labor demand l^{kc} . So if the labor market is clearing, these firms optimally hire $l^{kc} = L^{kc}$. These production and employment levels induce unique demands for aggregate intermediates X^{kc} and aggregate consumption bundles. Meeting the demand for aggregates induces unique demands (from the aggregate firms) for composite intermediates x_k^c and x_j^{kc} . For the composite intermediate firms to meet these demand, they require the unique amounts of raw intermediates $y_{kc'}^c$ and $y_{jc'}^{kc}$. So as long as these raw intermediate demands (plus additional demand to cover icebergs) sum to the original supplies y_{kc} , all of the other markets are clearing. In other words, the only economically meaningful trade in goods and labor is happening between raw intermediate producers and consumers, and the other markets can be viewed as withincountry bundling steps. The advantages of the present formulation are that (i) the CES demands simplify analysis and computation and (ii) it is explicit and transparent about where trade and trade barriers are in the chain.



Figure 7: **Model Diagram** Note: Triangles represent icebergs.

equilibrium expenditure shares and Domar weights (which we define in Appendix A) is sufficient for calculating how the model changes for small shocks. The effect of large shocks can then be calculated by dividing into steps and performing numerical integration. Since the derivatives of the model are available in closed form (up to matrix inverses), this procedure can be performed without numerical optimization and approaches the exact solution as the number of steps in integration is increased. Calibration consists of only two sets of numbers: the elasticities (σ , ϵ , θ , θ_k) and the expenditure shares and Domar weights, which we can calculate from trade input-output tables. Appendix A explains with full rigor how we solve for the effect of shocks in the model. Along the way, we provide a detailed proof of a matrix version of the key theorem in Baqaee and Farhi (2024) that enables the exact calculation of the model's derivatives and global approximation of the effect of shocks.

5 Data

To use the model to calculate the effects of trade scenarios, we require two sets of inputs. First, we need input-output trade data to initialize the model, in particular the expenditure shares of producers and consumers. Second, we need values for the model's elasticities of substitution (σ , ϵ , θ , θ_k). Note that while labor endowments, productivity parameters, and the underlying consumption/production weights affect equilibrium, knowledge of them is not required for performing counterfactuals: as we explain in detail in Appendix A, realized expenditure shares and Domar weights are sufficient for computing the model's derivatives.

We set the initial expenditure shares using the OECD, Inter-Country Input-Output (ICIO) Tables, specifically the 2019 table.¹⁴ For 45 industries and 77 countries (including "rest-of-world" ROW), the OECD ICIO gives the intermediate sales of each industry in each country to all other industry/country pairs, as well as the final-use sales to each country. We perform three adjustments to the raw data before running

 $^{^{14}}$ See OECD (2023).

the model: (1) a standard correction for negative inventories, (2) a trade balance correction, and (3) an aggregation scheme required for computational reasons. The details and logic of our approach are described in Appendix B. After aggregation, we are left with 38 industries (see Appendix Table 2) and 34 countries, which include Switzerland, ROW, Switzerland's major trade partners, and several regional aggregates (see Appendix Tables 3 and 4.). We take the elasticity parameters (see Appendix Tables 1 and 2) from Baqaee and Farhi (2024) and Eppinger et al. (2023).

When we feed shocks into the model, the algorithm returns the changes in all price indexes, expenditure shares, etc. for all countries and industries. While we report all changes in real income across our scenarios, at the industry level we focus on six key sectors for Switzerland (highlighted in Table 2): Food products, beverages and tobacco ("Food products"; C10_C12), Chemical and chemical products ("Chemicals"; C20), Pharmaceuticals, medicinal chemical and botanical products ("Pharma"; C21), Computer, electronic and optical equipment ("Precision devices"; C26), Machinery and equipment, n.e.c. ("Machinery"; C28), and Financial and insurance activities ("Finance"; K). Nestlé S.A. is a Swiss example from "Food products" and Sika AG and Clariant AG are large Swiss companies in "Chemicals." Roche Holding AG and Novartis AG are two Swiss examples from "Pharma." The Swiss companies Swatch Group Ltd, Logitech International S.A., and OC Oerlikon Corporation AG are in "Precision devices," and the Schindler and Stadler Rail are two examples from "Machinery." "Finance" includes UBS.¹⁵

We would like to add two cautionary remarks regarding our data. First, while we use the latest non-COVID year of the OECD ICIO tables (2019), these data may not reflect structural changes in trade patterns that occurred between 2019 and 2024. In cases where this is particularly relevant, it is possible to provide back-of-the-envelopes that update our real income change assessment to reflect 2024 trade patterns (see, for example, Footnote 25). Second, there is always uncertainty surrounding the extent to which IO tables and other statistics, in particular trade statistics on service exports

¹⁵We categorize these Swiss companies according to their main NACE Rev. 2 codes from ORBIS.

and imports, represent the true underlying situation.¹⁶

6 Scenarios

In what follows, we shock our model of the global trade network in various ways and investigate the effects on the small open economy of Switzerland, as well as the other countries in our model. For each scenario, we display the same four sets of information. First, we show the % change in real income for all 34 countries and regions. Note that we define a country's real income in the model to be nominal GDP divided by the local natural consumer price index.¹⁷ The real income effects for all scenarios and countries are collected in Appendix Table 5. Second, we report the % change in real income for the 6 key Swiss (CHE) industries described in Section 5. In the model, this is the percent change in the real wage for the particular Swiss industry, where the real wage is the nominal wage divided by the natural consumer price index. Third, we plot the % change in real exports for these Swiss industries. Real exports are defined to be nominal exports divided by the sales price (p_{kc}) . Fourth, we show the change (in percentage points) in what we call the "Intermediate Cost Ratio," defined to be the Swiss industry-specific intermediate good input costs (P^{kc} in the model's Equation 6) divided by the sales price p_{kc} . When this measure falls, it means the change in the sales price (marginal cost) exceeds the change in the cost of intermediate goods. And when it rises, intermediate goods costs are outstripping sales prices.

For some sets of scenarios, we distinguish between "short run" and "long run." Long run refers to our baseline calibration described in Section 5. Following Baqaee et al. (2024), short run means we set all trade elasticities ($\theta_k - 1$) to 0.5 instead of using the

¹⁶We have started to assess such uncertainty by allowing for error bounds on IO data entries.

¹⁷Deflating by the consumer price index creates the consumer welfare-relevant measure of economic activity in the model, as we saw in Equation 2. Our definition of real income corresponds to real GNE in Baqaee and Farhi (2024) but differs from usual calculations of real GDP by statistical agencies. One could also calculate changes in real GDP in the model, but doing so for large shocks would require a stance on the method of deflation, which varies across countries. And, in any case, real income corresponds to welfare in our theory. See Kehoe and Ruhl (2008) and Oulton (2023) for an in-depth discussion of this topic. Kehoe and Ruhl (2008) note that real income is sometimes referred to as command-basis GDP.

values in Appendix Table $2.^{18}$

The algorithm we use for solving the model is described in Appendix A. In each scenario, we use 30 steps in numerical integration.

6.1 Cold War 2.0 and Formation of Two Power Spheres

6.1.1 Cold War 2.0: First-Layer Effects

We call our first scenario Cold War 2.0, borrowing the term from Baqaee et al. (2024) but with different specifications. This scenario represents an extreme escalation of existing global conflicts. A US-aligned power sphere forms, and the US is joined by the EU, Norway, Switzerland, and non-EU G7 (Canada, Japan, and UK) in putting large trade barriers on exports from a second power sphere: China (with Taiwan) and Russia. Specifically, 300% icebergs in all Europe/G7 block countries are applied to all exports of goods and services from the China/Russia block (which equivalently reciprocates). Countries outside of the two spheres continue to trade without direct disruption but are affected by spillovers.

First-Layer Effects

The first layer, model-based effects are summarized in Figure 8. The real income impacts are mostly negative and quite large in some cases (more than -8.5% for Taiwan, almost -7% for Russia, -2.65% for China, around -2% for Ireland and Japan, and -2.39% for Poland). Some economies outside of the two power spheres experience non-trivial gains, for example Vietnam (+2.64\%), Mexico (+0.68\%), and Turkey (+0.79\%). The change is -0.94% for the US.

The income loss for Switzerland is substantial (-1.12%) but comparable to the effect in its neighboring countries Austria (-1.37%), Germany (-1.60%), France (-1.46%), and Italy (-0.91%). However, the aggregate loss for Switzerland masks substantial sectoral

¹⁸We think of the short run as less than 6 months and the long run as beyond 2 years, although this is only a loose interpretation as the model does not contain dynamics. Note also that there is considerable uncertainty in the literature regarding sectoral trade elasticity estimates.



Figure 8: Cold War 2.0

Note: In the scenario, a China/Russia block and a Europe/G7 block put 300% icebergs on each other's exports. "ROE" means Rest-of-EU, "LAA" is a subset of Latin American economies, "EEA" is a subset of east Asian economies, "AFR" is a subset of African economies, and "ROW" means Rest-of-World. The Intermediate Cost Ratio is defined to be the Swiss industry-specific intermediate good input costs divided by the sales price.

heterogeneity: there are real wage declines of 4.40% and 3.85% in Swiss machinery and pharmaceuticals, respectively, and there are smaller but still significant losses in finance and food products. But these losses are offset by income gains of over 10% in precision devices and around 1.65% chemicals. Intermediate input costs actually rise in both beneficiary industries, but sales prices from demand shifting to Switzerland increase even more (as we see in the bottom right panel of Figure 8.). Interestingly, while intermediate costs fall for Swiss pharma, sales prices fall even more on a account of weakening demand. Real exports contract substantially in all 6 key Swiss industries.

6.1.2 Cold War 2.0: Second-Layer Effects

The second-layer effects are particularly relevant for this scenario, and we discuss them in turn.¹⁹

¹⁹See also Baqaee et al. (2024) for an excellent account of caveats when using a similar trade model to assess the consequences for Germany of a hard decoupling from China.

Critical Raw Materials

Although most goods and services can be substituted over the very long term, certain raw materials present a distinct challenge due to their intrinsic scarcity as natural resources. Given China's dominant position in the global raw materials market, the dependence of western economies on such raw materials is obvious and would add second-layer costs of decoupling from China: our model only considers the sectoral level, with substantial aggregation of products, and is thus not suitable for examining dependencies on individual critical inputs in production.

For instance, Germany is particularly dependent on specific raw materials that are vital to its key industries, and any disruptions in their supply could have significant economic repercussions. One way to assess Germany's reliance on China for raw material supply is to use the European Commission's framework, which identifies 16 critical raw materials as outlined in the EU Raw Materials Act (52018PC0368, Annex 1). These materials are classified as critical due to their essential role in key technologies and strategic industries, such as defense, combined with a high risk of supply disruption stemming from a concentrated supplier market.²⁰ Flach et al. (2022) identify nine critical raw materials with a high degree of supplier concentration and usage in more than half of the key technologies. Moreover, as shown by Baqaee et al. (2024), the automotive and high-tech sectors, which heavily depend on four critical raw materials, are particularly vulnerable to decoupling from China. This vulnerability arises from China's dominant position in global production and the limited short-term substitutability of these materials from alternative sources.

The Swiss economy does not have the same exposure as that of Germany but would be severely affected in other ways. Switzerland's most important export sector, pharmaceuticals, is strongly dependent on particular intermediate products from China: China is a dominant global supplier of Active Pharmaceutical Ingredients (APIs),

²⁰The following list of critical raw materials has been identified: bismuth, boron, cobalt, copper, gallium, germanium, lithium, magnesium, manganese, natural graphite, nickel, platinum, rare earth elements, silicon metal, titanium, and tungsten.

which are heavily used by western pharmaceutical companies.²¹ A recent KOF survey (Eichenauer and Domjahn, 2023) reveals that "one-fifth of Swiss industrial companies are moderately to heavily reliant on critical inputs from China. The greatest dependence is in the electronics sector, followed by pharmaceutical and chemical sectors."

Hence, similar to Germany, the discontinuation of the supply of critical raw materials and APIs from China would amplify the loss of income we report for the first layer. The results of the Eichenauer and Domjahn (2023) KOF survey suggest that direct Chinese inputs could be essential in production for approximately 10% of Swiss firms in pharmaceuticals, chemicals, and electronics. According to the 2019 OECD ICIO, chemicals (C20), pharmaceuticals (C21), computer, electronic and optical equipment (C26), and electrical equipment (C27) comprise around 10% of Swiss value added. So a rough back-of-the-envelope calculation suggests the possibility of a -1% secondlayer effect on Swiss welfare from a breakdown in production due to particular Chinese inputs.

Chip Production

A Cold War 2.0, with Taiwan in the Russia/China block, would likely disrupt Taiwan's chip exports to Europe and the G7, which could have severe economic ramifications.

According to Jones et al. (2023), Taiwan represents 18% of global semiconductor manufacturing capacity. Moreover, it dominates almost entirely high-end semiconductor production, mostly in the logical but also in the memory chip category. Approximately 92% of the world's most advanced chip manufacturing capacity is concentrated in Taiwan.

In a Cold War 2.0 with a breakdown of this chip supply, western economies are affected through three channels. The first is reliance on direct imports from Taiwan (or indirect imports via third countries) for their use as intermediate inputs in the downstream production of goods and services. The second channel is dependence on imports of

²¹While precise numbers are not reported in scientific outlets, various business reports illustrate the dominant position of China in this market. See, e.g., DCAT Value Chain Insights (2023).

electronic products produced in third countries (including China),²² which incorporate Taiwan-made semiconductors as critical components. Third, the product range of semiconductors and its global value chains are highly complex with a few countries dominating trade including connected equipment and material inputs with substantial mutual trade dependencies (see e.g. Hillrichs and Wölfl (2025)). Hence, the emergence of Cold War 2.0 is likely to further disrupt semiconductor supply chains, affecting firms in both the Western and Chinese blocs.

