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DE-RISKING U.S. **SUPPLY CHAINS** IN THE ERA OF DECOUPLING

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Introduction

The COVID-19 pandemic and escalating geopolitical tensions between the United States and China have compounded U.S. concerns about supply chain resiliency and economic security. These concerns inspired Executive Order (EO) 14017 [1], which led to a 100-day review of the supply chains of four critical product categories: semiconductors and advanced packaging, critical minerals and materials, large-capacity batteries for vehicles and grid storage, and active pharmaceutical ingredients products. The review led to the itemization of the products that each of these supply chains comprises.

Motivated by the executive order, MITRE’s Center for Strategic Competition conducted a year-long research effort to quantify supply chain risks across the EO 14017 products using confidential, firm-level Economic Census and Customs data. The effort analyzed potential effects of policy decisions meant to de-risk U.S. supply chains and reduce their exposure to China.¹ The study aimed to identify U.S. sourcing of these critical products, assess the costs of decoupling shocks to U.S. producers, and quantify the extent to which proactive de-risking policies can blunt the economic costs of decoupling.

The report finds that China is an integral player in U.S. imports of the critical products identified in EO 14017. This implies that any policy changes or economic shocks that increases the costs of trading between the U.S. and China will negatively impact U.S. firms. To this end, the report investigates how *decoupling* shocks will impact the United States’ access to the products that have been prioritized in EO 14017. It then quantifies the economic impacts of proactive *de-risking* policies meant to encourage U.S. firms to diversify their suppliers of critical products prior to the realization

¹ See Howard and Underwood (2024) [2] for a complete technical description of the research effort.

of a *decoupling* shock. To be explicit, this report will refer to *decoupling* as a reduction in U.S. imports from China due to geopolitical events and policy changes, while *de-risking* is defined as a policy meant to incentivize U.S. firms to add new suppliers preemptively.

This effort identified three new stylized facts on U.S. sourcing behaviors across the critical products and sectors outlined in EO 14017. A model was then developed to quantify the possible repercussion of a decrease in Chinese imports of these critical products. The stylized facts (1) demonstrate the importance of these commodities to U.S. firms and workers, (2) emphasize China's importance as a supplier of these products to U.S. firms, and (3) highlight groups of countries that might be underutilized as suppliers of critical products due to high barriers of entry. Motivated by these facts, the research effort utilized firm-level data to develop an international sourcing model. The model can be used to explore the possible repercussions of a decrease in China's exports of critical products to the United States, and to estimate the impact of potential policy shifts that promote supply chain de-risking.

Reducing reliance on China will require U.S. importers to either import less, which will impact U.S. productivity, or go through the process of establishing new sourcing relationships in other countries, which will be costly. U.S. firms have spent decades building relationships, manufacturing capacity, and shipping networks across China. These relationships represent costly investments made by U.S. firms that allow them to efficiently conduct business in China. Such investments can be tangible, like the construction of foreign facilities, or intangible, like the time spent customizing the manufacturing processes or developing knowledge of Chinese regulations and business conditions that may be sector specific. To shift sourcing to countries outside of China, U.S. importers will most likely need to bear the one-time sunk costs to repeat these activities in new countries.

The MITRE research project implemented a model of U.S. production where U.S. firms produce output by sourcing critical products from international and/or domestic suppliers. The model considers the potential a country provides a firm as a sourcing partner and the sunk costs firms incur when sourcing a product from a partner country for the first time. The model is then applied to two scenarios of decoupling and de-risking.

The first scenario estimates the impact of an unexpected decoupling between the United States and China. This is estimated by assuming China's potential as a U.S. supplier is halved, making it more costly to import all Chinese products. The model allows for the quantification of the effect of this shock on U.S. revenues, showing the shock could lead to decreases in U.S. firm revenues of 10 to 50%, depending on the importer's sector. The report then seeks to understand how a proactive de-risking policy can impact the risks associated with decoupling. To quantify how a preemptive de-risking policy can reduce the effects of a decoupling shock, the report re-estimates the same decoupling scenario but instead assumes that the U.S. has entered into a formal trade agreement with market access provisions centered on the Indo-Pacific Economic Framework (IPEF). The difference in outcomes for U.S. firms across these scenarios quantifies how a proactive trade agreement could be used to reduce risks to U.S. importers from decoupling shocks. The result of this analysis indicates a reduction in tariffs through a trade agreement with IPEF partner countries could reduce the economic costs of decoupling for U.S. importers, with imports of critical minerals and semiconductors potentially benefiting the most from the hypothetical trade agreement.

