REVISTA MEXICANA DE ECONOMÍA Y FINANZAS Nueva Época REMEF (THE MEXICAN JOURNAL OF ECONOMICS AND FINANCE)

Revista Mexicana de Economía y Finanzas, Nueva Época

Volumen 17 Número 2, Abril - Junio 2022, pp. 1-20, e717

DOI: https://doi.org/10.21919/remef.v17i2.717

(Received: May 10, 2021, Accepted: August 27, 2021. Published: October 25, 2021)

imef fundación de investigación

Finance for Climate Action: Postcovid-19 Recovery Challenges

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Abstract

This paper is oriented to explore the new developments in climate action financing within the framework of Just Transition. This discourse is linked to the post COVID-19 recovery and the sustainable finance agenda. The study is done through extensive literature review, combining aspects PRISMA guidelines and the Recursive Content Abstraction (RCA) analytical approach. After presenting the Just Transition framework, we analyze the provisions on financing of the Paris Agreement. Next, the financing gaps are identified with the COVID -19 impact. We pay a special attention on the debt service, the related developing countries difficulties, and the challenges for sub-national governments. Then we analyze the efficient market theory and its distortion in the time of COVID-19 crisis. Based on the topics discussed, at the end the paper presents some final remarks.

JEL Classification: C73, F34, F53, H81, O16, Q54.

Keywords: climate action financing, just transition, Paris Agreement, PostCOVID-19 recovery.

Finanzas para la acción climática: desafíos de la recuperación postcovid-19

Resumen

Este articulo está orientado a explorar los nuevos desarrollos en el financiamiento de la acción climática en el marco de la Transición Justa. Este discurso está vinculado a la recuperación post COVID-19 y la agenda de finanzas sostenibles. El estudio se realiza a través de una extensa revisión de la literatura, combinando aspectos de las pautas PRISMA y el enfoque analítico de Abstracción de Contenido Recursivo (RCA). Tras presentar el marco de Transición Justa, analizamos las disposiciones sobre financiación del Acuerdo de París. A continuación, se identifican las brechas de financiamiento con el impacto de COVID -19. Prestamos especial atención al servicio de la deuda, a las dificultades de los países en desarrollo en este contexto, así como a los retos para los gobiernos subnacionales. Luego analizamos la teoría del mercado eficiente y su distorsión en la época de la crisis del COVID-19. Con base en los temas discutidos, al final el estudio presenta algunas consideraciones finales.

Clasificación JEL: C73, F34, F53, H81, O16, Q54.

Palabras clave: financiamiento de acción climática, transición justa, Acuerdo de Paris, reconstrucción posCOVID-19.

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* No source of funding for research development

1. Introduction: Just Transiton and Redistribution Effects

COVID-19 has governments at all levels operating in a context of radical uncertainty. The regional and local impact of the COVID-19 crisis is highly heterogeneous, with significant implications for crisis management, policy responses, and financing options.

The Just Transition discussion gained importance since the Paris Agreement and is almost mainstreamed. Originating from civil society discourse and activism around issues of environmental and, primarily, labor/workers' rights, it is now morphed to be inextricably intertwined with the equity and justice presuppositions of climate change discussions as well as linked to the implicit and explicit underlying principles of equity in the UNFCCC. This was explicitly recognized in the Paris Agreement and the 2018 Just Transition Declaration signed by 53 countries at COP 24, which 'recognized the need to factor in the needs of workers and communities to build public support for a rapid shift to a zero-carbon economy.

Increasingly, Just Transitions is being linked to climate finance and investment. A variety of institutions who work, or, are affiliated with the banking and finance sectors are calling for actions, processes and instruments of finance and investment oriented towards climate change to be aligned with Just Transitions (CSIC, 2021). The argument as best outlined by Robin et al., (2020) is that finance will be crucial to making JT a reality as the scale and pace of finance has implications for both the impact and process of transitions.

Climate policies impose costs on specific sectors to create a public good. The climate benefits they produce are non-excludable; that is, everyone gains, including those who do not bear the costs of climate policies why workers in the fossil fuel and trucking industries view themselves as carrying the burden of climate protection—without much compensation. Unequal burden sharing fosters a sense of victimhood, leading to a backlash against climate policies. That imposes costs disproportionately on specific sectors did not focus on equity in terms of helping those who bear the costs of climate policies. These inequalities are growing in times of pandemics.

A second layer of argument is that the vast amounts of money dedicated to address climate change is focused on addressing mitigation such as phasing out fossil fuels and closing coal mines but not enough on addressing the impact of climate change on the people. Moreover, these are affected due to losses and damages from climate change or the population impacted by solutions to address climate change such as de-carbonization measures, which affect workers in the fossil fuel and transport sectors. Additionally, there are people harmed by polluting sectors: indigenous men and women, and poor communities. It is argued that very few resources are available to countries, investors, civil society, and international development institutions seeking to achieve a just transition (Just Transition Declaration, 2018; Robin et al., 2020).

The 2020 report of the International Energy Agency (IEA, 2020), informs that in 2020 global CO2 emissions were reduced by 6%, the most significant reduction since the Second World War. To put it in context, it amounts to the fact that the European Union had not issued anything during that period.

The lowest emissions were around 14% below those of 2019 around April, during the first global peak of the pandemic. An important aspect is that the reductions were, of course, stronger in some sectors than in others. For example, in April 2020, aviation generated 70% fewer emissions

than in April 2019, and for the entire 2020, they were reduced by 45%, which is equivalent to taking about 100 million cars out of circulation. The demand for oil fell by just over 8.5% and that for coal by 4%.

