Credit Enforcement and Monetary-Policy Transmission in a Search Economy

Markus Althanns[1]*   Hugo van Buggenum[1]†   Hans Gersbach[1]‡

[1]KOF Swiss Economic Institute at ETH Zurich

EEA-ESEM 2024 – Rotterdam
August 27, 2024

*malthanns@ethz.ch
†hvanbuggenum@ethz.ch
‡hgersbach@ethz.ch

Motivation and Research Questions

Financial intermediaries (e.g., commercial banks) exert a **dual role**: they

- **write credit contracts** and
- **create private money** by intermediating their claims on credit repayment.

Motivation and Research Questions

Financial intermediaries (e.g., commercial banks) exert a **dual role**: they

- **write credit contracts** and
- **create private money** by intermediating their claims on credit repayment.

Does the **degree of enforcement** of promises in credit contracts matter

1. for the transmission of long-run inflation to **trading frequencies**?

Motivation and Research Questions

Financial intermediaries (e.g., commercial banks) exert a **dual role**: they

- **write credit contracts** and
- **create private money** by intermediating their claims on credit repayment.

Does the **degree of enforcement** of promises in credit contracts matter

1. for the transmission of long-run inflation to **trading frequencies**?
2. for whether **private-money creation** is good or bad for welfare?

Methodological Approach

We employ a

- New-Monetarist model (Lagos & Wright, 2005)
- with directed and competitive search (Lagos & Rocheteau, 2005; Wright, Kircher, Julien, & Guerrieri, 2021)
- in continuous time (Choi & Rocheteau, 2021).

Methodological Approach

We employ a

- New-Monetarist model (Lagos & Wright, 2005)
- with directed and competitive search (Lagos & Rocheteau, 2005; Wright et al., 2021)
- in continuous time (Choi & Rocheteau, 2021).

We refer to two strands of the literature:

- the **hot-potato effect** in New-Monetarist models
- the **money-creation privilege**

Hot-Potato Effect of Inflation

Hot-Potato Effect of Inflation

Irving Fisher characterizes the **hot-potato effect** of inflation (Humphre, 1993):

> *"When depreciation is anticipated, there is a tendency among owners of money to spend it speedily."*

Hot-Potato Effect of Inflation

Irving Fisher characterizes the **hot-potato effect** of inflation (Humphre, 1993):

> *"When depreciation is anticipated, there is a tendency among owners of money to spend it speedily."*

Issue: buyers in general cannot *avoid* the cost of carrying money by spending it faster; they can only *pass it on* to sellers.

Hot-Potato Effect of Inflation

Irving Fisher characterizes the **hot-potato effect** of inflation (Humphre, 1993):
> *"When depreciation is anticipated, there is a tendency among owners of money to spend it speedily."*

Issue: buyers in general cannot *avoid* the cost of carrying money by spending it faster; they can only *pass it on* to sellers.

Approaches to generate the hot-potato effect in money-search models:

- **directed and competitive search** (Lagos & Rocheteau, 2005);
- ability of buyers to reshuffle money balances as compared to sellers and match-specific preference shocks (Dong & Jiang, 2014; Ennis, 2009; Liu et al., 2011; Nosal, 2011)

Hot-Potato Effect of Inflation

Irving Fisher characterizes the **hot-potato effect** of inflation (Humphre, 1993):

> *"When depreciation is anticipated, there is a tendency among owners of money to spend it speedily."*

Issue: buyers in general cannot *avoid* the cost of carrying money by spending it faster; they can only *pass it on* to sellers.

Approaches to generate the hot-potato effect in money-search models:

- **directed and competitive search** (Lagos & Rocheteau, 2005);
- ability of buyers to reshuffle money balances as compared to sellers and match-specific preference shocks (Dong & Jiang, 2014; Ennis, 2009; Liu et al., 2011; Nosal, 2011)

Preview: Inflation accelerates trade iff enforcement in credit contracts is strong.