The main conclusion of Jones et al. (2023) for the US economy is that in the event of a significant manufacturing disruption in Taiwan, there would be large increases in chip prices, with the US logic chip segment facing the most severe consequences. Given current capacities, domestic US production of logic chips would increase approximately 5%, providing little compensation for the decline in supply.

The dependence of the EU and Switzerland on chips from Taiwan is more pronounced than that of the US, particularly for advanced and specialized semiconductors. Efforts like the EU Chips Act aim to reduce this reliance, but in the short to medium term, Europe remains quite vulnerable to disruptions in Taiwan's semiconductor production (Ragonnaud, 2023). Hence, one would expect at least the same consequences for the EU and Switzerland as in the US. Further disruptions through the third channel strengthen this conclusion.

Regarding the second channel, that is, the reliance on imports of electronic products produced in third countries that incorporate Taiwan-made semiconductors as critical components, there is little information on its scale, but we would expect substantial price increases for some final goods. Indeed, according to our first-layer (model-based) effects of a Cold War 2.0, Swiss final goods inflation for electrical equipment and computer, electronic, and optical equipment is second only to final textiles inflation. We estimate that prices for these sectors rise in Switzerland by more than 6% relative to the price of final Swiss food consumption.

²²At the present, it seems unlikely that Taiwan chip production could be smoothly incorporated in Chinese manufacturing, due to reliance on advanced components from the West.

Amplification of Downturns

Our static and flexible price trade model does not account for two classic sources of downturn amplification. First, the decline in incomes from a Cold War 2.0 may be further aggravated by the feedback on production and employment according to standard Keynesian reasoning in the presence of nominal rigidities. Higher prices for imports due to trade barriers reduce overall consumer spending, which in turn dampens production and employment, leading to further declines in consumption and reinforcing the output decline. Second, financial frictions can also amplify economic downturns if first-layer losses cause firms to cut back on investments in the face of credit constraints. As the downturn in a Cold War 2.0 scenario is large, these amplifications will likely be strong. Estimates in the literature (Baqaee et al., 2024) suggest that the output decline is amplified by a factor of 1.3.

Foreign Direct Investment, Capital Accumulation, R&D, and Growth

A Cold War 2.0 would affect investments and capital accumulation in three important ways. First, it would wipe out to a significant extent the value of foreign direct investment (FDI) in the block with which one cannot trade anymore, preventing repatriation of future profits. For Switzerland, this would be significant as the stock of Swiss FDI in China reached CHF 27.9 billion, with FDI flows recorded at CHF 2.4 billion in 2022 (SECO, 2024). Although Chinese investments in Switzerland have increased over recent years, the overall total stock of Chinese FDI in Switzerland is much smaller. Overall, while the losses on FDI in China could be substantial, they would be comparatively small in relationship to Switzerland's total FDI abroad, which amounted to CHF 1,288 billion in 2023 (Swiss National Bank, 2024).²³ Hence, we would not expect a major negative income contribution from this second-layer effect in Switzerland.

Second, future FDI would be redirected, and we expect that FDI within the Europe/G7 block would increase. But such reshuffling would occur slowly and likely not contribute to further declines of output.

 $^{^{23}{\}rm Note}$ that this figure includes equity capital and intragroup loans held by Swiss-domiciled companies in their non-resident subsidiaries.

Third, the associated downturn from a Cold War 2.0 could affect saving and long-run capital accumulation. While these effects are likely present, a recent study (Kleinman et al., 2023) suggests that incorporating capital accumulation into quantitative trade models like the one we use here does not significantly amplify the long-run effects of policy counterfactuals, relative to static models, for the types of scenarios we consider. However, a Cold War 2.0 could also affect growth through impairing private R&D or technology diffusion. Overall, we expect negative growth factors would exacerbate the first-layer declines in welfare, although the effect need not be permanent, and it is difficult to quantify.

Other Second-Layer Effects

If a Cold War 2.0 developed very quickly, one would expect rising defaults of firms in supply chains that become impossible, which could lead to substantial spillovers to the financial system, banks in particular. While a breakdown of the banking system could be avoided by central banks and governments (as illustrated in previous crises), it would add to the drastic downturn caused by the sum of the other effects.

Summary Assessment of Second Layer Effects

Considering all second-layer effects, the amplification factor for first-layer effects is at least 3 if Cold War 2.0 unfolds within a short time frame. Being conservative and using a factor of 3, the Cold War 2.0 downturn for Switzerland is already clearly above its biggest annual real GDP losses from the 2008/2009 global financial crisis and Covid recessions. However, unlike recessions, which are generally followed by above-average growth, recovery from dramatic global trade disruptions could be extremely slow, with a large share of income losses remaining permanent. If Cold War 2.0 unfolds gradually, the losses will be smaller, decreasing as economies have more time to adjust. However, they will remain significant nonetheless.

6.2 Trump Tariffs

In this section, we explore the economic consequences of the US imposing various import restrictions. We vary the size of tariffs, time frame, and assumptions about retaliation. Throughout, we model trade barriers as icebergs, so our analysis ignores the potential effects from tariff revenue (which we effectively assume is wasted) and tax distortions. Unlike in the Cold War 2.0 scenario where trade barriers applied to all goods and services, we here assume that icebergs only apply to goods: agriculture, fishing, mining, manufacturing, and wholesale/retail trade.²⁴

6.2.1 General Tariffs on US Imports: First Layer

We first consider the model-based implications of the US imposing universal tariffs on its goods imports from around the world. Figure 9 shows the results for a 20% iceberg on exports from all countries to the US. The bars compare the long- and short-run effects, assuming either no retaliation or 20% retaliation by the EU.

For Switzerland, the long-run effect on real income is -0.19% (-0.18% with EU retaliation), and the impact is more than halved in the short run.²⁵

The biggest losses are in Canada, Mexico, Ireland, and the US itself, which suffers short-run losses of around 1.6% (and long-run losses of around 1.1%). Net exporters to the US (including Switzerland) experience smaller impacts in the short run. Initially, it is difficult for the US to substitute away from imports, whereas in the higher trade elasticity long run, the US can more easily switch to domestic inputs and goods. Consequently, the pattern is reversed for the US, which has larger losses in the short

²⁴That is, all A codes, B codes, and C codes, as well as code G, in Appendix Table 2.

²⁵For this scenario, the update to 2024 trade patterns is particularly important. Accounting for a rising Swiss export share to the US since 2019, a back-of-the-envelope suggests the Swiss loss of 0.19% should be amplified by a factor of 1.2 (up to around 0.23). At current levels of Swiss GDP per capita, the total loss translates into at least the 200 CHF per capita per year we reported in Section 3 and in the KOF news feed on October 30, 2024 (https://kof.ethz.ch/en/news-and-events/kof-news0 /2024/10/trade-tariffs.html).

Appendix Table 5 also shows the real income changes for a 25% unreciprocated US tariff on all countries. In that case, the change for Switzerland with the 2024 amplification factor is around -0.28%.



Figure 9: Trump Tariffs

Note: In the scenario, the US puts 20% icebergs on goods exports from all countries. "EU Retaliation" means the countries of the European Union also put 20% icebergs on goods exports from the US. "Short Run" means we set the trade elasticities ($\theta_k - 1$) to 0.5, instead of using the values from Appendix Table 2. "ROE" means Rest-of-EU, "LAA" is a subset of Latin American economies, "EEA" is a subset of east Asian economies, "AFR" is a subset of African economies, and "ROW" means Rest-of-World. The Intermediate Cost Ratio is defined to be the Swiss industry-specific intermediate good input costs divided by the sales price.

run.

Though the net loss for Switzerland is relatively small, there is heterogeneity across sectors, with Switzerland experiencing substantial declines in real income in some of its key industries over the long term. Pharma contracts by more than 1.8%, machinery shows a loss of around 0.9%, and the other key industries are also at risk (except finance, which is not directly affected by the tariff and could even experience a long-term gain).²⁶ Machinery, precision devices, and chemicals benefit in terms of real income in the short run.

Figure 10 also illustrates general US tariffs but considers retaliation by all countries (including Switzerland) and varies the size of the iceberg. The overall pattern is similar

²⁶The global contraction appears to reduce intermediate input costs for the Swiss finance industry.



Figure 10: Trump Tariffs

Note: In the scenario, the US puts 10% or 20% icebergs on goods exports from all countries. "All Retaliate" means all countries put the same icebergs on exports from the US. "ROE" means Rest-of-EU, "LAA" is a subset of Latin American economies, "EEA" is a subset of east Asian economies, "AFR" is a subset of African economies, and "ROW" means Rest-of-World. The Intermediate Cost Ratio is defined to be the Swiss industry-specific intermediate good input costs divided by the sales price.

to one we have just described, except that retaliation by all countries (vs. EU only) greatly amplifies losses in many places, which is not surprising since the US is a major exporter. With full retaliation against the US, some of the long-term real income changes for a 20% iceberg are -0.29% (Switzerland), -1.50% (US), -2.75% (Mexico), -2.05% (Canada), and -1.25% (Ireland). In this case, real income in Swiss pharma falls by more than 2.5% and machinery by almost 0.9% (without retaliation). Even though chemicals are included in the tariffs, this industry experiences income gains in Switzerland when there is global retaliation against the US, presumably because some demand switches to Switzerland.

6.2.2 General Tariffs on US Imports: Second Layer

Also for Trump tariffs we expect significant second-layer effects for which we provide a brief account here. Unmodeled appreciation of the dollar relative to the main US trading partners could further offset the impact of tariffs, and a new push by trading partners for FDI in the US is another possible effect. Yet, we expect the most significant second-layer effects from two other forces. First, with general tariffs and retaliation of this magnitude, the associated income losses are significant, and Keynesian effects could amplify the downturn by at least 30%. Second, we expect substantial unmodeled disruptions of supply chains, in particular the complex supply chain networks integrating the US economy with Mexico and Canada. The structure of supply chains running through Europe could also be stressed, perhaps causing firm exit or even default, and all of these factors together would likely dampen growth.

Finally, we note that even with tariffs of the magnitude in our scenario, which are against *all* trading partners, only a small fraction of US federal spending can be financed. Rough calculations show that the share of federal spending that can be financed is less than 10%.²⁷

6.2.3 US/China Trade War: First Layer

Next, we explore the consequences, according to the model, of an escalating trade war between the US and China alone. Figure 11 shows the effects of a 10% or 60% US iceberg on imports from China, both with and without equivalent retaliation from China.

While the real income effects are non-trivial for the US and China (-0.42%) and -0.34%, respectively, for 60\% with retaliation), the impact is negligible for most other countries (including Switzerland), and Mexico and Vietnam experience signif-

 $^{^{27}}$ With current data on goods trade and the federal budget one would obtain a number close to 10%. Yet, imports will decline once tariffs are enacted, lowering this number significantly below 10%. For trade and federal budget data see Bureau of Economic Analysis (2025), and for the federal budget see Congressional Budget Office (2025).


Figure 11: Trump Tariffs

Note: In the scenario, the US puts 10% or 60% icebergs on goods exports from China. "Retaliation" means China puts the same icebergs on exports from the US. "ROE" means Rest-of-EU, "LAA" is a subset of Latin American economies, "EEA" is a subset of east Asian economies, "AFR" is a subset of African economies, and "ROW" means Rest-of-World. The Intermediate Cost Ratio is defined to be the Swiss industry-specific intermediate good input costs divided by the sales price.

icant gains.

The Swiss precision devices sector substantially benefits (nearly 0.6% in real income with a 60% retaliated tariff), due to demand switching to Switzerland: Swiss exports expand in this sector and sales prices rise relative to the cost of intermediate inputs. Swiss chemicals also benefit but to a lesser degree.

Finally, Figure 12 shows the long- and short-term effects for a full-blown US/China trade war with reciprocated 300% icebergs on all goods and services. Here, the impacts are quite substantial for the US and China, especially in the short run (-2.23% and -1.52%, respectively). Switzerland experiences significant gains in precision devices, machinery, and chemicals, particularly in the short term. However, falling demand from economic contraction in the US and China leads to income losses in Swiss finance and pharma (a change of around -0.4% in the short run).





Note: In the scenario, the US and China put 300% icebergs on each other's exports (all goods and services). "Short Run" means we set the trade elasticities ($\theta_k - 1$) to 0.5, instead of using the values from Appendix Table 2. "ROE" means Rest-of-EU, "LAA" is a subset of Latin American economies, "EEA" is a subset of east Asian economies, "AFR" is a subset of African economies, and "ROW" means Rest-of-World. The Intermediate Cost Ratio is defined to be the Swiss industry-specific intermediate good input costs divided by the sales price.

6.2.4 US/China Trade War: Second Layer

A trade war between China and the US could once again trigger second-layer effects, though these would be less pronounced than in a scenario where tariffs apply to all trading partners. However, with tariffs reaching 60% or a full-blown trade war, both the US and Chinese economies could experience economic contractions significantly amplified beyond the results of the model. Trade barriers of this magnitude would also disrupt supply chains, with spillover effects extending globally. While most countries outside the US and China either benefit or remain unaffected in the model, secondlayer effects from such large barriers could turn many into net losers. Even beneficiaries like Mexico and Vietnam, who profit from trade diversions, might see their advantages erased once all effects are considered.

