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A dual theory of price and value in a meso-scale economic model with stochastic profit rate

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HIGHLIGHTS

- Physical and monetary flows are modeled as an economic network.
- Prices and direct labor are eigenvector solutions to balanced flow equations.
- Price and labor content are related stochastically.

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ABSTRACT

The problem of commodity price determination in a market-based, capitalist economy has a long and contentious history. Neoclassical microeconomic theories are based typically on marginal utility assumptions, while classical macroeconomic theories tend to be value-based. In the current work, I study a simplified meso-scale model of a commodity capitalist economy. The production/exchange model is represented by a network whose nodes are firms, workers, capitalists, and markets, and whose directed edges represent physical or monetary flows. A pair of multivariate linear equations with stochastic input parameters represent physical (supply/demand) and monetary (income/expense) balance. The input parameters yield a non-degenerate profit rate distribution across firms. Labor time and price are found to be eigenvector solutions to the respective balance equations. A simple relation is derived relating the expected value of commodity price to commodity labor content. Results of Monte Carlo simulations are consistent with the stochastic price/labor content relation.

1. Introduction

A central problem for any economic theory lies in the understanding of price, the monetary magnitude at which goods exchange. For over a century there have been two principal competing views to account for this. The conventional view, that of neoclassical theory, bases price on microeconomic marginal utility assumptions [1,2]. The alternative, macroeconomic labor value theory, postulates that commodity prices derive their underlying exchange value[1] from the labor content embodied in their production [4, Ch. 3]. Sraffa's [5] analysis of price yielded a fundamental critique of marginalism [6].

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[1] In this work, 'value' refers to the hypothesized property of each commodity that permits it to be exchanged in the market for definite quantity of any other commodity, on average. By hypothesis, the magnitude of the value of a commodity is given by its socially necessary labor time. 'Exchange value' is form that value takes in the exchange process [3, Ch. 12].

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Simultaneously, his analysis also challenged the fundamental assumptions of the alternative price/value theory [7, Ch. 10]; [8], and until relatively recently, it was believed by many that, from a theoretical standpoint, labor content did not accurately predict price (e.g., Ref. [9, Ch. 4]). However, as Farjoun and Machover [10] point out, this was based on a false assumption that rates of profit are uniform across firms, which is known empirically to be false [11,12], and they derived a stochastic price/labor content relation. Cockshott et al. [13, Ch. 9] have extended this result in a model of a simple commodity economy (SCE). However, the SCE model does not account for some of the essential features of capitalism, most importantly the separation between ownership of the means of production and the ownership of labor power, which are included in the production/exchange model proposed here.

The goal of the current work is to determine the relation between price and labor value in a model of a simple capitalist economy. The key conjecture is that labor content determines the expected value of price for each commodity in a probabilistic sense, given the simplifying assumptions of the model. The current work is motivated by the apparent utility of bridging the methodological and conceptual gap between the deterministic multivariate modeling of Leontief [14] and Sraffa [5], the stochastic approach of Farjoun and Machover, and the work of Cockshott et al. [13] in their analysis of a simple commodity economy.

2. Theory

In this section, a class of models is derived and given a network representation. By assuming fixed production periods and both physical and monetary balance, a pair of multivariate linear equations emerge. Their respective eigenvector solutions represent the direct labor content and price vectors for the model economy. These solutions are found to be related stochastically, i.e., the expected value of commodity price depends linearly on the commodity labor content.

2.1. The model economy as a production/exchange network

The models may be represented as production/exchange networks, as illustrated in Figs. 1–3. There are four types network nodes: firms, workers, capitalists, and exchanges (markets). Firms are of two types: those which produce consumer goods, and those which produce intermediate input (or producer) goods. The nodes are connected by directed edges which represent flows between nodes. Flows are of two types: physical and monetary. Each valid network (equivalently, each graph) represents an economy. The model assumes that:

- Each firm produces only one commodity type. The commodity types are distinct between firms.
- The workers of each firm receive the same wage per unit time, though this may vary from firm to firm. Their income is spent entirely on consumer commodities, based on their demand functions.
- The capitalists are essentially rentiers; that is, their only function is to receive income (profit) from the firm, which they spend on consumer goods, based on their demand functions.
- Both workers and capitalists have demand functions that may vary between the two classes, and also among the various firms. The demand functions are constant across production periods.
- Each firm has an intermediate input demand function that varies across firms but is constant across production periods.
- Each firm has a productivity function (physical output per unit labor time) that may vary across firms, but is fixed over production periods.
- There is only simple reproduction, i.e., the economy does not grow (or shrink) over time.
- The market is completely cleared in each production period, i.e., all goods are sold, and all income is spent on purchasing the goods that were produced in that period.
- The market is essentially rudimentary; that is goods are exchanged for money in the absence of effective competition. The market in non-competitive, in the sense that each firm produces only one commodity, and each commodity is produced by only one firm.
- The money form does not have a special relation with any commodity, e.g., gold. It serves simply as a numeraire for exchange.

To illustrate the key concepts, a very simple economy is shown in Fig. 1. This economy consists of one consumer goods and one producer goods firm. The edges (flows) are labeled, corresponding to their physical or monetary interpretation. For each firm, the physical inputs consist of labor and producer goods, and the material output consists of some magnitude of a single commodity. These specify the material flows for the firm. The monetary flows consist of income (from the sale of commodities) and expenses, which are comprised of wages, profits, and the cost of intermediate inputs. For workers and capitalists, the physical inputs are consumer commodities. For workers, their labor time is their material output. Capitalists, as rentiers, have no material output. Worker monetary flows consist of income (wages) and expenses (for consumer goods). Capitalist monetary flows consist of income (profits) and expenses (for consumer goods). The model assumes that all flows balance for each production period, i.e., income equals expenses for each node, and physical inputs equal physical outputs.

Using the network topology and the verbal description of the economy as a guide, it is possible to model the material and monetary flows as a set of linear equations, constrained to balance physical and monetary inputs and outputs at each node.