The second scenario simulated the impact of decoupling via a disruption in shipping lanes in the South China Sea. The results indicate a 50% increase in shipping costs from the loss of shipping routes in the South China Sea could

cause a 15% decrease in U.S. firm production. The model predicts that the disruption would be most pronounced for importers of critical minerals and materials, largely for two reasons. First, the countries most exposed to the South China Sea disruption are important suppliers of critical minerals to the United States, such as Vietnam, which processes raw critical minerals. Second, critical minerals and materials rely the most on maritime shipping and are the least able to shift to alternative modes of transportation.²

The results of both scenarios provide insights into the potential effects of supply chain disruptions on U.S. production as well as the effects of preemptive policy measures such as promoting domestic production of critical goods, incentivizing diversification of supply chains, and strengthening alliances and trade relationships with other countries.

Data and Stylized Facts

This research initiative used confidential U.S. Census firm-level data from 2007 through 2017. The data has firm-level information on imports, industries of operation, revenues, domestic sourcing activities, and employment of U.S. workers. This allowed MITRE to create statistics on the number of U.S. manufacturing and wholesale firms, such as the number of these firms that import from specific countries (the extensive margin) and the volume of goods that these firms import from each country (the intensive margin). These two statistics reveal the number of firms that import from China and other sourcing partners. Publicly available data, which contains only information on import values, does not provide the critical firm-specific information required to

evaluate the potential impact of decoupling and de-risking on U.S. firms.

Leveraging the confidential data from Census, this report documents three stylized facts about U.S. importers of the critical commodities:

1. Firms that import critical commodities, especially from multiple countries, tend to have higher revenues and more U.S. employees.
2. China is a key supplier across each critical subsector, often ranking first and never below third based on the number of U.S. firms that import critical products from each country.
3. The number of U.S. firms importing critical products from a country and the total value of those imports generally increase together. However, there are outlier countries that vary across sectors, which may provide a significant amount of critical products to relatively few U.S. companies.

The first fact indicates that diversified sourcing of critical commodities may benefit U.S. firms and workers. However, the second fact highlights the risk of dependency on China as a major supplier. The third fact points to country- and sector-specific barriers facing U.S. firms when sourcing critical products. Policies that can reduce the barriers of importing from under-utilized outliers could promote de-risking among U.S. importers.

Figure 1 illustrates facts two and three. It presents the relationship between the number of firms that import from a country and the value of those imports. China plays a substantial role as a supplier across each of these subsectors. With its diverse manufacturing sector and comprehensive supply networks, China supplies more U.S. firms than any other country, across most of the critical

² The model also considers how shipping modes are chosen. This allows for the estimation of how shipping costs change across countries of origin for a particular critical product in response to a shipping disruption that might impact shipments of a single mode type.

sectors. Additionally, import values clearly indicate that China is a major player across many of the critical sectors, which further emphasizes the pain a forced decoupling between the United States and China would bring to U.S. firms.

Across these critical subsectors, however, Canada, South Korea, Germany, Japan, and Taiwan are also

consistently important suppliers to U.S. manufacturers and wholesalers. There are also important suppliers, in terms of import values, that might be underutilized by U.S. firms, such as Singapore, Thailand, and the Philippines in the case of semiconductors, and Switzerland and Italy in the case of testing and diagnostics equipment for public health

