



SYSTEMIC BANKING CRISES  
IN COMPLEX ECONOMIES

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# Systemic banking crises in complex economies\*

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## Abstract

This paper provides an early warning exercise suggesting that in complex economies, characterized by the production of knowledge-intensive products, systemic banking crises are more frequent, even after considering standard predictors of crises. We relate our findings to standard contributions in development theory linking economic growth to structural transformation of the economy. In this perspective, we argue that while transitioning from a simple to a more complex productive structure can promote economic growth, it can also increase financial instability.

*Keywords*— Financial fragility; Economic complexity Index; production Capabilities

*JEL Code*— G01, 014, 033

## 1 Introduction

Endogenous growth models suggest that changes in the economy’s structure, along with technological innovation and expansions in production capabilities, drive development in emerging economies (Rosenstein-Rodan, 1943; Hirschman, 1980; McCloskey, 1981; Romer, 1990; De Vries, 1994). However, structural transformations can also entail detrimental social effects, such as job displacement and social dislocation (Kuznets, 1971; Robinson and Acemoglu, 2012; McMillan et al., 2014; Rodrik, 2016).

This paper aims to investigate whether structural changes in the economy, along with technological innovation and the expansion of production capabilities, may also affect countries’ financial fragility. We quantify the knowledge embedded in a country’s production sector using the Economic Complexity Index (ECI) introduced by Hidalgo and Hausmann (2009). The ECI provides a quantitative measure of a country’s production structure based on its potential product range, reflecting the available knowledge and technology. This approach assumes that the rarity of certain products signifies higher required knowledge since they can only be produced in locations with the appropriate expertise.<sup>1</sup>

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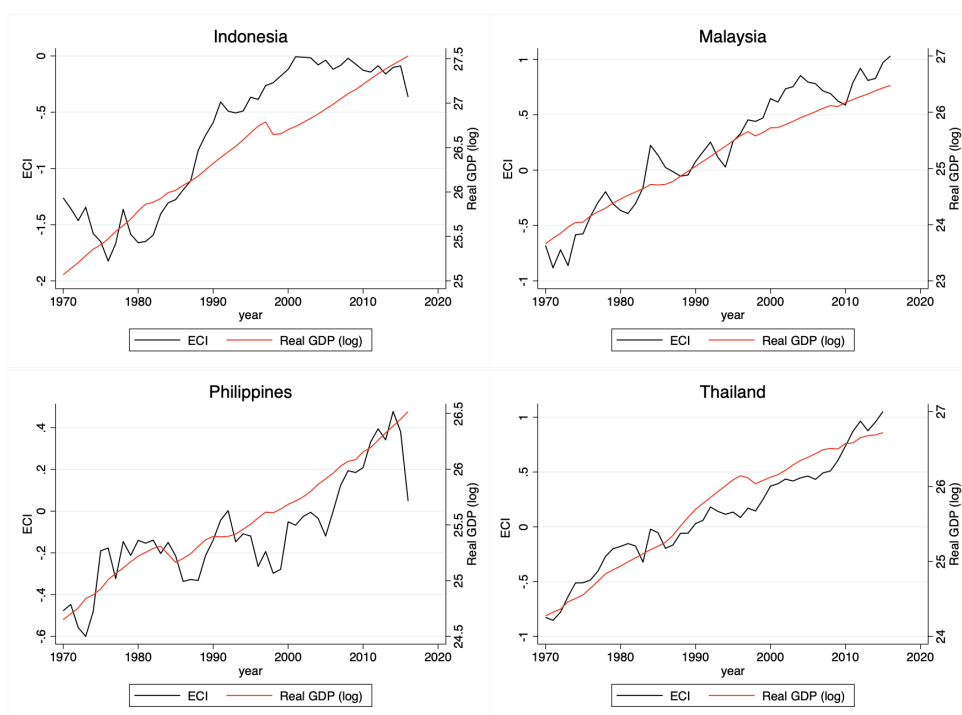
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<sup>1</sup>See Section 2 for details about the construction of the ECI.

