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Optimal Cryptocurrency Policy and Optimal Monetary Policy: Observing Transactions Patterns, Heterogeneity and Wealth Effects, and the Implications of Micro-Market Frictions (Lecture 11)

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- ❖ Tokens and cryptocurrency satisfy velocity and frequent-use-in-payments definitions of money

- ❖ Room for them, due to gaps, not equating IMRS.
  - ➢ Potentially improved intermediation

- ❖ From monetary theory, the value of fiat money can be endogenous and potentially indeterminate, loss of the fundamental welfare theorems, empirical tests for optimal size of bubbles –same here for crypto

- ❖ Or, money can have a value due to taxes or legal stipulations, cash in advance, or as reduced-form money in utility function
  - ➢ Crypto here as utility tokens in mechanisms

- ❖ Either way, endogenous valuation or with exogeneous restrictions, cryptocurrency can have value or play a role on top of the fiat structure

- ❖ Indeterminacy, inflation, speculation have remedies in the same roots of monetary theory: interest on currency/reserves, central bank reputation or digital reserve bank commitment, use requirements gives minimum lower bound

- ❖ Smart contracts and an algorithmic digital reserve system can implement optimal activist policy as in monetary models using transactions data

Figure 1
The Turnpike Model
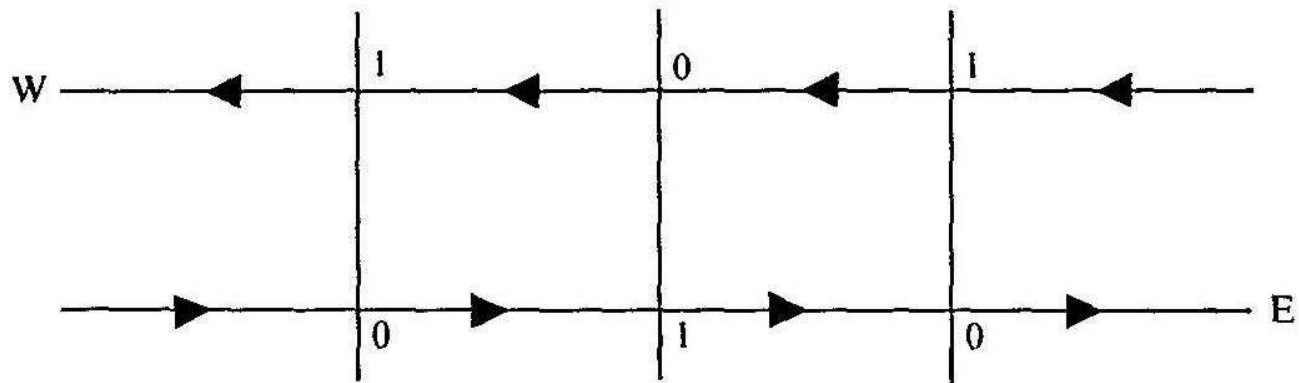
Each agent has preferences over her or his (infinite) lifetime consumption sequence $\{c_t\}_{t=0}^{\infty}$ as described by the utility function $\sum_{t=0}^{\infty} \beta^t U(c_t)$ where $c_t \geqslant 0$, $0 < \beta < 1$, and $U(\cdot)$ is strictly concave, strictly increasing, bounded, and continuously differentiable with $U'(0) = \infty$. Thus all agents have the same time separable utility function of a rather special form, and in particular, all discount future over present consumption at the same rate, β.[9]

- All agents who start with 0 are referred to as agents of *type A*. A similar restriction is placed on those who begin with 1 unit, agents of *type B*. It bears repeating here that when an allocation is termed optimal below, it is only established to be optimal in the class of symmetric allocations

Problem 1:

$$\max_{\{c_t^A\}_{t=0}^{\infty},\; \{c_t^B\}_{t=0}^{\infty}} w^A\left[\sum_{t=0}^{\infty}\beta^t U(c_t^A)\right] + w^B\left[\sum_{t=0}^{\infty}\beta^t U(c_t^B)\right]$$

subject to (1) where $w^A > 0$, $w^B > 0$, $w^A + w^B = 1$. Necessary and sufficient first-order conditions for Problem 1 are

$$(2) \qquad w^i\beta^t U'(c_t^i) - \theta_t = 0, \;\; i = A, B \qquad t \geqslant 0$$

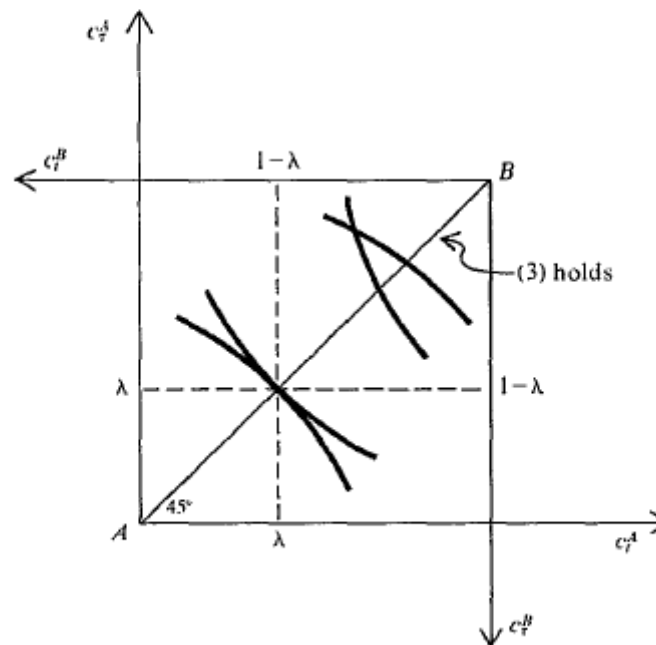where the θ_t are positive Lagrange multipliers. Trivial manipulation of (2) yields

$$(3) \qquad \frac{U'(c_t^A)}{U'(c_\tau^A)} = \frac{U'(c_t^B)}{U'(c_\tau^B)} \qquad \text{all } t, \tau \geqslant 0.$$

Conditions (1) and (3) are fully equivalent with

$$(4) \qquad c_t^A = \lambda, \;\; c_t^B = 1 - \lambda, \;\; 0 < \lambda < 1 \qquad \text{all } t \geqslant 0.$$

(See Figure 2.) Thus a necessary and sufficient condition for a feasible interior allocation $\{c_t^A\}_{t=0}^{\infty}$, $\{c_t^B\}_{t=0}^{\infty}$ to be optimal is that each agent of type A receive λ units of the consumption good in each period t. That this condition is necessary for optimality follows from the obvious fact that if condition (3) is not satisfied for some periods t and τ, then there is a Pareto superior feasible allocation.

