Does Trade in Primary Commodities Matter?

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Geopolitical instability and a burgeoning demand for critical resources have made understanding the role of international trade in primary commodities ever more important. While the share of primary commodities (mineral, fuel, and agricultural products) in world trade has declined over the past century, they play an essential role in global value chains and are particularly vulnerable to trade wars and tariffs. Here, we argue that the aggregate welfare gains from trade are much larger than previously hypothesized when we account for key features of commodities, such as difficulty in finding substitutes and in increasing supply, and high dispersion of natural resources across countries.

Primary commodities such as agricultural products, minerals, and fuels are the building blocks of every consumable good and manufactured product. Given the importance of commodities for the production of such goods, a concern associated with globalization is whether countries can rely on trading partners for access to these crucial inputs to production, and ultimately how important such access is. In particular, the prospect of continued trade disputes and increasing demand for critical minerals has made worries over access to commodities more pressing.

It is important to develop measures that quantify the interdependency of countries through trade in natural resources, and whether they play a specific role relative to other traded goods. These measurements can help to understand the losses from imposing barriers to commodity trade, such as the creation of tariffs on imported commodities or embargoes of key trading partners.

Risks of Importing Primary Commodities Compared to Manufactured Goods

There are risks for importers sourcing any product from abroad, whether it be the imposition of import tariffs on primary commodities, such as iron and aluminum, or on manufactured products, such as solar panels or washing machines. Recently, in February 2018, the U.S. implemented tariffs on almost 13% of total imports, including products such as these. In a recent NBER working paper from 2019, Fajgelbaum and co-authors examine the rise in average tariffs on those goods from 2.6% to 17% and conclude that these tariffs have been completely passed on to U.S. consumers in the form of higher prices on imported inputs.

Given these risks, a natural question may be: from the perspective of domestic consumers, are the risks of importing manufactured products, such as consumer appliances, larger than that of primary commodities? As a share of world trade, manufactured products compose a much larger share of world imports than primary commodities. Thus, it may seem natural to conclude that the risks of importing finished products such as washing machines are much larger.

However, this logic ignores that, with the proper blueprints, any country with access to the inputs required to make washing machines (such as steel, copper, zinc, and oil for use in plastic) could theoretically produce them if one can no longer access washing machines on the world market. But suppose that you want to make a washing machine without some of these primary commodities—it may be possible, but it would be very difficult and costly to find substitutes to these materials. This holds true, of course, for most manufactured products.

Furthermore, iron, copper, and zinc are all scarce natural resources, for which the expansion of supply requires costly exploration efforts. For many countries, it is either difficult or impossible to find such natural resources, and we observe that some countries are quite rich in natural resources that others do not possess. Therefore, only a few countries can cheaply provide the natural resources required to produce manufactured goods. If you need sorghum for products and you cannot source from the U.S., or need uranium but cannot trade with South Africa, or rely on China for rare earth elements, it will be far more difficult to source these commodities from abroad, as these respective countries account for the largest share of each commodity on the world market.

Theoretical Motivation

These combined factors lead us to believe that commodities play a crucial role in international trade. In particular, both the difficulty in finding substitutes for commodities (economists refer to this as having a low elasticity of demand) and the difficulty in increasing supply of commodities in response to higher prices (correspondingly, a low elasticity of supply) magnifies their importance in trade.

The logic for this is as follows—to evaluate the gains from trade, we need to know what a country would produce and consume in a counterfactual equilibrium without trade, as well as in one where trade is permitted. Since moving back to a world in autarky would mean that countries could consume only what they produce, countries would have to move away from their specialized production patterns in commodities that we observe (as we highlight below).

