UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

Technical and statistical report

Enhancing policy options for countries to finance their development goals sustainably

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Abstract

UN Trade and Development (UNCTAD) developed the first version (Mark I) of the Sustainable Development Finance Assessment (SDFA) Framework as a tool for policymakers to assess their country's development finance needs to achieve the most relevant sustainable development goals (SDGs 1 to 4) while simultaneously ensuring the sustainability of their external and public sector financial positions. This report extends this framework to also consider SDG 13 — climate action —and climate aspects of other SDGs in an SDFA Framework Mark II.

The UNCTAD SDFA Framework proceeds from a demand-led growth regime in which the balance of payments acts as the most important economic constraint to growth and development. Developing countries are likely to have a greater external constraint on growth than developed countries because of their position within the global economy, which is typically characterised by recurring trade deficits that arise from their productive-technological backwardness and subordinated international monetary-financial position. Consequently, developing countries are often in a position in which they cannot finance their balance of payment deficits in domestic currency, making the availability of foreign exchange a binding constraint.

The SDFA Framework Mark I comprises three main components: a) an assessment of external financial sustainability that considers the cost of servicing a country's net external liabilities and the growth in its capacity to generate foreign currency; b) an assessment of public sector financial sustainability that reflects the relationship between changes in public sector net liabilities and the capacity to service them; and c) an integrated financial sustainability assessment that incorporates a balance of payments-constrained economic growth model capturing the interaction between external and public sector sustainability.

The Mark II version developed in this report further incorporates an input-output construct that transforms it into a multisectoral model, allowing for the simulation of possible scenarios for a country's zero-carbon transition. It accommodates shifts in the production structure of the economy towards greener economic activities alongside investments in climate adaptation. It allows users to analyze the interactions between spending on climate mitigation and adaptation (referred to as Climate Action Policies or CAP), the production structure of the economy, the different sources of financing, and external and public sector financial sustainability. This enables developing countries to assess different policy options to ensure that they can finance their climate-related goals sustainably.

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1. Introduction

UNCTAD has developed the Sustainable Development Finance Assessment (SDFA) Framework as a tool for policymakers[1] to assess their country's development finance needs to accomplish the most relevant SDGs[2] while simultaneously ensuring the sustainability of the external and public sector financial positions (UNCTAD, 2022). This report extends this framework to additionally consider SDG 13 – Climate action – and the climate-related aspects of other SDGs.

The UNCTAD SDFA framework proceeds from a demand-led growth regime in which the balance of payments (BoP) is the most important economic constraint to growth and development. This is especially important as developing countries are likely to have a greater external constraint on growth than developed countries because of their position within the global economy (Prebisch and Cabañas, 1949), which is usually characterised by recurring trade deficits reflecting productive-technological backwardness (Porcile et al., 2021) and the non-issuance of international currencies, reflecting their global monetary-financial position (Fritz et al., 2018). As a consequence, developing countries are often in a position in which they cannot finance their balance of payment deficits in domestic currency, making the availability of foreign currency a constraint on economic growth.

Climate change reinforces the constraints on economic growth in developing countries. In addition to being the most affected by climate change-related natural disasters (IPCC, 2023), developing economies are more fragile as they are typically more dependent on brown[3] sectors and lack the financial and technological capacities to develop green industries (UNCTAD, 2021). Moreover, developing countries are less economically diversified and less competitive in high-tech sectors as they lack the necessary technological and productive capabilities (Hidalgo and Hausmann, 2009; Hausmann and Hidalgo, 2010). Recent studies have shown that there is a correlation between emissions and productive sophistication, indicating that sectors and products with higher technological content are generally greener and emit less carbon (Boleti et al., 2021; Romero and Gramkow, 2021; Avenyo and Tregenna, 2022).

These structural weaknesses mean that as developing countries seek to promote structural transformation of the economy[4] towards greener activities, more imported technology, capital goods, and intermediate inputs are required, placing further pressure on the balance of payments (Magacho et al., 2023). In addition, developing countries dependent on domestic and dollar

1 The beneficiary countries are: Belize, Cabo Verde, Union of the Comoros and Saint Vincent and the Grenadines

2 In the current version, the first four SDGs are: 1) no poverty; 2) no hunger; 3) good access to health services and; 4) access to quality education

3 Industries or economic activities that are heavily reliant on fossil fuels and other environmentally damaging practices.

4 Since the Paris Agreement, which urges all countries for an effort to transform how economies are currently structured, many countries are adopting policies and promoting technological changes to advance a transition to a carbon-neutral economy. This transition to carbon neutrality can be considered a specific type of structural change in which one observes, on the one hand, an increase in the importance of low-emission sectors while there is a reduction in the importance of high-emission sectors (Semieniuk et al., 2021; Magacho et al., 2023; Moreno et al., 2023), and, on the other hand, a transversal search to reduce the emission per value added of all sectors – mainly throughout the adoption of technology and greener sources of energy and materials.

revenues from emissions-intensive sectors may experience reduced export earnings due to lower prices and demand (Savona and Ciarli, 2019; Semieniuk et al., 2021). However, all countries also need to consider the impact and cost of “doing nothing”(Godin et al., 2023). Essentially it is necessary to adapt the domestic productive structure to a new global demand scenario, in spite of associated costs (Mealy and Teytelboym, 2022).

Developing countries then are in a complex situation in which, despite their fragile external and public sector positions, they are expected to urgently increase investments to promote a structural transformation of their economies towards greener activities and net-zero emission - which will probably reinforce their vulnerabilities in the short term. However, this investment is also an opportunity to improve their structural resilience over the medium-to-long. To achieve this, climate action policies (CAP) must be aligned with a strategy of reducing the productive-technological gap (Cimoli and Porcile, 2014), increasing economic complexity and shifting towards industries with greater elasticity of demand for exports (Gouvea and Lima, 2010).

The UNCTAD SDFA Framework can assist, first, in identifying the financial needs of developing countries to promote both structural change and investments in climate adaptation to increase the resilience to natural disasters and slow onset events related to climate change; and second, in analyzing the impact of these investments on their external and public sector financial sustainability.

Based on the work of Bhering et al. (2019), Bhering (2021b), Schonerwald (2022), UNCTAD (2022), and Lockwood (2022), the UNCTAD SDFA Mark I identifies two indicators: a) an indicator of external financial sustainability, reflected in the ratio of the country’s net external liabilities and their cost-free inflows of an international reserve currency that can be used to repay these liabilities (exports and remittances); and b) an indicator of public sector financial sustainability, reflected in the ratio of public sector net liabilities to gross domestic product (GDP) - which is used as a proxy for repayment capacity. These indicators, and the interplay between them, underline a range of policy options to ensure external financial and public sector financial sustainability while simultaneously achieving the SDGs.

The UNCTAD SDFA Mark II adds climate-related SDGs to this framework. It incorporates a disaggregated production structure that allows users to investigate the impact of investments and government policies aimed at achieving the SDGs associated with climate action (i.e., investments in climate mitigation and adaptation) on the external and public sector financial sustainability of the country concerned.

2. UNCTAD SDFA Mark II: Financial sustainability of the external sector

Following Bhering (2021), the analysis starts with the basic structure of the balance of payments (BoP), which, following the IMF's Balance of Payments and International Investment Position Manual Sixth Edition (BPM6), can be described as the sum of the current account (CA), the capital account (KA) and the financial account (FA), as:

$$BoP_t = CA_t + FA_t + KA_t \tag{1}$$

Equation 1 is in foreign currency and includes changes in international reserves, which means that $BoP = 0$ in the equation above. The current account and the financial account are composed, respectively, by:

$$CA = X_t - M_t + Primary\ Income_t + Secondary\ Income_t \tag{2}$$

$$FA_t = D_t + DI_t + PI_t - \delta R_t \tag{3}$$

Where X is the sum of exports and M is the sum of imports, and the FA net inflows (inflows - outflows) are composed of: a) D = Net External Debt[5]; b) DI = Direct Investment; c) PI = Portfolio Investment; and d) R = Reserves.

[5] External debt as a liability refers to a debt that a resident borrowed from a non-resident. Debt as an asset means the opposite. In the case of developing countries that do not issue international currencies, external debt issued abroad is a liability denominated in foreign currency.

Due to the importance of remittances for several developing countries, the UNCTAD SDFA accords these flows special treatment and includes them as part of exports of goods and services. The sum of exports and remittances are called augmented exports. To facilitate this inclusion, it is necessary to separate remittance flows in the basic accounting. Bhering (2021b) considers remittances as compensation of employees in the primary income account and as personal transfers in the secondary income account. Furthermore, since the analysis deals with a free-of-cost inflow of foreign currency, only the remittance credits (inflows) in the BoP account are considered. The free-of-cost remittance inflow is represented as:

$$Gross\ Remittances = GRMT_t = Compensation\ of\ Employees_{credit} + Personal\ Transfers_{credit} \tag{4}$$

Then, the adjusted primary income (which also reflects the net income from abroad - NIFA) and the adjusted secondary income are given by:

$$Primary\ Income_{GRMT} = Primary\ Income - Compensation\ of\ Employees_{credit} = NIFA_t \tag{5}$$

$$Secondary\ Income_{GRMT} = Secondary\ Income - Personal\ Transfers_{credit} \tag{6}$$

Moreover, since a relevant share of CAP- and SDG- related investment in developing countries is financed by Official Development Assistance (ODA), it is important to characterize and decompose ODA to record it correctly in the balance of payments. ODA can be recorded in the current account, the capital account or the financial account, depending on the nature of the flows. First, most ODA such as grants and financial aid for humanitarian or development purposes that does not have to be repaid is considered unilateral transfers[6] and is recorded in the current account despite not involving any exchange of goods or services. Second, ODA related to debt relief for the recipient country and aid used to finance capital formation, such as transfers related to infrastructure projects, debt forgiveness, or large development projects, may be recorded as capital transfers. Third, when ODA is provided as concessional loans[7], these flows are recorded in the financial account and are treated similarly to other forms of debt. Thus, ODA can be decomposed as:

Thus $ODA = ODA_{grants} + ODA_{ka} + ODA_{concessional}$, and augmented exports now also include ODA_{grants} ($X_t{}^* = X_t + GRMT + ODA_{grants}$), capital account incorporates ODA_{ka} ($KA^* = KA + ODA_{ka}$), and concessional loans are included in the financial account ($FA^* = FA + ODA_{concessional}$). Assuming BoP = 0 the current account can be re-written as:

$$CA_t = X^* - M_t + NIFA_t + Secondary\ Income_{GRMT} \tag{7}$$

and the general equation for the BoP as:

$$-(X_t^* - M_t + NIFA_t + Secondary\ Income_{GRMTt}) + KA^*{}_t = D_t + DI_t + PI_t - \delta R_t + ODA_{concessional_t} \tag{8}$$

6 These transfers include donations, technical assistance, and other non-repayable support.
7 Soft loans with favorable terms, such as low interest rates below market-rates and long repayment periods.

External financial sustainability: Basic equations

Imbalances in the external account give rise to foreign liabilities and foreign assets. As explained in the introduction, the basic indicator considered for external financial sustainability is the ratio between the stock of net external liabilities (foreign liabilities minus foreign assets) and augmented export revenues, which are a flow registered in the balance of payments. If the stock of net external liabilities increases faster than the country's capacity to repay those liabilities (represented by foreign currency earnings derived from exports of goods and services and remittances), it suggests that the rate at which the country is accumulating net external liabilities is becoming relatively less sustainable.

The value of foreign liabilities and foreign assets varies over time due to both newly incurred liabilities and newly acquired assets, as well as due to changes in their respective stock valuations. This means that nominal variations in stocks are determined by net inflows and asset and liability price variations referred to as holding gains. Bhering (2021a) proposes that the following expressions measure the financial account, maintaining stock - flow consistency:

$$FA^* = \overbrace{\sum(p^{\$}_{Lit} L^{\$}_{it} - (1+\hat{p}^{\$}_{Li}) p^{\$}_{Lit-1} L^{\$}_{it-1})}^{Liability\ flows\ in\ dollars} + \overbrace{\sum(\frac{p_{Lit}}{e_t} L_{it} - (1+\frac{\hat{p}_{Li}-\hat{e}}{1+\hat{e}})\frac{p_{Lit-1}}{e_{t-1}} L_{it-1})}^{Liability\ flows\ in\ local\ currency} - \overbrace{\sum(p^{\$}_{Ait} A^{\$}_{it} - (1+\hat{p}^{\$}_{Ai}) p^{\$}_{Ait-1} A^{\$}_{it-1})}^{Asset\ flows\ in\ dollars} - \overbrace{\sum(\frac{p_{Ait}}{e_t} A_{it} - \left(1+\frac{\hat{p}_{Ai}-\hat{e}}{1+\hat{e}}\right)\frac{p_{Ait-1}}{e_{t-1}} A_{it-1})}^{Asset\ flows\ in\ local\ currency} - \overbrace{(p_{Rt}R_t - (1+\hat{p}_R)p_{Rt-1}R_{t-1})}^{Variation\ in\ Reserves} \quad (9)$$

Where A and L are, respectively, the quantities of assets and liabilities, p and $\hat{p}$ are, respectively, the current price and price inflation (or deflation), e is the nominal exchange rate defined as the ratio of local currency relative to dollars and $\hat{e}$ is the per cent change in the exchange rate. Here, $\hat{p}_r$ is the change in the value in dollars of the assets held as reserves, including changes in dollar exchange rates of other currencies held as foreign reserves and capital gains or losses in dollars on all assets held as foreign reserves, such as U.S. government bonds. Assets and liabilities with superscript \$ are denominated in dollars, while the absence of a superscript refers to assets and liabilities designated in local currency. In this equation, $i = D, DI, PI, ODA_{concessional}$.

