

Extending MRIO Analysis to Hazardous Materials: Structural Linkages of Asbestos Use Examined through Japan's Historical Industrial Structure

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Asbestos health risks have been well known from medical evidence since the 1960s, with asbestos leading to such serious health effects as lung cancer, mesothelioma, and asbestosis. In response, international bodies, including the World Health Organization (WHO) and the International Labour Organization (ILO), have intensified efforts to ban asbestos. Nevertheless, asbestos continues to be mined, traded, and used in many parts of the world. Although many developed countries have progressively introduced bans, more than 130 countries still use asbestos domestically as a material in products. As a result, asbestos exposure remains an ongoing global concern rather than a resolved historical issue, and an increase in patients with asbestos-related health effects is predicted for those asbestos mining/using countries.

The asbestos health risk issue cannot be treated solely as a domestic problem of the asbestos mining/using countries. Even economies that have already banned asbestos have induced asbestos mining and production indirectly through international trade and global supply chains. However, most research to date has focused primarily on medical and epidemiological impacts, or on single countries, making limited effort to clarify this issue economically by an analysis of asbestos mining/using activities via global supply chains.

Building on Tsukui (IIOA 2025), the present study empirically investigates how global production and consumption structures induce asbestos mining/using through international supply chains using an extended multi-regional input-output framework. We develop Asbestos-extended Multi-Regional Input-Output Table (AMRIOT) 2014 as an extension of the OECD Inter-Country Input-Output Table (OECD-ICIO) for 2014 that explicitly represents asbestos-related sectors, given that latency periods of asbestos-related diseases generally exceed 10 years. Structural path analysis (SPA) is used to identify the principal industrial pathways linking final demand to asbestos mining, as well as to characterise the global structure of asbestos-related economic flows.

In constructing this framework, the mining sector is disaggregated into asbestos mining and other mining activities, while manufacturing sectors are decomposed into asbestos-containing and non-asbestos product groups using the UN Comtrade database. This enables estimation of asbestos flows in both monetary and physical terms. We utilise Japan's 1970 input-output table to clarify the manufacturing activities for asbestos-containing products because asbestos was widely used as an industrial material at that time in Japan. As asbestos has already been banned in many developed countries, existing life-cycle inventory databases do not contain sufficient data on asbestos-related production. The model estimates the extent to which final demand in each country induces asbestos mining and traces how this demand propagates through international production networks.

The results indicate that asbestos mining is closely linked to demand generated through construction, machinery, and transport-related production chains, particularly in rapidly industrialising economies such as China and India. SPA shows that China's final demand induces asbestos mining mainly through its domestic manufacturing sectors, including motor vehicle parts, machinery, and construction, and similar mechanisms appear in India, where brake linings, cement, and transport-related demand play significant roles.

At the same time, inducement structures differ markedly across country groups. In asbestos-mining economies such as Russia, Brazil, and Kazakhstan, demand patterns are relatively concentrated, with construction-related uses—especially cement and asbestos cement—dominating the connection between domestic demand and mining activity. Even countries that have already banned asbestos have non-negligible effects on the worldwide asbestos mining. For example, imports by the United States and European economies from asbestos-using countries continue to induce asbestos

mining indirectly through multi-tier supply chains, demonstrating that asbestos dependence is embedded in global production systems rather than confined to a small group of producing nations. These findings suggest that the continued use of asbestos does not merely reflect regulatory delay or technological constraints but is a structural feature of the global economy, in which those who benefit economically from asbestos use are geographically and institutionally separated from those who bear the associated health risks. By providing an empirical analysis grounded in the input-output methodology, this study clarifies the international supply-chain mechanisms sustaining asbestos use and offers new insights into the need for internationally coordinated strategies to reduce asbestos-related risks.