Although numerous factors could link the ECI to financial fragility, to our knowledge, no research has explored this connection. Countries producing complex products tend to have intricate intersectoral linkages where small shocks can lead to significant aggregate effects ([Acemoglu et al., 2017](#); [Hausmann et al., 2014](#); [Elliott and Jackson, 2023](#)). Additionally, the interdependence among sectors increases uncertainty and opacity, complicating risk assessment and management ([Kline and Rosenberg, 2010](#)). Conversely, in countries where productive knowledge is such that agriculture is the dominant sector, fluctuations in agricultural commodity prices can be a significant source of financial instability ([Eberhardt and Presbitero, 2021](#)). Our findings show that countries with advanced production knowledge and technology experience more frequent financial crises than others, even after controlling for standard crisis predictors.

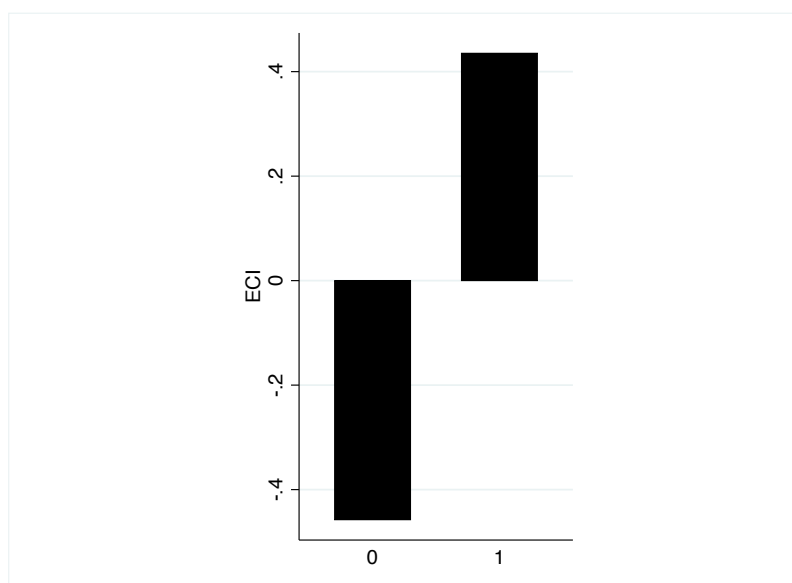
While we recognize that our estimates should be interpreted cautiously, the potential relationship between countries' productive structure and financial fragility raises interesting points that deserve scholars' attention. The ECI significantly explains cross-country income and growth differences, serving as a predictor of economic growth ([Hausmann et al., 2014](#)). Hence, simple economies may transition to high-growth paths by implementing structural reforms to increase production system complexity ([Hickson, 2017](#)). For instance, the Tigers—Indonesia, Malaysia, the Philippines, and Thailand—experienced rapid industrialization in the late 1960s, with manufacturing growing over 10% annually for three decades. This industrialization process has been accompanied by economic growth and an increase in the complexity of these countries (Figure 1).

Figure 1: ECI and Real GDP for the Tigers



In this view, our findings suggest that moving from a simple to a more complex production structure can foster economic growth but also increase financial instability. The Tigers, notably, were all affected by the Asian crisis, a crisis that seems to have spared the less complex countries in the Southeast Asia region (Figure 2).

Figure 2: The Economic Complexity Index and the Asian Crisis



The Figure shows the average Economic Complexity Index by groups in the 1996 (one year before the onset of the Asian crisis). The group 0 identifies countries in the East Asia and Southeast Asia that did not experience financial turmoils during the Asian crisis. The group 1 identifies countries East Asia and Southeast Asia that experienced financial turmoils during the Asian crisis (1997-1998).

Our paper relates to an extensive literature discussing the determinants of systemic banking crises. Macroeconomic imbalances are often associated with financial fragility (Demirgüç-Kunt and Detragiache, 1998; Kaminsky and Reinhart, 1999). Following the contribution of Diaz-Alejandro (1985), several papers emphasize the role of financial liberalizations and credit booms in promoting financial instability (Noy, 2004; Loayza and Ranciere, 2006; Jordà et al., 2011, 2013). Other contributions examine the effect of financial openness (Klomp, 2010; Joyce, 2011). Papi et al. (2015) showed that countries participating in international support programs, such as IMF lending programs, are less likely to experience systemic banking crises.

