A new perspective for the calculation of Ghosh-like forward multipliers

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Abstract

This paper focuses on a contribution to improve multisectoral national/regional analysis. The tools currently used to identify and measure forward effects in disaggregated multi-sector models are widely considered inadequate. While the multi-sector approach is broadly accepted, the Ghosh classical model (1958), commonly employed in these analyses, has faced substantial criticism for two primary reasons. First, the model fails to accurately represent the technological characteristics of a market economy. Second, it gives rise to conceptual inconsistencies in the relationship between value-added and output levels. To overcome these limitations, we propose a new and straightforward method, grounded in standard theory, for identifying and measuring forward effects. Although this approach departs from the Ghosh model, it retains the core principle of examining the dependence of output on value-added, while enabling wider insights for economic analysis and policy evaluation.

Keywords

Forward linkages; Regional analysis, Multiplier matrices; Value added drivers.

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Extended abstract

The Ghosh output allocation model (Ghosh, 1958), more commonly known as the supply-driven input-output (IO) model, has been a subject of debate since its inception. The primary and most acute criticism was initiated by Oosterhaven (1988, 1989), who highlights two major concerns with the model.

The first one is the absence of a technological framework linking inputs and outputs to support the model. The second observation is the odd behavior of output distribution based on fixed coefficients that fail to respond to market signals, such as demand and prices. The final materialization is that, mathematically, the Ghosh model describes production levels as a response to value-added levels, creating a paradoxical situation: an additional injection of value-added in one sector stimulates activity levels across all sectors, even though no changes occur in the value-added of other sectors. In other words, production increases without a corresponding rise in the value-added applied in the other sectors. Oosterhaven categorizes this awkward behavior as implausibility.

Another limitation of the Ghosh model is that changes in output levels, resulting from a change in the value-added of a specific sector, do not have a roundabout effect on the value-added of the triggering sector. The initial change in this sector's value-added remains fixed and unaffected by changes taking place in the rest of the economy. However, the general readjustment of activity levels implies that sectoral interdependence should influence value-added not only in other sectors but also in the initiating sector itself. The absence of this feedback effect introduces an additional layer of implausibility in the Ghosh model that, to our knowledge, has not been reported in the literature so far.

Finally, total value-added is composed of various components (such as value-added from low-skilled labor, high-skilled labor, capital services, etc.). However, the Ghosh model remains blind to these distinctions. Changes in any type of value-added will produce identical effects on output delivered, which is clearly unrealistic.

Note also that an economy in which sectoral activity levels can increase without there being a need to inject new value-added into all sectors would indicate that its initial state is technically un-efficient, or at least un-monotonic, under the usual tenets of production theory.

Although Ghosh himself indicated that his model was designed to describe a situation of output distribution, such as would occur in a planned economy or in a fully monopolistic economy, there is little doubt that the descriptive capacity of the model, in the version initially developed by Ghosh, seems limited in the context of market economies.

The peculiarities of the Ghosh model have also been highlighted by De Mesnard (2009), who emphasizes the model's descriptive insufficiency for properly

distinguishing between prices and quantities. Although Dietzenbacher (1997) demonstrates that the Ghosh model can be reinterpreted as a price model consistent with the Leontief (1936) model, De Mesnard concludes that the Ghosh model is entirely redundant and unnecessary. If the objective of the study is price determination, the Leontief model already provides the solution without requiring reliance on interpretive concepts that are unconventional.

The challenges associated with the model prompted efforts to revitalize it. Guerra & Sancho (2011) proposed an extension to the model, incorporating two categories of value-added within the framework of a planned economy. While this extension resolves the issue of mutual insensitivity between the categories of value-added, it seems to introduce new problems related to the criteria for output redistribution (Oosterhaven, 2012; Manresa & Sancho, 2013, 2020). In this line of attempted improvements, Altimira (2024) separates value-added in the Ghosh model into exogenous and endogenous components, with the model being driven solely by changes in the exogenous component. While this approach makes value-added responsive throughout the model, it appears to merely shift the Ghosh model's underlying difficulty from dealing with changes in total value-added to handling changes in the exogenous component.

Despite its conceptual issues, the Ghosh model has been systematically used to study *forward* effects in market economies. These effects aim to trace how changes in resources, i.e., value-added injected into a sector, stimulate activity levels within that sector and in other sectors. This question is of genuine interest in economic policy, as its answer would help identify which sectors could most effectively amplify economic activity, making it valuable for designing supply-side stimulus policies. The transmission mechanism between resource availability and activity levels is found in the Ghosh model's multiplier matrix, which is derived from the flows recorded in an input-output table using sales coefficients. From the perspective of a sector, its intermediate sales to other sectors are divided by the output of the sector in question, defining the allocation coefficients.

Given the conceptual challenges of the Ghosh model, as noted by Oosterhaven (1988, 1989) and De Mesnard (2009), the widespread use of the Ghosh multiplier matrix to calculate forward effects in applied studies appears unjustified. If the model cannot credibly address this requirement, the development of an alternative framework is needed, one capable of calculating forward effects by linking value-added with activity levels, while adhering to central theoretical principles and avoiding interpretive distortions. This is the primary objective of this work.

Once we introduce an alternative model for estimating forward effects, we illustrate its applicability and apply the proposed model to recent empirical data for Spain. Finally, we provide a brief conclusion.