Understanding and Forecasting Geopolitical Risk and Benefits

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Our World Transformed: Geopolitical Shocks and Risks

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Executive Summary

Over the past few decades, global human development has improved across multiple dimensions. Poverty has fallen, incomes have grown, and improvements in education, health, infrastructure, and governance have been sustained. However, the drivers of this success (technology and globalization in particular) have created new sets of problems that threaten these post-Cold War achievements. We forecast the impacts of five potential geopolitical disruptions—increased global trade protectionism, the collapse of the European Union, heightened political-military tensions between China and the United States, an energy shortage stemming from Middle East conflict, and global water scarcity across five measures of development: global GDP, extreme poverty, middle- and upper-class size, internal political instability, and networks of dependence.[1]

This project utilizes the International Futures (IFs) tool, a freely available integrated assessment model. Download or use the tool from pardee.du.edu.

The analysis is rooted in the IFs Base Case, a dynamic forecast for 186 countries across the following interconnected issue areas: agriculture, demographics, economy, education, energy, environment, governance, government finance, health, infrastructure, international politics, and technology. The Base Case sets reasonable expectations for how the world might unfold without major geopolitical disruptions.

Seven of the scenarios explored in this report are:

- Protectionist Victory: Globally, in this scenario, GDP would be $18 trillion lower, 25 million more people would live in extreme poverty, 54 million fewer people would fall into the middle or upper class, and 63 more countries would experience heightened risk of internal political instability, compared to the Base Case.
- EU Collapse: Global trade is restructured as formerly EU states intensify trade with non-European countries. In this scenario, global GDP would be $4 trillion lower, 4 million fewer people would fall into the middle or upper class and two additional countries would experience heightened risk of instability, compared to the Base Case.
- Arid Earth: In this scenario, which assumes greater water scarcity worldwide, countries with more robust water resources and capacity to increase food exports acquire prominence in the trade network. Overall, global GDP would be $1.8 trillion lower, and 15 more countries would experience increased risk of instability, compared to the Base Case. In countries that do not become net exporters of agricultural goods, the number of people in extreme poverty would increase by 6.8 million and 11.5 million fewer people would fall into the middle or upper class, compared to the Base Case.
- Severe Weather: This scenario assumes that governments would divert resources from other productive sectors to make their agricultural sectors more resilient. Consequently, compared to the Base Case, global GDP would be $6.7 trillion lower, and 21 more countries would experience higher risk of instability. In 2032, when global yield losses are forecast to peak, 21 million more people would live in extreme poverty and 38 million fewer people would fall into the middle or upper class, compared to the Base Case.
- New Cold War: In this scenario, which assumes heightened political-military tensions between China and the United States, global GDP would be $34.5 trillion lower, 22.6 million more people

[1] For a detailed description of the parameters used in each scenario see Appendix A.

would live in extreme poverty, 88 million fewer people would fall into the middle or upper class and 46 more countries experience greater risk of instability, compared to the Base Case.

- Constrained Energy: In this scenario, which assumes a tightening of global energy resources due to Middle East conflict, global GDP would be $54.4 trillion lower, 23 million more people would live in extreme poverty, 93 million people fewer people would fall into the middle or upper class and 26 more countries would experience heightened risk of instability, compared to the Base Case.
- Accelerated Renewables: In this scenario, which simulates a global push for renewables in lieu of constraints on other energy resources, global GDP would be $46.4 trillion lower, 16 million more people would live in extreme poverty, 76 million fewer people would fall into the middle or upper class, and 24 more countries would experience greater risk of instability, compared to the Base Case.

			Cumulative GDP *Billion USD*	**Extreme Poverty** *Million People*	**Middle Class** *Million People*	**Instability** *Number of Countries*
Base Case		**2016**	81,960	950	2,475	-
		2035	141,410	711	3,950	-
Protectionism	**Protectionist Victory**	**2035**	-18,040	33	-54	63
Climate	**Arid Earth**	**2035**	-1,830	6.8**	-11.5**	15
	Severe Weather	**2035**	-7,000	21***	-38***	21
Europe	**EU Collapse***	**2035**	-3,991	0.014	4	2
China-US	**New Cold War**	**2035**	-34,540	20	-88	46
Iran-Saudi	**Accelerated Renewables**	**2035**	-46,360	16	-76	24
	Constrained Energy	**2035**	-54,400	23	-93	26

*Table 1: Overview of findings for geopolitical risk scenarios. Note: The Base Case indicates values for 2016 and 2035, whereas all other scenarios are represented as the difference relative to the Base Case. GDP is reported as the cumulative difference between Base Case and each scenario through 2035. Extreme poverty measures those living on less than $1.90 per day. Middle class includes those living on greater than $10 per day. Instability is reported as the number of countries experiencing higher levels of internal political instability relative to the Base Case. Source: IFs 7.28. *For the EU Collapse scenario, results for poverty and middle class pertain only to that of the EU without the United Kingdom. **Reported for countries that experience an increase in poverty and a reduction in the size of the middle class relative to the Base Case. *** Reported for 2032 (a peak year in yield loss). During peak years of crop loss in the Severe Weather scenario, nearly 40 countries experience an increased probability of internal political instability.*

The greatest disruption to global GDP occurs in the two energy crisis scenarios. The greatest increase in extreme poverty takes place in the protectionist scenario, which also shows the highest number of countries experiencing heightened risk of domestic conflict. The greatest reduction in the number of people in the middle or upper class is seen across energy scenarios and in the scenario that models conflict between China and the United States.

Introduction

A resurgence of 19th century ideals about *laissez-faire* economic liberalism occurred in the 1970s. During this period, governments across the world started implementing policies of privatization, fiscal austerity, deregulation and free trade. The ensuing upsurge in global economic growth and associated technological advances led to progress in multiple dimensions of human wellbeing. In the past three decades, poverty fallen and incomes increased. Strong advances were made in health, education and infrastructure. Moreover, quality of governance has improved, the number of democracies has risen, and conflict has declined. However, strong economic growth and technological advances—the very drivers of this success—also engendered their own political, economic and environmental problems, and failed to address others. This project evaluates how these geopolitical problems could undermine progress over the next 20 years.

Economic growth and technological advances have not been a panacea. Economic liberalism has exacerbated inequality in many developed countries. This has led to a wave of trade protectionism, which could threaten prominent international trading blocs, including the EU, and constrain global economic growth

This is not to suggest that contemporary geopolitical stresses are solely an outcome of economic growth and liberalism—far from it. Increased automation and cultural shifts associated with technological advances have contributed a great deal to a global sense of malaise. Our purpose here is to stress that we face varied challenges despite and because of this economic and technological progress. In this report, we focus on five geopolitical risks: increased global trade protectionism, EU collapse, heightened political-military tensions between the China and US, an energy shock emanating from the Middle East, and global water scarcity.

Comparable wildcard type events have dramatically shifted incentives and changed the policy-making environment in the past. As the world changes with increasing rapidity—a character of globalization and the diffusion of technology—such risks are becoming more acute, impactful, and less predictable. It is possible that a world overwhelmed by information reduces the ability of decision-makers to respond to such risks. The surprise and uncertainty with which many decision-makers reacted to recent global transitions seems to support this view, but we believe business and governmental decision-makers can be equipped with tools to understand the world in which they make decisions.

This project provides tools—conceptual frameworks and models—to help decision-makers visualize, evaluate and manage the impacts of potential disruptions in the future. But before we proceed to the conceptual framework and model analysis, it is important to explain our understanding of geopolitical risk. We define geopolitical risk as the potential for disruption of political-economic trends conducive to human wellbeing. Admittedly, the term ‘wellbeing’ is subjective. Here we focus on the physical requirements of human prosperity.

We think of geopolitical risk as emanating from three interconnected systems: (a) political, (b) economic, and (c) natural. A risk is political if it is a product of interaction between actors engaged in power competition. The most drastic manifestation of this risk is violent conflict, but it can include other forms of disruptive competition. A risk is economic if it originates from the dynamics of market interaction. A recent example of this risk is the financial shock caused by the collapse of the US housing market. A risk is natural if it is produced by changes in the non-human environment, even if these changes are produced by human activity. Climate change has engendered some natural risks, notably water scarcity. It is

important to recognize that these risks unfold not only within systems but across them. For example, water scarcity (a natural risk) can result in military tensions (a political risk) which can cause the disruption of trade (an economic risk). Understanding the system(s) in which the risk originates and the process of cross-system contagion are important to our approach.

Our conceptualization of geopolitical risk also involves three interacting levels of analysis: (i) subnational, (ii) national, and (iii) networked. The subnational level of analysis is characterized by actors that have competing interests within a national context. For instance, provinces or political parties that are differentially affected by economic or natural disruptions can have diverging interests within a country. At the national level, we are interested in how sovereign actors interact with their broader environment, both in response to changing subnational pressures as well as a changing international context. The networked level of analysis encompasses the broader interrelation of actors in interaction, within, across, and outside of national units. Here we are interested in how unfolding disruptions cascade through clusters of connected state and non-state actors. This level of analysis focuses on the variables that result from the interaction of actors in the international system.

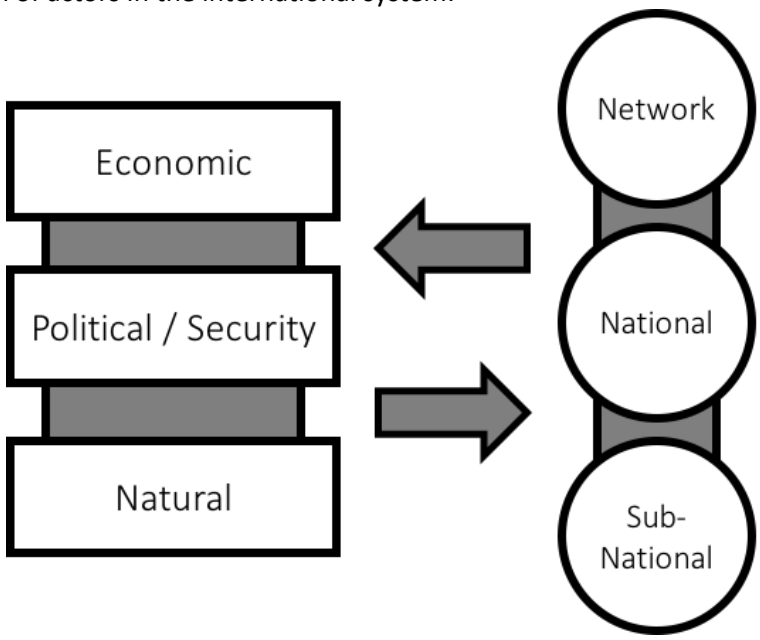

Figure 1: Conceptual framework for thinking about geopolitical risks.

We use the International Futures (IFs) integrated forecasting platform to evaluate the potential impact of geopolitical disruptions on measures of global human wellbeing over the next 20 years. We begin our analysis with the Base Case. This scenario models dynamic interactions within and across these systems for the entire world. It is the tool's estimation of how the world is going to proceed without dramatic policy interventions, environmental transformations or large-scale wildcard events. We compare the Base Case to five alternative futures capturing a world affected by each geopolitical risk. This allows us to gauge the effects of each geopolitical risk on human wellbeing compared to what we would expect otherwise. The variables used to measure human wellbeing in this report are global growth, global extreme poverty, the global middle class, the probability of internal political instability.

We build scenarios exploring five geopolitical risks: increased global trade protectionism, EU collapse, heightened political-military tensions between the US and China, direct conflict between Iran and Saudi Arabia, and global water scarcity. Table 1 lists how each risk scenario differs from the Base Case in terms of human prosperity outcomes. This is obviously not an exhaustive list of geopolitical risks, but rather a

starting point that attempts to compare across risk profiles that can be more broadly applied to additional risks in the future.

These results frame uncertainty and are designed to help people think about their shared futures. They should not be interpreted as predictions which, as we define them, are specific claims about when and where certain things will occur.

The assumptions used in this analysis can be found in the appendix, and the tool primarily used to create these results can be downloaded for free at pardee.du.edu. An understanding of IFs architecture will be helpful to anyone seeking a deeper understanding of these and other scenarios.

The first chapter of this report explains the Base Case in greater detail, as it provides essential context for interpreting alternative scenarios results. The following chapters, two through six, discuss each set of scenarios in more detail, providing historical background, a discussion of the drivers (framed in the levels of analysis), a discussion of the Base Case as it relates to the scenario, an explanation of the scenario model, a description of model results, and an explanation of the implications.

	A world of sustained trade protectionism	A Collapse of the European Union	An Arid Earth	A New Cold War between China and the United States	Constrained Energy Production in the Middle East
Scenario Intervention:	Compared with a world where economic openness increases at similar rates to the period of peak globalization, a sustained period of trade protectionism would lead to:	Compared with a world where the European Union continues to incrementally grow in institutional strength, an unraveling of the EU would lead to:	Compared with a world where water resources were continually constrained, though not dramatically constrained, a long-term global water crisis would lead to:	Compared with a world of increasing economic and institutional interdependence where China and the US remain competitive but cooperative, a world of overt conflict between China and the US would lead to:	Compared with a world of low energy prices and little overt conflict between rivals in the Middle East, a world where conflict between Saudi Arabia and Iran drives increased energy prices would lead to:
Networked Effects:	A shift in economic interdependence, with China playing a more central role in global trade, and an increase in regionalism.	EU core remains connected, but periphery states scatter and Russia sees increased influence.	Increased focus on states sharing river basins and a shift in global economic interdependence with large agriculture-producing states driving trade.	A shift in global poles with clear and distinct spheres of influence that broadly compete.	An increase in domestic production of fossil fuels and investment in renewable energy drives down economic interdependence.
National Effects:	A reduction in global cumulative GDP of $18 trillion.	A reduction in cumulative GDP of former EU members by $3.9 trillion.	A decline in global cumulative GDP of $1.8 trillion.	A decline in global cumulative GDP of $35 trillion.	A decline in global cumulative GDP of $54 trillion.
Subnational Effects:	An increase in global poverty by 24 million and upper/middle class reduced by 48 million.	A reduction in the EU upper/middle class by 4.1 million.	An increase in global poverty by 13 million and a reduction in the upper/middle class by 4 million.	An increase in global poverty by 23 million and a reduction in the upper/middle class by 83 million.	An increase in global poverty by 23 million and a reduction in the upper/middle class by 92 million

Table 2: Summary of scenarios covered in this report to 2035. Source: Frederick S. Pardee Center for International Futures.

Chapter 1: International Futures and the Base Case scenario

International Futures

The quantitative component of this project relies largely on the International Futures (IFs) tool housed at the Frederick S. Pardee Center for International Futures at the Josef Korbel School of International Studies at the University of Denver. The IFs tool is an integrated assessment model that quantitatively connects variables across countries, time, and issue areas. Specifically, it models macro trends within and across 12 substantive issue areas for 186 countries and their interactions (see Figure 2). The tool incorporates a database of more than 3,500 series with data from 1960, when available.

IFs has been used to inform strategic planning and thinking across a wide range of development contexts, including for the US National Intelligence Council's Global Trends reports, the UN Global Environmental Outlook, various projects for the European Commission and other national governments, NGOs, and businesses.[2] See pardee.du.edu to download the tool, access full model documentation, and learn more about this open research.

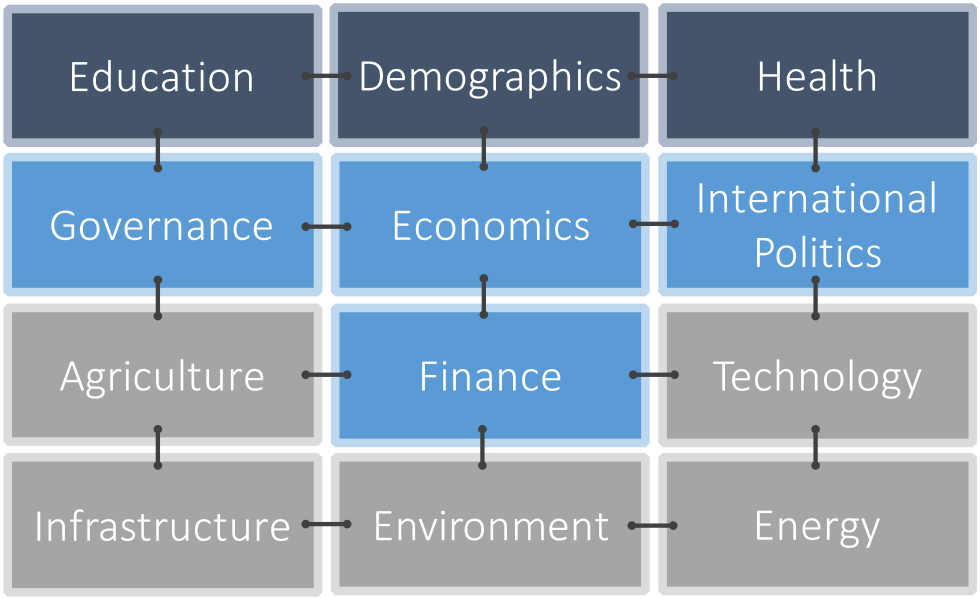

Figure 2: Sub-modules of the International Futures (IFs) Forecasting System.

A quick introduction to each model may help readers as a reference (from Hughes, 2015, pg. 2-5):

> The demographic model uses a standard cohort-component representation, portraying demographics in 5-year categories (adequate for most users), but building on underlying 1-year categories. Both fertility and mortality are computed endogenously. Migration is specified exogenously, currently using forecasts from IIASA.[3]

[2] For more information regarding the projects, and partnerships, and publications that use IFs see: http://pardee.du.edu/research-and-projects. Referenced in text: US NIC (2008, 2012), UNEP (2007) and Cave et al. (2009).

[3] As a result of project work connected to the Shared Socio-economic Pathways (SSP) initiative discussed later, the IFs system includes in its database IIASA forecasts on migration and education, Organization for Cooperation and Development and Potsdam

The economic model structure represents the contributions to production from labor, capital, and multifactor productivity (which is substantially an endogenous function of human capital, social capital/governance, physical capital–infrastructure and energy–and knowledge capital). A social accounting matrix structure flows across sectors and agent categories, assuring full financial flow consistency, including age-influenced savings and consumption patterns and relationships with government via taxes and transfers.

The education model represents the progression of students, year-by-year, through primary, lower secondary, upper secondary, and tertiary education, with some representation also of vocational education and the portion of tertiary students in science and engineering. Government spending on education per student and overall education spending is also important.

The IFs global health model uses drivers at both distal (i.e., income, education, and technology) and proximate (e.g. risk factors such as smoking rates and undernutrition levels) drivers to produce outcomes. This approach enables users to explore dynamic age, sex, and country-specific health outcomes related to 15 individual and clustered causes of mortality.

The domestic governance model represents governance in terms of three dimensions: security, capacity, and inclusion, each of which involves two or more elaborating variables. Variables connected to the dimensions include risk of domestic conflict, corruption, government effectiveness, democracy, and gender empowerment. Change in these variables is driven by variables across the other models, especially by income and educational levels but also demographic structure. Change in the three governance dimensions, in turn, drives other aspects of the integrated system, including economic productivity growth.

Revenues and expenditures are another critical element of governance represented in the model. Revenues involve streams from firms, households, and, in the case of foreign aid, from other governments. Expenditures involve streams to transfer payments and to direct expenditure on the military, education, health, infrastructure, R&D, and a residual other category. Government revenues and expenditures are fully integrated within the larger social accounting matrix system.

Energy and agricultural models are partial equilibrium with a physical basis that is translated to monetary terms for interface with the economic model. The energy model represents resources and reserves on the production side, which differentiates oil, gas, coal, hydroelectric, nuclear, and other renewable sources. The dynamics around the stocks of fossil resources and their use and those around the development of renewable forms are critical. The agricultural model represents land usage on the production side, which differentiates crops, meat and fish. As in the economic model, production-side representations are key to long-term dynamics. Trade in the energy, agricultural, and broader economic models uses a pooled approach rather than bilateral flows.

The energy model is driven on the demand side by the size of economies and populations, representing also the continued reduction of energy intensities in most countries.

Institute for Climate Impact Research forecasts of GDP, and National Center for Atmospheric Research forecasts of urbanization. The system also includes forecasts on its key variables from many other sources, allowing systematic comparison of those with each other and with the forecasts of IFs.

On the supply side, production requires not only resource bases, but also the accumulation of capital stock via investment in competition with other sectors. Trade is responsive to differential cost and price structures across countries. Interventions by the user can represent geopolitically based constraint in the growth of production, as well as decisions to restrain exports. Global prices are normally calculated so as to clear the market, but user interventions can override market prices. Most data are from the International Energy Agency. A recent update of the model added data on and forecasting of contributions from unconventional fossil resources (aggregating shale oil and gas, tight oil, coal-bed methane, etc.).

The agricultural model is similar to the energy model in general structure. Demand is very responsive to population and income levels; assumptions about future meat demand of emerging countries are important to long-term dynamics. On the supply side, crop yield per hectare is critical. Trade and price equilibration are similar to those in energy. Most data are from the UN Food and Agriculture Organization. The project is now substantially extending its treatment of aquaculture and wild fisheries.

The infrastructure model addresses selected forms of transportation (roads and paved percentage of them), electricity generation and access, water and sanitation, and information and communications technology (land-lines, mobile telephones and broadband connectivity by mobile phone or line). Demand and supply are related through the interaction of financial requirements and availability of private and public funds. Many parameters for setting and pursuing targets of access are available, and data are drawn from many sources.

The environmental model is closely tied to energy and agriculture, because both demands from those systems (for fossil fuels, land, fish, and water) and outputs from them (especially carbon dioxide) are key drivers of the model. The model represents atmospheric carbon as a stock and feeds its level forward to temperature and precipitation changes that, in turn, affect agriculture.

Technology is not actually a separate model. Rather, technology is represented across and within all the other models, for instance in changing cost structures for energy forms and rates of progress in raising agricultural yields.

The international political model calculates national material power (from inputs such as economic output, population, military spending, and a proxy for technological advance), but also allows the user flexibility around including and weighting these and other elements. Whether countries pose a threat to each other is a complex function of such power and of a number of other variables including level of democratization and trade relationships. The variables of the international political model are primarily satellites to the rest of the IFs system, but power dynamics do affect military spending levels directly and therefore all government finance indirectly.

The strengths of the model include (1) its representation of a wide range of fundamental structures in global issue systems, (2) the extensive data foundations of the system, (3) its integration of important global subsystems, and (4) its usability and transparency. It allows us to analyze the macro-economic, financial, and social implications geopolitical risk that we have sketched here and to which we now turn.

Base Case results

The IFs Base Case is a collection of forecasts that represent a dynamically interactive continuation of current policy choices and environmental conditions. Although the Base Case generally demonstrates continuity with historical patterns, it provides a structure that generates non-linear, dynamic, and endogenous forecasts rather than just a simple linear extrapolation of historical trends. The Base Case assumes no major paradigm shifts, policy changes or low probability but disruptive events, such as a global pandemic or a nuclear war. Given that the Base Case is built from initial conditions of all historical variables and is periodically analyzed in comparison to many other forecasts, it is a good starting point to carry out scenario analysis and construct alternative future scenarios. This section briefly covers some important trends that we will revisit in the scenario analysis sections throughout this report.

In the Base Case, Global GDP is forecast to increase to $141 trillion by the year 2035 from $81 trillion today.[4] Chinese GDP is forecast to increase from $9.3 trillion today to $31 trillion by 2035, surpassing the GDPs of both United States and the European Union by the mid to late 2020s. The below figures show GDP at MER for the United States, China, European Union and the rest of the world from 1960 to 2035.[5]

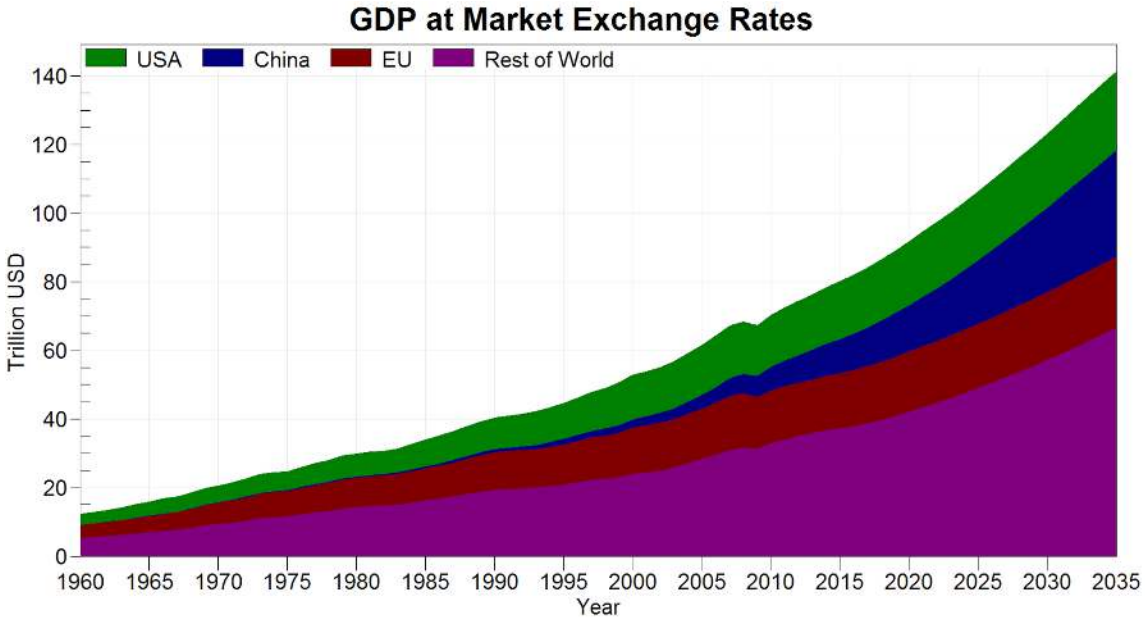

Figure 3: GDP at MER for major regions in the Base Case, forecast to 2035. Source: Historical data from IMF (2016) and forecast from IFs 7.28.

By 2035, China, the United States, India, Japan, and Germany are forecast to be the largest economies in the world in terms of GDP. The table below shows the change in the sizes of the ten largest economies in the world between 2016 and 2035.

[4] Currency forecasts are in real US dollars, and do not assume a particular rate of inflation.

[5] Unless otherwise noted, the European Union refers to the current member states excluding the United Kingdom.

Country	GDP at MER in trillion dollars (2016)	Rank in 2016	GDP at MER in trillion dollars (2021)	Rank in 2021	Change in Rank from 2016-2021	GDP at MER in trillion dollars (2035)	Rank in 2035	Change in Rank from 2016-2035
United States	17.2	1	19.0	1	-	23.1	2	↓
China	10.7	2	14.4	2	-	31.0	1	↑
Japan	6.2	3	6.3	3	-	6.7	4	↓
Germany	4.0	4	4.2	4	-	4.5	5	↓
France	3.0	5	3.2	6	↓	3.8	7	↓
United Kingdom	2.9	6	3.1	7	↓	3.8	6	-
India	2.6	7	3.8	5	↑	9.9	3	↑
Brazil	2.5	8	2.8	8	-	3.6	8	-
Italy	2.2	9	2.3	9	-	2.5	11	↓
Canada	1.9	10	2.1	10	-	2.6	10	-

Table 3: The 10 biggest economies in the world in 2016, 2021 and 2035 in the Base Case. Source: Forecast from IFs 7.28 using historical data from IMF (2016).

With increasing levels of globalization, inequality between countries has reduced significantly and global incomes have risen, and this trend is forecast to continue up to 2035 in the Base Case. However, even though inequality between nations is falling, inequality within some nations has risen considerably in the past years. The Base Case forecasts this trend to remain an obstacle to reducing poverty and extending access to basic services in many countries.

Globally, the number of people living on less than $1.90 per day is forecast to fall from 991 million today to 735 million in 2035 in the Base Case, with extreme poverty in China alone forecast to reduce from 69 million people today to 51 million people in 2035. The population without access to electricity is forecast to reduce by 217 million people by 2035 in the Base Case. Similarly, the undernourished population is forecast to reduce by 288 million people compared to 2016 by 2035 and the population without access to improved water resources is forecast to reduce by 30 million people compared to 2016. The threat of internal, or domestic, political instability (as shown in the figure below) is forecast to reduce across all World Bank country groups in the world up to 2035.[6]

[6] For more information regarding the measure of domestic instability used in this report please see Hughes et al., (2014).

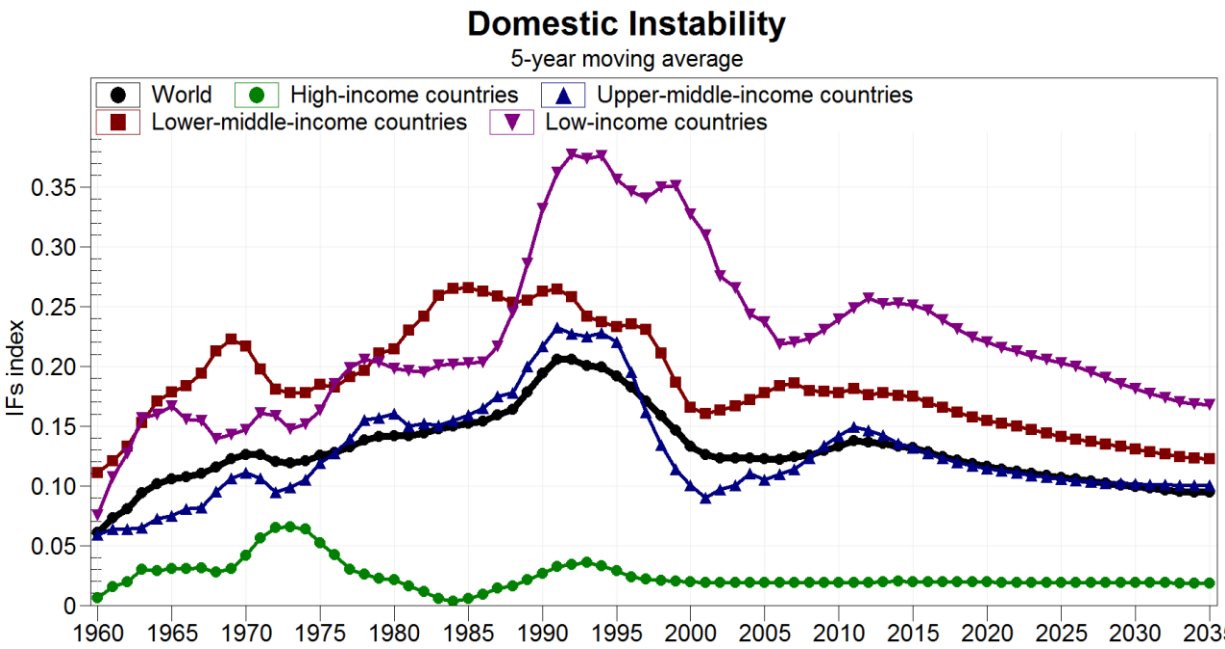

Figure 4: Threat of domestic instability across country groups (five-year moving average) in the Base Case. Source: IFs Index from Hughes et al. (2014) and forecasts from IFs 7.28.

Globally, energy demand is forecast to rise from around 90 billion barrels of oil equivalent (BBOE) in 2016 to over 140 BBOE by 2035. However, the production mix required to meet this demand is forecast to change significantly by 2035. Coal production is forecast to slow down by 2035 and will likely be replaced by gas and renewables as primary sources of energy production. Gas production is forecast to rise from 23 BBOE in 2016 to 39 BBOE by 2035. Renewables are forecast to constitute approximately 18 percent of total energy production by 2035 in the Base Case compared to 5 percent today. The figure below shows energy production by type of primary energy source.

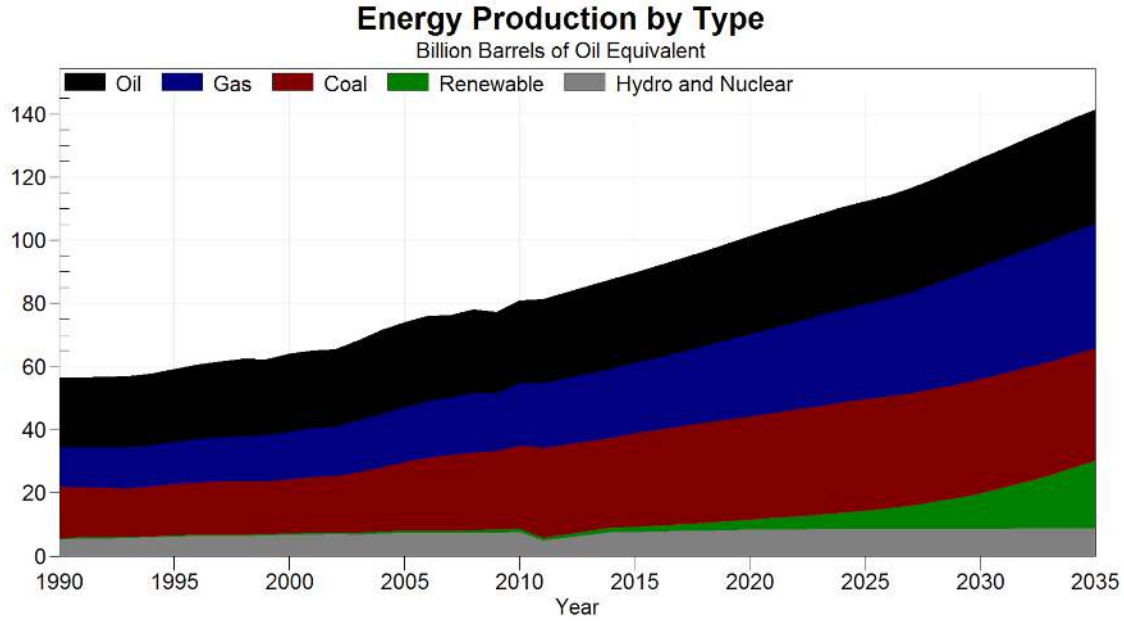

Figure 5: Global energy production by type of energy, forecast to 2035. Note: The renewable category excludes hydropower production. Source: Historical data from the International Energy Agency (2013) and forecast from IFs 7.28.

In the Base Case, military spending in the United States is forecast to fall from 3.4 percent of GDP (roughly $590 billion) to 2.4 percent of GDP ($560 billion) in 2035. Chinese military spending is forecast to surpass that of the United States during the late 2020s. India's military spending is forecast to rise from 2.5 percent of GDP ($65 billion) in 2016 to 2.78 percent of GDP ($270 billion) by 2035. Behind the United States and China, India, Russia and Saudi Arabia are forecast to have the next largest share of global military spending by 2035. The table below shows the changes in military spending among the ten biggest spenders up to 2035 in the Base Case.

Country	Military spending in billions (2016)	Global Rank in 2016	Military spending in billions (2021)	Global Rank in 2021	Change in Rank between 2016-2021	Military spending in billions (2035)	Global Rank in 2035	Change in Rank between 2016-2035
USA	586.8	1	555.6	1	-	559.9	2	↓
China	217.0	2	345.9	2	-	718.3	1	↑
Russia	84.7	3	85.0	4	↓	90.2	5	↓
Saudi Arabia	80.9	4	77.9	5	↓	102.9	4	-
India	65.3	5	100.4	3	↑	274.6	3	↑
France	65.3	6	61.4	7	↓	68.6	6	-
United Kingdom	56.9	7	56.1	8	↓	66.5	7	-
Japan	56.6	8	40.4	11	↓	21.9	20	↓
Germany	48.1	9	49.4	9	-	49.2	10	↓
South Korea	36.0	10	41.9	10	-	54.9	9	↑

Table 4: Military spending along with global ranks in the Base Case, forecast in 2016, 2021 and 2035. Source: IFs 7.28.

Participation in intergovernmental organizations (IGOs) is forecast to rise steadily through 2035. Chinese participation is forecast to rise more quickly than that of the US, though the US is still forecast to be a member of a greater number of important IGOs. In terms of the share of global power, as defined by the Global Power Index (GPI), China, United States, India, France and the UK are forecast to be the five most powerful countries in the world by 2035.[7] China is forecast to surpass the United States in GPI by the late 2020s in the Base Case. The table below shows changes in the GPI across the 10 most powerful countries in the Base Case in 2016, 2021 and 2035.

Country	GPI in 2016	Global Rank in 2016	GPI in 2021	Global Rank in 2021	Change in rank from 2016-2021	GPI in 2035	Global Rank in 2035	Change in rank from 2016-2035

[7] We use the Global Power Index (GPI) to measure and forecast relative power within the interstate system. The GPI is a multivariate index that captures a state's share of global power from 1816-2050. Power is defined in this index as a measure of states' military, economy, technology, political capacity, and human capital. Additionally, each variable contains multiple proxies with a variety of data sources that are updated annually. These variables are weighted based upon time periods and technological advances.

USA	23.3	1	21.9	1	-	18.0	2	↓
China	13.1	2	15.6	2	-	21.7	1	↑
Japan	5.4	3	4.8	3	-	3.5	6	↓
Germany	5.1	4	4.7	4	-	3.4	7	↓
France	4.9	5	4.6	5	-	3.8	4	↑
United Kingdom	4.5	6	4.3	6	-	3.8	5	↑
Russia	4.1	7	3.8	8	↓	3.1	8	↓
India	3.1	8	4.1	7	↑	7.0	3	↑
Brazil	2.3	9	2.2	9	-	2.0	9	-
Italy	2.2	10	2.0	10	-	1.5	14	↓

Table 5: Change in GPI across countries in 2016, 2021 and 2035. Source: Diplometrics at the Frederick S. Pardee Center for International Futures (2016) and IFs 7.28.

The IFs Base Case forecasts that global trade will grow at a slower rate than what was observed prior to the recession. However, barring any major disruptions to global value chains or trade patterns, including widespread and lasting backlash against globalization, trade networks are forecast to become increasingly dense and interconnected.[8] Since the early 2000s, the trade network has seen a significant increase in both the number of ties and the value of goods and services traded between partners. This trend is forecast to continue, though at a somewhat slower rate compared with pre-recession levels, through 2035. More specifically, the agricultural trade network has undergone more rapid expansion over the last decade. While this has helped provide access to a wide variety of goods and has diffused value added across globe, it may also create greater vulnerability to economic and weather-related shocks.

