

Fraud Risk Mitigation in Real-Time Payments: A Strategic Agent-Based Analysis

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“A payment in which the transmission of the payment message and the availability of ‘final’ funds to the receiver occur in real time or near-real time on as near to a 24-hour and seven-day (24/7) basis as possible.”

–Committee on Payments and Market Infrastructure, 2016



Fraud in Real-Time Payments

- Required speed makes fraud detection more difficult
 - Manual fraud detection review process averages 5 - 10 minutes per payment
 - May have to rely on quick, but less accurate indicators of fraud

- Allows fraudsters to be more successful

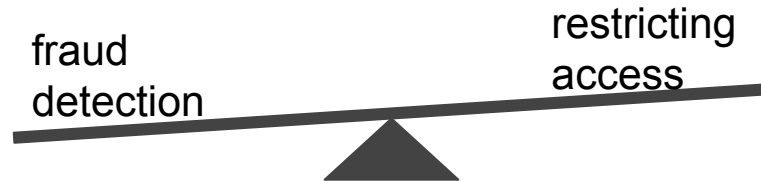


A. Diadiushkin, K. Sandkuhl, and A. Maiatin. Fraud Detection in Payments Transactions: Overview of Existing Approaches and Usage for Instant Payments. *Complex Systems Informatics and Modeling Quarterly*, pages 72-88, 2019.

J.L. Taylor and T. Galicia. A New Code to Protect Victims in the UK from Authorized Push Payments Fraud. *Banking & Finance Law Review*, 35:327-332, 2020.

We explore the **mitigation of RTP fraud risk** by banks as a **strategic decision**, seeking to understand (i) the strategic choices of banks and fraudsters and (ii) the **impact on the network**.

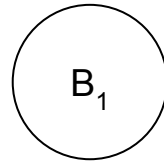
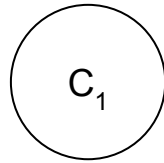
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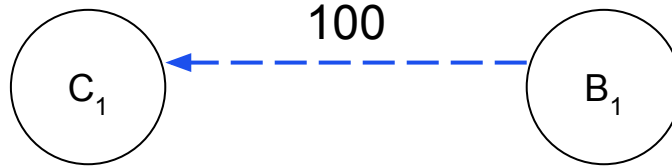
Studying Fraud Risk Mitigation

- Introduce an agent-based model of the payments system
- Define an RTP fraud game played within the model
 - Parameterized by different choices for bank fraud liability and customer demand for RTPs
- Employ empirical game-theoretic analysis to
 - Identify Nash equilibria of the games
 - Assess the benefit of the different mitigation techniques (*strategic feature gains assessment*)

Payments Model

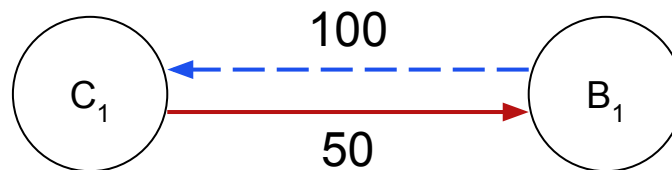


Payments Model



Represent deposits in an account as a **debt** owed **by the bank to the customer**

