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GREEN STRUCTURAL CHANGE AND FISCAL POLICY SPACE IN A BALANCE-OF-PAYMENTS CONSTRAINT FRAMEWORK

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Introduction

The escalating climate emergency and the intensification of the global sustainability agenda have introduced a new dimension to the research agenda on economic growth. The transition to a low-carbon economy imposes a limit on an ecological growth structure characterized by the intensive extraction of natural resources, a fact that is especially important for peripheral economies. In such circumstances, a dilemma concerning the transition towards a green economy is evident for such economies: they are required to pursue green structural change whilst simultaneously addressing international financial asymmetries and constrained monetary and fiscal policy space (Valdecantos, 2025).

Our main purpose is to construct a non-linear recursive and interactive simulation model analogous to those employed by Souza & Amorim (2024) and Barbosa-Filho (2026). The aim of this is to elucidate the constraints on fiscal policy in the context of fiscal autonomous demand, as proposed by Blecker

(2013) and Porcile & Spinola (2018). In this sense, the present research agenda is enriched by the addition of a composition of parametric interactions that establishes fiscal space for a developing economy.

The Model

The Thirlwall & Hussain (1982) equilibrium equation is employed to model the long-run balance of payments constraint:

$$y_{bpt}=(E_t/R_t\ e_t(z_t)+C_t/R_t\ (c_t-p_{dt}))/p_t \quad (1)$$

Where y_{bpt} is the income growth rate of balance-of-payments equilibrium, e_t is the income elasticity of exports demand, z_t is the income growth rate of the rest of the world, c_t is the growth rate of capital inflows and p_{dt} is the growth rate of prices of the domestic production concentrated on natural resources, p_t is the income elasticity of imports demand, E_t/R_t and C_t/R_t are the shares of exports and capital inflows in the total external revenues ($R_t=E_t+C_t$).

The model is divided into three distinct sets of equations, each of which is designed to define a specific aspect of the model. The factors to be considered are as follows: firstly, green structural change; secondly, capital inflow and financial international asymmetries; and thirdly, fiscal policy space. The three primary components of the system are characterized by the presence of internal non-linearities, interactive and recursive effects with each other.

Green Structural Change

The initial set of equations is defined by a system of interactions between the growth rate of the balance of payments equilibrium and the domestic demand growth rate, with technological development driven by green research and development:

$$e_t=?e_t^G+(1-?)e_t^T \quad (2)$$

$$p_t=(1-?)p_t^G+?p_t^T \quad (3)$$

$$?=?_{max}/(1+??_1\ e?^(-?_2\ (?r\&d?_{Gt}))) \quad (4)$$

?_min=lim-(RDGY?0) ?_max/(1+??_1 e?^(-?_2 (?r&d?_Gt)))=?_max/(1+?_1) (4.1)

?=?_max/(1+??_1 e?^(-?_2 (?r&d?_Gt))) (5)

?_min=lim-(RDGY?0) ?_max/(1+??_1 e?^(-?_2 (?r&d?_Gt)))=?_max/(1+?_1) (5.1)

Where e_t^G and p_t^G are the income elasticity of exports and imports of more technological green goods, e_t^T and p_t^T are the income elasticity of exports and imports of less technological natural resources goods, ? and ? are the proportions of exports of green goods and imports of traditional goods, and the oscillate between ?_max and ?_min and ?_max and ?_min according the growth rate of green research and development (?r&d?_Gt). The parameters ?_1 and ?_1 stablishes a minimal exports share of green goods and minimal import share of traditional goods, and ?_2 and ?_2 stablishes the size of the spillover effects of green research and development over exports and imports of green goods. In this sense, green structural change depends on green research and development and the insensitivity of the spillover effects.

The growth rate of green research and development is defined by:

?r&d?_Gt=ß_2 y_(et-1)+ß_3 ?fdi?_(t-1)+ß_4 a_(t-1) (6)

Where y_et is the effetctive income growth rate, ?fdi?_t is the growth rate of foreign direct investment, a_t is the growth rate of autonomous fiscal demand, and ß_2, ß_3 and ß_4 are the Kaldor-Verdoorn effect, the international technology spillover effect and the crowding in (ß_4>0) or crowding out (ß_4<0) effect. Effective income growth (y_et) is defined by:

y_et=min-?(y_bpt;y_dt) (7)

y_dt=ß_0+ß_1 ((?Y_(et-1))/K_(t-1) -i_(t-1)^*·(1-d_0) ?OSIN?_(t-1)-i_(t-1) (1-d_0) ?InDebt?_(t-1)/Y_(t-1))+a_t (8)

Where, y_dt is the domestic income growth, ??Y?_et/K_t is the profit rate per capital ratio, ?OSIN?_t is the external indebtedness per income ratio, or original sin index, ?InDebt?_t/Y_t is the private internal indebtedness per income ratio, i_t^* is the international interest rate, i_t is the domestic interest rate, a_t is the growth rate of fiscal expenditures, d_0 is the share of public debt on total debt, ß_0 is the “animal spirts” and ß_1 the effect of private profits on income growth.