Today, China and the USA are the two most central countries in the global trade network.[9] By 2035, IFs forecasts that some high-income countries like the United States and Germany could become less central as countries like India and Indonesia become more deeply embedded in global value chains. Nevertheless, countries like France and Turkey, which have strong connections with both the high-income economies and many of these rising exporters, are forecast to become more central by 2035. In both energy and agricultural trade networks, China is forecast to become significantly more central over the horizon.

Total Trade Network	
2015	2035
China	China
USA	India
Germany	USA
India	Germany
France	France
Italy	Netherlands
Netherlands	Italy
UK	UK

Energy Trade Network	
2015	2035
USA	USA
France	India
UK	China
Germany	France
China	Nigeria
Australia	UK
Netherlands	Spain
Italy	South Korea

Agriculture Trade Network	
2015	2035
Netherlands	China
Germany	Netherlands
USA	USA
France	France
China	Germany
Italy	Italy
Belgium	Brazil
Spain	Belgium

[8] Here, density is calculated as the sum of the value of agricultural exports between all countries, divided by the product of the largest export value observed between two countries and the total number of possible trade partnerships.

[9] In this report, unless otherwise stated, centrality refers to the eigenvector centrality of a country within a given network, calculated by year for a sample network, which excludes ties less than one standard deviation above the mean in 2015.

Spain	Turkey	Spain	Italy	Brazil	UK
South Korea	Spain	Russia	Australia	UK	Spain
Japan	South Korea	Canada	Brazil	Russia	India
Russia	Japan	South Africa	Germany	Malaysia	Russia
Turkey	Switzerland	Japan	Indonesia	Turkey	Turkey
Switzerland	Belgium	Nigeria	Netherlands	Thailand	Vietnam
Belgium	Russia	South Korea	South Africa	Poland	Thailand
Brazil	UAE	India	Russia	India	Malaysia
Sweden	Ireland	Brazil	Canada	Argentina	Argentina
Canada	Indonesia	Algeria	Saudi Arabia	Canada	Poland
UAE	Canada	Norway	Japan	Vietnam	Indonesia
Thailand	Brazil	Saudi Arabia	Algeria	Japan	Ireland

Table 6: Top 20 most central countries by year and network. Source: IFs 7.28

Over time, centrality has become more evenly distributed, and this trend is forecast to continue across each network. This indicates that smaller, less developed, or more isolated countries are playing an increasingly important role in global value chains.[10] India's importance as a trade partner for both the developed and developing world has grown substantially over the past decade and a half, and is forecast to surpass the US in terms of centrality in the global trade network by the early- to mid-2020s.

[10] While higher levels of centrality are indicative of deeper embeddedness in global value chains, since the network in question includes trade across all sectors, centrality does not by itself imply any particular position within the production process.

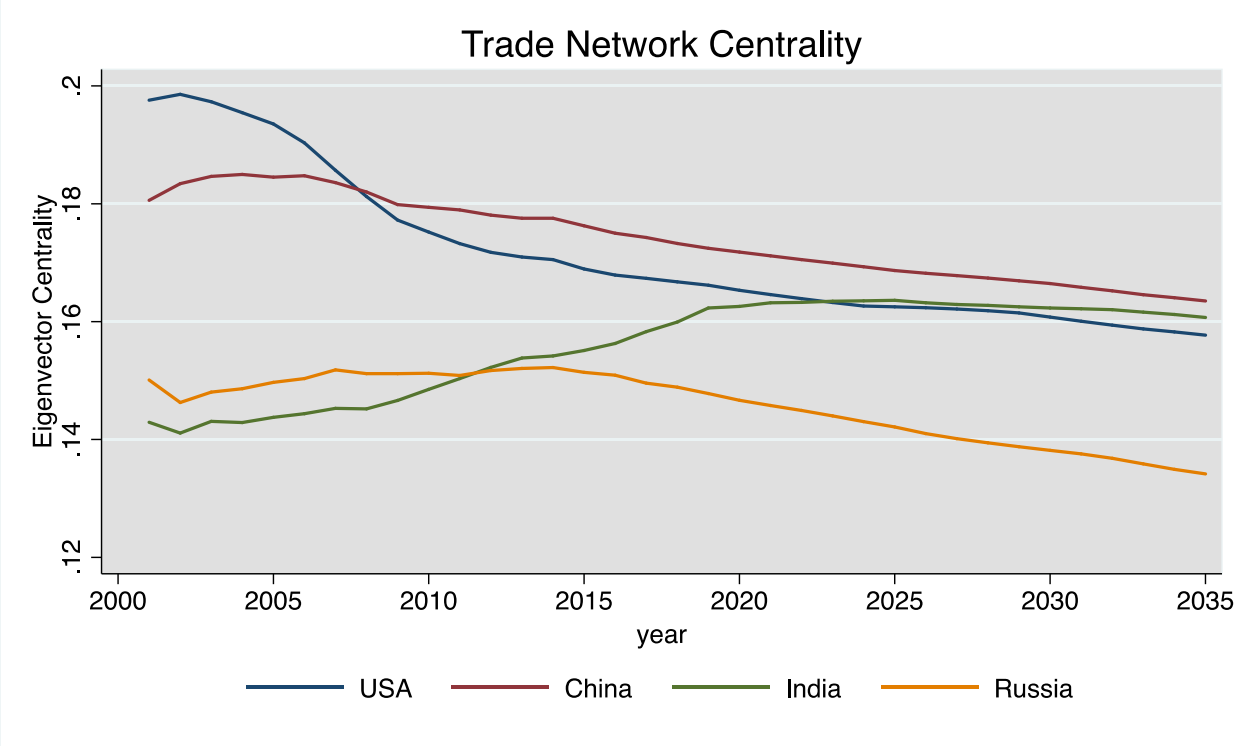

Figure 6: Eigenvector centrality within the global trade network for select countries. The trade network includes observations that were one standard deviation above the mean level of logged dyadic exports. Source: Calculated by the Frederick S. Pardee Center for International Futures with historical data from CEPII (2016) and forecasts from IFs 7.28.

Economic communities are shaped by multiple economic, political, and geographic forces.[11] In 2015, the community detection algorithm detected five communities: (1) one of primarily countries in the Western Hemisphere, (2) another centered on the European Union and peripheral trade partners in Europe, the Middle East, and Africa, (3) an Asian bloc with China acting as a hub, (4) a smaller Eastern Europe and Western Asia community with strong ties to Russia, and (5) some of the core Southern Africa Development Community (SADC) members.[12] The first three of these communities account for over 90 percent of global trade and power (measured by the GPI).

[11] Unless explicitly stated, communities, in reference to trade networks, refer to sub-networks of countries that tend to trade more among themselves than with the rest of the world.

[12] The community detection algorithm used for this calculation comes from Blondel et al. (2008). It is important to note that network visualization is a partially inductive process and results should be understood to be indicative of clusters of spheres of influence and not definitive measures of economic communities or spheres of influence. There is substantial uncertainty of long-range forecasts of network structures given the importance of social and political factors in their development.

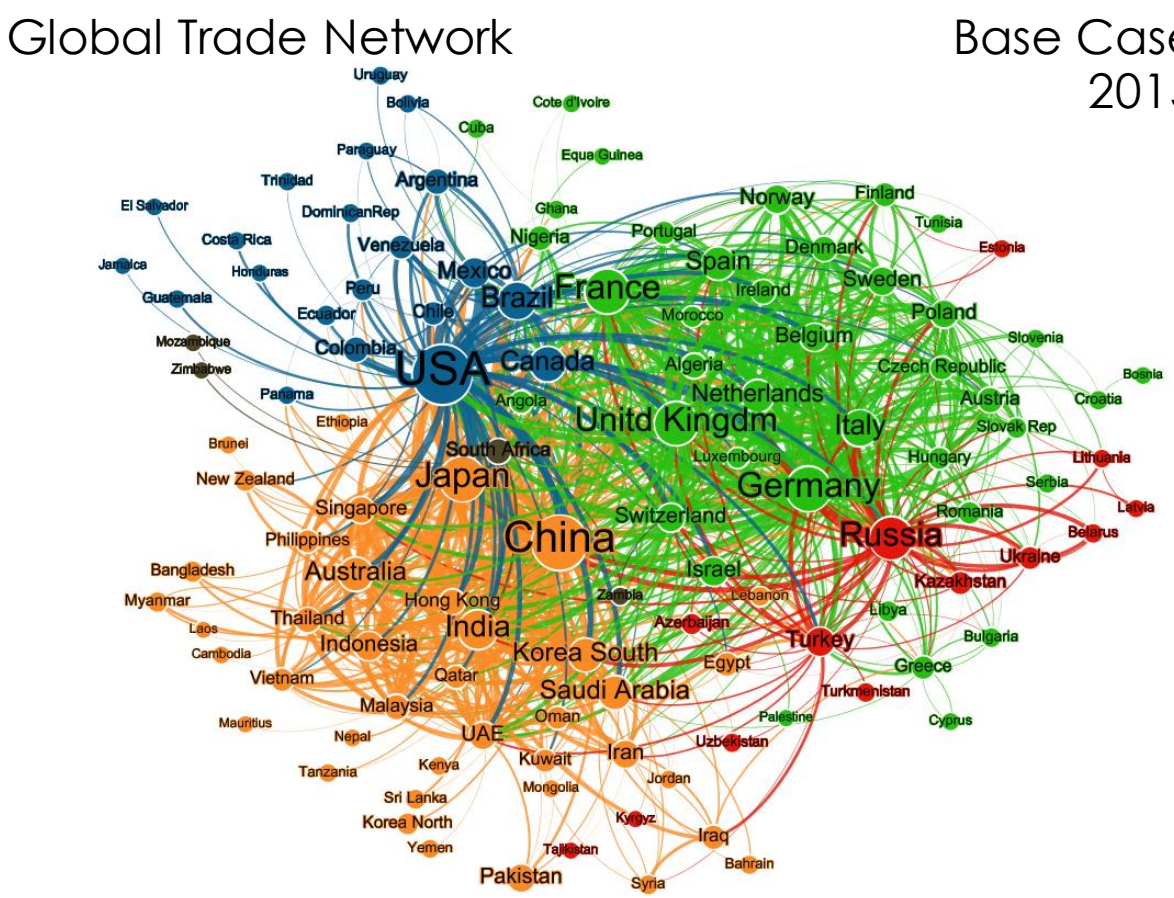

Figure 7: Global trade network in 2015 in the Base Case. The strength of ties is visualized using the natural log of exports between countries. Connection color is determined by the community of the exporting country. Colors groupings are determined by a one standard deviation above the mean level of logged dyadic trade threshold. The size of each node represents the relative power of the nation (according to the GPI). Node colors indicate communities within a network defined by bilateral exports as a percent of total imports of the partner country. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: IFs 7.28.

By 2035, the "center of mass" of global trade is forecast to shift toward the Global South as India (forecast to be the third most powerful country in terms of GPI) deepens relations across the globe, particularly with Eastern Africa and its most proximate South Asian neighbors. Nigeria and other members of the Economic Community of West African States (ECOWAS) are also forecast to strengthen economic interdependence. South Africa and other SADC members continue to trend towards greater integration with India and other countries in its community. In addition, IFs forecasts greater interdependence between European states, extending to Russia and Turkey. Many countries that were previously in Russia's community follow suit; however, others such as Kazakhstan, Uzbekistan, and Kyrgyzstan are drawn more towards China.

Global Trade Network Base Case 2035

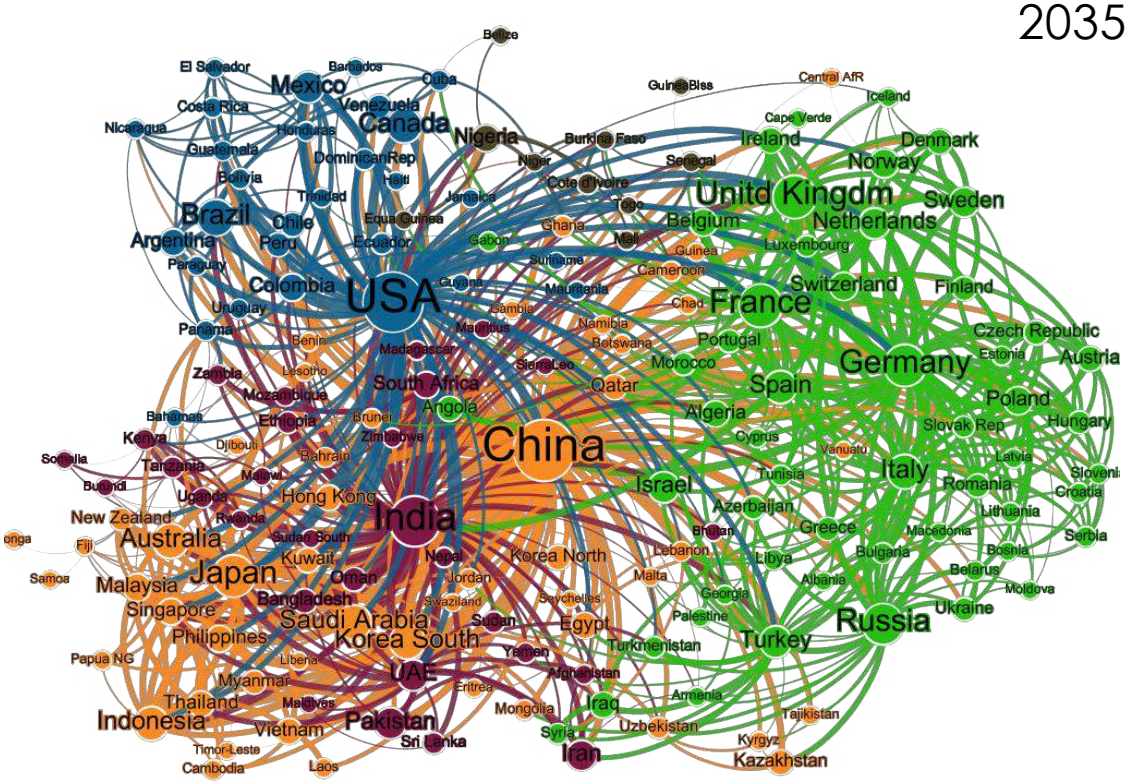

Figure 8: Global trade network in 2035 in the Base Case. The strength of ties is visualized using the natural log of exports between countries. Connection color is determined by the community of the exporting country. . Colors groupings are determined by a one standard deviation above the mean level of logged dyadic trade threshold . The size of each node represents the relative power of the nation (according to the Global Power Index). Node colors indicate communities within a network defined by bilateral exports as a percent of total imports of the partner country. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: IFs 7.28.

Some caveats about the Base Case are worth noting. The Base Case is not a prediction of what will happen. Rather, it is one of many possible scenarios and serves as a starting point to construct and evaluate alternative future scenarios. IFs Base Case forecasts are informed extensions of current trends and dynamics built upon assumptions about development patterns. While there are limits to any modeling endeavor (i.e., using them to predict specific rare events in the future), forecasting is a necessary human activity. Thinking systematically about the future, with the assistance of quantitative models, can create a platform for people to plan their future more effectively, even in the face of uncertainty. When forecasts are explicit and transparent, the utility of the analysis is enhanced. The IFs software provides that transparency, thereby helping policy-makers think more carefully about some of the risks and tradeoffs that accompany their choices.

Chapter 2: Trade Protectionism

Introduction

Globalization is associated with increased economic interdependence and free trade in goods and services. Classical liberals have argued for decades that reduced barriers to trade will drive increased overall economic growth through specialization. Indeed, especially at the global level, data has demonstrated these gains to trade and the theory of comparative advantage remains robust.

However, recent backlash against global free trade has arisen in many wealthy countries, where the loss of jobs in particular sectors highlights an unequal distribution of trade's benefits. Protectionist political victors in these countries have pushed for increased trade barriers to retain jobs lost to globalization and promote domestic industry.

In the Base Case, we forecast global trade as a share of GDP to remain relatively flat—a pattern that emerged since the Great Recession and one reflected in our Base Case scenario. However, it is possible that trade openness could grow again. In Globalism Resurgence, a revival of trade integration increases global economic output to 2035. It is also possible that trade openness will decline. In the Protectionist Victory scenario, global trade as a share of GDP declines significantly, resulting in a cumulative $44 trillion less in global economic output by 2035, relative to Globalism Resurgence.

More trade protectionism could—at least in the short run—benefit relatively scarce factors of production, like low-skilled labor in the European Union and United States. This is in contrast to the benefits that globalization has conferred on relatively plentiful factors—notably capital and high-skilled labor in high-income countries—by giving those factors global reach, while exposing relatively scarce low-skilled labor in those countries to competition from abroad.

In a less globalized world, developing countries would pay a price. The difference in the number of people living on $10 or more between Globalism Resurgence and Protectionist Victory would be over 120 million by 2035, or roughly the size of Mexico or Japan's population today. While the middle and upper classes in high-income economies remain largely the same across these scenarios, increased global protectionism undermines the growth of a middle class in the rest of the world. The vast majority of those that are unable to move out of a state of economic vulnerability (income between $3.10 and $10 per day) are from non-OECD countries. In Globalism Resurgence, the non-OECD middle-class (defined as the population living on between $10 and $50 per day) grows from 1.2 billion today to 2.4 billion in 2035, whereas in Protectionist Victory the non-OECD middle-class in 2035 is 100 million fewer.

Relative to the Base Case, the probability of internal political instability increases in 63 countries in Protectionist Victory. This increase in the probability of violent conflict is driven by stalling human development and government capacity. India, Egypt, the Philippines, and Thailand are among those that experience the greatest increase in risk of instability under this scenario.

			Change Relative to Base Case in 2035	
	Base Case 2016	**Base Case 2035**	**Globalism Resurgence**	**Protectionist Victory**
GDP *billion USD*	81,960	141,410	25,880	-18,040
Extreme Poverty *million people*	950	711	-22	33

Middle Class ($10+/day) *million people*	2,475	3,950	68	-54
Instability *count of countries*	-	-	0	63
Networked Effect *description*	-	-	China and India are the two most central countries in global trade networks in both scenarios. Under increased protectionism, Europe and south-central Asia lose prominence as Africa begins to play a more central role.	

Table 7: Overview of findings for Protectionism scenarios. Note: GDP is reported as the cumulative difference between the Base Case and Scenarios (billion USD); Extreme poverty measures those living on less than $1.90 per day (million people); Middle class includes those living on greater than $10 per day (million people); Instability is reported as the number of countries experiencing higher levels of instability relative to the Base Case. Source: IFs 7.28.

Background and theory

Historical trends

The second age of globalization, following World War II, ushered in considerable growth in global trade. Between 2000 and 2011, global exports doubled from $10.2 trillion (approximately one-fifth of global production in 2000) to nearly $21.5 trillion in 2011 (nearly one-third of global production). High-income economies still account for around 70 percent of global exports and imports. However, their share has been in decline since the mid-1980s, as upper- and lower-middle income economies continue to grow and integrate into the global economy. More recently, the value of exports has stagnated, exhibited by a slight decline since 2011.

Trade openness–a country's total trade relative to its GDP—has also grown across time, albeit unevenly.[13] It grew slowly in the 1960s, more rapidly in the 1970s, slowly again in the 1980s and then quite rapidly at the end of the Cold War—a trend which continued until roughly 2009. Since the end of the Cold War, trade openness in the European Union has increased by around 50 percent, China by nearly 75 percent, and India by over 140 percent. The global financial crisis marked a break in this trend. As attitudes sour toward globalization and protectionist measures become increasingly central to political debates, trade openness growth rates have stagnated and even contracted in some instances.

[13] While often conflated, trade openness and liberalization are not synonymous. Trade openness refers specifically to the ratio of trade to production, regardless of policy. Liberalization instead refers to policies and the absence of trade restrictions.

Figure 9: Global exports as a percent of GDP. Source: United Nations Conference on Trade and Development (UNCTAD) (2016).

The patterns of trade openness over the past decades have been accompanied by increasing density of trade relations. Further, China's meteoric rise as a major trade partner has played an important role in rewiring trade patterns over the last two decades. Since the mid-1990s, China's centrality in economic networks has risen so dramatically that today it is the most central country in the world by a small margin.[14]

[14] Note that a high degree of centrality in an aggregate trade network does not capture centrality within specific production processes but instead in overall trade flows.

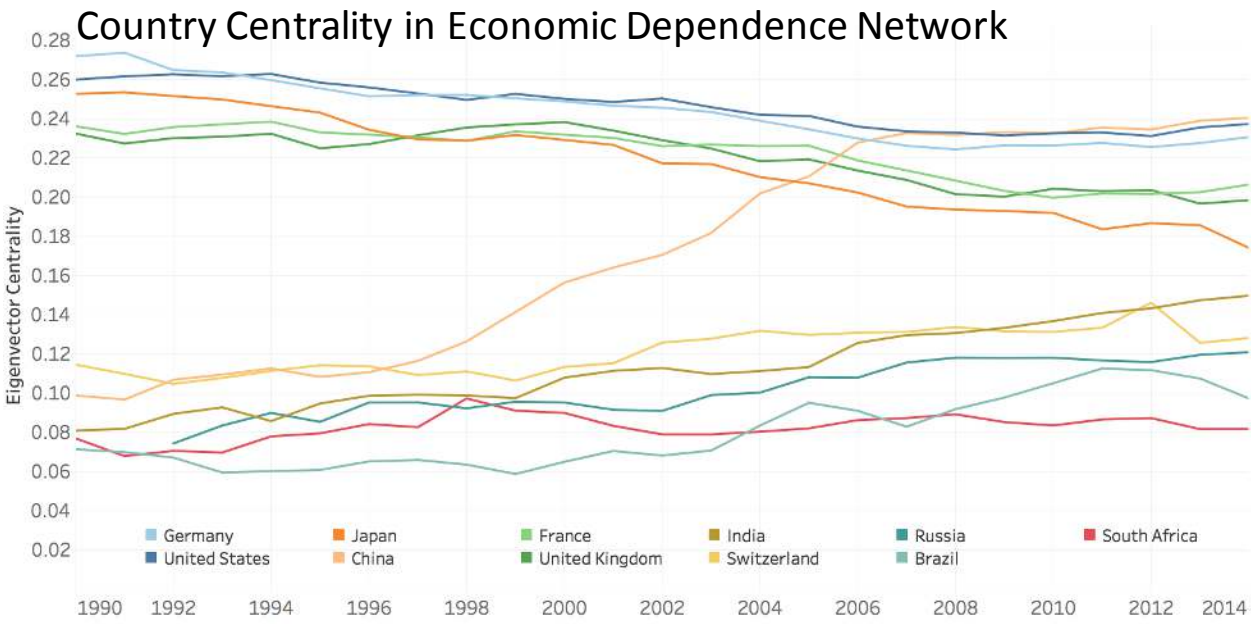

Figure 10: Country Centrality over time as measured by eigenvector centrality. Source: Frederick S. Pardee Center for International Futures with data from UNCTAD (2016).

With the rise in economic importance of China, many countries that have strong ties with the West are increasingly reliant on Chinese trade, aid, and investment. Pivot states, or countries that exist within overlapping spheres of influence between two or more major powers, can impact regional and global security, especially as their positioning changes relative to either power. In 1980, only a handful of pivot states existed between China and the U.S. (Zimbabwe, Sri Lanka, Singapore, and Myanmar, for example). But by 2014, many countries had moved away from exclusive economic and financial ties with one or the other, strengthening relationships and deepening economic dependence on both the United States and China. [15]

[15] The Economic Dependence Index uses the relative size of the flow between countries to capture how reliant one country is on another for economic activity. The components of the Economic Dependence Index include exports and foreign aid. Exports are included both as a share of total imports and as a percent of GDP of the importing country, and foreign aid is included both as a share of total aid and as a percent of GDP of the recipient country. Examining the relative share of each resource provides insight into the reliance of one country on another within a certain type of interaction, while the latter set of indicators measures the importance of that interaction type to a broader macro indicator within the same issue area.

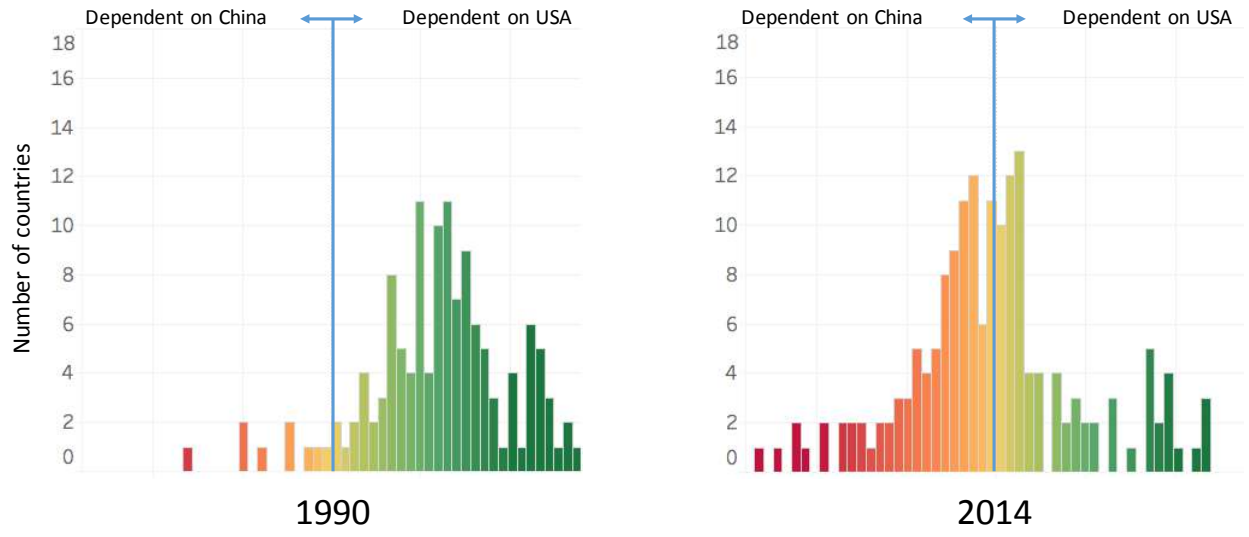

Figure 11: Distribution of countries dependent on China and the United States in 1990 and 2014. Source: Frederick S. Pardee Center for International Futures with historical data from UNCTAD (2016).

The map below shows that while there is certainly a geographic correlation with primary economic dependence, China's influence has spread across the globe.

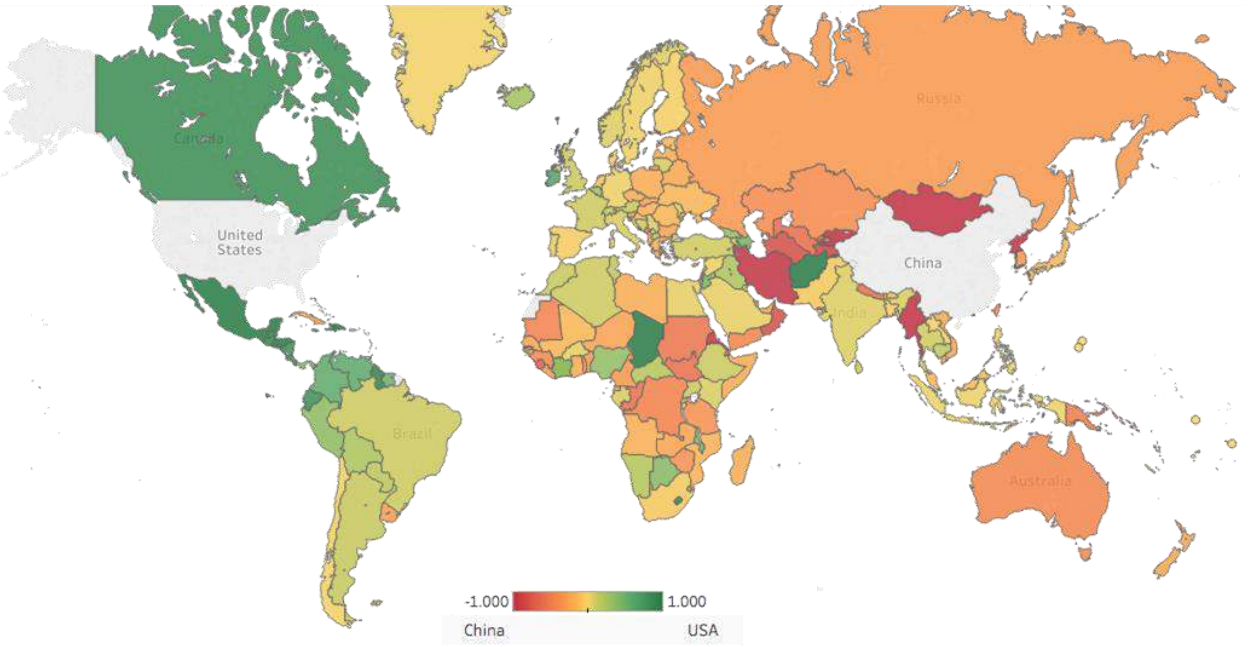

Figure 12: Map of countries dependent on China and the United States in 2014. Source: Frederick S. Pardee Center for International Futures.

Trade and growth

The potential benefits from international trade were first introduced by Adam Smith's *The Wealth of Nations*, which detailed how trade begets growth through enabling specialization, economies of scale, knowledge spillovers, and innovation. Ricardo's model of comparative advantage has become the fundamental model of neoclassical economics and demonstrates how all countries should benefit from trade: even without an absolute advantage, a country and its trading partners will experience productivity

gains and benefit from specialization. Smith's work and the Ricardian model support the notion that international trade facilitates long-term economic growth globally.

More recent research argues that increased trade, especially through the promotion of exports, leads to increased economic growth. The export-led growth paradigm that followed peaked in the 1980s and 90s. Economists argued that to fully realize the benefits of trade, countries should liberalize much as possible, a position supported by highly influential empirical work (Dollar, 1992; Krueger, 1997; Sachs & Warner, 1995). It is also possible that growth itself leads to increased trade as heightened skills and technology give a country a new comparative advantage (Bhagwati, 1989; Lancaster, 1980). And if both the export-led growth and growth-led export theories hold true, a feedback loop could lead to increasing returns (Bhagwati, 1989; Helpman & Krugman, 1985).

Other research has cast doubt on the rosy conclusions drawn by economists pushing for complete liberalization (Levine & Renelt, 1992; Rodríguez & Rodrik, 2000; Wacziarg & Welch, 2008). And less optimistic theories help to illuminate some of the nuances in the trade-growth relationship. Export dependence can make some countries vulnerable to an uncontrollable external market and discourage diversification (Jaffee, 1985; Prebisch, 1959). Further, while developing countries may benefit from the ability to import manufactured goods and technology, it can also make them slow to develop their own technology and reliant on primary commodities (Acemoglu & Zilbotti, 1999; Jaffee, 1985).

In fact, evidence generally points to a number of factors influencing the relationship between trade and growth. Earlier work in this regard suggests that countries may need to reach a minimum level of development or development of the trade structure to realize trade's benefits (Helleiner, 1986; Kohli & Singh, 1989). Recent studies have pointed to the importance of the regulatory environment, export dependence, labor market regulation, and property rights protection (Chang, Kaltani, & Loayza, 2009; Freund & Bolaky, 2008; Herzer, 2013). In some cases, countries may also be held back by low educational attainment, macroeconomic instability, lack of public infrastructure, and poor governance (Chang et al., 2009).

The case for protectionism tends to follow from these conditional factors. In developing countries, the focus is on import substitution—the substitution of domestic output for imports through tariffs, quotas, and subsidies. Selective protectionism can help countries with key comparative disadvantages, like in research and development, catch up (Acemoglu & Zilbotti, 1999). In developed countries, the case for protectionism may call to protect manufacturing and promote reindustrialization or may focus on promoting high-tech information industries considered vital to the economy (Bhagwati, 1985). Other arguments have been made for the importance of having a somewhat self-sufficient economy for national defense and to prevent dumping.

Restrictive trade policies may have several different effects. If sectors are linked internationally, restrictions will prevent knowledge spillovers, and countries/firms will be forced to engage in redundant research efforts—rediscovering what has already been discovered. Rivera-Batiz and Romer (1991) find that protectionism between two industrialized countries unambiguously impedes growth. However, research has shown that some selective protectionism may boost growth when trading partners are different sizes with widely divergent resource endowments (Rivera-Batiz & Xie, 1993), have wide gaps in technological capability (Grossman & Helpman, 1990) or when a country's initial comparative advantage is in agriculture (Matsuyama, 1992).

Clearly the notion that trade generates national economic growth is—while generally accepted and certainly not disproven—an overly simple assessment. Research shows that forcing a complete liberalization, a la the 'Washington Consensus,' can have harmful effects on a national level. But it would be just as wrongheaded to push for autarky. Trade has played an important role in the ascension of today's advanced economies, even if policies have not been totally liberal (Williamson, 2002). Overall, trade can be understood to encourage growth and certainly increase growth potential, with considerations for the economic conditions of the involved countries.

Employment and inequality

Trade also has differential implications on the subnational level. Theory has traditionally addressed this by looking at countries' resource endowments. For instance, a country with abundant arable land will have a comparative advantage in agricultural products. Through trade and specialization, the relative return on land will increase while that on other factors will fall (Stolper & Samuelson, 1941). Similarly, a capital-abundant and labor-scarce economy—like most advanced economies today—will specialize in capital-intensive production and move away from labor-intensive production, resulting in a fall in relative wages. So even while the economy is growing on a national level (and there is potential to redistribute those gains), trade is still generating winners and losers.

Under traditional trade models, which assume full employment and fully flexible wages, workers in 'losing' sectors can easily obtain better employment in the 'winning' sectors. This assumption is at the heart of the most visible and contentious trade policy debate: Does trade create or destroy jobs? Research shows that the relationship between trade and employment is complex but not entirely surprising. In some cases, increased trade tends to lead to higher employment when labor is focused in export industries (Davidson & Matusz, 2004; Dutt, Mitra, & Ranjan, 2009; Felbermayr, Prat, & Schmerer, 2011; Jenkins, 2004; Milner & Wright, 1998). However, where labor is concentrated in import-competing and high-turnover industries, trade may lead to unemployment (Davidson & Matusz, 2004; Helpman & Itskhoki, 2010; Janiak, 2006; Leichenko & Silva, 2004).

The ability of labor to adjust after a trade shock is also important here, if workers are to be picked up by expanding export sectors. Job destruction happens immediately whereas job creation takes time (Dutt et al., 2009). But this may be prevented entirely if labor productivity grows faster than demanded output, as happened in Brazil (Menezes-Filho & Muendler, 2011). This resulted in more displaced workers turning to the informal sector and much longer reallocation periods. Adjustment can also take the form of falling wages, in which wages in import-competing sectors drop sharply (around 20 percent) before readjusting to slightly below their initial value in around eight years (Artuç, Chaudhuri, & McLaren, 2010). It should also be noted that readjustment and reallocation is significantly more difficult for older and lower-skilled workers.

Closely related to labor market concerns, many are worried about trade's impact on the poor and unskilled. If trade is not sufficient to efficiently reallocate labor, a labor-scarce economy like the United States may expect to see rising inequality with liberalization. Feenstra and Hanson (2001) find that increased international trade, especially in intermediate inputs, contributes to the gap between skilled and unskilled wages in OECD countries. This appears consistent with a Stolper-Samuelson model which expects labor to suffer where labor is the scarce factor but to benefit when it is more abundant. But increased inequality has also been shown in labor-abundant developing countries through an increase in the skill premium, transitional unemployment, changes in industry wages, uncertainty, and labor market standards (Goldberg & Pavcnik, 2007). While the Stolper-Samuelson assumptions may account for some cross-sector inequality, Helpman, et al. (2012) use more recent models of firm heterogeneity to show that

increased trade can lead to within-sector inequality as well. Larger, exporting firms benefit disproportionately from trade and can pay higher wages than smaller, non-exporting firms—a gap that is enhanced by trade liberalization.

Distributional effects aside, it has been shown that integration into the global economy through trade can help to reduce poverty. To affirm this assertion requires two steps: that trade leads to growth and that economic growth reduces poverty. We find we can accept the first link in a very general and qualified sense, as explained previously. We can be more confident in the second link—between economic growth and reduced poverty. Not all economic growth is pro-poor. But on average, an increase in mean income will lead to a reduction of the proportion of people living in poverty (Ravallion, 2001). Therefore, in the long run and on average, increased trade should help to alleviate poverty (Winters, McCulloch, & McKay, 2004). Cline (2004) shows that the removal of protectionist barriers by industrial countries would speed up the rate of poverty reduction significantly. It follows that increased protectionism especially that imposed by developed on developing countries, could further slow the downward trend of poverty reduction around the globe.

Trade and conflict

Trade and economic interdependence are generally believed to have a pacifying influence. Put simply: more trade means less conflict. This idea is hardly new. For Kant (1795), economic interdependence was one of three key requirements for maintaining perpetual peace, along with democracy and international institutions. Trade creates common interests, encourages cooperation, and leads to transnational ties; meanwhile, productive members of society gain increased political power. Further, by hurting both the supply of importers and business of exporters, war often becomes too costly even in the event of victory (Angell, 1912). Support for the 'trade promotes peace' theory is widespread (Mansfield, 1995; Polachek, 1980). For instance, there is evidence that not only heightened trade between two countries but also general trade openness is associated with fewer incidences of militarized conflict (Oneal & Russet, 1997). In fact, Copeland (1996) has argued that it is not necessarily actual trade that prevents conflict, but 'trade expectations.' Countries that anticipate a beneficial economic relationship with one another will want to maintain friendly relations. But if trade expectations are bleak, countries will not have the same constraints against conflict. If this is true, protectionist measures and the subsequent deterioration of trade expectations could remove an important deterrent to conflict between powers like the U.S. and China.

Shifting trade patterns

Changes in trade policy can also be expected to affect international trade patterns. For one, restrictive policies may be meant to incentivize firms to move production from one country to another. But investments in physical capital are far from perfectly flexible. That is, once an automobile factory is built, it cannot overnight transform into a call center. The modeling literature refers to this as putty-clay modeling. Once flexible capital (putty) is turned into physical capital or durable goods (clay), it cannot be converted back (Fuss, 1977; Gilchrist & Williams, 1998). What happens to existing factories and processes if trade restrictions make production in one country less profitable? Empirical research on the capital adjustment process is difficult to obtain. But there is evidence that conditional factors include whether trade shocks were anticipated and if they are expected to be permanent or temporary (Van Wijnbergen, 1985), current demand trends, and whether a company can recover losses through exporting or domestic consumption (Tuong & Yeats, 1981).

