

**Conference on Climate Change  
and its Impact on the Financial System**

**December 5, 2019  
Mexico City, Mexico**

**Closing Remarks  
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**Closing Remarks**

- Good afternoon ladies and gentlemen, I am very pleased to close the **Conference on Climate Change and its Impact on the Financial System**. We had a distinguished group of experts sharing its perspectives and knowledge from different sides as academia, policy makers, climate change organizations and financial industry.
- I would first like to thank the collaborations of Banco de México and NGFS, which were a big support in the realization of this conference; also I would like to thank to all the presenters, who shed light on the ongoing work being done to study and assess the impact of Climate Change in the Financial System, as well as some of the actions currently being taken and that has to be take in order to have greener finances. I am very glad for the response obtained in the Call for Papers, as well as the time that the academics took to come and share its work with us. Last but not least important, I would like to thank to all our IT and administrative staff.
- This conference was very enriching since it presented in one side, evidence from cases of different jurisdictions, about the impact made by diverse climate risks and the effects on its own economies. More specifically:
  - In the first session, academics showed evidence of the (negative) impact produced by Climate risks as floods, rainfalls and climate policy shock, on aspects as inflation, bank lending and financial stability.
  - Then, second session deepen on the impact of physical risks as ocean's temperature variation and Tropical Cyclones. More specifically we saw the effect of "El Niño" both on the production and price fluctuation in Costa Rica, and on food inflation in Colombia. Also we saw the effect of Tropical Cyclones on manufacturing and services sectors in México.
  - Finally, the third academic session provides us with diverse investment and monitoring tools, based on the measurement of Climate Risk through the use of CoVar, Machine Learning and Multicriteria Analytical models

- First, in Bayangos et al. (2019), through the construction of the rainfall damage index (RDI), showed that extreme weather episodes have compelling impact on Philippine banking sector.
- Then, in Roncoroni et al. (2019), by the development of an innovative method to analyze the effect on financial stability of the interplay between shocks in climate policy and different market conditions; where they identify climate policy scenarios and market conditions under which systemic losses can pose a threat to financial stability
- Next, Faiella and Natoli (2019), constructed a long-term climate risk indicator to study bank lending to firms under risk of flooding. Following a municipal level approach, they found that banks are aware of climate-related catastrophe risk and ration credit to risky firms.
- In León (2017), explores the impact of “El Niño” on production and price fluctuations. The study found that this climate phenomena generates an increment in prices.
- For the next paper presented, Juárez-Torres and Puigvert, studied the effects of Tropical Cyclones (TC) on secondary and tertiary activities in México. They found that firms from manufacturing and services show negative effects of TC exposure.
- Then, in Abril et al. (2019), another study of the effects of “El Niño” was conducted. For this case they found evidence of a (nonlinear) relationship between this weather phenomena and food prices in Colombia.
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- In the other side, policy panels shed light on diverse topics. More precisely:
  - In the first session, representatives from Mexican bank firms discussed on the approaches that each one is taking in order to have sustainable and greener finances; they agreed that carrying out this task is of utmost importance not only for its own firm, but for the banking system as a whole.
  - Then, in the second policy panel, presenters contributed to show us some of the research currently being developed on climate change, green finance and economy, and the role that regulators could play in order to boost the study of these issues.
  - Next, the third policy sessions give us an insight on the role that institutional

investors and asset managers can take in order to move resources towards green investments, this with the help of tools based in ESG indicators, scenario analysis, data mining, AI, among others techniques, that could help investors to make a smoother transition to green investing.

- For the fourth panel, we deepen on the role that taxonomies play in the transition to an environmentally sustainable financial system, how to treat with its diversity, the different types and their application to the identification of greener products.
- In the last policy session
- Regarding to the knowledge shared during the conference, I would like to take advantage to make announce that all the material will be shared through our recently created *Latin American Journal of Central Banking*, which will be published by Elsevier and has the purpose to represent a meeting point for high quality research on the different topics that are relevant to central banks and other financial regulatory bodies.
- Also I would like to briefly mention firstly our editors: Manuel Ramos-Francia (chief editor), Serafín Martínez-Jaramillo, Tito Cordella, Darell Duffie, Alejandro Hernandez, Ayhan Kose, Dimitrios Tsomocos and Fernando Zapatero. And secondly our coeditors are: Stefano Battiston, Daniel Chiquiar, Santiago García-Verdú, Fabrizio López Gallo and Marco van der Leij.
- Let me conclude hoping you have had a pleasant stay in Mexico City, I encourage you to become active players in your institutions by using, applying and further investigating what you have learned during these two days. Thank you for your attention
  
- I hope that this Course becomes a reference across the region and, more importantly, contributes to train our Membership with the analytical capacity to better deal with the new challenges in financial stability analysis and monitoring. I also hope that you find that the material will be useful for allowing you to perform your current duties in a more efficient way.

- The inception of this Course relates to the fact that after the Global Financial Crisis (GFC), a wide consensus on the importance of financial stability began to form. This has taken place at the national, regional, and international levels. Moreover, this keen interest is shared by policy makers as well as academics. Nevertheless, this undeniable importance was less recognized before the GFC, as has been argued elsewhere.<sup>1</sup>
- Among some of the most relevant aspects that have been discussed (e.g., see Ramos Francia (2019)), we **first** find a lack of acknowledgment of the financial channel's relevance and its absence in most macroeconomic models. As a **second** aspect, there was little recognition of the high level of interconnectedness in the financial system. These, among other relevant aspects were well covered by our lecturers.