Money-Creation Privilege

Money-Creation Privilege

The debate on the money-creation privilege is recurrent:

1. Chicago plan (Fisher, 1935)
2. Swiss Vollgeld Initiative
3. discussions about CBDC
4. etc.

Money-Creation Privilege

The debate on the money-creation privilege is recurrent:

1. Chicago plan (Fisher, 1935)
2. Swiss Vollgeld Initiative
3. discussions about CBDC
4. etc.

Preview: The money-creation privilege improves welfare iff enforcement in credit contracts is strong.

Goods & Agents

Infinite-horizon continuous-time model with three types of agents:

- *sellers*
- *buyers*
- *financial intermediaries (FIs)*

Goods & Agents

Infinite-horizon continuous-time model with three types of agents:

- *sellers*
- *buyers*
- *financial intermediaries (FIs)*

Two types of **non-storable** consumption goods:

- *general goods*: can be produced and consumed by all agents
- *search goods*: exclusively produced (by sellers) and consumed (by buyers) in pairwise meetings

Directed & Competitive Search

Search goods are traded in search markets. They are continuously open and differ in two regards:

- **terms of trade** q, p: quantity & payment
- **market tightness** θ: relation of the masses of active buyers and sellers

Directed & Competitive Search

Search goods are traded in search markets. They are continuously open and differ in two regards:

- **terms of trade** q, p: quantity & payment
- **market tightness** θ: relation of the masses of active buyers and sellers

$\rightarrow$ A search market is fully characterized by (q, p, θ).

Directed & Competitive Search

Search goods are traded in search markets. They are continuously open and differ in two regards:

- **terms of trade** q, p: quantity & payment
- **market tightness** θ: relation of the masses of active buyers and sellers

$\rightarrow$ A search market is fully characterized by (q, p, θ).

Directed and **competitive** search:

- Buyers *direct* costly search effort to the most "favourable" search market.
- Sellers post terms of trade and *compete* for buyers' search effort.

Money

Money is necessary to facilitate trade in the search markets. Why?

Money

Money is necessary to facilitate trade in the search markets. Why?

Buyers lack commitment towards sellers. $\rightarrow$ no direct credit.

Money

Money is necessary to facilitate trade in the search markets. Why?

Buyers lack commitment towards sellers. $\rightarrow$ no direct credit.

We distinguish two types of money that are perfect substitutes in payment:
- **fiat money**: issued by the government
- **private money**: issued by FIs

Money

Money is necessary to facilitate trade in the search markets. Why?

Buyers lack commitment towards sellers. $\rightarrow$ no direct credit.

We distinguish two types of money that are perfect substitutes in payment:

- **fiat money**: issued by the government
- **private money**: issued by FIs

Remark: private-money creation is **not** necessary to facilitate trade.

Money

Money is necessary to facilitate trade in the search markets. Why?

Buyers lack commitment towards sellers. $\rightarrow$ no direct credit.

We distinguish two types of money that are perfect substitutes in payment:
- **fiat money**: issued by the government
- **private money**: issued by FIs

Remark: private-money creation is **not** necessary to facilitate trade.
  $\Rightarrow$ Private-money creation *per se* is not welfare improving.
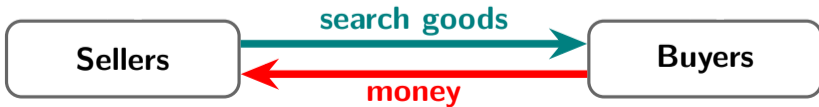
Overview of Goods Markets