$NIFA^*$, which represents the combination of nominal rates of return and costs of assets and liabilities plus per cent price variations, is given by:

$$NIFA^* = -\sum(\hat{p}^{\$}_{Li} + \overbrace{i^{\$}_{Li})p^{\$}_{Lit-1}L^{\$}_{it-1}}^{Cost\ of\ liabilities\ in\ dollars} - \sum(\frac{\hat{p}_{Li}-\hat{e}}{1+\hat{e}} \overbrace{+ i_{Li})\frac{p_{Lit-1}}{e_{it-1}}L_{it-1}}^{Cost\ of\ liabilities\ in\ local\ currency} + \overbrace{\sum(\hat{p}^{\$}_{Ai} + i^{\$}_{Ai})p^{\$}_{Ait-1}A^{\$}_{it-1}}^{Return\ on\ Assets\ in\ dollars} + \sum(\frac{\hat{p}_{Ai}-\hat{e}}{1+\hat{e}} \overbrace{i_{Ai})\frac{p_{Ait-1}}{e_{t-1}}A_{it-1}}^{Return\ on\ asset\ in\ local\ currency} + \sum(\hat{p}_R \overbrace{+\alpha)p_{Rt-1}R_{t-1})}^{Return\ on\ Reserves} \quad (10)$$

Where i represents nominal rates of return on assets and costs of liabilities and α is the rate of return on foreign reserves. Net external liabilities (NEL) – the negative value of the net international investment position – is the sum of all liabilities in period t minus all assets in t:

$$NEL_t = \sum p^{\$}_{Lit}L_{it}^{\$} + \sum \frac{p_{Lit}}{et} L_{it} - \sum p^{\$}_{Ait}A^{\$}_{it} - \sum \frac{p_{Ait}}{et} A_{it} - p_{Rt}R_t \quad (11)$$

Changes in net external liabilities (ΔNEL) will be the result of the adjusted trade deficit (including remittances), the net income from abroad plus any holding gains or losses ($NIFA^*$), and the adjusted secondary income and the capital accounts, as:

$$\Delta NEL = M_t - X_t^* - NIFA_t^* - Secondary\ Income_{GRMTt} - KA^*{}_t \tag{12}$$

Based on these equations, Bhering (2021b) and Schonerwald (2022) propose some indicators for analysing the external financial sustainability of countries. The first is the aforementioned indicator of net external liabilities to augmented exports. The boundary condition, in which this indicator remains constant over time, is that net external liabilities must grow as fast as augmented exports. From our general equation 12, we arrive at:

$$g_{NEL} = \frac{(1+g_m)M_{t-1} - (1+g_x^*)X_{t-1}^* - (1-g_\theta)\theta_{t-1}}{NEL_{t-1}} + \mathrm{r} \tag{13}$$

Where

$$\theta = Secondary\ Income_{GRMTt} + KA^* \tag{14}$$

And

$$r = \sum(\hat{p}_{Li}^{\$} + i_{Li}^{\$})\lambda_{Li}^{\$} + \sum(\frac{p_{Li}^{\$} - \hat{e}}{1+\hat{e}} + i_{Li})\lambda_{Li} - \sum(p_{Ai}^{\$} + i_{Ai}^{\$})\lambda_{Ai}^{\$} - \sum(\frac{\hat{p}_{Ai} - \hat{e}}{1+\hat{e}} + i_{Ai})\lambda_{Ai} - (\hat{p}_R + \alpha)\lambda_R \tag{15}$$

Where lambdas represent the weights of each component of assets and liabilities on NEL and g represents the growth rate of the respective variables; r represents the average cost of net external liabilities, including holding gains. For the stability condition (which determines our constraint), assuming given proportions, we have that $g_{NEL} = g_x*$, which yields:

$$\frac{M - X^* - \theta}{X^*} = (\frac{g_{x^*} - r}{1 + g_{x^*}})\frac{NEL}{X^*} \tag{16}$$

Equation 16 establishes two basic conditions for countries' external financial sustainability: First, in the presence of an adjusted trade deficit ($M - X^* - \theta$) the growth rate of augmented exports must be greater than the average cost of net liabilities, r. Second, for a given difference between the growth rate of augmented exports and r, the trade balance must be constant relative to augmented exports. This implies that imports must grow in line with the weighted average of augmented exports and θ. Since it is reasonable to assume that augmented exports tend to have greater importance than θ, we can assume that the long-run real constraint on growth is that $gm = gx*$.

External financial sustainability: Extended equation

As described in the introduction, government climate action is associated with a type of structural change in which green industries are stimulated relative to brown industries, leading to a transformation of the production structure of the economy. This structural change directly and indirectly impacts the balance of payments of countries, and thereby its external financial sustainability and macroeconomic exposure to external shocks (Magacho et al., 2023). To capture this type of structural shift, one must disaggregate equation 8 to take into account industry specifics, such as export orientation[8] and direct and indirect import input coefficients. Moreover, green industries may embody a greater amount of foreign technology. If this is the case, government investments in such industries may reinforce external constraints. The basic framework for understanding the mechanisms behind the impact of climate action policies (CAP) investments on external financial sustainability can be seen in Figure 1, below:

Figure 1
Mechanisms behind the impact of CAP on external financial sustainability

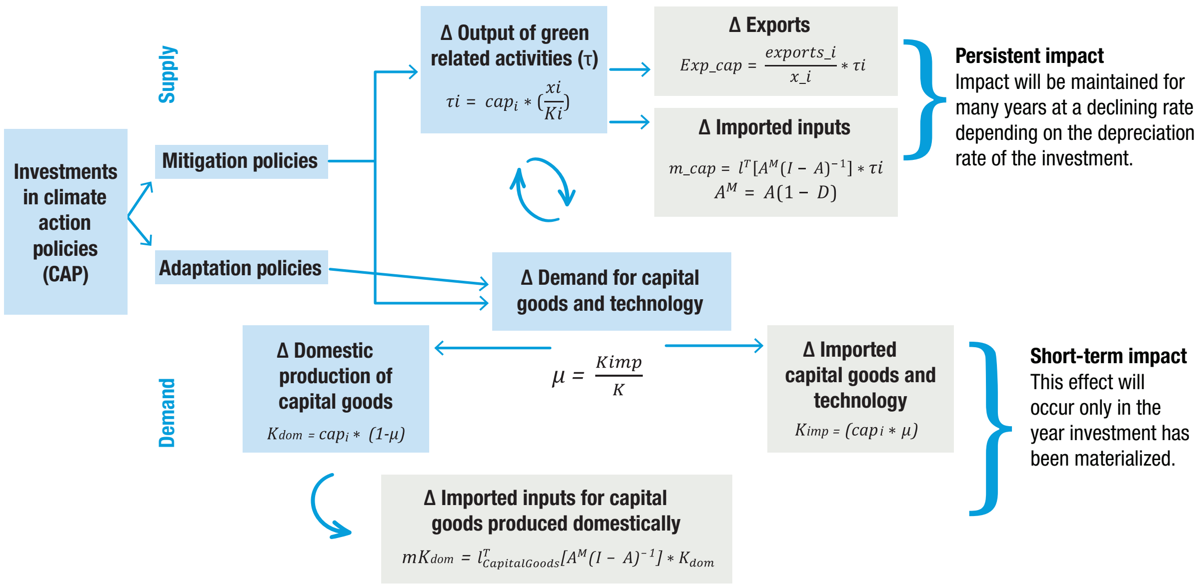


Figure 1 illustrates the mechanisms behind the relationship between investments in climate action policies and the country's external sector. Climate action policies have been divided into climate adaptation policies and climate mitigation policies since the nature of each type of policy impacts external and public sector financial sustainability differently. Climate adaptation[9] is mainly financed by the public sector and its financing institutions (Buchner et. al., 2023) and refers to adaptation solutions and actions to increase the resilience of the economy to current and future

8 The weight of exports in total output of the industry.

9 For more information and examples of climate adaptation please see the following link: https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction

climate change related-shocks[10]. On the other hand, climate mitigation policies may be financed by the private and the public sectors and are directly associated with the zero-carbon transition and, thus, with structural change of the economy. These differences are incorporated into the model by making both policies dependent on imported capital goods and technology, but only the latter has substantial implications for the production structure of the country concerned.

From the supply side, an investment in climate mitigation policies will increase the output capacity of the selected green industry based on the capital-to-output ratio. In turn, the increased capacity will raise production and part of the increased production may become exports depending on the export orientation of the industry. However, to do so, the country may also need to import inputs, depending on the industry's direct and indirect imported input coefficient. From the demand side, an increase in investment means a rise in demand for capital and intermediate goods that can be imported or produced domestically. Even in the case in which a country produces these goods domestically, an increase in imports can be observed since part of the inputs used in the production of capital and intermediate goods may be imported.

In summary, depending on the size of each relevant mechanism, CAP policies may increase or decrease external financial sustainability. The effect of each component is also different in terms of its time horizon. While variations in exports and imported inputs in production will persist as long as the expanded capacity is operational, imports of capital goods and inputs into its production will occur only in the year the investment takes place. Thus, in the short run, there will probably be an increase in a developing country's current account deficit due to its dependence on imported technology and capital goods. However, in the long run, the impact on its external financial sustainability will vary depending on how CAP investments impact net exports.

Initially, it is assumed that CAP investments are composed of both public and private investments as public investment in low-carbon transition may also stimulate private investments due to either externalities or market creation (Deleidi et al., 2020), and may come from domestic and external sources. To incorporate these dynamics in the balance of payments framework, exports and imports must first be disaggregated to account for government and private sector climate investments in specific industries and the net generation of foreign exchange by each industry.

The input-output (IO) framework, initially created by Leontief (1936), is an important tool for examining how industries are interconnected both within an economy and between different economies. Initially, IO models were constructed using data obtained from a specific region, usually a country, offering insights into the relationships between production sectors (Miller and Blair, 2009). Later, in order to account for the interdependencies of industries across different regions, multiregional IO models (MRIO) were developed (Chenery and Clark, 1953; Moses, 1955), and became particularly relevant in the context of globally integrated production systems.

[10] Climate adaptation policies and investments can increase and improve access to different technologies (such as forecasting and alarm systems), infrastructure (green and resilient infrastructure such as flood defenses), and nature-based solutions. To avoid unnecessary complexity, this model focuses on the implications for external financial sustainability of investments in the former, but it could incorporate investment in infrastructure, maintaining the intuition and results of the model analogous. In the case of infrastructure, current account implications could arise from imported machinery and inputs used in construction. Finally, nature-based solutions are less capital-intensive and would have the smallest impact in terms of the current account.

According to Miller and Blair (2009), one can derive the Multiregional Leontief matrix by considering that the total production of each industry in each country is determined by the sum of intermediate inputs and final demand (f), where intermediate inputs are calculated by multiplying the technical coefficient matrix (A) with the total production (x) column-vector.

$$x = Ax + f \tag{17}$$

Alternatively, one can write it as:

$$x = (I - A)^{-1} f \tag{18}$$

Where $L = (I - A)^{-1}$ is the Leontief matrix, which shows the direct and indirect inputs needed to produce one unit in each industry.

Industry exports per unit of production (η) are given by:

$$\eta_i = \frac{Exp_i}{x_i} \tag{19}$$

where Exp_i is the total exports of a country by an industry (i).

As argued above, climate action policies may include both public and private investments:

$$cap_i = Public\ Investment_{cap_i} + Private\ Investment_{cap_i} \tag{20}$$

Where cap is a vector composed of both public investment and induced private investment in green industries (Semieniuk and Mazzucato, 2019; Deleidi et al., 2020). Public investment is financed by domestic or external resources, which can be in the form of non-concessional (D) and concessional (CD) debt, ODA_{ka} and/or grants (ODA_{grants}). While concessional and non-concessional debt and ODA_{ka}[11] impact the external sector net liabilities, grants are a free-of-cost source of foreign revenues and therefore do not generate increases in external liabilities.

Private investment may be composed of domestic private investment (DPI) and foreign private investment (FPI)[12]:

$$Private\ Investment_{capi} = DPI_{capi} + FPI_{capi} \tag{21}$$

This investment will generate an increase in production τ, depending on the output-to-capital ratio (λ):

$$\tau_i = cap_i \lambda_1^{-1} \tag{22}$$

$$\lambda = \mathrm{K}/\mathrm{x} \tag{23}$$

Then, the extra foreign exchange generated by the exports resulting from the policy may be formalized as:

$$\mathrm{Exp}_{cap} = \eta_i \tau_i \tag{24}$$

Exp_{cap} is a column vector of total exports by industry generated by CAP policies. Current total exports become $X^*_{cap} = X^* + \mathrm{Exp}_{cap} + ODA_{grants}$

However, as stressed above, to increase production and generate extra exports, the country may need to import technology (in the process of increasing output capacity – e.g., importing machines and equipment) and inputs. Therefore, to measure the net generation of foreign exchange by each industry, it is necessary to calculate the imports of capital goods and the direct and indirect imported inputs embodied in the production of export goods.

11 For example, ODA_{ka} will affect external liabilities in the case of a debt relief.

12 FPI may be compose of all type of foreign investment, i.e., foreign direct investment (FDI) and portfolio investment in equity. Regardless of the source of investment, it adds to foreign liabilities and generates a flow in the primary income (for example, payment of dividends).