Table 1. Selected Estimates of Supply and Demand Elasticities for Mommodities

Commodity	Price Elasticity of Demand	Price Elasticity of Supply
Alfalfa	-0.107	0.44
Almonds	(-0.35 to -0.48)	0.19
Aluminium	(-0.07 to -0.7)	(0.05 to 1.15)
Bananas	(-0.566 to -0.738)	(0.2 to 0.4)
Barley	(-0.11 to -0.435)	(0.11 to 0.45)
Chromium	(-0.1 to -0.277)	
Citrus	(-0.804 to -0.994)	
Coal	(-0.3 to -0.7)	0.057
Cobalt	(-0.029 to -0.5)	(0.21 to 1.0)
Cocoa	(-0.01 to -0.14)	(0.03 to 0.12)
Coffee	(-0.07 to -0.54)	(0.02 to 0.55)
Copper	(-0.035 to -0.42)	(0.06 to 1.2)
Corn	(-0.1 to -0.39)	(0.08 to 0.7)
Crude Oil	(-0.003 to -0.08)	(0.0 to 0.289)
Gold	-0.411	
Iron	-0.086	0.589
Lead	(-0.111 to -0.22)	(0.109 to 1.84)
Manganese	-0.1	> 1.0
Mercury	-0.1	1
Natural Gas	(-0.053 to -0.95)	(0.0 to 0.15)
Nickel	-0.038	(0.133 to 2.03)
Niobium	(-0.295 to -0.3)	
Palladium	-0.2	
Peanuts	(0.0 to -0.4)	(0.04 to 0.5)
Petroleum	(-0.034 to -0.44)	
Platinum	(-0.28 to -0.7)	
Pulse grains	(-0.339 to -0.71)	0.17
Rice	(0.0 to -0.55)	(0.01 to 0.57)
Roots	(-0.635 to -0.737)	
Silver	-0.042	
Sorghum	(-0.06 to -0.49)	(0.16 to 0.53)
Soybeans	(-0.05 to -0.329)	(0.061 to 0.705)
Sugar	(-0.01 to -0.643)	(0.055 to 0.21)
Sunflower	(-0.083 to -0.15)	(0.15 to 0.41)
Tin	(-0.097 to -0.55)	(0.032 to 1.11)
Titanium	-0.16	
Tomatoes	(-0.32 to -0.723)	0.27
Tungsten	(-0.15 to -0.5)	(0.11 to 0.15)
Uranium		(1.1 to 11.4)
Vanadium	(-0.254 to -0.3)	
Walnuts	(-0.251 to -0.267)	0.02
Wheat	(-0.09 to -1.6)	(0.059 to 0.43)
Zinc	(-0.064 to -0.47)	(0.085 to 1.75)

A low elasticity of supply would suggest a higher degree of difficulty in changing production patterns to match domestic demand in the absence of imports, which would lead to much higher prices for these commodities. Likewise, a low elasticity of demand for commodities would suggest that end users of these goods (say, domestic producers in the manufacturing sector) would be less able to adjust their sourcing towards commodities more readily available domestically. Such adjustments would help to cope with the sudden inability to import a given commodity, even if the price of these commodities greatly increases. As such, with low elasticities of supply and demand for commodities, we would expect that consumers would be much worse off in a world without trade than they would in one where supply and demand adjust more flexibly.

Low Price Elasticities of Supply and Demand for Commodities

To confirm that commodities exhibit inelastic supply and demand, we conduct a review of the academic literature estimating price elasticities of supply and demand. Such estimates cover a wide number of commodities, as summarized in Table 1. On the supply side, estimates less than 1 indicate that the supply of the commodity is inelastic, or that supply rises less than proportionally in response to price increases.

Conversely, on the demand side, estimates between zero and -1 indicate that demand decreases less than proportionally in response to price increases. We find that most estimates fall within the 0.1 to 0.5 range in absolute value on the supply and demand side. The results are similar across a wide range of commodities, from agricultural products (e.g., cereals) to fuels (e.g., natural gas and petroleum), and indicate that the welfare gains from access to commodities in the world market may indeed be quite large.

High Dispersion of Natural Resources and Concentrated Production Patterns

In our paper, Commodity Trade Matters, we have assembled a rich dataset of information on commodity trade, production, and prices, which we have made available online at https://are.berkeley.edu/~fally/data.html for others to use. We use this source of data to provide a series of stylized facts to highlight the importance of commodities. Of particular interest are three important facts regarding the concentration of production of commodities.

The first fact is that for some countries, most of them low-income countries, primary commodities and natural resources account for a large share of their income. We count almost 33 countries with a population of greater than 1 million for which natural resource production accounts for more than a quarter of total GDP.

