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A SHIFT FROM THE PROBLEMATIC OF “TRANSFORMATION”

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Abstract: We examine the paradigm shift from that of the transformation model to that of stochastic profit models. Some of the anomalies undermining the transformation model are given graphically. In the last two sections we present volume II of *Capital* as an alternative starting point for thinking about the relation between value and price.

Keywords: reproduction-scheme; paradigm; profit rate

1. Scientific Shifts: Kuhn and Bachelard

By studying the shifts from Ptolemaic to Keplerian astronomy, Kuhn and Bachelard gave us two related concepts: *paradigm* and *problematic* (Kuhn 1970; Bachelard 1970).¹ They referred to the structure of ideas within which a discipline operated and addressed the elements involved when this structure was fundamentally changed. Kuhn is useful for understanding the process of change and Bachelard for understanding how the very thought processes of researchers are constrained by pre-existing sets of thinkable problems that they pose.

Suppose you wanted to come up with good predictions of lunar eclipses. If you were an astronomer of the Ptolemaic school—who believed that the moon orbited the earth in accordance with an epicycle rotating on a deferent—the relevant questions were the exact radii of the deferent and the epicycle. By contrast, if you were a later astronomer from the Kepler school—who believed the moon to have an elliptical orbit—you would want to know the ratio of the major and minor axes of the ellipse. These problematics literally set you different problems to solve.

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Kuhn describes how the accumulation of anomalies in observations eventually leads to a crisis in theory. A new and simpler theory can then emerge, which avoids the original anomalies and displaces the old paradigm. The new theory poses different problems and allows previously impossible predictions. So when new anomalies arise, famously in the orbit of Uranus, they could be resolved in Newtonian terms as the effect of an unknown planet. This, being in due course observed, was labelled Neptune.

This scientific cycle has been repeated in astronomy. Anomalies in Mercury's orbit, initially attributed to a hypothetical planet Vulcan were resolved by Einstein's theory of gravitation. More recently, "dark matter" has been invoked as a Newtonian explanation to account for anomalies in the orbit of stars around galaxies. This now competes with Milgrom's modified gravitational theory (Bekenstein and Milgrom 1984).

2. Epistemological Break: Ricardo to Marx

Althusser termed the shift from one problematic to another an "epistemological break." He details the epistemological break in the work of Marx from an early Feuerbachian/young Hegelian problematic to the more mature problematic of historical materialism. This occurs not just in his philosophy but in his political economy as well. From his mature problematic, Marx is able to see problems that his predecessors overlooked or ignored. An example was Smith's conflation of embodied labour with labour commanded that Marx criticises in *Theories of Surplus Value* (Marx 1999). The most famous example is the anomaly between the law of value and the apparent equalisation of profit rates (Ricardo 1951). Aside from incidental and mutually compensating fluctuations, Marx believed that persistent differences in profitability across industries "could not exist without abolishing the entire system of capitalist production" (Marx 1971). That is, the systemic process of competition and capital reallocation would eliminate such systematic differentials, which is apparently incompatible with value theory. He claimed to have resolved this anomaly via his transformation procedure to go from values to production price. We need hardly add, in the context of this symposium, that the procedure he adopted proved controversial.

The astronomical revolution pitted geocentric versus heliocentric interpretations (Hipparchus versus Aristarchus). In the case of economic value, you have capital-centric production price theory (Marx 1971) versus labour-centric value theory (Marx 1954; Marx and Engels 1956). In the labour-centric approach, market prices orbit labour content, whereas in the capital-centric approach, market prices orbit ideal profit-equalising prices. Unlike astronomy, however, in the case of value theory the two paradigms appear in sequential works of the one author. It is as if

Ptolemy’s astronomical treatise (Ptolemy 1998) had a volume giving Aristarchus’s heliocentric account before resolving the contradiction with his own modified geocentric theory.

3. New Paradigm: Farjoun and Machover

Until the 1980s, the debate around Marx’s transformation procedure was all carried out within the problematic of *Capital* vol. III, part II. It was assumed that the *process* of profit-rate equalisation warranted studying a state of affairs in which all profit rates *are* equal to each other. This can be justified on three different grounds:

- (i) Equal profit rates constitute a stable equilibrium state of the economy;
- (ii) The actual distribution of profit rates is narrow;
- (iii) Profit rates vary independently of capital intensities.