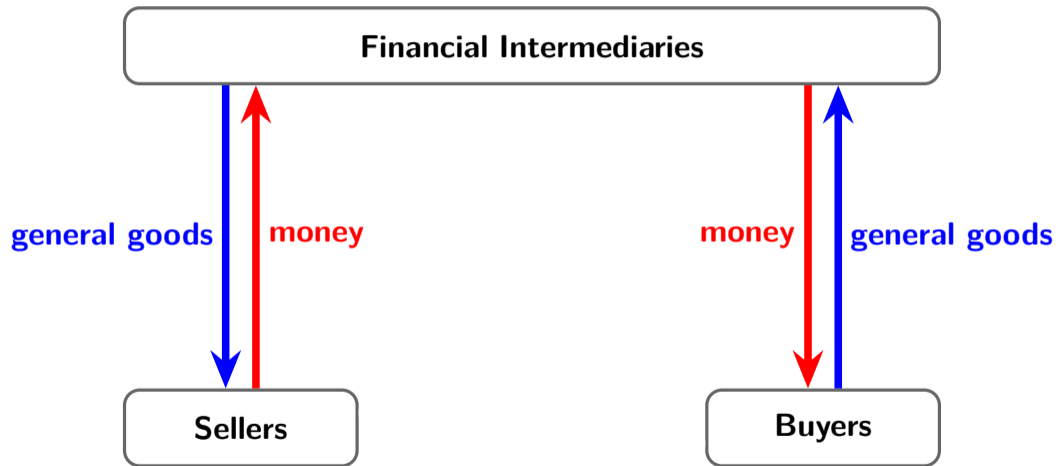|	Search markets	Competitive market (CM)
Traders	buyer $\leftrightarrow$ seller	buyers, sellers, FIs
Goods traded	search goods	general goods
Trading protocol	directed search	Walrasian

A Typical Search Market

Competitive Market

Financial Intermediaries' Dual Role

FIs exert a dual role:

Financial Intermediaries' Dual Role

FIs exert a dual role:

1. **credit extension**: FIs provide loans to sellers at real rate r_t^ℓ;

Financial Intermediaries' Dual Role

FIs exert a dual role:

1. **credit extension**: FIs provide loans to sellers at real rate r_t^{ℓ};
2. **private-money creation**: FIs intermediate a share η of arising claims to buyers at real rate r_t^p.

Financial Intermediaries' Dual Role

FIs exert a dual role:

1. **credit extension**: FIs provide loans to sellers at real rate r_t^ℓ;
2. **private-money creation**: FIs intermediate a share η of arising claims to buyers at real rate r_t^p.
   $\rightarrow$ FIs keep a share $1 - \eta$ of claims as **equity** due to capital requirements.

Why Credit Extension?

Why do FIs write loan contracts?

Why Credit Extension?

Why do FIs write loan contracts?

Let ρ denote all agents' rate of time preference. In equilibrium,

Why Credit Extension?

Why do FIs write loan contracts?

Let ρ denote all agents' rate of time preference. In equilibrium,

1. *credit extension* is costly: $r_t^\ell < \rho$
   $\rightarrow$ Credit is profitable for sellers: sellers want to **frontload consumption**.

Why Credit Extension?

Why do FIs write loan contracts?

Let ρ denote all agents' rate of time preference. In equilibrium,

1. *credit extension* is costly: $r_t^\ell < \rho$
   - $\rightarrow$ Credit is profitable for sellers: sellers want to **frontload consumption**.
2. *private-money creation* is profitable: $r_t^p < r_t^\ell < \rho$
   - $\rightarrow$ Money is costly for buyers.

Why Credit Extension?

Why do FIs write loan contracts?

Let ρ denote all agents' rate of time preference. In equilibrium,

1. *credit extension* is costly: $r_t^\ell < \rho$
   - $\rightarrow$ Credit is profitable for sellers: sellers want to **frontload consumption**.
2. *private-money creation* is profitable: $r_t^p < r_t^\ell < \rho$
   - $\rightarrow$ Money is costly for buyers.

$\Rightarrow$ FIs provide as many loans as necessary to back their private-money creation.

Credit Enforcement: Contract and Project Control

Sellers **pledge** their future income from search markets to FIs to obtain credit.