In the MRIO framework, the direct and indirect imported inputs embodied in the expanded production can be obtained as:

$$m_{cap} = [l^T [A^M (I - A)^{-1}] \tau_i \quad (25)$$

where

$$A^M = A \odot (1 - D) \quad (26)$$

m_{cap} is the row-vector of direct and indirect embodied imported inputs, l is a column vector of ones, D is a dummy matrix for within-country industry relations and zeros for trade flows (imports and exports) and $\odot$ denotes element-wise multiplication.

Besides imported inputs, to increase production capacity the industry requires capital goods, which may be sourced from either domestic production or imports. The industry weight of foreign capital (μ) can be described as:

$$m_i = \frac{K_{imp_i}}{K_i} \quad (27)$$

Thus, imported and domestic capital goods demanded by climate action policies may be formalized as:

$$k_{imp} = cap_i \, (\mu_i) \quad (28)$$

$$k_{domestic} = cap_i \, (1 - \mu) \quad (29)$$

k_{imp} is a column vector of imported capital goods by industry and $k_{domestic}$ is the column vector of capital goods produced domestically. However, to produce capital goods domestically, countries may also have to import inputs. In the MRIO framework, this can be obtained as:

$$mk_{cap} = [l^T \, [A^M (1 - A)^{-1}]] k_{domestic} \quad (30)$$

k_{cap} is a column vector of the imported inputs by industry necessary to produce capital goods domestically.

As we have shown, CAP investments would potentially impact the external account in four different ways: increasing exports (Exp_{cap}), increasing imported inputs used in production (m_{cap}), increasing the imports of capital goods (k_{imp}), and increasing the imported inputs used to produce capital goods domestically (mk_{cap}). Regarding the use of external currency, m_{cap} is associated with the operational expenditure (OPEX) of CAP and k_{imp} and mk_{cap} are associated with the capital expenditure (CAPEX) of CAP. Exp_{cap} and OPEX effects will be persistent and may be sustained for several years while CAPEX effects occur only when investment materialises. While it takes time (e.g., a year) for the increase in the output capacity generated by CAP to be translated into exports and imported inputs for production, after the output and the export capacity are developed, their effects will persist until the capacity is destroyed, up to the maturity period of the installed capacity. On the other hand, imports of capital goods and inputs necessary to produce the capital goods domestically will occur only in the year investment materialises. Appendix 1 illustrates this idea and how it affects the weight of the effect of each mechanism on external financial sustainability.

These effects and mechanisms of CAP investments are now incorporated into the proposed indicator of external financial sustainability. Assuming CAP policies are a medium-long-run plan for net zero emissions and are therefore part of an investment project spread equally over several years.

Current total imports become:

$$M_{cap} = M + \sum_i k_{imp_i} + \sum_i mk_{cap_i} + \sum_i m_{cap_i}\ ,\ M < M_{cap} \tag{31}$$

Since CAP has a persistent effect on exports and since CAP will occur each year at a constant rate, CAP investments will influence the growth rate of exports (gx), as:

$$gx_{cap} = gx^* + \lambda_{exp},\ gx < gx_{cap} \tag{32}$$

Where

$$\lambda_{exp} = \frac{Exp_{cap}}{X^*} \tag{33}$$

The total effect of CAP on external liabilities is:

$$L^{\$}_{cap_i} = L^{\$}_i + nx_{cap} \tag{34}$$

Where

$$nx_{cap} = X^*_{cap} - M_{cap} = D^{\$}{}_{cap} + CD^{\$}{}_{cap} - ODA_{ka_{cap}} + FPI \tag{35}$$

In the medium-long-run, $L^{\$}{}_{cap_i} \lesseqgtr L^*$ depending on whether $X^*_{cap} \lesseqgtr M_{cap}$. If the increase in augmented exports is greater than the increase in CAPEX and OPEX, in the medium-to-long run, the net external liabilities will tend to decrease. However, if the increase in augmented exports is smaller than the increase in CAPEX and OPEX, in the medium-to-long run, the net external liabilities will tend to increase. Including equation 34, equation 11 becomes:

$$NEL^* = \sum p^{\$}_{Lit} L^{\$}_{cap_{it}} + \sum \frac{p_{Lit}}{et} L_{it} - \sum p^{\$}_{Ait} A^{\$}_{it} - \sum \frac{p_{Ait}}{et} A_{it} - p_{Rt} R_t \tag{36}$$

and, as a consequence, the average real cost of rolling external liabilities varies depending on the weight of D_{cap} , CD_{cap} and $ODA_{ka_{cap}}$ in the composition of the cost structure of the net external liabilities:

$$\lambda^{\$*}_{Li} = \frac{L^{\$}_{cap_i}}{L^{\$*}_{cap_i} + L_i + A^{\$}_i + A_i + R} \tag{37}$$

and if we adjust the weight of each component of equation 15 accordingly, the cost of net external liabilities becomes:

$$r_{cap} = \sum(\hat{p}^{\$}_{Li} + i^{\$}_{Li})\lambda^{\$*}_{Li} + \sum\left(\frac{p^{\$}_{Li} - \hat{e}}{1+\hat{e}}\right)\lambda^*{}_{Li} - \sum(p^{\$}_{Ai} + i^{\$}_{Ai})\lambda^{\$*}_{Ai} - \sum\left(\frac{\hat{p}_{Ai} - \hat{e}}{1+\hat{e}}\right)\lambda^*{}_{Ai} - (\hat{p}_R + \alpha)\lambda^*{}_R \tag{38}$$

If we incorporate equation 31, 32, and 38 on equation 16, the indicator of external financial sustainability becomes:

$$\frac{M_{cap} - X^*{}_{cap} - \theta}{X^*{}_{cap}} = \left(\frac{g_{x^*cap} - r_{cap}}{1 + g_{x^*cap}}\right)\frac{NEL^*}{X^*{}_{cap}} \tag{39}$$

Using equation 16 and equation 39, the area of external financial sustainability can be drawn and analyzed as to how it is impacted by the CAP. Figure 2 shows the relationship between the adjusted trade deficit over augmented exports and the NEL/X^* when the growth rate of exports (gx) is greater than the average cost of net external liabilities (r).

Figure 2
Area of external financial sustainability

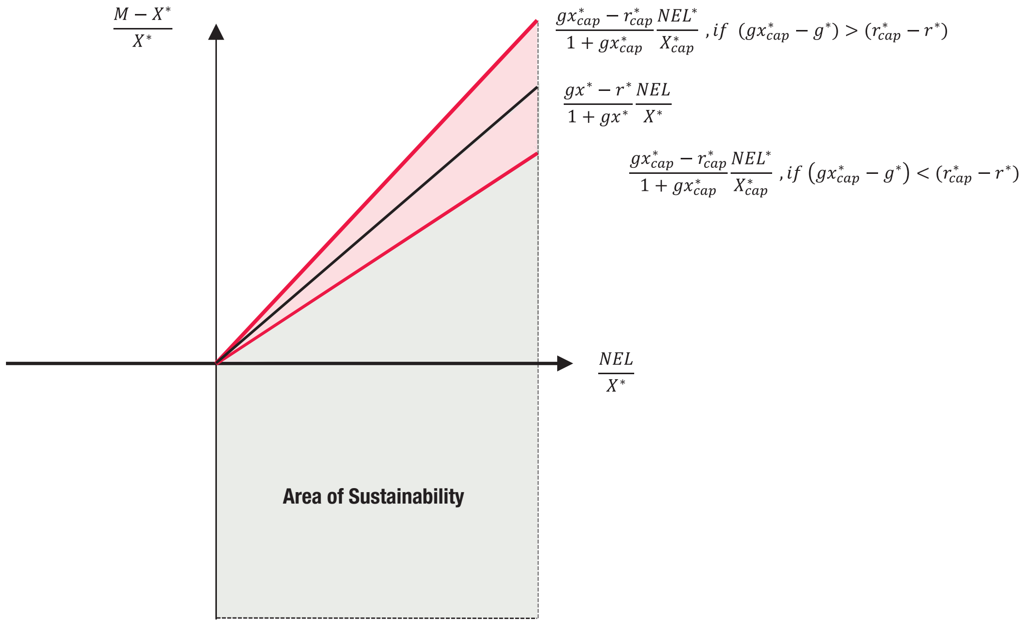


Figure 2 shows that CAP may increase or decrease the area of external financial sustainability depending on their effects on gx_{cap} and r_{cap}, On the one hand, if the green industry that had been selected for investments has a high export orientation and a low imported input coefficient (direct and indirect), the CAP may simultaneously reduce emissions and increase the area of external financial sustainability[13] – as reflected in the top red line. On the other hand, if the greener industry has a low export orientation and a high imported input coefficient (direct and indirect), the area of external financial sustainability will be reduced – as reflected in the lower red line – and may be a constraint to the CAP aimed at reducing emissions.

Bhering (2021b) also extends the model to evaluate situations in which NEL may face a constraint in its level relative to augmented exports, as in the case of net external debt in foreign currency. There can be credit constraints and a limit beyond which there may be a sudden stop on net borrowing (Bhering et al., 2019). Therefore, to evaluate the external financial sustainability situation, it is also important to analyse the dynamics of the ratio of net external debt in foreign currency ($NED^{\$}$) to augmented exports.

13 Green industrial policies may tackle both environmental issues and competitiveness issues simultaneously (Rodrik, 2017). So, if green sectors are not export-oriented and are import-dependent, complementary policies may be designed to change this, such as different sets of commercial policies, the use of national content requirements on public procurement, subsidies etc.

Let us analyze the two possible scenarios of a country where $NED^{\$}/X^{*}_{cap}$ is already at its maximum level. On the one hand, if a country finances its current account deficit with other inflows (such as DI or PI, for example), then we are back to equation 39. On the other hand, if the country is not able to finance all its current account deficit with other inflows, credit constraints may impose a tighter constraint on the adjusted trade deficit - that, other things remaining equal, will need to grow at a similar rate or a lower rate than augmented exports:

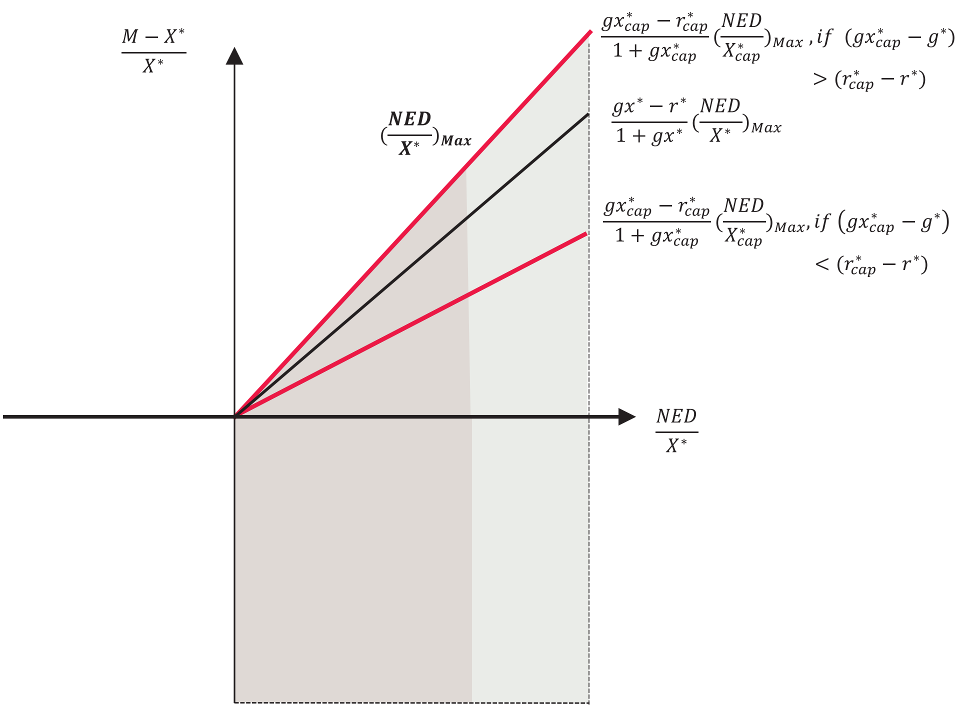
$$\frac{M_{cap}-X^{*}_{cap}-\theta}{X^{*}_{cap}} = \left(\frac{g_{x^{*}cap}-r_{cap}}{1+\ g_{x^{*}cap}}\right)\left(\frac{NED^{*}}{X^{*}_{cap}}\right)_{Max} \tag{40}$$

Where

$$r^{*} = (\hat{p}^{\$}_{LD} + i^{\$}_{LD})\theta^{\$}_{LD} - (\hat{p}^{\$}_{Ai} + i^{\$}_{Ai})\theta^{\$}_{AD} \tag{41}$$

Where θ represent shares of assets and liabilities in total $NED^{\$}$. Here, r^{*} represents the average cost of $NED^{\$}$. The subscript Max denotes the given maximum level of $NED^{\$}/X^{*}_{cap}$, which is the level that triggers a credit constraint. For a given adjusted trade deficit, the growth rate of exports must be higher than the cost of $NED^{\$}$. Moreover, for a given difference between the growth of exports and the cost of $NED^{\$}$, the adjusted trade deficit must remain constant relative to exports ($g_m = g_x^{*}$). Equation 40 shows that credit constraints that bind the level of loans (or an increase in NED) can impose a limit on the ratio between the adjusted trade deficit and augmented exports. Figure 3 below shows what happens to the relationship between the adjusted trade deficit over exports and the $NED^{\$}$ over exports in the case of a limit to indebtedness, thus, a constrained area of sustainability. The darker grey shaded area represents the constrained area of sustainability. Again, depending on the impact of CAP on net exports, the area of sustainability may be further reduced or increased.