However, it should not be forgotten that after the global financial crisis of 2008, global CO2 emissions from the combustion of fossil fuels and cement production were initially reduced by 1.4%, then increased by 5.9% in 2010 (Ivanova, 2020). Similarly, it is currently detected that as activities have restarted in different regions, emission rates have returned to high levels. In fact, last December they had not only increased compared to the minimum value of previous months, but were even higher than those of December 2019.

That´s why it is necessary to explore the evolution of climate financing during the economic recovery. The main objective of the paper is oriented to explore the new developments in climate action financing within the framework of Just Transition. This discourse is linked to the post COVID-19 recovery and the sustainable finance agenda. The steps to accomplish the task are the following specific objectives: (1) Present the Just Transition framework; (2) Explore the Paris Agreement, the Addis Ababa Action Agenda and their links to Sustainable development; (3) Discuss the availability and effectiveness of the public sector funding, debt service and the related developing countries difficulties identifying financing gaps under the COVID -19 impact. (4) Analyze some classical theories and their distortion in the time of COVID-19 crisis. We explore the efficient market theory, the competitive game model versus cooperative game model, and the public theory on finance, innovation, and creative destruction. These theories should be revised in their both theoretical basis, and practical performance.

The methodology is based on an extensive literature review, combining aspects of the "Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines"[2], and the Recursive Content Abstraction (RCA) analytical approach[3]. Secondary data were collected through review of relevant materials including peer-reviewed papers, conference presentations and official organization documents available on the internet. The documents were identified through a combination of searches, using keywords and terms associated with climate change finance and post COVID-19 recovery.

The paper is structured into three sections after this introduction. After presenting the Just Transition framework, we analyze the Paris Agreement, the Addis Ababa Action Agenda and their links to equity and sustainability, in the first section. The second section explores the availability and effectiveness of the public sector funding, debt service and the related developing countries difficulties identifying financing gaps under the COVID -19 impact. After presenting the current public financing and its challenges, in the third section we analyze the classical theories in the new pandemic environment: the competitive game model versus cooperative game model, the efficient market theory and its distortion in the time of COVID-19 crisis, and markets: public theory, financial

[2] PRISMA is an evidence-based minimum set of items for reporting in systematic reviews and meta-analyses. PRISMA primarily focuses on the reporting of reviews evaluating the effects of interventions, but can also be used as a basis for reporting systematic reviews with objectives other than evaluating interventions (e.g. evaluating etiology, prevalence, diagnosis or prognosis). According to PRISMA guidelines Scopus, Google Scholar databases and grey literature were searched.

[3] For analysis, the configurative and recursive content abstraction (RCA) approach was used. This is because it was important to summarize the information from the various sources in a concise and coherent manner to aid effective discussions and meaningful conclusion.

innovation, and creative destruction. Based on the topics discussed, at the end the paper presents some final remarks.

2. Paris Agreement, Addis Ababa Action Agenda and Sustainable Development

The Paris Agreement states that it is necessary making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development." This reflects a broadened focus, beyond the costs of climate impacts/adaptation and mitigation, to recognizing that both imply a structural shift of and, potentially, additional scale of, investment, that needs to engage the wider financial system. The IPCC 1.5C report estimated that 1.5^{O}C pathways would require *increased investment* of 0.5-1% of global GDP between now and 2050, which is up to 2.5% of global savings / investment over the period. The overall *shift of investment* from high to low carbon-intensive infrastructure would be 5.6–8.3 % of annual capital income for relevant sectors, illustrating climate-related finance as a macroeconomic issue. For developing and emerging economies SDG-compatible infrastructure investments in the most relevant sectors (energy, water, transport, agriculture & urban) are estimated to be around 4-5% of their GDP (World Bank 2019).

The parallel 2015 UN Addis Ababa Conference on Finance for Development, and its resulting Action Agenda, aims to 'address the challenge of financing ... to end poverty and hunger, and to achieve sustainable development in its three dimensions through promoting inclusive economic growth, protecting the environment, and promoting social inclusion.

The international community agreed in 2015 through the Addis Ababa Action Agenda (AAAA) "*to* address *the challenge of financing and creating an enabling environment at all levels for sustainable* development" (AAAA, 2015). At COP16 in Cancun, countries "established the Green Climate Fund (GCF) "*as an operating entity of the Financial Mechanism*" under Article 11 of the UNFCCC to help finance the transition to a low-carbon economy. Advanced economies pledged $100 billion a year by 2020, but so far, only $5 billion have been committed. Confronting the problem of insufficient funding remains a challenge (Geels et al., 2017).

Assumptions in modelled scenarios point to multiple challenges around mobilization of funds at the required scale including establishment of favorable policy environments to reduce the cost of capital (CoC) for both mitigation and adaptation projects. The CoC remains an important barrier to increased flows, being especially high in developing countries (Buhr et al. 2018) where much of the infrastructure still needs to be built (Ivanova 2019). Modelled scenarios are usually based on globally uniform cost of capital, but implementation of observed regionally differentiated rates leads to an increased burden of mitigation on developed economies. A major challenge facing investors is the "*tragedy of the horizon*", the contrast between short-termism in the financial sector and the long-term lens required to estimate impacts from climate scenarios. The fulfillment of the nationally determined contributions (NDCs) of the developing countries are linked to financial contributions from the green climate funds (on national and subnational level).

Equity is important for all Sustainable Development Goals (SDG), such as goals for no poverty, zero hunger, gender equality, affordable clean energy, reducing inequality, but also for climate action

(Goal 4 10). In addition to the public good nature of the environment (Hardin 1968) and free riding, equity issues are important reasons why it is difficult to reach a significant global agreement, as it is hard to agree on the optimal level of greenhouse gas mitigation (or emissions) and how mitigation should be distributed among countries (Kverndokk 2018). First, optimal emission reductions depend on ethical considerations. Examples follow from simulations made on integrated assessment models. As these models use different ethical parameters such as the time preference rate and the valuation of consumption between agents with different consumption levels (concavity of the utility function), they also produce different optimal mitigation (IPCC, 2018). Second, treaties that are considered unfair may be hard to implement. Lessons from case studies show that people may not accept a distribution that is considered unfair, even if there is a cost of not accepting (Ivanova et al., 2020). Such assessment indicates the importance of policy as a driver of change at multiple levels and across many actors, with potential for benefits as well as costs at many levels. Policies at multiple levels within nation-states remains important and national-level legislation may be particularly important to the credibility and long-term stability of policy to reduce the risks and hence cost of finance and for encouraging private sector innovation at scale.

