

Dollar Funding Shortage - A New Database and New Evidence

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Importance of Dollar Funding

The U.S. dollar's dominance in global finance: ▶ Figure

- 62% of banks' foreign currency liabilities are in dollars (BIS, 2022)
- 88% of FX transactions occur against the dollars (BIS, 2022)
- 83% of credit related cross-border payments are in dollars (ICC, 2018)

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Global dollar cycle correlates with the global economic downturn

- Following a 10 % \uparrow dollar, EMs GDP 1.5% \downarrow in 8Q (Obstfeld & Zhou, 2022)

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What about dollar funding shortage at the **country level**?

This paper: 1) Uses machine learning techniques to measure dollar funding conditions. 2) Examines the economic consequences of **country level** dollar shortage.

This Paper

Key contributions:

1. Introduces a new quarterly database that measures the dollar funding shortage for a sample of 119 economies since 1980
2. Empirical analysis of the adverse effect of **country-specific** dollar funding shortage episodes on various macroeconomic dimensions

Methodological contribution:

- Apply the most recent deep learning innovation announced in 2020: the **NLP-RoBERTa** model for article classification

Results Preview

Macro effects: Following a moderate level of dollar shortage crisis:

- 5.2% decline of **GDP** over 18 quarters
- 15.0% decline of **banks' dollar liability** over 17 quarters
- 7.2% decline of **imports** over 18 quarters
- 5.0% decline of **exports** over 14 quarters

Sectoral effects:

- Exports in sectors that are highly dependent on external dollar finance decline 15.0% more than low-dependent sectors

Related Literature

Text-based measurement of financial indicators:

- (Romer and Romer, 2017); (David & Leigh, 2018); (Ahir et al., 2022); (Caldara & Iacoviello, 2022); (Fratzscher et al., 2022)

This paper: Use NLP model to classify crisis information.

International role of the USD

- Dollar Funding: (Bruno & Shin, 2015); (Ivashina et al., 2015)
- Dollar Exposure Indicators: (Boz et al., 2020); (Benetrix et al., 2020)

This paper: Examines the influence of **country-specific dollar funding shortage episodes** on the real economy.

Plan of the Talk

- Construction of DFS Index
- Description and Validation
- Empirical Analysis

Definition: Dollar Funding Shortage

- Define **DFS** as a country-wide dollar liquidity stress in its **banking sector**
- Also includes:
 - ▶ Dollar shortage at non-bank financial institutions that affect the dollar liquidity in the banking sector
- Definition excludes:
 - ▶ Temporary BoP shock that does not affect banks' dollar liquidity
 - ▶ Firm-level dollar illiquidity

Data Source - News Based

- Screening the news using a **dictionary of words**
- **Global Media**: NYT, WSJ, BBC, the EIU Country Report, the Reuters, Dow Jones, Financial Times, and Agence-France-Press (AFP)
- **Regional and Domestic Lead Media**: 700+ news agencies from 156 countries. E.g., Ce Noticias Financieras, Arabic News, South China Morning Post, etc.
- DFS as covered by the English-language press

The Search Terms

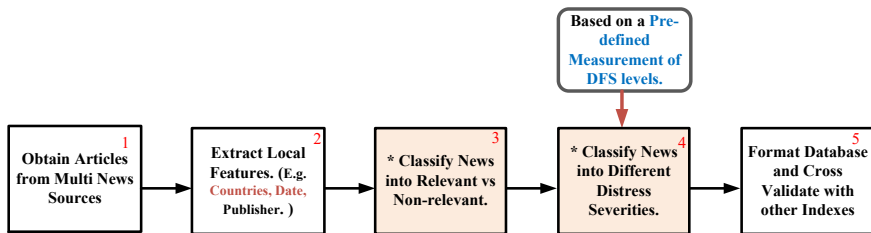
- I create a query comprising two bags of words, the first bag containing thesaurus of “**dollar**”, the second bag containing thesaurus of “**shortage**”
- The combination of two words must fall within a certain distance
- Words selection is based on my reading of 2500 articles
- No further screening at this step. **The NLP model will select the relevant news in the classification step**

The Search Terms

Panel A: Dollar Funding Shortage Dictionary of Words		
Dollar Bag of Words	Shortage Bag of Words	Notes
Dollar(s), USD, Greenback(s), Hard Currency, Foreign Currency	Shortage(s), Scarcity(ies), Pressure(s), Crisis, Crises, Struggle(s), Struggling Difficulty(ies), Distress, Stress, Shortfall(s), Squeeze(s), Crunch(es), Run, Lack, Dearth, Tight(ness)	In total: $8 * 26 = 208$ combinations
Panel B: Dollar Funding Shortage Query Syntax		
Exact Query Syntax	Explanation	Phrases Examples
<p>[dollar* near4 shortage*]; [dollar* near4 scarc*]; [dollar* near4 struggle*]; [dollar* near4 pressure*]; [dollar* near4 squeeze*]; [dollar* near4 crunch*]; [dollar* near4 stress]; [dollar* near4 difficult*]; [dollar* near4 cris*]; [dollar* near4 distress]; [dollar* near4 shortfall*]; [dollar* near1 run]</p> <p>"Dollar" in the above syntax includes: "Dollar(s)", "USD", "Greenback(s)", "Hard currency", "Foreign Currency"</p>	Articles that contain words "dollar" and "shortage". And two words are within the distance of 4 words.	Shortage of USD; Pressure of finding enough dollar; Hard currency shortfall; Severe crunches on USD; Dollars are scarce; Greenback shortages; Lack of dollar liquidity.

