A *New Developmentalist* model of structural change, economic growth and middle-income traps

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Motivation

- Immediate *vs* deep determinants of economic development
  - Physical and human capital, natural resources, scientific knowledge
  - Geography, institutions
- *Brazilian New Developmentalist School* $\Rightarrow$ Macroeconomic policy regime
  - Notably among middle-income countries
- Chronic real exchange rate overvaluation in Brazil and Argentina
  - Dutch disease + Growth strategy based on external savings

The model

- Factor uses and investment rates are "dynamic" while the real exchange rate is the policy control variable
- Seven blocks of equations

  1. Supply conditions
  2. Effective demand
  3. Technical progress
  4. Structural change
  5. Price setting
  6. Distributive conflict
  7. Real exchange rate

Supply conditions

$$pY = \min\left\{\frac{upK}{\vartheta}, eNpy\right\} \tag{1}$$

$$pY = \frac{upK}{\vartheta} = eNpy \tag{2}$$

$$\frac{\dot{e}}{e} = \frac{\dot{Y}}{Y} - \frac{\dot{y}}{y} - n \tag{3}$$

$$\frac{\dot{u}}{u} = \frac{\dot{Y}}{Y} - \frac{\dot{K}}{K} \tag{4}$$

where output, Y, results from a combination of capital, K, and labor, N; capacity utilization, u; ϑ stands as the optimal capital-output ratio; e is the participation rate; y is labour productivity; p stands as the price index.

Supply conditions

- $\dot{e}/e = 0$, results from output growing at the same rate as the natural rate
- $\dot{u}/u = 0$, requires that capital accumulation follows the rate of growth of output

$$I = \dot{K} \tag{5}$$

$$\frac{\dot{K}}{K} = \frac{hu}{\vartheta} \tag{6}$$

h is the marginal propensity to invest, being equal to investment, I, over output.

Effective demand

$$pY = pC + pI + pG + pX - p^f M \tag{7}$$

$$\begin{aligned} pC &= cpY \\ pI &= hpY \\ pG &= gpY \\ pM &= mpY \end{aligned} \tag{8}$$

where consumption, C; government expenditures, G; X stand as exports, M corresponds to imports, and p^f is the foreign price aggregate index.

Effective demand

$$Y = \sigma X \tag{9}$$

$$\frac{\dot{Y}}{Y} = \frac{\dot{X}}{X} + \frac{\dot{h}}{s + qm - h} \tag{10}$$

$$\frac{\dot{h}}{h} = \mu \left(u - u_n \right) \tag{11}$$

where $\mu > 0$ is a parameter that captures the response of the marginal propensity to invest to deviations of capacity utilization from its normal level, u_n.

Technical progress

$$\frac{\dot{y}}{y} = \alpha_0 + \alpha_1 \gamma \left(\frac{\dot{K}}{K} - \frac{\dot{L}}{L} \right) + \alpha_2 e \tag{12}$$

Assuming

$$\dot{y}/y \approx \dot{K}/K - \dot{L}/L$$

it follows,

$$\frac{\dot{y}}{y} = \frac{\alpha_0 + \alpha_2 e}{1 - \alpha_1 \gamma} \tag{13}$$

where α_0 is an arbitrary constant, $\alpha_1 > 0$ captures productivityt's response to capital accumulation; α_2 stands as the labour market effect on productivity; γ is the manufacturing share on real output.

Structural change

$$\frac{\dot{\gamma}}{\gamma} = \beta_0 + \beta_1 q - \beta_2 Gap \tag{14}$$

$$q^I = \frac{\beta_2 Gap - \beta_0}{\beta_1} \tag{15}$$

$$\frac{\dot{\gamma}}{\gamma} = \beta_1 \left(q - q^I \right) \tag{16}$$

$$\frac{\dot{X}}{X} = x_0 + x_1 \gamma \tag{17}$$

where *Gap* stands as the technology gap, $\beta_0 < 0$ captures "mature deindustrialization"; β_1 stands as manufacturing response to the exchange rate, β_2 corresponds to the sensitivity of the productive structure to the gap; x_0 captures exogenous determinants of exports, and x_1 corresponds to exports' sensitiveness to the manufacturing share.

Price setting

$$pY = wL + rpK \tag{18}$$

$$p = (1+z)\,\frac{w}{y} \tag{19}$$

$$z = \xi_0 + \xi_1 q \tag{20}$$

$$\begin{aligned} \varpi &= \frac{1}{1+z} \\ &= \frac{1}{1+\xi_0+\xi_1 q} \end{aligned} \tag{21}$$

where w stands as the nominal wage and r is the profit-rate; z is the mark-up rate; ϖ is the wage-share; ξ_0 and ξ_1 are exogenous parameters.