A new scenario user that has emerged since the AR5 is the climate-related financial risk disclosure. The community was jump started by the creation of the Task force on Climate-related Financial Disclosure (TCFD) in 2016 by the Financial Stability Board (FSB). The TCFD monitors and makes recommendations about the global financial system particularly with regard to climate-related financial risk and disclosure. Scenarios are needed to provide the foundational information that allows banks, businesses and other financial institutions to evaluate the physical (climate impacts) and transactional (emissions mitigation policies) financial risks. Scenarios need to include global, regional and local climate change information. Scenarios also need to provide the impacts of policies and measures on market prices and demands for commodities. Users need to provide their own assessments regarding the likelihood of alternative scenarios.

SD is a core concept within global development policy and agenda. It provides a development paradigm as well as concept that calls for improving living standards without jeopardizing the earth's ecosystems or causing environmental challenges such as deforestation and water and air pollution that can result in problems such as climate change and extinction of species (Zia and Kauffman, 2018).

Looked at as an approach, SD is an approach to development which relates the concept to the organizing principle for meeting human development goals while at the same time sustaining the ability of natural systems to provide the natural resources and ecosystem services upon which the economy and society depend. Considered from this angle, SD aims at achieving social progress, environmental equilibrium and economic growth (Zhai and Chang, 2019). Exploring the demands of SD, Ivanova et al. (2020) emphasized the need to move away from harmful socio-economic activities and rather engage in activities with positive environmental, economic and social impacts.

It is argued that the relevance of SD deepens with the dawn of every day because the population keeps increasing but the natural resources available for the satisfaction of human needs and wants do not. Griggs et al. (2014) maintain that, conscious of this phenomenon, global concerns have always been expressed for judicious use of the available resources so that it will always be possible to satisfy the needs of the present generation without undermining the ability of future generations to satisfy theirs. It implies that SD is an effort at guaranteeing a balance among economic

growth, environmental integrity and social well-being. This reinforces the argument that, implicit in the concept of SD is intergenerational equity, which recognizes both short and the long-term implications of sustainability and SD (Rosser, 2010). This is achievable through the integration of economic, environmental, and social concerns in decision-making processes. However, it is common for people to treat sustainability and SD as analogues and synonyms but the two concepts are distinguishable. Sustainability is the goal or endpoint of a process called sustainable development (Gray, 2010).

3. Public sector funding and debt instruments: consideration for developing countries under COVID-19 recovery

3.1 Consideration on availability and effectiveness of public financing

Drivers of public spending and alignment of public spending with the Paris Agreement debt levels have significantly increased over the past years with current and expected climate change impacts further burdening debt sustainability. Consequently, a debate has started about the appropriateness of the use of debt instruments in the context of international climate cooperation. Major challenges exist with regard to a robust calculation of indebtedness levels, in particular, the effect of climate change on the future GDP on the one hand and the appropriate use of debt instruments in particular in the context of adaptation and disaster response on the other hand. The methodology of rating agencies underpins the complexity of defining sustainable debt levels. Maastricht Treaty ceilings (3% of GDP government deficit and 60% of GDP (gross) government debt) are somehow artificial hurdle rates not considering aspects like maturity profile, GDP outlook and sensitivities, investor mixes and loan/debt terms.

With long-term economic impacts of climate change being in the focus of the modelling community, the volatility of GDP in the short term driven by shocks, such as COVID-19, is more difficult to analyze and requires country-specific deep-dives. IPCC scenario data is often not sufficient to perform such analysis with additional assumptions being (Acevedo 2016). For debt sustainability analysis, these more short-term impacts are, however, a crucial driver with transparency being limited to the significance of climate-related revision of estimates. Moody's takes into account the effects of both long-term climate trends as well as short-term shocks (Lafakis et al., 2019). IMF considers a 20-year time horizon with effect for the next 5 years and the period beyond 5 years being forecasted separately. A bottom-up approach is taken with country teams being responsible for the development of forecasts with a non-standardized approach regarding climate change impacts (IEA, 2019). The limited transparency resulting from this approach might result in a continued overestimation of future GDP as happened in the past increasing the vulnerability of highly indebted countries (Guzman, 2016). While climate change considerations have already affected country ratings and debt sustainability assessments (and financing costs), it is unclear whether current GDP forecasts are conservative enough. The review of the IMF debt sustainability framework leads to a stronger focus on vulnerability rather than only income thresholds when deciding upon eligibility for

debt relief and/or concessional resources (Mitchell, 2015), which could become a mitigation factor for the challenge described before.

With public funds becoming scarcer, a preference for loan rather than grant instruments could emerge in international climate cooperation requiring robust debt sustainability analysis as well as loan structures ensuring efficient debt restructuring and debt relief in events of extreme shocks and imminent over-indebtedness and sovereign debt default. In this context, the Commonwealth Secretariat flagged that the diversification of the lender portfolio made debt restructuring more difficult with more and more heterogeneous stakeholders being involved. This is a side effect of a stronger use of capital markets, which need to be carefully considered in the context of sovereign bond issuances. The use of debt-for-nature and debt-for-climate-swaps is still very limited and not mainstreamed but offers significant potential if used correctly although donor countries appear more reluctant to engage in debt relief given own resource constraints (Mitchell, 2015). At the same time, the limitation of the use of debt-based instruments as a response to climate-related disasters and counter-cyclical loans might be necessary (Griffith-Jones and Tyson, 2010).