Figure 3
External financial sustainability with a maximum level of net external debt over augmented exports



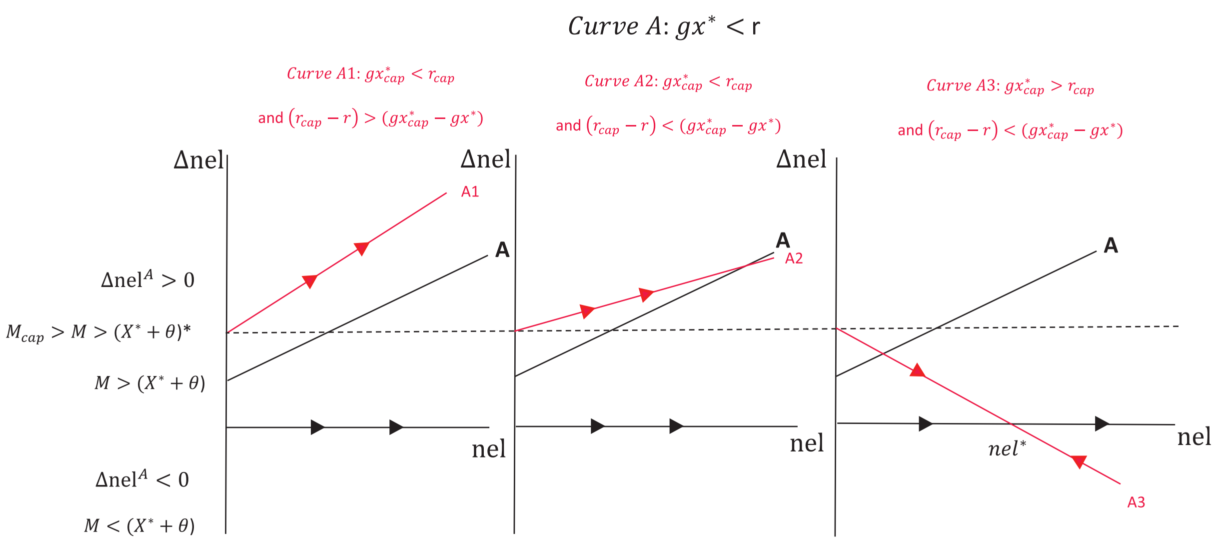
Let's turn now to analyze external financial sustainability dynamically. Following Bhering (2021b), the sustainability indicator $nel = NEL/X^*_{cap}$ changes over two consecutive periods, as:

$$\Delta nel = \frac{M_{cap} - X^*{}_{cap} - \theta}{X^*{}_{cap}} - \left(\frac{g_{x^*cap} - r_{cap}}{1 + g_{x^*cap}}\right) nel \qquad (42)$$

The static condition of equation 42 establishes that under a scenario of trade deficits, the growth rate of exports gx_{cap} must be greater than the cost of liabilities r_{cap}. However, in dynamic terms, multiple situations may arise depending on: a) if Δnel is positive or negative; b) if the growth rate of augmented exports is greater or smaller than the cost of net liabilities ($gx^* \lesseqgtr$ r); and c) there is a trade deficit or surplus ($M \lesseqgtr X^* + \theta$). Moreover, CAP investments may change the dynamics depending on their effect on the growth rate of exports and in the net cost of net liabilities. On the one hand, if the stimulated green activity is heavily dependent on imported inputs and technology, and is not export-oriented, it may be the case that a sustainable pattern of the external sector before the CAP investment ($gx^* > r$) becomes unsustainable ($r_{cap} > gx^*_{cap} > gx > r$). On the other hand, if the CAP investment is directed to sectors with substantial export propensity and low imported input dependency, it may be the case that an unsustainable pattern of the external sector before CAP investment ($gx^* <$ r) becomes sustainable ($r_{cap} < gx^*_{cap} > r > gx^*$).

In Figure 4 we draw some dynamics of *nel* and *ΔNEL* for different scenarios of the impact of CAP policies on the growth rate of exports and the cost of net liabilities. In all baseline scenarios, we have a developing country with a trade deficit (positive intercept) and an unsustainable pattern in which the net cost of liabilities is greater than the growth rate of augmented exports (thus, the positive slope of the black line – curve A). Curves A1, A2, and A3 illustrate three different scenarios in which CAP investments: (1) worsen the unsustainable trajectory; (2) improve the dynamics but do not solve the problem of the unsustainable trajectory, and (3) improve external sector dynamics to the point of changing from an unsustainable to a sustainable pattern.

Figure 4
External financial sustainability with a maximum level of net external debt over augmented exports



It is possible to see that in all scenarios, the trade deficits worsen after the CAP investments because of the necessity to import capital goods and/or inputs to produce capital goods domestically. In the left-hand side graph, there is permanent instability, before and after the CAP investments, so ΔNEL is always positive and NEL/X^* increases indefinitely. The intercept and the slope of curve A1 are higher than curve A, indicating that CAP investments not only increase trade deficits but also worsen the gap between the net cost of liabilities and the growth rate of exports. The graph in the middle has similar dynamics but indicates that CAP investments have increased trade deficits but reduced the gap between the net cost of liabilities and the growth rate of exports, even if not sufficiently transforming it into a sustainable scenario. Finally, the right-hand side graph illustrates the case in which CAP policies result in an initial increase in the deficit, but subsequently improve external financial sustainability up to the point of inverting the slope of curve A to A3, in which $gx_{cap} > r_{cap}$.

The stable level of the NEL-to-exports ratio (nel^*) depends on the relationship between the cost of net liabilities (r) and the growth rate of augmented exports and on the level of the NEL-to-exports ratio (nel). As explained by Schonerwald (2022), the NEL-to-exports ratio combines what one could call the “financial dimension” of sustainability, captured by the difference between the growth rate of augmented exports and the cost of net liabilities, and the “structural dimension”, described by an improvement in NEL and by the achievement of a surplus. In this way, the NEL-to-exports ratio shows how the financial and structural aspects of external financial sustainability are interlinked.

The framework also shows that in the case of an indebted low-income developing country (LIC), debt cancellation alone may not be a sufficient condition to avoid a new increase in external indebtedness (for example, the cases where $gx < r$). If the debt cancellation does not change the condition that $r_{cap} > gx^*_{cap}$ the debt will increase indefinitely. However, debt relief or other forms of financial support give some space to promote structural changes that improve the growth of the economy in general and the trade balance in particular. In this sense, if debt relief or other forms of financial support are used to finance CAP investments in sectors capable of improving and inverting the gap between gx and r, these policies will be reducing greenhouse gas emissions and external sustainability simultaneously. Figure 3 highlights the crucial role financing mechanisms can play in ensuring that developing countries are able to import technology and capital goods to achieve the structural change necessary for meeting the climate-related SDGs in the short to medium term.

3. UNCTAD SDFA Mark II: Financial sustainability of the public sector

This section investigates the dynamics of public sector financial sustainability and how it may be affected by the public investment necessary to promote climate-related SDGs.

Following Bhering et al. (2019), public sector net liabilities (PSNL) are defined as the difference between all liabilities held by the public sector minus all its assets:

$$PSNL_t = \left[\left(\frac{D_t}{\pi_t}\right) - \left(\frac{p_{Bt}}{\pi_t}\right)\right] + \left[\frac{e_t D^{\$}_{Gt}}{\pi_t} - \frac{e_t p_{Rt} R_t}{\pi_t}\right] + \frac{H_t}{\pi_t} \tag{43}$$

Where D is the gross internal debt denominated in local currency, B is internal assets, $D^{\$}$ is the public sector gross external debt, R represents international reserves, H is the monetary base, e is the nominal exchange rate defined as a ratio of local currency relative to US dollars, and π_t is a price index in local currency.

If all terms in t are isolated to the left-hand side of the equation and all terms in t-1 to the right-hand side and both sides are divided by real GDP (Y_t):

$$\frac{PSNL_t}{Y_t} = \left[\frac{G_t+F_t-T_t}{Y_t}\right] + \left[\frac{(1+r_d)D_{t-1}}{(1+g)(Y_{t-1})} - \left[\frac{(1+b_r+\hat{p}_{Bt})p_{Bt-1}B_{t-1}}{(1+g)(Y_{t-1})}\right] + \left[\frac{(1+r^*_{DG})e_{t-1}D^{\$}_{Gt-1}}{(1+g)(Y_{t-1})}\right] - \left[\frac{[1+\alpha_r+\hat{p}_{Rt}(1+\widehat{e_t})]e_{t-1}p_{Rt-1}R_{t-1}}{(1+g)(Y_{t-1})}\right] + \left[\frac{(1-\hat{\pi})H_{t-1}}{(1+g)(Y_{t-1})}\right] \tag{44}$$

Where G is government spending, F are transfers, T are tax revenues, r_D is the real cost of public internal debt net of taxes, b_r is the real return of internal assets, r^* is the real cost of public external debt, α_r is the real return of international reserves, and h_t is the return on the monetary base.

And the stability condition, $g_{PSNL} = g^*$, becomes:

$$\frac{G_t-F_t-T_t}{Y} = \left(\frac{g-\beta}{1+g}\right)\frac{PSNL}{Y} \tag{45}$$

Where

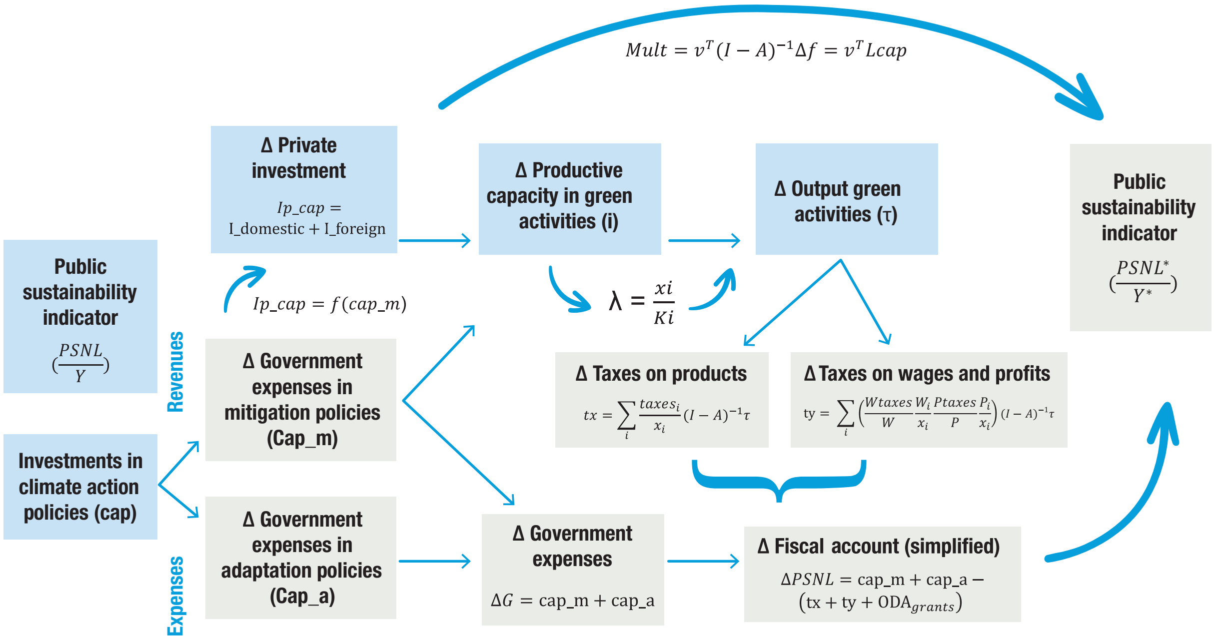
$$\beta = r_D\gamma_D - (b_r + \hat{p}_{Bt})\gamma_B + r^*_{DG}\gamma_{D^{\$}G} - (\alpha_r + \hat{e} + \hat{p}_{Rt}(1+\hat{e}_t))\gamma_R - \hat{\pi}\gamma_H \tag{46}$$

Where gammas represent the weight of each component of assets and liabilities on total PSNL and β is the weighted average cost of public sector net liabilities. If there is a fiscal deficit, output must grow faster than the weighted average cost of PSNL. Also, for a given difference between g and β, the public sector's final balance must remain constant relative to GDP.

Climate action policies that require public investments may impact public sector accounts considerably, depending on the amount of public investment, the amount of private investment that has been mobilized, their multiplier effect[14], and the weight of the fiscal contribution of the stimulated green activities. Figure 5 summarizes the basic mechanisms of the impact of CAP on public sector financial sustainability.