Process Overview

► Sub-steps Details



* Implement with RoBERTa pretraining self-supervised NLP systems

Measurement of DFS Severity

- Following Romer & Romer (2017), I define **five categories** to measure different dollar funding shortage severity

Dollar Funding Shortage Severity Categories	
Severity Levels	One Example of the Criteria
0 - No Shortage	No dollar shortage.
1 - Dollar Funding Disruption	The market will likely recover automatically without further actions.
2 - Dollar Funding Distress	Central banks temporarily intervene in the inter-bank market to add dollar liquidity.
3 - Moderate Dollar Funding Crisis (Systemic Crisis)	Central banks conduct frequent interventions and inject massive dollar liquidity.
4 - Major Dollar Funding Crisis (Systemic Crisis)	Central banks use extreme tools such as the ban on currency exchange and withdrawal of dollars from deposit accounts.

Machine Learning Outputs

Mechanism:

- Manually label a set of articles
- Train the NLP model to learn the labeling process
- Predict the labels of the remaining articles

Classification outputs:

Table: Summary of Accuracy Rate

	F1 Score
Relevance	0.94
3-Step Severity	0.80
5-Step Severity	0.64

Audit and Consolidation

Additional Review (Audit):

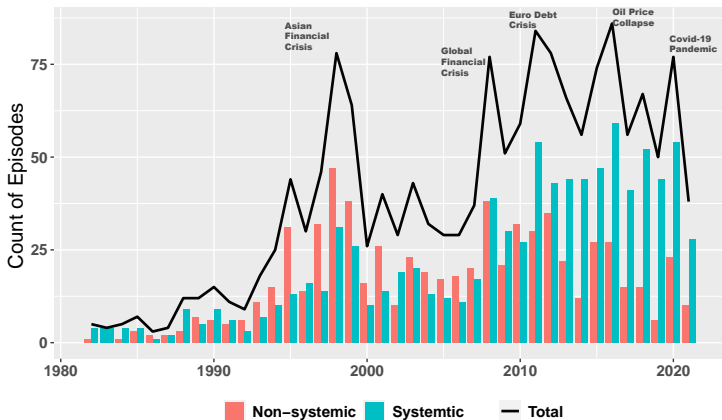
- Review episodes with low article coverage
- Threshold: **5** for the three categories and **10** for the five categories
- Additional check for inconsistent outputs between 3-steps and 5-steps

Consolidation:

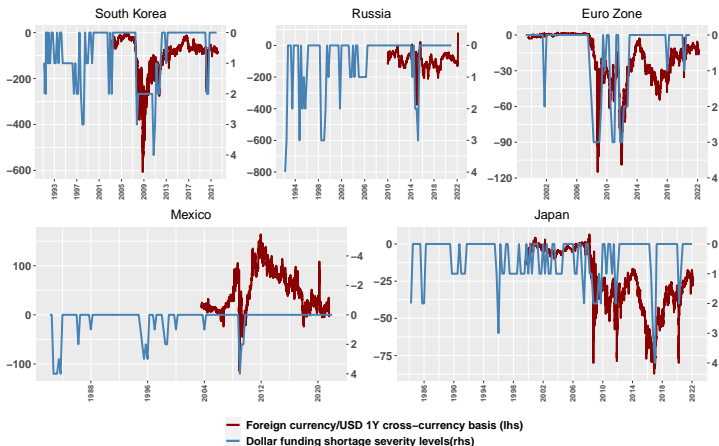
- Quarterly frequency
- Construct both **Average** and **Max** index
- Example:

Country	Date	Predict_3_max	Predict_5_max	Predict_3_mean	Predict_5_mean
Argentina	7/1/2014	2	4	1.963636364	3.117647059
Argentina	10/1/2014	2	4	1.807692308	3.047619048
Argentina	1/1/2015	2	4	1.692307692	2.545454545

Number of DFS Episodes by Year

[▶ Country-level DFS](#)[▶ Map](#)

Country DFS and Cross-currency Basis



- DFS captures the country-level dollar shortage episodes indicated by the CCB
- DFS is advantageous as it goes back in time and has a broad coverage of countries

Economic Effects of DFS

How could DFS affect the economy?

- Effects on GDP
 1. Standard Uncertainty/Macro Channels (-)
 2. Capital Flows/Investment Channel (-) [Avdjiev et al \(2019\)](#); [Obstfeld & Zhou \(2022\)](#)
 3. Trade Channel
- Effects on Import
 1. Competitiveness Channel (-)
- Effects on Export
 1. Competitiveness Channel (+)
 2. Financial Channel (-) [Bruno & Shin \(2022\)](#)

Macro Analysis: Panel Local Projection Method

Sectoral Analysis: [Rajan & Zingales\(1998\)](#)

Cross-country Effects: Empirical Strategies

Benchmark model:

$$y_{j,t+h} - y_{j,t-1} = \alpha_j^h + \gamma_t^h + \beta^h DFS_{j,t} + \sum_{k=1}^3 \varphi_k^h DFS_{j,t-k} + \sum_{k=1}^4 \theta_k^h \Delta y_{j,t-k} + e_{j,t}^h$$

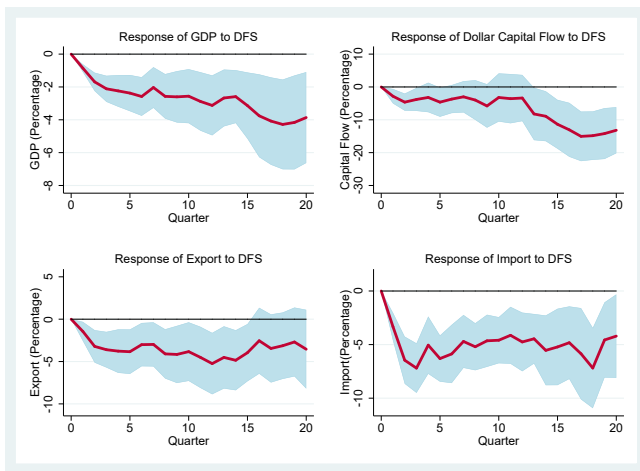
- Dependent variables: GDP, Dollar Capital Flows, Imports, Exports
- Identification: Outcome variables do not cause DFS contemporaneously, but they may be affected by the DFS within the period
- Use the 5-steps average DFS index