Foreign direct investment is also an important part of trade and trade patterns. FDI can be seen as a "composite bundle of stocks, know-how, and technology" (de Mello, 1997, p. 8), so theoretically it should

lead to greater output just by nature of the additional capital and technology. Beyond the immediate value-add of FDI production, FDI may also accelerate growth through productivity spillovers and investments in human and technology capital. However, most global-level research on FDI and economic growth yields mixed results (Carkovic & Levine, 2002; de Mello, 1999; Iamsiraroj & Ulubaşoğlu, 2015; Nair-Reichert & Weinhold, 2001). Some of this may be explained by differing absorptive factors of host countries—an insufficiently educated workforce, general underdevelopment, undeveloped financial markets, lack of human capital, and poor infrastructure (Balasubramanyam, Salisu, & Sapsford, 1996; Carkovic & Levine, 2002; de Mello, 1999). But it appears that trade policy may play an even more important role.

Several studies point out the differential effects of FDI on countries with import substitution policies (Balasubramanyam et al., 1996; Borensztein, De Gregorio, & Lee, 1998). But rather than trade policy being an absorptive condition, Moran (2005) argues that most contemporary FDI is meant to develop an integrated supplier network as part of a global value chain (GVC). These ventures invest in world-class technology and production processes in order generate intra-industry exports and contribute to national growth. Another type of FDI, tariff-jumping investments, is meant to service a protected domestic economy. These ventures are often too small to capture economies of scale and employ outdated equipment and production processes. While profitable for parent companies, these small operations are unable to generate growth through externalities and will not be competitive even if the country later liberalizes.

Of course, global value chains complicate more than just investment. Countries today operate on a vast GVC network and specialize in individual tasks rather than particular products or industries. At the country level, integration into GVCs is associated with higher growth rates (Saito, Ruta, & Turunen, 2013) with the benefits determined by the domestic 'value added.' Countries with high value-add industries tend to see more job creation in high-skilled sectors while lower value-add countries have greater employment in lower-skilled sector (Rashmi, 2013). Greater fragmentation of production processes means that a change in trade patterns could have multiplicative impacts on production and trade flows. Thus, economies that are highly integrated into GVCs are much more vulnerable to protectionist shocks. And traditional 'beggar thy neighbor' trade policy can turn into 'beggar thyself' policy if countries are interconnected (Gawande, Hoekman, & Cui, 2011).

Both the United States and China are deeply integrated into GVCs. In fact, China has one of the highest participation rates in GVCs globally (WEF, 2012). But their place within the GVC is different. While the United States has a high domestic value add compared to foreign value add (value add from imports), China, with a higher foreign value add, sees more gains due to scale of production than from value of production (Rashmi, 2013). The US economy depends on efficient imports in order to add value through domestic manufacturing before exports. Therefore, the imposition of protectionist measures by the US on imports would raise the domestic cost of production and make US exports less competitive.

Scenarios

Globalism Resurgence and Protectionist Victory

To understand the risks of an increasingly protectionist world, we explore two scenarios: **Globalism Resurgence** features an ambitious global growth in trade and FDI in the way envisioned by trade agreements like the Trans-Pacific Partnership (TPP) and Transatlantic Trade and Investment Partnership (TTIP). **Protectionist Victory**, by contrast, includes a significant reduction in trade and FDI as a share of

GDP globally. Both are compared against the Base Case which shows a global flattening of trade flows and FDI as a share of GDP.[16]

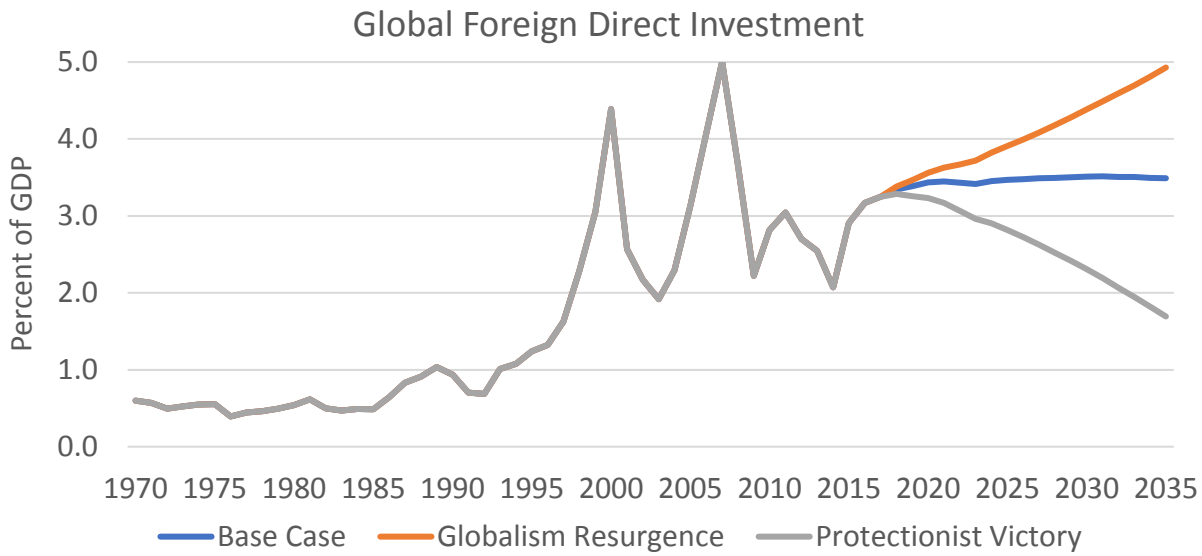

Figure 13: Global FDI assumptions (FDI inflows as a percent of GDP) of the Globalism Resurgence, Protectionist Victory, and Base Case scenarios. Source: Historical data from UNCTAD (2016) and the World Bank (2016) with forecasts from IFs 7.28.

Between Globalism Resurgence and Protectionist Victory is a cumulative difference in global economic output of $44 trillion by 2035. The foregone gains seen in Protectionist Victory are felt more strongly in countries that have not yet been able to take full advantage of the global economy. In that scenario, GDP (at MER) is 8 percent lower in low-income economies by 2035 compared with Globalism Resurgence and 5 percent lower in high-income countries.

	Base Case *2016*	Base Case *2035*	Globalism Resurgence *2035*	Protectionist Victory *2035*
Eastern Africa	5.1	6.7	7.2	6.1
Middle Africa	2.4	6.1	6.5	5.6
Northern Africa	3.1	3.5	4	3
Southern Africa	1.2	3.1	3.4	2.4
Western Africa	2.3	4.9	5.3	4.3
Caribbean	1.9	3.4	3.9	2.9
Central America	3.9	3.8	4.2	3.2
North America	2	1.4	1.7	0.9
South America	0	2.5	3	1.9
East Asia	4.1	3.5	3.9	3
South-Central Asia	6.2	6.2	6.8	5.6
South-East Asia	4.6	4.2	4.7	3.8
West Asia	2.7	3	3.3	2.6

[16]For a detailed description of the parameters used in each scenario see Appendix A.

Eastern Europe	1.1	1.6	1.9	1.1
Northern Europe	1.8	1.4	1.7	1
Southern Europe	1.2	0.5	0.9	0
Western Europe	1.4	0.7	1	0.4
Oceania	2.8	1.9	2.2	1.5

Table 8: Five-year moving average of economic growth rates of UN sub-regions under the Globalism Resurgence, Protectionist Victory, and Base Case scenarios. Source: IFs 7.28 with historical data from the IMF (2016).

The table above shows the economic growth rates across UN sub-regions. Eastern Africa and South Central Asia appear as the most sensitive to long-term protectionist policies, with a difference in GDP growth rates of 1.4 and 1.3 percentage points respectively between the Globalism Resurgence and Protectionist Victory scenarios. With some European countries already forecast to see lower levels of growth over the coming decades, an increase in global protectionism on the scale simulated in the Protectionist Victory scenario could translate into an economic recession. In this scenario, negative growth rates are forecast in Italy, Portugal, and Netherlands by 2035.

The difference in the number of people in the middle or upper class, living on $10 or more, between the Globalism Resurgence and Protectionist Victory scenarios would be over 120 million people by 2035, or roughly the size of Mexico or Japan's population today. While the middle and upper class in high-income economies remains largely the same across these scenarios, increased global protectionism undermines the growth of a middle class more so in the rest of the world, with the vast majority of those that are unable to graduate from a state of economic vulnerability (income between $3.10 and $10 per day) from non-OECD countries. In the Globalism Resurgence scenario, the non-OECD middle class grows from 1.2 billion today to 2.4 billion in 2035, whereas in Protectionist Victory the non-OECD middle class in 2035 grows to 2.3 billion by 2035.

Relative to the Base Case the probability of violent domestic conflict increases in 63 countries in the Protectionist Victory scenario. This increase in the probability of violent conflict is driven by stalling human development and government capacity. India, Egypt, the Philippines, and Thailand are among those that experience the greatest increase in risk of instability under the Protectionist Victory scenario.

Barring any major disruptions to global value chains or trade patterns, including widespread and lasting backlash against globalization, economic integration is forecast to continue to deepen and expand to include new partners.[17] Since the early 2000s, the trade network has seen a significant increase in the number of ties and value of goods and services traded between partners. The Base Case forecasts a similar trend through 2035; however, in Globalism Resurgence, integration continues at a similar pace to that seen in the years leading up to the great recession. In a scenario with greater protectionism, integration continues but at a slower pace than what is forecast in the Base Case, and driven primarily by less developed countries.

[17] Here, density is calculated as the sum of the value of agricultural exports between all countries, divided by the product of the largest export value observed between two countries and the total number of possible trade partnerships among the 186 countries covered in IFs

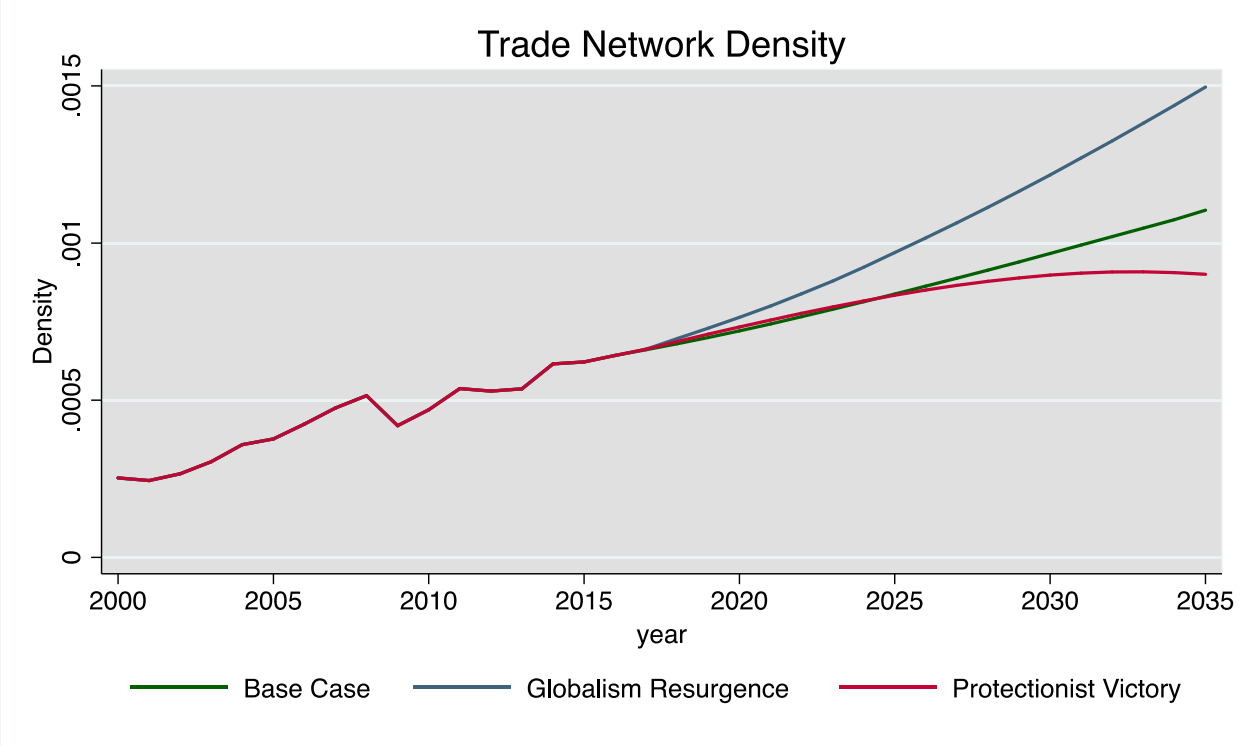

Figure 14: Trade network density for the Base Case, Globalism Resurgence, and Protectionist Victory scenarios. Calculated by the Frederick S. Pardee Center for International Futures with historical data from CEPII (2016) and forecasts from IFs 7.28.

The structure of the trade network in Globalism Resurgence remains similar to the Base Case in 2035, with India's community attracting some additional countries in Southern Africa and the Middle East, and Nigeria drawing closer to the Americas. However, under Protectionist Victory, as former proponents of trade liberalization begin to raise barriers and focus more regionally, many South American and African countries seek new trade partners to replace the vacuum left by the United States and Europe, and move towards greater reliance on China. Russia refortifies economic ties with former Soviet states and close neighbors, as well as with Iran, Iraq, Syria, and Libya. The share of global power (GPI) attributed to countries found in European or US communities falls nearly 10 percentage points in Protectionist Victory, and reaches a historical high for the countries found in China's community.

Global Trade Network Globalism Resurgence 2035

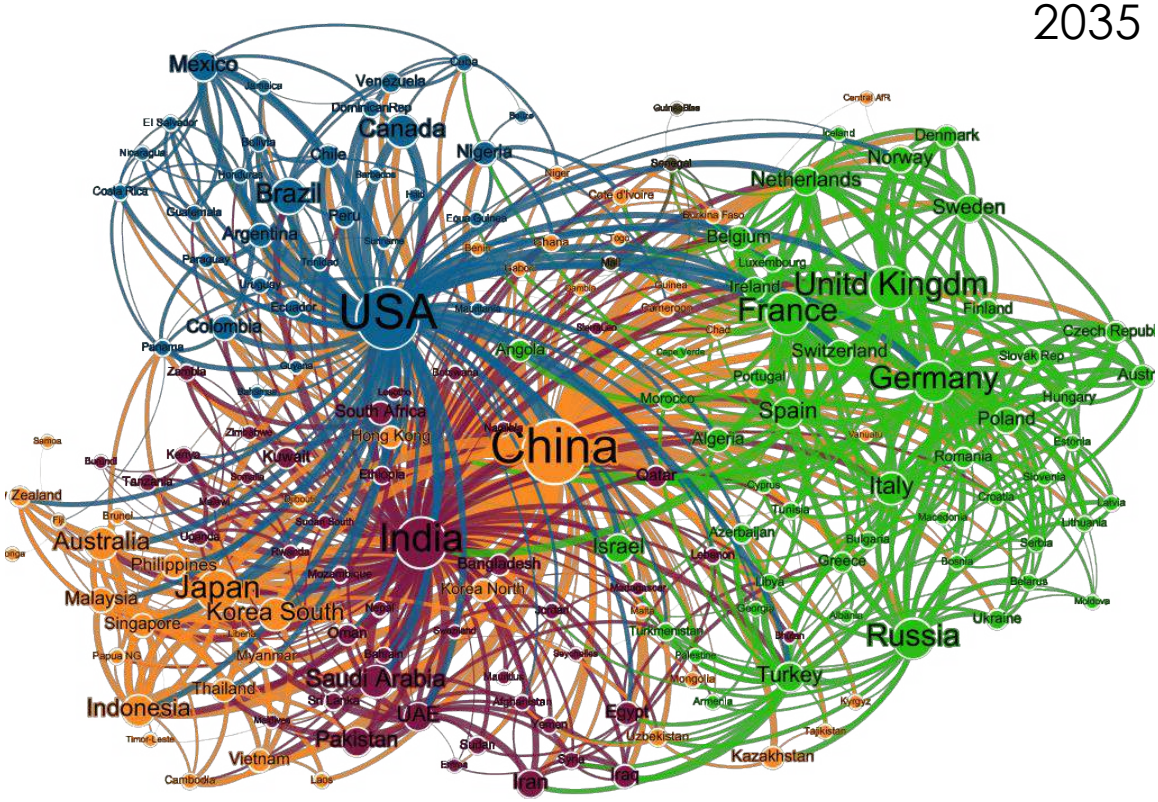

Figure 15: Global trade network in 2035 under the Globalism Resurgence scenario. The strength of ties is visualized using the natural log of exports between countries. Connection color is determined by the community of the exporting country. Visualization threshold is set at one standard deviation above the mean level of logged dyadic trade. The size of each node represents the relative power of the nation (according to the Global Power Index). Node colors indicate communities within a network defined by bilateral exports as a percent of total imports of the partner country. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: Frederick S. Pardee Center for International Futures and IFs 7.28.

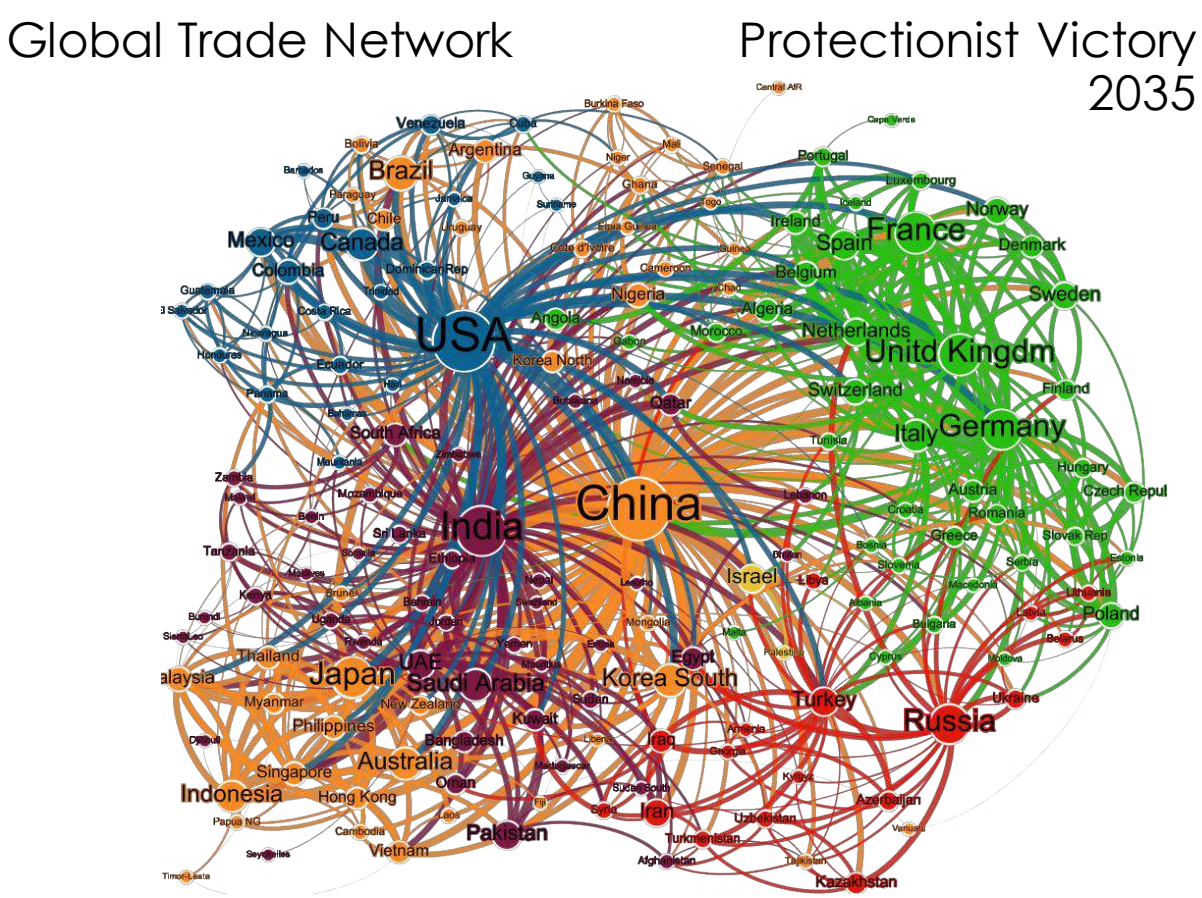

Figure 16: Global trade network in 2035 under the Protectionist Victory scenario. The strength of ties is visualized using the natural log of exports between countries. Connection color is determined by the community of the exporting country. Visualization threshold is set at one standard deviation above the mean level of logged dyadic trade. The size of each node represents the relative power of the nation (according to the Global Power Index). Node colors indicate communities within a network defined by bilateral exports as a percent of total imports of the partner country. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: Frederick S. Pardee Center for International Futures and IFs 7.28.

Trade can be used to project influence. The figures below use a measure introduced by the Diplometrics project (2016) to explore some implications arising from more protectionist policies in the United States. As the United States becomes less active in political and economic networks, it has a more difficult time promoting ideas beyond its borders. Figure 17 shows the reduction in US global influence in the Base Case and US Protectionism scenario next to that of China.

Box 1: The Influence Index

The Influence Index, created as part of the Diplometrics project at the Frederick S. Pardee Center for International Futures, measures influence capacity or potential influence across dyadic economic, security and political interactions. Because actual influence is context dependent and is usually not identifiable when it does occur, the Influence Index does not directly measure incidences of influence and instead measures countries' capacity to influence others across these three broad areas. The index comprises annualized data for pairs of countries (referred to as dyads) for the years 1962-2015 across two sub-indices: Bandwidth and Dependence. Each of these sub-indices measures a separate facet of influence. The Bandwidth sub-index is designed to measure shared interaction between the dyad, while

the Dependence sub-index uses relative indicators to measure the reliance of one state on another within specific systems. The combination of these two sub-indices creates the final Influence Index.

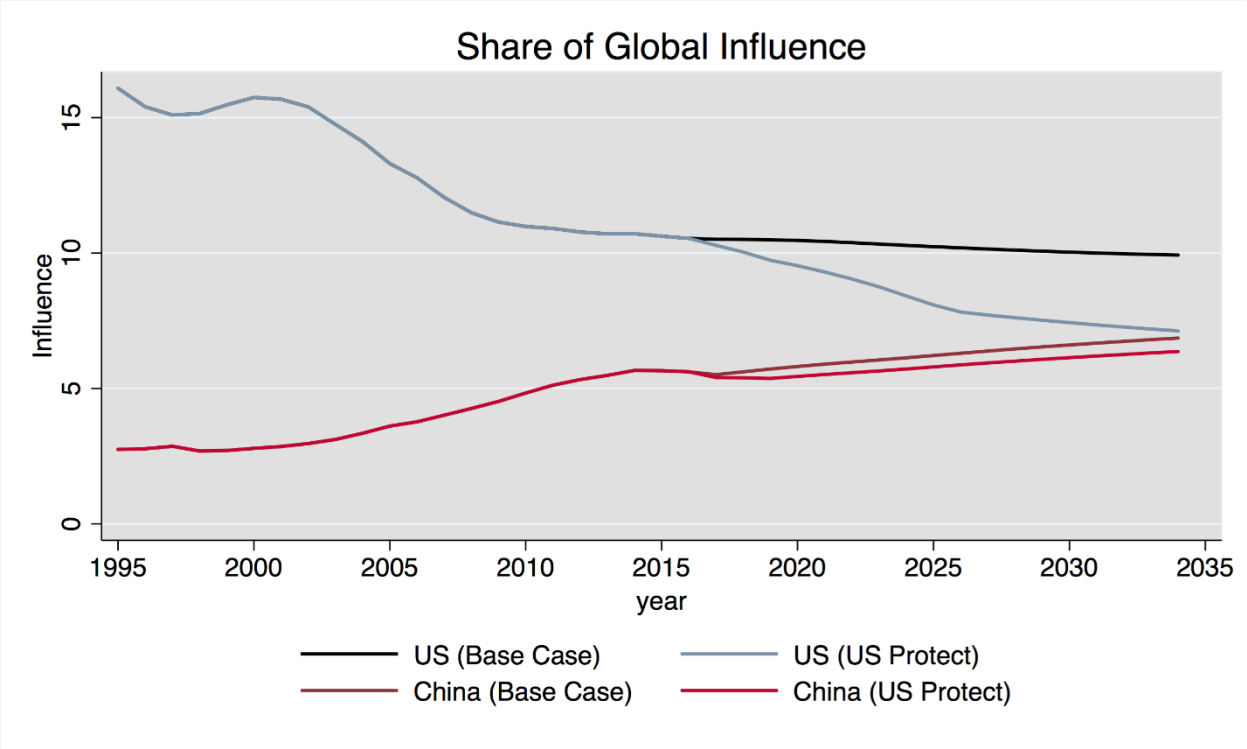

Figure 17: Outward influence as a percent of total global influence for China and the US across the Base Case and US Protectionism scenarios. Source: Calculated by the Frederick S. Pardee Center for International Futures with historical data from the Diplometrics project at the Frederick S. Pardee Center for International Futures (2016) and forecasts from IFs 7.28.

This reduction translates to a greater number of countries that have a higher level of engagement and are more dependent on China than the US. Figure 18 shows the number of countries that are more influenced by the US (green) or China (red). Countries towards the center of each graph have relatively similar levels of influence from both the US and China (yellow).

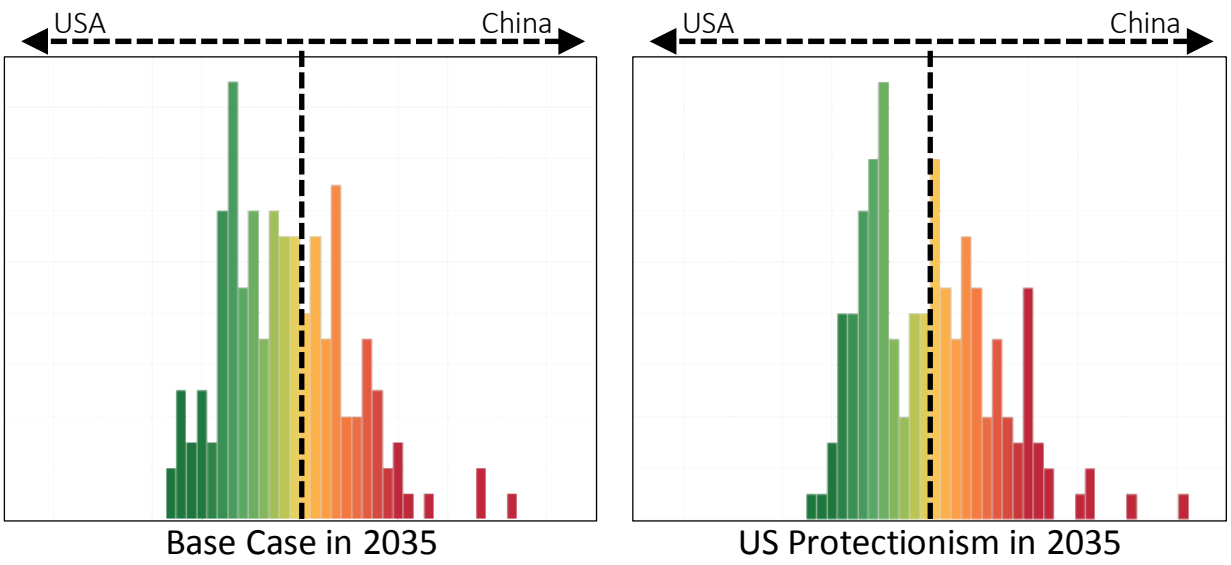

Figure 18: Distribution of influence between the US and China in 2035 under the Base Case and US Protectionism scenarios. Calculated by the Frederick S. Pardee Center for International Futures with forecasts from IFs 7.28.

The communities seen in the 2015 influence network largely mirror those seen in the trade networks above. Major clusters include Europe, the Americas and Pacific countries, and other Asian and African countries with close ties to China, India, and South Africa. Russia and former Soviet states comprise a smaller cluster that includes Egypt and has strong ties with other communities through Venezuela, Vietnam, Uganda, and several Eastern European states.

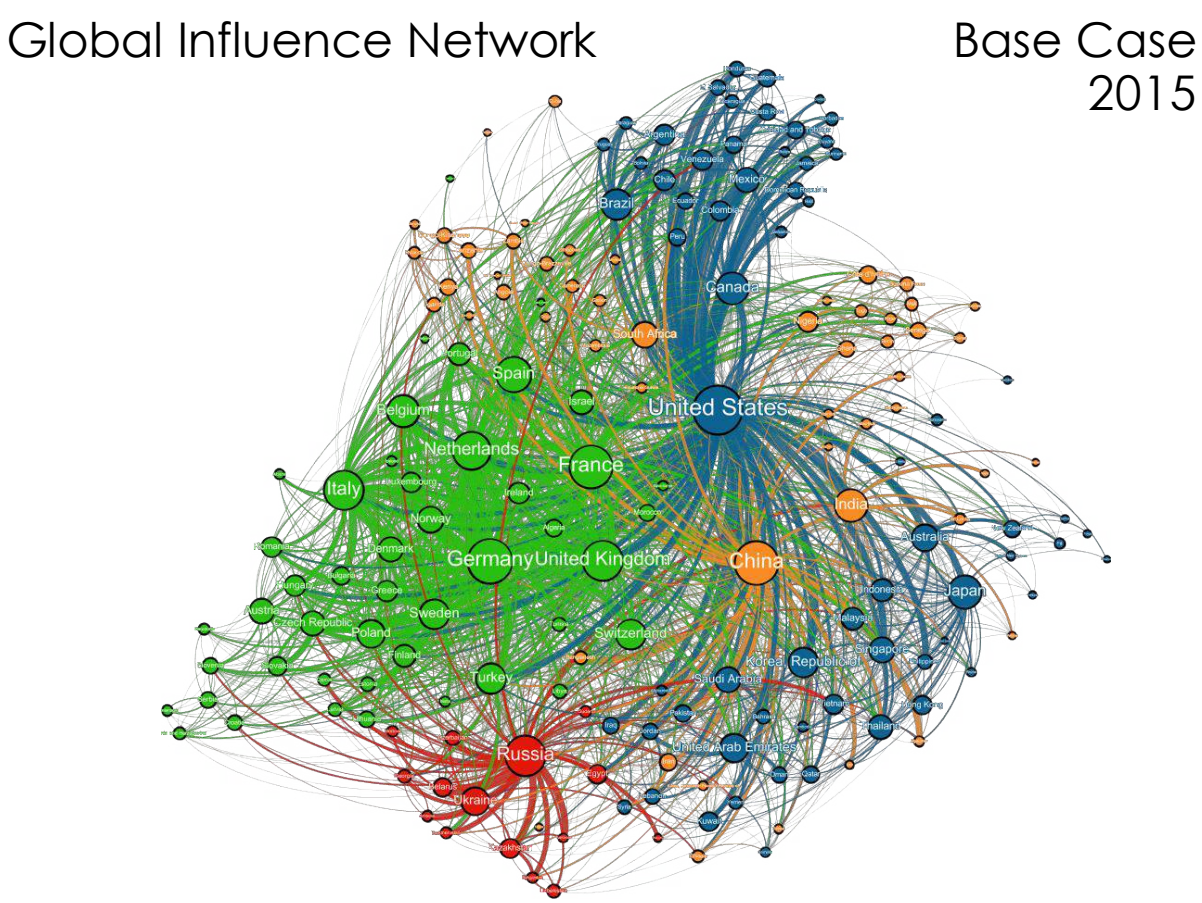

Figure 19: Global influence network in 2015 under Base Case scenario. The strength of ties is visualized using the natural log of influence between countries. Connection color is determined by the community of the influencer. Visualization threshold is set at one standard deviation above the mean level of logged influence. The size of each node represents the sum of outgoing influence of a country. Node colors indicate communities within the network. The community detection algorithm used for this calculation comes from Blondel et.al. (2008). Source: Frederick S. Pardee Center for International Futures with forecasts from IFs 7.28.

By 2025 in the Base Case, China is forecast to have increased its influence in many countries, extending its sphere of influence across much of Africa and the Pacific. India, which in recent years has experienced deeper relations with both the US and China, is forecast to align more closely with countries in the United States' sphere of influence. Russia and Europe's spheres of influence are forecast to remain relatively stable, with some countries moving from Russia's sphere of influence into Europe's by 2025.

Global Influence Network Base Case 2025

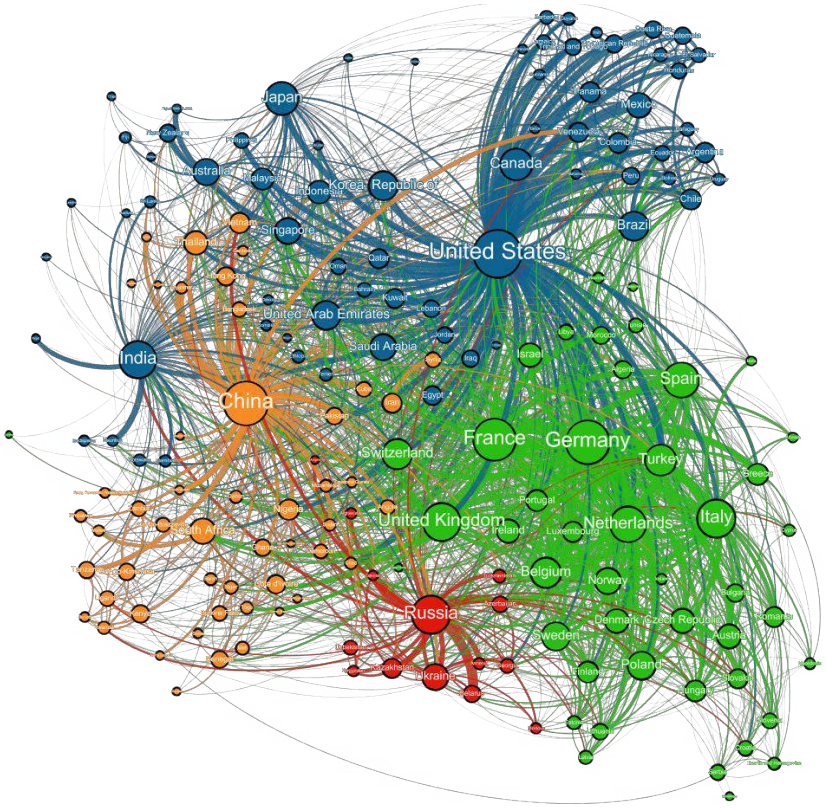

Figure 20: Global influence network in 2025 under Base Case scenario. The strength of ties is visualized using the natural log of influence between countries. Connection color is determined by the community of the influencer. Visualization threshold is set at one standard deviation above the mean level of logged influence. The size of each node represents the sum of outgoing influence of a country. Node colors indicate communities within the network. The community detection algorithm used for this calculation comes from Blondel et.al. (2008). Source: Frederick S. Pardee Center for International Futures with forecasts from IFs 7.28.

A world in which the US begins to disengage from global commerce would look increasingly regional. The vacuum left by the United States is likely to be filled, at least partly, by other actors like China, India and South Africa, which begin to carve out distinct spheres of influence. Beyond the immediate reduction in the level of interaction and avenues of influence available to the US, networks of exchange and influence would undergo significant rewiring. Under this scenario, new spheres of influence are drawn, with regional leaders such as India, Saudi Arabia, and the UAE in the Middle East and South Asia, and South Africa and Nigeria in Southern and West Africa, respectively.

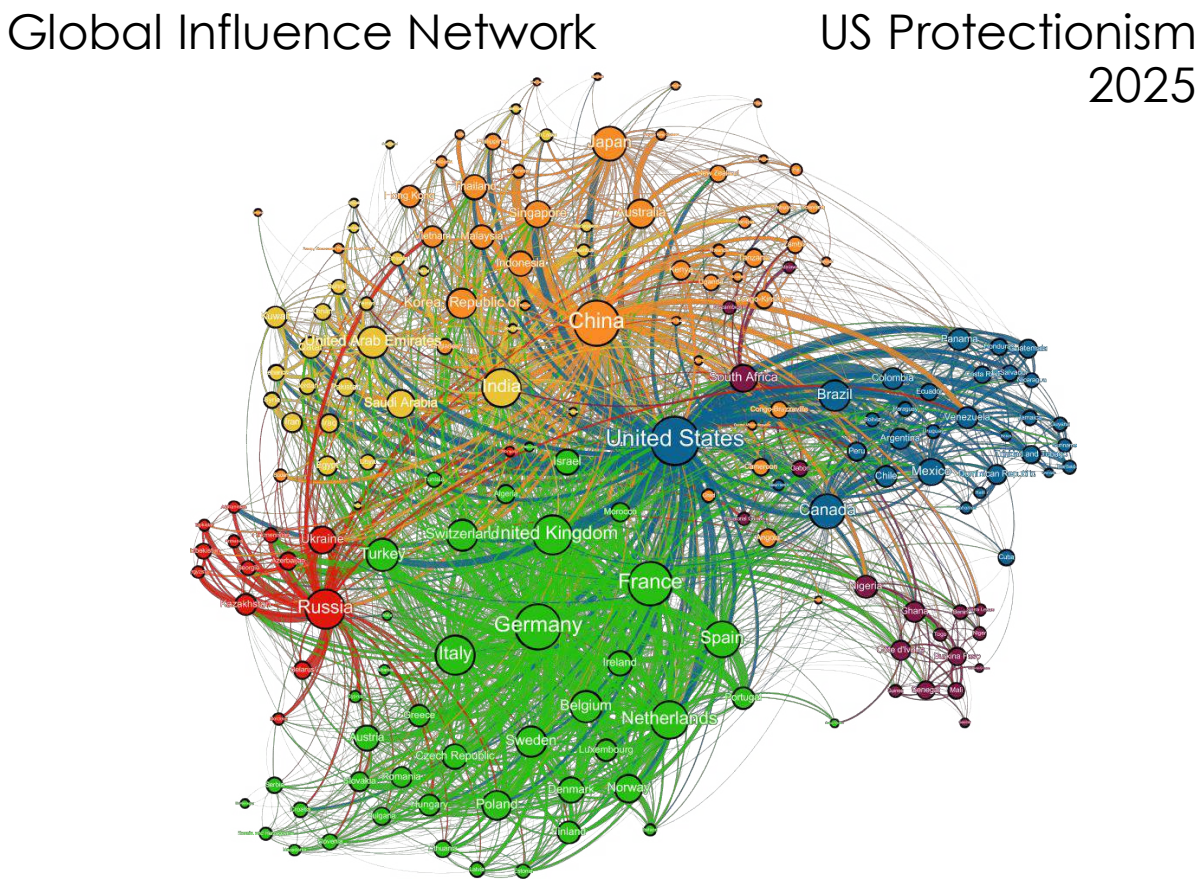

Figure 21: Global influence network in 2025 under the US Protectionism scenario. The strength of ties is visualized using the natural log of influence between countries. Connection color is determined by the community of the influencer. Visualization threshold is set at one standard deviation above the mean level of logged influence. The size of each node represents the sum of outgoing influence of a country. Node colors indicate communities within the network. The community detection algorithm used for this calculation comes from Blondel et.al. (2008). Source: Frederick S. Pardee Center for International Futures with forecasts from IFs 7.28.

