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Dahl Mineral Elasticity of Demand and Supply Database (MEDS)

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ABSTRACT
Minerals and metals are critical materials in advanced industrial economies as well as for those on the path to industrializing. Their criticality, capital intensity, and cyclicity all point to the need for those involved along the supply chain to understand the drivers in these markets and the size and speed of response to them. Since demand and supply elasticities can be valuable summaries to help us understand these responses, this database is an ongoing effort to collect and catalogue the available estimates. Most of the elasticities are derived from econometric work and the database contains elasticities as well as information on the sample (what, where, when), included variables and equations, statistical techniques and statistical properties of the estimates.

From use in skyscrapers and jet planes to toasters and bicycles, minerals and metals across the globe provide basic building blocks of modern life. The boom and bust nature of these markets in a rapidly industrializing world, the concentration of some of these resources in unstable areas of the world, worries that we are depleting these non-renewable resources, and the critical need for some of them for national defense goods and rapidly increasing renewable energy production has again put them in a spotlight. This is not a particularly new phenomenon. Figure 1 shows a metal price index for almost a century.

Commodity Metals Price Index (Real)
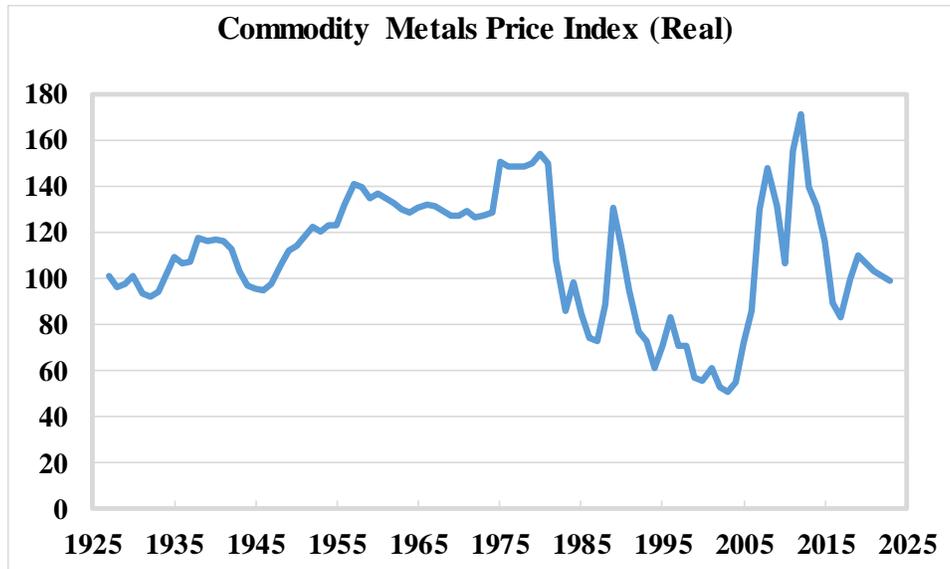
Source: Dahl (2019a, p 10)

The three most notable price run ups – the decade after World War II, 1975 to 1985 and again from 2005-2015 all caused concern and the interest in minerals and mineral policy to increase. Of interest to all concerned is how responsive quantity demanded and supplied of these products are to these increases in price. The responsiveness to price is often measured by price elasticities (the percentage change in quantity (Q) demanded or supplied as the result of a percentage change in price (P), which can be written as

$$\varepsilon_p = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}}$$

For modeling purposes, this expression is usually rearranged and converted to one of the following partial derivatives:

$$\varepsilon_p = \frac{\partial Q}{\partial P} \frac{P}{Q} \quad \text{or} \quad \frac{\partial \log Q}{\partial \log P}$$

Consumption and production may respond to price, while these price run ups may be caused by shifts in other variables that increase demand for mineral products or decrease their supply. Many of the models in the database measure elasticities with respect to these other variables of influence. (e.g. We get the elasticity of supply or demand for variable X by replacing P with X in the above formulas) From mine mouth, stockpiles, smelting, transportation, fabrication, through to the final consumer and scrap recover, such elasticities are of interest to those along the supply chain of these products as well as to governments making policy relating to these markets. Thus, dozens of studies have been conducted to investigate elasticities relating to demand and supply elasticities of various minerals. For example, Fally and Sayre (2018) survey the literature and present ranges of short and long run price elasticities of demand and supply for 20 metals from 30 studies. They use these and other commodity elasticities in a computable general equilibrium model to measure gains from trade. I build on their ambitious literature review by adding more detail on the studies they present and adding new studies. My intent is for this to be an ongoing public database. As more studies are located they will be added to the data base.

Including their studies, I have found more than 60 studies to date that provide such elasticities relating to supply and/or demand for more than two dozen metals and minerals. I only include studies that report elasticities or for which there is enough information to compute elasticities. Most are econometric studies but a few are based on the expert judgement of the author or other techniques. Figure 2 shows the distribution of these studies across time by publication date.
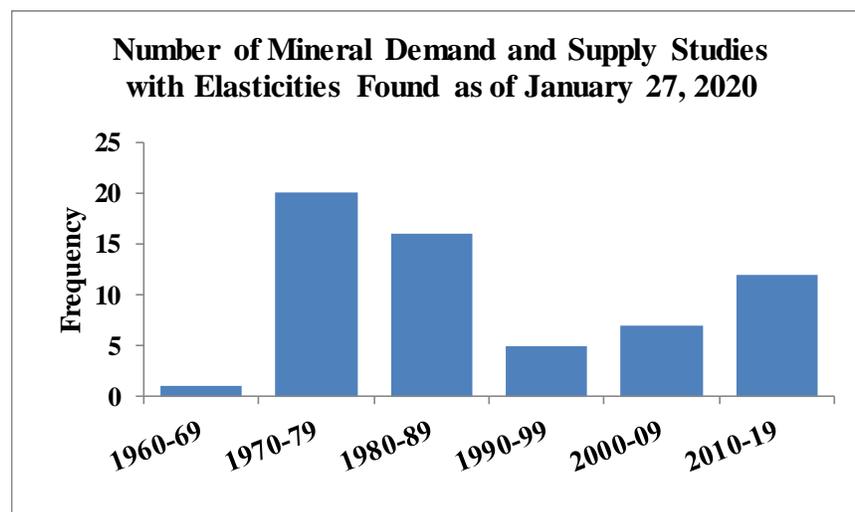

Figure 2: Histogram of collected studies by year of publication

The metal price spikes in the mid 1970s through the early 1980s and the mood of resource insecurity spawned the most studies. With the more recent price run up beginning in 2004, the studies have been picking up as well.

For the latest database with elasticity estimates by equations for a metal product including region and years for the estimate, included variables, and measure of statistical fit see http://dahl.mines.edu/MEDS.xlsx. The bibliography of studies included in the most recent

database can be found at http://dahl.mines.edu/MEDSBib.xlsx. Enjoy and send along your comments, corrections and suggested additions (cadahl@mines.edu).

Reference

Fally, Thibault and Sayre, James. (2018). *Commodity Trade Matters*. Retrieved from https://are.berkeley.edu/~fally/Papers/Paper_commodities.pdf