Robustness:

- Structural changes after GFC? Pre-GFC sample vs Post-GFC sample
- Non-linearity; Other identifications; Other DFS index; Other length of lags

Results: Baseline

Following a moderate level (3) of DFS:



- GDP 5.2% ↓; Exports 5.0% ↓; Import 7.2% ↓; Dollar capital flow 15% ↓
- Similar to the effect of a systemic banking crisis on GDP (6-8 percentage)

Sectoral Analysis

Remaining question on the adverse impacts of DFS:

- Is this because dollar funding crises tend to take place during economic/export downturns?
- Is the impact transmitted through the financial channel?

Hypothesis:

- Industries that are more dependent on **external dollar finance** would export less than other sectors during dollar funding crises

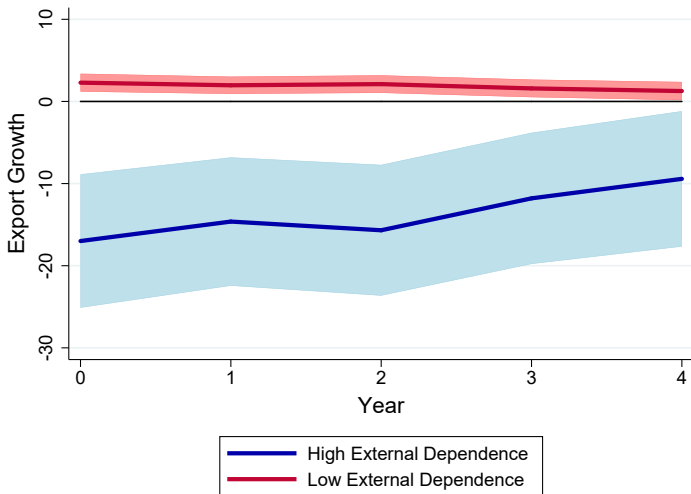
Sectoral Effects: Empirical Strategy

Benchmark model:

$$\ln(Y_{ijt}) = \alpha_{ij} + \beta_{it} + \gamma_{jt} + \delta \text{Dollar_Crisis}_{it} * \text{ExtFinDep}_j + \phi_j X_{it} + \varepsilon_{ijt}$$

- Identification: **DID method**. [Dell'Ariccia et al \(2008\)](#)
- Dependent variables: sectors' exports growth
- *ExtFinDep_j*: [Rajan & Zingales \(1998\)](#), ISIC 3&4 digit 36 sectors
- *Dollar_Crisis_{it}*: dummy for having a systemic DFS episode at country i

Extended Window (Local Projections): Exports



Conclusion

Contributions:

- Use ML to measure countries' dollar funding conditions
- Demonstrate the adverse impacts of DFS on various macro outcomes

Policy implications:

- Enhance the country surveillance on the international balance sheets and reserve buffers

Future research:

- Apply the state-of-art NLP to construct other indicators
- A closer examination of the triple crises (with banking and currency crises)



Thank you.

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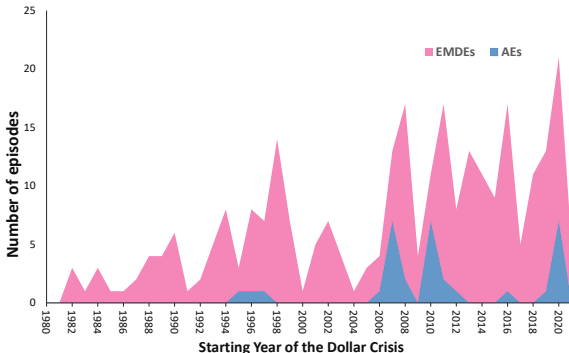
Summary Table

Table: Dollar Crisis Episodes Summary

Five Categories			Three Categories		
	Max	Average		Max	Average
0 - No Dollar Shortage	7,954	7,954	0 - No Dollar Shortage	7954	7954
1 - Dollar Funding Disruption	372	419	1 - Non-systemic	681	809
2 - Dollar Funding Distress	309	462	2 - Systemic Crisis	907	779
3 - Moderate Crisis	508	535			
4 - Major and Severe Crisis	399	172			
Total (Exclude 0)	1588	1588		1588	1588

Systemic Dollar Crises By Income Group, 1980-2021

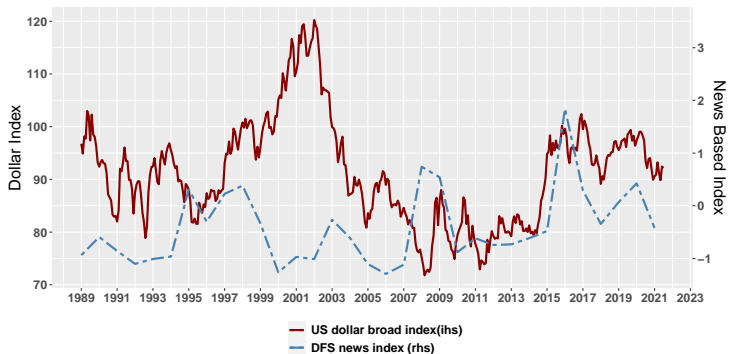
Figure: Systemic Dollar Crises Episodes by Income Group