6.2.5 Other Trump Scenarios

As the Trump presidency has unfolded in 2025, we have also considered more topical scenarios, although, as of writing, high uncertainty remains regarding the extent and permanence of new US trade barriers. Appendix Table 6 shows effects on real income and real exports for the following scenarios:

- 1. 25% US iceberg on all goods from Canada and Mexico, who retaliate equivalently
- 2. 10% US iceberg on all goods from China, who retaliates with 5%
- 3. 25% US iceberg on all goods from the EU (without retaliation)
- 25% US iceberg on all goods from the EU, who retaliates with 25% on all other countries
 - The EU does not retaliate in mining (ISIC codes B05_06, B07_08, and B09) or coke and petroleum (ISIC code C19).
- 5. 25% US icebergs on all imports in the following industries:
 - Wood and products of wood cork (ISIC code C16)





Note: In the scenario, the US puts 25% icebergs on goods exports from the EU. The EU reciprocates on all countries, except in mining and energy sectors (ISIC codes B05_06, B07_08, B09, and C19). "Short Run" means we set the trade elasticities ($\theta_k - 1$) to 0.5, instead of using the values from Appendix Table 2. "ROE" means Rest-of-EU, "LAA" is a subset of Latin American economies, "EEA" is a subset of east Asian economies, "AFR" is a subset of African economies, and "ROW" means Rest-of-World. The Intermediate Cost Ratio is defined to be the Swiss industry-specific intermediate good input costs divided by the sales price.

- Pharmaceuticals, medicinal chemical and botanical products (ISIC code C21)
- Computer, electronic and optical equipment (ISIC code C26)
- Motor Vehicles, trailers and semi-trailers (ISIC code C29)

Of particular relevance for Switzerland is the fourth scenario in which the EU responds to the US by effectively retrenching and putting barriers not just on the US but also on Switzerland (and everyone else), with mining and energy excepted. The results for this scenario are in Figure 13, and we see that the real income loss for Switzerland is large (1.11% in the long run). There is a strong negative effect in Europe overall, especially in Ireland and Poland.

6.3 Disruption of Critical Inputs from China

6.3.1 Disruption of Critical Inputs: First Layer

Building on our discussion from Section 6.1.2, we examine the effects of a major disruption of Chinese exports in several key industries. Figure 14 shows the impact of all countries putting a 300% iceberg on Chinese exports in mining (B05_06, B07_08, and B09), chemicals (C20), other non-metallic minerals (C23), and precision devices (C26). While the net impact is not devastating for any economy, most countries experience significant effects on real income, which is perhaps surprising since the shock is specific to a few Chinese industries. The largest real income losses (in excess of 0.5%) are in Australia, China, and Latin America. The biggest gains are in Switzerland (+0.46%) and Ireland (+0.69%). The gains in Switzerland are driven by a massive increase in demand in the precision devices and chemicals sectors, even though both experience intermediate cost spikes. On the other hand, Switzerland sees large income losses in machinery and pharma (which are offset by the gains in precision devices and chemicals).

6.3.2 Disruption of Critical Inputs: Second Layer

Although the disruption of critical inputs from China does not have devastating effects on most countries –and some, like Switzerland, even benefit – important second-layer effects must be considered. In particular, as in Cold War 2.0, we anticipate significant disruptions to global and Swiss production. The rough back-of-the-envelope calculation from Section 6.1.2 suggests that these second-layer effects could entirely offset Switzerland's initial gains. Furthermore, additional supply chain disruptions worldwide and amplification of downturns in other countries could push Switzerland's income change firmly into negative territory.



Figure 14: Disruption of Critical Inputs from China

Note: In the scenario, all countries put 300% icebergs on several critical inputs exported by China: mining (B05_06, B07_08, and B09), chemicals (C20), other non-metallic minerals (C23), and precision devices (C26). "ROE" means Rest-of-EU, "LAA" is a subset of Latin American economies, "EEA" is a subset of east Asian economies, "AFR" is a subset of African economies, and "ROW" means Rest-of-World. The Intermediate Cost Ratio is defined to be the Swiss industry-specific intermediate good input costs divided by the sales price.



Figure 15: Pharma Shock

Note: In the scenario, all countries put a 300% iceberg on China's pharmaceutical exports. "ROE" means Rest-of-EU, "LAA" is a subset of Latin American economies, "EEA" is a subset of east Asian economies, "AFR" is a subset of African economies, and "ROW" means Rest-of-World. The Intermediate Cost Ratio is defined to be the Swiss industry-specific intermediate good input costs divided by the sales price.

6.4 Pharma Shock

6.4.1 Pharma Shock: First Layer

Building on our discussion of Chinese APIs in Section 6.1.2, Figure 15 illustrates a major disruption of pharmaceutical exports from China. Specifically, we suppose that all countries put 300% icebergs on Chinese pharmaceutical exports. For Switzerland, this does indeed raise the intermediate input costs in pharma, but sales prices rise even more, as demand moves to Switzerland. Real exports in Swiss pharma rise by around 0.3%, and real income increases by more than 1%. The effect is even more dramatic for Ireland, another major exporter of pharmaceuticals, which experiences a total rise in real income of more than 0.1% just from the Chinese pharma shock.

Also for the pharma shock, there can be second-layer effects. In particular, since Swiss pharma companies depend on critical inputs from suppliers in China, there may be difficulties, on the extensive margin, in producing particular products at all. A more detailed assessment of the second-layer effects is left for future research, but they appear to be substantial and could undo much of the positive impact in Switzerland.

7 Conclusion

In this paper, we employ recent advances in quantitative trade theory to evaluate the potential effects of hypothetical global trade disruptions. We have focused especially on the resilience of the small open economy of Switzerland, but we also provide estimates for 33 other economies. In addition to reporting the results from our equilibrium model, we also draw upon the broader literature to provide context and describe the extent to which our estimates are lower or upper bounds.

The potential overall and sectoral losses to Switzerland are not small in absolute terms across our scenarios, but neither are they catastrophic. In our Cold War 2.0 scenario, for example, the real income loss for Switzerland is 1.12%, vs. 1.60% for Germany, 1.73% for Denmark, 1.98% for Ireland, and 2.65% for China. The sectoral effects in Switzerland depend critically on the particular scenario, but some global trade disruptions are an opportunity for Swiss precision devices and chemicals. In contrast, Swiss pharma and machinery appear somewhat vulnerable. Across various US tariff scenarios, the real income effect for Switzerland varies from a small gain to -1.11% (in the scenario where the EU responds to Trump tariffs with broad barriers that also apply to Switzerland).

For the US, the tariff scenarios we consider lead to sizable real income losses. For example, the model suggests that the US could easily lose upwards of 1.5% of real income, depending on the time frame considered and the response of other countries. As we have emphasized throughout this paper, the effects captured by a global trade network model can be amplified by second-layer effects, with the magnitude of this amplification depending on the specific trade disruption scenario. Therefore, a comprehensive assessment of an economy's resilience – such as that of Switzerland – must account for both first- and second-layer effects.

While our analysis focuses on quantifying the economic impact of trade disruptions globally and on Switzerland in particular, our findings provide a foundation for discussing how Swiss economic resilience can be strengthened and the role of government in this process. Key policy levers include free trade agreements to foster diversification and de-risking strategies, supply security frameworks, and a resilient innovation system. Future research could use our framework to examine how policy changes in these areas affect the resilience of the Swiss economy or other economies.

Finally, there are important avenues for extending the model further. Endogenous current account reactions to tariffs, nominal price rigidities, New Keynesian-type reactions to geopolitical shocks, labor mobility, and capital accumulation in a dynamic version would be natural directions to pursue.

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A Computing the Effect of Shocks

In this section, we use the method of Baqaee and Farhi (2024) to compute how equilibrium changes in response to iceberg shocks, and we offer a matrix version of their Theorem 3 specialized to our particular economy.²⁸ First, we show how equilibrium changes in response to small arbitrary changes in icebergs. Next, we explain how to calculate the effect of small productivity shocks by showing they are equivalent to particular icebergs. Finally, we show how to globally approximate the effect of large shocks using Euler's numerical integration method. In short, the strategy is to characterize analytically the derivative of the equilibrium system and then numerically integrate over the first-order changes to get an exact solution.

A.1 Derivatives

At the consumer optimum, it is straightforward to show that the utility of representative consumer $c \in C$ is equal to real income I^c/P^c . Therefore, for a small shock the percent change in utility U^c (1) is

$$d\log U^c = d\log I^c - d\log P^c.$$

Since labor supply is fixed, the first term is

$$d\log I^c = \sum_{k \in N} \left(\frac{w^{kc} L^{kc}}{I^c}\right) d\log w^{kc}$$
(7)

 $^{^{28}}$ Our model has a structure similar to the one used for quantitative exercises in Baqaee and Farhi (2024) and Bachmann et al. (2024). Our notation and exposition are based in part on Çakmakh et al. (2021).

Let w (without superscripts) be the $CN \times 1$ vector of wages for the world (stacking the wages of country 1, country 2, and so on). Let \mathcal{F}^c be the $1 \times N$ vector of labor income shares $w^{kc}L^{kc}/I^c$ for each country, and define the $C \times CN$ matrix of world labor income shares

$$\mathcal{F} = \begin{pmatrix} \mathcal{F}^1 & 0 & 0 & 0 \\ 0 & \mathcal{F}^2 & 0 & \vdots \\ \vdots & 0 & \ddots & 0 \\ 0 & \cdots & 0 & \mathcal{F}^C \end{pmatrix}.$$

Then letting I be the vector of country incomes, the matrix version of Equation 7 is

$$d\log I = \mathcal{F}d\log w. \tag{8}$$

Since \mathcal{F} can be constructed from data, we can compute the change in equilibrium nominal income if we know the change in wages.

To get the change in real income (welfare), we need to figure out the change in the consumer price indexes P^c . And it turns out you can solve for all price changes as a linear function of $d \log w$. So if we want to compute the change in welfare from a change in icebergs (the τ 's), we just need to compute the change in equilibrium nominal wages. Conveniently, as Baqaee and Farhi (2024) show, the changes in the equilibrium equations reduce to a linear system for the change in wages.

The first step is to show that price changes from small changes in icebergs are a linear function of $d \log w$, but this requires more notation. Let $d \log P$ be the vector of price

changes ordered as follows:

$$d\log P = \begin{pmatrix} \overrightarrow{d \log P^c} \\ \overrightarrow{d \log P^{kc}} \\ \overrightarrow{d \log P_k^c} \\ \overrightarrow{d \log P_k^c} \\ \overrightarrow{d \log P_j^{kc}} \\ \overrightarrow{d \log P_k^{kc}} \end{pmatrix}$$

where $\overrightarrow{d \log P^c}$ is the vector of consumer price index changes across countries, $\overrightarrow{d \log P^{kc}}$ is the vector of aggregate intermediate price changes across countries and industries, $\overrightarrow{d \log P_k^c}$ is the vector of prices changes for composite intermediates in the consumption sector across countries and industries, $\overrightarrow{d \log P_j^{kc}}$ is the vector of price changes for composite intermediates in the production sector across countries and industries, and $\overrightarrow{d \log p_{kc}}$ is the vector of raw intermediate price changes across countries and industries, and $\overrightarrow{d \log p_{kc}}$ is the vector of raw intermediate price changes across countries and industries. $\overrightarrow{d \log P_j^{kc}}$, for example, is $CN^2 \times 1$, and the whole vector has length $\mathcal{N} = C(1 + N + N + N^2 + N)$ (the number of firms and consumers). In words, the order is (1) consumer price indexes, (2) aggregate intermediates, (3) consumer composite intermediates, (4) producer composite intermediates, and (5) raw intermediates.

Next, let $G_{cc'}$ be the $N \times N$ matrix of iceberg changes when the composite consumption intermediates in country c import from the raw intermediates from country c'. This is a diagonal matrix with $d \log \tau_{jc'}^c$ on the diagonal and zeros elsewhere. Let $H_{c'}^{kc}$ be the $N \times N$ matrix of iceberg changes when the composite intermediate firms from industry k of country c buy raw intermediates from country c'. This is a diagonal matrix with $d \log \tau_{jc'}^{kc}$ on the diagonal and zeros elsewhere. Using those we define the matrices of iceberg changes in the consumption and production sector

$$d \log \tau^{cons} = \begin{pmatrix} G_{11} & G_{12} & \dots & G_{1C} \\ G_{21} & \ddots & \dots & G_{2C} \\ \vdots & \dots & \ddots & \vdots \\ G_{C1} & \dots & \dots & G_{CC} \end{pmatrix}, \qquad d \log \tau^{prod} = \begin{pmatrix} H_1^{11} & H_2^{11} & \dots & H_C^{11} \\ H_1^{21} & H_2^{21} & \dots & H_C^{21} \\ \vdots & \vdots & \ddots & \vdots \\ H_1^{N1} & H_2^{N1} & \dots & H_C^{N1} \\ H_1^{12} & H_2^{12} & \dots & H_C^{N1} \\ \vdots & \vdots & \ddots & \vdots \\ H_1^{NC} & H_2^{NC} & \dots & H_C^{NC} \end{pmatrix}$$

which are respectively $CN \times CN$ and $CN^2 \times CN$. Defined the matrix

which is $\mathcal{N} \times \mathcal{N}$.

Now we define the expenditure share matrices. Let Ω_c^{cons} be the $1 \times N$ vector of expenditure shares of consumer c on composite consumption intermediates $P_k^c x_k^c / I^c$. Similarly, we define Ω_{kc}^{prod} be the $1 \times N$ vector of expenditure shares of the aggregate intermediate firm k in country c on composite intermediates $P_j^{kc} x_j^{kc} / (P^{kc} X^{kc})$. Using those we define the expenditure share matrices

$$\Omega^{cons} = \begin{pmatrix} \Omega_{1}^{cons} & 0 & 0 & 0 \\ 0 & \Omega_{2}^{cons} & 0 & \vdots \\ \vdots & 0 & \ddots & 0 \\ 0 & \dots & 0 & \Omega_{C}^{cons} \end{pmatrix},$$

$$\Omega^{prod} = \begin{pmatrix} \Omega_{11}^{prod} & 0 & 0 & 0 & 0 & 0 \\ 0 & \Omega_{21}^{prod} & 0 & \vdots & \vdots & \vdots \\ 0 & 0 & \ddots & 0 & \vdots & \vdots & \vdots \\ 0 & \dots & 0 & \Omega_{N1}^{prod} & 0 & \vdots & \vdots \\ 0 & \dots & \dots & 0 & \Omega_{12}^{prod} & 0 & \vdots \\ 0 & \dots & \dots & 0 & \Omega_{NC}^{prod} \end{pmatrix},$$

respectively of size $C \times CN$ and $CN \times CN^2$.