3.2 COVID -19 and the Debt Service Suspension Mechanism

Before Covid-19, the situation was already alarming. For low and middle income countries, 2018 marked a new peak of debt levels amounting to 51% of GDP; between 2010 and 2018, external debt payments as a percentage of government revenue grew by 83 per cent in low- and middle-income countries, from an average of 6.71 per cent in 2010 to an average of 12.56 per cent in 2018. Global debt, also record high in 2018 with 230% of global GDP; Non-concessional debt on average 55% of debt of low-income countries; 50% of IDA countries are at high risk of debt distress or already in debt distress. Crisis will become the worst recession since the Great Depression and far worse than the Global Financial Crisis (-3% GDP in 2020).

However, investors in sovereign loans are much more diversified than during HIPC negotiations (and even more compared to the Latin America debt crisis) which private sector investors playing a stronger role in both bonds and syndicated loans. Creditor coordination problems are analyzed as one of the dominating reasons for inefficiency in sovereign distress situations (Ghosal and Miller 2003).

Considering the need for responses to short-term liquidity issues due to the COVID emergency, and long-term fiscal space, current action is rather focused the liquidity issue. IMF provides debt service relief to 25 countries, 6 months debt service; World Bank considers the debt service suspension as powerful, fast-acting measure, G20 economies allow for a suspension of bilateral debt as of May 1, 2020. World Bank provides some additional resources: 160 USD bn over the next 15 months, thereof 50 USD bn grants and highly concessional loans (+80 USD bn from other MDBs) An initiative of G20 considers postponement of up to 12 USD bn of pubic external debt for 77 countries, four year window for repayment.

The Debt Service Suspension Initiative (DSSI) potentially covers 77 LDC/IDA countries. The final list of possible beneficiaries was reduced to 73, as four countries (Eritrea, Sudan, Syria and Zimbabwe) are excluded due to being in arrears with the IMF and/or World Bank. Of those, 40 countries had confirmed their participation in the DSSI. Among the 33 countries that had not to date requested participation in the initiative, 12 countries were at high risk of debt distress in November

2020, according to the World Bank and IMF joint debt sustainability analyses. Many countries not participating in DSSI argued that they fear negative reaction from capital markets. S&P, Moody's and Fitch have stated that a private creditor standstill would lead to a downgrade of sovereign ratings (Fresnillo, 2020). Rating agencies had flagged the negative outlooks for many of those countries before and current investors must have been well aware of the risk so that an exclusion.

If focus remains on short-term support, underlying problems (more structural nature) of many low-income countries cannot be addressed (Fresnillo, 2020). The more longer-term discussion is not yet as much on the agenda as it needs to be, except, at least in EU, some kind of (very controversial) discussion about common liability bonds in the context of the Covid-19 recovery.

In order to ensure fiscal space for climate action in the coming decade of post pandemic recovery, a mix between debt relief, deferrals of liabilities, extended debt levels and sustainable lending practices including new solidarity structures need to be considered in addition to higher levels of bi/multilateral lending to reduce dependency on capital markets and to bridge the availability of sustainably structured loans for highly vulnerable and indebted countries. More standardized debt-for-climate swap, a higher share of GDP linked bonds or structures ensuring (partial) debt cancellation in case countries are hit by physical climate change impacts/shocks appear possible. The collective action clause might be a good example of a loan/debt term which became market standard. Definition of triggers is likely the most complex challenge in this context.

Delayed disorderly debt restructuring usually comes at very high costs, so a more relaxed view on and more standardized procedures for defaults might be needed as well. Many developing countries are perceived to delay any discussions on debt restructuring. However, inefficiencies and negotiation delays due to government behavior have received much less attention in the literature and there is barely any empirical evidence on the success or duration of restructurings of sovereign debt (Trebesch, 2008). Pitchford and Wright (2007) find that both creditor holdouts and creditor's free riding on negotiation effort contribute to a delay in debt restructuring. Interestingly, however, they also conclude that a reduction in delays via policy measures such as CACs (collective action clauses) would not be welfare improving. The paper on debt renegotiation by Bi (2008) argues that delays can be beneficial in that both creditors and debtors can share a larger "cake" once the debtor country has recovered. For this reason, both sides can have an incentive to delay a settlement if output is below a critical threshold. In the field of corporate finance, one can also find interesting empirical evidence on these issues. Franks and Torous (1994) study 45 distressed exchanges and reorganizations and come to an opposing result with regard to the latter. It is a striking feature, particularly during the late 1980s and early 1990s, that negotiations were suspended at the same time as payments were suspended. Bi also noted that some governments have explicitly justified negotiation delays with the wish to achieve an economic recovery first. Government behavior and political instability appear far more important in explaining lengthy restructurings. The volume of IMF credits has no systematic influence on the speed of crisis resolution (Trebesch, 2008).

3.3 Higher public spending levels driven by the impacts of Covid-19

Higher levels of public funding represent a massive chance but also a substantial risk. The missing alignment of public funding and investment activity with the Paris Agreement and sustainable development targets will result in significant carbon lock-ins and stranded assets and thus increase transitional risks. Many policy trackers have been established to monitor this alignment and flag inconsistencies.