Figure 2
Optimal Allocations in the Turnpike Model

Problem 2:

$$\max_{\{c_t^i\}_{t=0}^{\infty}, \{M_t^i\}_{t=1}^{\infty}} \sum_{t=0}^{\infty} \beta^t U(c_t^i)$$

subject to

$$
\begin{array}{lll}
c_t^i \geqslant 0 & & \text{all } t \geqslant 0 \\
M_t^i \geqslant 0 & & \text{all } t \geqslant 0 \\
(5) \qquad p_t c_t^i + M_{t+1}^i \leqslant p_t y_t^i + M_t^i - z_t^i & & \text{all } t \geqslant 0
\end{array}
$$

$$(6) \qquad -\frac{\beta^{t-1} U'(c_{t-1}^i)}{p_{t-1}} + \frac{\beta^t U'(c_t^i)}{p_t} + \theta_t^i = 0 \qquad \text{all } t \geqslant 1$$

Thus,

$$(7) \qquad \frac{U'(c_{t-1}^i)}{\beta U'(c_t^i)} \geqslant \frac{p_{t-1}}{p_t} \qquad\qquad \cdot \text{all } t \geqslant 1$$

where (7) must hold as an equality if $M_t^i > 0$ and as an inequality if and only if $\theta_t^i > 0$, that is, when the marginal utility of a unit of fiat money spent on period $t-1$ consumption exceeds the marginal utility of a unit of fiat money spent on period t consumption and there is no more fiat money to spend in period $t-1$.

DEFINITION. *A monetary equilibrium is a sequence of finite positive prices $\{p_t^*\}_{t=0}^{\infty}$ and sequences of consumptions $\{c_t^{i}*\}_{t=0}^{\infty}$, money balances $\{M_t^{i}*\}_{t=0}^{\infty}$, and lump-sum taxes $\{z_t^{i}*\}_{t=0}^{\infty}$ for each agent type $i = A, B$ such that*

- *Maximization: the sequences $\{c_t^{i}*\}_{t=0}^{\infty}$, $\{M_t^{i}*\}_{t=1}^{\infty}$ solve Problem 2 relative to $\{p_t^*\}_{t=0}^{\infty}$, $\{z_t^{i}*\}_{t=0}^{\infty}$, and $M_0^{i}*$.*
- *Market clearing: $c_t^{A}* + c_t^{B}* = 1$, all $t \geqslant 0$.*

PROPOSITION 1. *No interior optimum λ can be supported in a monetary equilibrium without intervention, that is, with $z_t^{i}* \equiv 0$ for all $i = A, B$.*

$$\frac{U'(\lambda)}{\beta U'(\lambda)} = \frac{p_{t-1}^*}{p_t^*} \qquad\qquad t \geqslant 2, t \text{ even}$$

$$\frac{U'(1-\lambda)}{\beta U'(1-\lambda)} = \frac{p_{t-1}^*}{p_t^*} \qquad\qquad t \geqslant 1, t \text{ odd.}$$

It follows that

(8) $\qquad\qquad p_t^* = \beta p_{t-1}^* \qquad\qquad$ all $t \geqslant 1$

that is, *the rate of deflation must be $1 - \beta$*. Now consider the evolution of money balances of agent type B given the price sequence $\{p_t^*\}_{t=0}^{\infty}$ and the specified consumption sequence $c_t^B = 1 - \lambda$, all $t \geqslant 0$. Agent type B begins life with $M_0^{B*} \geqslant 0$ units of fiat money, acquires $p_0^*\lambda$ units in period 0, and spends $p_1^*(1 - \lambda)$ units in period 1. Thus

(9) $\qquad\qquad M_2^{B*} - M_0^{B*} = p_0^*\lambda - p_1^*(1-\lambda).$

Clearly the increment to money balances from $t = 0$ to $t = 2$, the left-hand side of (9), is nonnegative if the right-hand side is nonnegative. Substituting from (8), the right-hand side is nonnegative if

(10) $\qquad\qquad \dfrac{\lambda}{1-\lambda} \geqslant \beta.$

Similar calculations establish that the increment to money balances is non-negative for agent type A from t to $t + 2$ for all t odd, if