Capital Inflows

Capital inflows are divided between portfolio inflows (?port?_t) and foreign direct investments inflows (?fdi?_t):

?port?_t=a_1 (g_(it-1)-g_(it-1)^*-?embi?_(t-1)) (9)

?fdi?_t=a_2 y_(et-1)+a_3 ?r&d?_(Gt-1)-a_4 ?embi?_(t-1) (10)

Where, g_it and g_it^* are the growth rates of domestic and international interest rates, ?embi?_t is the growth rate of country-risk, a_1 is the level of financial openness of this economy, a_2, a_3 and a_4 are gravitational elasticities. The aggregative stock variables are closed by a system of accounting identities:

?OSIN?_t=(?ExDebt?_(t-1)-?Res?_(t-1))/(?Ye?_(t-1)/?EX?_(t-1)) (11)

?ExDebt?_t-?Res?_t=(1+μ_1 i_(t-1)^*)(?ExDebt?_(t-1)-?Res?_(t-1))+s?PORT?_t (12)

?InDebt?_t=(1+μ_2 i_(t-1)) ?InDebt?_(t-1)+(1-s) ?PORT?_t (13)

Where ?ExDebt?_(t-1)-?Res?_(t-1) is the total net external liabilities, ?InDebt?_t is the total internal liabilities, ?EX?_t is the exchange rate level, μ_1 and μ_2 are the interest payment on external and internal liabilities that is renewed as additional debt, and s is the share of portfolio inflows that become external liability acquisition. The net capital inflows are defined by an accounting result:

C_t=?PORT?_t+?FDI?_t-(1-μ_1) i_(t-1)^* (?ExDebt?_(t-1)-?Res?_(t-1)) ?EX?_t-(1-μ_2) i_(t-1) ?InDebt?_(t-1) (14)

c_t=(dlnC_t)/dt (14.1)

The growth rate of natural resources prices is defined by the growth rate of international interest rate:

p_dt=-?g_it^* (15)

Where ? is the size of the financialization of commodities.

2.3 Fiscal policy space

The growth rate of fiscal expenditure is defined by an adjustment differentiation to make y_dt converge to y_bpt at a constant rate defined by ?_1:

da/dt=?_1 (y_(bpt-1)-y_(dt-1)) (16)

Public debt is defined by:

?PDebt?_t=d_0 (?ExDebt?_t-?Res?_t·?EX?_t+?InDebt?_t) (17)

?dd?_0/dt=d_1 (2a_(t-1)-y_(dt-1)) (17.1)

?pdebt?_t=(dln?PDebt?_t)/dt (17.2)

When fiscal expenditure expansion is higher than private demand expansion (a_(t-1)>y_(dt-1)-a_(t-1)), the share of public debt on total liabilities (d_0) increases at a constant rate d_1. Public debt increase affects the country-risk index:

?embi?_t=f_0+f_1 ?pdebt?_(t-1)-f_2 (e_(t-1)-p_(t-1))+f_3 g_(n-1) (18)

Where, ?pdebt?_t is the growth rate of public debt, g_n is the growth rate of carbon emissions, f_0, f_1, f_2, f_3 represents the exogenous perception of risk of international investors, the effects of public debt increase on country-risk index, the effect of structural change on country-risk index and the financial risks perception associated with climate change.

Carbon emissions react to income growth and technological change:

g_n=t_1 y_et-t_2 ?r&d?_Gt (19)

Where, t_1 and t_2 are the correlation indicators associated with income growth and green research and development growth and the growth rate of carbon emissions.

Preliminary Conclusions

The steady-state simulations (g_it=g_it^*=0) in the absence of monetary rule demonstrate that structural change is contingent on the spillover effect of

green research and development (?_2 and ?_2). The absence of a monetary rule in a scenario with no structural change further indicates that an initial fiscal contraction is insufficient to forestall an increase in the country-risk index, which ultimately results in capital outflows in the long run.

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Palavras-chave: green strucutural change; fiscal space; balance-of-payments constraint.