Climate action above all faces a global 'commons' problem, that is not easily amenable to independent local (national) actions alone, leading to the tragedy of the global commons without international coordination and cooperation. The 2015 Paris Agreement (UNFCCC 2015) is a hybrid of collective action (international commitments and monitoring), but with voluntary and nationally determined actions, provided or conditional upon financing availability for most developing countries. Fragmented moderate national actions lead to clearly unsustainable climate outcomes, but the possibility of staged accession with regional leadership among a few large players (front-runner coalitions such as EU and China or 'climate clubs') does better, although still falling short of averting a rise in temperatures of above a 'safe' 2°C and higher costs of mitigation actions than if coordinated globally (Kriegler et al., 2015). Country actions most often proceed unilaterally for domestic political and economic reasons (McGrath and Bernauer, 2017), but do worse when faced with free riding.

There is a problem, however, when we turn to climate finance. Discussing Theory of Change (TOC) options for climate finance, as if national borders do not matter and that climate finance, wherever sourced globally, and in whatever form raised, finds its way seamlessly to needs and opportunities across national borders. In turns out that finance in general, and climate finance, has a particularly large 'home bias'. Over 80% of climate finance is reported to originate and stay within borders, and even higher for private climate flows (over 90%). There are multiple reasons for such 'home bias' in finance - national policy support, differences in regulatory standards, exchange rate, political and governance risks, information market failures and credit rating home bias - which we examine in Section 15.6.3. There is evidence that trade and investment integration, as in EU, reduces the extent of this home bias (Gehring and Schneider, 2018), but recent trends towards 'trade and investment disintegration', globally or regionally, would make matters worse. Moreover, even in case of supranational institutions (EU budgets, MDBs, development finance institutions), the nationality of decision-makers appear to shift allocations towards 'home' countries (Gehring and Schneider 2018) and strategic choices. Such extensive home bias means that even if national actions are announced and intended to be implemented unilaterally and voluntarily, the ability to implement them requires access to climate finance that are constrained by the relative ability of domestic financial and capital markets, and access to global capital markets that requires supporting institutional policies in source countries. Enabling public policies and actions locally (cities, states, countries and regions), to reduce investment risks and boost domestic climate capital markets financing, and to enlarge the pool of external climate financing sources with policy support from source capital countries thus matter at a general level.

The particular context, however, is that the biggest problem in climate finance is likely to be in developing countries, even in the presence of such enabling policies and quite apart from any other considerations such as equity and climate justice (Klinsky et al., 2017) or questions about the equitable allocations of future 'climate budgets' (Ivanova et al., 2020). The differentiation between

developed and developing countries matter most on financing. Most developed countries have already achieved very high levels of incomes, have the largest pool of capital stock and financial capital (which can be more easily redeployed within these countries given the 'home bias' of financial markets), the most well-developed financial markets and the highest sovereign credit-ratings, in addition to starting with very high levels of per capita carbon consumption - factors that should allow the fastest adjustment to low carbon investments and transition in these countries from domestic policies alone. Whether this is happening at a fast-enough rate there is a different question, relatively unconstrained by access to well-developed financial markets and public resources.

The financial and economic circumstances are the opposite for virtually all developing countries, even within a heterogeneity of circumstances across countries. The dilemma, however, is that the fastest rates of the expected increase in future carbon emissions are in developing countries. The biggest problem of climate finance globally is thus likely to be the constraints to climate financing because of the opportunity costs and relative under-development of capital markets and financing constraints (and costs) at home in developing countries, and the relative availability or absence of adequate financing policy support internationally from developed countries. The Paris Agreement and commitment by developed countries to support the climate financing needs of developing countries thus continue to matter a great deal.

Other topic of concern are the subnational governments (OECD, 2020). That´s why it is important to introduce activate or reorient existing multi-level coordination bodies that bring together national and subnational government representatives to minimize the risk of a fragmented crisis response. Support cooperation across municipalities and regions to help minimize disjointed responses and competition for resources. Promote inter-regional or inter-municipal collaboration in procurement especially in emergencies. Promote the use of e-government tools and digital innovation to simplify, harmonize and accelerate procurement practices at subnational level.

The goal of the Sub-national Climate Fund Global (SnCF Global or the "Fund") is to catalyze long-term climate investment at the sub-national level for mitigation and adaptation solutions through a transformative financing model. The SnCF Global's business model is designed to attract primarily private institutional investment and to deliver certified climate and Sustainable Development impacts and Nature-based Solutions at global scale (SDGs, NbS). The subnational level is key: 70% of known climate solutions are located within the boundaries of subnational authorities. Significant additional investment is needed in this sector to achieve the climate goals of the Paris Agreement. The SnCF Global presents a positive disruptive solution on how subnational climate projects should be structured, de-risked, and funded by both private and public investors, while monitored and benchmarked at the highest level of rigor and quality (OECD, 2020).

If it is assumed then that there is a role for substantial international or global coordination to accelerate public and publicly supported or mobilized private climate finance flows to developing countries (the reason clearly why finance was added as a third goal in the 2015 Paris Agreement), then group strategic behavior, and its dynamics between nation-states become paramount. One useful analytic tool in this regard is game theory to inform choices about factors and conditions that might lead to successful outcomes on climate finance.

4. Analysis of some classical theories and models in the new reality

4.1 Competitive game model versus cooperative game model

There are two contrasting models. One is a competitive 'game' where nation-states primarily focus rationally about their own self-interests and then making decisions on how to behave (cooperate or free ride on the actions of others). Fortunately, this need not always be the case. Still, in a competitive climate finance coordination 'game', individual nation-states will always want to minimize their individual financial contributions to the group goal while hoping that others will contribute more - leading inevitably to a prisoner's dilemma where the group outcome (total climate finance contribution of all members) will be far less than a more socially optimal possibility where everyone would contribute more and the sum of the efforts would be of greater benefit to all in terms of a global public good such as global warming. All that is needed to arrive at this outcome are two assumptions: those nation-states value their individual self-interest more than the collective values one in terms of financial contributions, and second that the group cannot exercise any costs of non-compliance by any member to freeride or 'cheat' on their obligations.