Payments Model

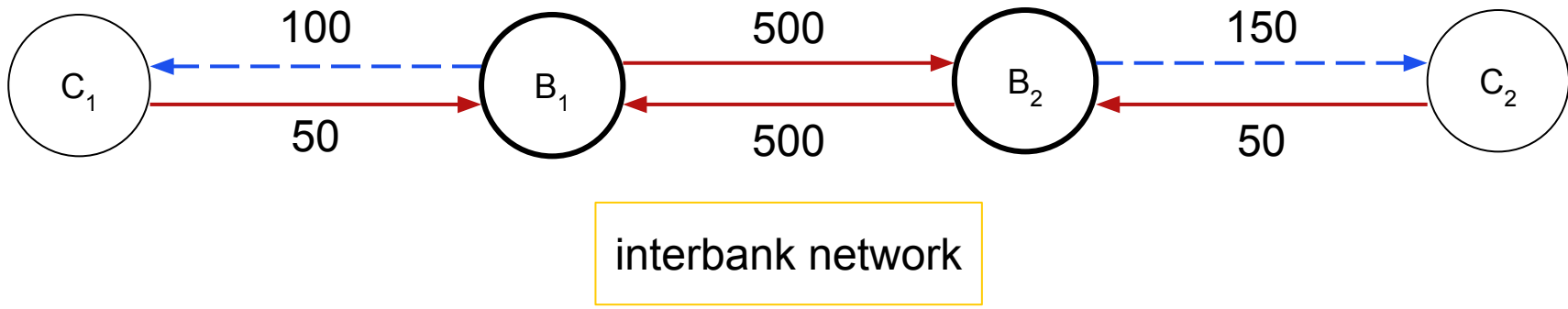


Customers have a **willingness to hold additional deposits** in their accounts
(e.g., FDIC insurance limits)

--- debt

— credit

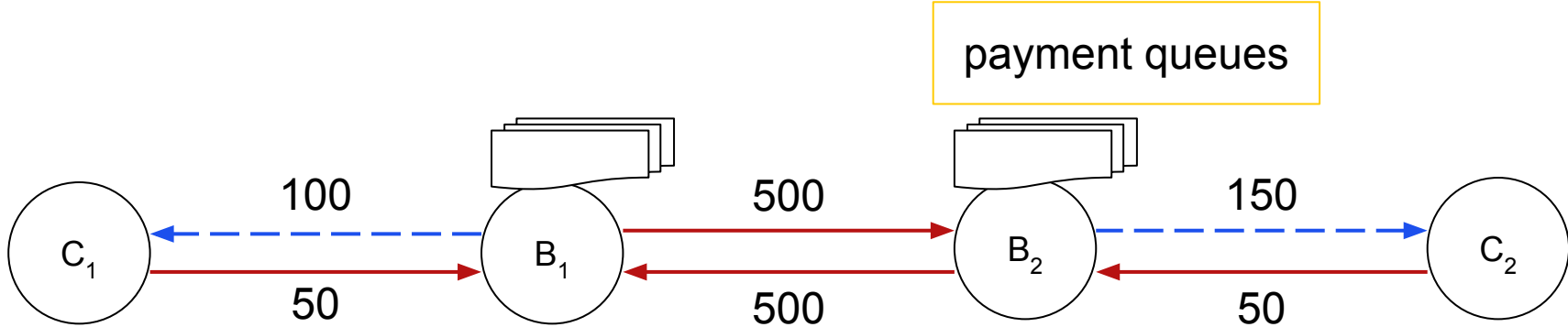
Payments Model



--- debt

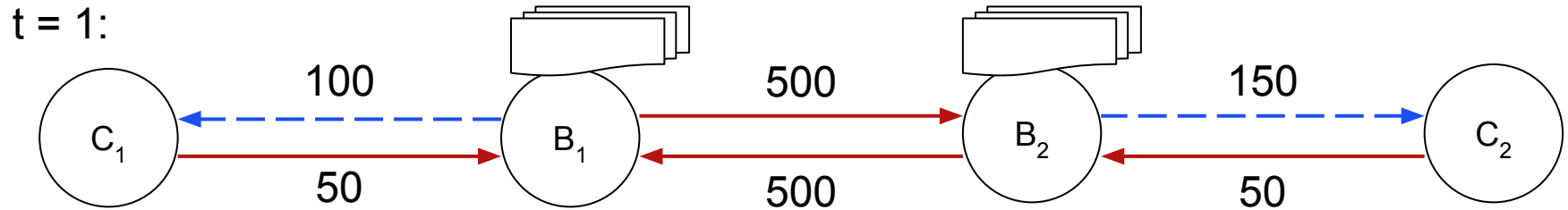
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Payments Model