► Table

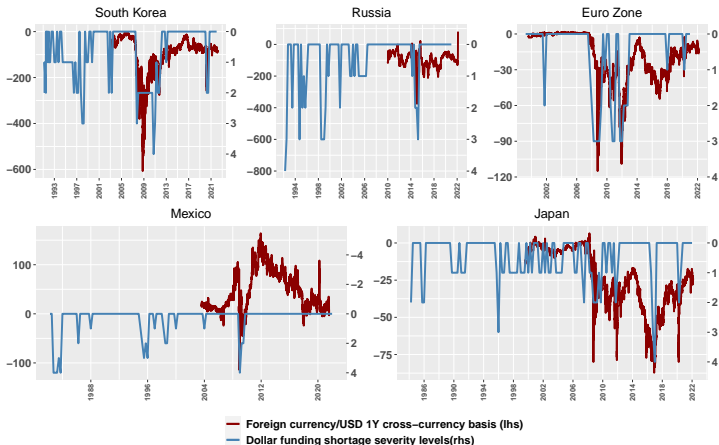
Notes: Crisis is counted only by its starting year even if it persists for years afterward.

Aggregated DFS Index and Broad Dollar Index



- Aggregated DFS goes hand-in-hand with the USD broad index after 2007
- Aggregated DFS is advantageous to the USD broad index as the indicator of the global dollar funding conditions prior to 2007

Country DFS and Cross-currency Basis



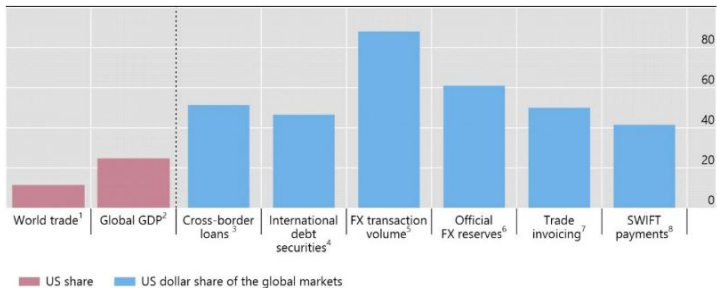
- DFS captures the country-level dollar shortage episodes indicated by the CCB
- DFS is advantageous as it goes back in time and has a broad coverage of countries

International Role of the USD

International role of the US dollar

In per cent

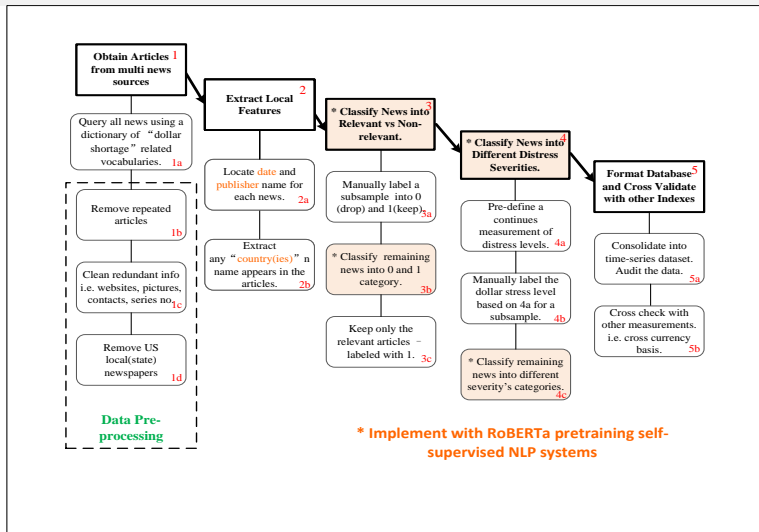
Graph 1



Source: Bank for International Settlements

► Back

Construction Process Overview



Measurement of DFS Severity

Level 0

► Back

Dollar Funding Shortage Severity Categories		
Severity Level	Criteria	Examples
1 - No Dollar Shortage	1) No dollar shortage. 2) Fully recovered from previous episodes. 3) Banks face potential dollar funding difficulties.	1) <i>"There is a shortage of dollars on the market and dollar loans are expensive, but this is a temporary situation and the rouble is likely to stabilise again."</i> 2) <i>"A shortage of dollars at month-end and ahead of Japan's Golden Week holidays, which start this weekend, initially propped up the dollar against the yen."</i>

Measurement of DFS Severity

Level 1

► Back

Dollar Funding Shortage Severity Categories		
Severity Level	Criteria	Examples
1 - Dollar Funding Disruption	1) No sign of other macroeconomic consequences. 2) Shortage will not be persistent. 3) Relieved from previous episodes. 4) Market will likely recover automatically without further actions.	1) <i>"There is a shortage of dollars on the market and dollar loans are expensive, but this is a temporary situation and the rouble is likely to stabilise again."</i> 2) <i>"A shortage of dollars at month-end and ahead of Japan's Golden Week holidays, which start this weekend, initially propped up the dollar against the yen."</i>

Measurement of DFS Severity

Level 2

▶ Back

Dollar Funding Shortage Severity Categories		
Severity Level	Criteria	Examples
2 - Dollar Funding Distress	1) Situation is not trivial, and will likely persist over the medium term. 2) Central banks temporarily intervene in the inter-bank market to add dollar liquidity. 3) No major spillovers that deteriorate other macro indicators. 4) Relieved from a major crisis.	1) "The Philippine Monetary Board has approved a proposal for the central bank to open dollar swap contracts with commercial banks. The move is a response to a scarcity of dollars in the market, and the central bank is hoping it will encourage banks to sell dollars in the spot market." 2) "We appreciate the central bank's move to ease pressure on the rupee. But some commercial banks are still holding dollar shortage positions, though they are not alarming."