In a cooperative game, with repeated interactions, the picture changes. Here the challenge is the collective action problem that not all members are necessarily equally committed to the group outcome (raising the maximum possible climate finance for developing countries given their circumstances) for a variety of possible reasons (limited public finances, political costs at home, other), and therefore, to prevent the consequences of freeriding by some (which if allowed to happen, may attract more 'defectors' or free-riders over time and lead to less than socially optimal outcomes), deterrence rules have to be devised. The twin problems with deterrence in a global climate outcome game are that: (a.) it is not possible to exclude any member from the benefits; and (b.) it is difficult or even impossible to enforce these rules, as in the case of the competitive game. What is possible in climate finance is, however, smaller initial coalitions or clubs (Nordhaus, 2015) with more cohesive and cooperative group selection of 'like-minded' members (Stua, 2017), with greater specific deterrence measures tied to access to climate finance benefits and (pre-) commitment rules of membership so that exit becomes costly (costs of leaving are greater than the costs of staying). Over time, the benefits of membership in this smaller climate finance group - faster access to climate finance, lower costs of financing, and reciprocal spillovers of higher growth and economic benefits of higher investments rates in climate investments in developing countries to source capital developed countries - may induce the membership to grow, so long as these benefits are demonstrable and the rules of membership are consolidated.

The key questions then are the initial membership selection (Ostrom, 2015) on which members and how many would bring greatest value to the group (the 'Shapley' value in game-theoretic terms (Shapley, 1953) which depends on attributes (of the contribution a member makes to the group), the rules of club membership (such as up-front financial commitments or pre-commitments clearly specified), and the costs of exit (cannot access preferential terms of financing or its derivatives). These are in fact also reasons that multi-lateral development banks (MDBs) came into existence and have operated successfully in expanding areas of development financing, which

now includes climate finance as key goals. However, the MDBs have multiple financing objectives not necessarily restricted to climate (diffusion), and have inherited their own priorities and governance structures which may not be fully compatible with the narrower goal of accelerating climate finance dramatically. In addition, the membership has become so broad that it may be difficult to establish new rules of the game - calling for a smaller, more cohesive climate finance North-South club and specific instruments, such as the large-scale use of multi-sovereign guarantees, and using 'shadow' price for social value of carbon mitigation action (SVMA) to determine the value of such guarantees (Pottier, 2018).

4.2 Efficient Financial Markets and Financial Regulation

An influential efficient financial markets hypothesis (Fama 1970, 1991) proceeds from the assumption that in well-developed financial markets, available information at any point of time is already well captured in capital markets with many participants. In addition, market participants rapidly absorb any new information (say, effects of fossil fuels on global warming and its downsides) and changing prices; therefore, public interventions can do little to improve the working of such financial markets and are not generally justified.

The efficient financial markets hypothesis is perhaps the most extensively tested model of capital markets. It was widely believed to be correct earlier but is now increasingly discredited (Sewell, 2011), especially by repeated episodes of very large and continuing global financial crashes and crises, and other widely noted anomalies (or irrationalities). However, the jury is still out on whether a weaker form of the efficient markets hypothesis still applies (that given enough time, investors cannot do better than the market, even if the latter makes short-term errors). Specifically turning to climate future, the rational markets hypothesis would argue that given enough time and information becoming credibly available, the market for climate finance would adjust on its own and start to increasingly provide the incentives for the scale and needs of climate finance. It is arguable from this point of view that as a cascade of more credible scientific information has been accumulating about the effects of global warming, it is being accompanied by rising levels of climate finance, such as global green bonds, while banks and institutional investors are also progressively rebalancing their investment portfolios away from fossil-fuels and towards rising portfolios of low-carbon investments as fastest-growing energy source until 2040, which however will not be sufficient (IEA, 2019; Monasterolo and Raberto, 2017).

However, the efficient markets hypothesis is only reliable in a weak form and almost certainly wrong in the extreme form (Fama 1991). In the meantime, the world runs the risk of sharp adjustments, crises and irreversible 'tipping points' that could be sufficiently dangerous to destabilize long-term climate outcomes. That leads to the policy prescription towards financial regulatory agencies requiring greater and swifter disclosure of information about rising climate risks faced by financial institutions in projects and portfolios and central bank attention to systemic climate risk problems as one possible route of policy action (Dietz et al. 2016). The reality is that in practice, market adjustment has so far been weak: disclosure requirements of risks and information in private settings remain mostly voluntary and difficult to implement (Monasterolo and Raberto, 2017), credit rating systems have paradoxically raised costs of borrowing for poor countries for

climate and non-climate financing (Buhr et al., 2018). At the same time, little has been done to alter the ground conditions for climate investment to shift decisively towards low-carbon investments in developed country markets, where there is no real differentiation except labelling and terminology yet between green bond markets and overall bond markets. The absolute volume of green bond markets (nearing 1 trillion USD cumulative) although rising remains small relative to the overall size of global bond markets (about 80 trillion USD), and there is as yet no significant rating changes evident for fossil-fuel companies and oil majors, other than coal, despite significantly rising risks of 'stranded assets' in fossil fuel sectors (Diaz-Rainey et al., 2017). The Efficient Market Hypothesis (EMH) suggests that prices incorporate all the available information at any point in time, yet as we show a systemic factor, the health risk, was not always rationally incorporated in stock prices. The Runs-tests confirm our assumption that the market was not efficient during the examined period. The reason for this inefficiency could be that something is missing from traditional finance models, such as the impact of fear of COVID-19. For this reason, we employ a *Coronavirus Fear Index* (CFI) based on Google searches and using Granger causality, we provide empirical evidence that the fear drives the S&P500 performance, and using a GARCH model, we show that the fear negatively influences the performance of the US stock market (Vasileiou, 2020).