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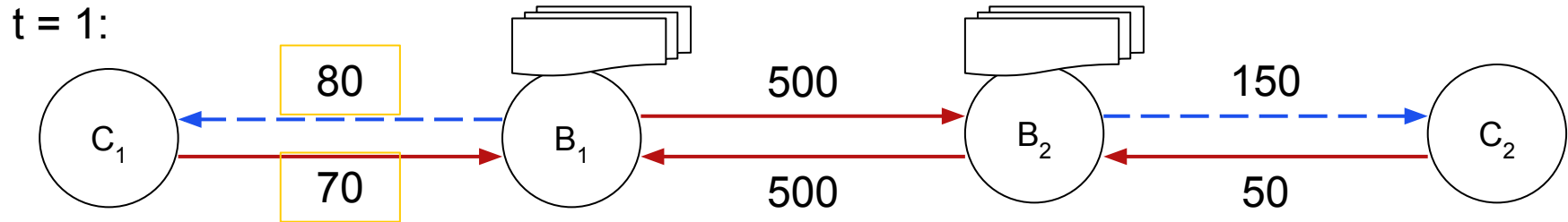
Payments Model: Standard Payments



C_1 makes a payment of 20 units to C_2

--- debt
— credit

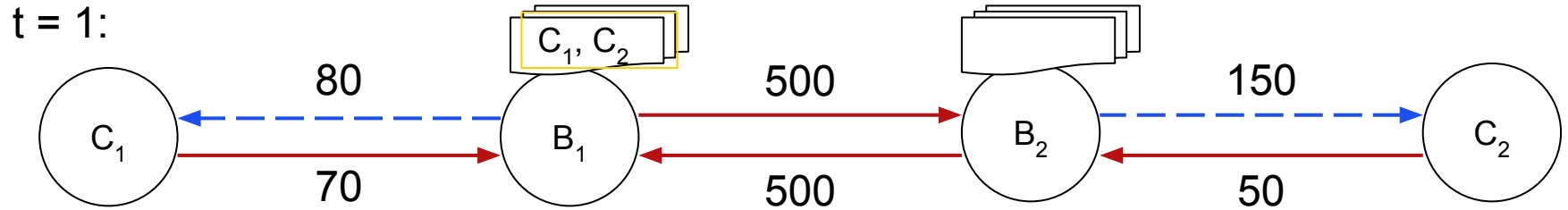
Payments Model: Standard Payments



C_1 draws on its deposits to make the payment

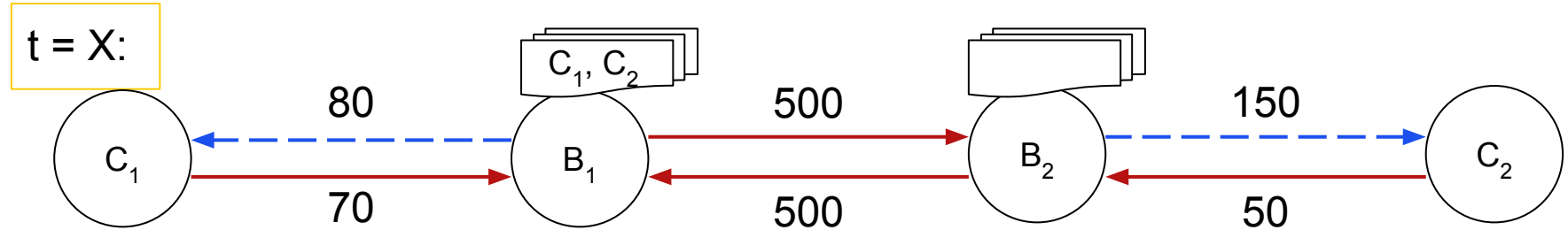
--- debt
— credit

Payments Model: Standard Payments



The payment is stored in B_1 's payment queue

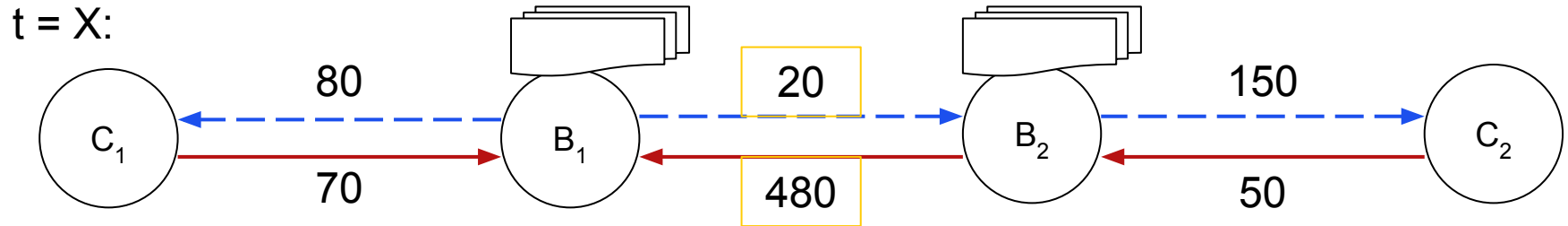
Payments Model: Standard Payments



At a later time step (**clearing period**), bank queues are cleared and payment processing completes

