Structural change and financial instability: a Pasinettian analysis

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17 May 2017

Aims of the paper

- Expand the original Pasinettian model of structural change → Introduce Unemployment and Aggregate savings
- Link the role of structural change (productivity growth) to assess the role of debt

Structure of the presentation

- The original Pasinettian model of Structural Change
- The modified model
  - General representation
  - Numerical example
- Conclusion

Pasinetti's model of structural change: The pre-institutional analysis

it is my purpose […] to develop first of all a theory which remains neutral with respect to the institutional organisation of society. My preoccupation will be that of singling out, to resume Ricardo's terminology, the 'primary and natural' features of a pure production system. And these 'primary and natural' features […] will simply emerge as necessary requirements for equilibrium growth (1981, p.25).

Equilibrium is defined as a "situation in which there is full employment of the labour force and full utilisation of the existing productive capacity" (1981, pp. 48–49).

This type of investigation is

a foundational, essentialistic type. [It is] aimed at discovering basic relations, which the Classical economists called 'natural', […] at a level which is so fundamental as to allow us to investigate them independently of the rules of individual and social behaviour to be chosen in order to achieve them. (2007, p. 275)

Symbols:

- c_{i} per capital consumption coefficient of good *i*;
- l_{i} labour coefficient: quantity of labour employed in the production of one unit of final good *i*
- Q_{i} quantity produced of good *i*
- *L* total labour force
- p_i price of good *i*
- *w* wage rate

The original pure labour model (with $n-1$ productive sectors)

The quantity system

$$\begin{bmatrix} 1 & 0 & \cdots & 0 & -c_1 \\ 0 & 1 & \ddots & \vdots & -c_2 \\ \vdots & \ddots & \ddots & 0 & \vdots \\ 0 & \cdots & 0 & 1 & -c_{n-1} \\ -l_1 & -l_2 & \cdots & -l_{n-1} & 1 \end{bmatrix} \begin{bmatrix} Q_1 \\ Q_2 \\ \vdots \\ Q_{n-1} \\ L \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ \vdots \\ 0 \\ 0 \end{bmatrix}$$

The price system

$$[p_1 \quad p_2 \quad \cdots \quad p_{n-1} \quad w] \begin{bmatrix} 1 & 0 & \cdots & 0 & -c_1 \\ 0 & 1 & \ddots & \vdots & -c_2 \\ \vdots & \ddots & \ddots & 0 & \vdots \\ 0 & \cdots & 0 & 1 & -c_{n-1} \\ -l_1 & -l_2 & \cdots & -l_{n-1} & 1 \end{bmatrix} = [0 \quad 0 \quad \cdots \quad 0 \quad 0]$$

In compact terms the system of equations can be represented as

$$\begin{bmatrix} \mathbf{I} & -\mathbf{c} \\ -\mathbf{l}^{\mathrm{T}} & 1 \end{bmatrix} \begin{bmatrix} \mathbf{q} \\ L \end{bmatrix} = \begin{bmatrix} \mathbf{0} \\ 0 \end{bmatrix}$$

$$[\mathbf{p}^{\mathrm{T}} \quad w] \begin{bmatrix} \mathbf{I} & -\mathbf{c} \\ -\mathbf{l}^{\mathrm{T}} & 1 \end{bmatrix} = [\mathbf{0}^{\mathrm{T}} \quad 0]$$

For each good, quantity produced is equal to total consumption of that commodity

$$Q_i = c_i L$$

The sum of the amount of labour employed in each productive sector is equal to the total of the labour force

$$\sum_{i=1}^{n-1} l_i Q_i = L$$

The price of each good is equal to the cost of labour embodied in it

$$p_i = l_i w$$

And the wage rate is equal to total expenditure

$$\sum_{i=1}^{n-1} c_i p_i = w$$

Technical change implies a reduction in the labour coefficients and an increase real income since $\frac{pi}{l_i} = w$

The macroeconomic condition of full employment

$$\sum_{i=1}^{n-1} c_i l_i = 1$$

When this condition is fulfilled the system works in full employment…

…However, there is no reason for the economic system to be at full employment

What breaks down is the last equation [of the systems of equations]; and this […] respectively means less (or pressure for more) than full employment in the physical quantity system and less (or tendentially more) than full expenditure of national income in the price equation system. We might say that sectoral *equilibrium may continue to hold, and that this is compatible with a macro-economic situation of disequilibrium* (1993, p.23).