Nevertheless, financial markets are innovating in search of solutions. They appear to be internalizing the increased scientific information now available on climate change risks, and the impacts already becoming evident on the ground. The pandemic risks are increasingly incorporated also (SARS, MERS, and now COVID-19). As a result, many more instruments of what is best termed as 'financial engineering' are being deployed to enable larger-scale long-lived low-carbon investments at individual project levels, as also at a more 'macro' level of sectors, cities and states (C40 Cities Climate Leadership Group et al., 2016). These include securitizing renewable energy to spread the risks beyond the reach of single investors, non-recourse project financing to protect sponsoring companies from debt risks (including establishing bankruptcy-protected companies), bundling construction financing, debt financing (bank term loans and bond market private placements), mezzanine financing (mezzanine debt, leasing, tax equity), pool financing (inverted leases, asset-backed securities (ABS), equity inflows through Real Estate Investment Trusts (REITs), master limited partnership (MLPs), yield cost (contracted cash-flows to secure debt), and the use of government guarantees to secure offtake risks and to generally de-risk projects and lower the cost of capital. Recognizing and dealing with stranded fossil-fuel assets is also a key area of growing concern that financial institutions are beginning to grapple with. Larger institutions with more patient capital (pensions, insurance) are also increasingly beginning to enter the financing of projects and green bond markets. The combined influence of these factors is that the size of innovative project innovation has grown rapidly, financing in effect the very rapid increases in clean energy, solar and wind projects, and starting to enter other sectors, especially the financing of transport and energy in cities in both developed and developing countries. Nevertheless, the scale has not been nearly enough to bridge the overall financing needs and gaps. The scarcity of 'bankable' or implementable projects of scale is also sometimes mentioned (C40 Cities Climate Leadership Group et al., 2016). Banga (2019) suggests that developing countries have lacking appropriate institutional arrangements, such as the conflicts of different organizational goals and policies, as well as the minimum size of green bonds, which requires a certain size of green projects to finance, and high transaction costs. Those

institutional and market barriers are obstructing the wider use of green bonds in developing countries.

The situation in developing countries is inherently more challenging because domestic financial markets are not well developed, and there are large currency, political, governance and other risks for cross-border private flows. The case for efficient financial markets in developing countries, which are expected to account for nearly two-thirds of financing needs for climate mitigation investments, is worse (Hong et al., 2019). This happens because of weaker financial institutions, heightened credit rationing behavior, high-risk aversion since most developing country markets are rated as junk or below investment grade or just barely above investment grade (barring exceptions of high savings countries, such as China). Other restrictions are the limited long-term financial instruments and underdeveloped domestic capital markets, absence of significant domestic bond markets for investments other than sovereign borrowing, inadequate term and tenor of financing, and other related financial constraints, which make the efficient markets thesis practically inapplicable and unviable for most countries and circumstances. Subnational governments´ effort to de-risk might turn out negative and encourage privatization of public services (Gabor, 2019). More generally, the development of subnational capital markets and robust domestic financial systems is a priority but takes a very long period of institutional change and can be expected to work only in a limited number of fast-growing and high savings middle-income countries and regions. More pro-active interventions, such as publicly organized and supported low-carbon infrastructures through resurrected national development banks may therefore be justified (OECD, 2020).

High investment risks tend to obstruct low-carbon investments, especially in LDCs and developing countries. It is important to implement effective de-risking measures to reduce investment risks, but lacking research and data availability hinders designing de-risking measures (Dietz et al., 2016). Also, the traditional risk financing mechanisms, such as solidarity and insurance, does not appropriately cover the long-term trend in weather-related disasters or climate change adaptation that can incur losses and damages on long-term investments. Especially in developing countries, traditional risk financing mechanisms often fail to cover extreme losses and climate adaptation, and the risks bearers with low financial resilience suffer severely from losses and are forced to give up their productive assets. In addition to the traditional risk financing, innovative risk financing mechanisms, such as index-based micro-insurance programs, catastrophe bonds and contingent credits, for disaster-risk management and climate change adaptation can be beneficial to enhancing financial resilience of risk bearers, especially the most vulnerable communities and their governments.

The financial market may follow the adaptive market hypothesis, instead of efficient market hypothesis. For example, the UK energy system satisfied the conditions for adaptive markets hypothesis that is based on evolutionary economics theory. The theory considers 'institutional and structural constraints, behavioral routines, and fundamental uncertainties.' In this sense, the range of climate policies for low-carbon investments may not be limited to providing subsidy and market mechanisms for supporting a rational return but expanded to changing agents' behaviors and overcoming structural constraints.

4.3 Markets: Public Theory, Finance, and Creative Destruction

The extension of the case for public policy to supporting new markets and the role of new entrepreneurship and finance has a long tradition, going back to Schumpeter (1934). The logic as applied increasingly in climate finance is that investments are not just about progressively enlarging the space of low-carbon investments but replacing one system (fossil fuels energy system) rapidly by another (low-carbon energy system), establishing a wave of 'creative destruction'. Normally, this might be expected to proceed without public policy intervention over a longer time when profit opportunities in older technologies are exhausted and replaced by newer ones. But the scale and urgency might force options of change to occur faster, supported by state policy because excessive financiarization may be impeding the establishment of new investments (Jerneck, 2017), the presence of strong complementarities between Schumpeterian (technological) and Keynesian (demand-related) policies (Dosi et al., 2017) and to avoid the lock-in damages of long-lasting infrastructure investments using fossil-fuel technologies.

