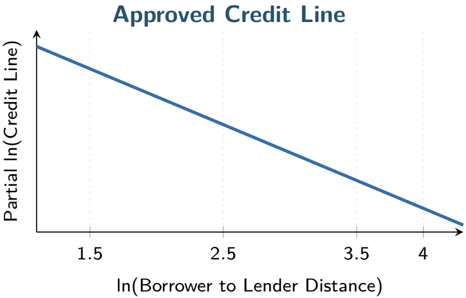
# Hard Information and Local Lending Markets

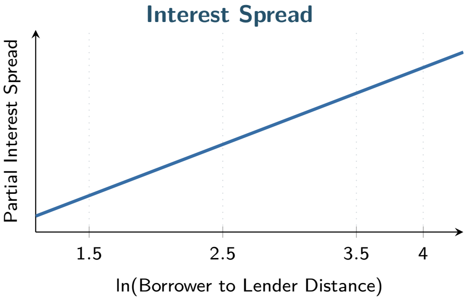
## Evidence from Invoice Digitalization

Yunyue Chen

Ghent University NYU Stern

# Before GT3, Distance Segmented Credit Quantity and Price




**More distant borrowers received smaller credit lines and paid higher spreads.**

# Banks Screen Small Firms with Hard and Soft Information

## Hard information

- Authenticated and standardized records
- Comparable across borrowers
- Easier to store and transmit inside the bank
- Can enter formal screening procedures

## Soft information

- Borrower specific knowledge
- Built through relationships and repeated contact
- Enriched by site visits and local context
- Difficult to codify and transmit

**Borrower specific soft information becomes harder to produce and use over distance.**

# Can Authenticated Records Make Lending Less Local? Yes.

**Authenticated records** $\longrightarrow$ **Bank assessments** $\longrightarrow$ **Contract terms** $\longrightarrow$ **Flatter quantity and price schedules** $\longrightarrow$ **Farther observed originations**

**Hard information substitutes for distance sensitive soft information in screening.**

**Geography remains relevant for contact and monitoring.**

# The Missing Evidence Is Substitution Inside Bank Screening

| | |
|---|---|
| **Relationship lending and soft information** | Petersen and Rajan (1994), Berger and Udell (1995), Stein (2002), Liberti and Petersen (2019) |
| **Distance, private information, and local lending** | Petersen and Rajan (2002), Degryse and Ongena (2005), Agarwal and Hauswald (2010), Beck et al. (2018) |
| **Standardized records and lending technology** | Hauswald and Marquez (2003), Berg et al. (2022), Fuster et al. (2022), Howell et al. (2024) |

**We know why small business lending is local. We know much less about whether a new hard signal changes screening inside banks.**

# GT3 Improves the Authentication of Invoice Records

## GT3 was introduced across provinces on different dates.

### What changed

Invoice issuance, uploading, storage, and authenticity checks moved under common technical standards.

### Why banks care

Borrower supplied invoice records became easier to check and pass through formal approval layers.

**GT3 is a tax administration reform, not a credit program.**

# The Data Connect Bank Assessments, Contracts, and Distance

## Confidential loan files

- About 154,000 originated small business loans
- Several banks, 2012 to 2022
- Bank assessed income
- Credit score
- Approved contract terms
- Borrower to lender distance

## Fixed effects used as controls

**Core FE** Year-month, bank, originating city, and borrower industry.

**Control FE** Payment method, borrower type, age, income, leverage, credit score, and maturity groups.

**All fixed effects enter the regressions as controls.**

# Hard Information Matters More When Prior Information Is Thin

$$\hat{r}_i^{post} = \frac{\tau_p(d_i)\hat{r}_i^{pre} + \tau_H h_i}{\tau_p(d_i) + \tau_H} = \hat{r}_i^{pre} + K_i\big(h_i - \hat{r}_i^{pre}\big), \qquad K_i = \frac{\tau_H}{\tau_p(d_i) + \tau_H}.$$

**Prior assessment**

$\hat{r}_i^{pre}$ is the bank's assessment before GT3.

$\tau_p(d_i)$ is its precision, with $\tau_p'(d_i) < 0$.

**Hard signal**

$h_i$ is the signal from authenticated invoice records.