Credit Extension

Credit Enforcement: Contract and Project Control

Sellers **pledge** their future income from search markets to FIs to obtain credit.

Credit Extension

Distinction between two **degrees of enforcement**:

Credit Enforcement: Contract and Project Control

Sellers **pledge** their future income from search markets to FIs to obtain credit.

Credit Extension

Distinction between two **degrees of enforcement**:

- **contract control**: FIs can observe and seize sellers' match revenues.

Credit Enforcement: Contract and Project Control

Sellers **pledge** their future income from search markets to FIs to obtain credit.

Distinction between two **degrees of enforcement**:

- **contract control**: FIs can observe and seize sellers' match revenues.
  - $\rightarrow$ necessary technology for credit to be feasible

Credit Enforcement: Contract and Project Control

Sellers **pledge** their future income from search markets to FIs to obtain credit.

Credit Extension

Distinction between two **degrees of enforcement**:

- **contract control**: FIs can observe and seize sellers' match revenues.
  - $\rightarrow$ necessary technology for credit to be feasible
- **project control**: FIs can enforce sellers' actions in the search markets.

Credit Enforcement: Contract and Project Control

Sellers **pledge** their future income from search markets to FIs to obtain credit.

Distinction between two **degrees of enforcement**:

- **contract control**: FIs can observe and seize sellers' match revenues.
  - $\rightarrow$ necessary technology for credit to be feasible
- **project control**: FIs can enforce sellers' actions in the search markets.
  - $\rightarrow$ higher degree of commitment between sellers and FIs

Credit-Contract Specification

Contract & project control: At time t, seller and FI contract

Credit-Contract Specification

Contract & project control: At time t, seller and FI contract

- debt repayment $d_{t+\Delta}$, subject to limited liability

Credit-Contract Specification

Contract & project control: At time t, seller and FI contract

- debt repayment $d_{t+\Delta}$, subject to limited liability
- search effort $\varepsilon_{t+\Delta}^s$ and search market $(q_{t+\Delta}, p_{t+\Delta}, \theta_{t+\Delta})$,

where $\Delta > 0$ is the pledgeability horizon (exogenous).

Credit-Contract Specification

Contract & project control: At time t, seller and FI contract

- debt repayment $d_{t+\Delta}$, subject to limited liability
- search effort $\varepsilon_{t+\Delta}^s$ and search market $(q_{t+\Delta}, p_{t+\Delta}, \theta_{t+\Delta})$,

where $\Delta > 0$ is the pledgeability horizon (exogenous).

Only **contract control**:

Credit-Contract Specification

Contract & project control: At time t, seller and FI contract

- debt repayment $d_{t+\Delta}$, subject to limited liability
- search effort $\varepsilon_{t+\Delta}^s$ and search market $(q_{t+\Delta}, p_{t+\Delta}, \theta_{t+\Delta})$,

where $\Delta > 0$ is the pledgeability horizon (exogenous).

Only **contract control**:

1. *ex-ante* (time t): seller and FI contract $d_{t+\Delta}$, subject to limited liability

Credit-Contract Specification

Contract & project control: At time t, seller and FI contract

- debt repayment $d_{t+\Delta}$, subject to limited liability
- search effort $\varepsilon_{t+\Delta}^s$ and search market $(q_{t+\Delta}, p_{t+\Delta}, \theta_{t+\Delta})$,

where $\Delta > 0$ is the pledgeability horizon (exogenous).

Only **contract control**:

1. *ex-ante* (time t): seller and FI contract $d_{t+\Delta}$, subject to limited liability
2. *ex-post* (time $t + \Delta$): seller chooses $\varepsilon_{t+\Delta}^s$ and $(q_{t+\Delta}, p_{t+\Delta}, \theta_{t+\Delta})$, given $d_{t+\Delta}$.