US-Chinese dynamic at risk

Today, imports from China are valued at 2.3 percent of the US's GDP (manufacturing imports from China valued at 1.3 percent of US GDP), and exports to China are valued at 0.6 percent of the US's GDP (manufacturing exports to China are valued at 0.4 percent of US GDP). Imports from the US are valued at 8.8 percent of Chinese GDP (manufacturing imports from US valued at 0.7 percent of Chinese GDP), and exports to the United States are valued at 18.9 percent of Chinese GDP (manufacturing exports to US are valued at 2.2 percent of Chinese GDP). China is nearly twice as dependent on US trade as the US is on Chinese trade (for more on the economic ties between China and the United States, refer to Chapter 5).

The ability of each country to adjust to the shock of much higher US tariffs is determined partially by their relative trade dependence, and how easily capital and labor can be reallocated given new domestic consumption and production patterns.

To illustrate this dynamic, we created two additional trade-related scenarios, both focusing exclusively on the China-US dyad. In the short run, the greatest potential gains that the US could experience from imposing a 45 percent punitive tariff on Chinese manufactured goods is a 2.5 percent increase in manufacturing production, 400 thousand additional jobs, and a 0.5 percent increase in GDP. This scenario,

which we call Unchallenged and Mobile, assumes that China does not retaliate with a similar (or more commensurate) tariff on US exports, that the US does not offset surplus demand with imports from other trade partners, and that the US is able to quickly and efficiently mobilize the necessary labor and capital to produce all surplus demand domestically. If we instead assume that the opposite is true (China retaliates with a similar tariff and US imports from other partners or is unable to quickly reallocate its factors of production), the country experiences a 0.9 percent reduction in manufacturing production, a loss of 140 thousand jobs, and a 0.2 percent reduction in GDP.[18]

		Change in Man. Imports	Change in Man. Exports	Change in Man. Prod.	Change in Man. Labor	Change in Man. Capital	Change in GDP	Change in GDP
		Percent	*Percent*	*Percent*	*Thousand People*	*Billion USD*	*Billion USD*	*Percent*
Unchallenged and Mobile	**China**	0.0	-5.7	-1.8	-3,720	-400	-100	-0.7
	USA	-5.4	0.0	2.5	400	270	100	0.5
Challenged and Immobile	**China**	-2.7	-5.7	-1.8	-3,720	-400	-100	-0.7
	USA	-5.4	-2.7	-0.9	-140	-90	-30	-0.2

Table 9: The effects of trade conflict between the United States and China. The Unchallenged and Mobile scenario assumes that China does not retaliate against the United States with any tariffs, and that the United States is able to mobilize domestic labor and capital quickly enough to produce all surplus demand domestically. In Challenged and Immobile, China responds with a similar set of tariffs on US imports, and US labor and capital are slower to adapt to surplus demand. Both scenarios assume that all foregone imports from China are met with domestic production (an unlikely, but best-case, scenario for the US manufacturing sector). Source: Frederick S. Pardee Center for International Futures.

In the long-run, in this second scenario (called Challenged and Immobile) trade between the two countries is modeled to decline by a cumulative $5.7 trillion by 2035 relative to the Base Case. In this scenario, cumulative GDP is $5.5 trillion lower in the US, and $4.2 trillion lower in China relative to the Base Case by 2035. Household consumption in the US would decline by an annual $550 billion relative to the Base Case by 2035. While household consumption in China would increase initially due to cheaper domestic prices, by 2035 it is roughly $120 billion lower than in the Base Case.

While the scenarios explored here are fairly simplistic, China's reaction to an increase in US tariffs on Chinese goods could take many forms. The most likely scenario would be the creation of separate spheres of Chinese and US economic activity. This would rewire trade networks and could significantly disrupt supply chains. This scenario is explored in greater depth in Chapter 5.

Conclusion

Even if a scenario like Protectionist Victory is not fully realized, the world has already diverged from a path of increasing economic openness. In the short-term, scarce factors of production may see short-term gains from blanket restrictions on the flow of capital and labor across borders. Some manufacturing jobs, for instance, may return to advanced countries that levy tariffs. But these immediate gains come at the cost of higher prices for goods and services and slower overall growth in the long term. Developing countries are especially vulnerable, as these more abundant lower-skill jobs make up a large share of the workforce.

[18] The Chinese retaliation simulated is limited to trade tariffs and does not include sovereign debt.

These countries experience higher rates of poverty and economic vulnerability, which further threatens stability.

This isn't the first time the world has seen a backlash against trade and globalization. The economic openness experienced in the late 19th and early 20th centuries was followed by a backlash that sustained through the interwar years. Workers in labor-scarce economies pushed for and achieved increasingly restrictive immigration policies, while retreat from free trade was achieved by the landed rich in labor-abundant countries (Williamson, 1998, 2002). This struggle also contributed to the rise of nationalist and communist movements across the globe. The disparate effects of economic integration on groups at the subnational level, unaccounted for, can shift politics at the national level. And the erosion of economic interdependence can increase the probability of overt conflict.

However, the current dense lattice of economic interdependence is completely different from the world of mercantilist trade and convertible currencies. Trade takes place through vast, transnational global value chains. The GVC structure may compound the effects of a trade shock as the impact is felt through numerous countries. Finally, international trade patterns readjust around restrictions, leading to shifts in economic interdependence and influence. An increasingly protectionist world could lead to increased regionalization. And risks that have been increasing in recent years—such as state failure and spread of conflict in some regions—could grow even faster.

Chapter 3: European Unity

Introduction

The EU is undergoing a period of significant instability. The original drivers of European integration have either dissipated or soured. Europe was impelled towards integration by the threat of war between its core states, but that is no longer considered a serious possibility. Soviet encroachment was also an existential threat to Europe that served to encourage integration, but this threat collapsed with the Soviet Union. There has been renewed belligerence from both Europe and Russia but not at levels experienced during the Cold War.

Some of the economic benefits of increased integration have materialized but the EU has not been a panacea for economic development. Increased integration has resulted in structural imbalances between core and periphery states, and has contributed new threats to the Union. Economic shocks like the Greek debt crisis have been far-reaching and enduring, and have exposed the relative lack of correctional tools available for flagging economies within the Eurozone. This, as well as the recent immigration crisis, has inflamed political tensions in EU states. States like France, the UK, Italy, and Germany are seeing a resurgence of populist nationalism. And terrorist attacks in core EU countries have further problematized responses to this crisis. The EU has not been able agree on an effective unified foreign policy in response to Russian incursions into Eastern Europe, leading to anxiety in some member states such as Latvia and Lithuania.

But the institutional make-up of the organization may be less of a concern than the broader geopolitical risks associated with different growth trajectories on the continent. Compared to the Base Case, the EU Collapse scenario outlined in this chapter would see a cumulative reduction in EU economic output of nearly $4 trillion to 2035.

	Base Case 2016	Base Case 2035	Change Relative to Base Case in 2035
			EU Collapse
GDP *billion USD*	16,400	20,700	-4,000
Extreme Poverty *thousand people*	770	360	14
Middle Class ($10+/day) *million people*	400	410	-4
Instability *count of countries*	-	-	2
Networked Effect *description*			EU trade relations begin to erode, and the continent is pulled in different directions. Western and Northern Europe looks to the global south, whereas Central, Southern, and Eastern Europe turn to the middle east and Russian spheres.

Table 10: Overview of findings for the EU Collapse scenario. Note: Unlike other sections, the values reported in this table pertain to the EU (excluding the UK). GDP is reported as the cumulative difference between the Base Case and EU Collapse (billion USD).Extreme poverty measures those living on less than $1.90 per day (thousand people). Middle class includes those living on greater than $10 per day (million people).Instability is reported as the number of countries experiencing higher levels of instability relative to the Base Case. Source: IFs 7.28.

Background and theory

The figure below summarizes a conceptual framework used to think about the future of integration in the EU. We used this framework to construct and operationalize a scenario in which the EU becomes increasingly disintegrated over the next two decades.

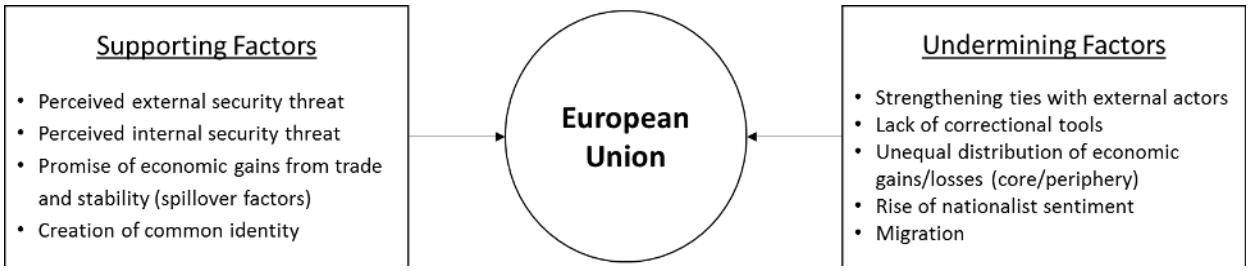

Figure 22: Conceptual framework used to think about European Union integration.

Drivers of integration

Realism emphasizes the role of hard capabilities and military power in determining the nature of interstate relationships. Realists, including Mearsheimer (1990), argue that European integration was driven by European states counterbalancing against the Soviet military threat and by the presence of US military forces in Europe, which neutralized security dilemmas between European states. However, European integration continued and intensified after the demise of the Soviet threat. Moreover, as Webber (2014, p. 344) points out, "uncertainty as to the durability or reliability of the American commitment to European military security has led to more rather than less security and defense cooperation between EU member states." US disengagement in Europe has arguably coincided with increased instability in the EU, but the Realist prediction that instability would stem from renewed hard power competition between European states has not materialized.

Some theories—neofunctionalism, transactionalism and intergovernmentalism—support the notion that integration is an "inexorable outcome of growing volumes of transnational exchange that force national governments to acquiesce in the transfer of more and more policymaking competences" to supranational organizations (Webber, 2014, p. 348). In this view, integration is a self-sustaining process that is bolstered by financial crises and other economic challenges, as they require further integration to effectively manage. In contrast to neofunctionalists and transactionalists, intergovernmentalists such as Moravcsik (1993) argue that states continue to be central actors, but agree that they are subject to the inexorable pressures of integration.

This optimistic assessment about the durability of the EU is supported by another theoretical view—historical institutionalism—which argues that the costs for member states associated with leaving supranational organizations increase over time, making these institutions increasingly resilient (Pierson, 1996). In contrast to neofunctionalists and transactionalists, intergovernmentalists such as Moravcsik (1993) argue that states continue to be central actors but agree that they are subject to the inexorable pressures of integration. According to this view, well-established supranational institutions are relatively immune to hostility stemming from the domestic context of member states.

Classical intergovernmentalism stresses that states maintain decision-making powers, and that 'integration is thus contingent on the degree of convergence of the preferences or interests of the governments of key member states shaped by the requirements of domestic politics' (Webber, 2014, p. 344). In this view, European integration is driven by the interests of the major European powers. International relations institutionalism claims that supranational organizations are desirable to states because they help overcome collective action problems (Keohane, 1993). However, the comparison to the EU pales somewhat here, as it is noted by Polyakova & Fligstein (2015) that some of the collective action issues faced by the EU have not been resolved by the EU structure, causing disillusionment towards European political elites within domestic political structures. Thus, supranational institutions may be largely durable but are vulnerable to changes in underlying state interests. Classical intergovernmentalism and international relations institutionalism agree that European integration is contingent on the interests and preferences of states, particularly major powers.

The argument that political integration is an inevitable outcome of economic interdependence does not survive comparative analysis with international trading blocs outside Europe. (Polyakova & Fligstein, 2015; Webber, 2014). Moreover, the argument that the cost of leaving a densely integrated supranational network is prohibitively high has been undermined by Britain's recent decision to exit the EU. Admittedly, the cost to Britain may only be apparent when it formally leaves, but the Brexit affirms that domestic public opinion could indeed impel states to pull out of the Union, regardless of the consequences. Various radical nationalist movements gaining traction within states across the EU represent a major subnational threat to European Union viability.

Below, we discuss various pathways by which the European Union could collapse or be significantlyweakened. A disintegration trajectory, using Webber's 2014 definition, would mean a decline in (a) the range of common or joint policies adopted and implemented in the EU; (b) the number of EU member states; and/or (c) the formal (i.e. treaty-rooted) and actual capacity of EU organs to make and implement decisions (if necessary against the will of individual members). Each of the pathways outlined below lend themselves also to movement down one or more of these disintegration trajectories.

Subnational risk factors

Numerous subnational factors are increasing the risk of a EU collapse. First, there has been a diminishment of quality working-class jobs, which is associated with the trade liberalization and increased automation of the proceeding decades. This trend has produced resentment in the working classes against institutions perceived to be representing the interests of the international market economy. This, and the attendant rise of economic nationalism, has empowered elites in many EU member states that have promised to either rollback its authority or withdraw their country from the union. Conversely, these impulses are also supported by industrial elites that prefer to be unencumbered by the EU's extensive system of rules and regulations.

Second, there is a strong cultural element to this subnational debate about the EU. The union sees and presents itself as a representation of post-modern ideals of global citizenship and technocratic collaboration. These values appeal strongly to the university-educated demographic that thrives in supranational mobility and is socially linked to the global economic and cultural elite. However, the working class does not share this cultural affinity with the EU, and has instead suffered from economic and cultural displacement associated with increased globalization (as explained in more detail in the previous chapter). A federal system requires widespread cultural acceptance to be sustainable, but the

cultural acceptance of the EU is limited to the upper-middle class demographic. The clear majority of EU citizens do not see themselves as European citizens, which suggests that without tangible economic benefits, many European citizens lack an incentive to fight for the survival of the European bureaucracy.

Third, related to this point, the EU has not been able to deliver upon its promises of growth because of its aging population and wide-ranging bureaucracy. The ratio of retirees to the working population has been rising rapidly, whereas the ratio of labor force size to the total population has been declining. This is driving significant reductions in growth. It is possible that growth can be achieved through ambitious economic planning. A report by McKinsey Global Institute notes that Europe could create 20 million new jobs through investments in education, innovation, infrastructure and energy, and by closing its output gap (Labaye et al., 2015). However, the EU continues to rely on its current economic architecture rather than pursue policies that encourage domestic consumption to increase growth. Furthermore, EU has failed to foster the kind of widespread institutional loyalty that might have mitigated the subnational response to such economic shortcomings.

National risk factors

Integration into the EU has been costly for states at the national level. Currency integration has produced three issues. First, currency integration has undercut state control over monetary and fiscal policy. This has been acutely felt in the aftermath of the Euro Crisis. Countries in the Eurozone are constrained by the common currency and unable to utilize sovereign instruments that are traditional means of addressing crises of this nature, including currency devaluation. Second, there is evidence that austerity measures implemented in response to the crisis are less effective because these states are part of an interdependent common market (Mazier & Petit, 2013). Third, the Euro crisis has caused significant strain between countries in the Union.

Countries also face foreign policy challenges with integration into the EU. Two external challenges have contributed to tensions within the Union. The first is the enormous refugee flow into Europe from conflicts in the Middle East and North African (MENA) region. This represented a failure on the part of the EU to create functioning external borders and stem the flow of refugees. But the crisis has unearthed deeper divides within member states about accepting refugees and empowered nationalist impulses aimed at refugees and—reasonably or not—the EU. The second external factor is Russian intransigence in the EU's eastern periphery, particularly in Georgia and Ukraine. The EU has struggled to achieve a unified foreign and security posture with regards to Russia. It imposed economic sanctions on Russia following its annexation of Crimea, but some member states including Italy and Slovakia want sanctions eased. The Core states have been unable to get many new member states to shoulder more of the defense burden, particularly those not threatened by prospects of Russian encroachment. The divergence between the national interest of states and their adherence to EU policies is an important source of risk towards EU disintegration.

Network risk factors

A major pathology characterizes the EU at the networked levels of analysis. The Core countries and Periphery countries are caught in a cycle of dependency whereby, as Bartlett and Prica (2016) note, the Core countries such as Germany avoid economic stagnation by exporting to the Periphery, leading to trade deficits there. As trade deficits become too high to finance, correction increasingly entails more bailouts or austerity. However, austerity can decrease domestic demand, which can prolong economic recessions. Thus, we can expect that, short of bailouts, this dependency will continue to grow and is unlikely to self-correct. As the case of Italy demonstrates, member-country-financed bailouts generate political tensions

over time and may accelerate external pressures for struggling economies in the Periphery to exit, rather than integrate. This pathology will continue to destabilize the EU, building risk, unless its supporters enact a comprehensive policy to address this imbalance.

Scenarios

EU Collapse

To explore the implications of stagnation in the EU,[19] we constructed EU Collapse, a scenario in which intra-regional exchange of capital, labor, goods and services stagnates. Trade between former EU members remains relatively flat through the 2035 horizon, increasingly closed borders drives inward migration to levels similar to that of Japan today, and FDI inflows (as a percent of GDP) return to 2000 levels.[20]

In this scenario intra-EU trade is reduced by 28 percent. Some of this foregone trade is made up with outside trade partners, while a portion is unrecovered. China, US, India, Switzerland, and Russia absorb the most surplus exports from the EU. By 2035, China absorbs a cumulative $560 billion more in former EU member exports, the US absorbs $300 billion, India absorbs $180 billion, Russia absorbs $150 billion, and Switzerland absorbs an additional $140 billion relative to the Base Case.

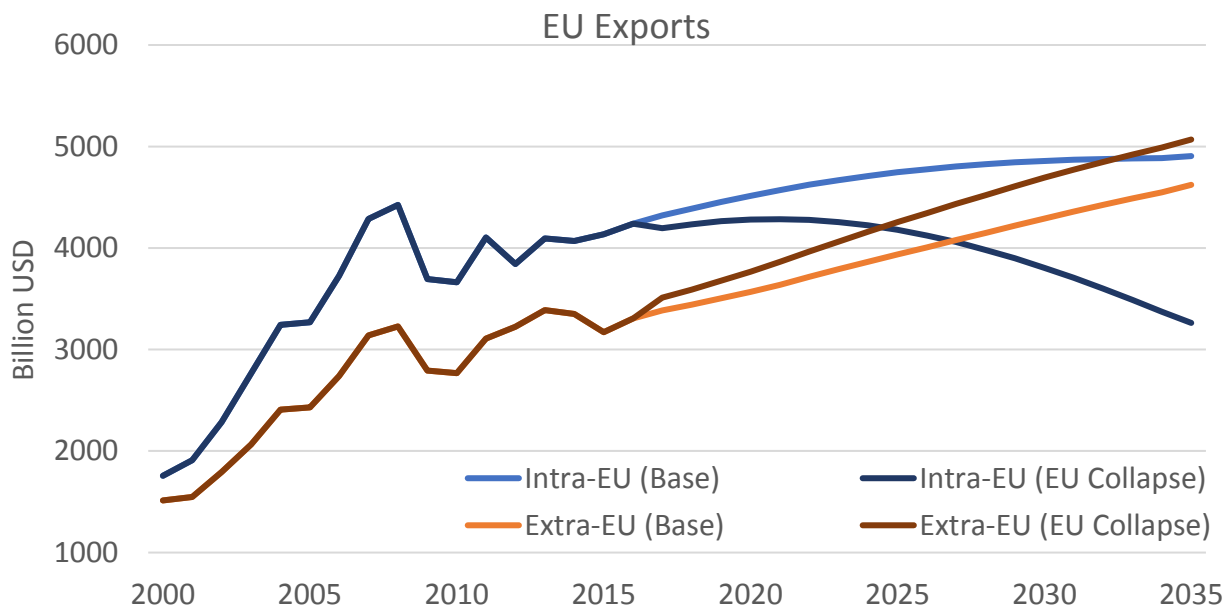

Figure 23: Intra-EU exports compared with EU exports to the rest of the world, in the Base Case and EU Collapse, forecast to 2035. Source: Historical data from UNCTAD (2016) and forecasts from IFs 7.28.

As the relative cost of intra-EU trade increases, this scenario anticipates that former members will look to redirect their surplus exports elsewhere, as well as establish new relationships for goods previously imported from their European neighbors. The process of offering surplus inventory to new outlets, and importing surplus demand from other sources would result in a rewiring of current trade networks. China, one of the world's largest economies, is particularly well positioned as a replacement trade partner. In EU

[19] EU here refers to the European Union excluding the United Kingdom.

[20] For a detailed description of the parameters used in each scenario see Appendix A.

Collapse, China becomes the primary recipient of surplus exports from most former EU members. While Russia becomes a stronger trade partner with Croatia, Latvia, Lithuania, Poland, and Slovenia, there is not a significant economic 'recapture' by Russia of the former Soviet East Central European countries. The network diagrams below illustrate trade network forecasts for the Base Case and EU Collapse scenarios in 2035.

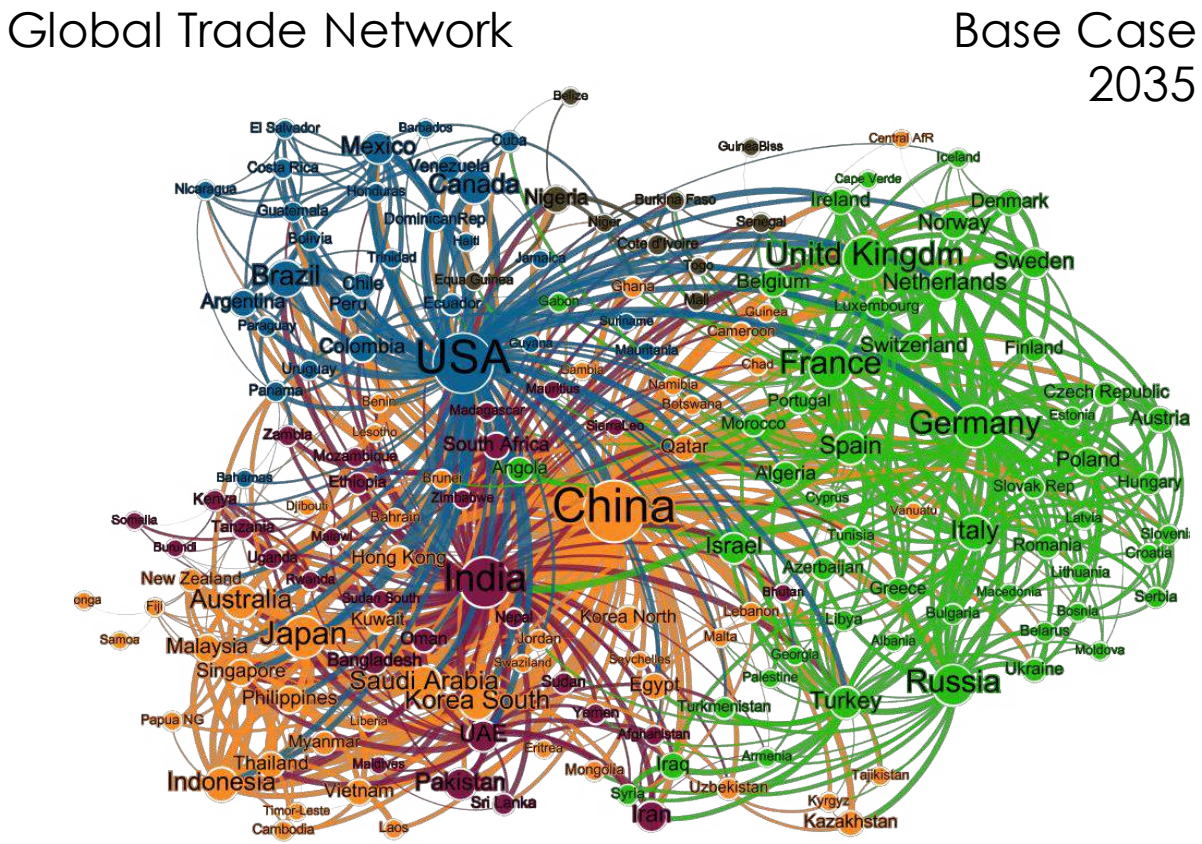

Figure 24: Global trade network in 2035 under the Base Case. The strength of ties is visualized using the natural log of exports between countries. Connection color is determined by the community of the exporting country. Visualization threshold is set at one standard deviation above the mean level of logged dyadic trade. The size of each node represents the relative power of the nation (according to the Global Power Index). Node colors indicate communities within a network defined by bilateral exports as a percent of total imports of the partner country. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: IFs 7.28.

In EU Collapse, the dense trade lattice now found between European countries begins to erode, and the continent is pulled in different directions. Western and Northern Europe (narrowly defined as west of Germany and Italy) looks to the Global South for more trade and better complementarity. Central, Southern, and Eastern Europe turn toward the Middle East and Russian spheres for increased trade connections. And Poland, Romania, and Bulgaria, which already have stronger ties to Russian networks, increase in their centrality to the global trade network. These countries could play important roles in facilitating trade between European and Russian networks and brokering new trade deals.

Global Trade Network EU Collapse 2035

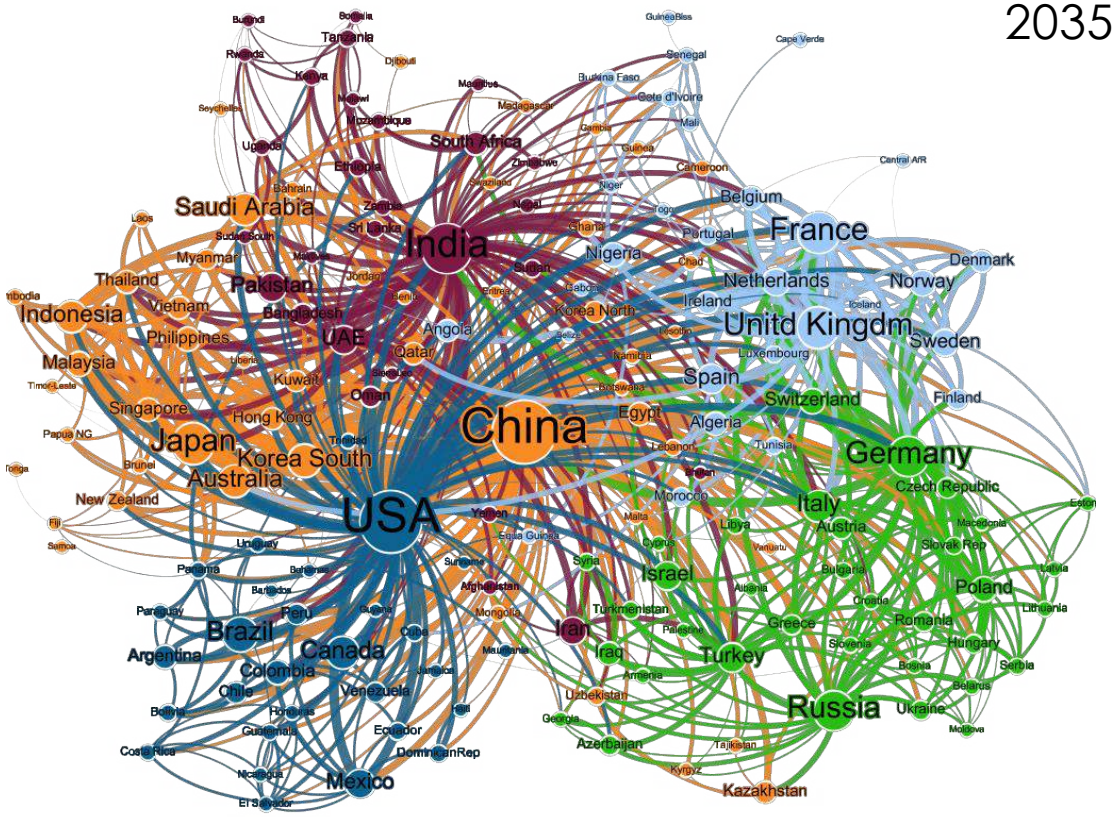

Figure 25: Global trade network in 2035 under EU Collapse. The strength of ties is visualized using the natural log of exports between countries. Connection color is determined by the community of the exporting country. Visualization threshold is set at one standard deviation above the mean level of logged dyadic trade. The size of each node represents the relative power of the nation (according to the Global Power Index). Node colors indicate communities within a network defined by bilateral exports as a percent of total imports of the partner country. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: IFs 7.28.

Many countries are forecast to be unable to find markets, either domestic or foreign, for their full export potential. It is also unlikely that domestic demand for foreign goods and services will be met by extra-EU providers. Thus, the post-collapse trade network rewiring results in an overall reduction in EU trade. The cumulative difference in former EU member exports is forecast to be $9.2 trillion lower in EU Collapse relative to the Base Case by 2035, a figure similar to total exports across the continent in 2014.

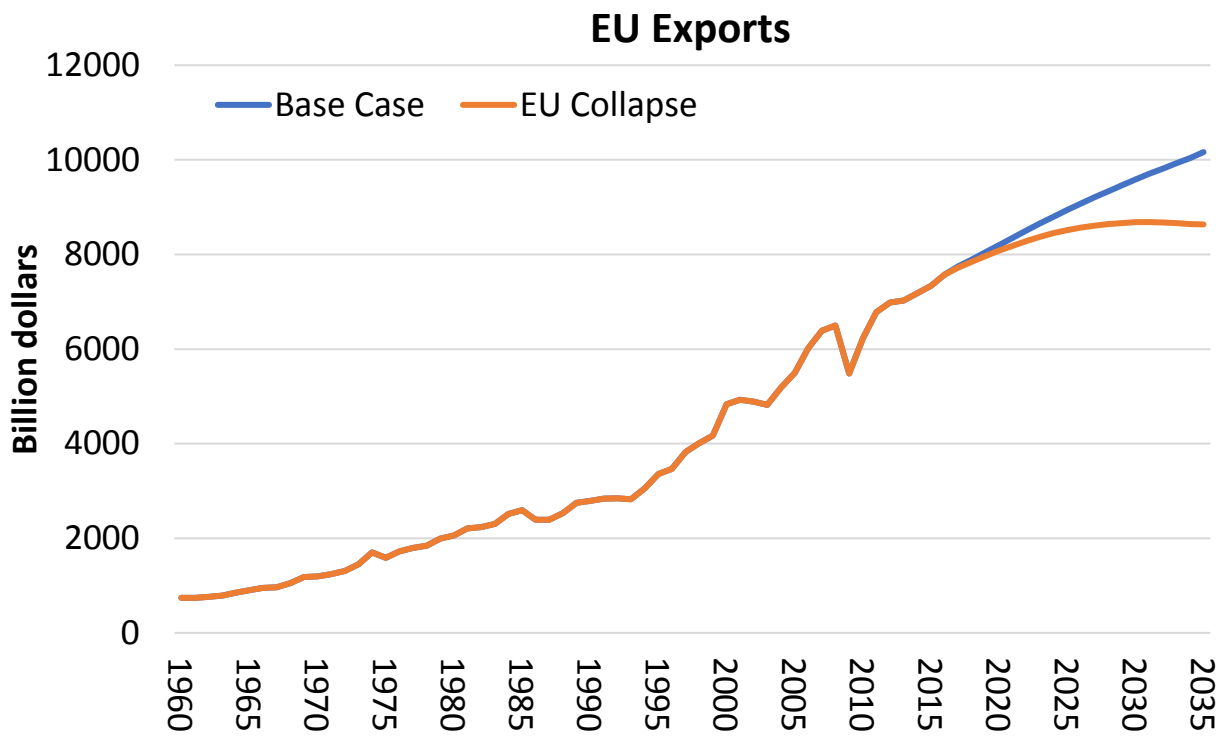

Figure 26: Total EU exports for Base Case and EU Collapse scenarios, forecast to 2035. Source: Historical data from UNCTAD (2016) and forecasts from IFs 7.28.

Countries highly dependent on exports to EU partners experience the most challenging adjustment. In 2014, trade with other EU members accounted for over 70 percent of trade for Croatia, Hungary, Slovenia, the Czech Republic, Slovakia, and Austria. In turn, these countries are forecast to experience the greatest reduction in exports and imports.

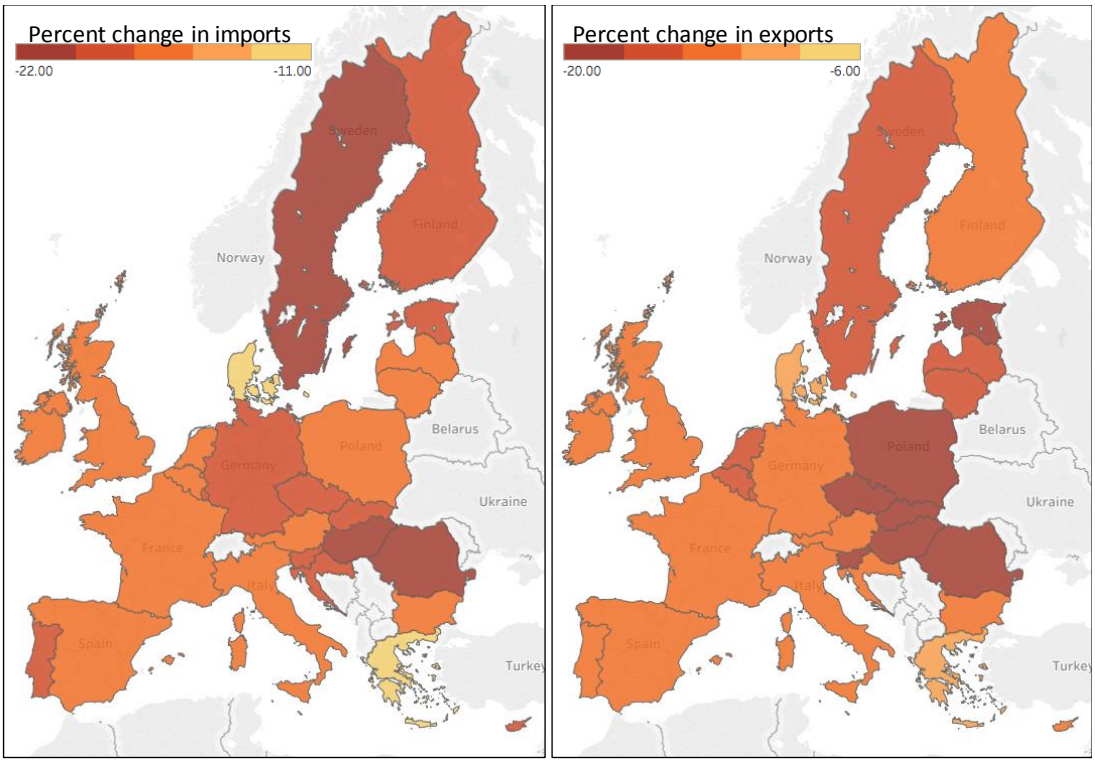

Figure 27: Percent change in imports (left) and exports (right) between the Base Case and the EU Collapse scenarios in 2035. Source: IFs 7.28.

With reductions to trade, economic growth and productivity derived from technology spillovers also decline. By 2035, the region is projected to experience a cumulative loss in GDP of $5.1 trillion, a figure comparable to Italy and the United Kingdom's economies combined. Portugal, Hungary, and the United Kingdom are among those that experience the greatest reduction in GDP. The reduction in imports is also felt by EU consumers, who face higher prices. By 2035, Malta, Cyprus, France, Portugal, and Sweden would be home to the household consumers hit worst from this new arrangement.

In EU Collapse, there would be 4.8 million fewer middle or upper class people living on more than $10 per day by 2035. In addition, as elderly populations continue to grow as a share of the European population, the lower growth experienced by the EU in the Collapse scenario makes it increasingly difficult for governments to provide pension.

Conclusion

The forces that historically drove integration in Europe—threat of interstate conflict and Soviet encroachment—have largely dissipated. Instead, European countries are experiencing heightened economic nationalism, cultural anxieties and economic imbalances that threaten to undermine European integration. These challenges in part stem from the unforeseen consequences and complications of integration itself.

The EU collapse scenario, which captures stagnation in various forms of intra-European economic exchange, represents a drastic restructuring of regional trade. Western and Northern Europe looks to the Global South for trade complementarity while Central, Southern and Eastern Europe look to the Middle East and Russian spheres for increased trade connections. China, US, India, Switzerland, and Russia absorb most surplus exports from the EU.

However, in this scenario, not all European exports are reabsorbed by outside trade partners, nor are these partners able to fulfill the excess demand in European countries created by the collapse. Consequently, the region would experience a cumulative loss in GDP of $5.1 trillion compared with the Base Case and a related reduction in middle class membership.

Chapter 4: Global Water Crisis

Introduction

Water scarcity is and will continue to be a significant geopolitical risk. Driven by increasing populations, growth in agricultural demand, expansion of manufacturing and increasing incomes, and compounded by climate change, water scarcity (and related food insecurity) could lead to greater domestic instability. Droughts have already contributed to conflicts, including the current crises in Syria and Sudan (Kelley, Mohtadi, Cane, Seager, & Kushnir, 2015; Nordås & Gleditsch, 2007).