The expenditure share matrices for the composite intermediates have a slightly different shape. For any two countries c, c', let $A_{cc'}$ be the $N \times N$ matrix of the expenditure share of consumption composite intermediates in country c on raw intermediates from country c'. This is a diagonal matrix with $(\tau_{kc'}^c p_{kc'} y_{kc'}^c)/(P_k^c x_k^c)$ on the diagonal and zeros elsewhere.

For any industry k and two countries c, c', we define $B_{c'}^{kc}$ to be the $N \times N$ matrix of the expenditure share of the production composite intermediates of industry k in country c on raw intermediates from country c'. This is a diagonal matrix with $(\tau_{jc'}^{kc}p_{jc'}y_{jc'}^{kc})/(P_j^{kc}x_j^{kc})$ on the diagonal and zeros elsewhere. Using those matrices, we define the expenditure share matrix of consumption composite intermediates on raw intermediates as well as the expenditure share matrix of production composite intermediates on raw intermediates as

$$\Omega^{comp-cons} = \begin{pmatrix} A_{11} & A_{12} & \dots & A_{1C} \\ A_{21} & \ddots & \dots & A_{2C} \\ \vdots & \dots & \ddots & \vdots \\ A_{C1} & \dots & \dots & A_{CC} \end{pmatrix}, \qquad \Omega^{comp-prod} = \begin{pmatrix} B_1^{11} & B_2^{11} & \dots & B_C^{11} \\ B_1^{21} & B_2^{21} & \dots & B_C^{21} \\ \vdots & \vdots & \ddots & \vdots \\ B_1^{N1} & B_2^{N1} & \dots & B_C^{N1} \\ B_1^{12} & B_2^{12} & \dots & B_C^{N1} \\ \vdots & \vdots & \ddots & \vdots \\ B_1^{NC} & B_2^{NC} & \dots & B_C^{NC} \end{pmatrix}$$

respectively of size $CN \times CN$ and $CN^2 \times CN$.

Finally, for any country c, let Ω_c^{raw} be the $N \times N$ matrix of expenditure shares of the raw production sectors in country c on aggregate intermediates in country c. This is a diagonal matrix with entries $(P^{kc}X^{kc})/(p_{kc}y_{kc})$ on the diagonal and zeros elsewhere. The expenditure shares matrix of raw intermediates on aggregate intermediates is defined as

$$\Omega^{raw} = \begin{pmatrix} \Omega_1^{raw} & 0 & \dots & 0 \\ 0 & \Omega_2^{raw} & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \Omega_C^{raw} \end{pmatrix}$$

which is of size $CN \times CN$. The resulting $\mathcal{N} \times \mathcal{N}$ input/output matrix Ω for the world

$$\Omega = \begin{pmatrix} 0 & 0 & \Omega^{cons} & 0 & 0 \\ 0 & 0 & 0 & \Omega^{prod} & 0 \\ 0 & 0 & 0 & 0 & \Omega^{comp-cons} \\ 0 & 0 & 0 & 0 & \Omega^{comp-prod} \\ 0 & \Omega^{raw} & 0 & 0 & 0 \end{pmatrix}$$

•

Finally, let \hat{F} be the diagonal $CN \times CN$ labor expenditure share matrix, which has $w^{kc}l^{kc}/p_{kc}y_{kc}$'s on the diagonal, and define the $\mathcal{N} \times CN$ matrix

$$F = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ \hat{F} \end{pmatrix}.$$

Let **1** be a vector of ones, let \mathcal{I} be the identity matrix, and let \circ be element-by-element multiplication. We can now prove a version of part of Theorem 3 from Baqaee and Farhi (2024).

Proposition 1 (Baqaee and Farhi (2024))

$$d\log P = (\mathcal{I} - \Omega)^{-1} F d\log w + (\mathcal{I} - \Omega)^{-1} (\Omega \circ d\log T) \mathbf{1}$$

Proof. Consider a generic CES producer with production function

$$q = a \left(\sum_{k} u_{k}^{\frac{1}{\gamma}} x_{k}^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}}$$

who faces prices $\tau_k p_k$ and chooses x_k to minimize the cost of producing q. Letting

is

 $\tilde{p} = \left(\sum_{k} u_k \left(\tau_k p_k\right)^{1-\gamma}\right)^{\frac{1}{1-\gamma}}$ and defining $p = \tilde{p}/a$, at the optimum

$$\frac{\tau_k p_k x_k}{pq} = u_k \left(\frac{\tau_k p_k}{\tilde{p}}\right)^{1-\gamma}$$

and p is the marginal cost of producing q. You get the same solution if the production function is a consumption aggregate, and a consumer with income I maximizes its value. In that case, p is the price index and pq = I at the optimum. And you can think of the inputs as labor, in which case the prices are wages.

Noting that $\log p = \frac{1}{1-\gamma} \log \left(\sum_{k} u_k \left(e^{\log \tau_k} p_k \right)^{1-\gamma} \right) - \log a$, we have

$$\frac{\partial \log p}{\partial \log \tau_j} = \frac{\sum_k u_k \left(\tau_k p_k\right)^{-\gamma} \tau_k \frac{\partial p_k}{\partial \log \tau_j}}{\tilde{p}^{1-\gamma}} + \frac{u_j \left(\tau_j p_j\right)^{-\gamma} \tau_j p_j}{\tilde{p}^{1-\gamma}} = \sum_k O_k \frac{\partial \log p_k}{\partial \log \tau_j} + O_j$$

where $O_j = \frac{\tau_k p_k x_k}{pq}$ is the expenditure share, and we used $d \log z/dy = (dz/dy)/z$. It follows that the total derivative is

$$d\log p = \sum_{k} O_k d\log p_k + \sum_{k} O_k d\log \tau_k.$$

This derivative holds for each producer of the model, although only the composite intermediate producers have the second direct iceberg term, and the raw intermediate producers only have two inputs: aggregate intermediates and labor. Returning to the notation of the paper and proposition, explicitly distinguishing between labor and intermediate inputs, and appropriately adding zeros in matrices to represent the structure of the model, the price derivative for the entire economy can be written in matrix form as

$$d\log P = \Omega d\log P + F d\log w + (\Omega \circ d\log T)\mathbf{1}.$$

Solving for $d \log P$ completes the proof.

The next and most difficult step is to use Equation 11 below – sales equal purchases in equilibrium – to write wage changes as a linear function of price changes. Doing so requires defining Domar weights. Letting $Y = \sum_{c \in C} I^c$ be world income, a firm's Domar weight (denoted by λ 's) is its share of world income. For example, the Domar weight for the firm in country c producing composite intermediate j for industry k is $\lambda_j^{kc} = P_j^{kc} x_j^{kc}/Y$, and the Domar weight for the industry k raw intermediate producer in country c is $\lambda_{kc} = p_{kc} y_{kc}/Y$. Let λ be the vector of Domar weights around the world, in the same order as $d \log P$ but excluding the consumers. This vector has size $\mathcal{M} \times 1$ where $\mathcal{M} := C(N + N + N^2 + N)$. The Domar weight for a consumer is $\chi^c = I^c/Y$, and χ is the vector of representative consumer Domar weights. $\Lambda^{kc} = w^{kc} L^{kc}/Y$ is the Domar weight for labor in country c's industry k. Let Λ be the vector of all Domar weights for labor Λ^{kc} and Λ^c be the country specific vector. Since world income is normalized to one (so dY = 0) and labor is fixed, we have $d\chi^c = \sum_{k \in N} \Lambda^{kc} d \log w^{kc}$ and

$$d\chi = \tilde{\Lambda} d\log w,\tag{9}$$

where $\tilde{\Lambda}$ is the $C \times CN$ matrix with Λ^c 's on the diagonal. Another consequence of fixed Y is

$$d\Lambda = \operatorname{diag}(\Lambda^{kc})d\log w,\tag{10}$$

implying the percent change in wages is equal to the percent change in labor Domar weights.

By market clearing, the income of a firm must be equal to expenditure on the firm by consumers and other firms. In other words, letting $\tilde{\Omega}$ be the above input/output matrix but with the first C columns and rows removed (consumption), we must have

$$\lambda' = \chi' \tilde{\Omega}^{cons} + \lambda' \tilde{\Omega} \implies \lambda' = \chi' \tilde{\Omega}^{cons} \Psi, \tag{11}$$

where $\Psi = (\mathcal{I} - \tilde{\Omega})^{-1}$, and $\tilde{\Omega}^{cons}$ is the top *C* rows of Ω after removing the first *C* columns. Using $d\Psi = \Psi d\tilde{\Omega}\Psi$ and Equation 11, we have

$$d\lambda' = d\chi'\tilde{\Omega}^{cons}\Psi + \chi'd\tilde{\Omega}^{cons}\Psi + \chi'\tilde{\Omega}^{cons}d\Psi = (d\chi'\tilde{\Omega}^{cons} + \chi'd\tilde{\Omega}^{cons} + \lambda'd\tilde{\Omega})\Psi.$$
 (12)

And let \tilde{F} be F with the first C rows removed. Then $\Lambda = \tilde{F}' \lambda$ and

$$d\Lambda' = d\lambda' \tilde{F} + \lambda' d\tilde{F}.$$
(13)

Suppose we can write $\lambda' d\tilde{F}$, $\chi' d\tilde{\Omega}^{cons}$, and $\lambda' d\tilde{\Omega}$ as linear functions of $d \log P$ and $d \log w$. Then with Proposition 1 and Equations 9, 10, 12, and 13, we can derive and solve a linear equation for $d \log w$. The next proposition (again corresponding to Theorem 3 of Baqaee and Farhi (2024)) writes $\lambda' d\tilde{F}$, $\chi' d\tilde{\Omega}^{cons}$, and $\lambda' d\tilde{\Omega}$ as linear functions of $d \log P$ and $d \log w$.

Proposition 2

1.
$$\lambda' d\tilde{F} = d \log w' \operatorname{diag}((1-\theta)\Lambda^{kc}) - d \log P' \Phi_A$$
, where

$$\Phi_A = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ \mathrm{diag}((1-\theta)\Lambda^{kc}) \end{bmatrix}$$

is $\mathcal{N} \times CN$

2. $\chi' d\tilde{\Omega}^{cons} = d \log P' \Phi_B$ where

is $\mathcal{N} \times \mathcal{M}$

3. $\lambda' d\tilde{\Omega} = d \log P' \Phi_C + \mathbf{1}' \Phi_D$ where

where ν has size $1 \times CN$ and is given by $[1 - \theta_k]_{kc}$. The vector μ is of size $CN \times 1$ and is given by ν' . Moreover, the first matrix has size $\mathcal{N} \times \mathcal{M}$ and the second matrix $\mathcal{N} \times \mathcal{M}$

Remark 1

In the proof that follows, it will sometimes be difficult to distinguish between vectors/matrices and the values inside of them. For example, λ_{kc} could both refer to the $CN \times 1$ vector of Domar weights or to the value $p_{kc}y_{kc}/Y$. In general, it should be possible to infer from the context what is meant. However, sometimes, to make sure everything is clear we will use the following notation. If a_k are some values indexed over $k \in I$ where I can be both explicit or implicit, then $[a_k]_k$ will refer to the row vector with entries a_k .

Moreover, previously, we defined \circ as the element-wise multiplication of matrices. We

extend this operation slightly. If A is an $n \times m$ matrix and v an $n \times 1$ vector, then, v \circ A will be taken to mean element-wise multiplication of v with each column of A. Similarly, if v is an $1 \times m$ vector, then, $v \circ A$ will be taken to mean element-wise multiplication of v with each row of A.

Proof. Recall that

$$d\log P' = [d\log P^{c'}, d\log P^{kc'}, d\log P^{kc'}_k, d\log P^{kc'}_j, d\log p_{kc'}].$$

Concerning the first part, we begin by observing that

$$\lambda' d\tilde{F} = \begin{bmatrix} \lambda^{kc'} & \lambda^{c'}_k & \lambda^{kc'}_j & \lambda_{kc'} \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 & d\hat{F} \end{bmatrix}^T = \lambda_{kc'} d\hat{F}$$
$$= \begin{bmatrix} \lambda_{kc} d\left(\frac{w^{kc} L^{kc}}{p_{kc} y_{kc}}\right) \end{bmatrix}_{kc}.$$

By CES in raw production (6), labor demand is $\frac{w^{kc}L^{kc}}{p_{kc}y_{kc}} = \alpha^{kc} \left(\frac{w^{kc}}{A^{kc}p_{kc}}\right)^{1-\theta}$. It follows

$$d\left(\frac{w^{kc}L^{kc}}{p_{kc}y_{kc}}\right) = d\left(\alpha^{kc}\left(\frac{w^{kc}}{A^{kc}p_{kc}}\right)^{1-\theta}\right)$$
$$= \frac{\alpha^{kc}}{(A^{kc})^{1-\theta}} \frac{(1-\theta)(w^{kc})^{1-\theta}p_{kc}^{1-\theta}d\log w^{kc} - (1-\theta)(w^{kc})^{1-\theta}p_{kc}^{1-\theta}d\log p_{kc}}{p_{kc}^{2(1-\theta)}}$$
$$= (1-\theta)\alpha^{kc}\left(\frac{w^{kc}}{A^{kc}p_{kc}}\right)^{1-\theta} \left(d\log w^{kc} - d\log p_{kc}\right)$$
$$= (1-\theta)\frac{w^{kc}L^{kc}}{p_{kc}y_{kc}} \left(d\log w^{kc} - d\log p_{kc}\right)$$

and thus

$$\lambda_{kc}d\left(\frac{w^{kc}L^{kc}}{p_{kc}y_{kc}}\right) = (1-\theta)\frac{w^{kc}L^{kc}}{Y}\left(d\log w^{kc} - d\log p_{kc}\right) = (1-\theta)\Lambda^{kc}\left(d\log w^{kc} - d\log p_{kc}\right)$$

and we are done.