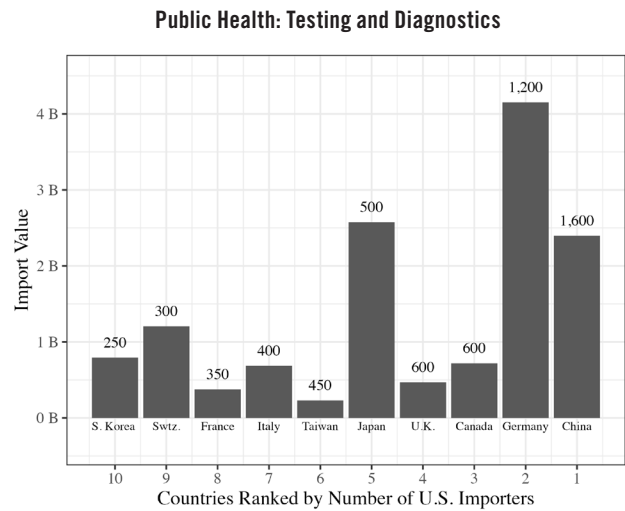
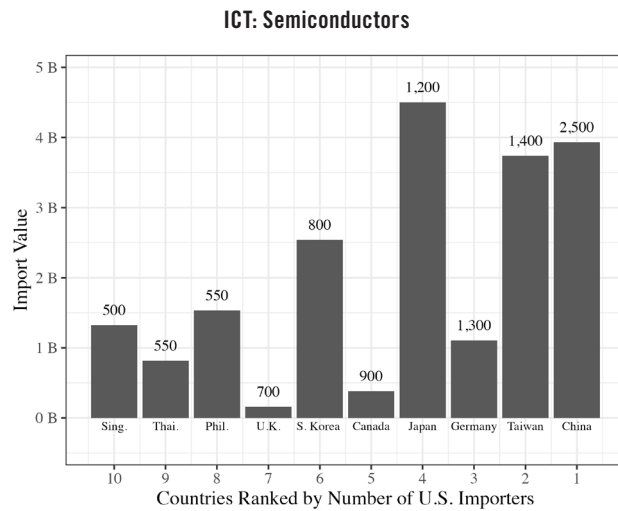
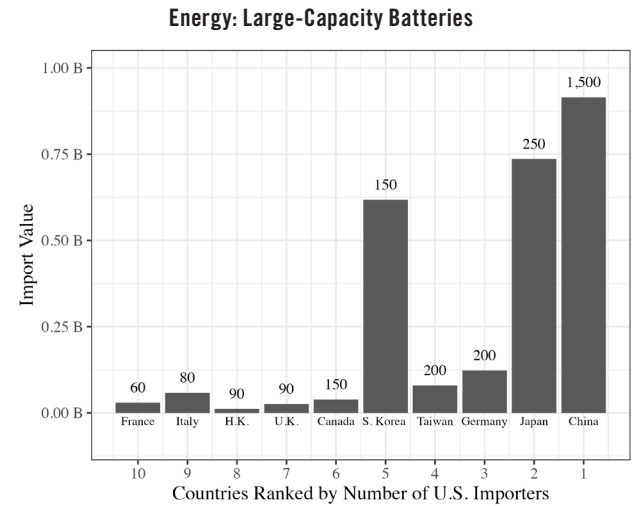
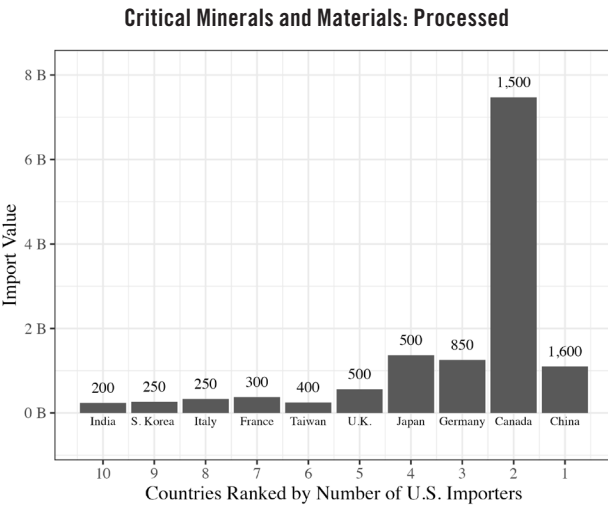


Figure 1: The Relationship Between the Intensive and Extensive Margin of Trade

Notes: Figures are calculated using import data for firms with at least one manufacturing establishment or are wholesale firms that import from the given sector. The numbers at the top of each bar reflect the number of U.S. firms that import subsector products from a given country and have been rounded according to Census disclosure rules. Likewise, the import values on the vertical axis have also been rounded. The horizontal axis ranks the top 10 countries by the number of U.S. firms that import from the country, with 1 being the country from which the most U.S. firms import. ICT stands for Information, Communication, Technology.

applications. The presence of these important partners suggests that policies undertaken today to de-risk U.S. supply chains, prior to any forced decoupling with China, may be able to offset some losses to U.S. firms in the event of decoupling.