$$(11) \qquad \frac{1-\lambda}{\lambda} \geqslant \beta.$$

Figure 3
The Relationship Between λ and β

As Figure 3 makes clear, with the discount rate β fixed, $0 < \beta < 1$, at least one of the relationships (10) and (11) must hold as a strict inequality for any value of λ between 0 and I. That is, at least one agent type will be accumulating money balances over time in the above sense. But then this cannot be an equilibrium.
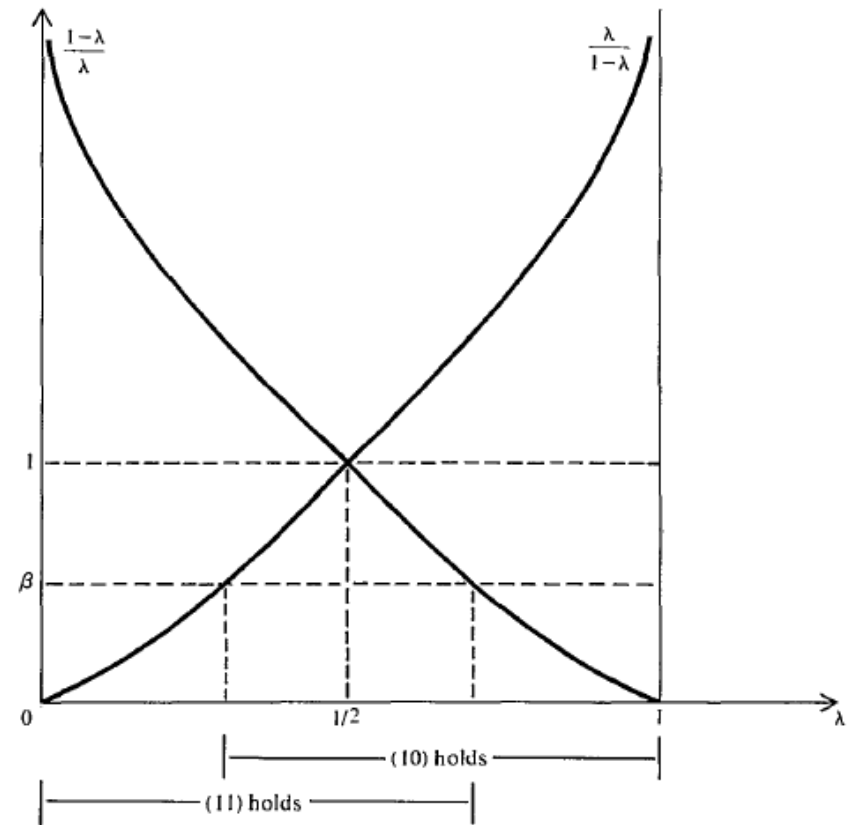
PROPOSITION 2. *Any interior optimum* λ *with* $\beta \leqslant [\lambda/(1-\lambda)]$ *and* $\beta \leqslant [(1-\lambda)/\lambda]$ *can be supported in a monetary equilibrium with rate of deflation* $1 - \beta$; *with* $z_t^{B*} = p_{t-1}^*[\lambda - \beta(1-\lambda)] \geqslant 0$ *for* $t \geqslant 1$, *t odd, and* $z_t^{B*} = 0$ *otherwise; and with* $z_t^{A*} = p_{t-1}^*[(1-\lambda) - \lambda\beta] \geqslant 0$ *for* $t \geqslant 2$, *t even, and* $z_t^{A*} = 0$ *otherwise.*

PROPOSITION 3. *Any monetary equilibrium with nonbinding nonnegativity constraints on money balances on each agent in each period supports an optimal allocation and hence requires some intervention.*

Figure 4
The Turnpike's Monetary Equilibrium

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The Turnpike's Monetary Equilibrium
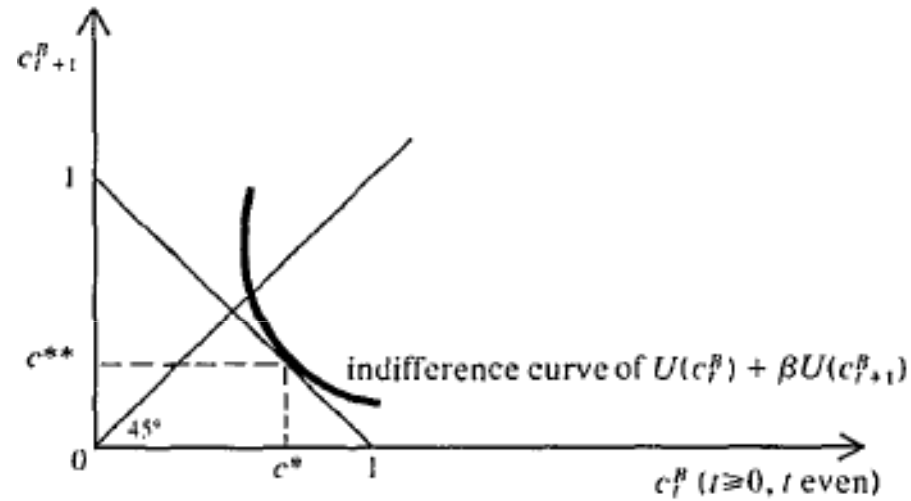
PROPOSITION 4. *There exists a noninterventionist monetary equilibrium with constant prices, with binding nonnegativity constraints on money balances in every other period, and with alternating consumption sequences.*

ALTERNATIVE MONETARY POLICIES IN A TURNPIKE ECONOMY: VINTAGE ARTICLE

MANUELLI AND SARGENT (2009)

The economy consists of equal numbers of two types of agents, whom we label as $i = e$ and $i = o$, where e stands for even and o stands for odd. Agents of type i have preferences over streams of consumption and labor supply $\{c_t^i, \ell_t^i\}_{t=0}^{\infty} = (c^i, \ell^i)$ that are ordered by

$$
(1) \qquad U(c^i, \ell^i) = \sum_{t=0}^{\infty} \beta^t u(c_t^i, 1 - \ell_t^i)
$$

where u is strictly concave and twice differentiable. Agent i has access to the technology for producing a single consumption good,

$$
y_t^i \leq \omega_t^i \ell_t^i
$$

where $\{\omega_t^i\}_{t=0}^\infty$ is a sequence of labor productivities for agent i and y_t^i is agent i's output of the time t consumption good. The consumption good is nonstorable.