Water scarcity is a problem that originates at the subnational level. However, it manifests at the national level via agricultural linkages, potentially causing food scarcity, undernutrition and increases in poverty. At the international level, water scarcity drives migration, increases pressure on food trade systems, and reduces the economic performance of countries participating in global trade networks.

In the Base Case, global water withdrawals are forecast to increase by 14 percent above current levels by 2035, creating acute pressures in already water-scarce regions. In this scenario, pressures on agricultural systems from climate change increase and food dependence grows for 18 countries. In **Arid Earth**, we gradually reduced exploitable water resources by 60 percent by 2035 due to increased pollution, variability in supply, rising sea-levels leading to more brackish sources, and more significant impacts from climate change. In **Severe Weather**, weather patterns are increasingly volatile and erratic. This leads to greater variability in crop yields due to more frequent droughts, flooding, soil erosion, and temperature fluctuation.

	Base Case 2016	Base Case 2035	Arid Earth in 2035	Severe Weather in 2035
Water Scarcity	46	51	90	51
Food Insecurity	14	18	27	19

Table 11: Number of countries experiencing Water Scarcity and Food Insecurity for the Base Case, Arid Earth, and Severe Weather. Food Insecurity is defined as net crop imports exceeding 75 percent of total domestic crop demand. Water Scarcity is defined as water demand exceeding 50 percent of renewable exploitable freshwater resources.

Table 11 shows the number of countries experiencing water and food scarcity in the Base Case, Arid Earth and Severe Weather. Water scarcity and food insecurity increase in all scenarios, reducing economic growth, increasing poverty, and increasing risk of domestic instability. Currently, 46 countries already face national water scarcity and 14 countries import more than 75 percent of food for consumption (which we define here as the threshold for food insecurity). In the Base Case to 2035, 51 countries are forecast to struggle with water scarcity at the national level while 18 countries are forecast to import more than 75 percent of their food demand. In Arid Earth, the number of countries experiencing water scarcity and food insecurity are forecast to increase to 90 and 27, respectively. These issues do not affect as many countries in Severe Weather, but the likelihood of domestic instability increases for 21 countries compared to the Base Case. Table 12 below shows the change in GDP, income levels and instability in the scenarios relative to the Base Case by 2035.

	Change Relative to Base Case in 2035

	Base Case 2016	Base Case 2035	Arid Earth	Severe Weather
GDP *billion USD*	82,000	141,400	-1,800	-6,700
Extreme Poverty *million people*	950	711	6.8*	21**
Middle Class ($10+/day) *million people*	2,480	3,950	-11.5*	-38**
Instability *count of countries*	-	-	15	21
Network Effect *description*			The global agricultural trade network becomes increasingly dense, as trade becomes more necessary to offset the negative impacts of decreased yields.	

*Table 12: Overview of findings for Water Crisis scenarios. Note: GDP is reported as the cumulative difference between Base Case and Scenario (billion USD); Extreme poverty measures those living on less than $1.90 per day (million people); Middle class includes those living on greater than $10 per day (million people); Instability is reported as the number of countries experiencing higher levels of instability relative to the Base Case. *Reported for countries that do not become net exporters of agricultural goods. **Reported for 2032 (peak year in yield loss).*

Background and theory

Measuring the impact of environmental scarcity factors (such as water scarcity) on human society has traditionally involved the usage of extended causal chain analysis, due to the complexity of interaction between physical and human systems (Meierding, 2013). Some early treatment of these chains involved disaggregation into 'social effects' such as economic decline, decreased agricultural production, population displacement, etc. (Homer-Dixon, 1991). Extending the length of the causal chain used for analysis introduces opportunities for confounding variables and intervening factors, which calls into question the validity or strength of the causal linkage in question. For example, in scholarship linking the recent Syrian civil war to water scarcity, causal chains have been constructed which included linked food scarcity, rural-urban migrations, subnational poverty, and economic instability (Gleick, 2014). Certain scholars like Meierding (2013) have advocated for an analytic focus on linkages between intervening variables in the chain in order to better understand and cement the effects of phenomena such as water scarcity on human systems. It is noted that a large portion of scholarship concerning linkages of this type have used changes in agricultural production as an intervening variable, though importance of agriculture to the overall system is usually assumed rather than analyzed explicitly (Gleditsch, 2012). Using IFs as an assessment tool for modeling the impact of water scarcity allows for this type of explicit analysis across subnational, national, and networked levels of risk.

Risks and drivers of risk at the national level

. The literature on conflict and cooperation over shared water resources is split. While some authors (Gleick, 1993) focus on the logical potential for instability that scarcity over shared resources engenders, other authors (Salehyan & Hendrix, 2014; Wolf, 2007) argue that, historically, cooperation has characterized periods of shared scarcity, rather than conflict.

Although attempts to link water scarcity to interstate conflict have produced mixed results, a study by Olmstead and Sigman (2015) suggests that countries typically take advantage of opportunities to free ride in water development decisions such as upstream damming in a shared basin as a way to 'export' costs associated with water development projects to foreign neighbors. Water pollution levels are also found

to be higher near international and subnational borders within countries. As we increasingly approach water demand limits, this trend has the potential to increase tensions between state actors as water becomes scarcer in shared basins (Olmstead & Sigman, 2015).

While interstate conflict over water resources may or may not represent a growing geopolitical risk, Warner et al. (2014, p. 51) find that, rather than an escalation of hard power along transboundary water interaction spaces, most transboundary spaces are effectively managed by soft power utilization, in the form of a "wide range of nonviolent, co-optative power manifestations" such as bribery, side payments, etc. The authors do however concede that "a soft power perspective may not yet be sophisticated enough to explain power relations between riparians" (Warner et al., 2014, p. 52).

Using agricultural production as an intervening variable, we can begin to assess economic implications of water scarcity on nations. A fall in agricultural productivity or decrease in productivity growth rate will, *ceteris paribus*, lead to increases in food prices over time (Trostle, 2008), potentially leading to slowdowns in economic growth in nations that are dependent on agricultural production, especially low-income food-importing countries (Timmer, 2008). Songwe (2011) notes that developing countries, especially food importing ones, were part of the early wave of countries affected by the financial crisis, due to increases in food price. In a more interconnected world, food price increases of this sort may lead to a slowdown in the economies of developed nations as well. The figure below shows the extent of food import dependence in various nations in the world.

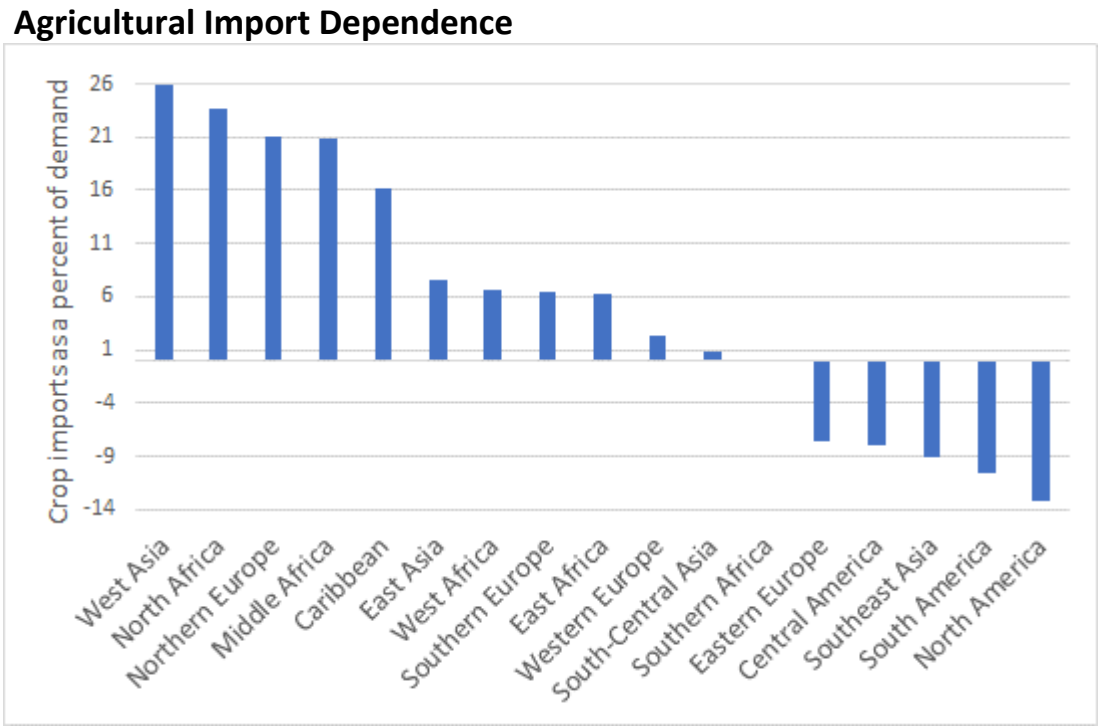

Figure 28 : Agricultural Import Dependence in 2016. Source: IFs 7.28.

Risks at the subnational level

The most acute impacts of climate change occur at the subnational level, where precipitation variability and extreme cycles of flood and drought is likely to worsen (Tschakert & Dietrich, 2010). Schewe et. al.

(2014) suggests that as the Earth passes the 2°C global warming threshold, we can expect a 40 percent increase in the amount of people living under absolute water scarcity, with the largest amounts of vulnerability being experienced by countries which are already severely affected by water scarcity. This, along with increases in the severity and disruption in timing of flooding cycles, have the potential to mire many developing nations in a poverty trap (Grames, Prskawetz, Grass, Viglione, & Blöschl, 2016). These trends are expected to be particularly felt in the arid and semi-arid regions of the southwest United States, southern Europe, Australia, Africa, and the Middle East (Schewe et al., 2014).

At the subnational or regional level, water scarcity can manifest itself through increasing levels of inequality, rising rates of undernutrition and deepening poverty. The FAO (2016) notes that most of the rural poor in the world are small landholding farmers whose livelihood depends on access to water. Insufficient availability and unreliable access undermines efforts to reduce hunger. Water scarcity can also increase national economic pressures, leading to internal migration due to extreme competition for jobs and the resulting unemployment. For instance, water scarcity has been cited as an underlying factor in the destabilization of Syria, where multiyear severe drought and crop failures prompted largescale internal migration to—and thus higher unemployment in—the country's urban centers.

Risks at the international (networked) level

The agricultural trade network has undergone more rapid expansion over the last decade, and the connections run nearly twice as deep and extensive as the energy trade network. While historically this has helped provide access to a wide variety of goods and diffused value add across the globe, it may also create greater vulnerability to economic and weather-related shocks. Environmental constraints, growing demand, and evolving food preference (i.e., increasing incomes drive more meat consumption, a more water intensive form of food production) is forecast to increase many countries' reliance on food imports, leading to agricultural trade systems becoming denser by 2035. The faltering economies of food importing nations in a more water scarce world may become increasingly dependent on imports, one likely effect of this being the expansion of the economies of food exporters.

Agricultural trade networks in 2015 show strong ties between markets in high-income countries of North America and Europe and those across Africa. North-South trade communities appear between UK, Ireland, and Southern African exporters such as South Africa, Mozambique, Zambia, and Zimbabwe. Spain, France, and Portugal still share strong ties with former colonies across northern and western Africa, though east African markets are deeply integrated with Russia and other western European and Middle Eastern countries. China and India hold central positions in southeast Asian, Pacific Island, and some equatorial African countries' agricultural markets.

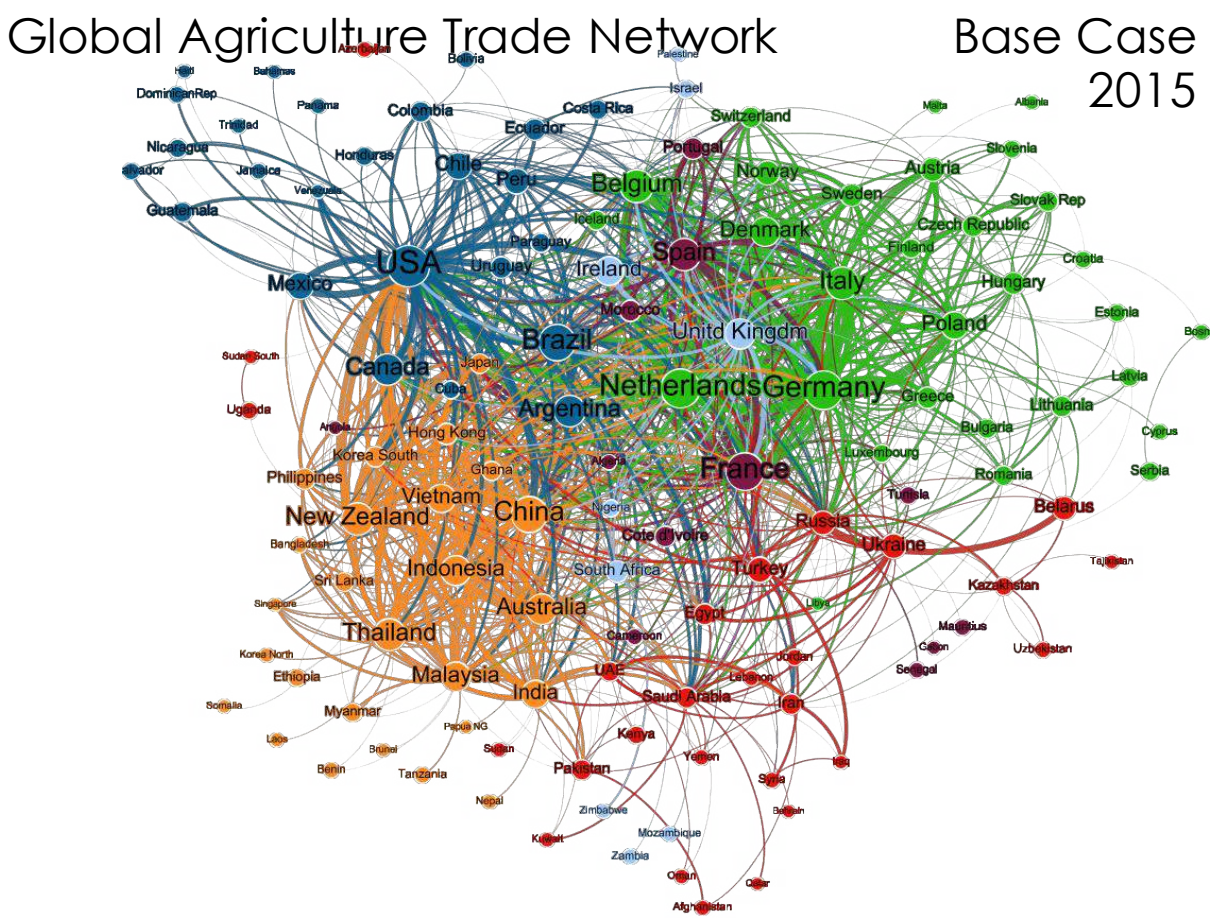

Figure 29: Global agricultural trade network in 2015 under the Base Case scenario. The strength of ties is visualized using the natural log of agricultural exports between countries. Connection color is determined by the community of the exporting country. Visualization threshold is set at one standard deviation above the mean level of logged agricultural dyadic exports. The size of each node represents total agricultural exports for a country. Node colors indicate communities within a network defined by bilateral agricultural exports as a percent of total imports of the partner country. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: IFs 7.28.

Scenarios

In this section, we explore water and food security through two alternative scenarios: In **Arid Earth**, we simulate a future in which reduced supply and slower advances in technology increase the number of countries facing acute instability pressures driven by water shortages and greater vulnerability to higher food prices. In this world, many more countries, including developed countries, and those in practically all regions of the world, experience significantly constrained water resources by 2035. The **Severe Weather** scenario is a future where more severe and erratic weather leads to more volatile crop yields globally, putting countries at even greater risk of political instability and economic degradation. Some scientists already believe we are on this path, as the frequency of extreme weather events has increased in recent years (Cai et al., 2014; Coumou & Rahmstorf, 2012).[21]

It is important to note, however, that even in the Base Case, IFs forecasts that many water-scarce regions—such as parts of Africa, Middle East and South Asia—will still lack the resources and governance

[21] For a detailed description of the parameters used in each scenario see Appendix A.

to implement solutions to mitigate water insecurity by 2035. Even in those countries with more means to cope with water insecurity, economic growth (mainly in the manufacturing and agricultural sectors) is constrained and food import dependence increases.

In the Base Case, water demand increases by 14 percent compared to levels today. This demand is forecast to be met largely through renewable freshwater resources (surface and ground) since desalinated water is forecast see only a modest increase in its share of total supply (remaining below 3 percent until 2035). Nevertheless, desalination could cost as much as $31 billion.[22]

Water scarcity in the Base Case—2035

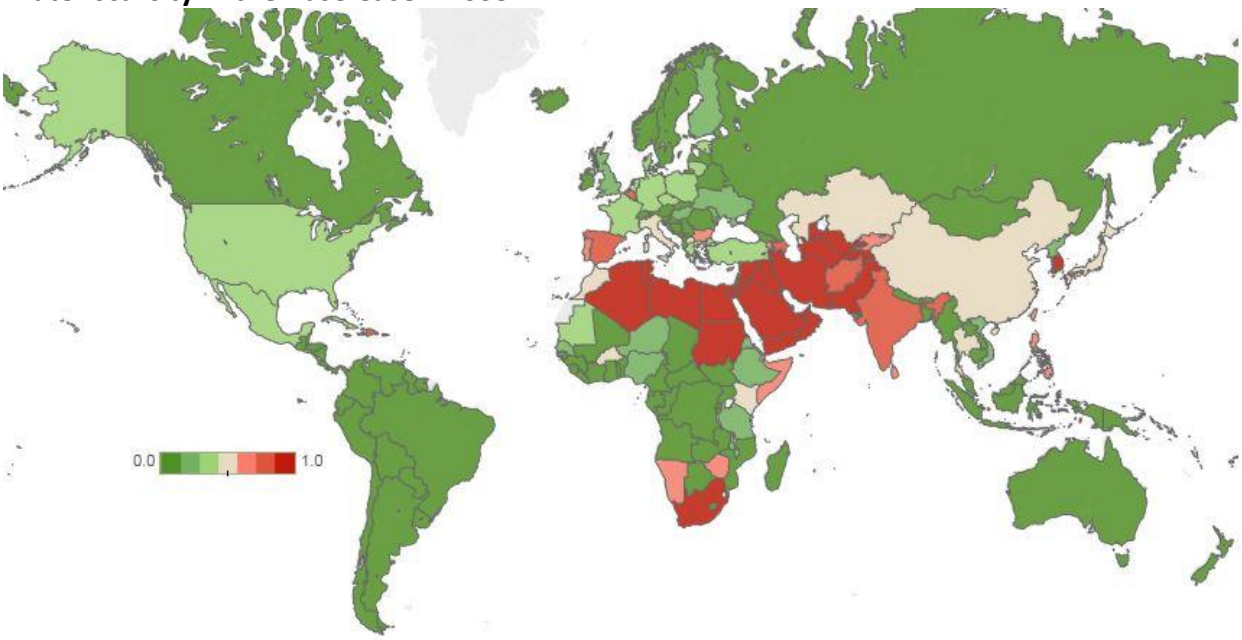

Figure 30: Water withdrawals over renewable exploitable freshwater resources. Red indicates that withdrawals is approaching or has already reached the sustainable limit. This indicates that the country in question must either be overexploiting or relying on alternative sources. Source: IFs 7.28.

From the early 2000s to today, the volume, value and number of agricultural trade partners has grown globally. This trend is forecast to continue through 2035, as agricultural demand is positioned to quickly outpace domestic supply in many countries. Central Asia, for example, currently only imports about 2 percent of their crop demand; however, more than 16 percent of their demand is forecast to be met with imports by 2035.[23] Similarly, dependence on agricultural imports for the Middle East and North Africa (MENA) increases in the Base Case from 29 percent to over 43 percent by 2035, likely resulting in higher food prices. Agricultural trade between Eastern Europe, Russia, parts of Africa, and Southern Asia increases, establishing a more closely knit community within the agricultural trade network. Western Europe also strengthens ties with agricultural producers throughout the African continent. The Americas are forecast to continue to be a large net exporter of agriculture through 2035.

During this period, the number of distinct trade communities is forecast to decline as European agricultural markets grow more deeply integrated with certain northern and western Africa. Stronger ties

[22] Cumulatively, if the average annual cost through 2035 remains similar to the global average annual cost of desalination today.

[23] Central Asia is defined in this report as: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Afghanistan.

between India, Indonesia, and some Middle East and eastern Africa countries lead to a discernable community within what, in 2015, was part of the community with China.

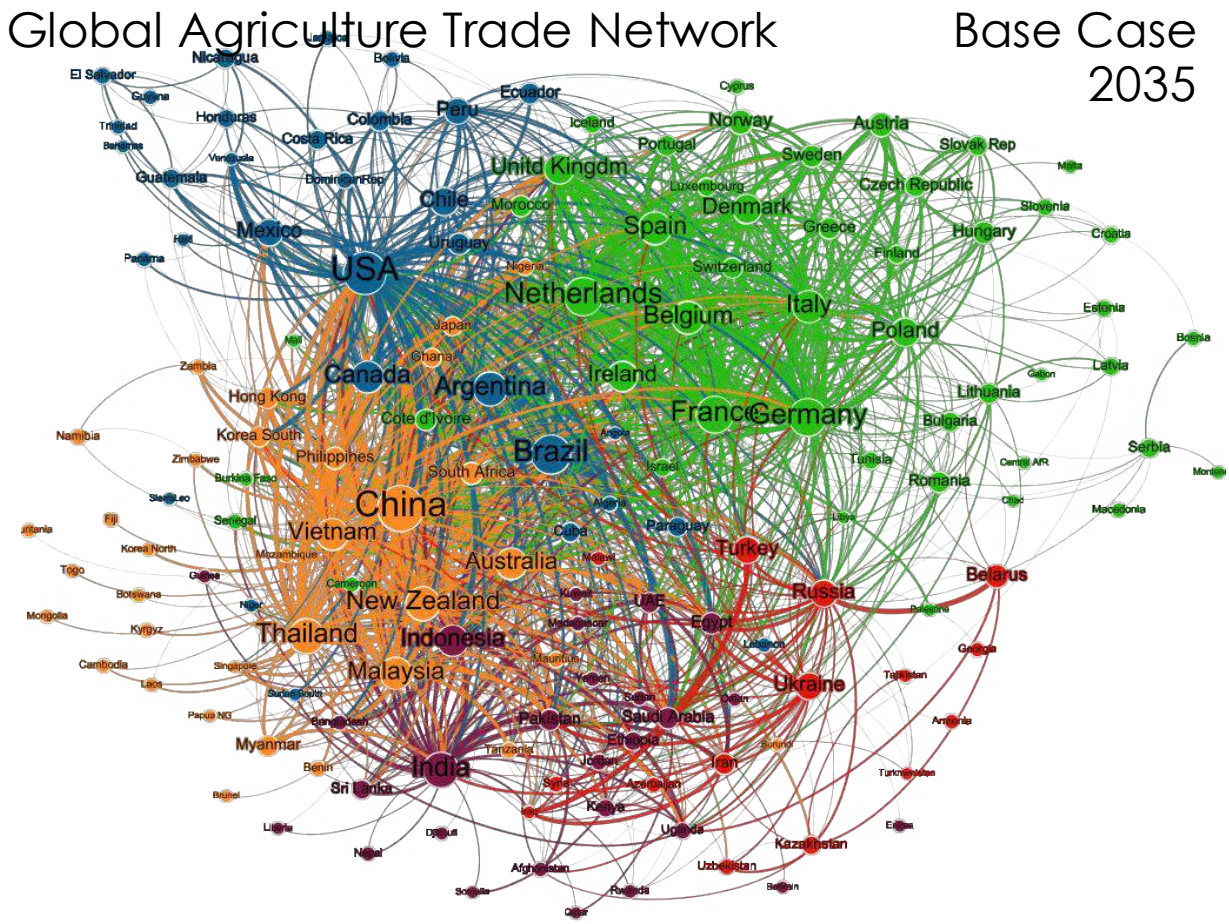

Figure 31: Global agricultural trade network in 2035 under the Base Case scenario. The strength of ties is visualized using the natural log of agricultural exports between countries. Connection color is determined by the community of the exporting country. Visualization threshold is set at one standard deviation above the mean level of logged agricultural dyadic exports. The size of each node represents total agricultural exports for a country. Node colors indicate communities within a network defined by bilateral agricultural exports as a percent of total imports of the partner country. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: IFs 7.28.

Arid Earth

Arid Earth is a future in which climate change dramatically reduces exploitable surface water and exploitable groundwater. Today, many countries in the Middle East and North Africa have already reached their exploitable limit and meet their demand through a combination of overexploitation, non-renewable groundwater, desalination, and treated wastewater. In this scenario, many more countries will face these constraints and will be forced to find alternative ways to balance supply and demand.

In addition, Arid Earth is a scenario where the technologies required for treated wastewater and desalinated water do not materialize. Demand restrictions are put in place on municipalities, industries, and the largest water sector: agriculture. Reduced water availability per hectare of irrigated land leads to a reduction in yield (as measured in tons per hectare). Below is a map showing the change in crop production in Arid Earth compared to the Base Case.

Change in Crop Production in Water Scarce World—2035

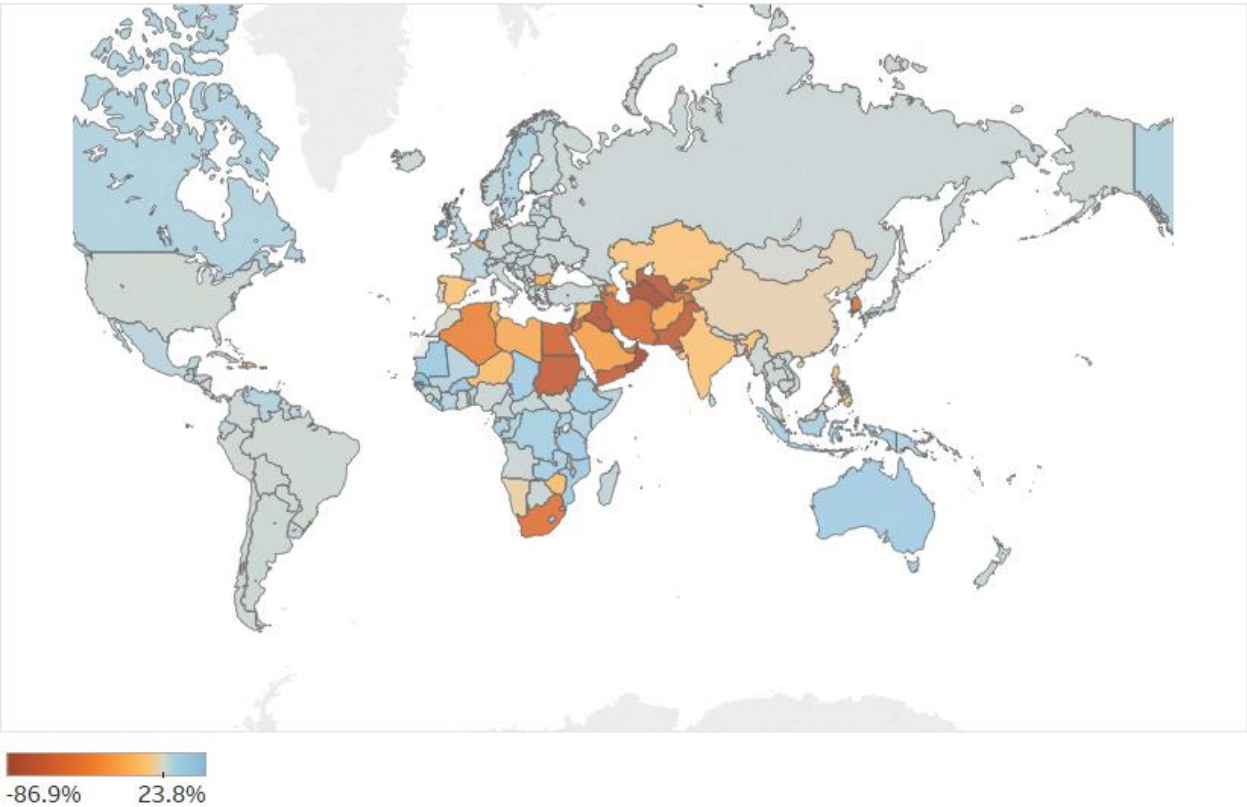

Figure 32: Percent change in crop production in the Arid Earth Scenario compared to the Base Case in 2035. Source: IFs 7.28.

As food imports are increasingly needed to offset the negative impacts of water scarcity on domestic crop production, countries become more integrated and dependent on the global agricultural trade network. In this scenario, crop import dependence (net, as a percent of demand) increases to over 67 percent in MENA and over 43 percent in Central Asia making these countries less food secure. Some European countries such as Spain, Portugal, and France deepen trade relationships with African partners. India, Indonesia, and eastern Africa draw closer to China, with Indonesia and Vietnam emerging as agricultural trade hubs for the region. At the same time, Brazil, Argentina, and other countries in South America form a distinct community with many Middle East countries.

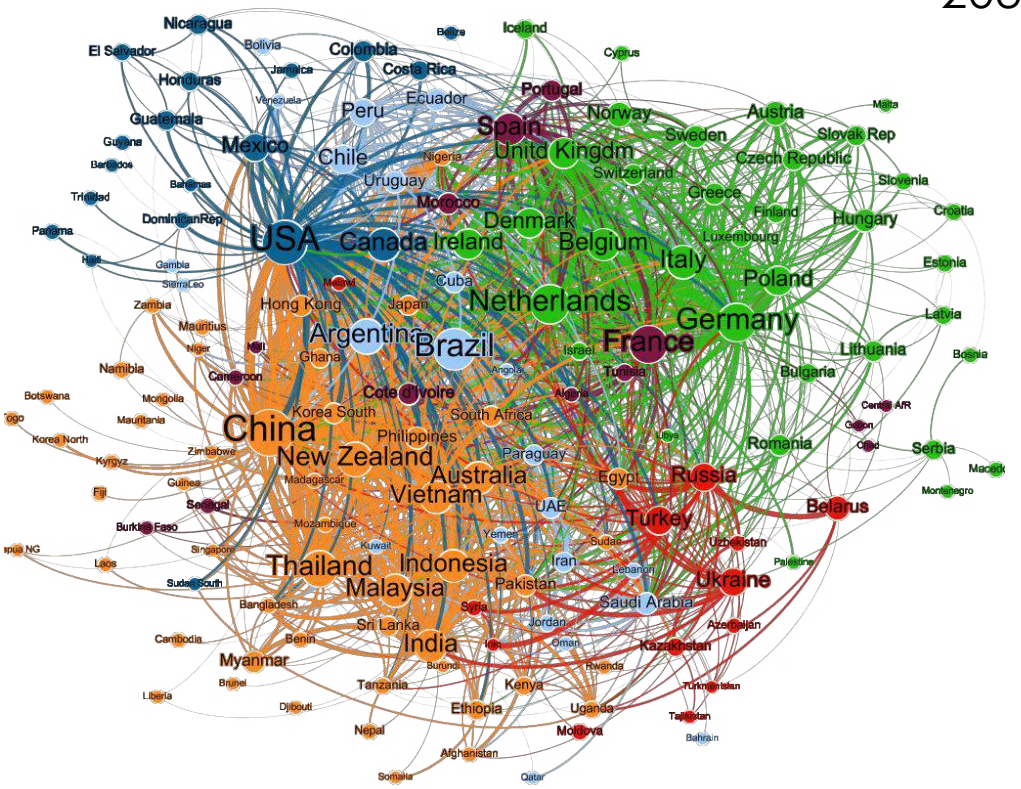

Figure 33: Global agricultural trade network in 2015 under the Arid Earth scenario. The strength of ties is visualized using the natural log of agricultural exports between countries. Connection color is determined by the community of the exporting country. Visualization threshold is set at one standard deviation above the mean level of logged agricultural dyadic exports. The size of each node represents total agricultural exports for a country. Node colors indicate communities within a network defined by bilateral agricultural exports as a percent of total imports of the partner country. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: IFs 7.28.

While essential for countries hit the worst by constrained water resources, the increased trade integration and network density in Arid Earth may increase vulnerability to economic or environmental shocks. As these communities become more globalized, spanning multiple continents, there is also a greater risk of trade disruption. For poorer countries, hit hardest by climate change and water scarcity, these disruptions could result in even higher levels of hunger, stunting, and instability. In negatively impacted countries, an additional 6.8 million people live in extreme poverty by 2035, with hunger forecast to increase by 35 million compared to the Base Case. Due to deteriorating conditions, 15 countries experience increased probabilities of domestic instability relative to the Base Case.

However, with higher global food prices, some countries that are less constrained by their water resources, invest more in their agricultural sector, boosting production and increasing exports. Brazil, USA, Indonesia, Russia, and Australia all increase agricultural production relative to the Base Case, with South American crop exports (net) increasing to over 20 percent of demand by 2035 (compared to 15 percent in the Base Case).

Nevertheless, the economic gains enjoyed by those able to produce and export more do not outweigh the losses of those hurt by increased water scarcity. In the Arid Earth, total global GDP would be reduced by

more than a cumulative 1.8 trillion cumulatively USD by 2035, relative to the Base Case. Furthermore, this new distribution of agricultural production leads to the deforestation of roughly 3.3 million hectares of land (an area larger than Belgium).

Severe Weather

In Severe Weather, water patterns are increasingly volatile and erratic, leading to more frequent droughts, flooding and soil erosion, and more variability in crop yields. Farmers and governments adjust to periods of underproduction by extending cropland, increasing irrigation (when possible), and investing more in the agricultural sector. This leads to significant production volatility (underproduction when crops are negatively impacted by weather and over production during periods of more favorable weather), less-efficient allocations of resources, and greater risk of disruptions in agricultural trade.

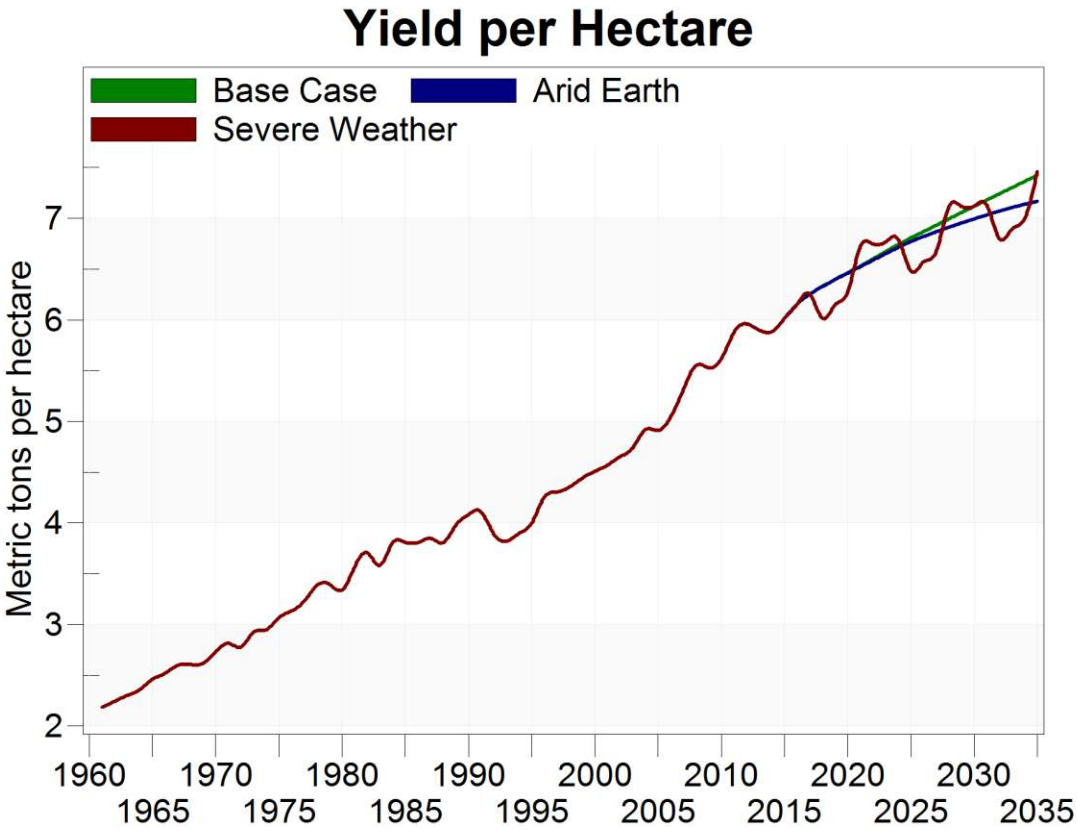

Figure 34: Agricultural yield under Severe Weather, Arid Earth, and the Base Case. Source: IFs 7.28

To account for the increased investment that would be necessary to mitigate highly inconsistent crop yields, this scenario diverts $3.6 trillion of capital to agriculture from other sectors of the economy, contributing to a cumulative $7 trillion reduction in global GDP and 22 million more hectares of forest converted into cropland by 2035, relative to the Base Case. Despite this attempt to bolster the sector, cumulative crop production globally would still be 1.4 billion metric tons less than the Base Case, and cumulative agricultural exports worldwide would be $500 billion less than the Base Case by 2035.

Food insecurity leads to 37 million additional people living in hunger, 14 million additional people living in poverty, and 9 million additional people living in extreme poverty. Between 13 and 27 million fewer

people living in the middle class (between $10 and $50 per day) during the mid-2020s to mid-2030s, and 21 countries experience increased probabilities of domestic instability relative to the Base Case.

Box 2: Major uncertainties in water and food security

There are significant uncertainties regarding these scenarios. The specific impact of climate change over short- and long-term horizons, as well as local and global geographies, is perhaps both the most significant and most uncertain element touched upon in this exercise. For this reason, governments, firms, and individuals must prepare for a wide range of possible scenarios. For example, severe drought impacts were particularly harmful in the Syrian case because of poor planning and over-exploitation. Before the 2006-7 drought, groundwater in Syria had also been substantially depleted. Southeastern Turkey suffered from the same drought, but Turkey's investment in irrigation allowed it, unlike Syria, to weather the downturns.