While Ptolemy had a millennium of Babylonian astronomical observations to go on, Marx did not have comparable amounts of empirical data to assess the equalisation theory.

If *Capital* vol. III were the *Almagest* of Marxist political economy, then Farjoun and Machover’s *Laws of Chaos* would be a Copernican reversion to Aristarchus (Farjoun and Machover 2020). Their results contradicted all three arguments above and were based on insights from statistical mechanics: Large-scale systems of uncoordinated units operating under constraints settle only in configurations with a wide dispersion of micro properties. They reasoned that this applied to capitalist firms and their profit rates as well, which they corroborated with empirical data. In fact, the very mechanism that was thought to bring about equalisation—competition and capital reallocation—also creates irreducible motion of firms away from equal profit rates. These properties would contradict arguments (i) and (ii) above.

Moreover, Farjoun and Machover showed that labour content served as an attractor for random market prices among interconnected firms that need to meet their labour costs. Firms with higher capital requirements per worker would then tend to earn lower profit rates, thus contradicting (iii).

4. Accumulation of Anomalies

Actual observational data started to accumulate in the years after *Laws of Chaos* was published. While the early econometric papers studying industry prices and labour values remained within the vol. III problematic, they did show that “anomalously” profit-equalising production prices fail to provide a more accurate account than labour values (Ochoa 1989; Petrovic 1987).

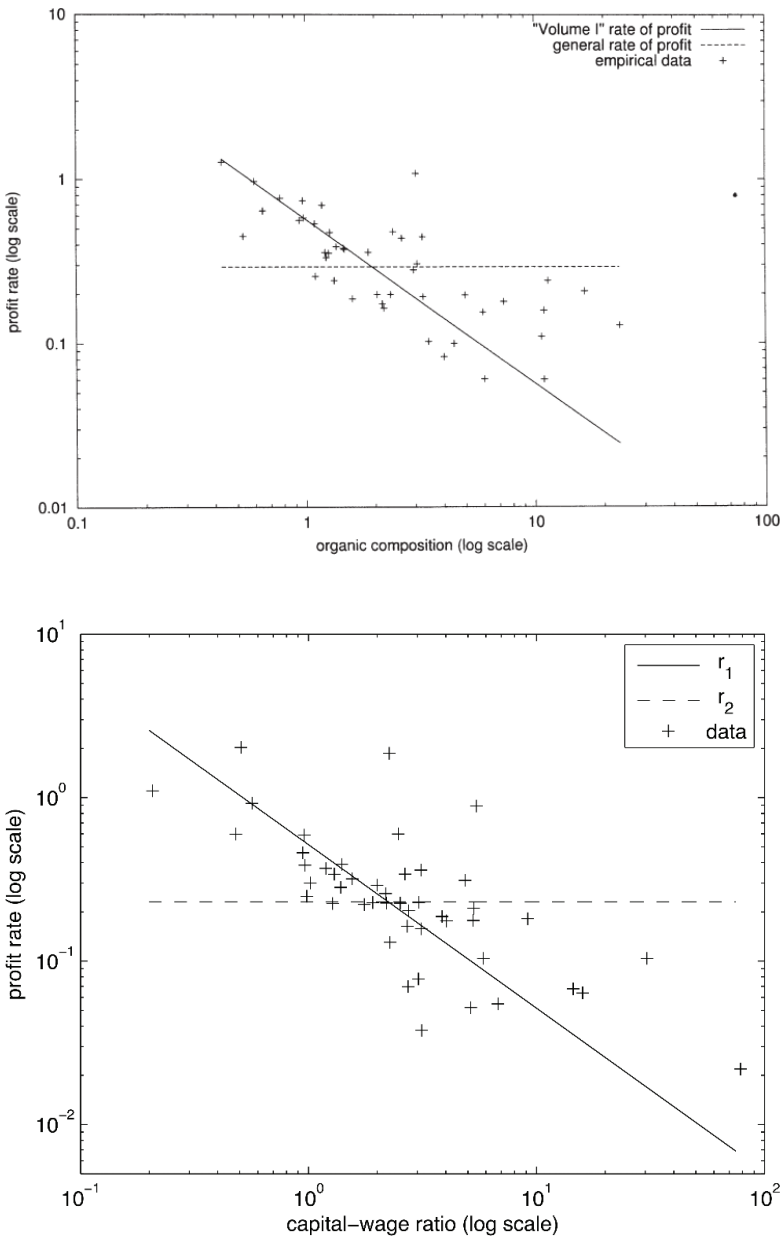


Figure 1. Relation between profit rates and capital intensity (organic composition). Top: 47 sectors of the US economy in 1987 (Cockshott and Cottrell 2003). Bottom: 47 sectors of the Swedish economy in 1995 (Zachariah 2006). Profit rates predicted by production price (dashed horizontal lines) and value theory (solid diagonal lines) (Cockshott and Cottrell 2003; Zachariah 2006).