$\tau_H$ is the precision of that signal.

$$\tau_p(d_i)\downarrow \implies K_i\uparrow$$

**A thinner prior gives the same authenticated signal more weight in underwriting.**

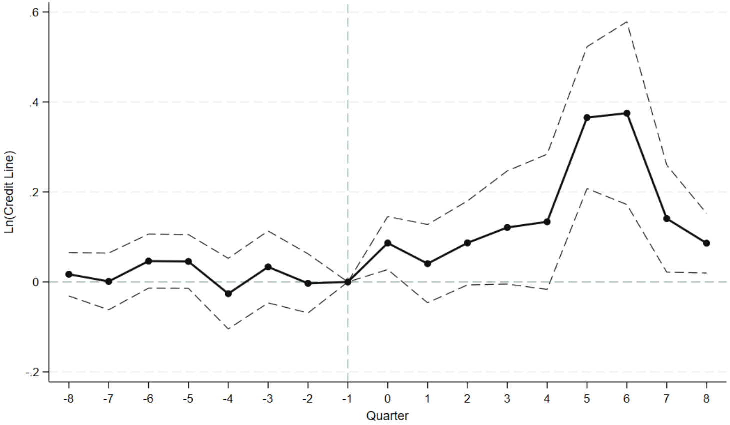
# Identification Uses Exact Provincial Rollout Dates

$$Y_i = \beta\, GT3_{p(i),t(i)} + F_i + \varepsilon_i,$$

$$Y_i = \beta_1 GT3_i + \beta_2 Z_i + \beta_3 \big(GT3_i \times Z_i\big) + F_i + \varepsilon_i.$$

- Treatment switches on at the exact provincial rollout date.
- $\beta_3$ measures the change in the relevant gradient.

# Credit Line Effects Emerge after GT3




**No comparable movement appears before rollout.**

# Banks Revise Assessed Income and Credit Scores

| | Formal reporting | Inside bank underwriting | |
|---|---|---|---|
| | ln(Tax Amount) | ln(Assessed Income) | Credit Score |
| GT3 | $0.076^{**}$ | $0.193^{***}$ | $6.642^{***}$ |
| | [2.29] | [3.31] | [4.99] |
| Province FE | Yes | | |
| Tax Category × Year FE | Yes | | |
| Taxpayer Category × Year FE | Yes | | |
| Lagged macro controls | Yes | | |
| Year-Month FE | | Yes | Yes |
| Bank FE | | Yes | Yes |
| City FE | | Yes | Yes |
| Industry FE | | Yes | Yes |
| Control FE | | Yes | Yes |
| Observations | 44,239 | 126,268 | 101,228 |

**Formal reporting changes upstream, then the bank revises assessed income and credit scores inside underwriting.**

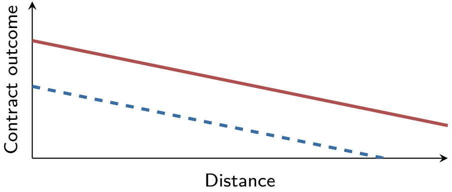
# GT3 Changes Loan Contracts

| | ln(Credit Line) | Interest Rate | Interest Spread | Maturity |
|---|---|---|---|---|
| GT3 | $0.179^{***}$ | $-0.404^{***}$ | $-0.442^{***}$ | $49.014^{**}$ |
| | [4.21] | [−3.77] | [−3.95] | [2.22] |
| Year-Month FE | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes | Yes |
| Control FE | Yes | Yes | Yes | Yes |
| Observations | 154,170 | 154,221 | 154,221 | 154,170 |

**Average contract effects establish economic importance. They do not yet establish substitution.**

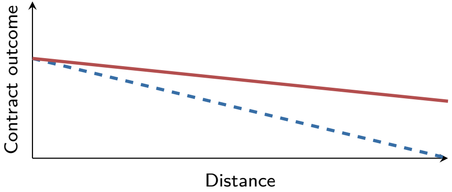
# Average Contract Changes Do Not Identify Substitution

**General credit expansion**




Average contracts change. The slope does not.