For the second part, we get by definition that

$$\chi' d\tilde{\Omega}^{cons} = \chi' \begin{bmatrix} 0 & d\Omega^{cons} & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & \left[\frac{I^c}{Y} d\left(\frac{P_k^c x_k^c}{I^c} \right) \right]_{kc} & 0 & 0 \end{bmatrix}.$$

By CES, consumer demand is $\frac{P_k^c x_k^c}{I^c} = b_k^c \frac{(P_k^c)^{1-\sigma}}{(P^c)^{1-\sigma}}$, and it follows

$$\begin{aligned} d\left(\frac{P_{k}^{c}x_{k}^{c}}{I^{c}}\right) &= d\left(b_{k}^{c}\frac{(P_{k}^{c})^{1-\sigma}}{(P^{c})^{1-\sigma}}\right) \\ &= b_{k}^{c}\frac{(P^{c})^{1-\sigma}(1-\sigma)(P_{k}^{c})^{1-\sigma}d\log P_{k}^{c} - (P_{k}^{c})^{1-\sigma}(1-\sigma)(P^{c})^{1-\sigma}d\log P^{c})}{(P^{c})^{2(1-\sigma)}} \\ &= b_{k}^{c}(1-\sigma)\left(\frac{P_{k}^{c}}{P^{c}}\right)^{1-\sigma}\left(d\log P_{k}^{c} - d\log P^{c}\right) \\ &= (1-\sigma)\frac{P_{k}^{c}x_{k}^{c}}{I^{c}}\left(d\log P_{k}^{c} - d\log P^{c}\right). \end{aligned}$$

Accordingly, we get

For the third part, it follows by definition that

$$\lambda' d\tilde{\Omega} = \begin{bmatrix} \lambda^{kc'} & \lambda^{c'}_k & \lambda^{kc'}_j & \lambda_{kc'} \end{bmatrix} \begin{bmatrix} 0 & 0 & d\Omega^{prod} & 0 \\ 0 & 0 & 0 & d\Omega^{comp-cons} \\ 0 & 0 & 0 & d\Omega^{comp-prod} \\ d\Omega^{raw} & 0 & 0 & 0 \end{bmatrix}$$
$$= \begin{bmatrix} \lambda_{kc}' d\Omega^{raw} & 0 & \lambda^{kc'} d\Omega^{prod} & \lambda^{c'}_k d\Omega^{comp-cons} + \lambda^{kc'}_j d\Omega^{comp-prod} \end{bmatrix}.$$

Using the definition, it holds that

$$\lambda_{kc}' d\Omega^{raw} = \left[\frac{p_{kc}y_{kc}}{Y} d\left(\frac{P^{kc}X^{kc}}{p_{kc}y_{kc}}\right)\right]_{kc}, \qquad \lambda^{kc'} d\Omega^{prod} = \left[\frac{P^{kc}X^{kc}}{Y} d\left(\frac{P_j^{kc}x_j^{kc}}{P^{kc}X^{kc}}\right)\right]_{kcj}$$
$$\lambda_k^{c'} d\Omega^{comp-cons} + \lambda_j^{kc'} d\Omega^{comp-prod} = \left[\sum_{\tilde{c}} \frac{P_k^{\tilde{c}}x_k^{\tilde{c}}}{Y} d\left(\frac{\tau_{kc}^{\tilde{c}}p_{kc}y_{kc}^{\tilde{c}}}{P_k^{\tilde{c}}x_k^{\tilde{c}}}\right) + \sum_{j,\tilde{c}} \lambda_k^{j\tilde{c}} d\left(\frac{\tau_{kc}^{j\tilde{c}}p_{kc}y_{kc}^{j\tilde{c}}}{P_k^{j\tilde{c}}x_k^{j\tilde{c}}}\right)\right]_{kc}.$$

We compute each part separately. Again by CES demand in raw production, it follows

$$d\left(\frac{P^{kc}X^{kc}}{p_{kc}y_{kc}}\right) = (1 - \alpha^{kc})d\left(\frac{(P^{kc})^{1-\theta}}{(A^{kc}p_{kc})^{1-\theta}}\right)$$
$$= (1 - \theta)(1 - \alpha^{kc})\left(\frac{(P^{kc})^{1-\theta}}{(A^{kc}p_{kc})^{1-\theta}}\right)\left(d\log P^{kc} - d\log p_{kc}\right)$$
$$= (1 - \theta)\frac{P^{kc}X^{kc}}{p_{kc}y_{kc}}\left(d\log P^{kc} - d\log p_{kc}\right).$$

Then using CES demand in the production of aggregate intermediates we get

$$d\left(\frac{P_j^{kc} x_j^{kc}}{P^{kc} X^{kc}}\right) = \omega_j^{kc} d\left(\frac{(P_j^{kc})^{1-\epsilon}}{(P^{kc})^{1-\epsilon}}\right)$$
$$= \omega_j^{kc} \left(\frac{P_j^{kc}}{P^{kc}}\right)^{1-\epsilon} (1-\epsilon) \left[d\log P_j^{kc} - d\log P^{kc}\right]$$
$$= \frac{P_j^{kc} x_j^{kc}}{P^{kc} X^{kc}} (1-\epsilon) \left[d\log P_j^{kc} - d\log P^{kc}\right].$$

CES demands for composite consumption importing implies

$$d\left(\frac{\tau_{kc}^{\tilde{c}}p_{kc}y_{kc}^{\tilde{c}}}{P_{k}^{\tilde{c}}x_{k}^{\tilde{c}}}\right) = \delta_{kc}^{\tilde{c}}d\left(\frac{(\tau_{kc}^{\tilde{c}}p_{kc})^{1-\theta_{k}}}{(P_{k}^{\tilde{c}})^{1-\theta_{k}}}\right)$$

= $(1-\theta_{k})\delta_{kc}^{\tilde{c}}\left(\frac{\tau_{kc}^{\tilde{c}}p_{kc}}{P_{k}^{\tilde{c}}}\right)^{1-\theta_{k}}\left[d\log p_{kc} + d\log \tau_{kc}^{\tilde{c}} - d\log P_{k}^{\tilde{c}}\right]$
= $(1-\theta_{k})\frac{\tau_{kc}^{\tilde{c}}p_{kc}y_{kc}^{\tilde{c}}}{P_{k}^{\tilde{c}}x_{k}^{\tilde{c}}}\left[d\log p_{kc} + d\log \tau_{kc}^{\tilde{c}} - d\log P_{k}^{\tilde{c}}\right].$

And finally the CES import demands of the composite intermediate firms on the production side give

$$\begin{aligned} d\Big(\frac{\tau_{kc}^{j\tilde{c}}p_{kc}y_{kc}^{j\tilde{c}}}{P_{k}^{j\tilde{c}}x_{k}^{j\tilde{c}}}\Big) &= \delta_{kc}^{j\tilde{c}}d\Big(\frac{(\tau_{kc}^{j\tilde{c}}p_{kc})^{1-\theta_{k}}}{(P_{k}^{j\tilde{c}})^{1-\theta_{k}}}\Big) \\ &= (1-\theta_{k})\delta_{kc}^{j\tilde{c}}\Big(\frac{\tau_{kc}^{j\tilde{c}}p_{kc}}{P_{k}^{j\tilde{c}}}\Big)^{1-\theta_{k}}\Big[d\log p_{kc} + d\log \tau_{kc}^{j\tilde{c}} - d\log P_{k}^{j\tilde{c}}\Big] \\ &= (1-\theta_{k})\frac{\tau_{kc}^{j\tilde{c}}p_{kc}y_{kc}^{j\tilde{c}}}{P_{k}^{j\tilde{c}}x_{k}^{j\tilde{c}}}\Big[d\log p_{kc} + d\log \tau_{kc}^{j\tilde{c}} - d\log P_{k}^{j\tilde{c}}\Big]. \end{aligned}$$

Accordingly, it follows

$$\begin{split} (\lambda_{k}^{c})'d\Omega^{comp-cons} &+ (\lambda_{j}^{kc})'d\Omega^{comp-prod} \\ &= \Big[(1-\theta_{k}) \Big(\sum_{\tilde{c}} \frac{\tau_{kc}^{\tilde{c}} p_{kc} y_{kc}^{\tilde{c}}}{Y} (d\log p_{kc} + d\log \tau_{kc}^{\tilde{c}} - d\log P_{k}^{\tilde{c}}) \\ &+ \sum_{j\tilde{c}} \frac{\tau_{kc}^{j\tilde{c}} p_{kc} y_{kc}^{j\tilde{c}}}{Y} (d\log p_{kc} + d\log \tau_{kc}^{j\tilde{c}} - d\log P_{k}^{j\tilde{c}})) \Big]_{kc} \\ &= \Big[(1-\theta_{k}) \big(\lambda_{kc} d\log p_{kc} + \\ &\sum_{\tilde{c}} \frac{\tau_{kc}^{\tilde{c}} p_{kc} y_{kc}^{\tilde{c}}}{Y} (d\log \tau_{kc}^{\tilde{c}} - d\log P_{k}^{\tilde{c}}) + \sum_{j\tilde{c}} \frac{\tau_{kc}^{j\tilde{c}} p_{kc} y_{kc}^{j\tilde{c}}}{Y} (d\log \tau_{kc}^{\tilde{c}} - d\log P_{k}^{\tilde{c}}) \Big]_{kc} \end{split}$$

where we used the raw intermediates market clearing condition to get the final equality. To compute the final matrix form of $\lambda' d\tilde{\Omega}$, we will find the matrix form of each of $\left[\lambda_{kc}' d\Omega^{raw} \ 0 \ 0 \ 0\right], \left[0 \ 0 \ \lambda^{kc'} d\Omega^{prod} \ 0\right]$ and $\left[0 \ 0 \ 0 \ \lambda^{c'}_k d\Omega^{comp-cons} + \lambda^{kc'}_j d\Omega^{comp-prod}\right]$ and then combine them together. Therefore, we get

$$\begin{bmatrix} 0 & 0 & \lambda^{kc'} d\Omega^{prod} & 0 \end{bmatrix} = (1 - \epsilon) \begin{bmatrix} 0 & 0 & [\lambda_j^{kc} [d \log P_j^{kc} - d \log P^{kc}]]_{kcj} & 0 \end{bmatrix}$$
$$= (1 - \epsilon) d \log P' \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & -\lambda^{kc} \circ \Omega^{prod} & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & \dim(\lambda_j^{kc}) & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}.$$

We get

and we are done. \blacksquare

We now combine all of the previous results to get a system of linear equations for $d \log w$ and $d \log P$. Equations (12) and (13) imply that

$$d\lambda'\tilde{F} = (d\chi'\tilde{\Omega}^{cons} + \chi'd\tilde{\Omega}^{cons} + \lambda'd\tilde{\Omega})\Psi\tilde{F}$$
$$d\lambda'\tilde{F} = d\Lambda' - \lambda'd\tilde{F}.$$

For the first of those equations, we can use Proposition 2 as well as Equation (9) to get

$$d\lambda' \tilde{F} = (d \log w' \tilde{\Lambda}' \tilde{\Omega}^{cons} + d \log P' \Phi_B + d \log P' \Phi_C + \mathbf{1}' \Phi_D) \Psi \tilde{F}$$
$$= (d \log w' \tilde{\Lambda}' \tilde{\Omega}^{cons} + d \log P' (\Phi_B + \Phi_C) + \mathbf{1}' \Phi_D) \Psi \tilde{F}.$$

Concerning the second equation, we use Proposition 2 as well as Equation (10)

$$d\lambda' \tilde{F} = d\log w' \operatorname{diag}(\Lambda^{kc}) - d\log w' \operatorname{diag}((1-\theta)\Lambda^{kc}) + d\log P' \Phi_A$$
$$= d\log w' \operatorname{diag}(\theta\Lambda^{kc}) + d\log P' \Phi_A.$$

Combining everything together we get

$$d\log w' \left(\operatorname{diag}(\theta \Lambda^{kc}) - \tilde{\Lambda}' \tilde{\Omega}^{cons} \Psi \tilde{F} \right) = d\log P' \left(\left(\Phi_B + \Phi_C \right) \Psi \tilde{F} - \Phi_A \right) + \mathbf{1}' \Phi_D \Psi \tilde{F}.$$

Finally, we use Proposition 1 and solve for $d \log w$ to arrive at the equation for the changes in wages:

Corollary 1

$$d\log w' \left(\operatorname{diag}(\theta \Lambda^{kc}) - \tilde{\Lambda}' \tilde{\Omega}^{cons} \Psi \tilde{F} - F' (\mathcal{I} - \Omega')^{-1} \left((\Phi_B + \Phi_C) \Psi \tilde{F} - \Phi_A \right) \right)$$
$$= \mathbf{1}' \left[\Phi_D \Psi \tilde{F} + (\Omega' \circ d \log T') (\mathcal{I} - \Omega')^{-1} \left((\Phi_B + \Phi_C) \Psi \tilde{F} - \Phi_A \right) \right].$$