The Effect of Inflation on the Incentive to Take out Credit

We consider long-run inflation in stationary equilibria.

The Effect of Inflation on the Incentive to Take out Credit

We consider long-run inflation in stationary equilibria.

Effects of an **increase of long-run inflation** $\pi \uparrow$:

The Effect of Inflation on the Incentive to Take out Credit

We consider long-run inflation in stationary equilibria.

Effects of an **increase of long-run inflation** $\pi \uparrow$:

1. perfect substitutability of private and fiat money
   $\rightarrow$ real interest rate on private money $r^p \downarrow$

The Effect of Inflation on the Incentive to Take out Credit

We consider long-run inflation in stationary equilibria.

Effects of an **increase of long-run inflation** $\pi \uparrow$:

1. perfect substitutability of private and fiat money
   $\rightarrow$ real interest rate on private money $r^p \downarrow$
2. perfect competition among FIs
   $\rightarrow$ real loan rate $r^\ell \downarrow$

The Effect of Inflation on the Incentive to Take out Credit

We consider long-run inflation in stationary equilibria.

Effects of an **increase of long-run inflation** $\pi \uparrow$:

1. perfect substitutability of private and fiat money
   $\rightarrow$ real interest rate on private money $r^p \downarrow$
2. perfect competition among FIs
   $\rightarrow$ real loan rate $r^\ell \downarrow$
3. sellers' incentive to take out credit $\uparrow$

Transmission of Inflation

Sellers want to increase the present value of their future revenues.

Transmission of Inflation

Sellers want to increase the present value of their future revenues.

Contract & project control:
- Sellers commit to more economic activity.
  - ⇒ The economy **overheats.**

Transmission of Inflation

Sellers want to increase the present value of their future revenues.

Contract & project control:
- Sellers commit to more economic activity.
    - $\Rightarrow$ The economy **overheats.**

Only contract control:

Transmission of Inflation

Sellers want to increase the present value of their future revenues.

Contract & project control:
- Sellers commit to more economic activity.
  - $\Rightarrow$ The economy **overheats.**

Only contract control:
- *Ex ante*: sellers contract a larger contingent repayment $d_{t+\Delta}$

Transmission of Inflation

Sellers want to increase the present value of their future revenues.

Contract & project control:
- Sellers commit to more economic activity.
  $\Rightarrow$ The economy **overheats.**

Only contract control:
- *Ex ante*: sellers contract a larger contingent repayment $d_{t+\Delta}$
- *Ex post*: the sellers' incentive to be economically active declines.

Transmission of Inflation

Sellers want to increase the present value of their future revenues.

Contract & project control:

- Sellers commit to more economic activity.
  ⇒ The economy **overheats.**

Only contract control:

- *Ex ante*: sellers contract a larger contingent repayment $d_{t+\Delta}$
- *Ex post*: the sellers' incentive to be economically active declines.
  ⇒ The economy **cools down.**

Calibration Strategy

We calibrate three different economies to U.S. data from 1968 to 2019:

Calibration Strategy

We calibrate three different economies to U.S. data from 1968 to 2019:

1. economy F: **without** intermediation;

Calibration Strategy

We calibrate three different economies to U.S. data from 1968 to 2019:

1. economy F: **without** intermediation;
2. economy P: with intermediation **with** project control:

Calibration Strategy

We calibrate three different economies to U.S. data from 1968 to 2019:

1. economy F: **without** intermediation;
2. economy P: with intermediation **with** project control:
3. economy NP: with intermediation **without** project control

Calibration Strategy

We calibrate three different economies to U.S. data from 1968 to 2019:

1. economy F: **without** intermediation;
2. economy P: with intermediation **with** project control:
3. economy NP: with intermediation **without** project control