Odd and even agents are identified by their productivity sequences. In particular, let $a > 0, b > 0$. Then $\{\omega_t^o\}$ and $\{\omega_t^e\}$ are the sequences

$$\{\omega_t^o\}_{t=0}^\infty = \{a, 0, 0, b, a, 0, 0, b, \ldots\}$$

$$\{\omega_t^e\}_{t=0}^\infty = \{0, b, a, 0, 0, b, a, 0, \ldots\} .$$

Individual productivity sequences are of period four, while the aggregate productivity sequence $\omega_t^o + \omega_t^e$ is of period two. Every two periods, odd and even agents experience a reversal of productivity prospects as characterized by the tails $\{\omega_s^i\}_{s=t}^\infty$ of their productivity sequences.
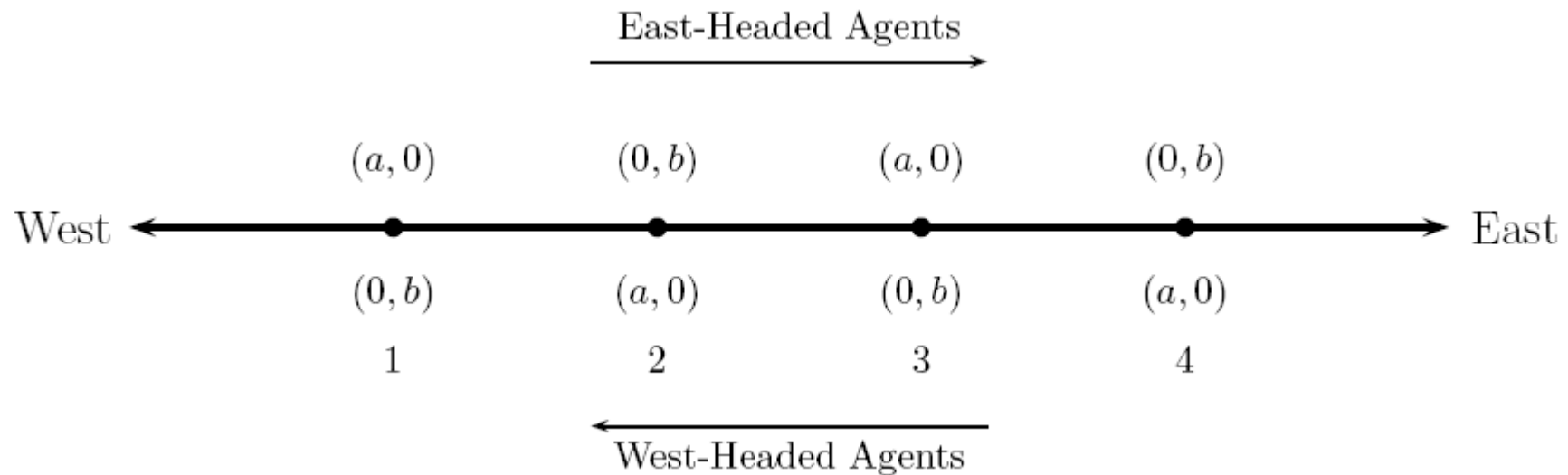
Figure 1. A turnpike in which east headed agents meet west headed agents for two periods. At each integer, there are equal numbers of east headed and west headed agents. For $t = 0, 4, \ldots$, odd agents have two-period endowment $(a, 0)$, and even agents have two-period endowment $(0, b)$. For $t = 2, 6, \ldots$, even agents have two period endowment $(a, 0)$, and odd agents have two-period endowment $(0, b)$. Agents move in their assigned directions at the start of every even period $t \geq 2$.

- The only asset that can be carried across locations is a government issued fiat currency that is initially distributed equally across all locations.

- We let p_{jt} denote the nominal price level at location j at time t. We let r_{jt} denote the gross real interest rate on consumption loans from t to $t + 1$ at location j. In this paper, we restrict attention to equilibria in which prices and interest rates are identical at all locations, and we let p_t denote the common price level and R_t denote the common gross interest rate at t.

The economy starts out with a per capita quantity of currency of $H/2$ in each location. The government pays interest on currency held from t to $t+1$ at a net nominal rate of r_0 for t even and r_1 for t odd. We let $\{r_t\}$ denote this period two sequence of nominal rates on currency. For convenience, we denote the gross two-period nominal interest rate on currency as $r = (1+r_0)(1+r_1)$. Interest payments are financed by anonymous lump sum taxes at each location: all agents at all locations bear the same tax at a given time.[10] The government budget constraint holds location by location, so that interest payments at a location are fully financed by local taxes. We study policies that hold the stock of currency constant through time. Let τ_0 be the nominal tax on each agent in even periods, and τ_1 the nominal tax in odd periods. The government's budget constraints are

$$Hr_0 = 2\tau_1, \qquad Hr_1 = 2\tau_0.$$

A government policy is a four-tuple $(r_0, r_1, \tau_0, \tau_1)$. A policy of not paying interest on currency involves the setting $(0,0,0,0)$. This corresponds to what has sometimes been called a "laissez faire" or "noninterventionist" policy.

$$(1) \qquad \sum_{t=0}^{\infty} \beta^t u(c_t^i, 1 - \ell_t^i)$$

subject to

$$(2) \qquad \frac{m_t^i}{p_t} + b_t^i + c_t^i + \tau_t \le \omega_t^i \ell_t^i + R_{t-1} b_{t-1}^i + (1 + r_{t-1}) \frac{m_{t-1}^i}{p_t}$$

$$(3) \qquad b_t^i = 0 \text{ for } t = 1, 3, 5, \dots$$

$$(4) \qquad m_{-1}^i = \bar{m}_{-1}^i \text{ given}, \quad b_{-1}^i = 0 \text{ given}$$

The statement of the household's problem leaves the household free not to hold currency, which implies that if currency is held from t to $t+1$ for t even, currency and consumption loans must bear equal real rates of return. Restriction (3) captures the feature that debt cannot be transferred across locations. Notice that it rules out explosive processes ("Ponzi schemes") for private debt.