However, due to Walras' law, this linear system is not of full rank. Accordingly, to solve it, we need to add to it the equation $\mathbf{1}' d\chi = 0$ (world income is fixed), which is equivalent to

$$\sum_{kc} \Lambda^{kc} d\log w^{kc} = 0.$$

A.1.1 Derivatives of Domar Weights and Expenditure Shares

After having computed $d \log w$ we can use Proposition 1 and 2 as well as Equations (9), (10) and (12) to compute the derivatives of the other variables. We get

$$d \log P = (\mathcal{I} - \Omega)^{-1} F d \log w + (\mathcal{I} - \Omega)^{-1} (\Omega \circ d \log T) \mathbf{1}$$
$$d\chi = \tilde{\Lambda} d \log w$$
$$d\Lambda = \operatorname{diag}(\Lambda^{kc}) d \log w$$
$$d\lambda = \Psi'(d\chi' \tilde{\Omega}^{cons} + \chi' d\tilde{\Omega}^{cons} + \lambda' d\tilde{\Omega})'$$
$$= \Psi'(d \log w' \tilde{\Lambda}' \tilde{\Omega}^{cons} + d \log P' \Phi_B + d \log P' \Phi_C + \mathbf{1}' \Phi_D)'$$
$$= \Psi'((\tilde{\Omega}^{cons})' \tilde{\Lambda} d \log w + \Phi'_B d \log P + \Phi'_C d \log P + \Phi'_D \mathbf{1}).$$

For the derivatives of the input/output matrix Ω and labor shares \hat{F} we can reuse parts of the proof of Proposition 2. Recall that Ω^{raw} is of size $CN \times CN$ and that

$$\Omega^{raw} = \begin{pmatrix} \Omega_1^{raw} & 0 & 0\\ 0 & \ddots & 0\\ 0 & 0 & \Omega_C^{raw} \end{pmatrix}, \qquad \Omega_c^{raw} = \operatorname{diag}\left(\frac{P^{kc}X^{kc}}{p_{kc}y_{kc}}\right)_{kc}$$
$$d\left(\frac{P^{kc}X^{kc}}{p_{kc}y_{kc}}\right) = (1-\theta)\frac{P^{kc}X^{kc}}{p_{kc}y_{kc}}(d\log P^{kc} - d\log p_{kc}).$$

This implies that $d\Omega^{raw} = (1 - \theta) \left([d \log P^{kc}]_{kc} \circ \Omega^{raw} - [d \log p_{kc}]_{kc} \circ \Omega^{raw} \right).$

Recall that Ω^{cons} is of size $C \times CN$ and that

$$\Omega^{cons} = \begin{pmatrix} \Omega_1^{cons} & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \Omega_C^{cons} \end{pmatrix}, \qquad \Omega_c^{cons} = \begin{bmatrix} \frac{P_k^c x_k^c}{I^c} \end{bmatrix}_k$$
$$d\left(\frac{P_k^c x_k^c}{I^c}\right) = (1 - \sigma) \frac{P_k^c x_k^c}{I^c} (d \log P_k^c - d \log P^c).$$

This implies that $d\Omega^{cons} = (1 - \sigma) \left([d \log P_k^c]_{kc} \circ \Omega^{cons} - [d \log P^c]_c' \circ \Omega^{cons} \right).$

Recall that Ω^{prod} is of size $CN \times CN^2$ and that

$$\Omega^{prod} = \begin{pmatrix} \Omega_{11}^{prod} & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \Omega_{NC}^{prod} \end{pmatrix}, \qquad \Omega_{kc}^{prod} = \begin{bmatrix} \frac{P_j^{kc} x_j^{kc}}{P^{kc} X^{kc}} \end{bmatrix}_j$$
$$d\left(\frac{P_j^{kc} x_j^{kc}}{P^{kc} X^{kc}}\right) = (1-\epsilon) \frac{P_j^{kc} x_j^{kc}}{P^{kc} X^{kc}} (d\log P_j^{kc} - d\log P^{kc}).$$

This implies that $d\Omega^{prod} = (1 - \epsilon) \left([d \log P_j^{kc}]_{kcj} \circ \Omega^{prod} - [d \log P^{kc}]'_{kc} \circ \Omega^{prod} \right).$ Recall that $\Omega^{comp-cons}$ is of size $CN \times CN$ and that

$$\Omega^{comp-cons} = \begin{pmatrix} A_{11} & \dots & A_{1C} \\ \vdots & \ddots & \vdots \\ A_{C1} & \dots & A_{CC} \end{pmatrix}, \qquad A_{cc'} = \operatorname{diag} \left(\frac{\tau_{kc'}^c p_{kc'} y_{kc'}^c}{P_k^c x_k^c} \right)_k$$
$$d\left(\frac{\tau_{kc'}^c p_{kc'} y_{kc'}^c}{P_k^c x_k^c} \right) = (1 - \theta_k) \frac{\tau_{kc'}^c p_{kc'} y_{kc'}^c}{P_k^c x_k^c} (d \log p_{kc'} + d \log \tau_{kc'}^c - d \log P_k^c).$$

This implies that

$$d\Omega^{comp-cons} = [1 - \theta_k]'_{kc} \circ \left(d \log \tau^{cons} \circ \Omega^{comp-cons} + [d \log p_{kc}]_{kc} \circ \Omega^{comp-cons} - [d \log P_k^c]'_{kc} \circ \Omega^{comp-cons} \right).$$

Recall that $\Omega^{comp-prod}$ is of size $CN^2 \times CN$ and that

$$\Omega^{comp-prod} = \begin{pmatrix} B_1^{11} & \dots & B_C^{11} \\ \vdots & \ddots & \vdots \\ B_1^{NC} & \dots & B_C^{NC} \end{pmatrix}, \qquad B_{c'}^{kc} = \operatorname{diag} \left(\frac{\tau_{jc'}^{kc} p_{jc'} y_{jc'}^{kc}}{P_j^{kc} x_j^{kc}} \right)_j$$
$$d\left(\frac{\tau_{jc'}^{kc} p_{jc'} y_{jc'}^{kc}}{P_j^{kc} x_j^{kc}} \right) = (1 - \theta_j) \frac{\tau_{jc'}^{kc} p_{jc'} y_{jc'}^{kc}}{P_j^{kc} x_j^{kc}} (d \log p_{jc'} + d \log \tau_{jc'}^{kc} - d \log P_j^{kc}).$$

This implies that

$$d\Omega^{comp-prod} = [1 - \theta_k]'_{kc} \circ \left(d\log \tau^{prod} \circ \Omega^{comp-prod} + [d\log p_{kc}]_{kc} \circ \Omega^{comp-prod} - [d\log P_j^{kc}]'_{kcj} \circ \Omega^{comp-prod} \right)$$

Recall that $\hat{F} = \text{diag}\left(\frac{w^{kc}L^{kc}}{p_{kc}y_{kc}}\right)_{kc}$ is of size $CN \times CN$ and that

$$d\left(\frac{w^{kc}L^{kc}}{p_{kc}y_{kc}}\right) = (1-\theta)\frac{w^{kc}L^{kc}}{p_{kc}y_{kc}}(d\log w^{kc} - d\log p_{kc})$$

This implies that $d\hat{F} = (1 - \theta) \left(\left[d \log w^{kc} \right]_{kc} \circ \hat{F} - \left[d \log p_{kc} \right]_{kc} \circ \hat{F} \right)$

A.2 Productivity Shocks

Note that the preceding analysis also applies to productivity shocks, since we can rewrite the productivities A^{kc} as uniform icebergs across all buyers. To see this, write the raw production function (6) as

$$\tilde{y}_{kc} = \frac{y_{kc}}{A^{kc}} = \left((\alpha^{kc})^{\frac{1}{\theta}} \left(l^{kc} \right)^{\frac{\theta-1}{\theta}} + (1 - \alpha^{kc})^{\frac{1}{\theta}} \left(X^{kc} \right)^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}$$

the price index as

$$\tilde{p}_{kc} = A^{kc} p_{kc} = \left(\alpha^{kc} (w^{kc})^{1-\theta} + (1-\alpha^{kc}) (P^{kc})^{1-\theta} \right)^{\frac{1}{1-\theta}},$$

and market clearing as

$$\tilde{y}_{kc} = \frac{1}{A^{kc}} \left(\sum_{c' \in C} y_{kc}^{c'} + \sum_{jc' \in N \times C} y_{kc}^{jc'} \right).$$

Then the equilibrium $(\tilde{y}_{kc}, \tilde{p}_{kc})$ with uniform icebergs $\tau_{kc}^{c'} = \tau_{kc}^{jc'} = \frac{1}{A^{kc}}$ and unitary productivity is equivalent to the equilibrium with unitary icebergs and productivity A^{kc} , except $y_{kc} = A^{kc}\tilde{y}_{kc}$ and $p_{kc} = \frac{\tilde{p}_{kc}}{A^{kc}}$ (so the value of production doesn't change). All other variables are identical because in the both cases (1) the buyers pay the same effective prices and (2) the raw producers have the same nominal sales. So to compute the effect of a productivity shock, one must simply calculate the response to the corresponding iceberg shock and then adjust the raw prices.

A.3 Computing the Effect of Large Shocks

In Section A.1, we provided close-form expressions for how equilibrium changes in response to arbitrary, small iceberg shocks. Section A.2 explained how to use the same equations to calculate the effects of small productivity shocks. Here we explain how, by numerically integrating these derivatives, we can compute equilibrium changes in response to large shocks.

Given elasticities, icebergs $d \log T$, initial expenditure shares F_0 and Ω_0 , and Domar weights λ_0 , Λ_0 , and χ_0 , we solve for the change in equilibrium using Euler integration. Let S be the number of steps. Using Proposition 1 and Corollary 1, calculate $d \log w_1$ and $d \log P_1$ for the shock $d \log T/S$. Then calculate $d\chi_1$, $d\Lambda_1$, $d\lambda_1$, dF_1 , and $d\Omega_1$ according to Section A.1.1. This generates the updated variables $\chi_1 = \chi_0 + d\chi_1$, $\Omega_1 = \Omega_0 + d\Omega_1$, and so on. Then repeat the derivatives, starting at the updated matrices and vectors.

After S steps, $\sum_{s=1}^{S} d \log P_s$ and $\sum_{s=1}^{S} d \log w_s$ are the total percent changes in prices and wages, and χ_S , Λ_S , λ_S , F_S , and Ω_S are the resulting Domar weights and expenditure shares. Since world income is normalized to one throughout, the total change in welfare for the countries is the vector

$$\log(\chi_S) - \log(\chi_0) - \sum_{s=1}^S d\log P_s^C$$

As S becomes large, the procedure converges to the true change in equilibrium.

B Calibration Details

While the derivatives in Propositions 1 and 2 and Section A.1.1 depend on the preference, production, and trade elasticity parameters, for which there are estimates from the trade literature, they do not depend directly on the taste and production weights (the δ 's, ω 's, and so on). Nor do the derivatives depend directly on the initial labor supplies or productivities. Instead, the realized expenditure shares and Domar weights, which can be measured from data, turn out to be sufficient statistics for the underlying unobserved structure of the economy. And the Domar weights and expenditure shares can be easily calculated from the empirical input/ouput tables, e.g., the OECD ICIO. Therefore, counterfactual exercises require only three inputs: (1) elasticity parameters, (2) iceberg shocks, and (3) an input/output table.

We calibrate the model using the OECD ICIO, specifically the 2019 table, which is the most recent version not during the COVID crisis. The data include 77 countries (including "rest-of-world" ROW) and 45 industries, and we use two parts of the table. The first part is the raw intermediate use matrix we call *IO*. Each row corresponds to a different country/industry source of goods or services, and each entry of the row gives, in dollars, purchases from that country/industry pair by all country/industry pairs. The second part is the final use matrix. Each row corresponds to a different country/industry source of goods or services, and each entry of the row gives, in dollars, purchases from that country/industry pair by all country/industry. uses are household consumption, non-profits' consumption for households, government consumption, investment, the change in inventories, and direct purchases abroad. For computational reasons, as described in Section B.3, we add some of the countries into ROW, form several regional aggregate economies, and aggregate some of the industries together, leaving us with C = 34 and N = 38.

By summing across final uses for each country, we create the $CN \times C$ total absorption matrix we call CONS, which corresponds to consumption in our model. As discussed in Eppinger et al. (2023) and the appendix of Costinot and Rodríguez-Clare (2014), simply adding columns can generate negative entries for absorption, which are not allowed in the model, because there are negative values for inventories and investment. To correct for this, we follow the procedure of Costinot and Rodríguez-Clare (2014) (after performing the aggregation of Section B.3). Let X be the vector of total sales, and let A be IO with each row divided by X, that is, intermediate expenditures as a fraction of (buyer) sales. Letting CONS (corrected) be the sum of the positive parts of absorption, and letting neq be the sum of the negative parts of absorption, we have X = $AX + CONS\mathbf{1} + neg\mathbf{1}$ by construction. Defining $\tilde{X} = (\mathcal{I} - A)^{-1}CONS\mathbf{1}$, the corrected intermediate use table (corrected IO) is $A \circ \tilde{X}'$,²⁹ and we have $\tilde{X} = A\tilde{X} + CONS\mathbf{1}$ (note that dividing each row of $A \circ \tilde{X}'$ by \tilde{X} simply yields A). Intuitively, this amounts to assuming negative inventories and investments were produced and consumed in the current period. Mechanically, the corrected IO multiplies each row by the vector of \tilde{X} divided element-wise by X, proportionally scaling up current sales to include inventoried prior sales. In what follows, we assume CONS and IO have been adjusted as described.