--- debt
— credit

Payments Model: Standard Payments

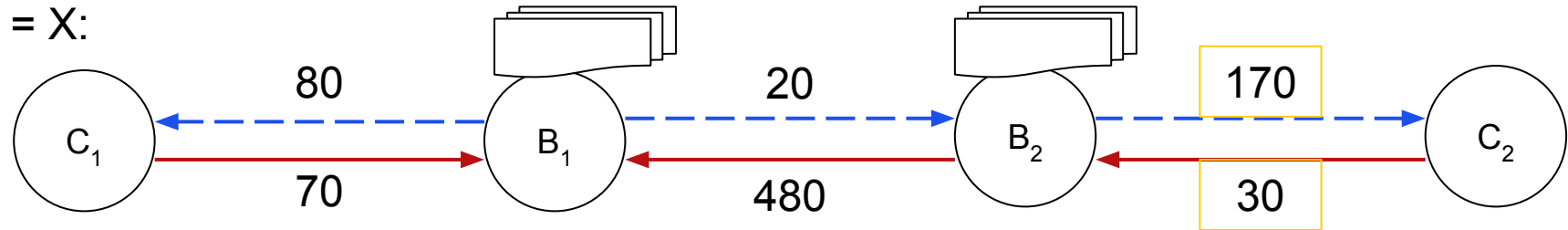


B_1 uses the interbank network to route the payment to B_2

--- debt
— credit

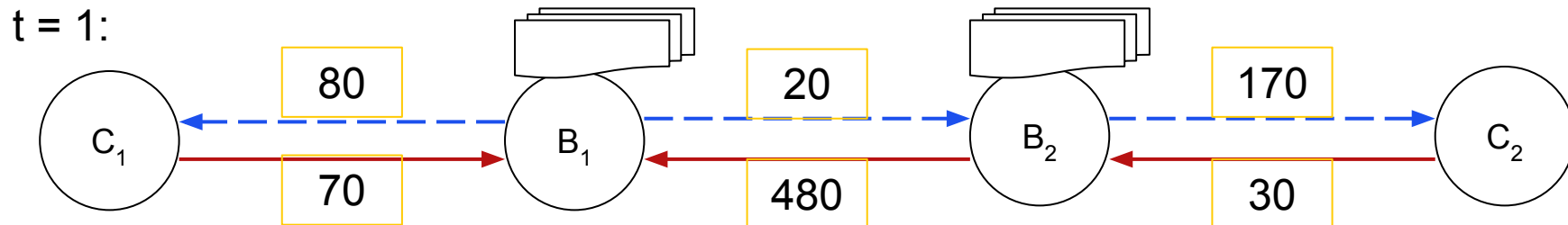
Payments Model: Standard Payments

$t = X:$



C_2 receives the payment in its account

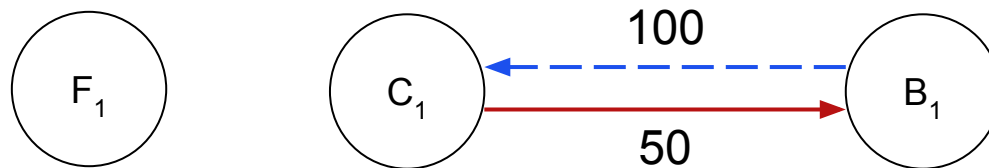
Payments Model: Real-Time Payments



For an RTP, all edge updates occur in the initial time step

- debt
- credit
- fraud

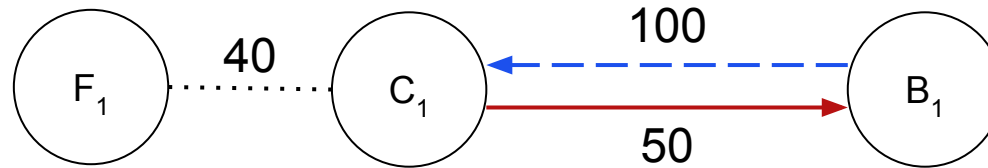
Payments Model: Fraudster Node



Fraud occurs when a *fraudster* draws on a customer's deposits to make a payment

- debt
- credit
- fraud

Payments Model: Fraudster Node



Remaining payment steps are unchanged

RTP Fraud Game Overview

- **Agents:** bank nodes and a fraudster node

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- **Agents:** bank nodes and a fraudster node

- **Strategies:**
 - Bank nodes: maximum threshold and investment in fraud detection for RTPs
 - Fraudster node: target for fraud
 - Payment type: RTP-only, Any
 - Bank target rule: highest RTP threshold, historical success

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- **Game steps:**

- Assign customers to banks assuming they prefer a bank that meets their RTP preferences
- Generate random customer and fraudster payments over T time steps

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- Assign customers to banks assuming they prefer a bank that meets their RTP preferences