Conclusion

Dealing with water security and global water pressures in the near to long-term future requires humanity to "do better with less" (OECD, 2015). Governments can mitigate some of the worst effects of growing water scarcity. The introduction of water pricing, for example, in countries where water is relatively cheap could have an immediate impact in lessening scarcity. Farmers in many developing countries, such as India, currently have little incentive to conserve. The needs of the poor have to be protected so that water pricing does not deprive them of vital access. NGOs can instruct poor farmers in ways to conserve water, including helping them invest in low-cost water-saving technologies.

Greater agricultural investments in drought-resistant and heat-tolerant crops could also help mitigate some of the worst impacts. For example, new varieties of pearl millet, the most inherently drought-tolerant of all the major staples, together with sorghum, are increasingly being planted in the drylands of southern Africa (CGIAR, n.d.).

Desalination and wastewater treatment are tried and tested technologies for mitigating water scarcity that even now are undergoing rapid technological improvement. Desalination is still expensive so foreign investment in such a technology for poorer, developing countries would be needed if water scarcity is to be avoided. Desalination is only feasible with large supplies of available seawater and even in some of these cases, needed transport over long distances may not make it a feasible investment.

For firms, increasing water insecurity opens up opportunities to develop lower cost technologies that increase food production using less water. Development by firms and governments of better early warning systems, providing actionable intelligence about droughts, storm surges and flooding will be in demand as water insecurity grows.

Chapter 5: China-US Relations

Introduction

On display at the 15th Asia Security Summit last June, China-US relations have firmly settled into a character of "strategic distrust," of the type described by Lieberthal and Jisi (2012). Political discourse on both sides of the Pacific has taken on an increasingly critical character. Following the political transition in the US, Secretary of State Rex Tillerson has elevated criticism of Chinese military activities, suggesting implementation of measures to block Chinese access to constructed islands housing weapons systems and military-length airstrips (Denyer, 2017). For his part, Xi Jinping has been a vocal critic of an upsurge in protectionist sentiment across the globe, taking what many believed to be a stance against Trump at the World Economic Forum in Davos (Elliott & Wearden, 2017).

China and the United States also continue to develop their own military capabilities. Chinese defense spending was estimated at $143 billion in 2015, and has risen, on average, by 9.8 percent annually from 2006 to 2015 (Cronk, 2016; Heginbotham et al., 2015). This is still dwarfed by U.S. defense spending at around $560 billion per year in 2015, or roughly four times the Chinese budget (Heginbotham et al., 2015). Despite this relative disadvantage, the Chinese military and navy are modernizing rapidly. Additionally, the U.S. Department of Defense notes that the People's Liberation Army Air Force (PLAAF) is rapidly closing the gap with Western forces. Because of the geographic context of potential conflict, by some assessments, China's military capabilities would not have to exceed that of the United States in order to effectively challenge and overcome the US in some Chinese naval arenas (Heginbotham et al., 2015). The US clearly retains military dominance currently, and may well continue to do so into the future, but as China's prowess increases, the US may lack the ability to conduct a successful military campaign far afield.

Economically and institutionally, the US and China remain tightly woven together via trade networks, private and state investment, international organizations, and complex global value chains (GVCs). It is noted that any sort of outright conflict between the US and China could have devastating economic effects, with some analysts placing the potential impact on Chinese GDP at a 25 to 35 percent decrease, and the US at 5 to 10 percent decrease (Gompert, Cevallos, & Garafola, 2016). Disruptions of GVCs would have a severe effect on the structure of U.S. trade markets, causing relatively more impact on the US than on China, by virtue of Chinese construction of regional economic spheres of production and consumption within the ASEAN countries. Disruptions in foreign investment also have potentially severe implications for the respective labor markets and capital flows of both countries.

Though the potential for severe economic effect should be expected to be a strong deterrent to outright conflict (Gompert et al., 2016), it is possible that we will continue to see political tensions increase between the US and China, potentially spilling over into global economic interactions. This sort of transition may see the production of a new "cold war" atmosphere between the US and China, of the sort experienced historically between the US and the Soviet Union.

The Base Case assumes that the relationship between China and the United States will continue to be characterized by both increasing interconnection and competition. China and the US should therefore become increasingly institutionally and economically interdependent across time, though will continue to hold divergent views on governance, which will continue to drive tension. We forecast that the trade between the two countries will grow from $632 billion in 2016 to $1.7 trillion annually by 2035 in the Base Case.

The New Cold War scenario assumes that the relationship between China and the United States deteriorates, and becomes characterized by more conflict than competition. Trade between the two countries decreases significantly in this scenario. A sustained conflict between China and the United States could produce a world that would be polarized similarly to the Cold War. Such a world would see a significant diminution of trade *across* spheres of influence, would leave many states between spheres of influence, and could drive violent proxy conflicts.

Compared with the Base Case, and driven by reductions in benefits gleaned from comparative advantage, global GDP would decline by a cumulative $35 trillion in New Cold War relative to the Base Case, with 23 million additional people living in extreme poverty, 88 million fewer people living on more than $10 per day, and 46 countries experiencing higher levels of instability.

	Base Case 2016	Base Case 2035	Change Relative to Base Case in 2035
			New Cold War
GDP *billion USD*	81,960	141,340	-34,471
Extreme Poverty *million people*	950	710	22.6
Middle Class ($10+/day) *million people*	2,475	3,950	-88
Instability *count of countries*	-	-	46
Networked Effect *description*			A shift in global poles with clear and distinct spheres of influence that broadly compete. China's sphere expands to include many additional African partners and some South American countries. Russia reestablishes a core community with Turkey and former Soviet East Central European countries.

Table 6: Overview of findings for China-US scenarios. Note: GDP is reported as the cumulative difference between the Base Case and Scenarios (billion USD); Extreme poverty measures those living on less than $1.90 per day (million people); Middle class includes those living on greater than $10 per day (million people); Instability is reported as the number of countries experiencing higher levels of instability relative to the Base Case.

Background and theory

Long-standing debates in the field of International Relations focus on the drivers of conflict and cooperation between states and have shaped contemporary thinking about the potential for interstate conflict. Liberal accounts tend to focus on the role of economic, institutional, and normative interdependence, forming the 'Kantian tripod' (Russett, Oneal, & Davis, 1998). It is argued that these forces reduce the incentive for conflict by changing the cost of engaging in disruptive violence. On the other hand, classical Realist accounts of conflict tend to start by focusing on the survival of states and the protection of interests. These theories emphasize the role of relative material capabilities, rivalries, and other drivers of conflict (Oneal & Russett, 1999).

China and the United States have grown in liberal measures of economic and institutional interdependence since the end of the Cold War. US exports to China have increased from $349 billion in 2000 to $1.8 trillion in 2014, while Chinese exports to the United States have increased from $1.2 trillion

in 2000 to $4.1 trillion in 2014. The number of international organizations that the two countries share membership in has also grown, from 39 in 1990 to 51 in 2014. This increasing interdependence has led to a relationship that can be characterized as competitive but cooperative. China has risen largely within the framework of Bretton Woods organizations, and, while the country's leaders have taken on their own organizations (Shanghai Cooperation Organization, for example) to project their influence, they remain largely committed to the process of increasing institutional and economic interdependence through classical liberal mechanisms. However, differences in governance values both historically and today between the two countries have not produced normative convergence. This normative 'leg' of the Kantian tripod remains underdeveloped and is a potential weak point in China-US relations.

Power transition theory states that the likelihood for conflict is significantly increased between politically relevant dyads when one country catches up and surpasses another (Rapkin & Thompson, 2003). In particular, this threat of conflict is greatly increased when the rising power is revisionist and is interested in changing the status quo of the international system. The rise of China has been characterized by only moderate revisionism, which suggests that there is room for the transition between it and the United States to be managed effectively (Pan & Lo, 2017). The growth of the Chinese economy has been tremendous and has passed the United States in GDP measured at purchasing power parity. While still lagging behind the United States in GDP measured at market exchange rates (a measure more relevant to thinking about global power), they are forecast to increase their relative material capabilities and pass the United States before 2030.

Subnational political realities in the United States appear to be pressuring the country toward a more revisionist position regarding increasing trade and political protectionism. This could eventually make the United States a declining revisionist power, something scholars have spent very little time theorizing about. While recent political shifts have occurred over too brief a timeframe to reasonably form any confident trend, the possibility of a shift in U.S. policy away from economic liberalism is still present. Thus, the current developmental context between China and the United States is characterized by deep and strong ties between the countries both economically and institutionally, with a rising power largely interested in preserving and enhancing those connections and a declining power potentially interested in changing the rules of the game. This context will continue to be subject to various political, economic, and institutional pressures, and will evolve accordingly over time.

With this in mind, we can begin to explore various characteristics of the two actors and their positions within global systems of organization, in order to highlight and better understand various risk factors and their implications across the subnational, national, and networked levels of risk analysis.

Relationship between US and China

Figure 35 (below) tracks interdependence across the three "legs" of the Kantian tripod: institutions, norms, and economy. The "Polity Ratio" above is a proxy measure for normative interdependence. A polity ratio tracks how similar governance regimes are across a pair of states. Two democratic regimes will experience a very high polity ratio, as will two autocratic regimes. Conversely, a democratic-autocratic dyadic pair will exhibit a very low polity ratio. Regime type has historically been very different between China and the United States. Despite this, economic interdependence (measured in trade terms) and institutional interdependence (measured in shared membership in international organizations) remains elevated, and, barring any major geopolitical disruptions, is forecast to increase into the future. As GDP and trade are both important correlative factors in membership in international organizations (Boli &

Thomas, 1999), it is pertinent here to focus on the relative economic interdependence between China and the United States.

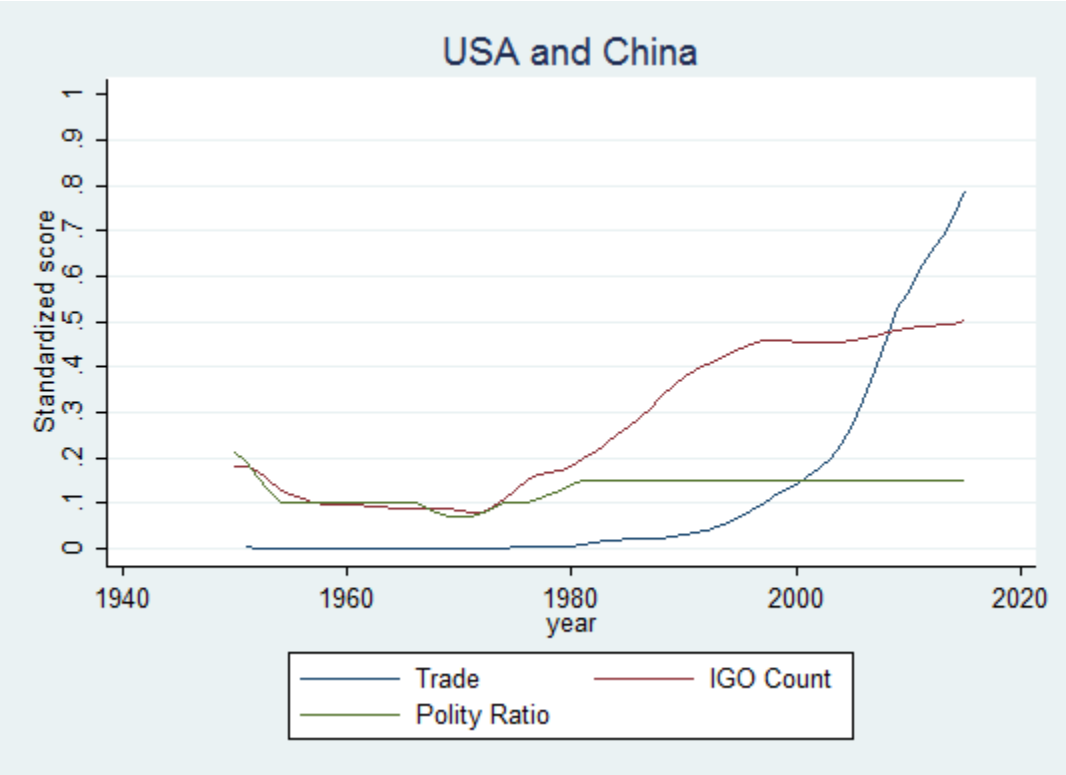

Figure 35: China—US Interdependence: Trade, Polity Ratio, and IGO Count. Calculated by the Frederick S. Pardee Center for International Futures with historical data from UNCTAD (2016), the Center for Systemic Peace (2015), and the Diplometrics project at the Frederick S. Pardee Center for International Futures (2016) and forecasts from IFs 7.28.

Foreign direct investment (FDI) is an important aspect of economic interdependence between the countries. Total global stock of FDI was around $19 trillion in 2011, with the US holding about 19 percent and China holding about 10 percent (Dollar, 2015). In terms of inward FDI, China was the largest recipient of inflowing FDI in 2014 while the United States was the third largest recipient in the same year (UNCTAD, 2015). United States' FDI to China totaled $228 billion from 1990-2015. Chinese investment in the US during the same period was $64 billion (Hanneman & Gao, 2016). The United States was the biggest investment destination for Chinese FDI in 2012, but the same was not true for US FDI inflows to China, because of greater Chinese restrictions on incoming foreign investment and poor protection of intellectual property rights (Dollar, 2015).

Bilateral FDI is expected to increase between the two nations in the future. However, Chinese investment into the US continues to increase more rapidly than US investment into China, but from a much lower base (Dollar, 2015). The Chinese economy is also expected to welcome more FDI through legislation protecting Intellectual Property Rights (IPRs), expected to be passed later this year. The economic interdependence between the two countries is discussed in more detail in the next sub-section.

Global value chains, economic interdependence and employment outcomes

The creation of Global Value Chains (GVCs) has led trading partners to move away from developing comparative advantages in individual products and instead to specialize in individual tasks. China and the United States contributed the two highest shares of value added in the GVC in 2011 (OECD, 2013). The value added from trade goes beyond pure export value and describes the net gains that a country derives out of operating in the chain, since it is also important for employment with respect to the particular activities that a country specializes in (Rashmi, 2013). The US and China occupy different positions within the GVC. The Chinese economy mainly relies on low-value manufacturing while the US economy relies on high-value service provision and domestic consumption as a source of growth. Given the complementarities between the two economies, as well as the amount of value added each contributes to the chain, a trade shock in either country can adversely impact all participants in the chain.

The amount of value added that a country generates through participation in GVCs can directly affect its employment opportunities. China is at the epicenter of the chain when it comes to manufacturing activities (Lamy, 2013) but only specializes in low-value manufacturing and assembly, mostly relying on its economies of scale for its value added. For example, China only added $4 out of the total value of the iPod ($150), as the product is only assembled by Chinese firms and the underlying technology is largely owned by Apple, a US based firm (Linden, Kraemer, & Dedrick, 2009). The United States on the other hand operates at a higher level by specializing in activities that add higher value such as design and innovation. However, the US specialization in high-value activities is made possible to a large extent through the low cost of importing goods from countries like China. When it comes to GVCs, it is not just the ability but the efficiency with which firms import that is important (Lamy, 2013). For example, firms in the United States that sell final products continue to rely on firms in China for imports of intermediate goods. In fact, the United States was the biggest importer of intermediate goods from China in 2011. Figure 36 below shows the levels of imports of intermediate goods from China by the United States.

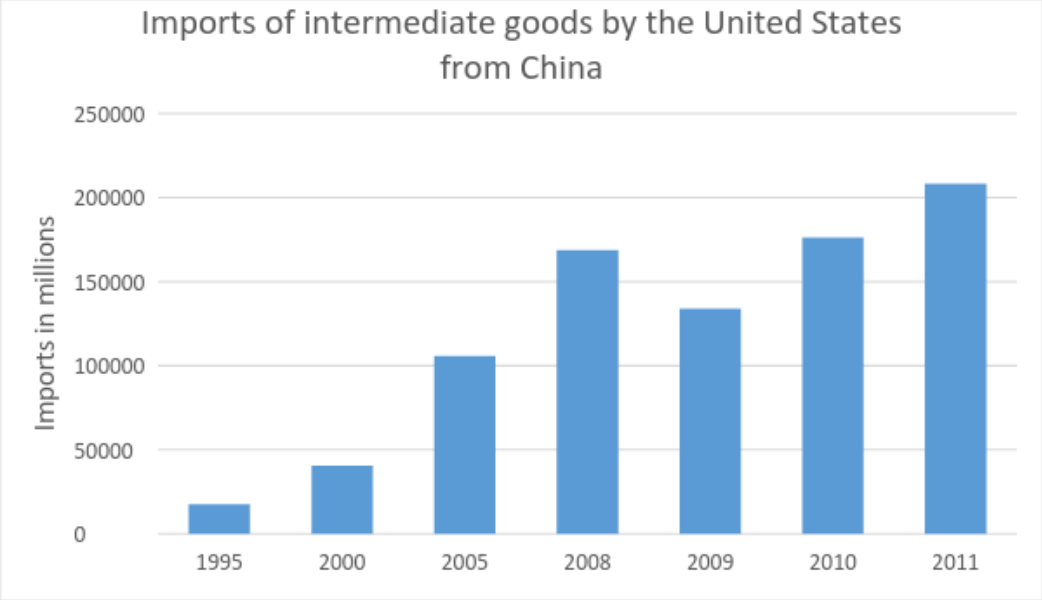

Figure 36: Imports of intermediate goods by the United States from China in million USD. Source: OECD (2015).

China and the US both derive significant gains from their participation and integration through GVCs. However, the positions they both occupy are somewhat fluid. A rise in the price of Chinese exports may render firms in the US uncompetitive while a fall in U.S. imports may negatively affect Chinese value added

through trade. Moreover, with the two countries being the highest contributors to value added from trade in the GVC, a slowdown in either economy could lead to an economic contraction in every other country that derives a significant amount of value added from the chain. This suggests that an economic contraction in either the US or China would lead to a corresponding economic contraction in the other. Also, as the countries are the two largest participants in GVCs, a slowdown in either economy should lead to a global economic slowdown.

The Chinese economy is transitioning from one that is based on export-oriented manufacturing to one that relies on domestic consumption for growth. With the country's aging population, export-oriented manufacturing may not be sustainable in the long term. Currently, the country has a very small share of household consumption in its GDP compared to other major economies, as shown in the figure below.

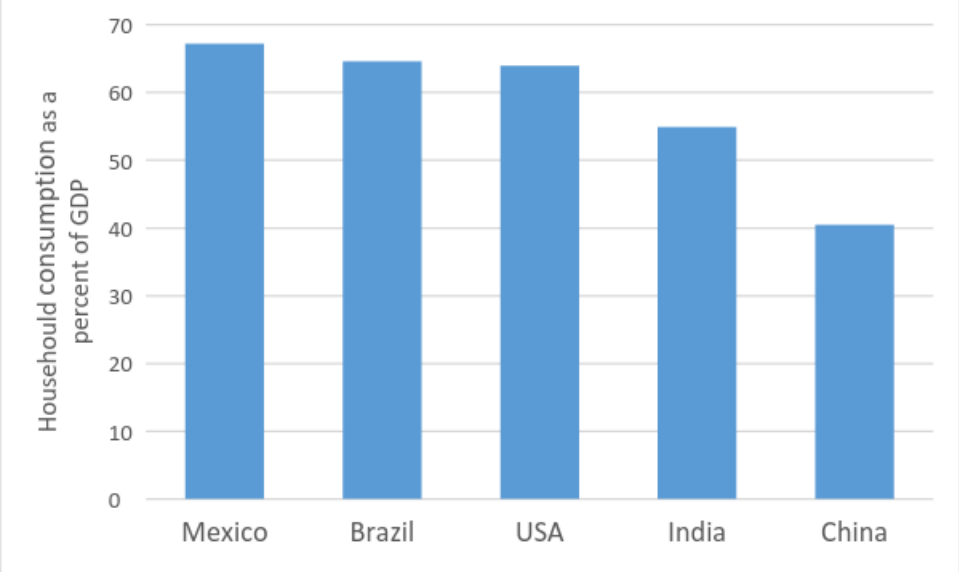

Figure 37: Household consumption as a percentage of GDP in 2015 Source: World Bank (2016)

This economic transition towards domestic consumption is necessary if China is to ensure inclusive and sustainable growth in the long run. Given China's current manufacturing position in the GVC, this transition will likely be accompanied by slowing growth in manufacturing output and therefore a reduction in economic growth (at least in the short term). The country may subsequently have to rely more on FDI as a buffer for the transition to occur smoothly. FDI plays an important role in the economies of more developed nations such as the United States, especially in terms of providing a counter balance to trade deficits (UNCTAD, 2015). FDI for the United States is more of a source of capital, while FDI in China is associated more with employment outcomes. US investment in China in 2012 created 1.6 million jobs, while Chinese investment in the US in the same year created 100,000 jobs (Hanneman & Gao, 2016).

Power and conflict

Though economic concerns should be a significant consideration in the development of China-US relations into the future, the normative weakness in connectivity between the two actors leaves room for risk. Realist scholarship on the issue of China-US relations suggests that, as China draws nearer to parity in military and economic terms with the United States, the likelihood of conflict increases somewhat proportionally, with nuclear weapons capabilities providing the only substantive deterrence (Glaser, 2015). The movement towards economic parity is happening rapidly. For example, in 2003, Chinese GDP was only one eighth of US GDP, but not even 10 years later Chinese GDP had climbed to one third of the

US GDP (Yahuda, 2013). In the Base Case, Chinese GDP (at MER) is expected to pass that of the U.S. before 2030. As economic shifts factor into the balance of power globally over time via increased potential allotment to military budgeting, risk of military tension or escalation between the two countries should increase relative to U.S. erosion of 'strategic primacy' in various possible military arenas (Mearsheimer, 2010)

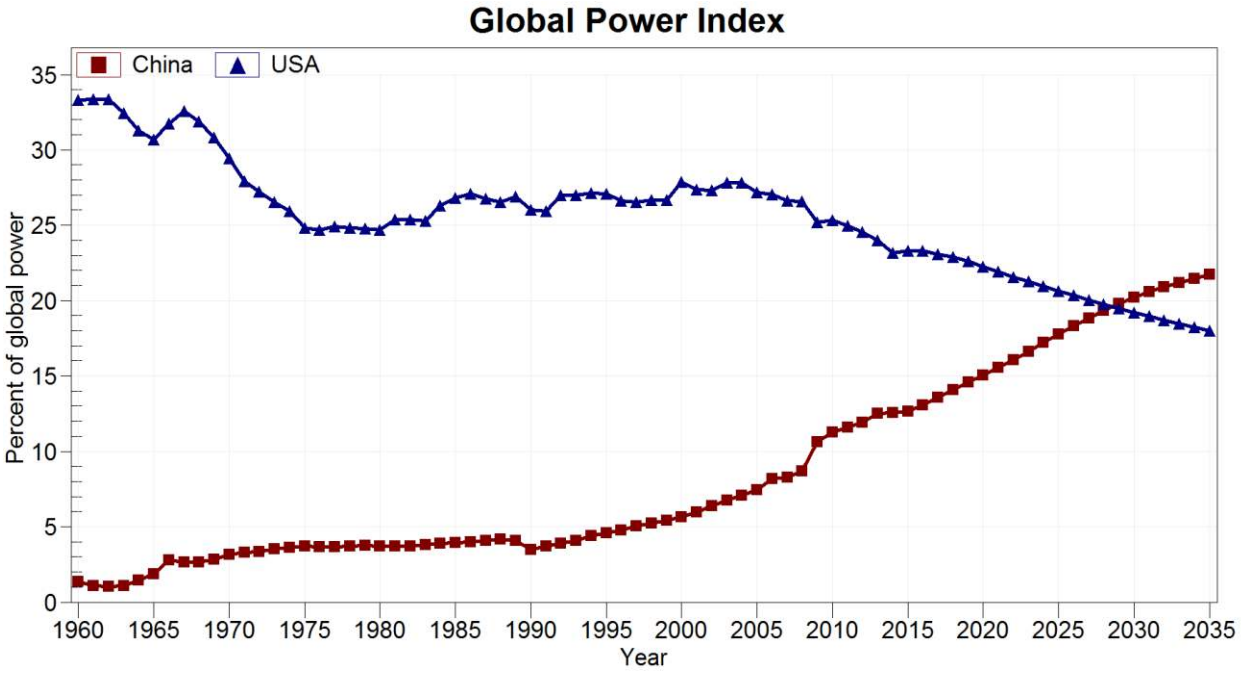

Figure 38: Percent of global power as determined by the GPI of the United States and China on the Base Case. Source: The Diplometrics project at the Frederick S. Pardee Center for International Futures (2016) and IFs 7.28

Even though this analysis indicates that China is an emerging power, the country currently does not play a revisionist role in the global architecture. The last time a major power transition occurred was when Britain reluctantly transferred its hegemonic position to the United States in the early 20th century because of the perils faced in Europe (Schweller, 2011). However, the United States did not assume a revisionist role in the global architecture until after World War II. Schweller (2011, p.5) notes that "the United States only assumed global responsibilities many years after it became the most powerful state on earth, when it produced almost half of the world's total economic output—a relative power position that China is not even close to achieving at this stage in its current stage of development."

In fact, the extent of a revisionist role that a country assumes is also driven by its domestic political environment. Given the popularity of protectionist rhetoric seen in U.S. political discussions today, the US may currently pose a greater threat to the global power structure rather than China.

However, the potential for manageable power transition globally is still clearly present. In response to recent protectionist rhetoric coming from the US, China has been acting increasingly as a 'status-quo' power in an institutional and economic context in order to preserve the economic system through which its rise was facilitated. The future of China-US relations over the next decade will likely be defined by increasing economic interconnectedness and a movement towards power parity. Even if conflict between the two powers is unlikely, the two nations are expected to continue their economic and political dominance, both demonstrating strong influence over the structure of global networks.

Spheres of influence and their capabilities

Since the end of the Cold War, there has been a proliferation of treaties, a broadening of alliance structures, increased accession and importance of intergovernmental organizations, an expansion of diplomatic representation, and a deepening of economic interaction across the globe. The structure of the international system today is increasingly defined by participation in multilateral institutions and networks. The resurgence of nationalist sentiment across the western world, and rise of China as a great power may be a signal of changing patterns of international relations.

In recent years, China has built a network out of strong bilateral connections (Rolf & Agnew, 2016). This strategy is potentially aimed at creating, or in this case, replacing the "hub and spoke" system of bilateral security relations originally developed in East Asia by the United States (Ikenberry, 2014). Though the US and other Western interests still have a strong foothold, international politics in the Pacific are increasingly multipolar (Rolf & Agnew, 2016). This structure is conducive to increased overlap of spheres of security influence moving towards 2035. Understanding patterns of Chinese and US spheres may help inform where and how increasing tensions between the two actors could play out.

While China's expansion of regional influence is much more recent, the country has already made strong in-roads into important countries like Pakistan and South Korea. While this has changed—and undermined to some extent—the older, more established US sphere, much of China's expansion has been in regions with weaker ties to the US. The map below colors countries according to their security proximity to China and the US. This measure considers influence as a bilateral exchange, representing the potential for one country to effect change in another. While both China and the US have some level of influence in all countries, the colors indicate a "net influence"—the difference in levels of influence between the two countries—with red indicating stronger influence from China and blue indicating strong influence from the US. States occupying a space between the two (colored grey in the map below) can be thought of as pivot states.

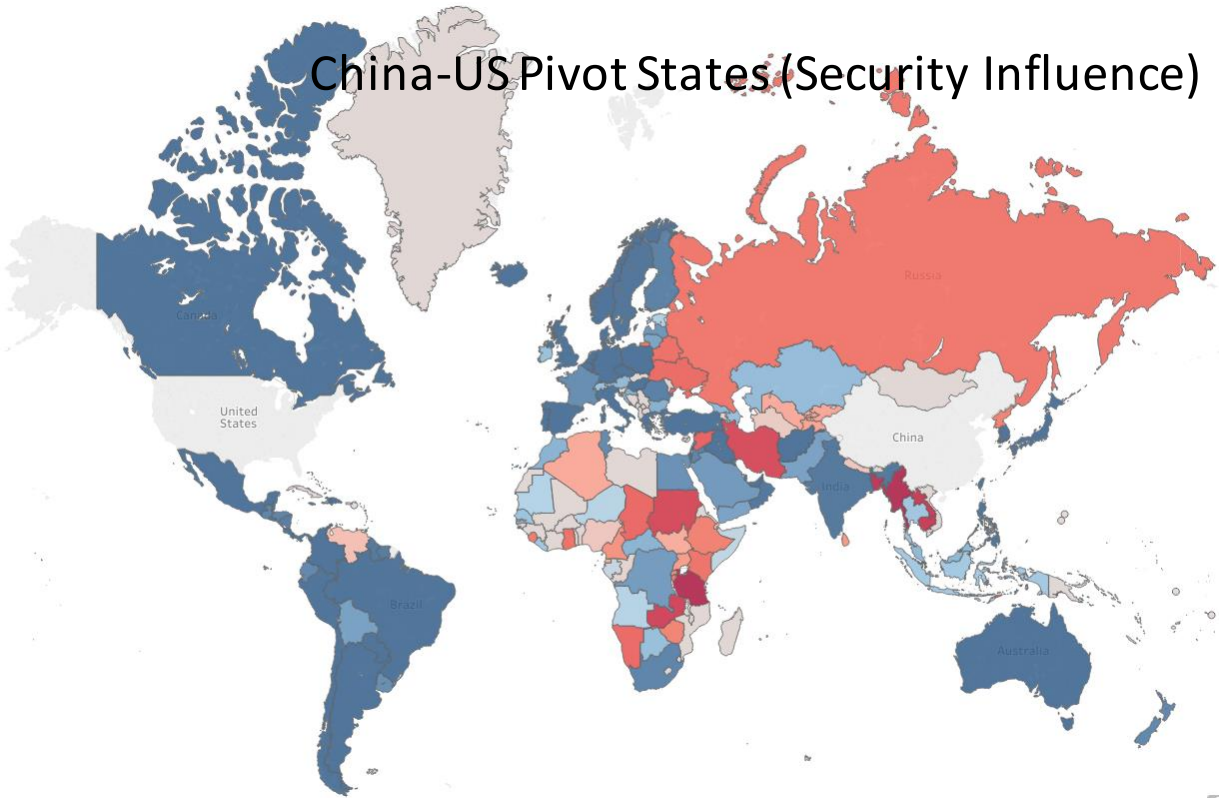

Figure 39: Chinese and US security spheres of influence, based on the Security Influence Index from the Diplometrics project at the Frederick S. Pardee Center for International Futures (2016). Blue indicates stronger U.S. security influence, and Red indicates stronger Chinese security influence. As the color gradient of a state moves towards grey, the state can be thought of more as a 'pivot state', with hard grey states existing equally between China and U.S. security spheres.

Pivot states, which exist within overlapping spheres of influence between two or more major powers, are traditionally considered important for regional and global security via shifts in their posture. States can be either passive, being 'used' by major powers in the region, or active, shaping the nature of the global or regional conflict/tension (Sweijs, Oosterveld, Knowles, & Schellekens, 2014). If tensions between China and the US continue to escalate, and as China pursues an increasingly stronger regional presence, the existing relationships between other actors within the geopolitical arena may shift or cement via 'capture' into either country's emerging sphere of influence.

During the Cold War, containment and domino theory were based on conceptions of securing 'pivotal states' (Chase, Hill, & Kennedy, 1996). It is noted by Chase et al. (1996, p. 34) that US strategy in this area was "never sufficiently discriminate" during the Cold War and contributed to "America's strategic overexpansion." If the world moves towards a more securitized and bipolar atmosphere, as we would expect escalating tensions between the US and China to create, pivot states will become more important global actors. Shifts in cooperation with the US or China will have potentially significant implications for national security interests of the major global powers, and internal stability of pivot states should be considered carefully, as "a pivotal state is so important regionally that its collapse would spell transboundary mayhem" (Chase et al., 1996, p. 37).

In the network diagram below, the relative size of the circles represents the degree of overlap between the emerging security structures, meaning, the larger the bubble, the stronger the pivot quality. It should also be noted that the clustering on network analysis takes into account the structure of the entire system, treating spheres of influence as a more multilateral concept. This approach could locate in a country, such

as India, which is more directly within the US sphere of influence (bilaterally) and in China's sphere (multilaterally) because of its strong ties with other countries more deeply connected with China.

In Figure 40, Pakistan emerges as one of the key pivot states within the new geopolitical picture. Taking into consideration the supposed transboundary effects of pivot state instability, and the history of conflict between India and Pakistan, an increase in China-US tensions could also lead to increased tension in South Asia.

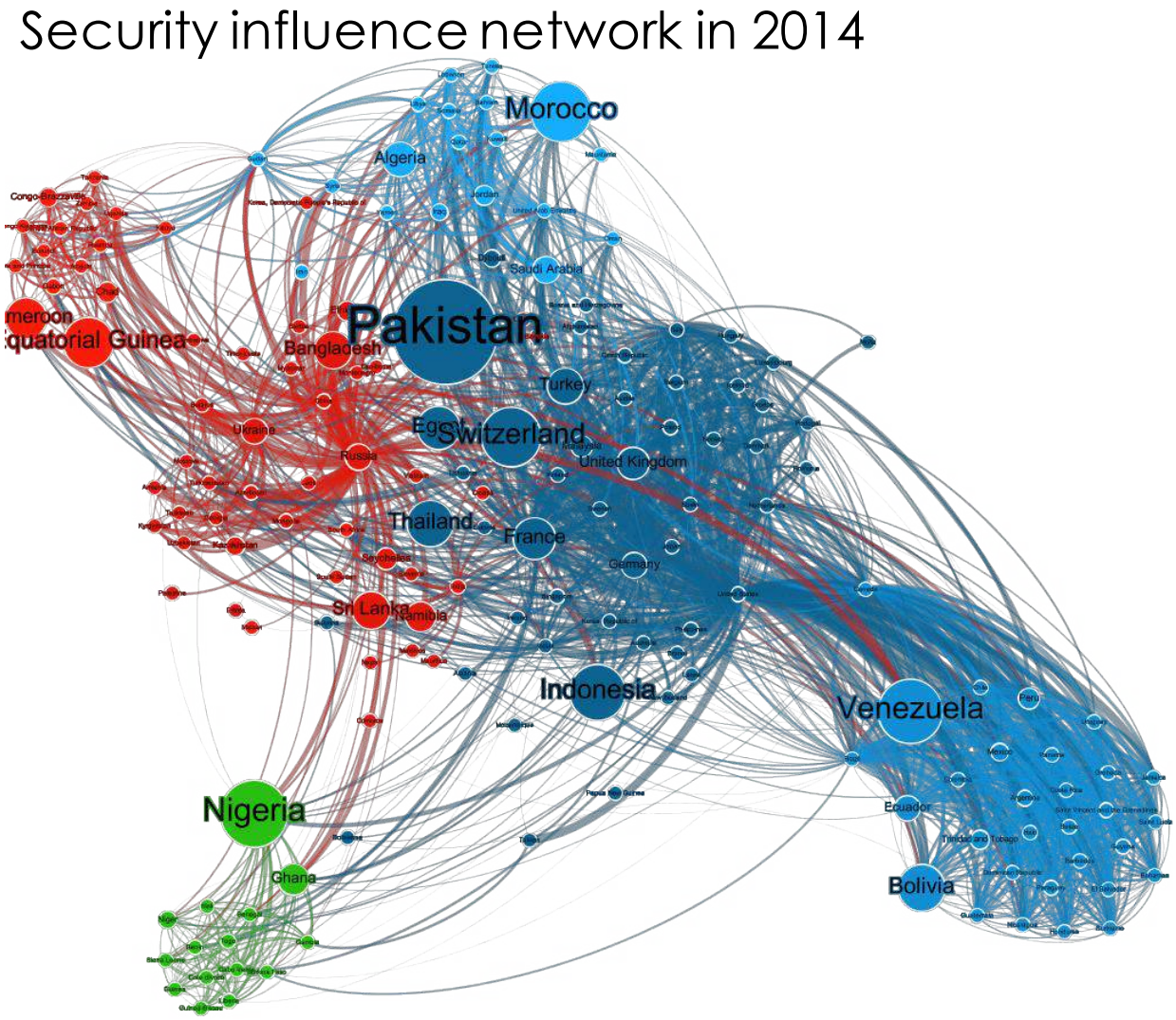

Figure 40: Global security influence network in 2016. The strength of ties is visualized using the level of security influence. Connection color is determined by the community of the influencing country, with different shades of red and blue indicating communities which are found to be a part of China's sphere (red) and the U.S. sphere (blue) at higher community resolution (resulting in fewer communities). Visualization threshold is set at one standard deviation above the mean level of security influence. The size of each node represents the inverse difference in bilateral influence between the China and the US for each country, so that larger nodes represent countries in which China and the US have similar levels of influence in. Node colors indicate communities within the security influence network in 2016. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: The Diplometrics project at the Frederick S. Pardee Center for International Futures (2016)

By 2035, the GDP (at MER) of China's sphere is forecast to grow at an average of 5.5 percent per year, while the U.S. security sphere is forecast to grow at 1.7 percent. China's sphere is forecast to grow more

rapidly, though it is forecast to remain smaller, with overall GDP of countries in China's sphere in 2035 reaching the level of the U.S.'s sphere today (roughly $50 trillion). The sectoral distribution of the economies of the more developed countries in the US sphere is forecast to remain, on average, similar throughout this horizon. The economies in China's sphere of influence are forecast to see a stronger shift towards manufacturing and services. Cumulative military spending between the two security spheres is expected to reach parity before 2035.