Subsequent work showed that not only were profit rates more widely dispersed than their related variables, but they were also persistently negatively associated with capital intensity across a wide range of capitalist economies (Cockshott and Cottrell 1998, 2003; Zachariah 2006). That is, industries with higher capital requirements tend to have systematically lower profit rates; see Figure 1 for an illustration of two capitalist economies.

That this should occur is inexplicable within the vol. III problematic and any subsequent literature on transformation problem that ignores this anomalous result now lacks scientific justification. Such work should be seen as scholasticism rather than science. By contrast, the negative association between profit rates and capital intensity should only be expected within the vol. I problematic. But so ingrained has been the assumption that profit rates do equalise that economists trained in the vol. III problematic ask: what stops the profit rates from equalising?

At one level, the question is invalid since it assumes an unproven hypothesis—that equal profit rates constitute an equilibrium state—to be the norm and demands a special explanation why it does not happen. Seeking an explanation for an anomaly of a general rule is only sensible after you establish that the rule is accurate in all previous cases. The precession of the ellipse of Mercury was anomalous because it slightly exceeded that allowed for by Newton, but the Newtonian model had already established itself for all the other planets and comets. If the statistical independence of profit rates and capital intensities had in fact been empirically demonstrated to hold for many other countries, then finding merely a few contrary cases would indeed be an anomaly. But there is no such prior evidence base to back the hypothesis.

Let's nevertheless allow the question: Why do profit rates not equalise? The response of *Laws of Chaos* was that this is an unstable state in a large-scale system of uncoordinated firms and that instead the labour-centric law of value should emerge as a statistical property. This form of reasoning was unfamiliar to Marxist economists, trained in a different problematic, and therefore fell on deaf ears.

5. Profit Equalisation and Economic Reproduction

In the following section we will show that a more familiar form of argument can be marshalled based on the constraints of economic reproduction analysed in volume II of *Capital*. That is, we consider a self-reproducing multi-sector economy in state A with unequal profit rates and the basic difficulties to transition into supposedly stable state B with equalised profit rates.

5.1 Price Adjustments

We illustrate initial state A by using a monetary reproduction table in the style of vol. II. Firms are divided into three sectors corresponding to capital goods

Table 1. Economic Reproduction Table

Sector	c	v	s	Supply	s/v	$s/(c+v)$
i	£250.00	£100.00	£100.00	£450.00	100%	29%
ii _a	£100.00	£50.00	£52.50	£202.50	105%	35%
ii _b	£100.00	£52.50	£50.93	£203.43	97%	33%
Demand	£450.00	£202.50	£203.43	£855.93		

Notes: This shows necessary equalities between cells to meet vol. II reproduction conditions that supply and demand balance. Profit rates $s/(c+v)$ and rates of surplus-value s/v have a dispersion—measured as coefficient of variation—of 0.10 and 0.04, respectively. The setup mirrors the empirical fact that the profit rates exhibit a greater dispersion than rates of surplus-value. The average profit rate is 31%.

Table 2. Effect of Equalising by Ex-Fiat Price Adjustments (Nominal Step above the Middle Line)

	c	v	s	Supply	s/v	$s/(c+v)$	Adjust
i	£268.67	£100.00	£114.94	£483.61	115%	31%	+7%
ii _a	£107.47	£50.00	£49.09	£206.56	98%	31%	+2%
ii _b	£107.47	£52.50	£49.87	£209.84	95%	31%	+3%
Demand	£483.61	£202.50	£213.90	£900.02			
i	£268.67	£100.00	£114.94	£483.61	115%	31%	+7%
ii _a	£107.47	£50.00	£45.03	£202.50	90%	29%	+0%
ii _b	£107.47	£52.50	£53.93	£213.90	103%	34%	+5%
Demand	£483.61	£202.50	£213.90	£900.02			

Notes: The dispersion of profit rates is now 0, but supply and demand no longer balance. The table below the middle line shows the actual sales and price adjustment that are realisable (to match supply and demand constraints), but now profit rate dispersion is 0.08.