Model and Estimation

This report develops a model of firm production and sourcing that allows the estimation of country- and subsector-specific importing costs faced by U.S. firms. U.S. firms face three dimensions of importing costs when sourcing critical inputs from abroad: a unit cost, an annual fixed cost, and a one-time sunk cost that must be paid in the first year during which a firm imports from a given location. Firms are modeled such that they source inputs from the lowest unit-cost supplier among the countries, considering per-unit costs, fixed costs, and sunk costs. This model builds on the work of Antràs, Fort, and Tintelnot (2017) [3] and Hoang (2022) [4], which include only one sector in their analysis. This report expands the scope of their analysis to include multiple sectors, and contributes to new methods of estimation. The model assumes firm production is composed of a combination of domestically sourced and foreign-sourced inputs across multiple sectors.

Firms facing sourcing decisions must choose which countries are best to source from. Many factors determine what makes a country a good sourcing partner, but the report defines the benefit a source country may provide a firm as *sourcing potential*. The sourcing potential of a country is made up of factors such as country-sector specific trade costs (including tariffs), wages, technology, and other unobserved factors that affect a country's appeal to importing firms. Sourcing potential increases as the unit cost of importing from a country falls.

Firms may import from many countries but must pay an annual fixed cost for every country from

which they source inputs. These fixed costs include the expenses associated with maintaining supply channels in each country. Additionally, a firm incurs an initial cost to learn how to import a critical product from a new country. Sunk costs could encompass the time employees need to familiarize themselves with local business customs or the initial expenses from building production facilities. Absent fixed and sunk costs, firms would simply import from the set of countries with the highest sourcing potential in each sector and face no penalty when importing from a new country. The existence of fixed and sunk costs requires firms to be forward-looking in their sourcing decisions and limits the flexibility of firm sourcing decisions in response to shocks.

Using firm-level data, this project estimated market parameters such as demand elasticities for final goods, firm import elasticities, sourcing potential, and fixed and sunk costs for critical sectors, and then used these parameters to construct potential policy scenarios. It departs from previous approaches that have used country-specific wages to estimate firm import elasticities and instead uses data on observed shipping costs. Data on shipping costs has the advantage of varying across three dimensions (firm, country, and product), rather than a single dimension in the case of country-specific wages. The additional dimensions of variation allow for more precise sourcing potential estimates across multiple sectors compared with previous studies.

Figure 2 shows a positive but uneven relationship between the number of firms that import from a country and the sourcing potential of that country, with a few significant outliers that contradict this pattern. For example, despite South Africa and Canada having similar sourcing potentials for processed critical minerals and materials, more U.S. firms source these minerals from Canada even though the distance between countries has been accounted for in the model. This is likely due to the fixed and sunk costs of starting to import

