PROYECTO DE INVESTIGACIÓN INTERNO SIN FINANCIAMIENTO PII-DM-2021-03
"Credit risk contagion in private banking sector: a case study for Ecuador"

En la ciudad de Quito D.M., a los veinte y cuatro días del mes de octubre del año dos mil veintidós, comparecen a la celebración de la presente Acta de Finalización del Proyecto de Investigación Interno Sin Financiamiento ***PII-DM-2021-03 "Credit risk contagion in private banking sector: a case study for Ecuador"***, por una parte, la ***Dra. Alexandra Patricia Alvarado Cevallos*** en calidad de ***Vicerrectora de Investigación, Innovación y Vinculación*** de la Escuela Politécnica Nacional, y por otra la Dra. Adriana Uquillas Andrade en calidad de ***Directora del Proyecto de Investigación Interno sin financiamiento PII-DM-2021-03,*** al tenor de lo siguiente:

1. ANTECEDENTES:

a) Mediante Memorando EPN-DM-2021-0198-M del 6 de abril de 2021, La Jefatura del Departamento de Matemática - DM solicita al Vicerrectorado de Investigación, Innovación y Vinculación la aprobación del proyecto de investigación interno sin financiamiento titulado: *"Credit risk contagion in private banking sector: a case study for Ecuador",* propuesto por la Dra. Adriana Uquillas.

b) El Consejo de Investigación, Innovación y Vinculación, en sesión ordinaria del 15 de junio de 2021, mediante Resolución RCIIV-098-2021 aprobó el *"Informe de Propuestas de Proyectos de Investigación Internos sin Financiamiento – mayo 2021"*; entre los proyectos aprobados en el informe se encuentra el proyecto "*Credit risk contagion in private banking sector: a case study for Ecuador*", propuesto por la Dra. Adriana Uquillas.

c) Mediante Memorando EPN-DI-2021-0535-M del 24 de junio de 2021, la Dirección de Investigación notifica a la Jefatura del Departamento de Matemática, la aprobación del proyecto de investigación interno sin financiamiento con código PII-DM-2021-03, con fecha de inicio 28 de junio de 2021 y fecha de finalización 27 de junio de 2022.

2. DATOS GENERALES DEL PROYECTO:

Código del proyecto	PII-DM-2021-03
Título del proyecto	Credit risk contagion in private banking sector: a case study for Ecuador
Director	-UQUILLAS ANDRADE ADRIANA
Unidad ejecutora	Departamento de Matemática
Líneas de investigación	- Modelos econométricos - Teoría de probabilidades y procesos estocásticos
Objetivo	To analyze and understand the overall relationship between credit risk portfolios; to determine the effects of this relationship on the management of credit risk in private financial sector
Duración del proyecto	*Fecha de Inicio: 2021-06-28 *Fecha de Fin Planeada: 2022-06-27 *Fecha de Fin Real: 2022-06-27 *Duración total: 12 meses
Presupuesto asignado	0,00 USD
Entrega del informe final	30 de septiembre 2022

Vicerrectorado de Investigación, Innovación y Vinculación
Campus Politécnico "J. Rubén Orellana R." /Av. Ladrón de Guevara E11-253 y Andalucía / Teléfono: 2976300 Ext. 1050
Quito-Ecuador

3. INFORME FINAL:

Mediante Memorando Nro. EPN-DM-2022-0935-M del 30 de septiembre de 2022, la Dra. Adriana Uquillas, Directora del proyecto de investigación interno sin financiamiento PII-DM-2021-03 presenta el Informe Final del proyecto que dirige. La información es recibida y revisada por la Dirección de Investigación, se anexa a la presente acta y forma parte integrante de la misma, cuyas conclusiones y productos generados son:

CONCLUSIONES:

Credit risk is one of the most important risks in risk management and administration by financial system entities. Identifying the factors that affect credit risk helps us discover vulnerabilities in the financial system that could cause losses to the economy sector and to the entities that integrated the system. To allows us to establish economic and risk control policies that positively impact the financial system's health and stability. From the empirical results for the private banking system of Ecuador, it is established that:

1. In Ecuador's private banking system, shocks are transmitted quickly in the explanatory variables. Deposits, GDP ratios, net financial absorption degree margins, liquidity indexes, ROE, and credit volumes simultaneously affect consumer delinquency loans, microenterprises, and housing portfolios. A shock to net productive assets proportion and inflation takes a month to affect loan quality. On the other hand, the effects of the shock of the variation of primary non-oil exports and the variation of imports of consumer goods takes two months. Some of these indicators as exogenous variables in the model are widely supported in the literature (Marcucci & Quagliariello, 2008; Rinaldi & Sanchis- Arellano, 2006; Vazquez et al., 2012; Uquillas & González, 2017). Delays of the autoregressive part of the model's endogenous variables have the most significant effect. This because their shocks are transmitted short term (they take six months) but not cumulatively.