## 2 The Construction of the Economic Complexity Index

Due to data availability, the ECI is computed by looking at exports. Let  $X_{cp}$  be the total export of country  $c$  in product  $p$ ,  $C$  is the number of countries and  $P$  is the number of products in the global trade market. Let  $R_{cp}$  be the ratio between the weight of product  $p$  in the bundle of products that the country  $c$  exports and the world average weight of product  $p$  in the exports.

$$R_{cp} = \frac{X_{cp} / \sum_{p'}^P X_{cp'}}{\sum_{c'}^C X_{c'p} / \sum_{c'}^C \sum_{p'}^P X_{c'p'}} \quad (1)$$

We say that a country has a revealed comparative advantage in exporting a product  $p$  if  $R_{cp} \geq 1$ . Let us define a matrix  $M \in \mathbb{R}^{C \times P}$ :

$$M_{c,p} = 1 \text{ If } RCA_{cp} \geq 1$$

$$M_{c,p} = 0 \text{ If } RCA_{cp} < 1$$

That is, the matrix  $M$  assigns value 1 to the cell  $(c, p)$  if the country  $c$  has a revealed comparative advantage in exporting a product  $p$ . From the matrix  $M$ , it is possible to compute two measures: the diversity and the ubiquity.

$$\text{Diversity}_c = k_{c0} = \sum_p M_{c,p}$$

$$\text{Ubiquity}_p = k_{p0} = \sum_c M_{c,p}$$

The diversity of a country counts the number of products in which the country has a revealed comparative advantage. Instead, the ubiquity of a product counts the number of countries that have a revealed comparative advantage in exporting that product. Let us define a matrix  $\tilde{M} \in \mathbb{R}^{C \times C}$  whose

entries are as follows:

$$\tilde{M}_{c,c'} = \sum_p \frac{M_{c,p}}{k_{c0}} \frac{M_{c',p}}{k_{p,0}}$$

The entry  $(c, c')$  in the matrix  $\tilde{M}$  increases if countries  $c$  and  $c'$  have both relative comparative advantages in the same products. The term  $M_{c,p}M_{c',p}$  is divided for the ubiquity of the product  $p$  to weight more the products that are competitively exported only by a handful of other countries. Finally, the ECI of a country  $c$  is defined as:

$$ECI_c = \frac{K_c - \sum_c^C K_c / C}{\sigma_K}$$

Where  $K_c$  is the  $c$  entry of the eigenvector of  $\tilde{M}$  associated to the second largest eigenvalue. Intuitively, a country has a positive ECI if the bundle it exports is above the world mean in terms of diversity and ubiquity.<sup>2</sup>

### 3 Descriptive Statistics and Empirical Specification

Our analysis integrates various datasets. To identify country-year observations in which a financial crisis is present, we use the criteria established by [Laeven and Valencia \(2013\)](#): significant signs of distress in the banking system and notable policy interventions. ECI data are publicly available from [The Growth Lab at Harvard University \(2019\)](#). Control variables cover standard predictors of crises, including macroeconomic conditions, financial indicators, the country’s openness, and policy indicators. Macroeconomic indicators include GDP, income growth, current account balance, and inflation from the [World Bank Database](#). Financial indicators are derived from [Svirydzenka \(2016\)](#) and capture the efficiency of financial institutions (e.g., net interest margin, lending-deposit spread, return on assets, return on equity, and overhead costs to total assets) and financial markets (constructed from the ratio of the value of stocks traded to stock market capitalization), along with domestic credit expressed as a percentage of GDP. Openness indicators, sourced from [Chinn and Ito \(2008\)](#) and the [World Bank Database](#), encompass financial openness, merchandise trade, and foreign direct investments. The polity index, discussed by [Marshall et al. \(2011\)](#) and sourced from the [The Systemic Peace Database](#), gauges political characteristics. The final sample consists of a panel of 107 countries from 1980 to 2016. Table 1 in the appendix reports the list of the countries included in our dataset, while Table 1 provides