Secondly, for many countries, a few commodities account for a large share of their total exports and subsequently GDP, as seen in Table 2. Exports of a single commodity make up more than 50% of exports for several countries, even including large countries such as Venezuela. For other countries, a majority of their exports are comprised by no more than a few commodities, such as Angola. While petroleum is a common commodity in which many larger countries specialize (such as Angola and Venezuela), other commodities also account for a very large share of exports from some countries. For example, cashew nuts account for 85% of Guinea-Bissau's exports, and cotton comprises almost three-quarters of exports for Burkina Faso.

Such specialization leaves exporters especially vulnerable to price fluctuations in commodity prices. But these extreme specialization patterns also shed light on the large gains from trade in commodities. International trade creates a much larger relative demand

in commodities than would be sustainable domestically in these highly specialized countries.

Third, there are numerous commodities for which a limited number of producers account for most of the world's supply. A common example is copper, for which Chile accounts for 37% of world primary ore production, making it the world's largest producer. However, many commodities are even more geographically concentrated in terms of production than copper. The list of commodities where 75% of production or more occurs in one country includes many mineral products as well as agricultural products: canary seeds, spinach, garlic, rare earth metals, antimony, and platinum, for example. Overall, in 2012, 39.5% of the total production of primary commodities came from countries responsible for the production of 50% or more of their respective world market share.

Modeling Commodity Trade

To confirm that commodities play an outsized role in world trade, we develop a general-equilibrium model of consumption, production, and input-output linkages. Relative to the literature, our model explicitly accounts for the features of commodities, such as their low price elasticities of supply and demand and high dispersion of production. We use our model to examine various counterfactual scenarios using computer simulations wherein we enact barriers on the trade of primary commodities. Our simulations confirm that the welfare losses from trade barriers are significantly larger than models that do not account for natural resources, especially when considering large trade cost changes.

What Would Happen if Trade Stopped Entirely?

One of the questions we answer is a stark hypothetical, but nevertheless a question popular in the international trade literature—how much would countries be hurt by completely closing their borders to trade permanently? The common answer, as posited by a formula proposed by Arkolakis, Costinot, and Rodriguez-Clare in 2012 in the *American Economic Review*, is "not much"—most countries receive a welfare loss of no larger than 10%, which is even smaller (1.4%) for large countries such as the United States. These models, however, make stark assumptions that do not fit stylized facts about most primary commodities. In contrast, considering the unique features of commodities, we find that the welfare losses for countries, especially small countries, can be extremely large for this hypothetical. The welfare losses for countries vary based on their size and production composition; however, we conclude that trade, and particularly commodity trade, matters greatly for the well-being of nations.

This makes intuitive sense. Suppose that a country can no longer import a natural resource it does not possess. If such a resource is crucial to the manufacture of modern products, such an outcome could be very harmful, turning back the clock substantially on technological progress. The degree to which a country experiences such adverse effects depends on whether a country can find suitable substitutes for the natural resource among the natural resources it does possess. Of course, such a drastic scenario has few examples in the modern era, and whether countries can develop innovations or not in such a scenario remains speculative. However, it is likely that the adverse effects of trade shutdowns would be quite large without some of these crucial inputs.

Intermediate (and Temporary?) Trade Barriers: Tariffs and Trade Embargoes

However, milder forms of trade barriers are not without precedent in the modern era. In recent years, unprecedented increases in import tariffs and trade embargoes on crucial natural resources have led many countries and firms to re-examine the risks present in their supply chains. To understand the risks caused by some of the largest exporters of given commodities, we use our model to simulate the welfare effects of tariff increases, in addition to the adverse effects of losing access to the largest exporter of a given commodity.