Measurement of DFS Severity

Level 3

▶ Back

Dollar Funding Shortage Severity Categories		
Severity Level	Criteria	Examples
<p>3 - Moderate Dollar Funding Crisis (Systemic Crisis)</p>	<ol style="list-style-type: none"> 1) Serious and widespread. 2) Central banks conduct frequent interventions and inject massive dollar liquidity. 3) The activation of the currency swap line. 4) Despite the situation, the financial system and the economy have not lost control. 	<ol style="list-style-type: none"> 1) <i>"Dealers said all commercial banks were short of dollars despite central bank intervention and sugar export inflows in the week...Commercial banks are suffering from an acute shortage of dollars."</i> 2) <i>"... a shortage of dollar liquidity in Europe forced the fed to extend dollar swap lines with the European central bank in September."</i>

Measurement of DFS Severity

Level 4

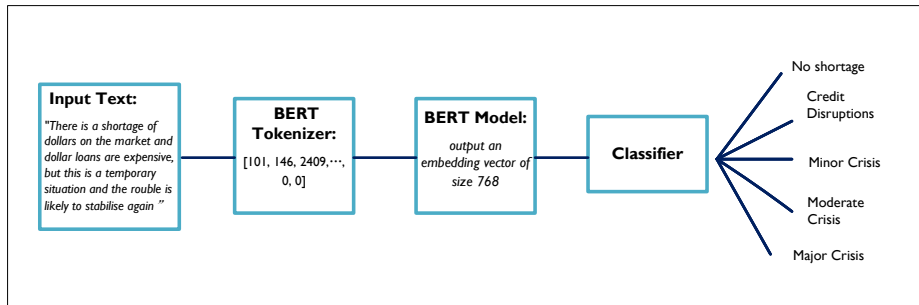
▶ Back

Dollar Funding Shortage Severity Categories		
Severity Level	Criteria	Examples
<p>4 - Major Dollar Funding Crisis (Systemic Crisis)</p>	<ol style="list-style-type: none"> 1) Severe and chronic dollar shortage in the banking system. 2) Has a catastrophic impact on the real economy. 3) Central banks use extreme tools such as the ban on the withdrawal of dollars from deposit accounts. 4) Central banks already deplete dollar reserves or face other limitations to rescue banks. 5) Resorts to the IMF or other nations for dollar funding. 6) Have trouble importing basic commodities 	<ol style="list-style-type: none"> 1) <i>"Failing to slow annual inflation rates of almost 50 percent and reduce the shortage of dollars that is causing scarcity of everything from communion wine to toilet paper."</i> 2) <i>"Argentina is a country that desperately requires reservations to have dollars...it is forbidden to withdraw dollars from banks."</i>

BERT Model for Text Classification

What is BERT?

- Transformer-based machine learning model for NLP applications.
- Goal of BERT: categorize a text into one of the predefined labels.



NLP Outputs: Binary (Relevance) Classification

Evaluate the Classification Accuracy

Table: Relevance vs Non-Relevance Classifications Performance

	Precision	Recall	F1	N
1 - Relevant News	0.95717	0.92739	0.94294	1446
0 - Irrelevant News	0.92637	0.95655	0.94122	1441
Accuracy			0.94164	2887
Macro Average	0.94177	0.94197	0.94163	2887
Weight Average	0.94212	0.94163	0.94163	2887

Notes: This table presents the binary classification results on topic relevance using pre-trained NLP model - RoBERTa. The overall classification accuracy F1 equals 0.94. News that is classified as "relevant (table 1)" will be forwarded to the next step: severity classification. Non-relevant News will be discarded.

► Explain F1

► Back

NLP Outputs: 5-steps Severity Classification

Table: Severity Classifications Performance - Five Categories

	Precision	Recall	F1	N
0 - No Dollar Shortage	0.78261	0.71739	0.74858	276
1 - Dollar Funding Disruption	0.58065	0.66176	0.61856	136
2 - Dollar Funding Distress	0.51538	0.51538	0.51538	130
3 - Moderate Crisis	0.55340	0.50000	0.52535	114
4 - Major Crisis	0.74359	0.82270	0.78114	141
Accuracy			0.66248	797
Macro Average	0.63513	0.64345	0.63780	797
Weight Average	0.66487	0.66248	0.66219	797

Notes: This table presents the 5-steps classification results on "severity levels" using pre-trained NLP model - RoBERTa. The overall classification accuracy F1 equals 0.64.

NLP Outputs: 3-steps Severity Classification

Table: Severity Classifications Performance - Three Categories

	Precision	Recall	F1	N
0 - No Shortage	0.81048	0.76718	0.78824	262
1 - Non-systemic	0.73602	0.73832	0.73717	321
2 - Systemic	0.85822	0.87984	0.86890	516
Accuracy			0.81165	1099
Macro Average	0.80158	0.79511	0.79810	1099
Weight Average	0.81115	0.81165	0.81165	1099

Notes: This table presents the 3-step classification results on "severity levels" using the pre-trained NLP model - RoBERTa. 0 corresponds to no dollar shortage distress; 1 corresponds to a non-systemic dollar shortage crisis. 2 corresponds to a systemic dollar shortage crisis. The overall classification accuracy F1 equals 0.80.

Accuracy improvement for 3-steps due to a larger sample and easier task.

What is F1 score in NLP?

B.A Explaining Precision, Recall and F1 score.