(i), wage goods (ii_a) and luxury goods (ii_b), see Table 1. For the sake of simplicity, we use a slight modification in that the rate of surplus-value varies across sectors.

The initial step towards state B favoured in the literature is one of instantaneous price adjustments. That is, firms spontaneously adjust their prices to be profit-equalising ones, resulting in the final column in Table 2. But this immediately fails to satisfy supply and demand constraints for reproduction, as pointed out in von Bortkiewicz (1952). In the initial period, workers were paid £202.50, which is insufficient to buy the total output of wage goods (ii_a) at its new marked-up price of £206.56. By contrast, if the capitalists spend their profit of £213.90 on luxury goods (ii_b), available at the marked-up price of £209.84, there will be excess demand. So realised sales of wage and luxury goods will have to adjust to meet demand, as seen in the lower half of Table 2. Now supply and demand balance, but profit rates are no longer equalised.

The example demonstrates that the constraints of reproduction necessitate that the process of profit-rate equalisation also adjusts quantities.

The dispersion of profit rates is now 0, but supply and demand no longer balance. The bottom half of the table shows the actual sales and price adjustments that are realisable (to match supply and demand constraints), but now profit-rate dispersion is 0.08.

5.2 Capital Flow Adjustments

The equalisation process is thought to emerge through marginal shifts of capital between sectors. That is, capital moves into more profitable sectors, expands production and drives down prices and profit rates due to over-supply.

But this will not necessarily occur. A shift of capital from more to less capital-intensive sectors will by definition increase the demand for labour power and thus for wage goods. Consider the example in Table 1, where sector *i* is the least profitable and most capital-intensive sector. Then the transfer of marginal units of capital to the more profitable sector *iia* would, in this case, raise the relative price and profitability of wage goods: the opposite of what is needed to equalise profit rates! Equalisation could then only come about in the reverse situation in which sector *i* was more profitable and was less capital intensive than sector *iia*.

Marginal flows of capital between sectors affect the overall rate of surplus-value and thus the relative demand for wage and luxury goods. A mistake of the standard profit equalisation story is the assumption that inter-sectoral capital flows only affect supply, but not demand. This leads back to the realisation that the vol. II reproduction schemes specify not only inter-sectoral supply and demand constraints, but also implicitly specify prices that balance supply and demand.

6. Labour-Centric Derivation of Value

The economic constraints embedded in the reproduction schemes of volume II enable a derivation of value from first principles (Zachariah and Cockshott 2020). We can generalise the schemes from three sectors to an economy of *m* units of production that jointly produce *d* distinct output types. This is operationalised using supply and use tables compiled by national statistics bureaus.

For a given period, the quantities of net products can be listed in vector *n*. For any given real-wage rate, we can specify matrix *R* such that vector *Rn* represents the necessary consumption of the workforce out of *n*. Suppose *vn* is the value of the net product (or value-added), where *v* is any valuation vector of choice. While we could stipulate *v* to be anything—e.g. average market prices or production prices—certain valuation vectors *v* can be determined from the above basic conditions of reproduction alone.

The value of the workers' consumption is vRn and thus the share of surplus-value is

$$\sigma = \frac{vn - vRn}{vn}.$$

Suppose we seek economic valuations for which the surplus share only changes with the real-wage rate and the structure of the economy. That is, find v such that σ is invariant to changes in n alone. It can be shown that v is uniquely determined by the conditions of production and is equivalent to social labour requirements that are quantifiable in time. In a sense, the analysis in volume II completes the labour-centric theory of value that was presented in volume I of *Capital*.

Can we also find capital-centric production price embedded in economic reproduction in a similar manner? To answer this, let $0 \leq u \leq \sigma$ denote the share of unproductive surplus consumption. Suppose we seek an alternative valuation such that the unproductive consumption share only changes with the structure of the economy. That is, find v' such that u —rather than σ —is invariant to changes in n alone. In a restricted economy where investments are constrained to ensure a balanced growth rate (Pasinetti 1979), such a v' can be found uniquely and turns out to be equivalent to production price. But this, ironically, relegates the application of production price to the domain of expanding planned economies.

Note

1. The term “problematic” became more familiar to the non-French readership through the works of Althusser, particularly Althusser (2018).

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