With adjusted *CONS* and *IO* in hand, we can directly compute the expenditure shares corresponding to our model. In keeping with our previous notation, let $IO_{jc'}^{kc}$ be purchases of industry j in country c' by industry k in country c. This corresponds

²⁹As in Section A, \circ means element-by-element multiplication when the matrices have the same dimensions and row-by-row or column-by-column element-by-element multiplication when one of the matrices is a vector. So $A \circ \tilde{X}'$ means element-by-element multiplication of each row of A by the row vector \tilde{X}' .
to cell $(N \times (c'-1) + j, N \times (c-1) + k)$ of *IO*. Define $CONS_{jc'}^c$ analogously. Then, assuming the data reflect equilibrium in the model, we have

$$\frac{w^{kc}l^{kc}}{p_{kc}y_{kc}} = \frac{\sum_{jc'} IO_{kc}^{jc'} + \sum_{c'} CONS_{kc}^{c'} - \sum_{jc'} IO_{jc'}^{kc}}{\sum_{jc'} IO_{kc}^{jc'} + \sum_{c'} CONS_{kc}^{c'}}$$
$$\frac{P^{kc}X^{kc}}{p_{kc}y_{kc}} = 1 - \frac{w^{kc}l^{kc}}{p_{kc}y_{kc}}$$
$$\frac{P^{c}_{k}x^{c}_{k}}{I^{c}} = \frac{\sum_{c'} CONS_{kc'}^{c}}{\sum_{jc'} CONS_{jc'}^{c}}$$
$$\frac{T^{c}_{kc'}p_{kc'}y^{c}_{kc'}}{P^{c}_{k}x^{c}_{k}} = \frac{CONS_{kc'}^{c}}{\sum_{m} CONS_{km}^{c}}$$
$$\frac{P^{jc}_{k}x^{kc}_{j}}{P^{kc}X^{kc}} = \frac{\sum_{c'} IO_{jc'}^{kc}}{\sum_{ic'} IO_{ic'}^{kc}}$$
$$\frac{\tau^{tc}_{jc'}p_{jc'}y^{jc'}_{jc'}}{P^{kc}_{j}x^{kc}} = \frac{IO_{jc'}^{kc}}{\sum_{m} IO_{jm}^{kc}},$$

which are all we need to calculate the matrices Ω (goods expenditure shares) and F (labor shares) from Appendix A.

We now turn to the calibration of the other quantities required for computing the model and discuss the issue of the overall trade balance.

B.1 Domar Weights and Trade Imbalances

To implement the solution algorithm in Section A.3, we also need to calculate the Domar weights for labor Λ (value added by industry), the consumer Domar weights χ , and the producer Domar weights λ . One could directly calculate these objects from *IO* and *CONS* in the OECD ICIO (after aggregation and the negative inventory correction), but doing so would lead to inconsistencies with the model equations. For example, suppose one were to compute labor Domar weights Λ as industry value added in each country, divided by global value added, and calculated χ by summing across industries within each country. Then Equation 11 (sales equal purchases; $\lambda' = \chi' \tilde{\Omega}^{cons} \Psi$)) immediately gives us the producer Domar weights λ since Ψ only depends on Ω . But the resulting λ would not equal the corresponding Domar weights directly calculated from the OECD ICIO. And, consequently, the labor shares F in the model would deviate from their empirical counterparts. The reason is that, due to trade imbalances and cross-border factor payments, total value added in each country is not equal to absorption or income in the data. In contrast, while the model exhibits lots of gross trade, trade in the model is balanced in the aggregate, final absorption equals country value added (wages), and GDP equals income.

Alternatively, one could directly calculate λ and χ and then back out Λ using the observed value added shares F. In this case, Λ would not add up to χ (as required in the model), again because of the assumption of balanced trade.

The upshot is that one must either (i) include trade imbalances/cross-border factor payments in the model, which is challenging because the model is static or (ii) perform some additional correction to *IO* and *CONS*. We adopt the latter approach.

Specifically, we adjust the OECD ICIO to be consistent with the model equations, while respecting the observed expenditure shares Ω and F. Returning to our notation from the negative inventories correction, let A be IO with the rows divided by total sales. Let B be CONS with the rows divided by total spending. So B is a $CN \times C$ matrix of consumption weights. Next define the "ownership matrx" \mathcal{O} that describes how factor payments (value added) are distributed. We assume, following the model, that \mathcal{O} is $C \times CN$ with $1 \times N$ vectors of ones on the diagonal (so GDP equals income). Lastly, let \mathcal{L} be the $CN \times CN$ matrix with the observed labor shares on the diagonal and zeros elsewhere (in the model, we called this \hat{F}).

We calculate the $CN \times 1$ vector of sales \hat{X} satisfying

$$\hat{X} = A\hat{X} + B\mathcal{OL}\hat{X}$$
$$\mathbf{1}'\mathcal{L}\hat{X} = 1.$$

Note that $\mathcal{L}\hat{X}$ is the $CN \times 1$ vector of value added by country/industry, so the second equation normalizes world GDP to one, as the first equation only determines \hat{X} up to

a multiplicative constant (it is the first eigenvector of $A + BO\mathcal{L}$, which has spectral radius one since the rows sum to one). The solution yields the corrected *IO* matrix $A \circ \hat{X}'$, the corrected *CONS* matrix $B \circ (O\mathcal{L}\hat{X})'$, $\Lambda = \mathcal{L}\hat{X}$, $\lambda = \hat{X}$, and $\chi = O\mathcal{L}\hat{X}$. And we have

$$\lambda = A\lambda + B\chi,$$

which is the same as Equation 11. Corrected *IO* and *CONS* are thus constructed to respect the observed expenditure and labor shares, and implied industry value added sums to total final consumption expenditure in each country:

$$\mathbf{1}'(B \circ (\mathcal{OL}\hat{X})') = (\mathcal{OL}\hat{X})' = \chi',$$

which is due to the fact that the rows of B sum to one by construction.

While the corrected matrices match the observed expenditure and labor shares, they produce Domar weights different from those directly calculated from the OECD ICIO. However, the differences are not too large. After implementing our aggregation scheme described in Section B.3 and performing the negative inventory and trade balance corrections described above, the cross-country correlation between the corrected and direct Domar weights is approximately 0.99 for χ , Λ , and λ . For Switzerland, the correlations for Λ and λ are > 0.99, and Switzerland comprises approximately 1% of global value added, with and without the correction.

With Ω , F, Λ , λ , and χ in hand, after choosing elasticity parameters (see Section B.2) and icebergs, we have information sufficient for calculating changes in equilibrium according to Section A. For counterfactual exercises reported in terms of changes, it is not necessary for us to take a stance on the underlying labor supplies, productivities, or preference/production weights. The only assumption we need to proceed is that the corrected OECD ICIO reflects an equilibrium in the model. One can remain agnostic on the extent to which initial patterns in the data are driven by productivity, labor supply, preferences, or technology.

Nevertheless, it is straightforward to calibrate the primitives of the model such that the initial equilibrium matches key features of the observed data. Doing so is not necessary for counterfactuals, but it can be useful for generating synthetic data and comparing solution methods. We describe one such calibration approach here, as it may be of theoretical interest.

Suppose the labor supplies are effective labor (labor force times labor productivity). And suppose we could find a set of labor productivities ensuring that all equilibrium prices and wages are equal to one. Then from the CES demand curves and price indexes, the equilibrium expenditure shares are all equal to the underlying preference and production weights, e.g. $\frac{w^{kc}l^{kc}}{p_{kc}y_{kc}} = \alpha^{kc}$ (as would have been the case if we had originally imposed Cobb-Douglas). The following proposition and remark show how to compute these effective labor supplies.

Proposition 3

Given production weights $\delta_{kc'}^c, \omega_j^{kc}, \delta_{jc'}^{kc}, \alpha^{kc}$ and taste parameters b_k^c , we assume that the productivities A^{kc} and icebergs $\tau_{kc}^{c'}, \tau_{kc}^{jc'}$ are all equal to one and that the industry-country labor allocation fulfill

$$\frac{L^{kc}}{\alpha^{kc}} = \sum_{jc'} \left(\delta_{kc}^{c'} b_k^{c'} + \delta_{kc}^{jc'} \omega_k^{jc'} \frac{1 - \alpha^{jc'}}{\alpha^{jc'}} \right) L^{jc'}.$$
(14)

Then, there exists an equilibrium in which all the prices and wages are equal to 1 such that the expenditure shares of firms are exactly equal to the production weights and the expenditure shares of consumers are equal to the taste parameters. **Remark 2**

Writing the system of CN equations above in matrix form as y = Qy, where y is the vector formed from L^{kc}/α^{kc} , y is the first eigenvector of Q, which has spectral radius one since the rows sum to one. Assuming Q is irreducible, the solution y is unique up to a multiplicative constant. In that case, imposing $1 = \sum_{kc} L^{kc}$ then uniquely pins down the labor supplies.

Proof. We start by assuming that all the prices and wages are equal to 1. Clearly, it

follows that prices and wages equal marginal costs and satisfy the price indexes. The CES demand curves, the budget constraint of the consumers, and the market clearing condition imply directly that

$$\begin{aligned} x_{k}^{c} &= b_{k}^{c} \sum_{j} L^{jc}, \qquad y_{kc'}^{c} = \delta_{kc'}^{c} b_{k}^{c} \sum_{j} L^{jc}, \qquad y_{kc} = \frac{L^{kc}}{\alpha^{kc}}, \qquad X^{kc} = \frac{1 - \alpha^{kc}}{\alpha^{kc}} L^{kc}, \\ x_{j}^{kc} &= \omega_{j}^{kc} \frac{1 - \alpha^{kc}}{\alpha^{kc}} L^{kc}, \quad y_{jc'}^{kc} = \delta_{jc'}^{kc} \omega_{j}^{kc} \frac{1 - \alpha^{kc}}{\alpha^{kc}} L^{kc} \qquad I^{c} = \sum_{k} L^{kc} \qquad y_{kc} = \sum_{c'} y_{kc}^{c'} + \sum_{jc'} y_{kc'}^{jc'} + \sum_{jc'} y_{kc'}^{jc'$$

If all of those equations hold, then we have a market equilibrium. After plugging in $y_{kc}, y_{kc}^{c'}$ and $y_{kc}^{jc'}$ in the market clearing condition we get the equation as stated. Assuming the labor supplies satisfy Proposition 3 and total labor is set to one, world income and all prices and wages are one, and the model matches the observed expenditure and labor shares, provided the preference and productions weight are set equal to them. It is then straightforward to calculate the Domar weights:

$$\begin{split} \chi^c &= \sum_k L^{kc} \\ \Lambda^{kc} &= L^{kc} \\ \lambda_{kc} &= \frac{L^{kc}}{\alpha^{kc}} \\ \lambda^{kc} &= \frac{1 - \alpha^{kc}}{\alpha^{kc}} L^{kc} \\ \lambda^c_k &= b^c_k \chi^c \\ \lambda^{kc}_j &= \omega^{kc}_j \lambda^{kc} \end{split}$$

Because this procedure respects both the model equations and observed expenditure and labor shares, it yields exactly the same Domar weights as those that come from implementing our balanced trade correction described earlier in the section. Therefore, one can think of our correction to the OECD ICIO as redistributing world factors such that assuming net balanced trade implies the observed expenditure and labor shares.

B.2 Elasticities

We take the preference/production elasticities, σ , θ , and ϵ , from Baqaee and Farhi (2024) (Table 1), and we use the trade elasticities $\theta^k - 1$ from Eppinger et al. (2023) (Table 2).

 $\begin{array}{c|c} \hline \text{Elasticity Parameter} & \underline{\text{Value}} & \underline{\text{Source}} \\ \hline \text{Consumption} (\sigma) & 0.9 & \text{Baqaee and Farhi (2024)} \\ \text{Labor/Intermediates } (\theta) & 0.5 & \text{Baqaee and Farhi (2024)} \\ \hline \text{Cross-Industry } (\epsilon) & 0.2 & \text{Baqaee and Farhi (2024)} \end{array}$

Table 1: Preferences/Technology Elasticity Parameters

Note: σ is the cross-industry consumption elasticity of substitution. θ is the raw producer elasticity of substitution between labor and aggregate intermediate inputs. ϵ is the cross-industry elasticity of substitution in creating aggregate intermediate bundles.

B.3 Aggregation

The matrix inverses required for the solution algorithm in Section A do not exist when the underlying input-output table has zero columns or rows. Additionally, zero rows or columns will render the key matrix in the trade balance correction reducible, meaning the correction might not be unique. Furthermore, the computation of the expenditure shares requires that, for any column of the input-output table, the sum of the entries from the same industry but across all countries be strictly positive.³⁰ Lastly, with N = 45 and C = 77, the number of agents is $\mathcal{N} = 166,397$, which requires the storage and inversion of extremely large matrices. For all of these reasons, we combine some industries together and put some countries into ROW and regional aggregates.

While aggregation obviously requires many judgment calls, we use the following general approach, which aims to resolve the issues mentioned above while preserving a level of disaggregation useful for current Swiss and global policy questions. First, there are some countries with either many zero rows/columns or zero rows/columns in industries

³⁰In other words, this means $\sum_{jc'} CONS_{jc'}^c$ and $\sum_{jc'} IO_{jc'}^{kc}$ both strictly positive for any c, k.

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Table 2: Industry Detail and Trade Elasticities

Note: The table lists the 38 industries we consider in our quantitative analysis. The top panel contains the 33 ISIC Rev. 4 industries we use as given in the OECD ICIO. The bottom panel describes how we aggregate the remaining 12 OECD ICIO industries into the 5 used in our analysis. The last column displays the trade elasticity estimates from Eppinger et al. (2023), which correspond to our θ_k parameters (minus one). For C17_18 we use the C17 elasticity in Eppinger et al. (2023). The highlighted industries are the focus of our main analysis for Switzerland.

of general policy importance. These countries are natural to put in aggregates such as Rest-of-EU (ROE), Subset of Africa (AFR), or ROW. For example, in Belgium and Portugal, the industry "Mining and quarrying, energy producing products" has zero output. The sector considered being highly relevant for policy questions, those two countries were added to the Rest-of-EU aggregate. Second, there are industries of less interest with either zero rows/columns for many countries or zero rows/columns for countries we would like to consider individually. These industries are natural to combine with related industries. An example of this is the industry "Activities of households as employers" which has zero output for many important countries and was therefore combined with other service related industries. Third, after removing such natural industries and countries, dealing with the remaining zeros requires more difficult judgment calls, and we proceed by optimizing for Switzerland, combining some countries and industries to maintain key Swiss trade partners and sectors in our analysis. Finally, to speed up our computations, we put some smaller countries into aggregates, while keeping Switzerland's biggest trade partners.