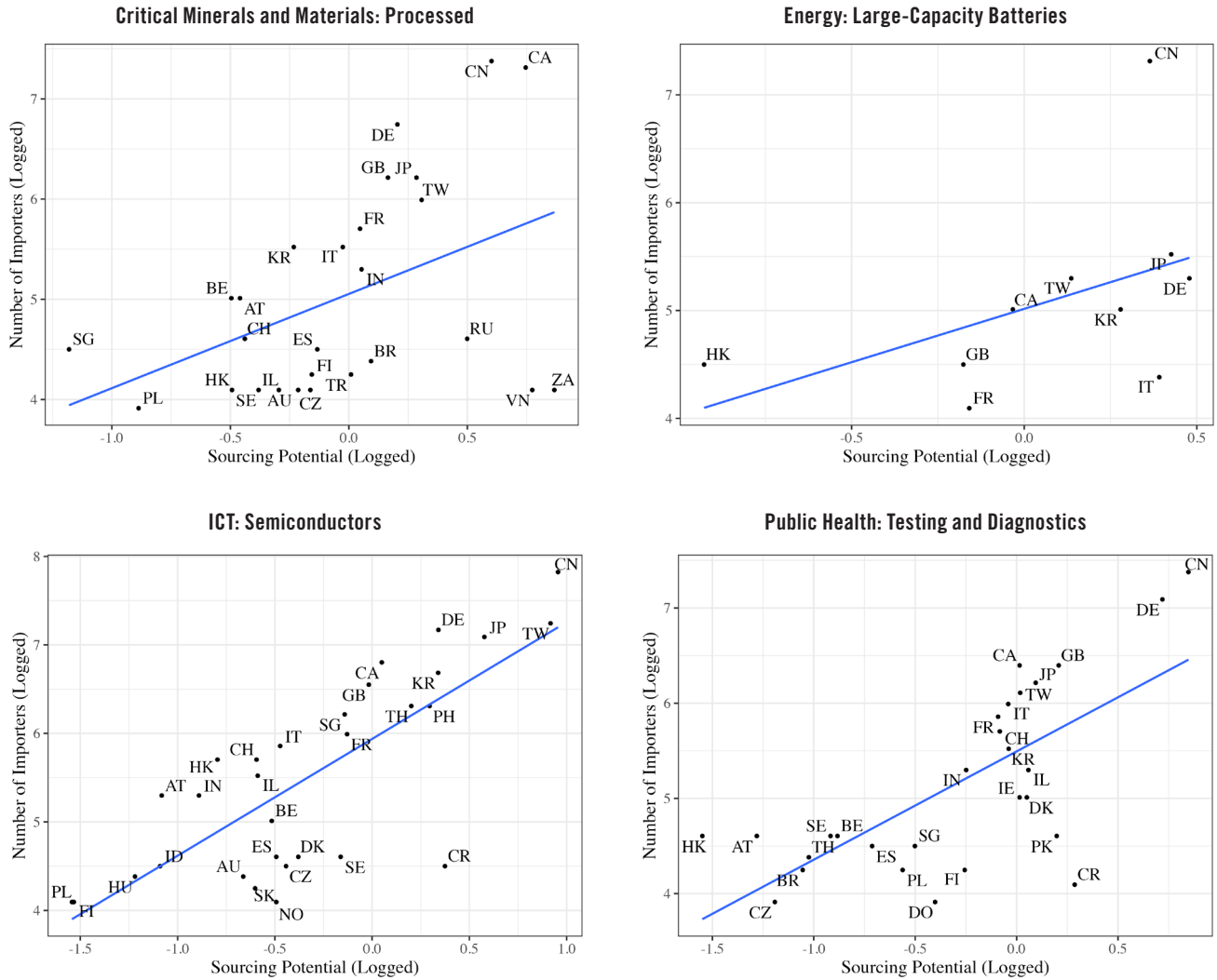


Figure 2: Sourcing Potential and the Extensive Margin of Trade

Notes: The horizontal axis presents the logged value of the sourcing potential of importing from each country. A firm-country-subsector specific sourcing potential is estimated and the point represented in this figure is the median value, taken across firms. The vertical axis plots the logged number of U.S. manufacturing or wholesale firms that import subsector-specific products from each country. The blue line represents the average relationship between the logged median sourcing potential and the logged number of firms that import from a country. ICT stands for Information, Communication, Technology.

from a new country.³ The figure also shows that a country’s efficiency as a supplier can vary across different critical subsectors. It is also clear from the figures that a country’s relative position varies across the four subsectors. This implies

that different countries are specialized in their ability to supply U.S. firms across different critical subsectors. For example, Japan ranks high as an efficient supplier of semiconductors and large-capacity batteries. However, Japan is less efficient

³ Historically, more firms have imported from Canada in the past compared with South Africa. Thus, to import from South Africa, U.S. importers would more likely be subject to a sunk cost compared with Canada.

at supplying testing and diagnostics public health equipment or processed critical minerals.

This report uses Hoang’s method to estimate bounds for fixed and sunk costs, utilizing a revealed preferences approach.⁴ The approach groups importers from a particular country in a specific year into four categories, based on whether the importer sources from the country for the first time, stops sourcing from the country, continues to source from the country, or never sources from the country. The model developed in the report allows for the estimation of how hypothetical deviations in observed sourcing strategies would impact firm profits across these four groups. This creates conditions that allow for estimating the upper and lower bounds on the sunk costs and fixed costs, by realizing that the profit of each firm’s observed behavior must be greater than any of the hypothetical deviations.