We employ the following:

Definition 1: An *equilibrium* is a collection of sequences $\{\bar{p}, \bar{R}, \bar{c}^i, \bar{\ell}^i, \bar{m}^i, \bar{b}^i, i = o, e\}$ that satisfy

(i) (Utility maximization):

Given $\bar{p}$ and $\bar{R}$, for $i = o, e$, $\{\bar{c}^i, \bar{\ell}^i, \bar{m}^i, \bar{b}^i\}$ solves the household's problem.

(ii) (Market Clearing)

(5)
$$c_t^o + c_t^e = \omega_t^o \ell_t^o + \omega_t^e \ell_t^e$$
$$m_t^o + m_t^e = m_{t-1}^o + m_{t-1}^e$$

(iii) (Initial endowments of currency)

(6)
$$m_{-1}^o + m_{-1}^e = H$$

We call it a *monetary equilibrium* if $1/p_t > 0$ for all $t \geq 0$. We call it a *nonmonetary equilibrium* otherwise.

prices that are *symmetric* and *periodic*. By *symmetric*, we mean that identically situated agents are treated equally. By *periodic*, we mean that the allocations satisfy[11]

$$\{c_t^o\} = \{c_0, c_1, a\ell_0 - c_0, b\ell_1 - c_1, c_0, c_1, a\ell_0 - c_0, b\ell_1 - c_1, \ldots\}$$

$$\{\ell_t^o\} = \{\ell_0, 0, 0, \ell_1, \ell_0, 0, 0, \ell_1, \ldots\}$$

(7)

$$\{c_t^e\} = \{a\ell_0 - c_0, b\ell_1 - c_1, c_0, c_1, a\ell_0 - c_0, b\ell_1 - c_1, c_0, c_1, \ldots\}$$

$$\{\ell_t^e\} = \{0, \ell_1, \ell_0, 0, 0, \ell_1 \ell_0, 0, \ldots\} \ ,$$

and that the price level satisfies

(8)
$$p_t = \{p_0, p_1, p_0, p_1, \ldots\} \ .$$

Evaluating the first order conditions for the household's problems at the periodic sequences for allocations and nominal prices for $t = 0, 1$ gives

$t = 0$	odd	even
(9a)	$$\frac{u_1(c_0, 1 - \ell_0)}{p_0} = \frac{\beta(1 + r_0)u_1(c_1, 1)}{p_1}$$	$$\frac{u_1(a\ell_0 - c_0, 1)}{p_0} = \frac{\beta(1 + r_0)u_1(b\ell_1 - c_1, 1 - \ell_1)}{p_1}$$
	$u_1(c_0, 1 - \ell_0)a = u_2(c_0, 1 - \ell_0)$	

$t = 1$	odd	even
(9b)	$$\frac{u_1(c_1, 1)}{p_1} \geq \beta(1 + r_1)\frac{u_1(a\ell_0 - c_0, 1)}{p_0}$$	$$\frac{u_1(b\ell_1 - c_1, 1 - \ell_1)}{p_1} \geq \beta(1 + r_1)\frac{u_1(c_0, 1 - \ell_0)}{p_0}$$
		$u_1(b\ell_1 - c_1, 1 - \ell_1)b = u_2(b\ell_1 - c_1, 1 - \ell_1)$

This is Type II
Possibly odd guy is
running out of money

Type I equilibrium
Even guy is running out of
money

We consider two possible kinds of periodic equilibria, depending on which type of agent i sets $m_1^i > 0$. We use

Definition 2: In a type I (periodic) equilibrium, $m_{-1}^e > 0, m_{-1}^o = 0, m_1^o > 0.$

Odd guy facing (a, 0) come into t = 0 with zero money

Definition 3: In a type II (periodic) equilibrium, $m_{-1}^o > 0, m_{-1}^e = 0, m_1^e > 0.$

Acquires money at t − 1 to carry to t = 2

(9a) and (9b) at equality

(10a)

$$u_1(c_0, 1 - \ell_0) = \beta^2(1 + r_0)(1 + r_1)u_1(a\ell_0 - c_0, 1)$$

$$u_1(c_0, 1 - \ell_0)a = u_2(c_0, 1 - \ell_0)$$

This is labor supply

MRP

(10b)

$$u_1(c_1, 1) = \beta^2(1 + r_0)(1 + r_1)u_1(b\ell_1 - c_1, 1 - \ell_1)$$

$$u_1(b\ell_1 - c_1, 1 - \ell_1)b = u_2(b\ell_1 - c_1, 1 - \ell_1)$$

Proposition 1: *Assume that u is strictly concave and C^2, $u_{12} \geq 0$, and $\forall x \leq 1$, $\lim_{(c,\ell) \to (0,x)} u_1(c, 1-\ell) = +\infty$. Then the system of equations (10a) and (10b) has a unique solution.*

Proposition 2: *Let (c_0, ℓ_0) be the solution to (10a) and let (c_1, ℓ_1) be the solution to (10b). Under the assumptions of Proposition 1, following statements are true:*

(i) c_0 is decreasing in $\beta^2(1 + r_0)(1 + r_1)$. | Odd guy is acquiring money and higher future wealth, eats less today |

(i') c_1 is increasing in $\beta^2(1 + r_0)(1 + r_1)$, and $\lim_{b \to \infty} c_1 = \infty$. | Already internalizing increase in consumption |

(ii) ℓ_0 is increasing in $\beta^2(1 + r_0)(1 + r_1)$. | Also worthwhile to work more today to get into money |

(ii') ℓ_1 is decreasing in $\beta^2(1 + r_0)(1 + r_1)$.

(iii) $a\ell_0 - c_0$ is increasing in both $\beta(1 + r_0)(1 + r_1)$ and a, and $\lim_{a \to \infty}(a\ell_0 - c_0) = \infty$.