A literature review of the policy-induced technological choices for low-climate investment conducted for the European Commission (Mercure et al. 2016), concludes that all surveyed branches of macro-innovation theory (under different models) could be grouped into two principal classes: 'equilibrium – optimization' theories that treat innovators as rational perfectly informed agents and reaching equilibrium under market price signals; and the other 'non-equilibrium' theory where market choices are shaped by history and institutional forces and the role of public policy is to intervene in processes, given a historical context, to promote a better outcome or new economic trajectory. One implication of the latter is that new technologies might not find their way to the market without price or regulatory policies to reduce uncertainty on expected economic returns. However, the review suggests that more evidence is needed (for use in simulation models) about the conditions under which policies that promote low-carbon, capital-intensive investment in the place of conventional, less capital-intensive alternatives would divert financial resources and displace investment elsewhere (significantly) in the economy and whether the pool of financial resources available is large enough. A key issue is the perception of risk by investors and financial institutions and modelling the financial sector more adequately (in the simulation models). Some reviews of the role of the financial system in other studies suggest that a systemic approach using multiple instruments (cutting subsidies to fossil fuels, supporting clean energy innovation and diffusion, levelling the institutional playing field and making risks transparent) is key to redirecting private investment, whereas others suggest that a bigger systemic push may be needed in particular, the role of 'institutional innovation intermediaries' (Polzin, 2017).

The Schumpeterian three-stage process of invention, innovation and diffusion was unpacked for eight core countries in the European wind-sector by Lam et al. (2018). They suggest that public R&D support did not necessarily induce significant effects on invention (patents), there were large cross-border knowledge spillovers (impact of international patents) indicating that openness to trade was important, capacity expansion had positive effects on learning-by-doing on innovation over time, and that feed-in-tariffs (FITs), in particular, had positive impacts on technology diffusion. The FITs program - long-term (10 to 25 years) power purchase contracts with guaranteed grid-access and cost-based prices - more generally has been associated with rapid increase in early renewables capacity expansion across the world (in over 50 countries) by reducing market risks in

financing and stability in project revenues. However, with later rapidly rising fiscal costs of subsidies and rapid gains in technology driving generation close to grid-parity, has now increasingly halted or switched to alternative designs of more cost-effective public support, with greater differentiation (location, size, technology), performance-based systems, progressive cost-reductions given technology changes and increasingly, reverse auctions instead of baseline FITs (Lam et al., 2018). More complex policy questions are also now becoming evident on the design of public risk-reduction innovation and diffusion support as the size of renewables electricity generation expands, such as storage options and costs (including meeting peak demands with more rapid demand-sensitive fossil-fuels such as gas turbines as a complement), scarcity pricing, electricity grid-interconnectivity across borders, factors driving decline in costs by scaled production and adoption of new technologies in major global manufacturing centers, innovation and technology transfer in global value chains (Zhai and Chang 2017), and equilibrating the marginal social cost of different sources of renewable energy.

5. Final remarks

There is growing recognition that the just transition is the next step in climate action. Not only is there a principled need to connect climate action with questions of social justice, but there is also a powerful economic case. The just transition neatly connects the climate agenda with the regional imbalances and development imbalances on world level.

The awareness of the need for solidarity at moments of disruption has been further deepened by the experience of the COVID-19 crisis. Regardless of the approach, environmental and climate groups seem to agree that support for effective climate policy depends on more equitable processes, policies, and investments. "Just transition" policies are hence seen as an important course correction in this regard.

Developing countries have lacking appropriate institutional arrangements, such as the conflicts of different organizational goals and policies, as well as the minimum size of green bonds, which requires a certain size of green projects to finance, and high transaction costs. Those institutional and market barriers are obstructing the wider use of green bonds in developing countries.

The multilateral development banks (MDBs) have multiple financing objectives not necessarily restricted to climate (diffusion), and have inherited their own priorities and governance structures which may not be fully compatible with the narrower goal of accelerating climate finance dramatically, and its membership has become so broad that it may be difficult to establish new rules of the game - calling for a smaller, more cohesive climate finance North-South club and specific instruments, such as the large-scale use of multi-sovereign guarantees

Innovative financial products with increased transparency on climate risk can facilitate investor identification and eventual uptake of low carbon investments. Innovative products may not necessarily increase financial flows for climate solutions in the near term; however, they can help build capacity on climate risk and opportunities within institutions and companies to pave the way for increased flows over time.

Some orientations of the climate action financing in the post COVID-19 recovery should be the following: Introduce, activate or reorient existing multi-level coordination bodies that bring together national and subnational government representatives to minimize the risk of a fragmented crisis response.

Support cooperation across municipalities and regions to help minimize disjointed responses and competition for resources. Promote inter-regional or inter-municipal collaboration in procurement especially in emergencies. Promote the use of e-government tools and digital innovation to simplify, harmonize and accelerate procurement practices at subnational level.

It is necessary to strengthen international, national and subnational-level support to vulnerable groups to limit further deterioration in their circumstances and to strengthen inclusiveness, including by simplifying and facilitating access to support programs, ensuring well-targeted services, introducing adequate and/or innovative fiscal support schemes, and identifying the needs for revising fiscal equalization policies.

National and subnational governments should foster the cooperative measures regarding COVID-19's fiscal impact on subnational budgets using shared evidence and data and taking into account the differentiated impact of the crisis. Help subnational governments reduce the gap between decreasing revenues and increasing expenditures during the COVID-19 crisis to avoid underfunded and unfunded mandates and possible sharp cuts in subnational spending. Special grant schemes could help close these gaps.

The new reality is distorting some classical models and theories. The macro-innovation theory is performing as 'non-equilibrium' theory where market choices are shaped by history and institutional forces and the role of public policy is to intervene in processes, given a specific socio-economic context, to foster a better outcome or new economic trajectory. The cooperative game model is gaining place versus the competitive game model, although not all members are necessarily equally committed to the group outcome.

Finally, some widely accepted hypothesis, as the efficient financial markets must be revised, as it is performing more as adaptive market hypothesis, including COVID-19 (and other pandemic) fear indexes.

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