Precision tells us that out of the results classified as positive by our model, how many were actually positive. The equation that represents precision is:

$$precision = \frac{\text{True Positives}}{\text{True Positives} + \text{False Positives}}$$

Recall tells us how many of the positive cases the classifier correctly predicted, over all the positive cases in the data. The equation that represents recall is:

$$Recall = \frac{\text{True Positives}}{\text{True Positives} + \text{False Negatives}}$$

F1 Score is the weighted average of Precision and Recall. The equation that represents F1 score is:

$$F1 = 2 \times \frac{\text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}$$

Table B.1: confusion matrix of classification

	Predicted Positives	Predicted Native
Positives	True Positives	False Negative
Negatives	False Postivies	True Negative

NLP Outputs: Confusion Matrix

Table: Confusion Matrix for Three Categories Classifications

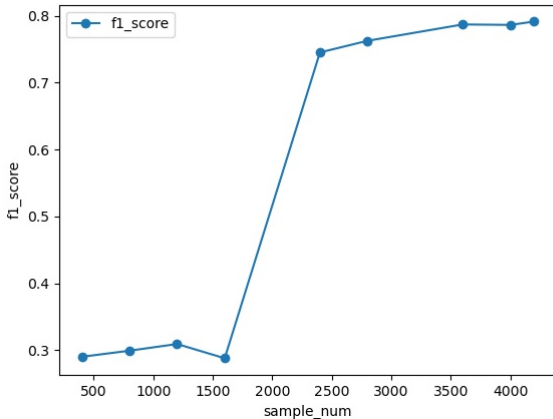
Confusion Matrix		Predicted Class		
		No Shortage	Non-systemic	systemic
Actual Class	No Shortage	201	37	24
	Non-systemic	33	237	51
	Systemic	14	48	454

Table: Confusion Matrix for Five Categories Classifications

Confusion Matrix		Predicted Class				
		0 -No	1 -Disruption	2 -Minor	3 -Moderate	4 -Major
Actual Class	0 -No	198	19	28	18	13
	1 - Disruption	24	73	33	3	3
	2 - Distress	15	13	73	22	7
	3 -Moderate	8	4	20	54	28
	4 -Major	4	1	6	11	119

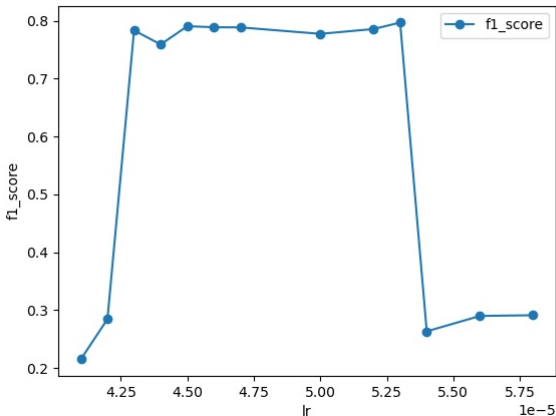


NLP: Learning Curve for Sample Size



Notes: This figure shows changes in learning performance with the increasing size of training samples. The model converges at a sample size larger or equal to 3500, with the F1 score reaching its optimal around 0.8. This demonstration is based on the model that produces three-category classifications.

NLP: Hyper-parameter Tuning

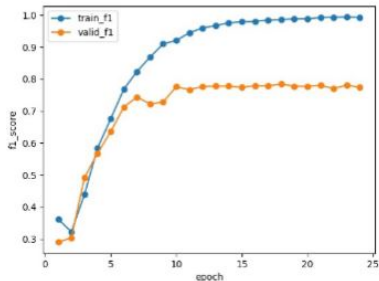


Notes: This figure shows the changes in learning performance at different learning rate parameters. I started with the learning rate parameter, which $\lambda = 4.75e-5$. The optimal learning rate range is $4.3e-5$ - $5.3e-5$. The best learning rate in this range is $5.3e-5$. This demonstration is based on the model that produces three-category classifications..

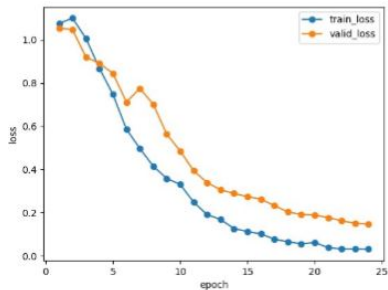
NLP: Convergence

Figure B.4: Validation Accuracy Overtime for the Best Optimizer

Pane A. Accuracy



Pane B. Loss function



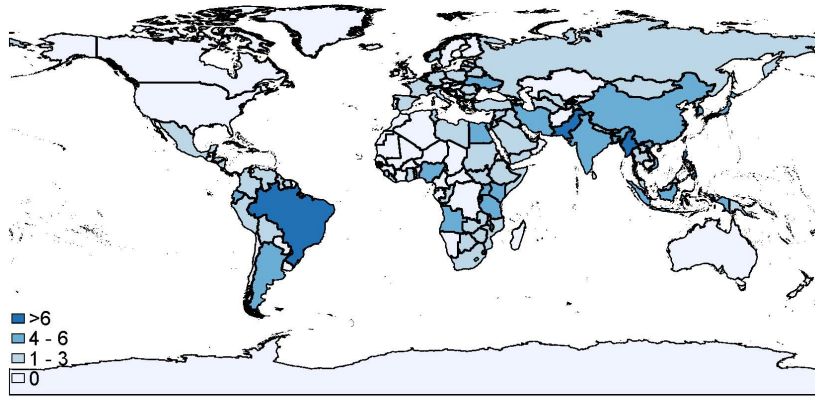
Notes: The left panel shows that the prediction result no longer improves after 10 epochs. The right panel shows the change of loss function with each additional epoch. The fact that the loss function decreases the test accuracy yet is stable suggests that this model is not over-fitting.

Main Results: Cross-country Time Series DFS



Notes: This figure shows selective major countries' dollar funding shortage severity level changes. The level starts from 0 to 4. Source: Author's calculations.