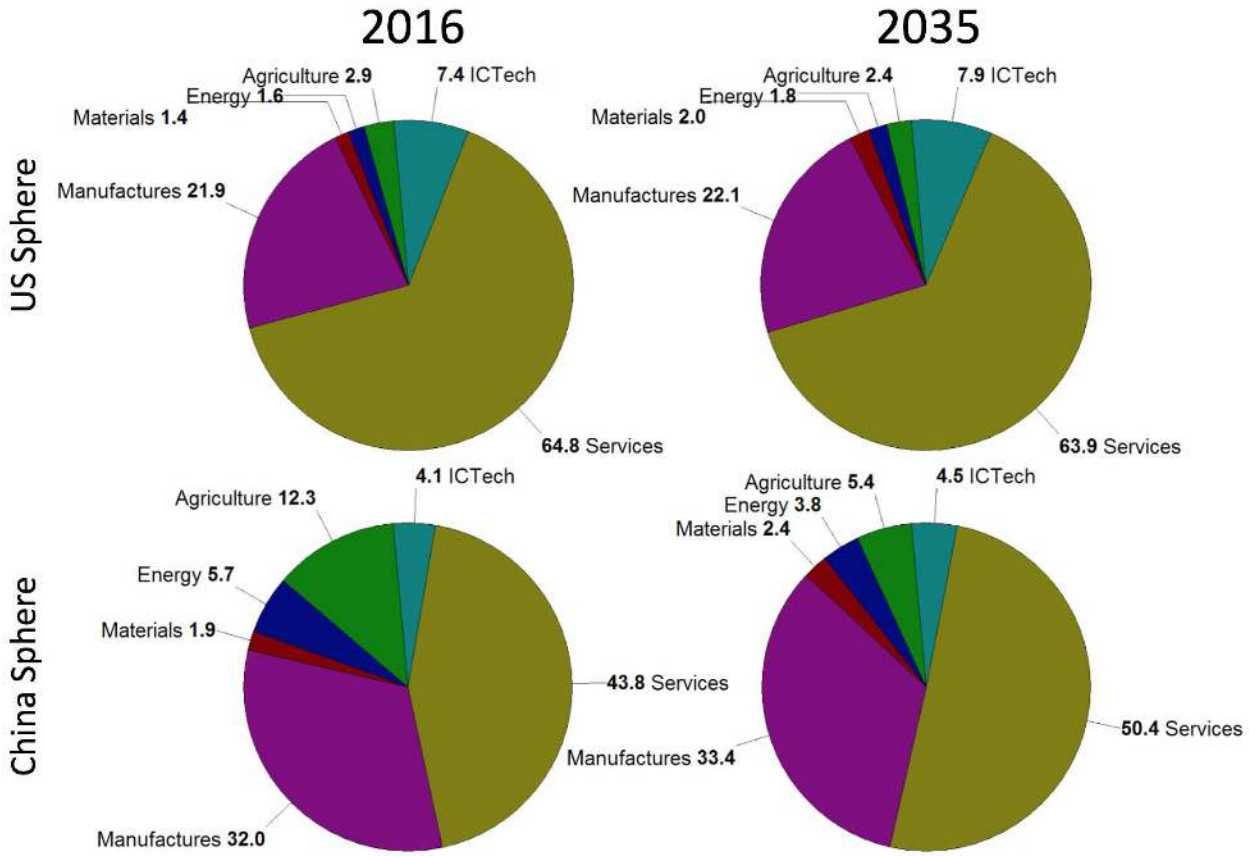

Figure 41: Value add by sector as a percent of GDP for Chinese and US security spheres in 2016 and 2035. Source: IFs 7.28.

China's sphere of influence is comprised of countries with less democratic regimes. According to the Polity Index, China's sphere can be categorized as anocratic, with the average regime type of countries somewhere between that of democracy and autocracy. China's sphere of influence is also characterized by lower levels of development in terms of average income, higher levels of poverty, a younger population, and a greater risk of domestic instability compared to that of countries in the US sphere. Table 13 below compares the levels of development between the two spheres in the Base Case in 2016 and 2035.

	China Sphere		**US Sphere**	
Variable	*2016*	*2035*	*2016*	*2035*
GDP per capita *thousand dollars at PPP*	9.0	16.0	27.6	34.4

Extreme Poverty *millions of people*	603	383	87	54
Life Expectancy *Years*	71	75	76	79
Median age *Years*	30	36	35	39
Polity score *0 is fully autocratic; 20 is fully democratic*	10.8	12.3	17.7	18.1

Table 13: Levels of development in the China Sphere and the US Sphere. Source: IFS 7.28.

Scenarios

New Cold War

In the **New Cold War** scenario, China and the US more aggressively shore up their own separate spheres of influence (described in the previous section). Both countries expend significantly more on increasing military capabilities, and NATO members reach the military spending target of 2 percent of GDP. Relative to the Base Case, these interventions lead to a $5 trillion cumulative increase in military spending globally, resulting in a cumulative reduction of $4 trillion on health spending, $2 trillion on education spending, and $1.3 trillion on infrastructure spending. China increases military spending and surpasses the US in military by the mid-2020s.[24]

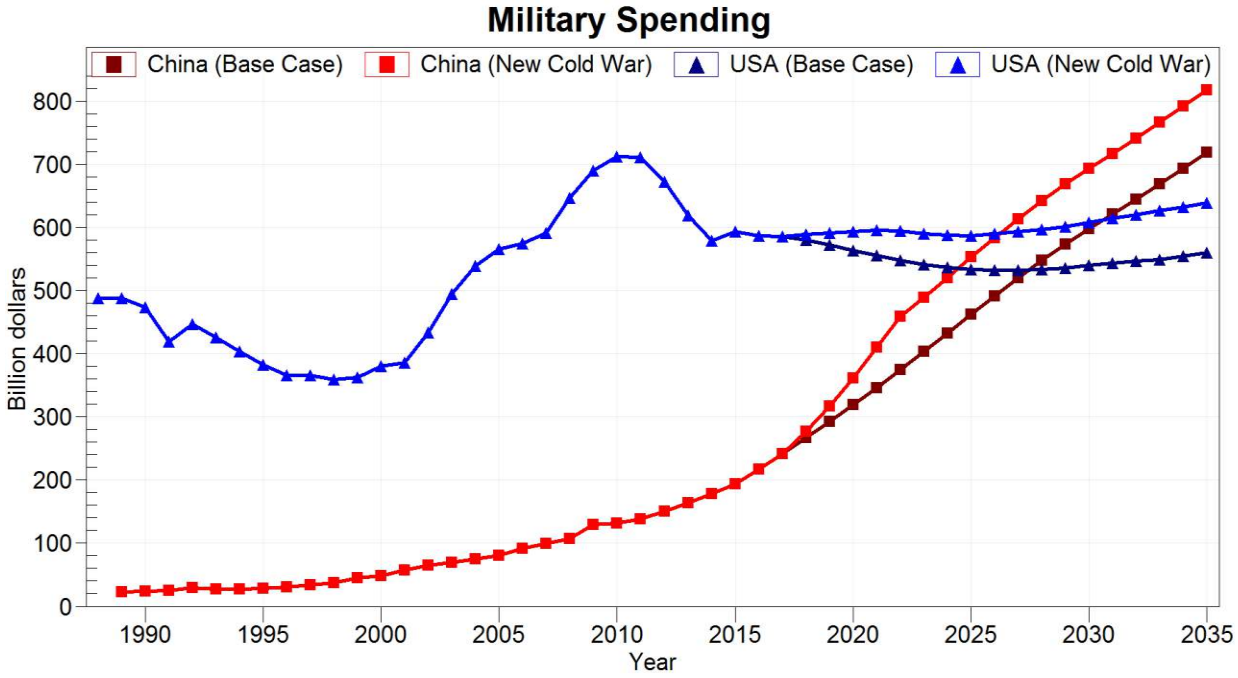

Figure 42: Chinese and US military spending across the Base Case and New Cold War scenarios. Source: Historical data from the Stockholm International Peace Research Institute (2016) and forecasts from IFs 7.28

As tensions rise, we model a reduction in trade between China and the US, which extends to the two

[24] For a detailed description of the parameters used in each scenario see Appendix A.

countries' spheres of influence. By 2035, we model a $95 trillion cumulative reduction in global exports relative to the Base Case. FDI growth also begins to slow globally, but there is an increase in foreign aid sent to countries on the periphery of both Chinese and U.S. spheres of influence.

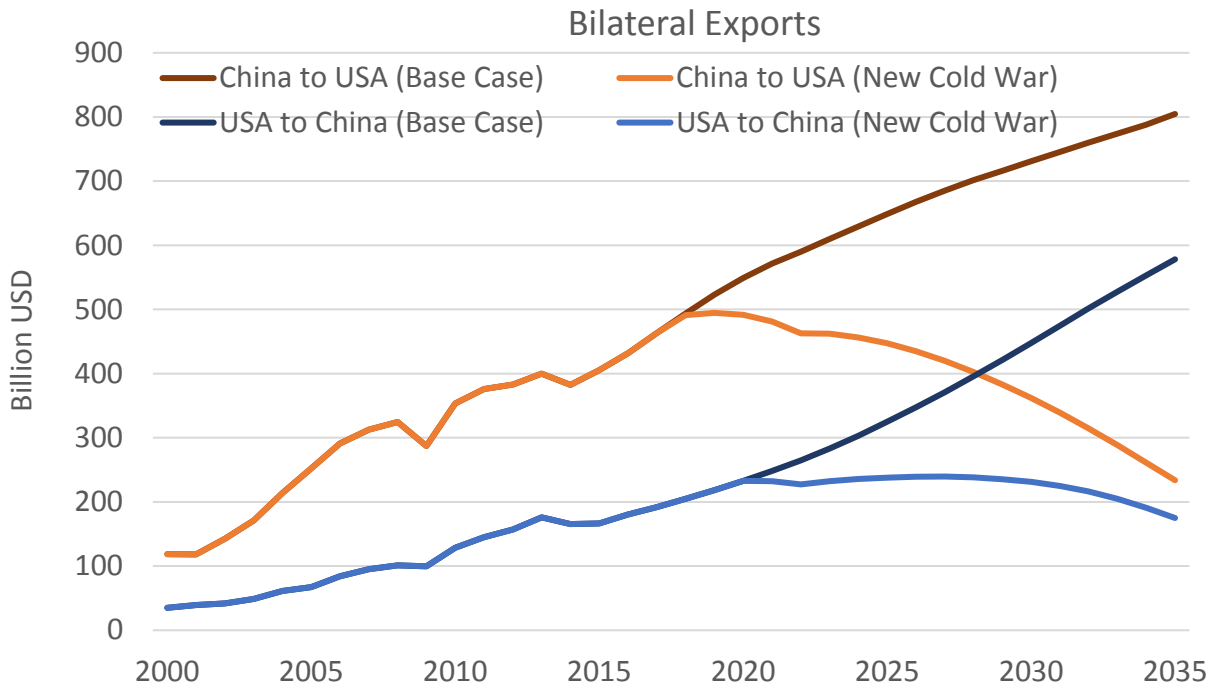

Figure 43: Exports between the US and China under the Base Case and New Cold War scenarios. Source: Historical data from UNCTAD (2016) and forecasts from IFs 7.28

In New Cold War, many of the developing countries in China's sphere, which would have otherwise enjoyed higher levels of trade with the more developed countries in the U.S.'s sphere, experience only limited access to Western markets. At the same time, the US and other high-income countries within the same security sphere of influence miss out on many of the trade and investment opportunities found in the more rapidly growing markets in Africa and Asia. By 2035 however, the new structure of international trade under New Cold War can provide new opportunities for countries like India, which are able to quickly capitalize on the trade vacuum, and later for countries within the security spheres of influence closest to China and India.

Global Trade Network Base Case 2035

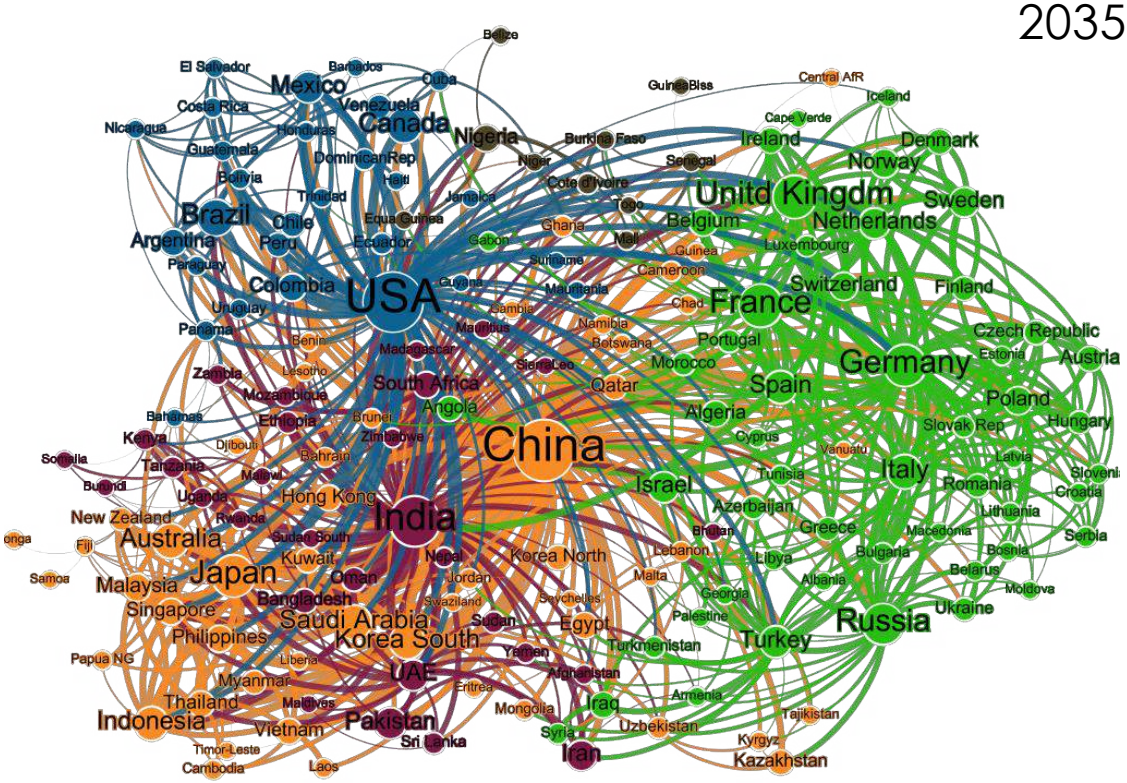

Figure 44: Global trade network in 2035 under the Base Case scenario. The strength of ties is visualized using the natural log of exports between countries. Connection color is determined by the community of the exporting country. Visualization threshold is set at one standard deviation above the mean level of logged dyadic trade. The size of each node represents the relative power of the nation (according to the Global Power Index). Node colors indicate communities within a network defined by bilateral exports as a percent of total imports of the partner country. The community detection algorithm used for this calculation comes from Blondel et.al. 2008. Source: IFs 7.28.

Under the New Cold War scenario, both China and the US are forecast to reduce network centrality as trade partners begin to pull out of current arrangements. However, since the security community of the US comprises Latin America and high-income European countries, the now more isolated trade community has less room to expand than the more rapidly growing economies found within China's security sphere of influence. By 2035, China's trade bloc is forecast to have grown to include many additional African partners as well as South American countries such as Brazil, Argentina, Chile, and Peru. Russia reestablishes a core community with Turkey and former Soviet East Central European countries. Cut off from some of the newest and most rapidly growing markets, economic growth in the US and Europe is more constrained than in other parts of the world; however, China, and to a lesser extent India, which are becoming more competitive with high-income economies, are hurt the most by this isolation.

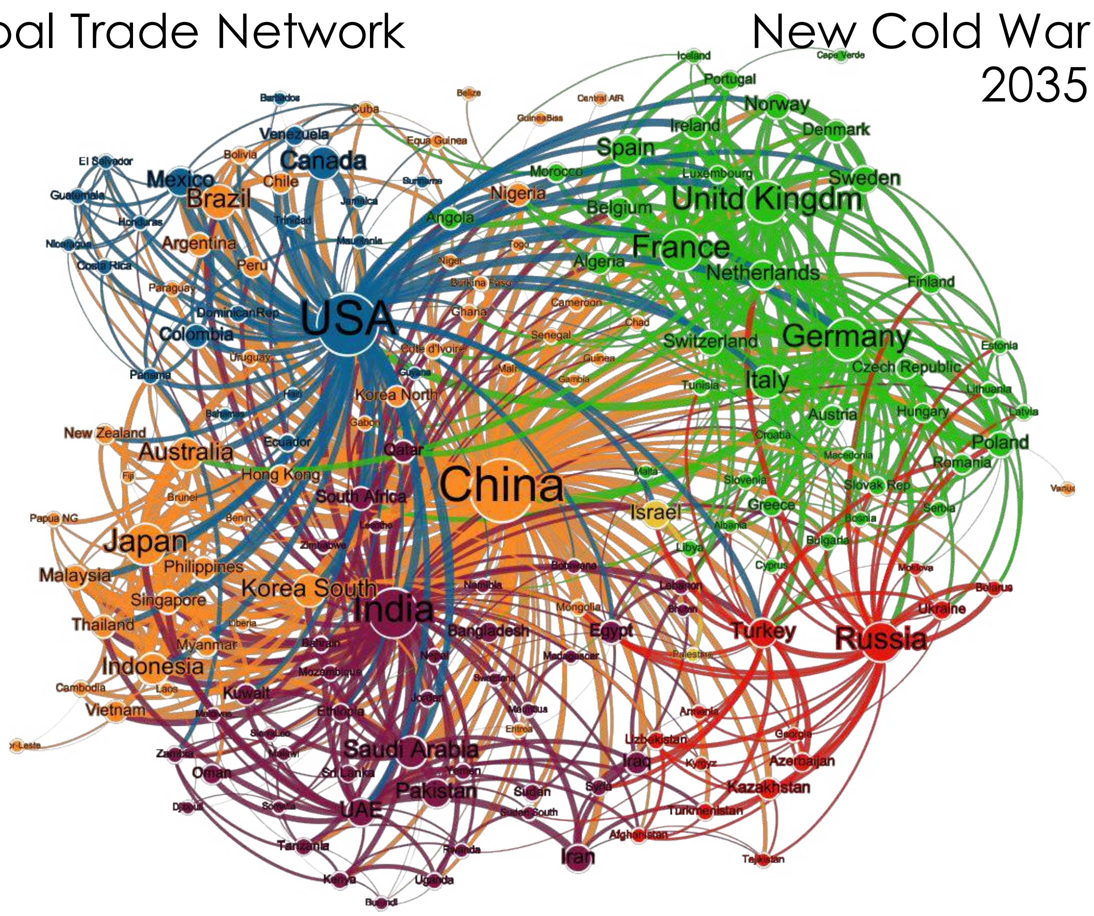

Figure 45: Global trade network in 2035 under the New Cold War scenario. The strength of ties is visualized using the natural log of exports between countries. Connection color is determined by the community of the exporting country. Visualization threshold is set at one standard deviation above the mean level of logged dyadic trade. The size of each node represents the relative power of the nation (according to the Global Power Index). Node colors indicate communities within a network defined by bilateral exports as a percent of total imports of the partner country. The community detection algorithm used for this calculation comes from Blondel et al. 2008. Source: IFs 7.28.

The foregone benefits of comparative advantage owed to higher levels of trade and a diversion of resources away from longer-term investments in human capital puts the world on a lower economic growth trajectory. By 2035, relative to the Base Case, global GDP is reduced by a cumulative $35 trillion. This leads to 23 million additional people living in extreme poverty, 45 million additional people living on less than $3.10 per day, and 86 million people fewer people living on $10 or more per day globally. With a reduction in trade openness, a reduction in economic growth and higher levels of infant mortality due health spending cuts, nearly 50 countries experience a higher probability of conflict in this scenario.

Conclusion

The gradual decline of U.S. hegemony and the rise of China as a great power is currently underway. Barring very significant changes in long-term U.S. and Chinese growth, this transition of power is very likely. China's growth and development will, however, continue to be closely tied to the cooperation and integration promoted by the Bretton Woods institutions. The U.S. on the other hand has recently signaled a willingness to withdrawal of the current economic arrangement. In 10 years, a rising revisionist China may represent the largest threat to the current structure of the international system. Until then, a declining revisionist United States may pose a greater risk.

If the competitive yet cooperative relationship between China and the US becomes increasingly conflictual, a new set of dynamics is likely to emerge that shapes the world into separate spheres of influence. China is growing rapidly and, while it may experience a significant reduction in growth in the near future (the so-called “hard landing”), it will continue to remain an extremely significant player throughout Asia and the rest of the world. The New Cold War scenario demonstrates the extensive impact on human development that deteriorating relations between US and China will have on the global economy. By 2035, this scenario results in a cumulative reduction in global GDP of $35 trillion, an increase of 22.6 million people in extreme poverty, a decrease of 88 million people living on $10 or more per day, and 46 countries experiencing greater probably of internal instability, compared to the Base Case.

Chapter 6: High energy prices stemming from Iran-Saudi conflict

Introduction

Global energy markets are fundamental to human development and economic growth. Today, many economies are heavily dependent on fossil fuel imports for economic production. Other states rely on fossil fuel exports for a sizable portion of their economy. Renewable energy makes up an increasingly large share of global energy production and consumption, but fossil fuels remain central. It is easy to forget this fact given the currently depressed state of oil prices in the international market.

The low price of oil is largely an outcome of Saudi Arabia overproducing to undermine the oil revenues of its rival Iran (and other oil producers). Iran and Saudi Arabia are prominent oil exporters and enjoy considerable influence in the Middle East—a region that has more than half of the world's proven oil reserves and is the source of about 32 percent of global oil production. It is possible that future energy price shocks will emanate from the relationship between these two states.

The relationship between these two regional powers has historically been characterized by rivalry as well as cooperation, particularly against common threats. Consequently, it is hard to predict how the relationship will develop going forward. On one hand, both states are engaged in violent proxy wars in at least a couple of regional states. On the other hand, they appear to be cooperating in the energy sector, with Saudi Arabia softening its stance on undermining Iranian oil production.

There is a strong argument that both intense conflict and close cooperation between the two powers could constrain oil production. This rationale is explained in greater detail below. This section later explores some of the consequences that sustained conflict between Iran and Saudi Arabia could have on the global economy and stability through 2035. The scenarios in this section assume that the conflict scenario will lead to a deterioration in stability and a substantial reduction in energy production across the region. From this starting point, we explore two separate pathways.

In the Constrained Energy scenario, other sources of energy, including renewables, cannot make up for the loss of Middle East energy supplies, resulting in a significant increase in global energy prices, incentivizing additional production in countries with significant fossil fuel reserves. In Accelerated Renewables, the spike in energy prices spurs further investment in the development of renewables, and improving technology makes alternative energy cheaper and more competitive globally.

These two scenarios are compared against the Base Case which assumes no significant escalation in Iran-Saudi tensions, and steady energy production in the Middle East. We measure the impact of these scenarios on global economic indicators—namely global GDP, the number of people living in extreme poverty, the number of people in the middle class, and the number of countries at increased or decreased risk of political instability.

			Change Relative to Base Case in 2035	
	Base Case 2016	**Base Case 2035**	**With Renew**	**Without Renew**
GDP *billion USD*	82,000	141,400	-46,400	-54,400
Extreme Poverty *million people*	950	710	16	23

Middle Class ($10+/day) *million people*	2,480	3,950	-76	-93
Instability *count of countries*	-	-	24	26
Networks *description*			Many countries with significant untapped energy resources, such as Norway, South Africa, Thailand, Russia, Venezuela, and Angola, play more central roles in global energy distribution. Europe becomes increasingly dependent on Russian energy and Indonesia provides energy to much of Asia and Africa. Venezuela, India, and Angola form the core of an energy trade community that spans four continents.	

Table 14: Overview of findings for Saudi-Iran scenarios. Note: GDP is reported as the cumulative difference between Base Case and Scenario (billion USD); Extreme poverty measures those living on less than $1.90 per day (million people); Middle class includes those living on greater than $10 per day (million people); Instability is reported as the number of countries experiencing higher levels of instability relative to the Base Case.

This chapter proceeds with a section analyzing the sources of this geopolitical risk emanating from the various levels of analysis. This is followed by a section that highlights the assumptions and scenarios. The final section explains and exhibits the results.

Background and theory

History

Present day tensions between Iran and Saudi Arabia originate with the 1979 Iranian Revolution. Prior to the revolution, since the British departure from the Persian Gulf in 1971, Iran and Saudi Arabia had a relationship characterized by tacit nonaggression (Chubin & Tripp, 2004). However, after the revolution, with the emergence of an Iranian state dedicated to a radical populist interpretation of Islam that explicitly advocated for a dramatic revision of status quo in the Muslim world, ideological and political pressure began to mount on the conservative Saudi government. Since then, tensions between the two countries have waxed and waned.

Saudi Arabia aided Iraq during its long war with Iran by giving the former tens of billions of dollars and attempting to undermine Iran's oil income by overproducing (Hiro, 1990). During this time, Saudi Arabia and Iran engaged in brief military clashes over oil shipping in the Persian Gulf. The two countries severed ties after a clash between Iranian pilgrims and Saudi authorities left hundreds dead during the hajj in 1987. Relations were revived after the Iraqi invasion of Kuwait when Iran sided with the Gulf states in defense of the Kuwaiti monarchy (Jahner, 2012). The 1990s saw relative improvements in the economic, political and social relationship between the two powers (United States Institute of Peace, 2016) but ideological and geopolitical strains remained. These tensions would manifest in the regional disturbances of the following decade.

The US-led occupation of Iraq helped the advancement of Iranian interests in the region, as Nasr (2006, p.58) notes, "by liberating and empowering Iraq's Shiite majority, the Bush administration helped launch a broad Shiite revival that will upset sectarian balance in Iraq and the Middle East for years to come." Doran (2011) conceives of the emerging Iranian project as undertaken by a larger resistance 'bloc' including Hezbollah as well as covert capabilities and associated groups in Iraq. The 'Arab Spring' further destabilized the region, spurring Iran to establish a foothold in Syria, through Hezbollah and its own

military forces, in support of the Assad regime's fight against the Sunni uprising (Abboud, 2015). The regional upheaval has also enabled the spread of Saudi influence. The Syrian rebellion has received considerable monetary and material support from Gulf states, notably Saudi Arabia and Qatar (Gardner, 2015). Saudi forces have intervened in Bahrain to help the Sunni monarchy crush an uprising by the majority Shia populace (Bronner & Slackman, 2011). Saudi Arabia has also intervened militarily in Yemen to prevent a Shia-led rebellion from defeating the Saudi-friendly government (Rohde, Stewart, & McDowall, 2016). Iran has been providing weapons and training to rebels in Bahrain and Yemen (Bayoumy & Stewart, 2016; Levitt & Knights, 2017). The powerful Shia militant group Hezbollah is Iran's historical ally in Lebanon. The group's increasing influence in the Lebanese state has been a source of frustration for Saudi Arabia which has previously funded Sunnis in the country (Evans & McDowall, 2016).

It should be noted that neither Iran nor Saudi Arabia exercise complete control over client factions in these states. The behavior of these regimes and rebels is driven primarily by their own agendas considering the varied political and military dynamics of their respective countries. As Kaye, et al. (2011, p. 186) note, "U.S. policymakers should avoid a two-dimensional reading of the strategic map as a coherent bloc of Iranian-directed actors marching in lock step; such a view ignores the new dimension of Arab politics in which domestic environments matter more than ever." Saudi Arabia and Iran have exacerbated conflict by propping up combatant factions—a practice apparent in the Syrian civil war—but they are usually reacting to local shifts in the balance of power. Such shifts create an escalatory cycle as both sides channel increasing amounts of weapons, finances and military assistance to their clients. This complexity also makes it hard to identify a general trend in the region with regards to conflict between these two broad coalitions beyond a snapshot of the current situation. Syria and Yemen are presently experiencing fighting with intermittent ceasefires. Lebanon and Bahrain are relatively stable. The civil war in Iraq is slowly winding down as the Iraqi government assisted by the US and Iranian-backed militias recaptures territory ceased by the Islamic State.

Sources of conflict

Subnational:

Iran's revolutionary Shia ideology is a challenge to conservative Sunnism that underpins the rule of the Saudi clan in Arabia. Moreover, the variant of Sunnism espoused by the Saudis—Salafism—is virulently anti-Shia. Religious elites in both countries routinely denounce each other, but these theological differences produce more than just rhetorical feuds. These regimes derive their legitimacy from sharply diverging interpretations of Islam, therefore religious disputes often escalate to political tensions. Tensions emanating from the Hajj—when Iranian pilgrims periodically clash with Saudi authorities over ritual rights—undermine interstate relations, as does Saudi destruction of ancient sites important to Shiaism. The two states have historically supported conflicting sectarian parties in countries from Pakistan to Lebanon and beyond. It is not coincidence that Saudi assistance is directed at factions associated with purist Sunnism and Iranian support finds its way to a variety of Shia groups.

Iran and Saudi Arabia are both vulnerable to internal pressures. Iran experienced popular protests before and after the 'Arab Spring' which it had to violently suppress (Hashemi & Postel, 2011). Its increasingly well-educated and growing middle-class is demanding increased freedoms and economic opportunities. Saudi Arabia experienced little protest during this time because of its weaker civil society and more stringent hold over political organization in the country but this is not necessarily a sign of regime strength. The kingdom is vulnerable to many of the same demographic pressures, including youth unemployment, in addition to threats from revolutionary Sunni groups that see it as an important target (Aarts & Roelants, 2015).

There is a risk that these regimes may go to war to negate domestic opposition. If domestic sentiment in either country is sufficiently radicalized, its regime will be pressured to adopt a confrontational stance against the other to shore up its ideological credentials and/or satisfy nationalistic urges. This dangerous possibility has become more likely with the recent wave of sectarian hostility in the region. Moreover, these regimes may also resort to international confrontation to undermine liberal opposition at home—this is more likely with Iran—by using the 'rally around the flag' effect to crackdown on voices calling for state reform.

National and international:

The two states also vie for political leadership in the Muslim world, but the Saudis have three advantages in this regard. First, about 85 percent of the world's Muslim population is Sunni, which means Iran's revolutionary model has limited appeal outside of Shia enclaves in Muslim-majority countries. Second, the Saudis control Islam's two holiest sites, which for historical and practical reasons provides them significant legitimacy and influence in the Muslim world. Third, the Saudis have been able to maintain a close alliance with the US, whereas Iran has suffered periodic sanctions and international isolation due to its antagonistic approach to the West, which means the Saudis buy influence and propagate their ideology abroad with greater ease.

The second perspective sees traditional power politics as the source conflict between these clans and states. It should be noted that sectarian groups in the region overlap with tribal identities. Realists argue that traditional forms of competition over resources and power underpins conflict in these countries even if sectarian differences exacerbate it and encourage inference by ideologically motivated patrons. The rivalry between Iran and Saudi Arabia can be explained as a rising regional hegemon threatening an established but vulnerable regional power. Iran has a larger population, more robust middle-class and a more dynamic economy than Saudi Arabia. In this view, Saudi Arabia is alarmed by Iranian efforts to acquire nuclear technology which would drastically alter the balance of power in the region, and is thus venomously opposing the nuclear deal. Moreover, Saudi Arabia is supporting Sunni regimes and rebels to prevent Iran establishing influence in Iraq, Syria, Lebanon, Yemen and Bahrain which could be used to undermine the Saudi regime. It should be remembered that Saudi Arabia hosts a restive Shia minority which heightens its sense of vulnerability towards Iran.

The most serious threat of conflict may stem from geopolitics. As noted, with the rise of Shia political consciousness and demands for self-determination, Saudi Arabia may find itself surrounded by states and militias hostile to itself and sympathetic to its repressed Shia minority. In such as case, Saudi Arabia can be expected to escalate through military interventions, possibly leading to direct confrontation with Iran, which can be expected to continue supporting Shia factions fighting for rights and influence. Such a conflict scenario will involve the destabilization of other regional states. To conclude, Iran and Saudi Arabia may be compelled to engage in direct hostilities because of ideological and/or geopolitical factors.

Energy implications

The oil shocks of the 1973, when Arab oil producers proclaimed an embargo on countries supporting Israel in the Yom Kipper War, and in 1979 when the Iranian Revolution triggered interruptions in its oil exports, provide some insight into how energy markets will react to high intensity conflict in the region. In those cases, international markets reacted disproportionately to the proportion of oil being disrupted and suffered from long-term increases in prices. Consequently, some producers including Norway, Mexico, Venezuela and Texas and Alaska in the US experienced economic gains. However, these shocks greatly contributed to the recession experienced by the developed world that decade.

These historical trends cannot predict future developments. As a result of the 70s oil shocks, countries created strategic petroleum reserves and crude oil inventories for the purpose of providing economic security during future oil crises. The US and China along with other developed countries have the largest reserves. This suggests future oil shocks emanating from the region will be felt less severely by the developed world. The 70s oil shocks also contributed to the development of renewable energy sources. These fuels represent an increasingly large portion of global energy consumption, but their potential to fill demand for cheap energy in response to high oil prices is uncertain. In addition, the appearance of renewable sources of energy as an increasingly cost-effective and environmentally attractive alternative further differentiates a modern hypothetical oil crisis from that of the 70s.

Fossil fuels and renewable energy largely cater to different sections of the energy market. As an analyst at Bloomberg points out, 'oil is largely transportation fuel, and renewables are largely electricity sources that provide power' (Kaufman, 2016). They mostly do not directly compete in terms of prices. For this reason, renewable energy technology and usage has grown despite the historically low price of oil, though government subsidies and climate change concerns have played an important role. However, in terms of perception, oil constitutes the price floor through which investors and consumers evaluate the desirability of renewables. This is evident in the US stock market where solar power has long been impacted by the price of oil (Hoium, 2016). The price of oil arguably remains an important variable in determining the performance of renewables. Moreover, with the projected improvements in technology and reduction in prices, renewables will attempt to capture more of the transport and the non-OECD power market (where fossil fuels are more prominent). In this case, high oil prices will enhance their competitiveness and therefore contribute to their success.

Scenarios

Both scenarios begin with direct conflict between Iran and Saudi Arabia. Domestic instability increases substantially in both countries but further fuels the ongoing conflicts in Yemen, Iraq, Bahrain, Syria, Lebanon, and Qatar, spilling over to a lesser extent into Jordan, Egypt, Israel, and Turkey. Instead of a secular reduction in global conflict forecasts in the Base Case, the heightened conflict in the Middle East seen under these scenarios holds global instability at current levels through 2035. This instability significantly reduces energy production in the Middle East.[25]

Given the considerable ambiguity surrounding the performance of renewable forms of energy in the advent of high oil prices, we account for both possibilities in our modeling exercise: in Accelerated Renewables, renewable energy competitiveness is boosted through greater investment and improved technology. In Constrained Energy, renewables fail to come online as they do in the Base Case. One purpose of looking at these two variants is to answer the question, does a significant increase in renewables broadly mitigate the negative cost of a high-energy-price world?

Renewable energy makes up an increasingly large share of global energy production and consumption, but fossil fuels remain central. The historically low prices that characterize the fossil fuel market today are largely an outcome of Saudi Arabia overproducing crude oil to capture Iran's share in the market and dis-incentivize other producers (Borroz & Meighan, 2017). Iran and Saudi Arabia have a relationship that is increasingly characterized by ideological and geopolitical competition.

Under both scenarios, Iran and Saudi Arabia target each other's essential economic assets including oil production and delivery infrastructure, leading to a flattening of oil production among Middle East OPEC

[25] For a detailed description of the parameters used in each scenario see Appendix A.

countries. In the scenario in which renewable production fails to come online in a significant way, Middle East OPEC oil production grows from around 8.5 BBOE today to only 9 BBOE by 2035. This reduces global oil production by an annual 2.3 BBOE relative to the Base Case by 2035, or roughly that of the US's current annual output.

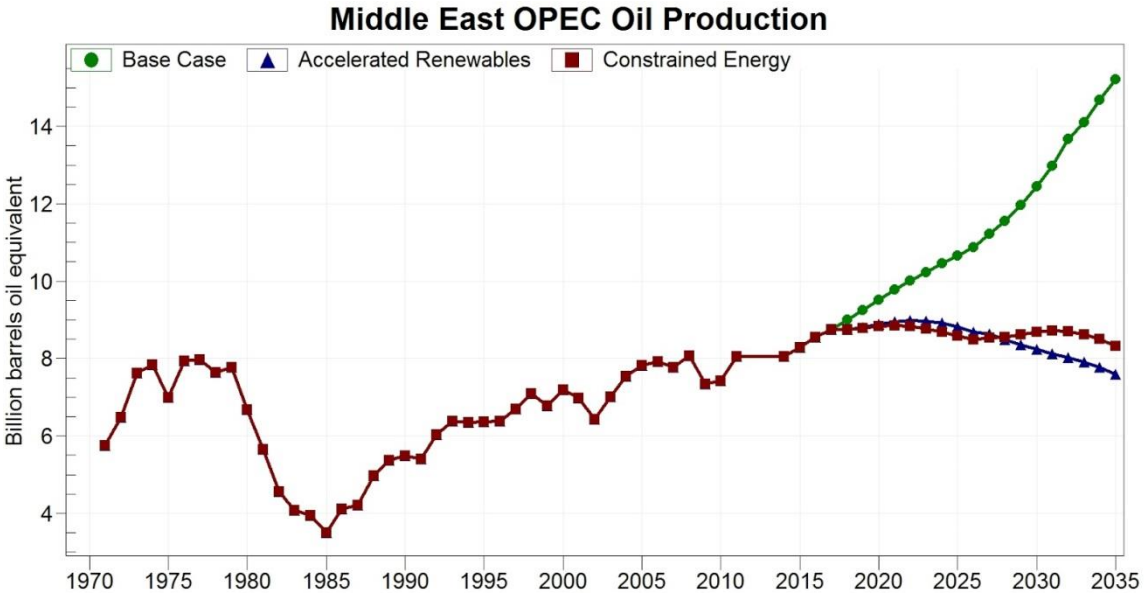

Figure 46: Oil production for Middle East OPEC countries for the Base Case, Iran-Saudi + Renewables, and Iran-Saudi no Renewables scenarios. Source: IEA (2012) and IFs 7.28

In Constrained Energy, the reduction in Middle East energy production drives prices from roughly $46 per barrel of oil equivalent (BOE) to over $80 BOE by 2035 (roughly 35 percent higher than in the Base Case).[26]

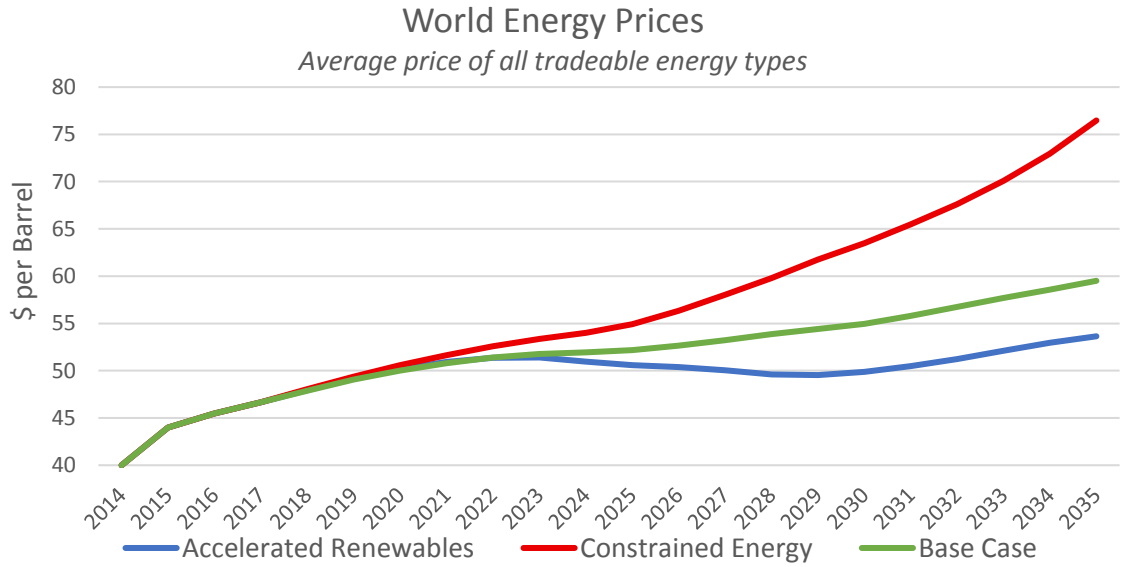

Figure 47: World Energy Prices under Accelerated Renewables and Constrained Energy Scenarios. Source: 7.28

[26] Prices reflect global energy prices set by a basket of energy sources of which oil is included. The actual price of oil in this scenario would be much higher.