### General Equilibrium models for financial stability

- In this context, Professor Tsomocos has been developing General Equilibrium models as well as Dynamic Stochastic General Equilibrium (DSGE) models, featuring key components such as incomplete financial markets, endogenous default and liquidity constraints. These are useful to analyze financial fragility and constitutes a solid foundation to study financial stability.
- During the course, you also studied the Bank of Chile and the Bank of Greece Case Studies', for which Professor Tsomocos shared with us his valuable experience.
  - In the case of Chile, in Kazakova et al. (2018), based on a DSGE model for a small open economy with heterogeneous banking sector, the authors study financial stability in the presence of financial frictions (liquidity constraints and default) and real economy shocks (copper price).
  - For the case of Greece, using a Real Business-Cycle (RBC) model explaining that the efficient use of funds from debt relief can have positive effects on both debtors and lenders. Such effects depend on a sensible positive profitability of future investments by the debtors, as well as their willingness to use these funds in such investments, as explained in Goodhart et al. (2016).
- You also learned that there is also an important case for the evaluation of regulatory policies using general equilibrium models. For instance, in Goodhart et al. (2013), the authors explore the interactions of different financial regulations and their impacts on financial stability and wealth.
- I have the conviction that this material will provide participants with a solid framework

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<sup>1</sup> Ramos-Francia (2019) during his opening speech at the CEMLA's IX Financial Stability Meeting

to study financial stability.

- In my following remarks, I would like to highlight two broad themes that were also covered in the course: first, interconnectedness and second, stress testing and agent-based models.

### Interconnectedness

- Allow me then to underscore the following **aspects** on interconnectedness.
- Broadly speaking, the analysis of interconnectedness and interdependencies across various markets and activities (layers) has gained prominence in financial stability. This is nowadays commonly done with a focus on systemic risk. In effect, the GFC revealed how interconnected the financial system really is. This had led to consider interconnectedness as a central feature for financial stability analysis and monitoring.
- **Moving on to more specific aspects:**
  - **First**, a key one that the GFC also revealed is that the **supervisory data to evaluate and monitor interconnectedness in the financial system** were simply not there when it was most needed. Opportunely, many financial authorities around the globe have already started to fill this important data gap.
  - **Second**, since the aftermath of the GFC, researchers started to enhance **interconnectedness measures** to improve our understanding of the evolution of the financial system's structure. This has mainly entailed a systemic risk perspective. Notwithstanding, the complexity in financial markets keeps challenging researchers and policy makers alike. This pushes them to constantly improve their methodological and analytical tools, and will allow all to better understand interdependences and connections across various markets and activities.
    - As an example of such a process, let me mention that in Battiston and Martinez-Jaramillo (2018). They highlighted the importance of rethinking how to model financial contagion considering various channels through which financial shocks are transmitted. In short, one should always consider how different layers of financial systems are interconnected.
  - **Third**, financial distress can be transmitted not only by direct losses but also by increasing funding rates and haircuts, and/or by reducing funding availability, and/or through asset fire sales. More empirical and theoretical work is needed to understand how financial distress is transmitted through different layers in financial systems and, in turn, to the real economy.

- Being more concrete, in a banking system, there are multiple interactions between the different layers. Thus, it is challenging to measure the level of contagion. In this context, Poledna et al. (2015) propose a novel model to estimate systemic risk in the Mexican Banking system. They take a multilayer network approach and they found that systemic risk is consistently underestimated if only a single layer approach is used instead.
  - **Fourth**, financial contagion is central for measuring systemic risk because of the amplification of initial shocks and its potential transmission through the financial system. Having said that, interconnectedness is not always bad. For instance, Martinez-Jaramillo et al. (2019) discuss cases in which higher connectivity is a positive feature from a financial perspective.
- I hope that you learned from Dr. van der Leij the most important aspects of this area, which have proven to be essential to understand issues such as contagion channels, stress testing and to quantify systemic risk.

#### Financial stability visualization and agent-based modelling

- As a second broad topic, allow me to make some remarks on Financial stability analytics, visualization, stress testing and agent-based modelling.
  - **First**, in many jurisdictions there has been an increasing effort to **monitor financial stability**. There are many approaches and useful tools to do so. We were glad to hear from Mark Flood his insights as a practitioner at the Office of Financial Research in the US.
  - **Second**, we learned how **stress testing** has evolved from a traditionally micro prudential tool into a macro prudential, data and model intensive policy tool. Mark presented with care this evolution of the stress tests and also highlighted some of the most relevant aspects to take into account when performing them.
  - **Third**, some of the emergent factors that could potentially lead to financial instability are endogenous. Thus, good theoretical models, which also consider its endogenous nature, are being designed. However, there is still much work to be done.
  - **Fourth**, a way to face some of these limitations, agent-based Modeling has been

proposed. This has proven to be a useful methodology in many fields<sup>2</sup> and also in economics and finance where agents are conceived as computational intelligent units. The Agent-based Computational Economics (ACE) approach is a field of research based on a “bottom-up” approach. This helps to explain, from micro interactions among economic agents, the macro dynamics of the economy.

- In this context, Martínez (2007), highlights the importance of the design of agents’ strategies. Among such design choices are: i) the decision-making process, the objective function, iii) the different levels of heterogeneity; and the learning mechanism. For instance, one of the most important results in Martínez (2007) is that the greater the agents’ heterogeneity the better the artificial financial market replicates key statistical properties of stock prices.
- We expect that Mark’s expertise in this new set of tools can be useful for those of you who are already involved in stress testing and financial stability monitoring, but also for those of you who are only starting to learn about them.

### Final remarks

- Let me conclude hoping you have had a pleasant stay in Mexico City, I encourage you to become active players in your institutions by using and applying what you have learned during these three days. Thank you for your attention.

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<sup>2</sup> Agent-based modelling is not exclusive of economic and finance applications. It is possible to find AB modelling in applications like pedestrian and traffic modeling, disease dynamics, drug development, energy flows in the power grid, etc.

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