Frequency of Systemic Dollar Crises, 1980 - 2021



▶ Back

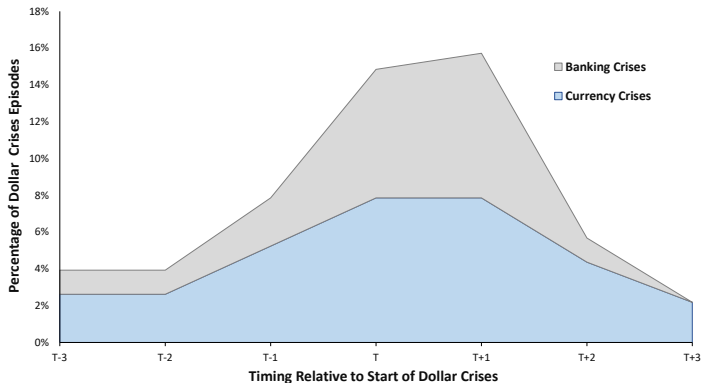
Dollar Crises By Income Group, 1980 -2021

Table: (Yearly) Dollar Crises Episodes by Income Group

	Non-systemic	Systemic
Advanced Economies	45	32
Emerging Markets and Developing Economies	222	247
Total	267	279

► Back

Sequencing of Crises, 1980 - 2017



Notes: The figure is constructed by selecting systemic dollar crises episodes and plotting the percentage of them that were followed, coincided, or were preceded by a banking or currency crisis, with T denoting the start of the dollar funding crisis.

Source: Banking and currency crisis, [Laeven & Valencia \(2020\)](#). Author's calculations.

Nexus of Three Crises

Banking and Dollar Crisis

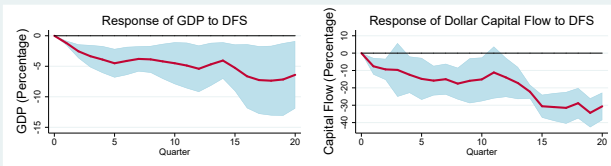
- Banking crisis → pessimistic on domestic currency → dollar withdraw.
- High financial dollarization → directly jeopardize balance sheet.
- Balance sheet liquidity mismatch.

Currency and Dollar Crisis

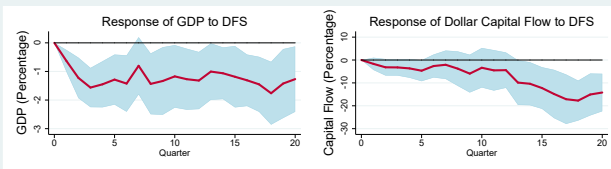
- Close relationship but different.
 1. Exchange Regime.
 2. Unofficial exchange rate.
 3. Currency crisis with enough dollar liquidity (e.g. Turkey).
 4. DFS is “subtle”. No exchange rate turmoil if central banks intervene properly.

Results: Pre-GFC vs Post-GFC

Panel A. Pre-GFC Sample

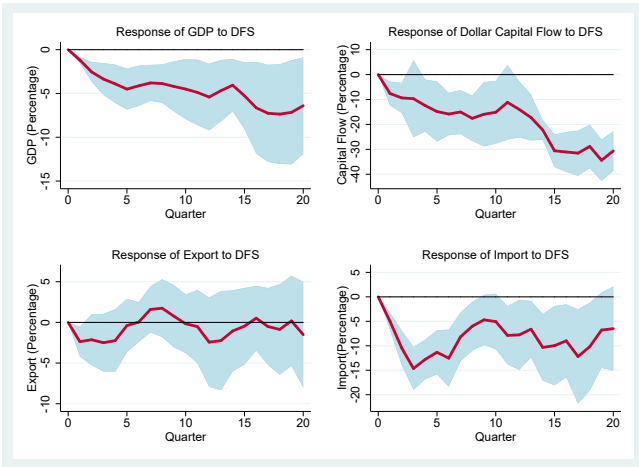


Panel B. Post-GFC Sample

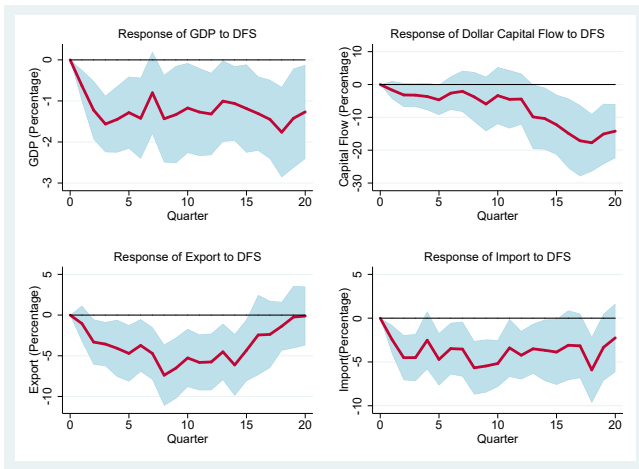


- Effects reduced by half after GFC

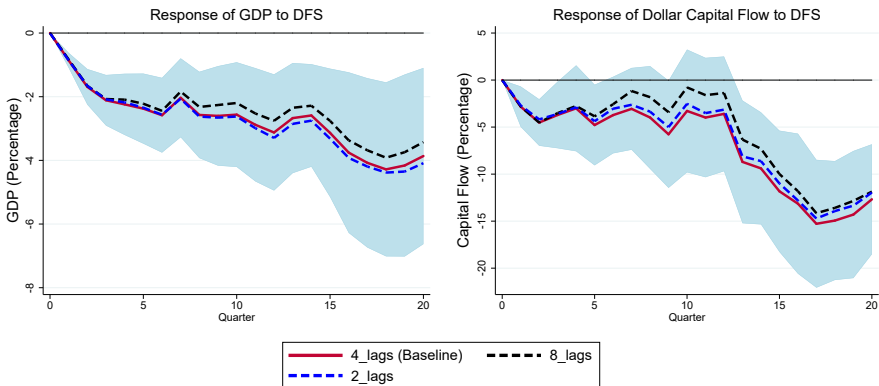
Results: Pre-GFC (With Trade)