Modification of the Pasinetti model: savings and unemployment

If households do not spend all their income

$$\sum_{i=1}^{n-1} c_i p_i < w$$

The last equation breaks down → The system is non-homogenous → the determinant of the coefficient matrix is different from 0 → $\sum_{i=1}^{n-1} c_i l_i \neq 1$

Price system

$$[\mathbf{p}^{\mathrm{T}} \quad w]\begin{bmatrix} \mathbf{I} & -\mathbf{c}' \\ -\mathbf{l}^{\mathrm{T}} & 1 \end{bmatrix} = [\mathbf{0}^{\mathrm{T}} \quad s]$$

Quantity system

Version 1: $\begin{bmatrix} \mathbf{I} & -\mathbf{c}' \\ -\mathbf{l}^{\mathrm{T}} & 1 \end{bmatrix}\begin{bmatrix} \mathbf{q}' \\ L \end{bmatrix} = \begin{bmatrix} \mathbf{0} \\ U \end{bmatrix}$

Version 2: $\begin{bmatrix} \mathbf{I} & -\mathbf{c}' \\ -\mathbf{l}^{\mathrm{T}} & 1 \end{bmatrix}\begin{bmatrix} \mathbf{q} \\ L \end{bmatrix} = \begin{bmatrix} \mathbf{b} \\ 0 \end{bmatrix}$

From the last equation of the price systems we have savings (*s*) $-\mathbf{p}^{\mathrm{T}}\mathbf{c}' + w = s$ or $\mathbf{p}^{\mathrm{T}}\mathbf{c}' = w - s$

s can be positive or negative

From the last equation of the quantity system (first version) we have that $-\mathbf{l}^{\mathrm{T}}\mathbf{q}' + L = U$

Vector **b** represents the vector of quantity in “excess” whose elements can be positive or negative

Numerical example.
Year 0

Two identical countries (A and B) → Same (2) productive sectors, same labour coefficients ($l_1 = l_2$ =0.5), consumption coefficients ($c_1 = c_2 = 1$) and labour force ($L_A = L_b$=10).

Year 0

Country A

Year 0: Price system

$$[0.5 \quad 0.5 \quad 1]\begin{bmatrix} 1 & 0 & -1 \\ 0 & 1 & -1 \\ -0.5 & -0.5 & 1 \end{bmatrix} = [0 \quad 0 \quad 0]$$

Year 0: Quantity system.

$$\begin{bmatrix} 1 & 0 & -1 \\ 0 & 1 & -1 \\ -0.5 & -0.5 & 1 \end{bmatrix}\begin{bmatrix} 10 \\ 10 \\ 10 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

Country B

Year 0: Price system

$$[0.5 \quad 0.5 \quad 1]\begin{bmatrix} 1 & 0 & -0.1 \\ 0 & 1 & -0.1 \\ -0.5 & -0.5 & 1 \end{bmatrix} = [0 \quad 0 \quad 0]$$

Year 0: Quantity system.

$$\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ -0.5 & -0.5 & 1 \end{bmatrix}\begin{bmatrix} 10 \\ 10 \\ 10 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

Numerical example
Year 1

- Country A consumes more than what is allowed by the technical conditions of the economy ($c_i = 1.2$) → aggregate dissavings (net capital inflows). Additional consumption is satisfied through imports (quantity system)
- County B consumes less than what is allowed by the technical conditions of the economy ($c_i = 0.8$) → aggregate savings (net capital outflows). Country B exports to Country A (quantity system)
- Debts contracted in *t* must be repaid entirely in year *t +1.* Interest rate = 0.
- All goods are perishable

Pasinetti's system with aggregate savings (dissavings) – Year 1

<u>Country A</u>

Year 1: Price system

$$[0.5 \quad 0.5 \quad 1]\begin{bmatrix} 1 & 0 & -1.2 \\ 0 & 1 & -1.2 \\ -0.5 & -0.5 & 1 \end{bmatrix} = [0 \quad 0 \quad -0.2]$$

Year 1: Quantity system.

$$\begin{bmatrix} 1 & 0 & -1.2 \\ 0 & 1 & -1.2 \\ -0.5 & -0.5 & 1 \end{bmatrix}\begin{bmatrix} 10 \\ 10 \\ 10 \end{bmatrix} = \begin{bmatrix} -2 \\ -2 \\ 0 \end{bmatrix}$$