Price setting

Define the mark-up and the wage-share resulting from a real exchange rate equal to its industrial equilibrium level:

$$z^I = \xi_0 + \xi_1 q^I$$

$$\varpi^I = \frac{1}{(1 + \xi_0 + \xi_1 q^I)}$$

We can write:

$$\varpi - \varpi^I = \frac{\xi_1}{(1+z)(1+z^I)}\left(q^I - q\right) \tag{22}$$

Distributive conflict and inflation

$$\pi = \frac{\dot{w}}{w} - \frac{\dot{y}}{y} \tag{23}$$

$$\frac{\dot{w}}{w} = \varepsilon_1 \pi^e + \varepsilon_2 \left(\bar{\varpi} - \varpi\right) + \left(1 - \varepsilon_1 - \varepsilon_2\right) e \tag{24}$$

where the target wage share, $\bar{\varpi}$; π^e is expected inflation while parameters ε_1 and ε_2 are such that $\varepsilon_1 + \varepsilon_2 < 1$.

Distributive conflict and inflation

$$\pi = \varepsilon_1 \pi^e + \varepsilon_2 \left(\bar{\varpi} - \frac{1}{1 + \xi_0 + \xi_1 q} \right) + (1 - \varepsilon_1 - \varepsilon_2)\, e - \left(\frac{\alpha_0 + \alpha_2 e}{1 - \alpha_1 \gamma} \right) \tag{25}$$

Suppose the Central Bank has an inflation target, $\bar{\pi}$. The level of the real exchange rate compatible with such a rate of inflation is given by

$$\bar{q} = \frac{1}{\bar{\varpi} - \frac{1}{\varepsilon_2} \left[(1 - \varepsilon_1)\, \bar{\pi} - (1 - \varepsilon_1 - \varepsilon_2)\, e + \left(\frac{\alpha_0 + \alpha_2 e}{1 - \alpha_1 \gamma} \right) \right]} - 1 \tag{26}$$

Exchange rate

$$d = \phi_0 - \phi_1 q \tag{27}$$

A Dutch disease occurs when $q^I > q^{CAB}$:

$$q^{CAB} = \frac{\phi_0}{\phi_1} \tag{28}$$

where ϕ_0 captures all variables that determine the current account deficit besides the exchange rate, and $\phi_1 > 0$ stands as the response of d to changes in q.

Exchange rate

- We know from, from Eq. (26), that $\bar{\pi}$ implies $\bar{q}$
- Using Eq. (27), we have that not only $\bar{d}$ is determined but that the exchange rate compatible with such a policy can be rewritten as:

$$\bar{q} = q^{CAB} - \frac{\bar{d}}{\phi_1} \tag{29}$$

Exchange rate

$$ca = \psi\left(i - i^f - \rho\right) \tag{30}$$

The interest rate compatible with the current account target, $ca = \bar{d}$, is given by:

$$i = i^f + \rho + \frac{\bar{d}}{\psi} \tag{31}$$

$$\bar{q} - q^I = \underbrace{\left(q^{CAB} - q^I\right)}_{\text{Dutch disease}} - \underbrace{\left(q^{CAB} - \bar{q}\right)}_{\text{External savings strategy}} \tag{32}$$

where i is the level of the domestic interest rate, i^f is the international interest rate, ρ is the country-risk premium, and ψ is a sensitivity parameter.

Dynamic system

$$\begin{aligned}
\frac{\dot{e}}{e} &= x_0 + x_1\gamma + \frac{h\mu\left(u - u_n\right)}{s + qm - h} - \left(\frac{\alpha_0 + \alpha_2 e}{1 - \alpha_1\gamma}\right) - n = j_1\left(e, u, h\right) \\
\frac{\dot{u}}{u} &= x_0 + x_1\gamma + \frac{h\mu\left(u - u_n\right)}{s + qm - h} - \frac{hu}{\vartheta} = j_2\left(u, h\right) \\
\frac{\dot{h}}{h} &= \mu\left(u - u_n\right) = j_3\left(u\right)
\end{aligned} \tag{33}$$

Equilibrium conditions:

$$x_0 + x_1\gamma = \frac{\alpha_0 + \alpha_2 e}{1 - \alpha_1\gamma} + n$$

$$x_0 + x_1\gamma = \frac{hu}{\vartheta}$$

$$u = u_n$$

Two dynamic systems

- $q = q^l$

$$
\begin{aligned}
\frac{\dot{e}}{e} &= x_0 + x_1\gamma + \frac{h\mu\left(u - u_n\right)}{s + q^l m - h} - \left(\frac{\alpha_0 + \alpha_2 e}{1 - \alpha_1 \gamma}\right) - n \\
\frac{\dot{u}}{u} &= x_0 + x_1\gamma + \frac{h\mu\left(u - u_n\right)}{s + q^l m - h} - \frac{hu}{\vartheta} \\
\frac{\dot{h}}{h} &= \mu\left(u - u_n\right)
\end{aligned}
\tag{34}
$$