These higher energy prices incentivize greater investment and production of oil, gas, and coal, and countries with large reserves begin to extract fossil resources, which were previously not economically viable to produce. The table below lists the top ten countries which increase oil, gas, and coal production by the most under the Iran-Saudi conflict, with less competitive renewables. In this scenario, Russia overtakes Saudi Arabia as the world's largest oil producer and approaches US levels of total energy production by 2035.

Top 10 largest increases in energy production *Cumulative additional production relative to the Base Case in BBOE*					
Oil		**Gas**		**Coal**	
Russia	6.50	China	59.38	USA	2.64
Canada	5.55	Russia	39.55	South Africa	1.45
China	5.06	Australia	18.36	Colombia	0.85
Brazil	2.32	USA	32.22	Kazakhstan	0.60
Venezuela	0.94	Brazil	8.78	Indonesia	0.60
Indonesia	0.92	Indonesia	13.18	Australia	0.22
Kazakhstan	0.77	Mexico	7.80	Ukraine	0.42
Norway	0.60	Algeria	5.76	Poland	0.39
Egypt	0.33	Nigeria	7.18	Turkey	0.29
Algeria	0.36	Egypt	5.39	India	0.46

Table 15: Largest Increases in energy production under the Constrained Energy scenario by 2035 relative to the Base Case. Source: IFs 7.28

Indonesia overtakes Saudi Arabia as the second largest energy exporter by 2030, and by 2035, Australia does the same. Russia dominance as the world's largest energy exporter grows substantially relative to the Base Case, strengthening trade relationships with China. Given the importance of energy discourse in shaping foreign policy, this redrawing of energy trade networks could have significant geopolitical implications for energy security and international relations.

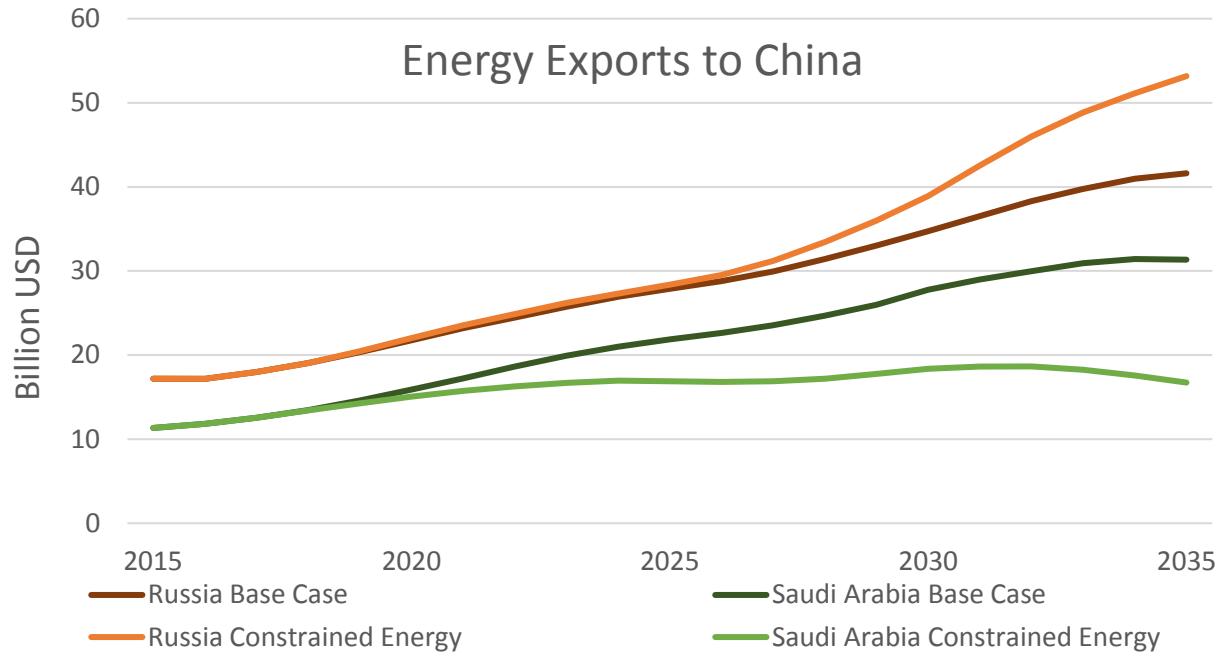

Figure 48: Energy Exports to China from Russia and Saudi Arabia. Source: IFs 7.28

The emergence of major energy importers such as China and India, and suppliers such as Nigeria have reshaped energy trade patterns in recent decades. In 2015, Russia has strong connections with its most proximate European, Middle Eastern, and Asian neighbors. The Americas, Western Europe, and North Africa are also deeply connected through energy trade, with Brazil and Angola playing central roles in the Latin American and African portions of the community. South Africa, Nigeria, and Iran are primary exporters within a community, which spans South America, western and southern Africa, and includes Ireland. Saudi Arabia and other Middle East OPEC members have particularly close ties with China, India, and other south East Asian and Pacific countries.

Global Energy Trade Network — Base Case 2015

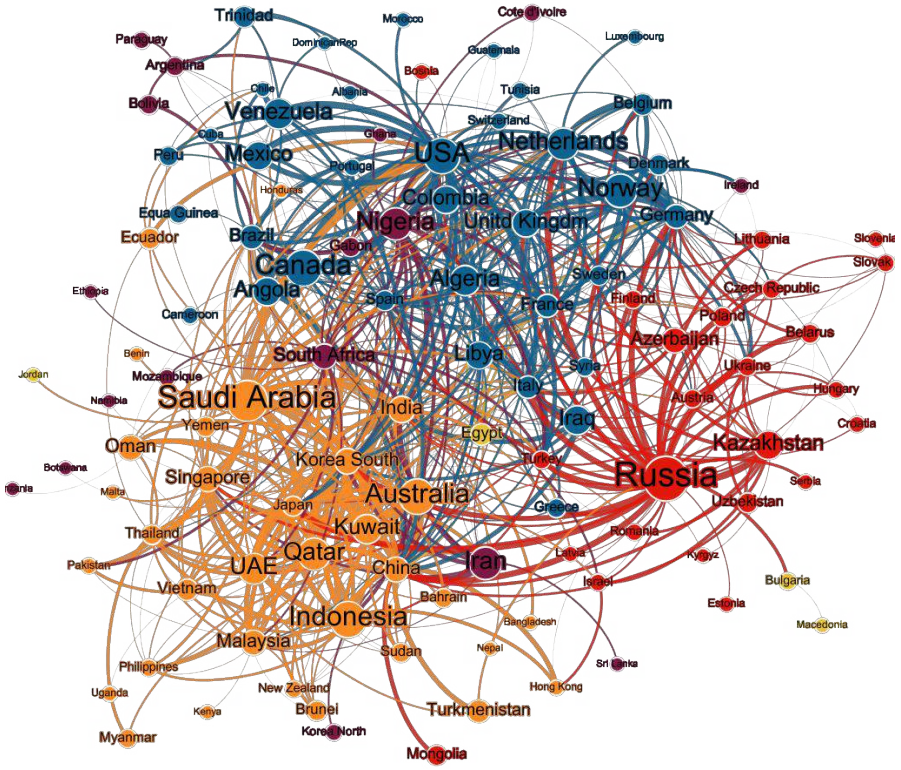

Figure 49: Global trade network in 2015 under the Base Case. The strength of ties is visualized using the natural log of exports between countries. Connection color is determined by the community of the exporting country. Visualization threshold is set at 90th percentile of logged dyadic trade. The size of each node represents the value of total energy exports for a country. Node colors indicate communities within a network defined by the natural log of bilateral energy exports. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: IFs 7.28.

By 2035, Europe becomes increasingly dependent on Russian energy but also forges stronger ties with suppliers in Northern Africa (Algeria and Tunisia) and the Americas (Canada, Venezuela, and Colombia). Indonesia becomes an important supplier to the Southeast Asian and Pacific region, and Nigeria and Angola carve out a community of smaller southern and western Africa nations. India, along with Iran and Kuwait, form the core of an energy trade community that includes some regional neighbors as well as a few countries in western Africa. The US and Saudi Arabia become central players in a very geographically diverse community that spreads across parts of Europe, Africa, The Middle East, and the Americas.

Global Energy Trade Network Base Case 2035

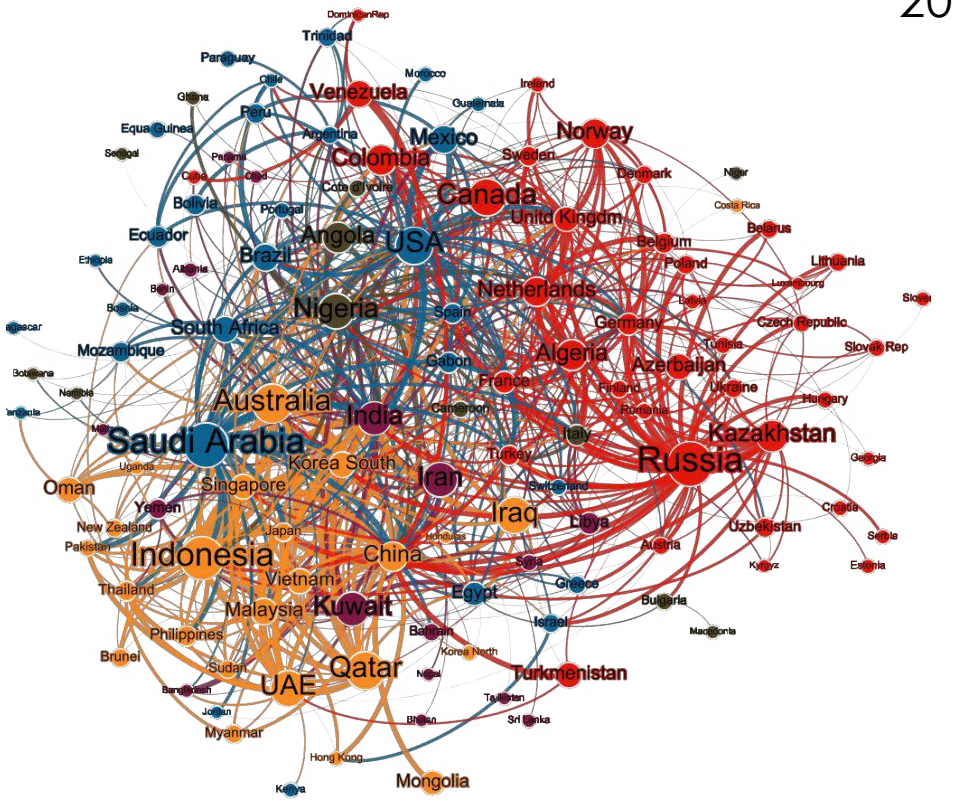

Figure 50: Global trade network in 2035 under the Base Case. The strength of ties is visualized using the natural log of exports between countries. Connection color is determined by the community of the exporting country. Visualization threshold is set at 90th percentile of logged dyadic trade. The size of each node represents the value of total energy exports for a country. Node colors indicate communities within a network defined by the natural log of bilateral energy exports. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: IFs 7.28.

Under a Constrained Energy scenario, many countries with significant untapped energy resources, such as Norway, South Africa, Thailand, Russia, Venezuela, Angola, and Nigeria, play more central roles in global energy distribution. West and Southern Africa form a strong regional core of a community which spans four continents and includes major partners such as India. The Saudi Arabia and other Middle East producers, no much less central to the energy trade, draw closer to the Southeast Asia and Pacific community. Russia remains the dominant supplier of energy to Europe, but some western European countries such as Spain, Portugal, and Switzerland remain more closely tied to American markets.

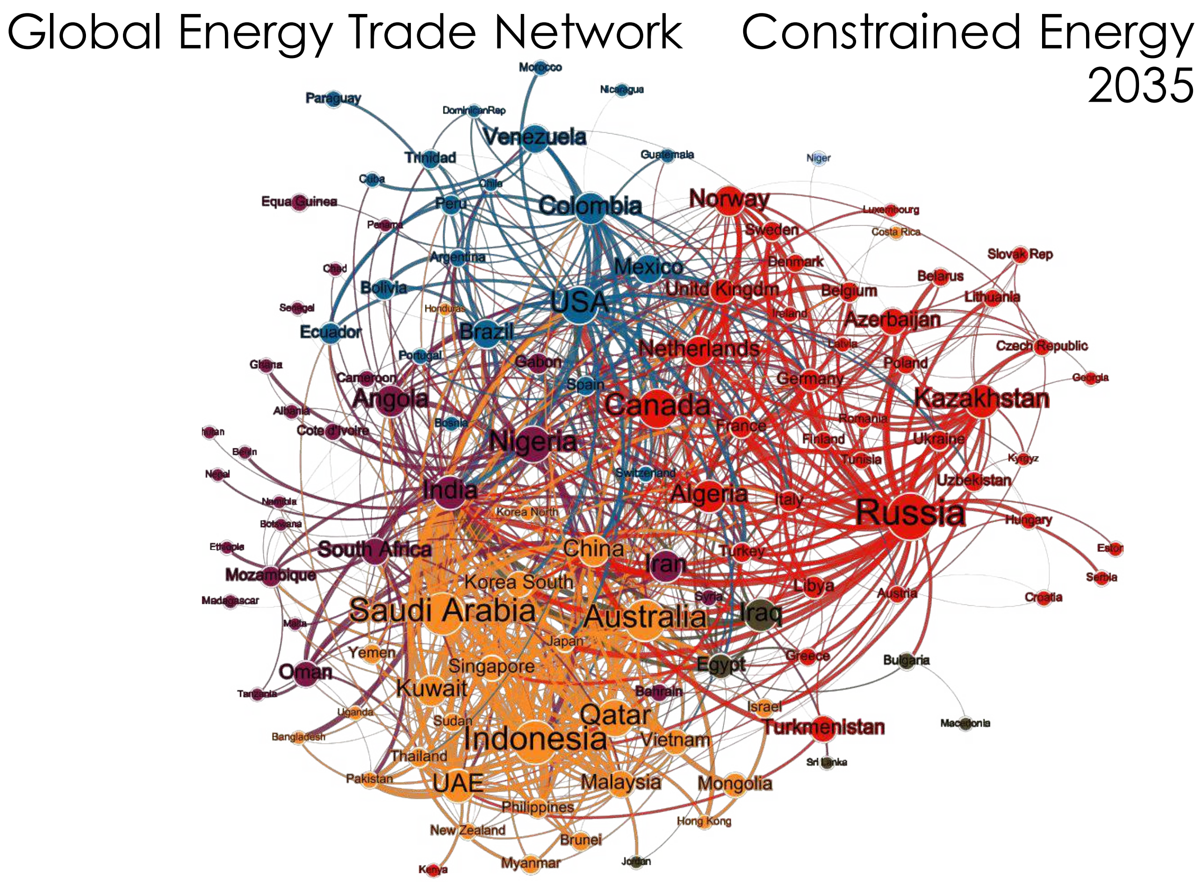

Figure 51: Global trade network in 2035 under the Constrained Energy scenario. The strength of ties is visualized using the natural log of exports between countries. Connection color is determined by the community of the exporting country. Visualization threshold is set at 90th percentile of logged dyadic trade. The size of each node represents the value of total energy exports for a country. Node colors indicate communities within a network defined by the natural log of bilateral energy exports. The community detection algorithm used for this calculation comes from Blondel et al. (2008). Source: IFs 7.28.

Increased production from other countries and energy sources does not fully offset reduced oil production from the Middle East, and energy trade under this scenario is still forecast to fall 3 percent short of that of the Base Case. Nevertheless, in many countries the disruption leads to a significant reallocation of capital towards the energy sector. This disruption ultimately leads to a $54 trillion cumulative reduction in global economic output relative to the Base Case by 2035. India, China, and the US are among those that are hit the hardest; however, some countries which have large energy sectors (relative to the greater economy), such as Russia, Turkmenistan, and Venezuela, enjoy an increase in GDP in Oil Crisis.

Percent Change in GDP Relative to the Base Case in 2035			
Top 15 Winners		**Top 15 Losers***	
Russia	3.8	Iceland	-5.9
Turkmenistan	3.0	USA	-5.6
Algeria	2.7	Germany	-5.6
Venezuela	2.5	Italy	-5.1
Gabon	2.4	Cambodia	-5.0
Kazakhstan	2.4	India	-4.9

Papua New Guinea	2.1	China	-4.8
Equatorial Guinea	2.1	Korea South	-4.7
Sudan South	1.6	Indonesia	-4.7
Mozambique	1.4	United Kingdom	-4.6
Timor-Leste	0.5	Spain	-4.6
Ukraine	0.3	France	-4.4
Suriname	0.3	Hong Kong	-4.2
Ecuador	0.2	Lesotho	-4.1
Libya	0.2	Netherlands	-4.1

*Table 16: Percent change in GDP under the Constrained Energy scenario in 2035, relative to the Base Case. * The list of top 15 countries experiencing lower growth excludes the Middle Eastern countries assumed in this scenario to be experiencing elevated violence and instability. Source: IFs 7.28*

Due to this global economic downturn, by 2035, the number of people living in extreme poverty (less than $1.90 per day) is forecast to be 23 million higher than in the Base Case, with an additional 52 million people living on less than $3.10 per day, and 38 million more people vulnerable to poverty (between $3.10 and $10 per day). At the same time, the size of the population living on greater than $10 per day contracts by 93 million people relative to the Base Case. Furthermore, in a future of higher energy prices, more than 20 additional countries experience a higher probability of conflict than in the Base Case.

If, however, renewable technology drives down the cost of alternative energy sources, or social/political pressures promote greater investment in clean energy, a conflict between Iran and Saudi Arabia that results in severely diminished oil output from the region may not have such a punctuated impact on the global economy. A shift towards renewables requires a greater upfront investment, though the payoffs help to mitigate some the economic impacts of the oil crisis in the long run. Early on, energy trade falls as countries consume more domestically. Eventually, though, global production fully offsets the reduction in oil production from the Middle East. Indeed, energy prices rise in the short term, as market work to readjust, but by the mid-2020s they begin to hold at around $50 BOE. By 2035, the global energy production profile is significantly different between the two conflict scenarios.

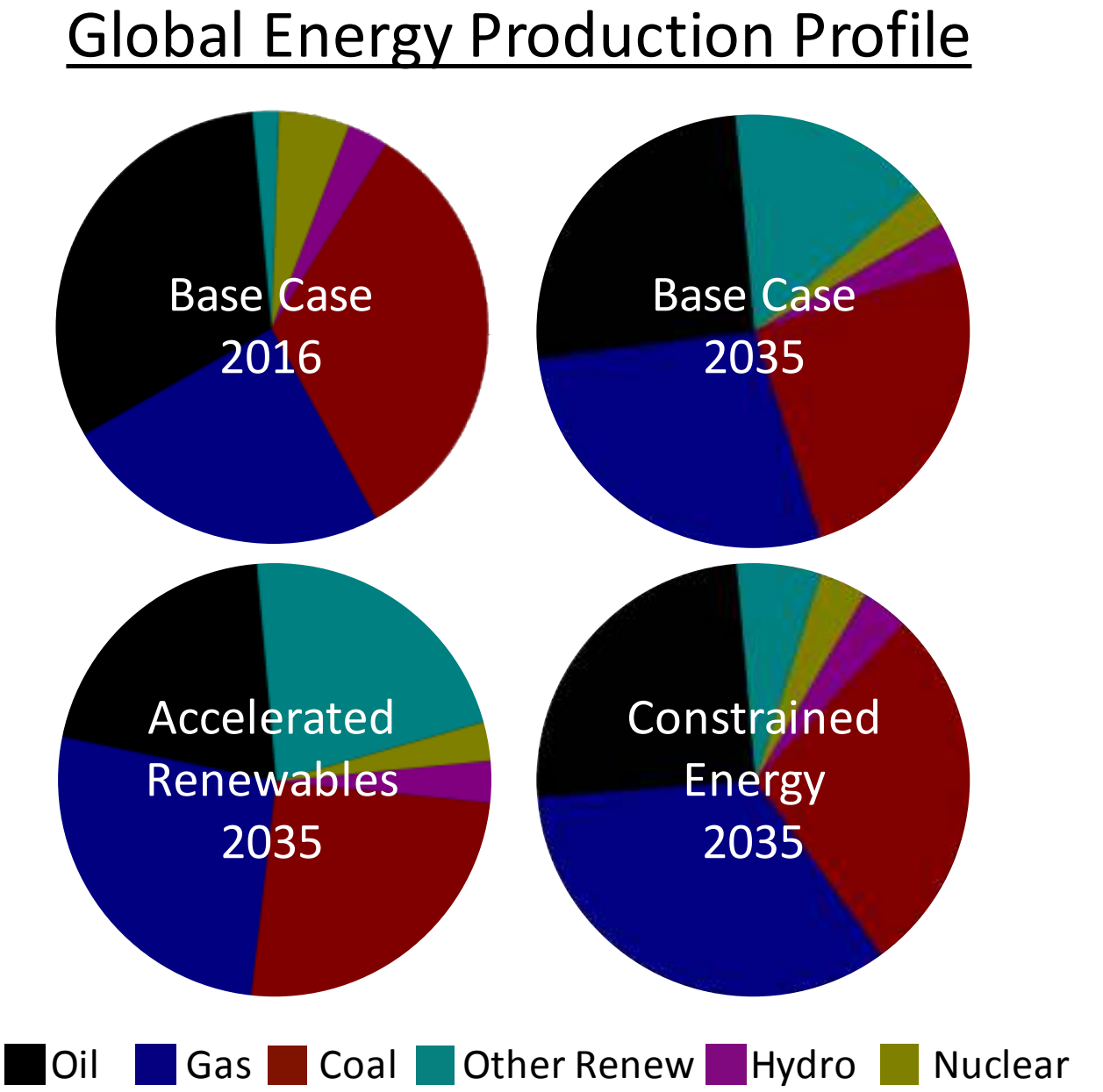

Figure 52: Global energy production distribution under the Base Case, Accelerated Renewables, and Constrained Energy scenarios. Source: IFs 7.28

In Constrained Energy, global carbon emissions drop relative to the Base Case for the first few years through the mid-2020s. However, as global markets readjust, and fossil production is scaled up in many countries to offset reduced output from the Middle East, annual emissions reach and surpass those forecast in the Base Case.

With the more rapid adoption of renewable technology in Accelerated Renewables, nearly all countries reduce their global carbon footprint relative to the Base Case. Carbon emissions in a few major fossil-fuel exporters increase somewhat relative to the Base Case—though other countries, which already have

significant renewable production in their energy profile, see an absolute reduction in emissions by the 2020s. This leads to a cumulative 5.4-billion-ton reduction in global carbon emissions relative to the Base Case by 2035.[27] The figure below shows the impact of these different scenarios on global temperature change.

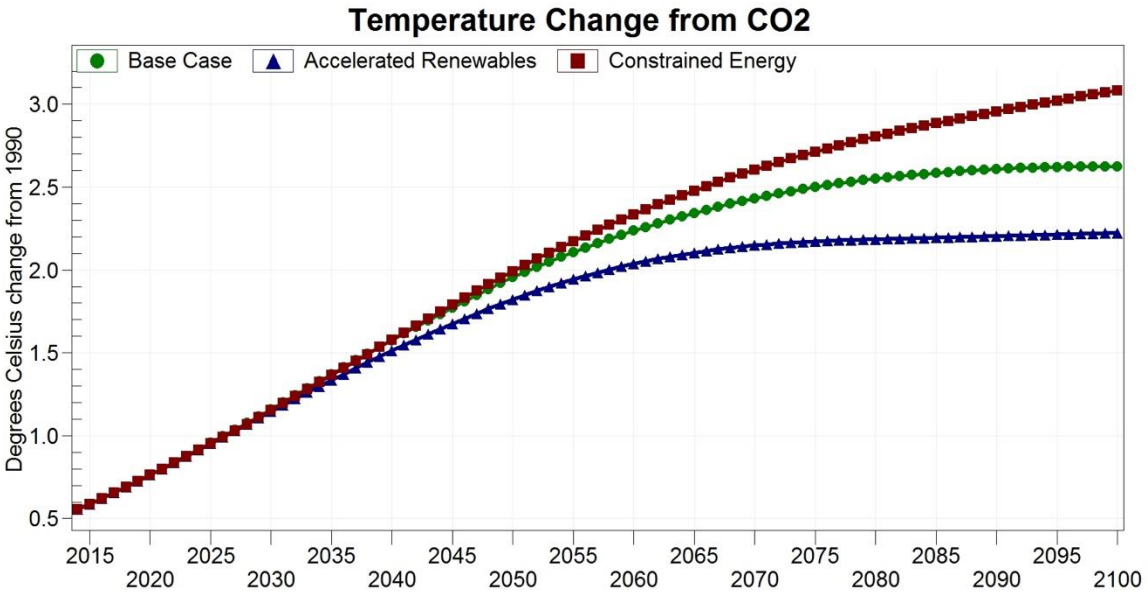

Table 17: Global temperature change relative to 1990 levels across the Base Case, Accelerated Renewables, and Constrained Energy. Source: IFs 7.28

In Accelerated Renewables, the global economy is still forecast to slow down relative to the Base Case (a cumulative $46 trillion difference in 2035), but with greater renewable production and investment, global GDP is a cumulative $8 trillion greater than in a scenario with slower renewable uptake. In countries like the US, increased renewable consumption can allow for higher levels of energy exports. In the Base Case the US is the 6th largest energy exporter by 2035. In this scenario, it becomes the 4th. Similarly, countries which benefit the most relative to the scenario with slower renewable uptake are typically those that had higher levels of energy import dependence.

Poverty and the middle class still suffer relative to the Base Case, with 16 million additional people living in extreme poverty, 41 million people living on less than $3.10 per day, and 76 million fewer people in the global middle and upper class. However, relative to the scenario with limited renewable investment, there are 7 million fewer people living in extreme poverty, 12 million fewer people living on less than $3.10 per day, and 17 million additional people in the global middle and upper class.

Conclusion

By 2035, in a world in which Middle East OPEC oil production is significantly reduced and renewables fail to develop as rapidly as expected (Constrained Energy), world energy prices increase by 35 percent relative to the Base Case (over $80 per barrel of oil equivalent). Countries like Russia, Canada, China, Brazil, and Venezuela produce an additional cumulative 20 billion barrels of oil, to meet global demand. Energy exports are still (measured in BBOE) 3 percent lower than in the Base Case. However, due to higher

[27] The Base Case includes improvements in energy efficiency and an increased investment in renewables, though it does not explicitly assume that all countries meet COP21 targets. In the Base Case, atmospheric carbon dioxide reaches 553 parts per million, and global temperatures reach 2.6 degrees Celsius above 1990 levels by 2100. Scientists estimate that, as of 2016, the world has already surpassed the COP21 target of 400 PPM (Kahn, 2016).

energy prices, global energy exports are valued $900 billion more and could reach nearly 3.5 percent of global GDP by 2035. With diminished output from the Middle East, the US, China and many other large economies consume more of their production domestically and become less central in the energy trade network. Russia is the dominant supplier of energy to Europe and North Africa.

This disruption has significant impacts on the global economy. Global GDP is reduced by a cumulative $54 trillion, resulting in 93 million people fewer people living on $10 or more per day globally, 23 million additional people living in extreme poverty, and 52 million additional people living on less than $3.10 per day. More than 30 countries experience a higher probability of conflict.

By 2035, in a world in which Middle East OPEC oil production is significantly reduced but renewables become more competitive (Accelerated Renewables), energy prices rise in the short term, as markets work to readjust, but by the mid-2020s they begin to hold at around $51 to $52 barrels of oil equivalent (11 percent lower than the Base Case). Early into the scenario, energy trade falls as countries consume more domestically. Global production is eventually able to fully offset the reduction in oil production from the Middle East. By 2035, the global energy production profile is significantly different between the two conflict scenarios.

Global GDP is reduced by a cumulative $46 trillion ($8 trillion less than the scenario without increased renewable production), with 76 million people fewer people living on $10 or more per day globally, 16 million additional people living in extreme poverty, and 41 million additional people living on less than $3.10 per day. Twenty-nine more countries experience a higher probability of conflict than in the Base Case.

Conclusion

The goal of this report was to explore five broad global geopolitical risks across levels of analysis, issue areas, and time. We unpacked literature describing each issue area, modeled the base-case diffusion, and then explored scenarios. The results of this modeling exercise are not to predict the future, but instead help decision-makers think more carefully about trade-offs and magnitude of impact when one of these unfortunate events occurs.

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Appendix A: Scenario Assumptions

The following table lists the parameters used in each of the scenarios covered in this report. Beyond the interventions specified in this appendix, each scenario also includes the four parameters found in the Base Case. For more information regarding any of the parameters listed below please refer to the IFs documentation or help system available from pardee.du.edu.

Intervention	Parameter	Definition	Region	Start	End
Base Case					
Activate the bilateral trade model of IFs	bilateraltradeforwardlinksw	Bilateral Trade Forward Linkage Switch	World	1	1
Adjust the relationship between trade openness and productivity	mfpeconint	Elasticity of multifactor productivity to economic integration	World	1.2	1.2
Adjust global trade to be in line with IFs Base Case	xshift	eXport shift as result of promotion of exports	World	0	-0.12
Activate new irrigation code in IFs	watertoyieldswitch	switch to allow water to constrain ag yield	World	1	1
Protectionist Victory					
Reduce the propensity to export	elasxinc	Elasticity of exports with gross production of sector	World	0.85	1
Reduce the propensity to import	elasminc	Elasticity of imports with income (demand base of sector)	World	0.85	1
Reduce global capital flows (FDI)	xfdiwgradd	Foreign direct investment (FDI) world add rate relative to GDP growth	World	0.5	-2
Increase barriers to agricultural trade	tradecostgeneral	General cost of bilateral trade	World	1	1.8
Increase barriers to energy trade	tradecostgeneral	General cost of bilateral trade	World	1	1.8
Increase barriers to manufacturing trade	tradecostgeneral	General cost of bilateral trade	World	1	1.8
Increase barriers to materials trade	tradecostgeneral	General cost of bilateral trade	World	1	1.8
Increase barriers to ICT trade	tradecostgeneral	General cost of bilateral trade	World	1	1.8
Increase barriers to services trade	tradecostgeneral	General cost of bilateral trade	World	1	1.8
Globalism Resurgence					
Increase the propensity to export	elasxinc	Elasticity of exports with gross production of sector	World	0.85	1.4
Increase the propensity to import	elasminc	Elasticity of imports with income (demand base of sector)	World	0.85	1.4
Increase export promotion	xshift	eXport shift as result of promotion of exports	World	0	0.05
Increase global capital flows (FDI)	xfdiwgradd	Foreign direct investment (FDI) world add rate relative to GDP growth	World	0.5	2
EU Collapse					
Increase barriers to agricultural trade	tradecostgeneral	General cost of bilateral trade	EU	1	1.5
Increase barriers to energy trade	tradecostgeneral	General cost of bilateral trade	EU	1	1.5

Increase barriers to manufacturing trade	tradecostgeneral	General cost of bilateral trade	EU	1	1.5
Increase barriers to materials trade	tradecostgeneral	General cost of bilateral trade	EU	1	1.5
Increase barriers to ICT trade	tradecostgeneral	General cost of bilateral trade	EU	1	1.5
Increase barriers to services trade	tradecostgeneral	General cost of bilateral trade	EU	1	1.5
Reduce capital flows into the EU (FDI)	xfdistockm	Foreign direct investment (FDI), stocks of investment from abroad, multiplier	EU	1	0.9
Reduce migration into EU countries	migrater	Migration rate (inward), net percent of population	EU	0.169	0.03
New Cold War					
Increased military spending due to preceived threat	reac	Reactivity of countries to threat from each other, military spending	China to USA	1	10
Increased military spending due to preceived threat	reac	Reactivity of countries to threat from each other, military spending	USA to China	1	10
Capital flows (FDI) slow globally	xfdiwgradd	Foreign direct investment (FDI) world add rate relative to GDP growth	World	0.5	0.25
Trade slows globally	protecm	Protectionism in trade, multipler on import prices	World	1	1.4
NATO reaches 2 percent of GDP military spending target	gdstrgtval	Government Spending Target, % of GDP, Value	NATO	0	2
NATO reaches 2 percent of GDP military spending target	gdstrgtyr	Time for Reaching Government Spending Target, Years from Base Year	NATO	0	7
Increase military spending	gdsm	Government expenditures by destination multiplier	China	1	1.2
Increase military spending due to preceived threat	reac	Reactivity of countries to threat from each other, military spending	USA to Russia	1	5
Increase military spending due to preceived threat	reac	Reactivity of countries to threat from each other, military spending	Russia to USA	1	5
Increase foreign aid to non-aligned countries	aidrecm	Aid (foreign) receipts multiplier	Western Africa security sphere	1	1.5
Increase foreign aid to non-aligned countries	aidrecm	Aid (foreign) receipts multiplier	Middle east security sphere	1	1.5
Increase barriers to trade across all economic sectors	tradecostgeneral	General cost of bilateral trade	China security sphere to US security sphere	1	1.25
Increase barriers to trade across all economic sectors	tradecostgeneral	General cost of bilateral trade	US security sphere to China security sphere	1	1.25
Increase barriers to trade across all economic sectors	tradecostgeneral	General cost of bilateral trade	USA to China	1	1.8
Increase barriers to trade across all economic sectors	tradecostgeneral	General cost of bilateral trade	China to USA	1	1.8

Arid Earth					
Desalination technology limits growth in produciton	waterdesalinatedgr	Desalinated water initial growth rate	World	1	0.5
Surface water resources are increasingly limited	watresexploitrenewm	Exploitable renewable freshwater resources multiplier	World	1	0.4
Ground water resources are increasingly limited	watresexploitrenewm	Exploitable renewable freshwater resources multiplier	World	1	0.4
Wastewater treatment advances more slowly	wastewatertreatedm	treated wastewater multiplier	World	1	0.25
Agricultural trade slows globally	protecm	Protectionism in trade, multipler on import prices	World	1	5
Countries are forced to more rapidly return to sustainable levels of surface water withdrawl	waterrenewconverge	time for country to return to exploitable limit of renewable freshwater resources	World	50	20
Countries are forced to more rapidly return to sustainable levels of ground water withdrawl	waterrenewconverge	time for country to return to exploitable limit of renewable freshwater resources	World	50	20
Severe Weather					
Crop yields are periodically affected by drought, flood, and temperature	ylm	Yields (agricultural), multiplier	World	1	0.95
Accelerated Renewables					
Renewable technology makes production more cost effective	qem	Q (capital costs-to-output ratio) in energy, multiplier	World	1	0.7
Reduce energy production for OPEC- Middle East	enpm	Energy production multiplier	OPEC Middle East	1	0.5
Increase energy investment	eninvm	Energy investment multiplier	World	1	1.2
Increased probability of internal war for select countries	sfintlwaradd	State failure/internal war, addition	Saudi Arabia, Iran, Yemen, Iraq, Bahrain, Syria, Lebanon, Qatar	0	0.6
Increased probability of internal war for select countries	sfintlwaradd	State failure/internal war, addition	Jordan, Egypt, Israel, Turkey	0	0.3
Constrained Energy					
Increase cost output ratio for unconventional energy from 2017 to 2035	qeunconm	Q (capital costs-to-output ratio) in unconventional energy, multiplier	World	1	3
Increase cost output ratio for other renewables from 2017 to 2035	qem	Q (capital costs-to-output ratio) in energy, multiplier	World	1	3
Reduce energy production for OPEC (Middle eastern cuntries)	enpm	Energy production multiplier	OPEC Middle East	1	0.5
Reduce energy investment globally	eninvm	Energy investment multiplier	World	1	0.5
Increased probability of internal war for select countries	sfintlwaradd	State failure/internal war, addition	Saudi Arabia, Iran, Yemen, Iraq, Bahrain,	0	0.6

			Syria, Lebanon, Qatar		
Increased probability of internal war for select countries	sfintlwaradd	State failure/internal war, addition	Jordan, Egypt, Israel, Turkey	0	0.3