Results: Post-GFC (With Trade)

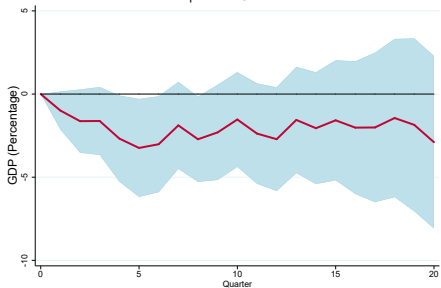


Results: Alternative Lags

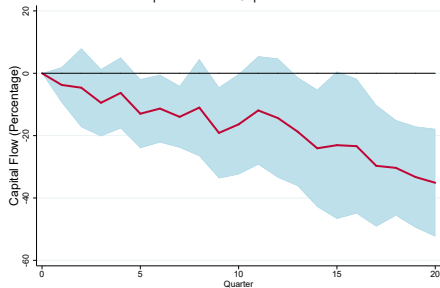


Results: Non-linearity

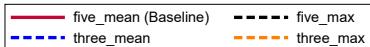
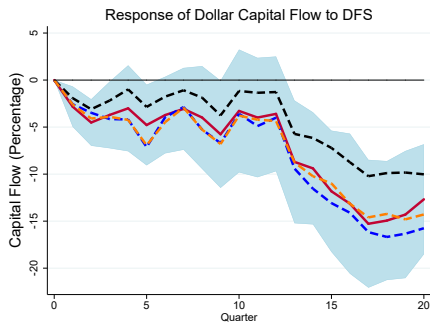
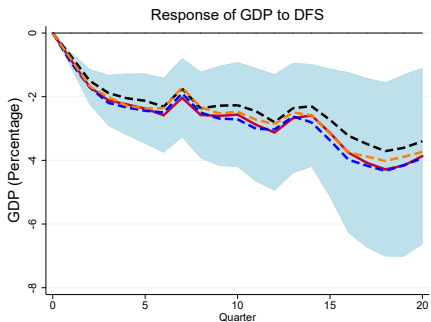
Response of GDP to DFS



Response of Dollar Capital Flow to DFS

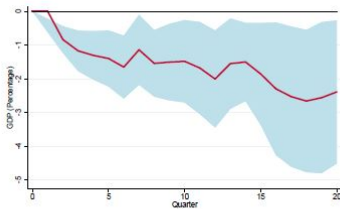


Results: Alternative Indexes

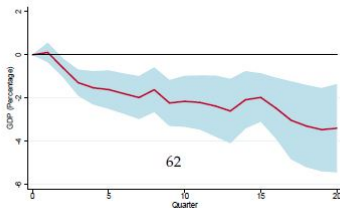


Results: Alternative Timing Assumption

Panel B. DFS in t cannot affect output in t



Panel C. DFS in $t+1$ can affect output in t



Extended Window: Exports

Table: 4-year window: Differential Effect of Dollar Crisis on Export Growth

	(1)	(2)
RZ*Dollar Funding Crisis_t	-0.082* [0.047]	-0.090** [0.046]
RZ*Dollar Funding Crisis_t+1	-0.137** [0.053]	-0.158*** [0.058]
RZ*Dollar Funding Crisis_t+2	-0.201*** [0.059]	-0.169*** [0.061]
RZ*Dollar Funding Crisis_t+3	-0.049 [0.051]	-0.035 [0.053]
RZ*Dollar Funding Crisis_t+4	-0.082* [0.049]	-0.062 [0.052]
RZ*Banking Crisis		-0.130** [0.063]
RZ* Currency Crisis		0.019 [0.078]
RZ*FINdev		0.005*** [0.001]
Constant	9.898*** [0.005]	9.867*** [0.02]
<i>N</i>	76519	69509

Result: Outputs

Table: Baseline: Differential Effect of Dollar Crisis on Value Added Growth

	(1)	(2)	(3)	(4)
RZ*Dollar Funding Crisis	0.013 [0.029]	0.022 [0.031]	0.032 [0.042]	
RZ*Dollar Funding Crisis *Financial Dollarization			-0.005** [0.003]	-0.005** [0.003]
RZ*Banking Crisis		-0.082** [0.036]	-0.103** [0.049]	-0.099** [0.047]
RZ* Currency Crisis		-0.001 [0.044]	-0.019 [0.074]	-0.01 [0.074]
Share (t - 1)	7.644*** [0.438]	7.639*** [0.438]	7.790*** [0.594]	7.790*** [0.594]
Constant	18.926*** [0.021]	18.929*** [0.021]	18.890*** [0.035]	18.892*** [0.036]
<i>N</i>	39487	39487	23952	23952

$$RZ * \underbrace{(Dollar_Crisis_{it} * Financial_Dollarization_{it})}_{\text{Importance of DFS to Financial Sector}}$$



Summary Statistics: Micro Analysis

Table: Summary Statistics: $Y = \text{Export}$

	No. obs.	Min	Max	Mean	Std. Dev
Export (log)	92959	0	20.19284	9.548709	4.147554
RZ*Dollar Shortage	93381	-0.45	1.49	0.060144	0.219466
RZ*Banking Crisis	93381	-0.45	1.49	0.022708	0.137922
RZ* Currency Crisis	93381	-0.45	1.49	0.009067	0.087853
RZ*FINdev	84887	-116.527	385.8343	15.72951	31.06478