Proposition 3 tells us that for any given monetary policy as parameterized by $r = (1 + r_0)(1 + r_1)$, existence of a monetary equilibrium is more 'likely' the bigger is the discrepancy between a and b, say as measured by a/b or b/a, whichever is larger. The discrepancy between a and b measures the potential utility gains to smoothing consumption across meeting periods (see figure 1). The discrepancy between a and b interacts with the elasticity of the marginal utility of consumption evaluated at $\ell = 1$ in determining existence of a monetary equilibrium. For example, inspection of (11) and (13) shows that no monetary equilibrium exists when $r < \beta^{-1}$ when $u(c, 1 - \ell) = \log(c) + v(1 - \ell)$ for any concave function v. This example shows that existence is not guaranteed for a "noninterventionist" $(r = 1)$ monetary equilibrium. Additionally, a monetary policy characterized by higher interest on currency will make, in some cases, existence of an equilibrium more likely. In particular if the function $u_1(x, 1)x$ is increasing in x (roughly this corresponds to an intertemporal elasticity of substitution exceeding one) the higher is r the more likely it is for conditions (11) and (13) to be satisfied. In this case, economies in which there exist no noninterventionist monetary equilibrium $(r = 1)$ may have a monetary equilibrium under an interest on currency scheme. Existence of a monetary equilibrium is more tenuous in the present model than in most cash-in-advance models or than in Townsend's original version of the turnpike model because of the access agents have to consumption loans as a vehicle for achieving some consumption smoothing.

The optimal policy has the effect of making $R_1 = 1 + r_1$ and, hence, effectively eliminating existing rate of return dominance.

No private institution can be created, given the environment, that is capable of eliminating the suboptimality of the equilibrium allocation. the fact that the optimal policy is framed in terms of a restriction on a *two-period* rate r reveals that it is the imperfection of the monetary equilibrium as a mechanism for carrying goods from t to $t+1$ for t odd that the optimal policy is correcting. In other words, private markets are effectively "myopic" in this environment. Unrestricted borrowing and lending "solves" the "short term" (one period) borrowing needs. However, the structure of the economy is such that the demand for loans induced by the smoothing motive is more long term (four periods). It is this limitation of private loan markets that is being solved by the optimal monetary policy.
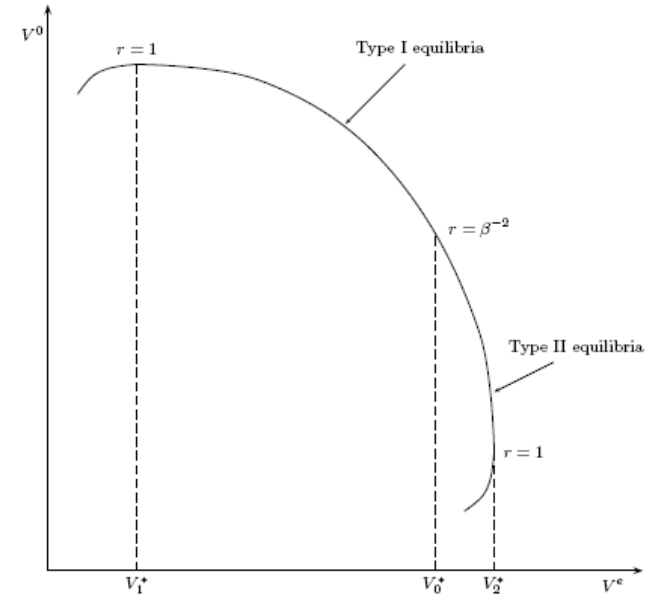
Figure 2. The function $F(V^*)$ depicts the set of restricted Pareto optimal utilities, where 'restricted' means utilities attainable via a periodic allocation satisfying (7). The function $F(V^*)$ is inside the utility possibility frontier for the economy, except at the point $(V_0^*, F(V_0^*))$.

As we increase r from 1 toward β^{-2},

type I equilibria the welfare of odd agents falls and the welfare of even agents rises. The $(V_2^*, F(V_2^*))$ equilibrium is a type II equilibria with $r = 1$. Among all periodic equilibria, this one makes the even agents best off. Within type II equilibria, welfare of even agents falls as that of odd agents rises as r is increased from 1 to β^{-2}.

It is then clear that in this model the proposal of following the optimal monetary rule starting from some suboptimal equilibrium does not have unanimous support. Any movement towards an equilibrium with $r = \beta^{-2}$ will result in a utility loss for either the even or odd individuals depending on the equilibrium the economy is in.[13]

In cash-in-advance and money-in-the-utility function models, proposals to increase the rate of return on currency from one toward β^{-2} are Pareto improving, and so have unanimous support. In the present model, half of the agents are harmed by such increases, while half

The optimal equilibrium under interest on currency is determinate in several relevant senses. Equilibrium allocations and therefore real interest rates are unique. The odd period price level p_1 is uniquely determined. The even period price level p_0 is not determined until r_0 is set. There remains enough flexibility to select r_0 so that $p_0 = p_1$, but such price stability is not required to implement the optimal policy.

It is noteworthy that the optimal policy cannot be characterized in terms of paying interest at a "market rate" associated with some suboptimal equilibrium. In *any* equilibrium in which currency is valued, currency and *some* private loans bear identical rates of return. Of course, there are *other* loans that, in some periods, bear a higher rate of return. It is then possible to state the policy as picking a rate of return on currency holdings that eliminates the difference between the highest return riskless assets and money.

In contrast, in our model, government issued currency continues to play an essential role under the optimal interest on currency policy. The allocation achieved under that policy differs from the one that would be associated with the corresponding economy with the locational restrictions voided and centralized time zero trades permitted. Further, the interest on currency policy does not work in a way that can be replicated by permitting free banking. Also, the price level remains determinate under the optimal interest on currency policy.