<u>Country B</u>

Year 1: Price system

$$[0.5 \quad 0.5 \quad 1]\begin{bmatrix} 1 & 0 & -0.8 \\ 0 & 1 & -0.8 \\ -0.5 & -0.5 & 1 \end{bmatrix} = [0 \quad 0 \quad +0.2]$$

Year 1: Quantity system.

$$\begin{bmatrix} 1 & 0 & -0.8 \\ 0 & 1 & -0.8 \\ -0.5 & -0.5 & 1 \end{bmatrix}\begin{bmatrix} 10 \\ 10 \\ 10 \end{bmatrix} = \begin{bmatrix} +2 \\ +2 \\ 0 \end{bmatrix}$$

3 Scenarios		Technical change
1	Country A repays outstanding debt entirely in year 2	No
2	Country A continues to consume above what allowed by the technology (roll-over debts)	No
3	Country A records an increase in productivity in year 2.	Only in country A

Outcome

Scenario 1
Country A saves in order to repay its debt. Consumption decreases

Scenario 2
Country A continues to consume above what is allowed by the technology. Gross flows continue to increase

Scenario 3

In year 2, Country A records an increase in productivity of 50% in both sectors. The labour coefficients (l_i) decrease from 0.5 to 0.33. → Productivity changes allow real income to increase in Country A.

If the macroeconomic conditions of full employment held the price and quantity systems in country A would be

Price system

$$[0.33 \quad 0.33 \quad 1]\begin{bmatrix} 1 & 0 & -1.5 \\ 0 & 1 & -1.5 \\ -0.33 & -0.33 & 1 \end{bmatrix} = [0 \quad 0 \quad 0]$$

Quantity system

$$\begin{bmatrix} 1 & 0 & -1.5 \\ 0 & 1 & -1.5 \\ -0.33 & -0.33 & 1 \end{bmatrix}\begin{bmatrix} 15 \\ 15 \\ 10 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

Scenario 3. Technical change in Country A – Year 2

<u>Country A</u>

Year 2: Price system.

$$[0.33 \quad 0.33 \quad 1]\begin{bmatrix} 1 & 0 & -1.3 \\ 0 & 1 & -1.3 \\ -0.33 & -0.33 & 1 \end{bmatrix} = [0 \quad 0 \quad 0.13]$$

Year 2: Quantity system.

$$\begin{bmatrix} 1 & 0 & -1.3 \\ 0 & 1 & -1.3 \\ -0.33 & -0.33 & 1 \end{bmatrix}\begin{bmatrix} 15 \\ 15 \\ 10 \end{bmatrix} = \begin{bmatrix} 2 \\ 2 \\ 0 \end{bmatrix}$$

<u>Country B</u>

Year 2: Price system.

$$[0.5 \quad 0.5 \quad 1]\begin{bmatrix} 1 & 0 & -1.2 \\ 0 & 1 & -1.2 \\ -0.5 & -0.5 & 1 \end{bmatrix} = [0 \quad 0 \quad -0.2]$$

Year 2: Quantity system.

$$\begin{bmatrix} 1 & 0 & -1.2 \\ 0 & 1 & -1.2 \\ -0.5 & -0.5 & 1 \end{bmatrix}\begin{bmatrix} 10 \\ 10 \\ 10 \end{bmatrix} = \begin{bmatrix} -2 \\ -2 \\ 0 \end{bmatrix}$$

- In year 2 Country A has to repay its debt → It needs to save part of its income
- County A increases its consumption thanks to technical change, although below what allowed by the new technical conditions (because it has to repay outstanding debt)
- Country A now exports to country B
- Country A is able to repay entirely the debt in year 2 without reducing its consumption (differently from the other scenarios). → Technical change increase the capacity of facing debt repayment

Scenario	Technical change	Consumption	Debt
1	No	Decrease	Extinguished
2	No	Unchanged	Refinanced
3	In country A	Increase	Extinguished

Conclusions

- Unemployment and savings have been introduced into a Pasinettian pure labour model of structural change
- Changes in productivity have impact on income and influence debt repayment

Limitations of the current analysis and future steps

- From a pure labour economy to a capitalist one
- Interest rates
- Introduce different rates of technical change (within countries and sectors), non transferable technical knowledge and combine them with different consumption patterns