[14] Here we are considering a production multiplier calculated using the traditional Leontief inverse, but consumption could be endogenized in the model (Miller and Blair, 2009) and also different econometric techniques could be used to calculated fiscal multipliers (Oberholzer, 2023)

Figure 5
Mechanisms behind CAP impact on public sector sustainability



Government expenses may be decomposed into expenses to tackle the first four SDGs and CAP investments in climate adaptation and mitigation, the latter aiming at promoting a structural change in the economy for achieving climate-related SDGs:

$$G_t = G_t + G_{SDG4} + G_{SDGcap_{a,m}} \tag{47}$$

It is assumed that all CAP investments in adaptation are undertaken entirely by the public sector, while investments in climate mitigation are undertaken by both the public and the private sectors (Buchner et. al, 2023)[15]. The latter depends on the capacity of the public sector to mobilise the private sector to participate in the investment project (Deleidi et al., 2020):

$$G_{SDG_{cap,i}} = cap_i - Private\ Investment_{cap} \tag{48}$$

Where

$$Private\ Investment_{cap} = \varphi G_{SDG_{camp,m}} \tag{49}$$

And φ is the coefficient that captures the participation of the private sector in the investment project, which may be assumed to be zero if we want to test the hypothesis that no private investment was mobilised. These extra expenses will also impact revenues and the economy's growth rate. The latter may be calculated as:

$$g^* = g + \lambda^G_{SDG} \tag{50}$$

Where

$$\lambda^G_{SDG} = \frac{\emptyset cap}{Y} \tag{51}$$

where $\emptyset$ is the output multiplier of the investment $(\sum_{i-1}^{n} l_{ij})$.

[15] How private investments are financed matters. However, for simplicity, it is assumed private investment is undertaken by domestic capital. The main conclusions of the model would not change if external private investment and other financial mechanisms (such as blended finance and debt swaps) were incorporated.

Industry-level investments are part of government expenses but also generate extra revenues by increasing industry-level output and, thus, industry-level tax revenues. The total fiscal contribution generated by CAP can be then calculated as the sum of tax revenues raised in each selected industry, both in terms of taxation on products and in terms of tax on profits and wages. From the IO table, we can calculate taxation on products by unit of production t_i^P as:

$$t_i^P = \frac{Taxes_i}{x_i} \tag{52}$$

Since taxes are not levied sectorally on wages and profits they are considered as uniform across sectors within a country (following Magacho et al., 2023). Based on IMF Government Finance Statistics, sectoral tax contributions on wages and profits are estimated as:

$$t_i^Y = \frac{WagesTaxes}{Wages}\frac{Wages_i}{x_i} + \frac{ProfitsTaxes}{Profits}\frac{Profits_i}{x_i} \tag{53}$$

Total taxes collected[16] are then $t_i = t^P + t^Y$ and total taxes generated by CAP, directly and indirectly, may be calculated as:

$$t^{cap_i} = t_i(1-A)^{-1}\tau \tag{54}$$

where t^{cap_i} is a column vector with the total direct and indirect taxes collected by industry.

The difference between government expenses and revenues generated by CAP will impact the public sector net liabilities of equation 43 since part of the required extra expenses or increases in the primary deficit, need to be financed. The country can finance its expenses domestically (D) and externally, which can take the form of non-concessional debt (D), concessional debt (CD), ODA_{ka}[17] or ODA_{grants}. While ODA_{ka}, concessional and non-concessional external debt impact public sector net liabilities, ODA_{grants} are a free-of-cost source of government revenues and therefore, do not generate increases in liabilities.

Therefore, the net effect of $G_{SDG_{cap\,i}}$ in fiscal terms and in terms of public sector net liabilities is:

$$nGov_{cap} = \sum_i G_{SDG_{cap,i}} - \sum_i t^{cap_i} - \text{ODA}_{\text{grants}} \tag{55}$$

and

$$PSNL_{cap} = D_{cap} + D_{cap}^{\$} + CD_{cap}^{\$} - \text{ODA}_{ka} \tag{56}$$

And total public debt in domestic currency becomes $D^* = D + D_{cap}$, total public debt in foreign currency becomes $D^{\$*} = D^* + D_{cap}^{\$} + CD_{cap}^{\$} - \text{ODA}_{ka,debt\,relief}$, and total assets becomes $B^* = B + \text{ODA}_{ka,capital\,formation}$. Thus, the increase in the size of the public sector net liabilities depends on the share of the public deficit to be financed with debt denominated in domestic currency (D_{cap}), on the composition of the external financing (non-concessional, concessional, $\text{ODA}_{ka,debt\,relief}$ or $\text{ODA}_{\text{grants}}$) and the variation in internal assets financed by $\text{ODA}_{ka\ capital\,formation}$. Concessional finance and grants have special characteristics, such as low or zero interest rates, no provision for repayment or longer repayment periods, and more flexible conditions compared to non-concessional financing.

[16] For simplicity we are only considering taxes, but the model could incorporate net taxes (*taxes – subsidies*) without changing the main implications of the model.

[17] If ODAka is debt relief, it will reduce public sector liabilities, and if it is used to finance capital formation, it will increase assets.

If we substitute equation 47, 50, 55 and 56, in 44, the public sector financial sustainability indicator with CAP becomes:

$$\frac{PSNL^*{}_t}{Y_t} = \left[\frac{G_t + G_{SDG_4} + G_{SDG_{cap}} + F_t - (T_t + t^{cap_i} + \mathrm{ODA_{grants}})}{Y_t}\right] + \left[\frac{(1+r_d)D^*_{t-1}}{(1+g^*)(Y_{t-1})}\right] - \left[\frac{(1+b_r+\hat{p}_{B^*t})p_{B^*t-1}B^*{}_{t-1}}{(1+g^*)(Y_{t-1})}\right] + \left[\frac{(1+r^*_{DG})e_{t-1}D^{\$*}_{Gt-1}}{(1+g^*)(Y_{t-1})}\right] + \left[\frac{(1+\psi_{CD})e_{t-1}CD^{\$}_{t-1}}{(1+g^*)(Y_{t-1})}\right] - \left[\frac{[1+\alpha_r+\hat{p}_{Rt}(1+\hat{e}_t)]e_{t-1}p_{Rt-1}R_{t-1}}{(1+g^*)(Y_{t-1})}\right] + \left[\frac{(1-\hat{\pi})H_{t-1}}{(1+g^*)(Y_{t-1})}\right] \quad (57)$$

Where ψ is the interest rate of CD[18]. For the stability conditions, $g_{PSNL}{}^* = g$, thus:

$$\frac{G_t + G_{SDG_4} + G_{SDG_{cap}} + F_t - (T_t + t^{cap_i} + \mathrm{ODA_{grants}})}{Y_t} = \left(\frac{g^* - \beta^*}{1 + g^*}\right)\frac{PSNL^*}{Y} \quad (58)$$

Where

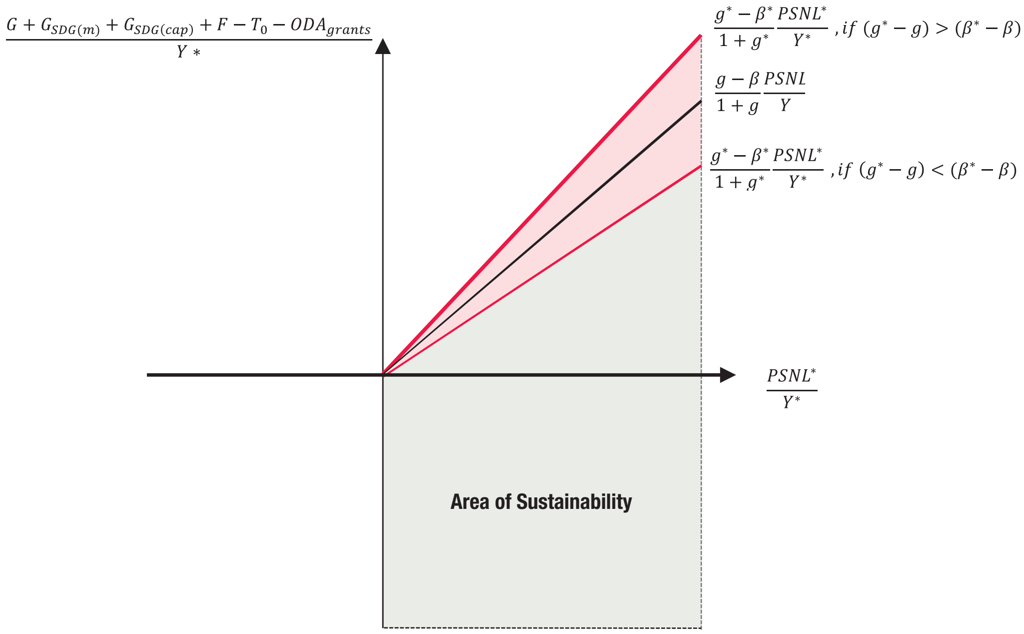
$$\beta^* = r_D\gamma^*{}_D - (b_r + \hat{p}_{Bt})\gamma^*{}_B + r^*_{DG}\gamma^*{}_{D\$G} + \psi_{CD}\gamma^*{}_{CD} - (\alpha_r + \hat{e} + \hat{p}_{Rt}(1+\hat{e}_t))\gamma^*{}_R - \hat{\pi}\gamma^*{}_H \quad (59)$$

Where γ * represents the modified weight of each component of PSNL as a result of equation 56, $\gamma^*{}_{CD}$ is the weight of CD in total PSNL and β* is the weighted average cost of public sector net liabilities.

Figure 6 shows the areas of public sector financial sustainability reflected in the relationship between the public sector current balance over GDP and the public sector net liabilities over GDP (PSNL/Y). As explained by Bhering (2021b), this graph is very similar to Pasinetti's analysis (Pasinetti, 1998), apart from the fact that Pasinetti presents the case of surplus countries, while here the focus is on deficit countries, which better reflects the situation of most developing countries. Cap may increase or decrease the area of financial sustainability depending on its effect on the growth rate of the economy and on the average cost of public sector net liabilities. In a scenario of very restricted fiscal space, CAP may only occur to the detriment of other public investments or expenses, and if the multiplier effect of CAP is smaller than the public expenses it substituted, there may be a case in which $g^* < g$, and the sustainability area is reduced. However, the most likely case is the one in which the extra investments mobilise private investments and have a positive multiplier, thus increasing the growth rate of the economy (i.e. $g^* > g$). If this increase is greater than the increase of β generated by the extra debt used to finance CAP investments, it will increase the area of public sector financial sustainability.

[18] Note that since grants typically do not carry any financial obligation for the recipient and are funds provided by governments, multilateral institutions and or non-governmental organizations that do not need to be repaid, they are not considered public sector liabilities.

Figure 6
Public sector financial sustainability



For the public sector, there is no clear boundary for either the level of net liabilities relative to GDP or the level of deficit relative to GDP. The limits to both these variables are determined by the sustainability condition, represented by equation 58. However, to incorporate fiscal policies used to achieve the sustainability of PSNL, different rules may be derived from equation 58, setting a ceiling to either PSNL over output, or to the balance between government spending, on one side, and transfers plus taxes net of interest payments on public debt, on the other side, over GDP.

Following Schonerwald (2022), to analyze the dynamics of public sector financial sustainability equation 58 can be re-written to indicate how the public sector financial sustainability indicator $d = PSNL/Y$ changes over two consecutive years, as:

$$\Delta d = \frac{G_t + G_{SDG_4} + G_{SDG_{cap}} + F_t - (T_t + t^{cap_i} - ODAgrants)}{Y^*_t} - (\frac{g^* - \beta^*}{1 + g^*})d \tag{60}$$

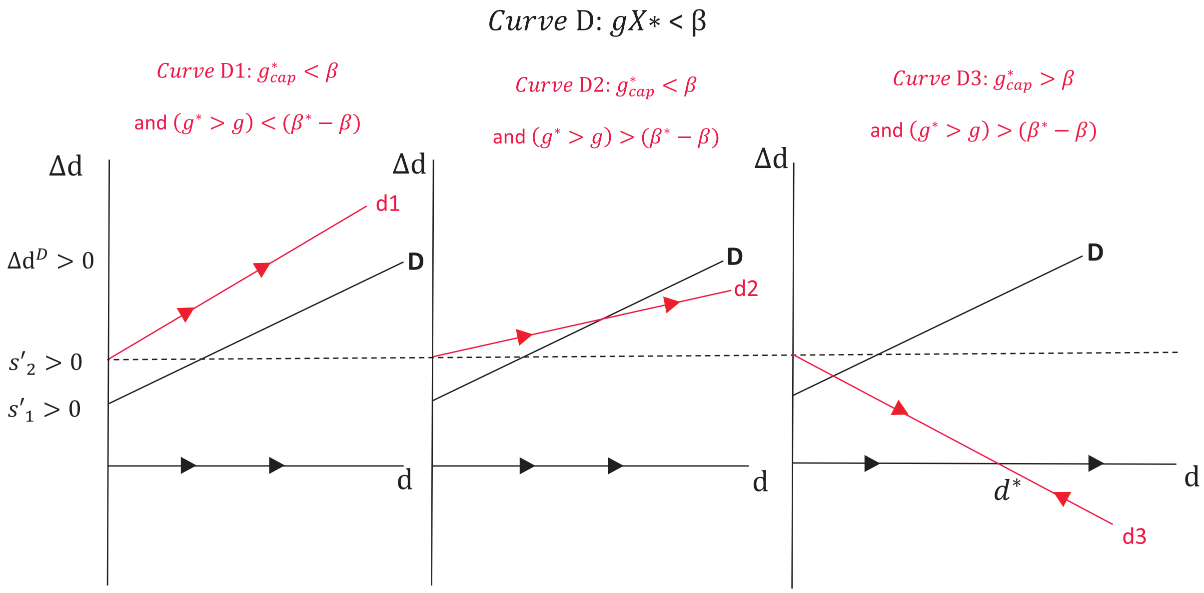
And if $\Delta d = 0$ and $s' = \frac{G_t + G_{SDG_4} + G_{SDG_{cap}} + F_t - (T_t + t^{cap_i} - ODAgrants)}{Y^*_t}$, equation 60 becomes:

$$d^* = \frac{s}{\frac{g^* - \beta^*}{1 + g^*}} \tag{61}$$

The term $(\frac{g^* - \beta^*}{1 + g^*})$ in equation 60 is well-known as the "snowball effect". Basically, this term indicates that, all else remaining equal, the debt-to-GDP ratio will tend to increase or to decrease over time, depending on the relationship between the weighted average cost of public sector net liabilities and the rate of GDP growth. In the case of $g^* < \beta^*$, the "snowball effect" is positive, implying that only a government surplus will prevent the debt-to-GDP ratio from increasing. In the case $g^* > \beta^*$, the "snowball effect" is negative, implying that, all else constant, the debt-to-GDP ratio will tend to decrease.