Figure 3 presents the estimated upper-bound estimates of fixed and sunk costs for four critical sectors. The black bars in the figure represent the upper bound of the annual fixed cost a firm must pay for each country from which it sources critical commodities. For instance, a firm sourcing large-capacity batteries pays an annual cost of up to approximately \$1.7 million to maintain a sourcing relationship in each country, meaning if it sourced from two countries, it would pay up to \$3.4 million annually to maintain sourcing operations in those two countries. The yellow bars represent the upper bounds on the sum of the sunk and fixed costs a firm must pay when sourcing critical commodities in the first year it imports from a new country. These costs are non-trivial, with the report’s findings showing that in the first

year of importing from a particular country, a firm’s fixed costs can be anywhere from 125 to 175% of its annual fixed costs of sourcing.

The presence of higher fixed costs in the first year of importing limits firms’ ability to respond to trade shocks. Suppose a firm imports products related to solar technologies from only China. If the variable costs of importing from China were to unexpectedly rise, this firm would have to pay higher costs to source solar products compared with a different firm that had experience importing from an additional location besides China.⁵ This provides the intuition for how policies that reduce the sunk cost of importing from a new location can improve U.S. resiliency to supply shocks—by making it easier for U.S. firms to source from new markets.

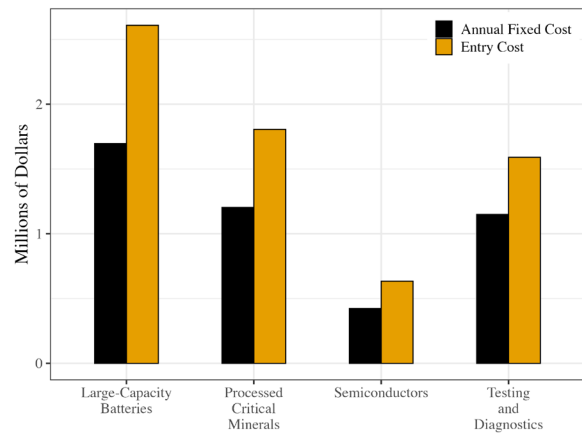


Figure 3: Fixed Costs of Importing

Notes: Testing and Diagnostics refers to relevant Testing and Diagnostics equipment used for Public Health, as defined in EO 14017.

⁴ The revealed preference approach of Hoang has a lower computational burden and requires fewer assumptions about firms’ expectations compared with the simulated method of moments estimator used in Antrás, Fort, and Tintelnot.

⁵ These costs could represent higher fixed costs if the China-reliant firm decided to import from a new country, or they could represent higher variable costs if the China-reliant firm decided to continue sourcing from China. The diversified firm could readily substitute away from China in response to the shock.

Scenario Analysis

This report simulates two potential scenarios. The first scenario centers on the decoupling of the U.S. and Chinese economies, and it uses a hypothetical formal trade agreement based on the IPEF to demonstrate how proactive de-risking trade policy can reduce U.S. exposure to Chinese shocks. The second scenario centers on a conflict in the South China Sea.

In the first scenario, China's sourcing potential is halved to simulate decoupling. This scenario is run twice, both with and without a proposed IPEF agreement in place prior to decoupling. A halving of China's sourcing potential, although arbitrary, aligns with the stated goals of both the Chinese Communist Party and the U.S. government.⁶ Due to China's significant role as a supplier of critical goods, this scenario results in a decrease in U.S. revenues across all critical sectors.

In Figure 4, the red dotted line indicates the decrease in firm revenues due to decoupling. For example, in the critical minerals sector, a sharp and significant decoupling from China leads to a revenue loss of more than 40% for U.S. importers. The estimates show the effect is between 15 and 50%, depending on the exact subsector, when there is no IPEF agreement in place. The black line indicates the effect on firm revenue for a given level of tariff reduction. A 20% IPEF tariff reduction for processed critical minerals would lead to a 12% increase in firm revenues in this sector. As tariffs fall further, the black line continues to rise, indicating a greater benefit to U.S. firms due to the IPEF agreement.