- Generate random customer and fraudster payments over T time steps
- All payments are sent through fraud detection
 - Modeled as black-boxes defined only by accuracy characteristic

Accuracy = probability payment is correctly labeled relative to true label

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- Assign customers to banks assuming they prefer a bank that meets their RTP preferences
- Generate random customer and fraudster payments over T time steps
- All payments are sent through fraud detection

- **Payoffs:**

- Bank nodes: initial deposits attracted, liability for fraud, fraud detection costs
- Fraudster node: fraud successfully committed

Key Findings

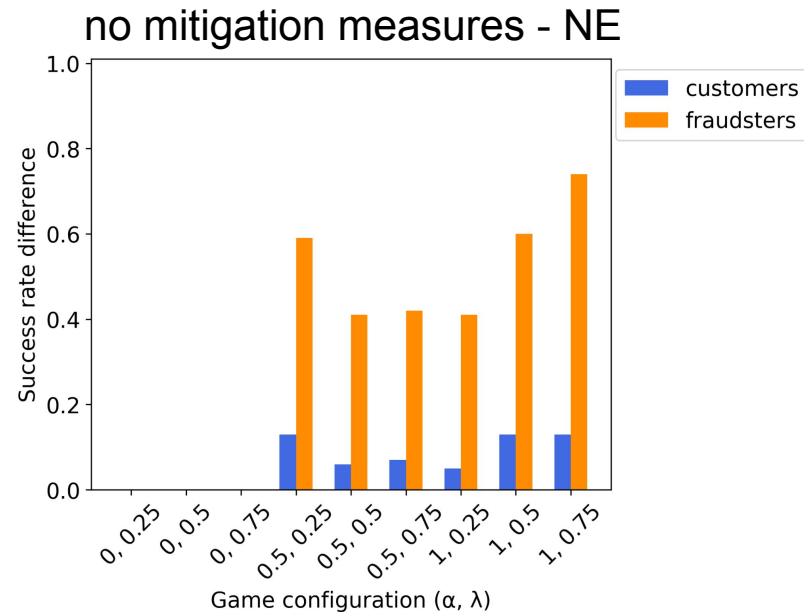
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 - Threshold setting is an important initial tool
- Fraudsters commit fraud with both payment types and target banks based on historical success
- Strategic mitigation measures drastically impact fraudsters with little disruption to customers



Summary

- Study how banks strategically mitigate fraud risk in real-time payments
 - Employ agent-based modeling and empirical game-theoretic analysis
- Find that banks' balance restricting customer access and investing in fraud detection
 - Allows them to limit fraud risk with minimal impact on customers

Thank you

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