Figure 7 illustrates the dynamics of public sector financial sustainability by presenting the relationship between Δd and the level of d. The figure reflects the dynamics of a hypothetical country with a deficit in the public sector accounts, as this is a common picture in developing countries. In all scenarios CAP worsens the public sector deficit in the short term, resulting in a shift in the intercept from S'_1 to S'_2.

Figure 7
The dynamics of public sector financial sustainability



In the baseline scenario (curve D – with positive slope) we are assuming the weighted average cost of public sector net liabilities β is greater than the growth rate of the economy, which means the government is in an unstable scenario in which Δd is always positive and $d = PSNL/Y$ increases indefinitely. In addition to the baseline scenario, Figure 5 shows how CAP investments may affect the dynamics of public sector financial sustainability. In the left-hand side graph, there is a rise in the deficit and in the gap between $g*$ and $\beta*$, worsening the already unsustainable trajectory of the baseline scenario. In the middle graph, CAP increases the GDP growth rate but not enough to make the trajectory sustainable ($\beta > g* > g$), so, while the initial position is worse, the trajectory of d is less unstable, and both will increase d permanently. Finally, in the right-hand side graph, CAP increases the GDP growth rate up to the point of making ($g* > \beta* > \beta > g$), thus, notwithstanding the worse initial position, the trajectory of d becomes sustainable as the “snowball effect” turns negative. The curve D3 also reflects a situation where the country begins to run a surplus, so the curve crosses into the negative quadrant. In terms of stability, either a deficit position or a surplus position will tend to an equilibrium point called stable node (d*), so for a deficit position the $\Delta d > 0$ and the d will increase towards $d*$, and for a surplus initial position, the $\Delta d < 0$ and the d will decrease towards $d*$ (see Harck (2000) as cited in Schonerwald (2022)).

4.
Connecting external accounts, public accounts and SDGs

In this section, the link between external financial sustainability and public sector financial sustainability is established. It indicates how economic policies and climate action policies interact to open the possibility of sustainable paths of growth and development where climate-related SDGs and external and public sector financial sustainability can be simultaneously achieved. More specifically, it develops the argument that maintaining external financial sustainability may generate a constraint on economic growth that also influences public sector financial sustainability. Initially, the analysis departs from the idea that the external constraint is the most relevant constraint to economic growth in developing countries. The proposed indicator suggests a constraint in level – which imposes a threshold for aggregate output if there is a threshold for NEL/X^* or NED/X^* and a long-run constraint on the growth rate, similar to the simplified version of the balance of payments constraint model in which augmented exports must grow as fast as imports.

Nominal imports are represented by:

$$M = p_m Q_m \tag{62}$$

Where p_m is the price index of imports and Q_m the quantity of imports. The common hypothesis that the quantity of imports is determined by the level of economic activity is added, thus:

$$Q_m = mY \tag{63}$$

Where m is the proportion of output that is imported. Substituting equation 63 into equation 62 the relationship between nominal imports and real output can be reflected as:

$$M = p_m mY \tag{64}$$

Substituting equation 64 in the sustainability condition given by equations 12 and 36, an equation for the level of output that is compatible with this given external constraint is derived:

$$Y \leq Y_{NEL} = \frac{X^*(1+k)}{p_m m} \tag{65}$$

$$Y \leq Y^{cap}{}_{NEL} = \frac{X^*(1+k^{cap})}{p_m m^*} \tag{66}$$

Where

$$k = \left(\frac{g_x{}^* - r}{1+g_x{}^*}\right)\frac{NEL}{X^*} \tag{67}$$

$$k_{cap} = \left(\frac{g_x{}^*{}_{cap} - r_{cap}}{1+g_x{}^*{}_{cap}}\right)\frac{NEL^*}{X^*{}_{cap}} \tag{68}$$

The long-run level of output of equation 65 depends on the external financial sustainability indicator and on the threshold we use for NEL (or NED). However, in a case where the country is over a threshold/limit scenario, CAP investments may increase or decrease the potential level of output depending on whether they have a greater impact on the growth rate of exports (gx^*) or on the real cost of net external liabilities (r^*). In other words, in the context of a country with high import dependency and no technological capability, in which $gx^*_{cap} < r_{cap}$, CAP may be impracticable in cases where there is no more space in prevailing NEL or NED levels. Continuing with these CAP investments will reduce the long-run output level unless they are coupled with improved financing conditions ($\downarrow r_{cap}$), debt relief (although this may not be sustainable in the long run) or trade policies that increase export orientation (exp/x) and reduce import penetration.

Alternatively, if a country has green industries with high export capacity and low import penetration, CAP may simultaneously reduce greenhouse gas emissions and increase the long-run level of output, even if it requires a considerable amount of capital goods (technology) in the short-term. If there are no green activities with those characteristics, a different set of policies may be implemented alongside the investments being undertaken. Altenburg and Rodrik (2017) describe those government interventions that promote structural change combining environmental and competitive objectives as green industrial policies.

As for the stability condition and the long-run constraint on growth, the condition remains that imports do not grow faster than exports. Thus, the growth rate of imports is formalised as:

$$g_M = (1 + \hat{p}_M)(1 + \hat{m})(1 + g) - 1 \tag{69}$$

$$g_{M_{cap}} = (1 + \hat{p}_M)(1 + \hat{m}^*)(1 + g_{cap}) - 1 \tag{70}$$

Applying this equation to the condition that exports must grow in line with imports yields:

$$g \leq g_{BP} = \left(\frac{gx^* - \hat{m} - \hat{p}_m - \hat{p}_M\hat{m}}{(1+\hat{p}_m)(1+\hat{m})}\right) \tag{71}$$

$$g \leq g_{BP_{cap}} = \left(\frac{gx^*{}_{cap} - \hat{m}^* - \hat{p}_m - \hat{p}_M\hat{m}^*}{(1+\hat{p}_m)(1+\hat{m}^*)}\right) \tag{72}$$

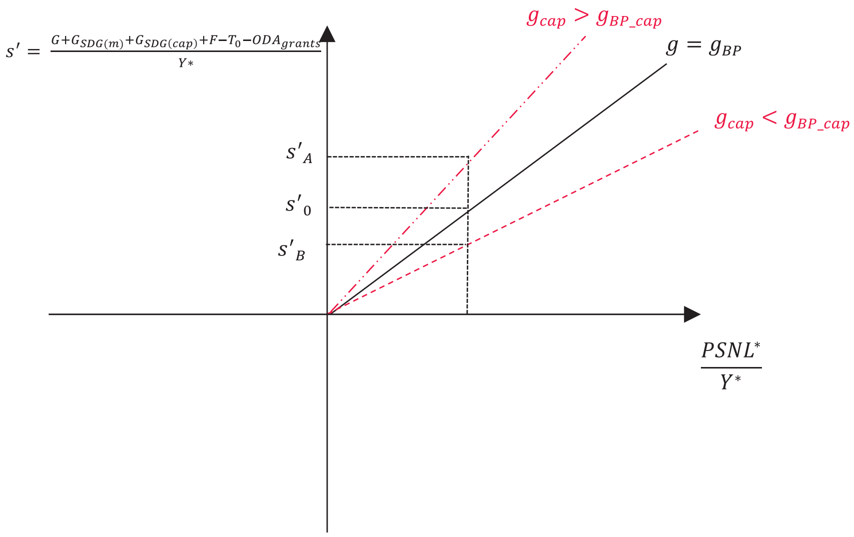
If external financial sustainability is a constraint to economic growth and economic growth is also a determinant of public sector sustainability, we can apply the long-run constraint on growth imposed by equation 71 in our equation 58 that establishes the long-run financial sustainability of the public sector:

$$\frac{G-F-T}{Y^*} = \left(\frac{g_{BP}-\beta}{1+g_{BP}}\right)\frac{PSNL}{Y} \tag{73}$$

$$\frac{G+F-(T+t^{cap}i+ODA_{grants})}{Y^*} = \left(\frac{g_{BP\,cap}-\beta^*{}_{cap}}{1+g_{BP\,cap}}\right)\frac{PSNL^*}{Y^*} \tag{74}$$

The equation above is the condition for a country to simultaneously achieve sustainability in both its external sector and public sector financial positions. It highlights two important implications regarding the relationship between the actual growth rate and the growth rate compatible with the external constraint. Firstly, if $g > g_{BP}$, then the current dynamics of GDP are not compatible with external account sustainability in the long run and some adjustments must be made in the growth rate. Thus, external sustainability imposes a long-run constraint on growth. However, the second implication is that, if the actual growth rate is lower than expressed in equation 73, the external account can accommodate a higher growth rate in the long run.

Figure 8
Actual growth rate compatible with an external constraint and the impact of climate action policies



As we have stressed over the report, climate action policies will impact the actual growth rate and the growth rate compatible with the external constraint. Depending on how CAP impact each of these, different outcomes will emerge in terms of fiscal space, and external and public sector financial sustainability. This implies that while planning public investments, in addition to the common analysis of their impact on the public sector balance, policymakers must also pay attention to the impact these investments will have on the dynamics of the country's external sector. This can be an additional constraint but may also offer new opportunities, since if CAP increases the growth rate compatible with the external constraint, it may generate extra space for fiscal policies.

5.
Final remarks and policy implications

The UNCTAD SDFA framework highlights a diverse range of policy options for a country that seeks to implement climate action investments and tackle the main SDGs while simultaneously maintaining external and public sector financial sustainability. Moreover, it can be used as a policy tool that guides the policy mix and expands the policy space of developing countries. Depending on the country's initial situation, and on the policies implemented, multiple scenarios may emerge. The framework makes an important contribution by connecting and building a bridge between external and public sector financial sustainability. Key to the analysis is showing how economic policies and climate action policies interact to make sustainable paths of growth and development, compatible with the simultaneous achievement of climate-related SDG's and external and public sector financial sustainability, possible.

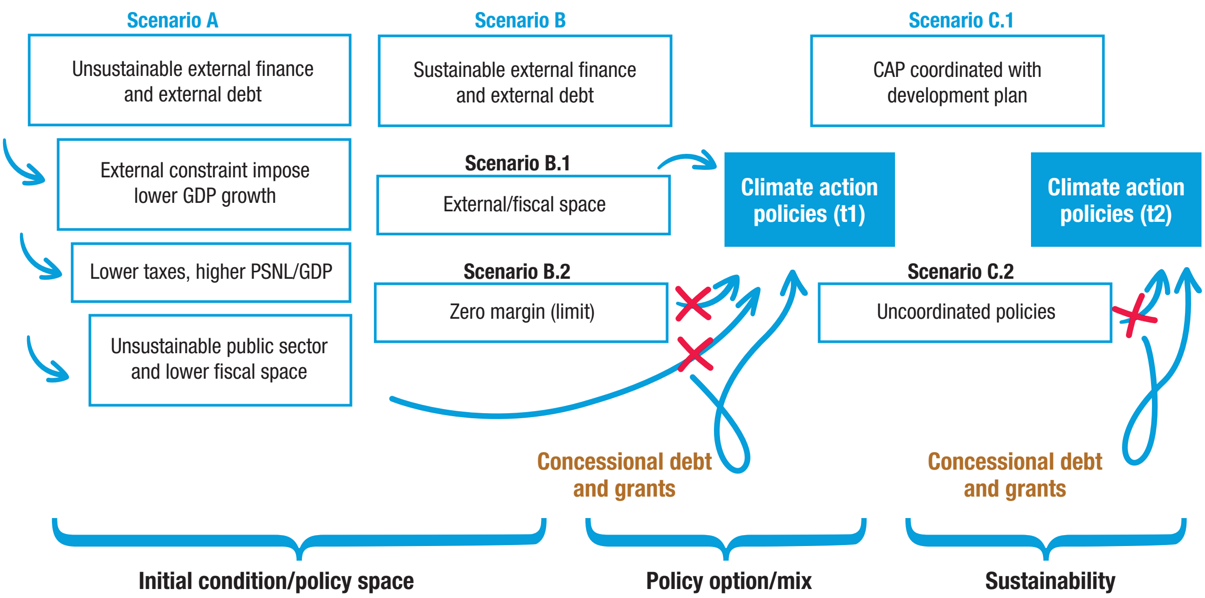
Besides allowing policymakers to study the possible policy mix regarding financing sources, the desired level of deficits/surplus and external and public sector financial positions, the UNCTAD SDFA Mark II helps develop an understanding of the implications of stimulating specific green industries and investing in climate adaptation. It enhances the understanding of the impact of climate-related investments on emissions, export growth, trade deficits, average cost of net external liabilities, fiscal revenues and fiscal multipliers and how these variables interact and impact their country's external and public sector financial sustainability. Therefore, on the one hand, it enables policymakers to analyse the external and fiscal space required to undertake CAP investments, and, on the other hand, it shows how CAP investments will affect the external and public sector financial sustainability over the short and long run.