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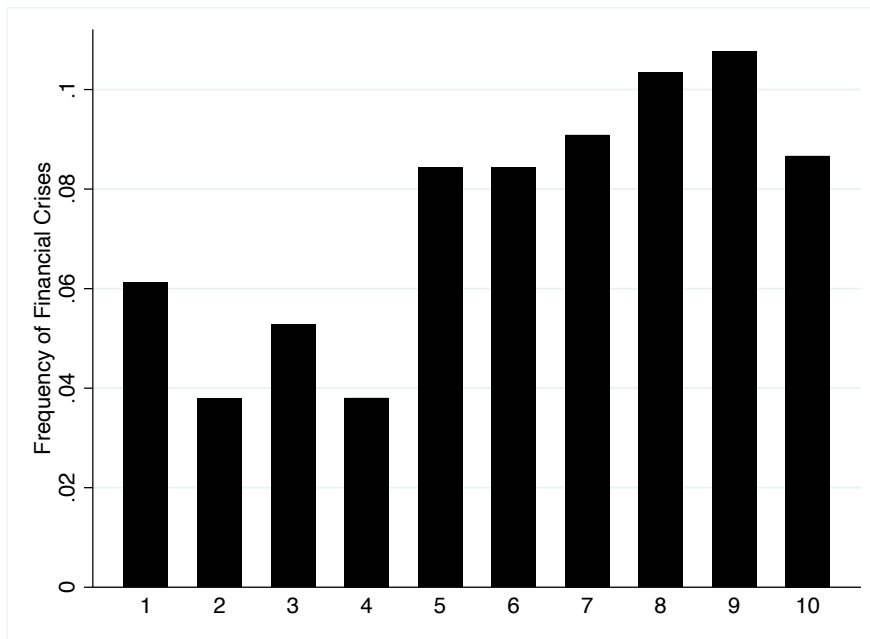
<sup>2</sup>See [Hidalgo and Hausmann \(2009\)](#) for more details.

summary statistics for the explanatory variables.<sup>3</sup>

Table 1: Explanatory Variables

	N	Mean	Std. Deviation	Min	Max
ECI		.0185624	1.012141	-2.79136	2.62482
Real GDP (log)		25.143	1.819429	21.18839	30.55151
Growth Rate Income Per Capita		.0206752	.0421428	-.2998648	.3303049
Current Account (% GDP)		-.0097542	.0716155	-.5710411	.706216
Inflation		24.81826	287.7804	-11.68611	11749.64
Merchandise Trade		59.36616	39.66474	4.909436	364.6777
Financial Openness		.5284202	.371584	0	1
FDI		3.331449	5.654181	-37.17265	86.47915
Domestic Credit		46.08797	38.22213	.163575	210.4865
Financial Institution Efficiency		.5768795	.1390259	0	.9220551
Financial Market Efficiency		.280858	.3385459	0	1
Polity Index		3.971914	6.712162	-10	10
N	3062				

Figure 3: Frequency of Years of Crisis across ECI's Deciles



<sup>3</sup>Data on inflation present exceptional values due to the Bolivian hyperinflation that occurred in the mid-1980s. Our empirical analysis exploits the entire sample; however, the results are qualitatively the same if we exclude outliers.