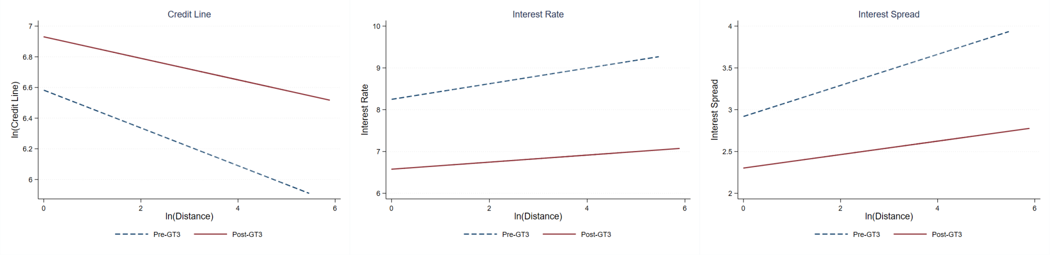
**Screening substitution**




The distance schedule rotates and becomes flatter.

**Substitution implies flatter quantity and price distance schedules.**

# GT3 Flattens Quantity and Price Distance Penalties



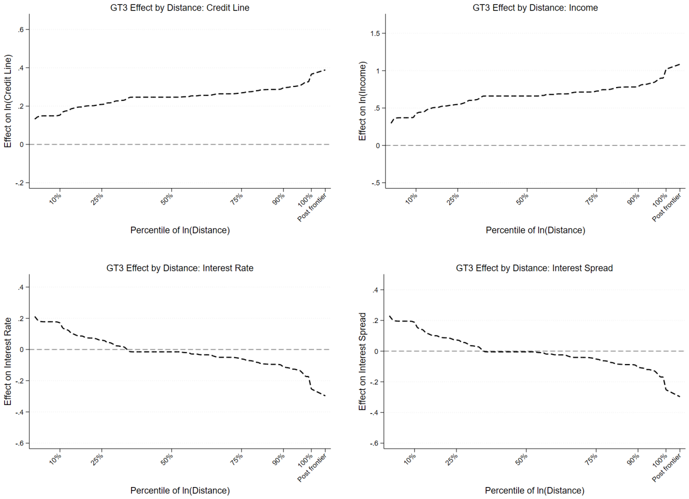

| | ln(Credit Line) | | Interest Rate | | Interest Spread | |
|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post |
| ln(Distance) | $-0.123^{***}$ | $-0.070^{***}$ | $0.187^{***}$ | $0.084^{***}$ | $0.186^{***}$ | $0.081^{***}$ |
| | [−22.90] | [−8.33] | [10.77] | [3.80] | [10.71] | [3.45] |
| City × Year-Month FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Control FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 48,609 | 45,354 | 48,609 | 45,354 | 48,609 | 45,354 |

# GT3 Effects Become More Favorable with Distance

| | ln(Credit Line) | Interest Rate | Interest Spread | ln(Income) |
|---|---|---|---|---|
| GT3 | 0.083 | 0.309** | 0.332** | 0.172 |
| | [0.62] | [2.30] | [2.44] | [0.57] |
| ln(Distance) | −0.124*** | 0.190*** | 0.190*** | −0.212*** |
| | [−21.06] | [10.09] | [10.03] | [−12.15] |
| GT3 × ln(Distance) | 0.052*** | −0.103*** | −0.107*** | 0.155*** |
| | [4.78] | [−3.39] | [−3.40] | [7.65] |
| City × Year-Month FE | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes | Yes |
| Control FE | Yes | Yes | Yes | Yes |
| Observations | 93,993 | 93,993 | 93,993 | 86,026 |

**The interaction is positive for assessment and credit quantity, and negative for pricing.**

# Implied GT3 Effects across the Distance Distribution



# The Gains Are Larger Where Prior Information Was Thinner

| | B2B | B2C | Pre-GT3 Specialization | Listed Firms |
|---|---|---|---|---|
| GT3 | 0.135*** | 0.213*** | 0.073** | 0.010 |
| | [3.69] | [3.59] | [2.08] | [0.50] |
| Bank Specialization | | | 0.050 | |
| | | | [1.53] | |
| GT3 × Bank Specialization | | | −0.125** | |
| | | | [−2.11] | |
| Year-Month FE | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes | |
| Industry FE | Yes | Yes | Yes | |
| Control FE | Yes | Yes | Yes | |
| Firm FE | | | | Yes |
| Loan Type FE | | | | Yes |
| Loan Purpose FE | | | | Yes |
| Currency FE | | | | Yes |
| Collateral FE | | | | Yes |
| Syndicate FE | | | | Yes |
| Observations | 68,767 | 73,146 | 117,945 | 151,065 |