Figure 9 illustrates some dynamics and relationships between the initial conditions of external and public sector sustainability, CAP and the need for concessional debt and grants. The initial conditions are represented in scenarios A and B. The initial condition will determine whether CAP require concessional debt and grants to be viable in the short term. The policy option/mix consists of implementing CAP that are coordinated (or not) with a broader development plan (scenarios C.1 and C.2, respectively), which aims to diversify and improve the production structure of the economy – thus changing the level and composition of exports. The impact of CAP on external and public sector financial sustainability will depend on whether they are coordinated with a development plan, which, in turn, will define the ability of the country to continue implementing CAP in subsequent periods.

In the worst-case scenario, developing countries' external accounts are on an unsustainable path, in which augmented export growth is not enough to offset import growth and the average cost of net external liabilities. In addition, under this scenario, the developing country is also on an unsustainable public sector finance trajectory, in which the GDP growth rate is lower than the average cost of public sector net liabilities. Therefore, the policy space to guarantee the necessary investments for the achievement of the main SDGs and climate-related SDGs would demand a higher GDP growth rate than is compatible with external sector sustainability. Consequently, the country would need to change policy direction and subdue economic growth, which would result in lower tax revenues and a higher ratio of public sector net liabilities to GDP, further reducing the policy space for SDGs and their necessary investments.

This vicious cycle can only be broken by a structural transformation of the economy, reducing the balance of payments constraint on growth – which may require medium to long-term efforts – and/or concessional debt or grants. In Figure 9 this is reflected in Scenario A and Scenario B.2. In the latter, the country is at a zero-margin limit in which net external debt has reached its maximum level and new foreign loans cannot be incurred. In this context, CAP investments that result in a deterioration of the external account in the short term due to the need for imported technologies and capital and intermediate inputs cannot be undertaken.

Figure 9
Policy implications and the vicious cycle of an unsustainable external and public sector finance trajectory



Should the country subsequently have access to development finance (for example, a grant[19]), or it moves to a position of external and public sector financial sustainability (Scenario B.1), which allows the policymaker to undertake CAP investments, the impact of such investments on external and public sector financial sustainability would depend on their effect on net external liabilities and the growth rate of augmented exports. In other words, the sustainability of CAP investments would depend on whether the policies are part of a broader development strategy, in which investments simultaneously tackle climate and development issues. As CAP investments require imported capital goods, inputs, and technology in the short run, if CAP does not promote the necessary structural transformation enabling a reduction in both emissions and an improvement in current account performance, CAP will jeopardize external and public sector financial sustainability. This would, in turn, further reduce the policy space available for the continued investment necessary to tackle climate-related SDGs.

[19] As we have stressed in the model, ODA can have different formats and characteristics, such as grants, debt restructuring and concessional loans. The flow of ODA enters the BoP in different ways depending on the type of ODA. While grants are registered in the current account as they are considered unilateral transfers, debt relief is registered in the capital account and concessional debt is registered in the financial account. In the model, we showed how they have different effects on external and public sector financial sustainability. For this hypothetical example in the conclusion, we consider that the country receives a grant.

Co-ordinating climate and development strategies may be the only way forward to achieve external and public sector financial sustainability while simultaneously tackling the climate-related SDGs (Scenario C1). Alternatively, if CAP reinforces an unsustainable external and public sector finance trajectory, such investment will only be achieved with official development assistance grants. The latter has the disadvantage that it may be, insufficient, and/or conditional, thus limiting the recipient countries' autonomy (Scenario C2). Hence, while most developing countries will need financial assistance in the short run, the continued need for it will depend on whether they succeed in addressing the current challenges to break the vicious cycle of weak productivity, poor application of technologies and regressive specialization.

The challenges involved in achieving climate-related SDGs and the obstacles to sustainable development are certainly significant and require a coordinated mix of policies. The investments required to achieve these goals are considerable, so both public and private investment must be seen as complementary – as in the case of climate mitigation. Often, the public sector may have to take the lead to stimulate and crowd-in private investments. Frequently, public investments will need to play the lead role – as in the case of climate adaptation. The UNCTAD SDFA framework shows that the productive structure of economies and their external and public sector financial sustainability are interlinked. Diversifying and upgrading the production structure of the economy – and thereby changing the level and composition of exports – should be seen as necessary policies to guarantee the external and public sector financial sustainability required for long-term development and the transition to a zero-carbon economy. This may require the coordination of macroeconomic policies – monetary, fiscal, and exchange rate policies[20] – with development policies – such as industrial, technological, and commercial policies.

Delving deeper into policy recommendations and design requires a more nuanced approach that considers country's unique circumstances and characteristics.

The UNCTAD SDFA Dashboard has been developed and is currently being improved to serve as a policy tool to help policymakers analyse different scenarios and the implications of different sets of policies that extend beyond the traditional fiscal consolidation and austerity they are often pressured to implement.

[20] Since the exchange rate has direct and indirect implications for most of the main variables of the model, in Appendix 2 we concisely analyze the main effects of exchange rate policies on the model.

References

Altenburg, T. and Rodrik, D. (2017). Green Industrial Policy: Accelerating Structural Change towards Wealthy Green Economies. In Altenburg, T. and Assmann, C., editors, *Green Industrial Policy: Concept, Policies, Country Experiences*, pages 2–20. UN Environment; German Development Institute / Deutsches Institut fu¨r Entwicklungspolitik (DIE), Geneva, Bonn.

Araujo, R. and Lima, G. (2007). A structural economic dynamics approach to balance-of-payments-constrained growth. *Cambridge Journal of Economics*, 31(5):755–774.

Atella, V., Atzeni, G. E., and Belvisi, P. L. (2003). Investment and exchange rate uncertainty. *Journal of Policy Modeling*, 25(8):811–824.

Avenyo, E. K. and Tregenna, F. (2022). Greening manufacturing: Technology intensity and carbon dioxide emissions in developing countries. *Applied Energy*, 324:119726.

Bhering, G. (2021a). Sustainable Development Finance Assessment and the Achievement of SDGs. Technical report, UNCTAD.

Bhering, G. (2021b). Sustainable Development Finance Assessment and the Pursuance of SDGs. Technical report, UNCTAD United Nations.

Bhering, G., Serrano, F., and Freitas, F. (2019). Thirlwall's law, external debt sustainability, and the balance-of-payments-constrained level and growth rates of output. *Review of Keynesian Economics*, 7(4):486–497.

Blecker, R. A. (2007). The economic consequences of dollar appreciation for US manufacturing investment: a time-series analysis. *International Review of Ap- plied Economics*, 21(4):491–517.

Boleti, E., Garas, A., Kyriakou, A., and Lapatinas, A. (2021). Economic Complexity and Environmental Performance: Evidence from a World Sample. *Environmental Modeling Assessment*, 26(3):251–270.

Bottega, A. and Romero, J. P. (2021). Innovation, export performance and trade elasticities across different sectors. *Structural Change and Economic Dynamics*, 58:174–184.

Bresser-Pereira, L. C., Arau´jo, E. C., and Costa Peres, S. (2020). An alternative to the middle-income trap. *Structural Change and Economic Dynamics*, 52:294– 312.

Bresser-Pereira, L. C. and Rugitsky, F. (2018). Industrial policy and exchange rate scepticism. *Cambridge Journal of Economics*, 42(3):617–632.

Buchner et. al (2023). Global Landscape of Climate Finance 2023. Technical report, Climate Policy Initiative.

Campa, J. and Goldberg, L. S. (1995). Investment in manufacturing, exchange rates and external exposure. *Journal of International Economics*, 38(3):297–320.

Campa, J. M. and Goldberg, L. S. (1999). Investment, pass-through, and exchange rates: A cross-country comparison. *International Economic Review*, 40(2):287– 314.

Carlos Schonerwald (2022). DYNAMIC MODELLING OF THE SUSTAINABLE DEVELOPMENT FINANCE ASSESSMENT AND THE SDGS. Technical report, UNCTAD.

Chenery, H. and Clark, P. (1953). The Structure and Growth of the Italian Economy, Regional Analysis. *United States Mutual Security Agency, Rome*.

Cimoli, M., Antonio Ocampo, J., Porcile, G., and Saporito, N. (2020). Choosing sides in the trilemma: international financial cycles and structural change in developing economies. *Economics of Innovation and New Technology*, 29(7):740– 761.

Cimoli, M. and Porcile, G. (2014). Technology, structural change and BOP constrained growth: a structuralist toolbox. *Cambridge Journal of Economics*, pages 215–237.

Deleidi, M., Mazzucato, M., and Semieniuk, G. (2020). Neither crowding in nor out: Public direct investment mobilising private investment into renewable electricity projects. *Energy Policy*, 140:111195.

Eichengreen, B. (2007). The real exchange rate and economic growth. *Social and Economic Studies*, pages 7–20.

Ferrari, Marcos Adolfo Ribeiro, Fábio Neves P. Freitas, and Nelson Barbosa Filho. "A taxa de câmbio real e a restrição externa: uma proposta de releitura com elasticidades endógenas." *Brazilian Journal of Political Economy* 33 (2013): 60-81.

Fritz, B., de Paula, L. F., and Prates, D. M. (2018). Global currency hierarchy and national policy space: a framework for peripheral economies. *European Journal of Economics and Economic Policies*, 15(2):208–218.

Godin, A., Yilmaz, D., Andrade, J., Barbosa, S., Guevara, D., Hernandez, G., and Rojas, L. (2023). Can Colombia cope with a Global Low Carbon transition? Technical report, AfD.

Gouvea, R. R. and Lima, G. T. (2010). Structural change, balance-of-payments constraint, and economic growth: evidence from the multisectoral Thirlwall's law. *Journal of Post Keynesian Economics*, 33(1):169–204.

Guzman, M., Ocampo, J. A., and Stiglitz, J. E. (2018). Real exchange rate policies for economic development. *World Development*, 110:51–62.

Harck, S. (2000). Notes and comments. On the sustainability area as a simplifying didactic device. *Cambridge Journal of Economics*, 24(4):505–509.

Hausmann, R. and Hidalgo, C. A. (2010). Country Diversification, Product Ubiquity, and Economic Divergence. CID Working Paper No. 201.

Hidalgo, C. A. and Hausmann, R. (2009). The building blocks of economic complexity. In *Proceedings of the national academy of sciences*, volume 106 (26), pages 10570–10575. PNAS.

Intergovernmental Panel on Climate Change (IPCC) (2023). AR6 Synthesis Report on Climate Change 2023. Technical report, IPCC, Geneva, Switzerland.

Li, G., Li, J., and Wu, Y. (2019). Exchange rate uncertainty and firm-level investment: Finding the Hartman–Abel effect. *Journal of Comparative Economics*, 47(2):441–457.

Lockwood, K. (2022). User Manual: UNCTAD Sustainable Development Finance Assessment Framework Policy Dashboard. Technical report, UNCTAD United Nations.

Magacho, G., Espagne, E., Godin, A., Mantes, A., and Yilmaz, D. (2023). Macroeconomic exposure of developing economies to low-carbon transition. *World Development*, 167:106231.

Magacho, G., Ribeiro, R., and Rocha, I. (2021). Economic complexity and price competitiveness dependence: empirical evidence using panel models. *International Journal of Development Issues*, (ahead-of-print).

Marconi, N., Araujo, E., Brancher, M. C., and Porto, T. C. (2021). The relationship between exchange rate and structural change: an approach based on income elasticities of trade. *Cambridge Journal of Economics*, 45(6):22.

Mealy, P. and Teytelboym, A. (2022). Economic complexity and the green economy. Research Policy, 51(8):103948.

Miao, Y. and Berg, M. A. (2010). *The real exchange rate and growth revisited: The Washington Consensus strikes back?* International Monetary Fund.

Miller, R. E. and Blair, P. D. (2009). *Input-output analysis: foundations and extensions*. Cambridge university press.

Missio, F., Araujo, R. A., and Jayme, F. G. (2017). Endogenous elasticities and the impact of the real exchange rate on structural economic dynamics. *Structural Change and Economic Dynamics*, 42:67–75.

Moreno, A., Guevara, D., Andrade, J., Pierros, C., Valdecantos, S., Godin, A., and Yilmaz, D. (2023). Low-carbon Transition and Macroeconomic Vulnerabilities: A Multidimensional Approach in Tracing Vulnerabilities and its Application in the Case of Colombia. Technical report.

Moses, L. N. (1955). The stability of interregional trading patterns and input- output analysis. *The American Economic Review*, 45(5):803–826.

Nassif, A., Bresser-Pereira, L. C., and Feijo, C. (2018). The case for reindustrialisation in developing countries: towards the connection between the macroeconomic regime and the industrial policy in Brazil. *Cambridge Journal of Economics*, 42(2):355–381.

Nucci, F. and Pozzolo, A. F. (2001). Investment and the exchange rate: An analysis with firm-level panel data. *European Economic Review*, 45(2):259–283.

Oberholzer, B. (2023). Moving Forward When There Are No Dollars: A Guide to Public Investment in Face of the Balance-of-Payments Constraint. *Review of Political Economy*, pages 1–24.

Ocampo, José Antonio, 'Industrial Policy, Macroeconomics, and Structural Change', in Arkebe Oqubay, and others (eds), The Oxford Handbook of Industrial Policy, edition Oxford Handbooks (2020; online edn, Oxford Academic, 10 November 2020), https://doi.org/10.1093/oxfordhb/9780198862420.013.3, accessed 4 Oct. 2024.

Pasinetti, L. L. (1998). The myth (or folly) of the 3% deficit *Cambridge journal of economics*, 22(1):103–116.