Table 2: Estimates

	(Logistic Regression)	(Logistic Regression)	(Margins)	(Margins)
	Banking Crisis	Banking Crisis	Banking Crisis	Banking Crisis
ECI	0.402*** (3.45)	0.527** (2.08)	0.0294*** (3.30)	0.0319** (2.09)
Real GDP (log)		-0.330** (-2.06)		-0.0200** (-2.08)
Growth Rate Income Per Capita		-10.16*** (-5.07)		-0.616*** (-4.73)
Current Account (% GDP)		-6.384*** (-3.34)		-0.387*** (-3.26)
Inflation		0.000476** (2.34)		0.0000289** (2.33)
Merchandise Trade		-0.0119** (-2.12)		-0.000722** (-2.12)
Financial Openness		-1.365** (-3.26)		-0.0828*** (-3.18)
FDI		0.0205 (1.18)		0.00124 (1.18)
Domestic Credit		0.0398*** (8.03)		0.00241*** (7.65)
Financial Institution Efficiency		-4.760*** (-6.30)		-0.289*** (-5.75)
Financial Market Efficiency		1.970*** (4.43)		0.119*** (4.23)
Polity Index		-0.0195 (-0.84)		-0.00118 (-0.84)
_cons	57.20*** (4.10)	91.63*** (3.77)	4.633** (2.26)	5.202*** (4.06)
Year Effects	Y	Y		
<i>N</i>	2928	2768	2928	2768

*t* statistics in parentheses

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.001$



Figure 3 provides a graphical illustration of the positive association between the complexity of an economy and its financial fragility. The Figure plots the frequency of years where financial turmoils are in place over the distribution of the ECI. The figure clearly illustrates that years of financial turmoil are more frequent in the right tail of the complexity distribution. To confirm whether the positive relationship between complexity and financial fragility persists when the variability of other factors is considered, we estimate a logistic regression with predetermined regressors (one year lag) to limit reverse causation. The specification includes year fixed effects. However, to extend the analysis to countries that never experience financial crisis, we do not include country’s fixed effects.

$$\text{Banking Crisis}_{i,t} = \alpha + \beta \text{ECI}_{i,t-1} + \gamma X_{i,t-1} + \mu_t + \varepsilon_{i,t} \quad (2)$$

Table 2 summarizes our findings. In the first column, we present estimates from a logistic regression that includes only the ECI and time effects. In the second column, we present estimates from a logistic regression that considers both the ECI and other controls. Columns (iii) and (iv) display the margins from the previous regressions. Standard predictors of financial crises show the expected signs, and the ECI exhibits a positive relationship with financial fragility.

## 4 Conclusion

Technological innovation and knowledge acquisition serve as potent catalysts for initiating economic development processes. Consequently, transitioning from a simplistic to a complex economic model is a desirable goal for developing nations. This transition not only enhances productivity but also fosters resilience against external shocks. However, our analysis reveals a positive relationship between production knowledge and financial fragility. This finding suggests that as countries enhance their production capabilities and complexity, they may inadvertently increase their vulnerability to financial instability.

# Appendices

## A Table

Table 1: List of Countries

Country	Freq.	Percent	Valid	Cum.
Albania	22	0.72	0.72	0.72
Algeria	37	1.21	1.21	1.92
Angola	18	0.59	0.59	2.51
Australia	37	1.21	1.21	3.72
Austria	33	1.08	1.08	4.80
Azerbaijan	20	0.65	0.65	5.45
Bangladesh	27	0.88	0.88	6.33
Belarus	8	0.26	0.26	6.59
Belgium	16	0.52	0.52	7.11
Bolivia	36	1.17	1.17	8.29
Botswana	17	0.55	0.55	8.84
Brazil	36	1.17	1.17	10.02
Bulgaria	23	0.75	0.75	10.77
Cambodia	22	0.72	0.72	11.48
Cameroon	36	1.17	1.17	12.66
Canada	12	0.39	0.39	13.05
Chile	37	1.21	1.21	14.26
China	30	0.98	0.98	15.24
Colombia	35	1.14	1.14	16.38
Congo, Rep.	28	0.91	0.91	17.29
South Africa	36	1.17	1.17	81.70
Spain	35	1.14	1.14	82.84
Sri Lanka	37	1.21	1.21	84.05
Sudan	31	1.01	1.01	85.06
Sweden	37	1.21	1.21	86.26
Switzerland	21	0.69	0.69	86.95
Syrian Arab Republic	31	1.01	1.01	87.96
Tanzania	29	0.95	0.95	88.91
Thailand	36	1.17	1.17	90.08
Togo	36	1.17	1.17	91.26
Trinidad and Tobago	33	1.08	1.08	92.33
Tunisia	33	1.08	1.08	93.41
Turkey	37	1.21	1.21	94.62

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