**Authenticated records matter most where lenders begin with less formal information.**

# Local Industry Lending Becomes More Dispersed after GT3

| | Local Excess Specialization | Industry HHI | Top-Industry Share | Active Industries |
|---|---|---|---|---|
| GT3 | $-0.138^{**}$ | $-0.211^{***}$ | $-0.167^{***}$ | $1.372^{**}$ |
| | [−2.28] | [−3.39] | [−3.17] | [2.46] |
| Bank FE | Yes | Yes | Yes | Yes |
| Province FE | Yes | Yes | Yes | Yes |
| Year-Quarter FE | Yes | Yes | Yes | Yes |
| Observations | 1,020 | 1,020 | 1,020 | 1,020 |

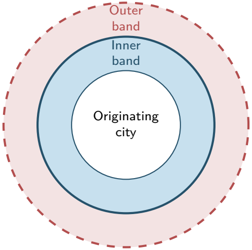
**Specialization, concentration, and the top-industry share fall, while the number of active industries rises.**

# Observed Originations Move Farther

| Outcome | ln(Borrower to Lender Distance) |
|---|---|
| GT3 | $0.135^{**}$ |
| | [2.10] |
| City $\times$ Year-Month FE | Yes |
| Bank FE | Yes |
| Industry FE | Yes |
| Control FE | Yes |
| Observations | 93,993 |

**The result describes originated loans, not approval probabilities.**

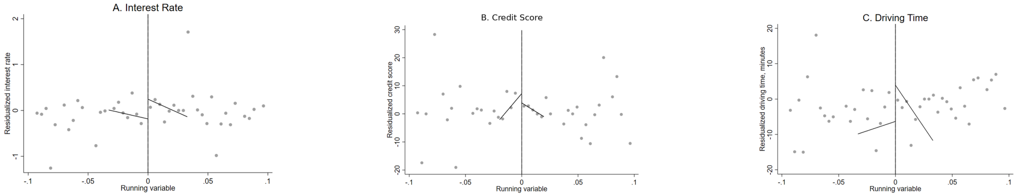
# What Remains at the Expanded Lending Boundary?




| | Interest Rate | Credit Score | Driving Time |
|---|---|---|---|
| Outer Band | 0.160** | 0.744 | 14.922*** |
| | [2.00] | [0.46] | [10.03] |
| City × Year-Month FE | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes |
| Control FE | Yes | Yes | Yes |
| Observations | 14,303 | 10,107 | 14,303 |

**Credit scores do not measurably decline. Travel time and rates rise, consistent with residual contact and monitoring costs.**

# Local RD at the Expanded Lending Boundary




| | Baseline $h$ | | | Robustness $2h$ | | |
|---|---|---|---|---|---|---|
| | Rate | Credit Score | Driving Time | Rate | Credit Score | Driving Time |
| RD estimate | 0.430*** | −3.358 | 10.225*** | 0.313*** | −2.791 | 10.327*** |
| | [2.91] | [−1.03] | [2.62] | [3.15] | [−1.01] | [4.53] |
| City × Year-Month FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Control FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 14,303 | 10,107 | 14,303 | 14,303 | 10,107 | 14,303 |

# Credit Line Pass Through Varies with Local Concentration

| Dependent variable | ln(Approved Credit Line) |
|---|---|
| GT3 | $0.341^{***}$ |
| | [3.81] |
| HHI | $-0.496$ |
| | [$-1.31$] |
| GT3 $\times$ HHI | $-1.327^{***}$ |
| | [$-3.37$] |
| Year-Month FE | Yes |
| Bank FE | Yes |
| City FE | Yes |
| Industry FE | Yes |
| Control FE | Yes |
| Observations | 140,253 |

**HHI lower by 0.10**

$\Downarrow$

**0.133 log points**

larger credit line response

**Lower concentration is associated with stronger pass through to credit lines.**

# Hard Information Makes Bank Screening Less Local

**Authenticated records** $\longrightarrow$ **Bank assessments** $\longrightarrow$ **Contract terms** $\longrightarrow$ **Flatter distance schedules** $\longrightarrow$ **Farther observed originations**

1. GT3 makes invoice records easier to authenticate and use in underwriting.
2. Banks revise assessments and contracts, and quantity and price distance schedules flatten.
3. Lending reaches farther, while geography still matters for contact and monitoring.

**Hard information changes which small firms banks can screen without being local.**