Porcile, G., Alcorta, L., Foster-McGregor, N., Verspagen, B., and Szirmai, A. (2021). Latin-American structuralism and neo-structuralism. *New perspectives on structural change: Causes and consequences of structural change in the global economy*, pages 50–71.

Prebisch, R. and Cabañas, G. M. (1949). El desarrollo económico de la América Latina y algunos de sus principales problemas. *El trimestre económico*, 16(63 (3):347–431.

Rapetti, M., Skott, P., and Razmi, A. (2012). The real exchange rate and economic growth: are developing countries different? *International Review of Applied Economics*, 26(6):735–753.

Ribeiro, R. S. M., McCombie, J. S. L., and Lima, G. T. (2020). Does real exchange rate undervaluation really promote economic growth? *Structural Change and Economic Dynamics*, 52:408–417.

Rodrik, D. (2008). The Real Exchange Rate and Economic Growth. *Brookings Papers on Economic Activity*, 2008(2):365–412.

Rodrik, D. (2017). Premature Deindustrialisation in the Developing World.

Romero, J. P. and Gramkow, C. (2021). Economic complexity and greenhouse gas emissions. *World Development*, 139:105317.

Savona, M. and Ciarli, T. (2019). Structural Changes and Sustainability. A Selected Review of the Empirical Evidence. *Ecological Economics*, 159:244–260.

Semieniuk, G., Campiglio, E., Mercure, J., Volz, U., and Edwards, N. R. (2021). Low-carbon transition risks for finance. *Wiley Interdisciplinary Reviews: Climate Change*, 12(1):e678.

Semieniuk, G. and Mazzucato, M. (2019). 11. Financing green growth. *Handbook on green growth*, page 240.

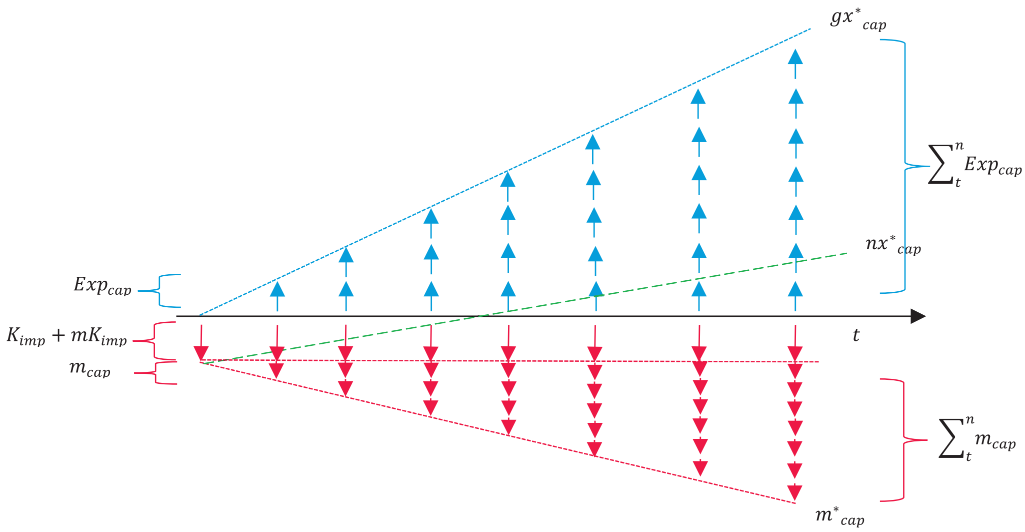
UNCTAD (2021). Climate Change, Green Recovery and Trade. United Nations Conference on Trade and Development Geneva, Switzerland.

UNCTAD (2022). UNCTAD Sustainable Development Finance (SDFA) Framework: Linking debt sustainability to the achievement of the 2030 Agenda. Technical report, UNCTAD.

Appendix 1

The figure below indicates a simplified version of investment dynamics where there is no depreciation and where the same amount of investments is realized every year. The impact on exports increases linearly because the effect of investment in exports is persistent[21]. We can see that in the year $t0$ there are no exports as we assume there is a period for the investment to be translated into an increase in output. Overall, this is to show that CAP investment will impact variable gx in the SDFA model. An analogous explanation is used to justify the dynamics of direct and indirect imported inputs ($mcap$), but of course, the signal is inversed. k_{imp} and mk_{imp} only impact imports in the year investment have materialized, and for an investment plan of several years it will affect imports at a constant rate (every year the investment takes place), thus will not alter the growth rate of imports. The net cost of liabilities will be determined in the long term by the highest and most persistent of the effects, and this is why for imports we only use the variable $mcap$ in order to measure the effect of CAP on net external liabilities. Finally, the net effect of the dynamics of $mcap$ and gx will form the green line ($nxcap$). The other two components – the short-term ($t0$) imported capital goods and imported inputs to produce capital goods domestically — will only enter the model in the equation that captures the current imports and current account, and thus, these two components would deteriorate the current account in the year the investment is materialized. In the graph below, we can see that if the investment is undertaken every year this cost will be constant over the period.

Figure 10
Effect of CAP project with constant investment for several years



If is included depreciation in the equation the dynamics would be similar but smoother since the persistent increase of exports would decrease along with the maturation of the installed capacity. The gx_{cap}, m_{cap}, and nx_{cap} curves would still increase and decrease but each rise (decrease) would be smaller every year, resembling a logarithmic growth curve. For simplicity the model proceeds without depreciation.

21 Investment increases production capacity, which increases output (depending on the output- to-capital ratio), of which some share may be exported depending on the export orientation of the industry

Appendix 2

There are several reasons for further elaborating on the effect of currency appreciations and depreciations in the SDFA framework and in developing countries' external and public sector sustainability and economic development. First, the exchange rate impacts directly or indirectly the most important variables of the model, in the short and in the long run. Second, a strong currency depreciation can be the outcome of an unsustainable external position and a BoP crisis. Third, it is often used as a policy tool for economic development. Therefore, this appendix will elaborate concisely on these three aspects.

Developing countries may face strong pressures for currency depreciation, especially if they are in a situation close to Scenario A, described in section 5 above. In this scenario, the country is in an unstable external and public sector financial position. Since the cost of the net external liability is out of the control of the country, it will face currency depreciation pressures, which would stimulate augmented exports and curb imports. The country could try to accommodate this pressure by selling international reserves, as currency depreciation may have negative effects on inflation, real wages, and debt burden. However the use of international reserves is limited by their size, and the situation of an unstable external financial position and no international reserve would create pressure for sharp depreciations, which in turn, would impact the net external liabilities and can make imported technology and capital goods suddenly too expensive, compromising CAP investments.

Alternatively, there may be the case of the opposite scenario, in which countries face a strong pressure for currency appreciation. This is the case of commodity exporting countries, a common feature of developing countries. During a commodity boom, which is normally also associated with periods of expansion of international financial flows and risk appetite, investors look to developing countries seeking short-term higher returns. The inflow of dollars may be pushed even further by countries that aim to attract foreign capital through the increase of domestic interest rates. The increase in the price of commodities and the huge inflow of capital will promote an exchange rate appreciation. An overvalued currency may help countries to tackle inflation, generate a sensation of higher income, make imports cheaper (which will affect the current account), and attenuate debt burdens in the short run. However, currency appreciation may harm the competitiveness of the country, especially in the manufacturing sector and in the most sophisticated industries and services associated with it, thereby, undermining export diversification and reducing the growth rate of exports. Consequently, while in the short term exchange rate appreciation may bring some relief for the external financial position, and for the import of technology and capital goods demanded by CAP investments, it can, in the medium to the long run, jeopardize productive sophistication and stimulate regressive specialization, which would, in turn, compromise the sustainability of the external sector in the long run by reducing export potential and increasing external liabilities.

As has been shown, the exchange rate can affect important variables of the economy, including the most important variables of the SDFA framework. That's one of the reasons why countries with managed exchange rate regimes[22] may use the exchange rate policy – normally a competitive (or undervalued) exchange rate – as a policy for economic development and structural change (Rodrik, 2008; Araujo and Lima, 2007; Missio et al., 2017; Ferrari et al., 2013; Marconi et al., 2021; Bresser-Pereira et al., 2020). Figure 11 briefly describes some possible[23] implications of an exchange rate depreciation to the main variables of the model:

Figure 11
Implications of an exchange rate depreciation for the main variables of the model

Acronym	Variable	Expected effect of currency depreciation
M, m	Imports and imported input coefficient	In the short run, both imports and imported inputs measured in local currency increase. The import of capital goods and technology of CAP investment will become more expensive. In the medium/long run, there may be a substitution effect in which imported inputs are substituted by inputs produced locally.
X, g_x	Exports and the growth rate of exports	In the short run, export revenues measured in local currency increases. In the medium/long run, currency depreciation makes local production more competitive and is supposed to foster the growth rate of exports.
NEL, NED $D_G^{\$}$,	Net external liabilities, net external debt and public gross external debt	As we have stressed in the framework, NEL, NED, and D are affected by flows and variations in stock prices (holding gains). In the short term, the stock of external liabilities (including external debt) doesn't vary in terms of dollars but increases in terms of local currency. Moreover, the increase in the cost of imports may jeopardize the current account, thus, increasing NEL/NED and D. In the medium/long run, currency depreciation may stimulate exports to the detriment of imports (both inputs and final goods), which may improve the current account, thus reducing NEL and NED. Finally, a depreciated currency may attract FDI.
r, β r^*_{dg},	The average cost of net external liabilities, the real cost of public external debt, and the average cost of public sector liabilities	Since currency depreciation affects NEL, NED, and D, it will have implications on the cost of external debt and the real cost of public external debt, thus, affecting the average cost of net external liabilities and the average cost of public sector liabilities, respectively.
g	The growth rate of the economy	Currency depreciation is supposed to impact the growth rate of the economy negatively in the short run, due to a decline in income in terms of local currency, and positively in the medium/long run due to increased competitiveness.

As Figure 11 shows, an exchange rate depreciation impacts the most important variables of the model, in different directions, depending on the time frame of the analysis (short vs medium/long run). The net effect on the external and public sector sustainability as well as on CAP investments, will depend on the size of each effect, which in turn, may also be influenced by several other factors (some will be discussed below). Therefore, it is not the objective of this analysis to defend a 'best practice' or simulate the net effect of an exchange rate policy on the model, but rather to pinpoint some expected outcomes of exchange rate policies that policymakers must be aware of.

In the short run, currency depreciation may increase (decrease) the volume of exports (imports) – but will increase the cost of imports measured in local currency – and will make CAP investments – dependent on imported technology and capital goods – more expensive.

22 Among the beneficiary countries, Belize and the Saint Vicent and Grenadines have a fixed exchange rate regime

23 This report does not aim to elaborate an exhaustive analysis nor does it aim to describe all possible implications of the exchange rate in the variables of the model, but rather to highlight some possible and expected effects

An increase in external debt burden in terms of local currency, which can be private or public external debt will impact the average cost of net external liabilities and public sector external liabilities. Currency devaluation is also expected to be contractionary in the short term. In the medium and long run, the imported inputs may be substituted by inputs produced locally, and the growth rate of exports may increase due to the rise in competitiveness (local production is cheaper in international currency). The current account would improve and could improve to the point of reducing NEL and NED, which, in turn, would reduce the average cost of net external liabilities.

The net effect will depend on the size of each mechanism. If the country is very dependent on imports, if international interest rates on external debt are very high, and if the currency depreciation does not stimulate exports considerably, NEL (NED) and the average cost of net external liabilities (debt) may increase permanently, making the negative short-run effect persistent over time. In this scenario, the policy space for CAP investments would be limited both in the short as well as in the long run. Alternatively, if there is some local capacity for input substitution, if there are complementary economic policies (ex. industrial, commercial, and technological policies) to foster export growth and export diversification, and if there is a better international financial environment (lower interest rates on liabilities), there may be the case in which the short-term negative effects of currency devaluation are more than compensated by the positive effects in the medium and long run. In this scenario, the growth rate of exports would rise, and the average cost of external liabilities would decrease, which could put the country in a sustainable external financial position. Moreover, if exports are very sensitive to currency devaluation, the devaluation may also boost economic growth in the medium to long run[24]. The improvement in the external financial position, and in the actual and BoP-constrained growth rate, would also improve the sustainability of the public sector, opening policy space for CAP investments.

Regardless of the scenario, the exchange rate policy alone may be insufficient to promote structural transformation and must be regarded as one policy option within a coordinated development strategy. Many authors that study the development process of developing and middle-income countries have been highlighting the importance of coordination between macroeconomic and industrial policies (Guzman et al., 2018; Ocampo, 2020; Cimoli et al., 2020; Bresser-Pereira and Rugitsky, 2018; Nassif et al., 2018). Country-specific studies on the the impact of exchange rate on structural change, exports, investment and growth have found heterogeneous outcomes depending on the export orientation of local firms (Atella et al., 2003; Nucci and Pozzolo, 2001), the imported input coefficients of the industries (Li et al., 2019), the level of technology and capabilities of the industry/country (Bottega and Romero, 2021; Magacho et al., 2021), financial and liquidity constraints (Blecker, 2007), and local firms profit margins (Campa and Goldberg, 1999, 1995). In conclusion, exchange rate fluctuations and policies may have important implications for the variables of the model depending on a diverse range of factors, and, as a consequence, should be carefully considered in the analysis by the policymakers.

24 There is considerable empirical literature that supports this outcome (Eichengreen, 2007; Rapetti et al., 2012; Miao and Berg, 2010). There is also some literature that argues that in wage-led growth economies, this is not the case (Ribeiro et al., 2020)

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