Blockchain-based Invoice Factoring: from Business Requirements to Commitments

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Joint work with Ettore Battaiola, Chan Nam Ngo and Pierantonia Sterlini
What happens when you send a bill to a company?

1.1 Send invoice

1.2 Ack invoice

3.1 Buyer pays invoice

3.2 PSP routes payment to Seller
It happens that you are in the s....

Buyer

1.1 Send invoice

1.2 Ack invoice

3.1 Buyer pays invoice

PSP

Seller

You did the job (paid the salary of workers etc.) and no money yet

3.2 PSP routes payment to Seller
You need help...

Buyer

1.1 Send invoice

1.2 Ack invoice

Seller

You did the job (paid the salary of workers etc.) and no money yet

The Factor

You need somebody to advance you the money or you go belly up

PSP

3.1 Buyer pays invoice

3.2 PSP routes payment to Seller
## EU factoring market (turnover) is 1.26 Trillions Euro in 2017

<table>
<thead>
<tr>
<th>Country</th>
<th>Factoring market size ‘17 (in bln)</th>
<th>Average payment term ‘17</th>
<th>Percentage of sales made on credit ‘17</th>
<th>Average ‘Days Sales outstanding’ (DSO) ‘17</th>
<th>GDP penetration ‘16</th>
<th>Contribution of SMEs to Value added at factor costs ‘16</th>
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High-level actors & interactions

1.1 Send invoice
1.2 Ack invoice

2.1 Negotiate terms
2.2 Send proposal to PSP
2.3 Factor acks proposal
2.4 Factor pays seller’s PSP
2.5 PSP sends money to Seller

3.1 Buyer pays invoice
3.2 PSP routes payment to Factor

2.3’ PSP makes proposal conditional
2.5’ Proposal condition fulfilled, Factor now “owns” the invoice
High-level actors & interactions

Buyer

1.1 Send invoice

1.2 Ack invoice

2.1 Negotiate terms

2.1 Double Pledging

Factor1

Factor2

2.5 PSP sends money to Seller

PSP

3.1 Buyer pays invoice

PSP routes payment to ????
The head of the business is served by risk-based assessment methods

Focus of today's receivables financing market

Several receivables financing options available:

- Supply Chain Finance (SCF)
- Reversed factoring (RF)
- Factoring (Fct)
- Credit

Portfolio based financing with KYC driven risk assessment

Intuition: give me ALL your invoices and I will factor them
The long tail of businesses is underserved due to current profile based risk assessment methods.

Focus of today’s receivables financing market:
- Several receivables financing options available:
  - Supply Chain Finance (SCF)
  - Reversed factoring (RF)
  - Factoring (Fct)
  - Credit Portfolio based financing with KYC driven risk assessment

Give me ALL your invoices and I will factor them.

Sorry fellah, the average Italian company has 2-3 banks, some up to a dozen banks...

Underserved long-tail of receivables financing

Receivables financing options very limited and unattractive

Opportunity for invoice based finance data driven risk assessment
UNBIAS ecosystem and needs

**Seller**
- Better access to financing options
- Receive better finance offerings
- Better cash flow predictability

**Buyer**
- Reduce effort of credit insurance requests
- Maintain in control of creditor portfolio, also after removal factoring ban
- Certainty of settling invoices

**Factor**
- Solution to prevent double factoring of invoices
- Trusted invoice information for risk assessment
  - Maintain individual competitive advantage

**Credit insurer**
- Trusted information for risk assessment, including invoice, seller and buyer information

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**Payment service provider (PSP)**
- Trusted for payments by all parties
- PSP connects factors, buyers and sellers to the UNBIAS platform
Assume there is a central server for all parties to send and receive data
  - Important: today it does not exist $\rightarrow$ nobody wants to share the data

Our task is to make the distributed system security indistinguishable from the ideal functionality
  - Uniqueness of invoices while preserving confidentiality of their details

Data:
  - Invoices and Payments

Party types
  - Buyer, Seller, Insurer, Factorer
  - Payment Service Provider (PSP)
More Security Requirements

• Actors are recognizable
  • TOR is expensive
  • And looks fishy

• First level requirements
  • Actions are undistinguishable
  • Data is confidential
  • Data preserves integrity
    • No double pledging, etc.
  • Data maintains unlinkability

• Second level requirements
  • Only certain actors are able to do something
  • “Yellow Pages” (certificate scheme) for VAT owners, IBAN owners, PSPs
  • Join/Leave the Yellow Pages
    • Is there a national ID/certification scheme?
UNBIAS Baseline: Permissioned blockchain solution

Permit blockchain solution

Permissioned Blockchain

Invoice #1
Invoice #2
...

Buyer

Seller

negotiate factoring terms

Factor

factor
read status: ack?
Pay-date known?
Insured?
double-pledged?

insert

PSP

Payments mediation and routing

acknowledge + update payment status

Pay date known?
Insured?
double-pledged?
Wait a minute, this is a distributed system, so every peer knows the content of ledger

UNBIAS Baseline: Permissioned blockchain solution
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Permissioned blockchain solution

Wait a minute, this is a distributed system, so every peer knows the content of ledger...

Oh but there are Access Control Lists
UNBIAS Baseline: Permissioned blockchain solution

Wait a minute, this is a distributed system, so every peer knows the content of ledger...

Oh but there are Access Control Lists

but the administrator knows... and this is a market of 209 BILLIONS...
You want to know who factored with your competitors, you can offer them better terms...
UNBIAS Solution: Hash-based solution for privacy

Secret data is shared between involved parties to ensure consistency with the public ledger

Hash(Invoice#1)
...
Hash(Invoice#2)
...
...

Distributed Ledger for public data, only hashes, maintained by all/major participants

Secret Data: Invoices, etc.

Buyer

Secret Data: Proposals, etc.

Factor

Secret Data: Invoices, etc.

Seller

Secret Data: Routing table, etc.

PSP
UNBIAS Development

• HyperLedger (Java) https://www.hyperledger.org
  • Customizable blockchain code
  • PBFT mode for consensus
• General crypto libs: OpenSSH, or just code snippets from major cryptocurrency code base
• Java Native Interface
  • Integration between blockchain and the crypto lib
Challenges beyond UNBIAS

• “Yellow Pages” for Players ID Management (bootstrap of the parties)
  • New initiatives of electronic invoicing creates identities but no solutions against double pledging...

• Con-currency in invoice status updates
  • E.g. Buyer pays the invoice and the Factorer pays the same invoice at the same time

• Compliance with PSD2
  • Sharing data between banks of the same party may require dynamic changes to invoice data access control

• Aborts and non-cooperation
  • Normally solved as penalty, financially or reputation-wise

• Next step replace hashes with zero-knowledge proofs
  • Libsnark https://github.com/scipr-lab/libsnark
  • Bootstrap the Common Reference String for libsnark
Interested in joint projects?

• “Blockchain & security/crypto economics?
  • Fabio Massacci ➔ fabio.massacci@unitn.it
  • Chan Nam Ngo ➔ channam.ngo@unitn.it
  • https://securitylab.disi.unitn.it/
  • Watch this space for our work on Futures Exchange (IEEE S&P 2018)
• Blockchain & distributed protocols
  • Alberto Montresor ➔ alberto.montresor@unitn.it
  • http://cricca.disi.unitn.it
• Or come to visit us.
• Possibly joint company project within EIT Digital Finance Action Line