We target

1. money demand, which relates M1/GDP to the 3-month T-bill rate;
2. the share of public money in the monetary aggregate: M0/M1;
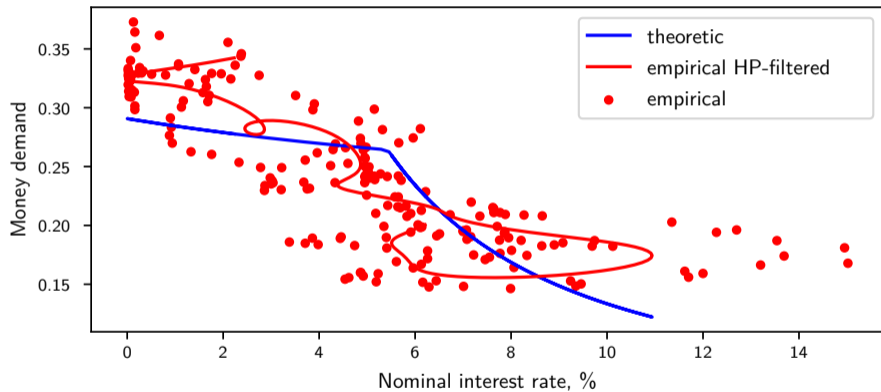3. firm-level markups.

Money Demand

Figure: Money demand in economy P.

Monetary-Policy Transmission

Friedman rule (FR): slight deflation that compensates for time discounting.

Monetary-Policy Transmission

Friedman rule (FR): slight deflation that compensates for time discounting.

How does a **deviation from the FR** affect the economy?

Monetary-Policy Transmission

Friedman rule (FR): slight deflation that compensates for time discounting.

How does a **deviation from the FR** affect the economy?

	economy P			economy NP		
	$\pi = 3\%$	$\pi = 8\%$	$\pi = 13\%$	$\pi = 3\%$	$\pi = 8\%$	$\pi = 13\%$
matching frequency	11.03	-5.15	-8.57	-12.99	-45.20	-72.99
welfare	-1.77	-28.84	-47.81	-5.11	-40.18	-69.99
GDP	0.27	-0.96	-0.22	-4.09	-8.77	-11.76

Table: Changes in percent for inflation levels π.

The sign and magnitude of monetary-policy transmission depend on the enforcement technology.

Money-Creation Privilege

Money-Creation Privilege

100-percent capital requirements ($\eta = 0$) on intermediaries—an effective ban of private-money creation—have the following effects:

Money-Creation Privilege

100-percent capital requirements $(\eta = 0)$ on intermediaries—an effective ban of private-money creation—have the following effects:

	economy P			economy NP		
	$\pi = 3\%$	$\pi = 8\%$	$\pi = 13\%$	$\pi = 3\%$	$\pi = 8\%$	$\pi = 13\%$
matching frequency	-13.82	-31.08	-42.78	13.04	71.96	144.42
welfare	-4.21	-9.66	-1.43	2.07	49.05	103.63
GDP	-3.40	-6.05	-8.40	1.22	3.58	3.34

Table: Changes in percent for inflation levels π.

Intermediation stimulates the economy and improves welfare iff enforcement is strong.

Conclusion

We model today's monetary architecture in a framework of directed and competitive search. FIs

- **extend credit** towards sellers against pledged future revenues;
- intermediate the arising claims to buyers $\rightarrow$ **money creation**.

Conclusion

We model today's monetary architecture in a framework of directed and competitive search. FIs

- **extend credit** towards sellers against pledged future revenues;
- intermediate the arising claims to buyers $\rightarrow$ **money creation**.

Results:

- **long-run inflation** accelerates trade;
- the intermediaries' **money-creation privilege** improves welfare and stimulates economic activity

iff the **degree of enforcement** in credit contracts is high.

7 Appendix

References I

Choi, M., & Rocheteau, G. (2021). New Monetarism in continuous time: Methods and applications. *Economic Journal*, *131*(634), 658–696.

Dong, M., & Jiang, J. H. (2014). Money and price posting under private information. *Journal of Economic Theory*, *150*(C), 740–777.