The figure also indicates that an IPEF-centered

agreement focused on de-risking prior to a de-coupling scenario would be most effective for semiconductors and critical minerals where firm revenue losses can most effectively be offset by tariff reductions targeting IPEF partners. However, it does not appear this approach would be as impactful for large-capacity batteries or public health testing and diagnostics. This indicates policy makers interested in de-risking large-capacity batteries may need to look for additional policy levers to offset the potential consequences of decoupling in these industries.

The second scenario explores a hypothetical situation in which maritime shipping costs increase due to a conflict in the South China Sea. Nearly a third of global trade passed through the South China Sea in 2016.⁷ China's aggressive claims over the South China Sea have been actively contested by Vietnam, Japan, and the Philippines, most recently exhibited in skirmishes involving Chinese Coast Guard vessels spraying Filipino vessels with water cannons.⁸ If these conflicts escalate, there is a risk of wider conflict in the area or of shipping vessels being attacked, potentially leading to increased shipping and insurance costs for vessels that pass through the region.

This report simulates the impact of such a conflict on U.S. importers' ability to source critical commodities from Southeast Asia, assuming a range of hypothetical transportation cost increases for impacted shipments. Initial results indicate that a 50% increase in trade costs between Southeast Asian countries and the United States would decrease firm revenues for testing and diagnostic sectors by 4%, semiconductors by 8%, and processed minerals by 15%. As trade costs increase, processed minerals are most significantly affected while testing and diagnostic sectors are affected much less.

⁶ For example see <https://www.cnn.com/2020/10/30/economy/china-economy-five-year-plan-intl-hnk/index.html> and <https://www.npr.org/2024/05/14/1250987721/biden-china-tariffs-electric-vehicles>

⁷ As estimated by the United Nation's Conference on Trade and Development (<https://unctad.org/publication/review-maritime-transport-2016>).

⁸ See <https://www.cfr.org/global-conflict-tracker/conflict/territorial-disputes-south-china-sea> and <https://www.reuters.com/world/asia-pacific/china-coast-guard-says-it-took-measures-against-philippine-vessels-south-china-2024-03-23/>