It is useful to study the effect of a given monetary policy in two economies that have different credit policies. In particular, we will argue that allowing for a minimal amount of heterogeneity (and hence making restrictions on private borrowing and lending meaningful) dramatically alters the impact on the economy of the different monetary policies considered so far. To simplify the presentation, we consider the case of no aggregate fluctuations in productivity $(a = b)$ and we concentrate in a type I equilibrium of the laissez-faire economy. A more general treatment is in Appendix B. First consider the effect of a policy of sustained increases in the money supply that are used to finance a transfer program. As described in section 7 an increase in the rate of growth of the money supply (μ) has ambiguous effects on the average level of output but increases its volatility when there are no restrictions on private borrowing and lending. However, in the economy in which individuals do not have access to private loan markets the results are quite different: an increase in μ *decreases* mean output and has *no effect* on volatility (which remains zero).

An opposite credit policy is a form of financial liberalization. Within the context of this model, it corresponds to an unanticipated elimination of the ban on private borrowing and lending at time zero. The effects are exactly the opposite to those described in the case of credit controls: prices increase and output becomes more volatile.[21] It is interesting that in describing actual experiences with financial deregulation, their potential destabilizing effects are often emphasized. For example, in reviewing the recent experiences of financial liberalization in the Southern Cone countries, the World Bank notes that "The biggest problems began in the real sectors of the economy, but efforts to liberalize the financial sector undoubtedly contributed to the resulting instability."[22] As one of the lessons from the reform the World Bank notes that "The clearest lesson is that reforms carried out against an unstable macroeconomic background can make that instability worse."[23] Thus, the concern shown by policy makers about the potential increase in instability associated with a liberalized credit market have a counterpart in the model as output volatility increases. However, in the model, a liberalized regime is superior from the point of view of welfare.

Lagos, Ricardo and Shengxing Zhang (2018) "Turnover Liquidity and the Transmission of Monetary Policy"

First, we provide original empirical evidence of a novel channel through which monetary policy influences financial markets: tight money increases the opportunity cost of holding the nominal assets used routinely to settle financial transactions (e.g., bank reserves, money balances), making these payment instruments scarcer. In turn, this scarcity reduces the resalability of financial assets, and this increased illiquidity leads to a reduction in price. We label this mechanism the *turnover-liquidity (transmission) mechanism (of monetary policy)*. Second, to gain a deeper understanding of this mechanism, we develop a theory of trade in financial over-the-counter (OTC) markets (that nests the competitive benchmark as a special case) in which money is used as a medium of exchange in financial transactions. The model shows how the details of the market microstructure and the quantity of money shape the performance of financial markets (e.g., as gauged by standard measures of market liquidity), contribute to the determination of asset prices (e.g., through the resale option value of assets), and—consistent with the evidence we document—offer a liquidity-based explanation for the negative correlation between real stock returns and unexpected increases in the nominal interest rate that is used to implement monetary policy.

Bloomberg.com: Why The Repo Markets Went Crazy (Podcast)

Back in September, chaos erupted in short-term funding markets, as the cost for financial institutions to borrow reserves soared. Immediately a major debate broke out over whether this represented a systemic problem for the financial system or merely a technical problem with the "plumbing." Things have quieted down since September, but the debate hasn't stopped. And there's still no permanent fix. On this week's Odd Lots podcast, we spoke with Zoltan Pozsar of Credit Suisse, who has a reputation for understanding the mechanics of these funding markets better than anyone else in the world. He broke down what really happened, and why we could see more craziness as soon as next month.

Running time 55:04

❖ https://www.bloomberg.com/news/audio/2019-11-08/why-the-repo-markets-went-crazy-podcast

Financial Times: Fed plans to double repo market intervention to avoid cash crunch

The US Federal Reserve will pump almost half a trillion dollars into the financial system over the end of the year, dramatically increasing intervention in the market in an attempt to avoid a repeat of September's alarming rise in short-term borrowing costs.

The New York Fed has been injecting money into the repo market, where investors borrow cash in exchange for high-quality collateral like Treasuries, for almost three months, in an attempt to stave off a shortage of short-term funding that had led interest rates to drift outside the central bank's target range.

The new plan includes overnight lending across New Year totalling $225bn and $190bn in longer-term repo loans, starting next week, that will provide cash to borrowers into 2020. Together with $75bn of cash already provided to the market to cover year-end, the Fed will have $490bn in lending outstanding over December 31 — close to double the scale of its recent repo interventions.

The overnight repo rate jumped as high as 10 per cent in September, startling traders and prompting the Fed's actions. Year-end has always been a volatile period for the repo market — on December 31 last year, the cost to borrow cash overnight soared to 6 per cent — so concern is especially elevated this year.

Massachusetts Institute of Technology

Thus, the ultimate effects on FHLB members depend on their ability to access other funding sources once the terms of the members' FHLB advances expire. If investor confidence in the financial system remains intact, large members should be able to substitute FHLB advances with alternatives such as repo or commercial paper. Funding costs to satisfy the LCR requirement may increase.[6] Yet for members without access to wholesale funding, advances are an important source of funding and liquidity.[7] Losing access to FHLB advances could potentially lead to a decrease in mortgage and small-business lending, especially by small thrifts and commercial banks. However, in case of a larger systemic distress, losing access to FHLB advances may put even large members at risk and result in significant pressure for government support, as occurred during the last financial crisis. Furthermore, while banks may be able to satisfy their liquidity needs (in the short-run) using the discount window, non-banks do not have this option.