Ennis, H. M. (2009). Avoiding the inflation tax. *International Economic Review*, *50*(2), 607–625.

Fisher, I. (1935). *100% money*. Adelphi Company, New York, NY.

Humphre, T. M. (1993). The origins of velocity functions. *Economic Quarterly (Federal Reserve Bank of Richmond)*, *Fall*, 1-17.

Lagos, R., & Rocheteau, G. (2005). Inflation, output, and welfare. *International Economic Review*, *46*(2), 495–522.

Lagos, R., & Wright, R. (2005). A unified framework for monetary theory and policy analysis. *Journal of Political Economy*, *113*(3), 463–484.
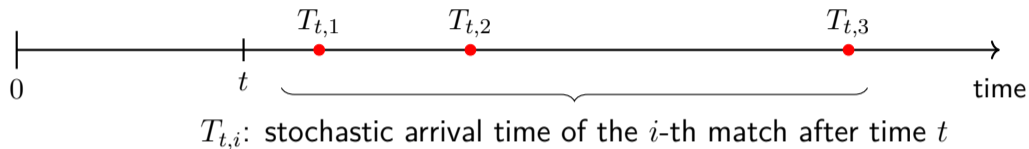
References II

Liu, L. Q., Wang, L., & Wright, R. (2011). On the "hot potato" effect of inflation: Intensive versus extensive margins. *Macroeconomic Dynamics*, *15*(S2), 191–216.

Nosal, E. (2011). Search, welfare, and the "hot potato" effect of inflation. *Macroeconomic Dynamics*, *15*(S2), 313–326.

Wright, R., Kircher, P., Julien, B., & Guerrieri, V. (2021). Directed search and competitive search equilibrium: A guided tour. *Journal of Economic Literature*, *59*(1), 90–148.
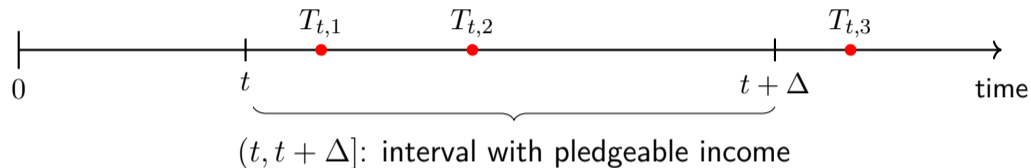
Credit Extension I
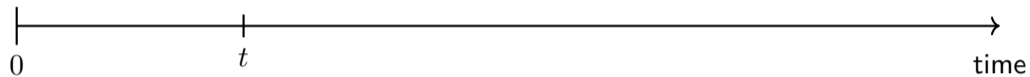
Credit extension at time t:

Credit Extension II

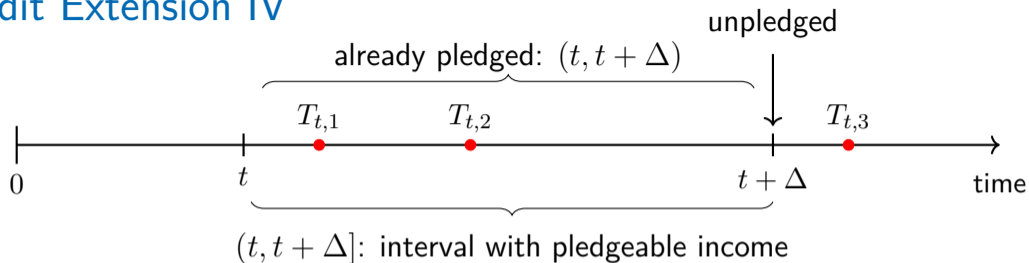$T_{t,i}$: stochastic arrival time of the i-th match after time t

Credit extension at time t:

Credit Extension III

$(t, t+\Delta]$: interval with pledgeable income

Credit extension at time t:

- $\Delta \mathrel{\widehat{=}}$ length of the time horizon over which the seller can commit to FIs.