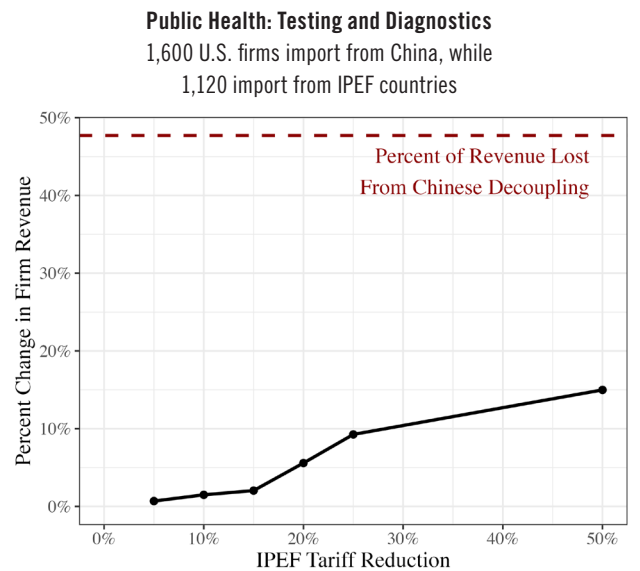
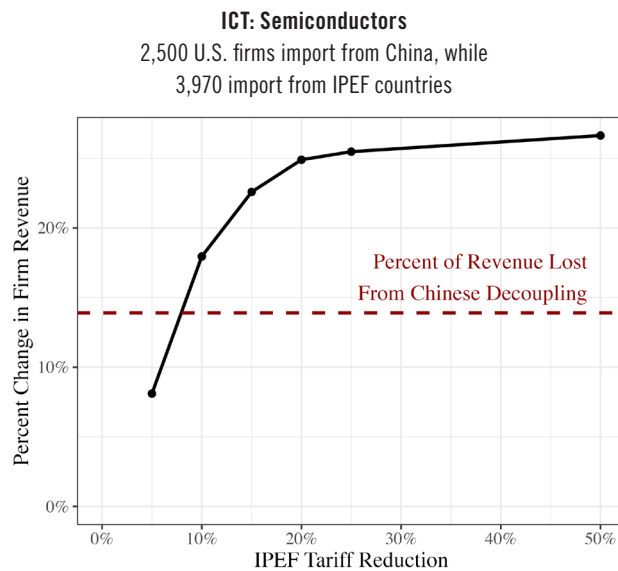
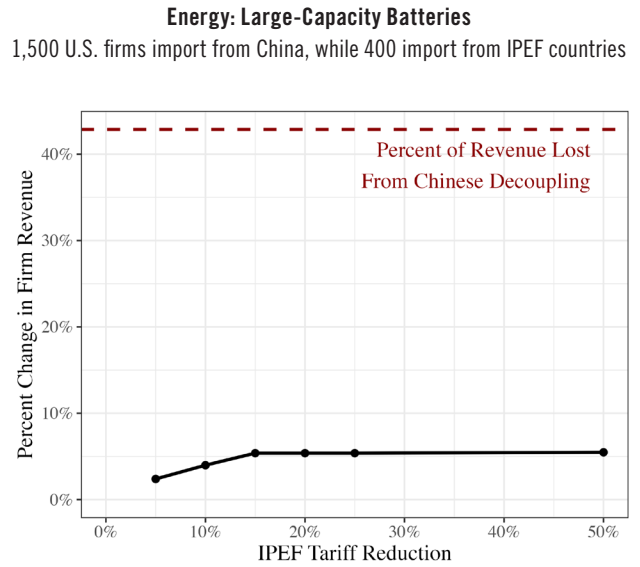
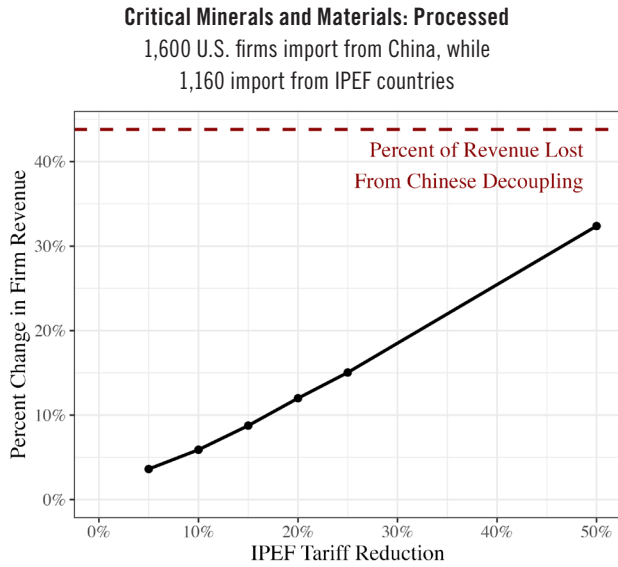


Figure 4: Change in Importer Revenues from Decoupling

Notes: The horizontal axis represents a percentage reduction in tariff rates; for example, if a tariff is 7% and is reduced by 10%, the 10% would reflect a reduction in the tariff rate of 0.7%. The vertical axis plots the percentage change in firm revenues for firms that actively source from IPEF countries, as represented by the black line, or China in the case of the dashed red line. These estimates do not allow for adjustments in the number of firms that import from a particular supplier. Future versions of Howard and Underwood (2024) [2] will incorporate these changes. ICT stands for Information, Communication, Technology.

Conclusion

This study developed an economic model of firm production and sourcing to better understand how escalating geopolitical tension between the United States and China may affect U.S. firms. The report also explored the potential policy levers that may reduce supply chain risk for critical sectors. It explored two scenarios: U.S. decoupling from China and a disruption of shipping lanes in the South China Sea. The results indicate that de-risking policies aimed at reducing reliance on China and diversifying supply chains are crucial to mitigate these risks. This could involve promoting domestic production of critical goods, incentivizing diversification of supply chains, and strengthening alliances and trade relationships with other countries. Future analysis will more carefully assess how a shipping disruption in the South China Sea would affect sourcing potential in third-party countries and allow for technical refinements that allow for the inclusion of additional policy levers.

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Any opinions and conclusions expressed herein are those of the authors and do not represent the views of the U.S. Census Bureau. The Census Bureau has reviewed this data product to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product. This research was performed at a Federal Statistical Research Data Center under CES Project 2157 (release on 03/01/2024).

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