Endogenizing capital in the value-added analysis of trade

Topic:
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This paper proposes a new methodology to account for capital goods and services in the analysis of global value chains (GVCs) and trade in value-added (TiVA). In conventional inter-country input-output (ICIO) models, capital is exogenously treated, which may underestimate the actual influence of capital on trade dynamics. Our approach endogenizes capital formation and incorporates both domestic and foreign capital contributions, resulting in the development of novel indicators that more accurately reflect capitalâ€™s role in trade.

As GVCs are highly fragmented and complex, with production processes distributed across multiple nations, the need for accurate representation of all contributing factors, including domestic and foreign capital, has intensified. Traditional TiVA indicators capture domestic and foreign value-added from intermediate goods and services in exports, but cannot identify the role of capital in generating value added in exports. Capital goods like machinery, equipment, and infrastructure are instrumental in enabling production across GVCs. Capital services that are part of research and development processes and central in IT strategies of firms are also key to understand global production. The exclusion of capitalâ€™s role in ICIO models applied to GVCs not only misrepresents the actual value creation in trade but also limits the understanding of a countryâ€™s strategic participation in global production networks, as well as interdependencies across countries in terms of capital formation.

In the IO literature, two primary methods have been identified to endogenize capital: the augmentation technique and the flow matrix method. The augmentation technique involves adding a separate additional sector to the inter-industry flow matrix to incorporate capital. This approach creates an artificial sector with a homogeneous commodity â€œcapitalâ€•, which is used and put into production according to the gross fixed capital formation (GFCF) vector and consumed based on the row vector of capital input. The flow matrix method decomposes capital by assets and sectors, creating a separate capital flow matrix. This matrix is then added to the conventional inter-industry matrix to construct the total flow matrix. By doing so, the role of capital is explicitly acknowledged, and the model captures the interdependence between capital and other sectors.

This paperâ€™s contribution lies in applying these capital-endogenized approaches to an ICIO framework and the decomposition of gross exports into value-added terms that reflect the foreign and domestic origin of value added. By constructing capital flow matrices that trace transactions between countries and industries, we assign value added associated with capital goods and services to the industries using them and we devise new indicators that measure domestic and foreign capital value added embodied in exports.

We calculate such indicators with capital matrices developed by the OECD that are consistent with the 2018 edition of OECD ICIO tables. Our empirical analysis highlights significant divergences in revealed comparative advantage (RCA) indices calculated with endogenized capital as compared to traditional RCAs based on gross exports or trade flows in value-added terms. The capital RCA approach reveals the export strength of major developed economies rooted in capital goods and services excellence, which traditional RCAs overlook. Comparison with standard TiVA accounting unveils systematically higher shares of value-added in intermediate versus final goods exports when capital is endogenized. This aligned with the role of capital goods in facilitating production across GVCs. Our capital-augmented ICIO framework offers a deeper insight into the interplay between

capital and global production processes.

We believe this paper makes several key contributions to the existing literature:
â€¢ It addresses a significant gap in input-output and trade in value-added accounting regarding the treatment of capital as an exogenous component.
â€¢ It implements techniques from past input-output literature to endogenize capital within an inter-country setting and applies this to trade analysis.
â€¢ It provides a framework to calculate new value-added trade indicators capturing domestic and foreign capital's role.
â€¢ It highlights, through an empirical exercise, major shifts in the measurement of revealed comparative advantages and export competitiveness when capital is incorporated.
â€¢ It unveils systematically higher shares of value-added in intermediate versus final goods exports when capital is endogenized in comparison with standard TiVA accounting.