Credit Extension IV

$(t, t + \Delta]$: interval with pledgeable income

Credit extension at time t:

- $\Delta \mathrel{\widehat{=}}$ length of the time horizon over which the seller can commit to FIs.
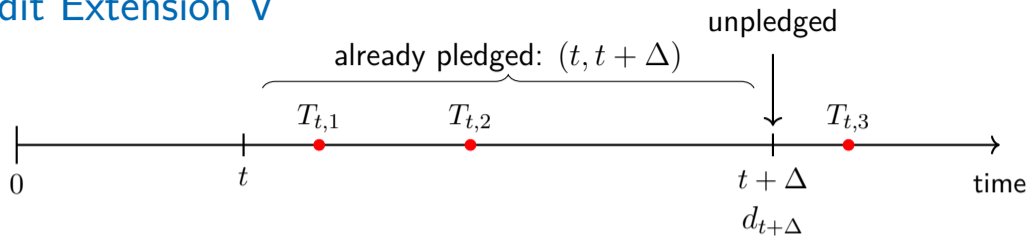
Credit Extension V

Credit extension at time t:

- $\Delta \mathrel{\hat{=}}$ length of the time horizon over which the seller can commit to FIs.
- Seller contracts debt repayment $d_{t+\Delta} \leq p_{t+\Delta}$ **contingent** on a match.
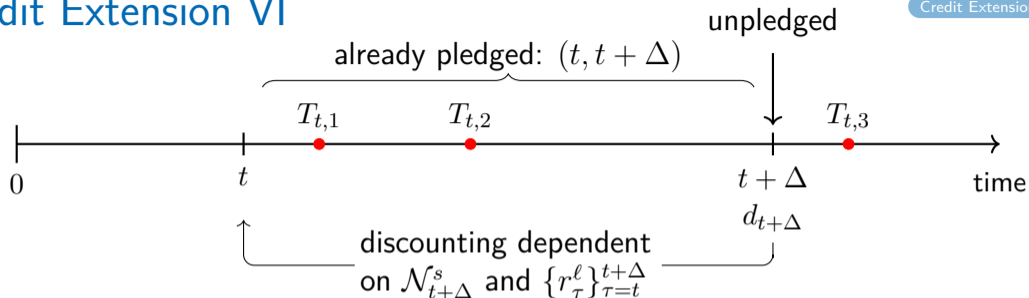
Credit Extension VI

Credit extension at time t:

- $\Delta \triangleq$ length of the time horizon over which the seller can commit to FIs.
- Seller contracts debt repayment $d_{t+\Delta} \leq p_{t+\Delta}$ **contingent** on a match.
- Seller receives the **actuarially fair** amount of general goods, depending on
  - the seller's matching rate $\mathcal{N}_{t+\Delta}^s$
  - loan rates $\{r_\tau^\ell\}_{\tau=t}^{t+\Delta}$

Calibration Targets

moment	description	data	economies P	NP	F
a_0	level of money demand	-1.0934	-1.0936	-1.0935	-1.0934
a_1	interest-rate semi-elasticity	-7.5169	-7.5131	-7.5171	-7.5166
$\overline{\varrho}$	average price markup	0.3600	0.3600	0.3601	0.3601
$\overline{\lambda}$	average share of M0 in M1	0.3278	0.3279	0.3278	-
	Euclidean distance $\times 10^4$	-	1.4324	0.5688	0.1940

Table: Empirical and theoretical moments in the calibrations.

Calibrated Parameters

parameter	description	economies		
		P	NP	F
σ	curvature of search-good utility function u	0.36	0.40	0.37
χ	buyers' bargaining power	0.35	0.60	0.48
G	production not accounted for by the model	6.99	5.68	6.39
Δ	pledgeability horizon	1.06	17.60	-

Table: Calibrated parameters.