We first consider the role that import tariffs on commodities play in terms of welfare. Our simulations indicate that modest import tariffs hurt consumer welfare on aggregate, but not much more than in a world where commodities are elastically demanded and supplied (an explanation is that lower demand and supply elasticities generally imply smaller deadweight losses, i.e., welfare losses from reduced trade

Table 2. Countries with the Largest Share of Top Commodity in Total Exports

Country	Top Commodity	Export Share
Iraq	Crude Oil	0.990
Chad	Crude Oil	0.945
Angola	Crude Oil	0.930
Guinea-Bissau	Cashews	0.857
Nigeria	Crude Oil	0.854
Iran	Crude Oil	0.807
Azerbaijan	Crude Oil	0.771
Saudi Arabia	Crude Oil	0.770
Congo	Crude Oil	0.767
Yemen	Crude Oil	0.744
Zambia	Copper	0.738
Turkmenistan	Natural Gas	0.737
Burkina Faso	Cotton	0.731
Tajikstan	Aluminium	0.687
Gabon	Crude Oil	0.663
Venezuela	Crude Oil	0.658
Oman	Crude Oil	0.631
Kuwait	Crude Oil	0.614
Malawi	Tobacco	0.558
Mozambique	Aluminium	0.555
Algeria	Crude Oil	0.536
Laos	Copper	0.520
Jamaica	Alumina	0.501
Kazahkstan	Crude Oil	0.490

Notes: Share of top commodity in total exports by country in 2007, showing the countries with the highest concentration of exports that have a population larger than 1 million.

Table 3. U.S. Price Increase from Shutting Down Commodity Production in China Compared to Chinese Market Share of Commodity

Commodity	Simulated Price Increase	China's Share of Exports (2007)	China's Share of Production (2007)
Rare Earth Minerals	695.66%	55.78%	98.40%
Bismuth	680.68%	40.78%	29.69%
Antimony	299.08%	61.13%	89.60%
Onions, Garlic, and Leeks	262.92%	25.71%	69.30%
Peanuts	197.13%	26.91%	51.80%
Magnesium	168.05%	39.92%	84.30%
Barytes and Strontium	142.30%	45.80%	66.94%
Manganese	104.42%	25.48%	27.85%
Graphite	101.17%	47.25%	70.70%
Talc	37.03%	22.36%	24.18%
Cotton	31.78%	17.06%	51.20%
Arsenic	16.77%	27.50%	54.10%
Tungsten	14.22%	12.82%	70.25%
Iron	10.96%	10.08%	36.67%

not recouped by consumers, producers, or the government).

We then consider a number of potential outcomes associated with the loss of trading opportunities with key exporters, recalling the high degree of specialization associated with the production of commodities. In particular, the reliance of importers on a few countries leads to high costs associated with barriers to trade with such suppliers, as importers have to shift their sourcing to other, potentially less productive suppliers. To illustrate and quantify the role of critical suppliers, we can focus on the role of China in commodity production, as China is the top exporter for almost 15 common commodities. A potential Chinese export embargo on those commodities would lead to large increases in prices and production costs. In the figure below, we display the counterfactual effect on prices for these commodities in the United States.

The largest impact would be for rare earth minerals, in which China accounts for 55% of world exports. Our simulations indicate a price increase of almost 700%, as reported in Table 3. This magnitude is large, but comparable with the temporary price increases of 525% experienced between the period of 2009–2011 due to the partial Chinese export embargo on rare earth minerals. Such large price increases are not limited solely to mineral commodities—for instance, we predict onions, garlic, and leeks would temporarily experience a 263% price increase in the U.S. if China stopped exporting such products, representing around a quarter of world trade in such products. On the contrary, for iron, the simulated effect on U.S. prices is limited to a 10% increase, a commodity for which China represents a smaller share of world export supply.

Conclusion

Despite their share of world trade, the role of primary commodities in international trade continues to be an outsized one given their importance as inputs to production processes and value chains. The decline of the share of primary commodities in world trade must be considered against the large decreases in tariffs and transportation costs over the past 70 years, and the resulting large increase in trade volume relative to GDP.

Increasing barriers to trade would lead to a resurgence of the share of primary commodities in total costs and create large welfare losses, particularly if such barriers are imposed upon the largest producers of such resources. Conversely, given the continued reliance of many countries on commodity exports, price volatility as well as the potential effects of trade barriers leave exporters especially vulnerable to fluctuations in the price of their main export. These concerns indicate that trade in commodities will continue to play an important role in world trade.

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