2. The analysis of the impulse-response functions shows us that housing's delinquency against shocks of the delinquency of consumption and microcredit represents the smallest effect in general terms. This result is mainly supported by the differences in microcredit and consumer products compared to housing loans. A personal loan is unsecured, whereas a mortgage uses your house as collateral if you default on a mortgage, you could lose your home. On the other hand, a unitary shock of consumer delinquency causes an increase in microcredit delinquency immediately, and its effect is maintained for a month later. Then, it presents a significant negative fall in the following month, until it stabilizes and disappears at the tenth month. Furthermore, a unit shock of microcredit delinquency produces increased consumer delinquency only in the medium term, after seven months.

3. Regarding the stress tests, the results of the static and dynamic predictions are very satisfactory. Also, the specification tests jointly with the time considered for the modeling give robustness to the model, so the model is reliable for stress testing. We consider a scenario where the private banking system is inefficient in the placement of its resources in productive assets and does not receive enough deposits from its clients.

Additionally, it does not generate enough income to cover its operating expenses, pay its shareholders, and has less liquidity. For this, we create one of the worst scenarios observed in its history for each selected variable. Under this scenario, the results indicate that one year after this shock in the economy and in credit management, consumer delinquency would increase by 4.69

percentage points, from 4.67% to 9.36% and microcredit delinquency increases 6.08 percentage points, from 4.93% to 11.01%. On the other hand, housing delinquencies would present the least effect, rising 0.6 percentage points, from 2.78% to 3.38%. In general terms, the proposed methodology is robust. Additionally, the inclusion of exogenous variables allows us to build and evaluate stress scenarios. Thus, this paper describes a model that mapsmultivariate scenarios to portfolio's credit risk by deterministic simulations. Our approach is an extension of existing macro stress-testing models. It distinguishes between the probability of default of each portfolio and allows inter- portfolio credit risk contagio, including macroeconomic and financial factors. Including inter- portfolio linkages in macro, stress-testing allows evaluating individual shocks' systemicimportance as their impact spreads among portfolios via a domino effect.

Simultaneously, the amount of endogenous risk due to "contagious" defaults may change from portfolio to portfolio, depending on the volume and concentration of interportfolio exposures. The overall advantage of analysing interportfoliolinkages is that it leads to a better understanding of systemic risk's micro-dynamics. Thus, analyzing the financial institution's delinquency rate, netting out interportfolio exposures might lead to underestimat-ing the credit risk. On the other hand, the analysis of inter-portfolio linkages represents only a first step in incorporatingfeedback effects into macro stress-testing. As we have maintained the assumption of banks keeping afixed portfolio over the simulation horizon (DVOL variable). Even more, each portfolio's credit volumes were not considered, which yields a static matrix of inter- portfolio claims.

In reality, banks attempt tore-optimise their inter-portfolio exposures, away from those products most affected by an adverse shock and thus most in need of liquidity. Another possibility is also to consider a feedback effect between the financial system and the real economy. However, the diversity of potentially significant feedback effect sand the research's ongoing nature argue against building a large, sophisticated model. It is better to start with a small model that can include additional feedback effects as needed and improved as the research develops. This because the equations are a reduced-form model of delinquency, which summarizes the complex interaction between the state of the economy and predetermined credit products. Using a short period for their development, it is unlikely that the parameters or functional forms remain stable. Finally, further research in this area might also focus on using macro stress-testing techniques as an operational tool to incorporate financial stability considerations into control risk policy decision-making.

PRODUCTOS:

- **Artículo publicado**: "*Inter-portfolio credit risk contagion including macroeconomic and financial factors: A case study for Ecuador*"; Adriana Uquillas; Ronny Tonato; *Economic Analysis and Policy* (Indexada Scopus, Q1 - 2021), ISSN: 03135926; diciembre 2021. https://doi.org/10.1016/j.eap.2021.11.006

- **Ponencia en evento**: "*Canales de contagio en riesgo de crédito";* Adriana Uquillas; Octava edición de la Conferencia de Matemáticos Ecuatorianos en Paris; 5 al 9 de septiembre de 2022 en París – Francia

- **Perfil de proyecto**: *"Entrepreneurship and Microfinance in developmental context: Managemen of Credit risk and liquidity risk"*, Adriana Uquillas; Presentado para proyecto interno de investigación sin financiamiento en la Escuela Politécnica Nacional.

4. LIQUIDACIÓN ECONÓMICA:

El Proyecto de Investigación Interno sin Financiamiento PII-DM-2021-03 no contó con asignación presupuestaria.

5. FINALIZACIÓN:

Con la presente Acta se declara finalizado y cerrado el Proyecto de Investigación Interno Sin Financiamiento PII-DM-2021-03 "*Credit risk contagion in private banking sector: a case study for Ecuador*".

Para constancia de lo ejecutado y por estar de acuerdo con el contenido de la presente Acta, las partes libre y voluntariamente suscriben la misma, en tres ejemplares de igual contenido, tenor y valor legal.

Dado en la ciudad de Quito, D.M. a los a los veinte y cuatro días del mes de octubre del año dos mil veintidós.

Firmado electrónicamente por:
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Directora del Proyecto PII-DM-2021-03

cc/np