Our industry aggregation scheme is described in Table 2. The top panel contains the 33 industries we keep at the level of disaggregation in the OECD ICIO. The bottom panel contains the 5 aggregates we create to remove zero rows and columns. Our country aggregation scheme is given in Tables 3 and 4.

B.4 Other Tables and Figures

ARG	Argentina	AUS	Australia
AUT	Austria	BRA	Brazil
CAN	Canada	CHE	Switzerland
CHN	China	DEU	Germany
DNK	Denmark	ESP	Spain
FRA	France	GBR	United Kingdom
IDN	Indonesia	IND	India
IRL	Republic of Ireland	ITA	Italy
JPN	Japan	KOR	Republic of Korea
MEX	Mexico	NLD	Netherlands
NOR	Norway	POL	Poland
RUS	Russia	SAU	Saudi Arabia
SWE	Sweden	TUR	Türkiye
TWN	Taiwan	USA	United States of America
VNM	Vietnam	ROE	Rest-of-EU
LAA	Subset of Latin America	EEA	Subset of East Asia
AFR	Subset of Africa	ROW	Rest-of-World

Table 3: Countries and Regions included in the Analysis

	Rest-of-EU (ROE)	Subset of East Asia (EEA)					
BEL	Belgium	BGD	Bangladesh				
BGR	Bulgaria	BRN	Brunei				
CYP	Cyprus	KHM	Cambodia				
CZE	Czechia	LAO	Laos				
EST	Estonia	MMR	Myanmar				
FIN	Finland	MYS	Malaysia				
GRC	Greece	PAK	Pakistan				
HRV	Croatia	PHL	Philippines				
HUN	Hungary	SGP	Singapore				
LTU	Lithuania	THA	Thailand				
LUX	Luxembourg						
LVA	Latvia	Sı	ubset of Africa (AFR)				
MLT	Malta	CIV	Côte d'Ivoire				
PRT	Portugal	CMR	Cameroon				
ROU	Romania	EGY	Egypt				
SVK	Slovakia	MAR	Morocco				
SVN	Slovenia	NGA	Nigeria				
		SEN	Senegal				
Subse	et of Latin America (LAA)	TUN	Tunisia				
CHL	Chile	ZAF	South Africa				
COL	Colombia						
CRI	Costa Rica	Added	l to Rest-of-World (ROW)				
PER	Peru	BLR	Belarus				
		ISL	Iceland				
		ISR	Israel				
		JOR	Jordan				
		KAZ	Kazakhstan				
		NZL	New Zealand				
		UKR	Ukraine				

 Table 4: Countries Aggregates

Note: The country ROW we use in our analysis is the sum of the original ROW category in the OECD ICIO plus the 7 countries in the bottom panel. CHN refers to China + Hong Kong, which are separated in the raw data but combined for our analysis.

-	Cold War 2.0	US/Cł	nina Trade War	Trump							Pharma	Chinese Inputs							
				Universal Tariff						China Tariff									
Size				10%	20%	10%	20%	10%	20%	20%	20%	25%	25%	10%	60%	10%	60%		
Retaliation				No	No	All	All	EU	EU	EU	No	No	No	No	No	China	China		
Horizon	LR	SR	LR	LR	LR	LR	LR	LR	LR	\mathbf{SR}	\mathbf{SR}	\mathbf{SR}	LR						
ARG	0.03	-0.01	0.02	-0.06	-0.11	-0.10	-0.17	-0.05	-0.10	-0.06	-0.07	-0.08	-0.13	0.00	0.00	0.00	0.00	0.00	-0.35
AUS	0.26	-0.11	-0.01	-0.04	-0.08	-0.06	-0.10	-0.03	-0.06	-0.03	-0.04	-0.05	-0.09	-0.02	-0.04	-0.01	-0.02	-0.01	-0.79
AUT	-1.37	0.05	0.04	-0.06	-0.10	-0.09	-0.16	-0.11	-0.18	-0.22	-0.06	-0.07	-0.12	0.01	0.02	0.01	0.02	0.00	-0.21
BRA	0.08	-0.02	0.01	-0.07	-0.13	-0.12	-0.21	-0.06	-0.12	-0.06	-0.07	-0.08	-0.15	-0.01	-0.02	0.00	0.00	-0.01	-0.32
CAN	-1.79	-0.08	0.04	-0.55	-1.00	-1.20	-2.05	-0.55	-1.01	-0.45	-0.44	-0.54	-1.20	0.00	0.02	0.00	0.01	0.00	-0.40
CHE	-1.12	0.07	0.03	-0.10	-0.19	-0.15	-0.29	-0.09	-0.18	-0.06	-0.08	-0.10	-0.23	0.01	0.02	0.01	0.03	0.04	0.46
CHN	-2.65	-1.52	-0.77	-0.04	-0.08	-0.08	-0.14	-0.04	-0.08	-0.05	-0.04	-0.05	-0.10	-0.07	-0.23	-0.11	-0.34	-0.01	-0.72
DEU	-1.60	0.06	0.04	-0.07	-0.12	-0.11	-0.19	-0.13	-0.23	-0.26	-0.07	-0.08	-0.15	0.01	0.02	0.01	0.03	0.00	-0.12
DNK	-1.73	0.01	0.03	-0.10	-0.18	-0.14	-0.24	-0.14	-0.25	-0.20	-0.09	-0.11	-0.22	0.01	0.01	0.00	0.01	0.02	-0.10
ESP	-1.15	0.02	0.03	-0.04	-0.07	-0.10	-0.16	-0.10	-0.16	-0.26	-0.07	-0.09	-0.08	0.01	0.03	0.01	0.02	0.00	-0.19
FRA	-1.46	0.03	0.03	-0.06	-0.10	-0.10	-0.17	-0.12	-0.20	-0.27	-0.08	-0.10	-0.12	0.00	0.02	0.00	0.02	0.00	-0.12
GBR	-1.45	-0.02	0.01	-0.04	-0.06	-0.13	-0.22	-0.04	-0.07	-0.08	-0.07	-0.08	-0.07	0.00	0.02	0.00	0.01	0.00	-0.20
IDN	0.26	0.08	0.08	-0.03	-0.06	-0.07	-0.12	-0.03	-0.06	-0.04	-0.04	-0.05	-0.08	0.02	0.07	0.02	0.06	0.00	-0.28
IND	0.16	0.09	0.11	-0.05	-0.09	-0.17	-0.28	-0.06	-0.10	-0.10	-0.08	-0.10	-0.10	0.03	0.11	0.02	0.08	0.01	-0.21
IRL	-1.98	0.38	0.27	-0.68	-1.30	-0.66	-1.25	-0.95	-1.75	-1.06	-0.36	-0.44	-1.59	0.00	-0.03	0.03	0.07	0.11	0.69
ITA	-0.91	0.07	0.06	-0.05	-0.09	-0.09	-0.15	-0.10	-0.16	-0.20	-0.06	-0.08	-0.11	0.01	0.04	0.01	0.04	0.00	-0.14
JPN	-2.05	0.08	0.05	-0.07	-0.14	-0.14	-0.24	-0.07	-0.14	-0.08	-0.08	-0.10	-0.17	0.01	0.03	0.01	0.04	0.00	-0.06
KOR	0.51	0.24	0.10	-0.14	-0.26	-0.25	-0.45	-0.13	-0.25	-0.13	-0.13	-0.16	-0.31	0.01	0.04	0.02	0.06	0.00	0.00
MEX	0.68	0.44	0.33	-0.72	-1.32	-1.61	-2.75	-0.73	-1.34	-0.63	-0.61	-0.74	-1.58	0.13	0.35	0.11	0.30	0.00	-0.30
NLD	-1.61	0.05	0.04	-0.09	-0.16	-0.11	-0.19	-0.15	-0.26	-0.29	-0.10	-0.12	-0.19	0.00	0.01	0.00	0.01	0.00	0.02
NOR	-0.42	-0.06	-0.02	-0.01	-0.02	-0.01	-0.02	0.03	0.04	0.14	0.08	0.10	-0.02	-0.01	-0.02	-0.01	-0.02	0.00	-0.44
POL	-2.39	0.04	0.05	-0.04	-0.06	-0.09	-0.14	-0.09	-0.14	-0.22	-0.07	-0.08	-0.07	0.02	0.06	0.01	0.04	0.00	-0.27
RUS	-6.87	-0.03	0.00	-0.02	-0.03	-0.01	-0.01	0.00	0.00	0.04	0.01	0.02	-0.03	0.00	0.00	0.00	0.00	-0.01	-0.48
SAU	0.53	-0.09	-0.04	-0.03	-0.06	-0.03	-0.06	-0.02	-0.04	0.08	0.07	0.08	-0.08	-0.02	-0.05	-0.01	-0.03	-0.01	-0.44
SWE	-1.65	0.04	0.03	-0.06	-0.11	-0.07	-0.13	-0.10	-0.17	-0.16	-0.05	-0.06	-0.14	0.00	0.01	0.01	0.02	0.01	-0.12
TUR	0.79	0.08	0.08	-0.04	-0.07	-0.12	-0.20	-0.04	-0.07	-0.08	-0.07	-0.08	-0.09	0.01	0.05	0.01	0.05	0.00	-0.41
TWN	-8.53	0.32	0.12	-0.17	-0.32	-0.35	-0.62	-0.17	-0.31	-0.16	-0.16	-0.20	-0.39	0.00	0.00	0.03	0.07	-0.01	0.26
USA	-0.94	-2.23	-0.76	-0.60	-1.07	-0.88	-1.50	-0.64	-1.14	-1.62	-1.56	-1.90	-1.27	-0.11	-0.34	-0.14	-0.42	0.00	-0.07
VNM	2.64	1.27	1.14	-0.22	-0.40	-0.54	-0.95	-0.23	-0.42	-0.20	-0.17	-0.20	-0.49	0.23	0.89	0.22	0.83	-0.02	0.19
ROE	-2.17	0.04	0.04	-0.04	-0.08	-0.09	-0.15	-0.10	-0.16	-0.21	-0.06	-0.07	-0.09	0.01	0.03	0.01	0.03	0.00	-0.16
LAA	0.22	-0.09	0.01	-0.16	-0.29	-0.33	-0.55	-0.15	-0.27	-0.14	-0.15	-0.19	-0.34	-0.01	-0.03	-0.01	-0.01	-0.01	-0.68
EAA	0.69	0.25	0.17	-0.11	-0.20	-0.22	-0.39	-0.10	-0.19	-0.12	-0.12	-0.15	-0.24	0.03	0.10	0.03	0.11	0.00	0.29
AFR	0.36	0.00	0.02	-0.04	-0.07	-0.08	-0.13	-0.03	-0.06	-0.01	-0.02	-0.03	-0.09	0.01	0.02	0.00	0.02	0.00	-0.39
ROW	0.62	-0.03	0.01	-0.06	-0.11	-0.07	-0.13	-0.04	-0.08	0.02	-0.01	-0.01	-0.14	-0.01	-0.03	0.00	-0.01	0.00	-0.50

Table 5: Percent Change in Real Income

Note: The figure shows how real income changes around the world across all of our scenarios. The "Retaliation" row says whether or not targeted countries reciprocate trade barriers and, if so, who is retaliating. LR mean long run and SR means short run. The bottom group of economies are the aggregates rest-of-EU (ROE), Latin America subset (LAA), east Asia subset (EAA), Africa subset (AFR), and rest-of-world (ROW). Real income in the model is defined to be nominal GDP divided by the natural consumer price index.

	Real Income	(% Change)	Real Exports (% Change)		
	Short Run	Long Run	Short Run	Long Run	
US–Canada–Mexico Scenario					
US	-0.58	-0.40	-1.39	-7.10	
Canada	-2.72	-2.68	-3.65	-15.61	
Mexico	-3.58	-3.85	-4.51	-18.78	
Switzerland	-0.01	0.00	0.01	0.04	
EU	0.00	0.01			
World	-0.20	-0.15			
US–China Scenario					
US	-0.16	-0.13	-0.27	-1.93	
China	-0.06	-0.09	-0.19	-1.72	
Switzerland	0.01	0.01	0.00	0.05	
EU	0.00	0.01			
World	-0.04	-0.04			
US-EU Scenario (No Retaliation)					
ÚS	-0.32	-0.18	-0.81	-3.80	
Germany	-0.10	-0.16	-0.09	-0.87	
France	-0.08	-0.12	-0.08	-0.58	
Italy	-0.10	-0.15	-0.12	-1.09	
Switzerland	0.07	0.13	0.03	0.83	
EU	-0.10	-0.17			
World	-0.08	-0.06			
US–EU Scenario					
(EU Retaliates on All Countries)					
US	-0.39	-0.23	-1.00	-4.82	
Germany	-1.56	-1.00	-2.04	-8.33	
France	-1.58	-1.08	-1.73	-6.54	
Italy	-1.30	-0.82	-2.13	-8.43	
Switzerland	-0.59	-1.11	-0.61	-5.47	
EU	-1.61	-1.06			
World	-0.48	-0.39			
Industry-Specific Scenario					
US	-0.59	-0.32	-0.87	-7.88	
China	-0.01	-0.03	-0.03	-0.58	
Switzerland	-0.04	-0.15	-0.03	-0.61	
EU	-0.02	-0.06			
World	-0.14	-0.11			

Note: See main text Section 6.2.5 for descriptions of scenarios. Real income in the model is nominal GDP divided by the consumer price index. Real income changes for the EU and World are averages of country-level effects weighted by the average of pre- and post-nominal GDP shares. Real export changes are computed by Fisher chain-weighting industry-level changes.

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