- $q = \bar{q}$

$$
\begin{aligned}
\frac{\dot{e}}{e} &= x_0 + \frac{h\mu\left(u - u_n\right)}{s + \bar{q}m - h} - \alpha_0 - \alpha_2 e - n \\
\frac{\dot{u}}{u} &= x_0 + \frac{h\mu\left(u - u_n\right)}{s + \bar{q}m - h} - \frac{hu}{\vartheta} \\
\frac{\dot{h}}{h} &= \mu\left(u - u_n\right)
\end{aligned}
\tag{35}
$$

Existence of equilibria

Proposition

When $q = q^I$, the dynamic system (34) has as a unique internal equilibrium point $E^I = \left(e^I, u^I, h^I\right)$ that is defined and given by:

$$e^I = \frac{(1-\alpha_1\gamma)(x_0 + x_1\gamma - n) - \alpha_0}{\alpha_2}$$

$$u^I = u_n$$

$$h^I = \frac{\vartheta(x_0 + x_1\gamma)}{u_n}$$

Existence of equilibria

Proposition

On the other hand, when $q = \bar{q}$, the dynamic system (35) admits a unique equilibrium solution $\bar{E} = (\bar{e}, \bar{u}, \bar{h})$ such that:

$$\bar{e} = \frac{x_0 - \alpha_0 - n}{\alpha_2}$$

$$\bar{u} = u_n$$

$$\bar{h} = \frac{\vartheta x_0}{u_n}$$

Numerical example

Reference values are:

$$x_0 = 0.015,\ x_1 = 0.1,\ \mu = 0.01,\ u_n = 0.7,$$
$$s = 0.2,\ m = 0.2,\ \alpha_0 = -0.019,\ \alpha_1 = 3,$$
$$\alpha_2 = 0.05,\ n = 0.01,\ \vartheta = 4.666$$

while

$$q^I = 3,\ \bar{q} = 2.75$$

Numerical example

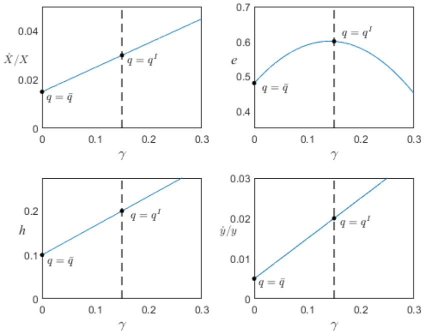

Figure: The manufacturing share in output determines the rate of growth of exports, the participation rate, the propensity to invest and the rate of growth of productivity. Adopting $q = q^I$ instead of $q = \bar{q}$ potentially leads to a Pareto superior equilibrium point.

Local stability

Proposition

In the neighbourhood of the internal equilibrium points E^I and $\bar{E}$, the dynamic systems (34) and (35) are locally asymptotically stable provided that:

$$\vartheta\sigma\mu < 1$$

Numerical example

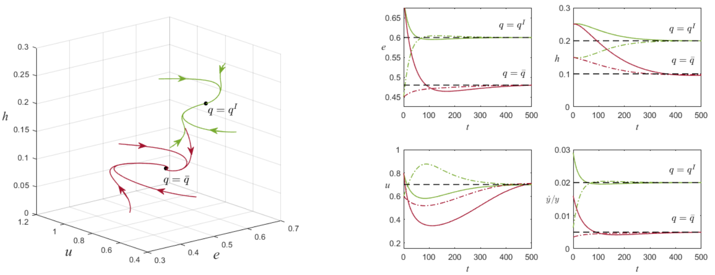

Figure: Convergence to the unique equilibrium solution when $q = q^I$, in green, and $q = \bar{q}$, in red, for different initial conditions. While capacity utilization in both cases is equal to the normal rate, the participation rate, the marginal propensity to invest and the rate of growth of labor productivity are higher under the developmentalist growth regime.

Final considerations

- Synthesis between classical development and demand-led growth theories
  - Exports are the engine of long-term growth
  - Real exchange rate
- *Brazilian New Developmentalist School* $\Rightarrow$ Macroeconomic policy regime
  - Middle-income trap might be the result of adopting an external savings growth strategy + Dutch disease
- The political economy problem to get out of such a trap