Finally, the FHLBs currently play a crucial role in the federal funds market, which represents a key source of liquidity for eligible depository institutions. FHLBs maintain a stable share of their portfolios in federal funds, mainly as their contingent liquidity buffer.[8] As a result, their presence in the federal funds market has been stable. But the decline of the overall size of the federal funds market has increased the relative importance of the FHLBs in this market. On some days, FHLBs account for almost the entire supply of federal funds. Should an FHLB experience difficulty in rolling over its short-term debt, the FHLB would likely withdraw from the federal funds market, which has the potential to disrupt trading activity. Assuming most FHLBs would withdraw, the Federal Reserve Bank of New York might need to rely on contingency options for the publication of the fed funds effective rate.[9] Such contingencies could be necessary given that the federal funds rate is used as the benchmark rate for a very large volume of financial products. Although the contingency options to handle the calculation of the federal funds rate are public, a hasty transition to an alternative reference rate could disrupt the functioning of money markets and complicate the communication of monetary policy.

https://www.federalreserve.gov/econres/notes/feds-notes/the-increased-role-of-the-federal-home-loan-bank-system-in-funding-markets-part-3-20171018.htm

Afonso et al (2020) "The Market Events of Mid-September 2019"

Abstract

This paper studies the mid-September 2019 stress in U.S. money markets: On September 16 and 17, unsecured and secured funding rates spiked up and, on September 17, the effective federal funds rate broke the ceiling of the Federal Open Market Committee (FOMC) target range. We highlight two factors that may have contributed to these events. First, reserves may have become scarce for at least some depository institutions, in the sense that these institutions' reserve holdings may have been close to, or lower than, their desired level. Moreover, frictions in the interbank market may have prevented the efficient allocation of reserves across institutions, so that although aggregate reserves may have been higher than the sum of reserves demanded by each institution, they were still scarce given the market's inability to allocate reserves efficiently. Second, we provide evidence that some large domestic dealers likely experienced an increase in intermediation costs, which led them to charge higher spreads to ultimate cash borrowers. This increase was due to a temporary reduction in lending from money market mutual funds, including through the Fixed Income Clearing Corporation's (FICC's) sponsored repo program.

Tilford, Rennison, Noonan, Smith and Greeley (2019) "Repo: How the financial markets' plumbing got blocked"

https://ig.ft.com/repo-rate/

The overnight repo rate spiked in September
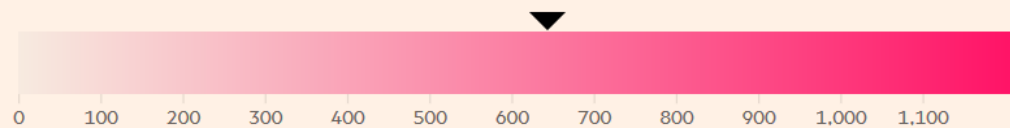
Overnight repo rate (%)
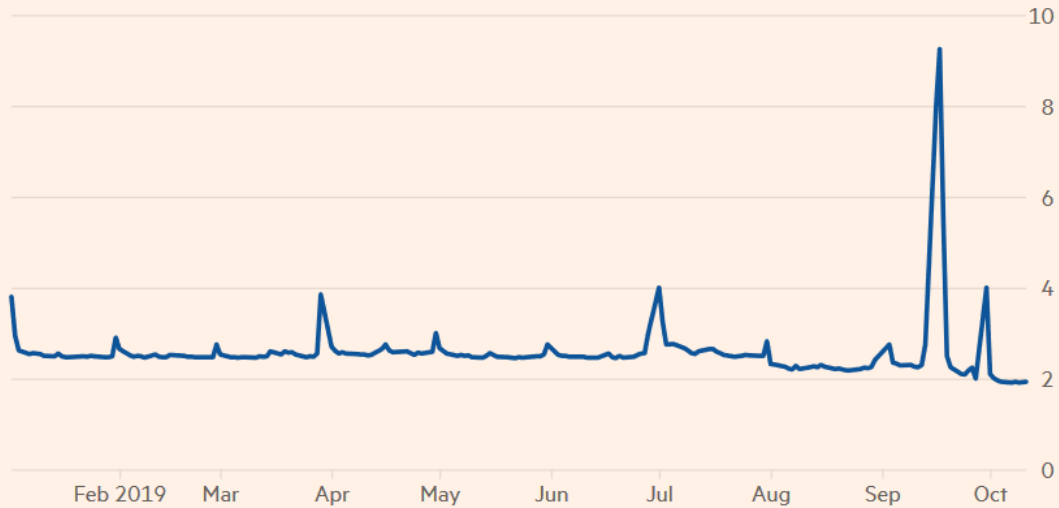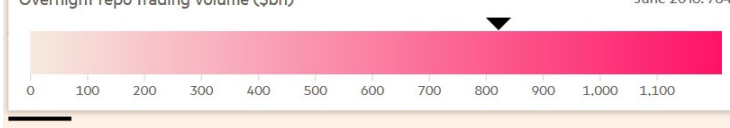

Source: Bloomberg
© FT

Demand for cash
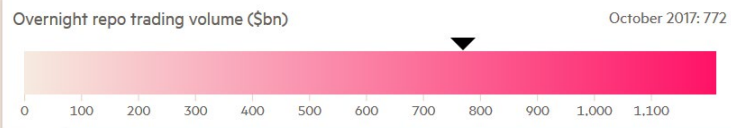
Overnight repo trading volume ($bn)   Pre October 2017: 645
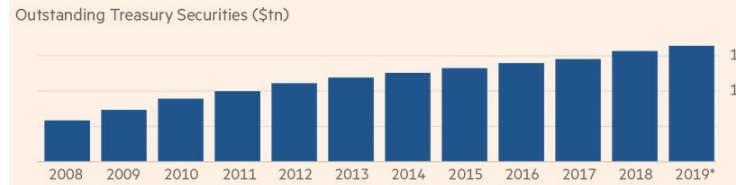

Source: Federal Reserve Bank of New York
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Overnight repo trading volume ($bn)   October 2017: 772

Fed balance sheet unwind

$tn

The Fed begins shrinking its balance sheet and a decline in bank reserves accelerates

Fed conducts three rounds of bond buying

Fed balance sheet

Bank excess reserves

Source: Bloomberg
© FT

Overnight repo trading volume ($bn)   June 2018: 784

As bank reserves fell, the fed funds rate bust through what markets thought was a cap

Replay ⟳

Sep 27 2019

Difference between fed funds rate and interest on excess reserves (basis points)

Reserves outstanding ($bn)
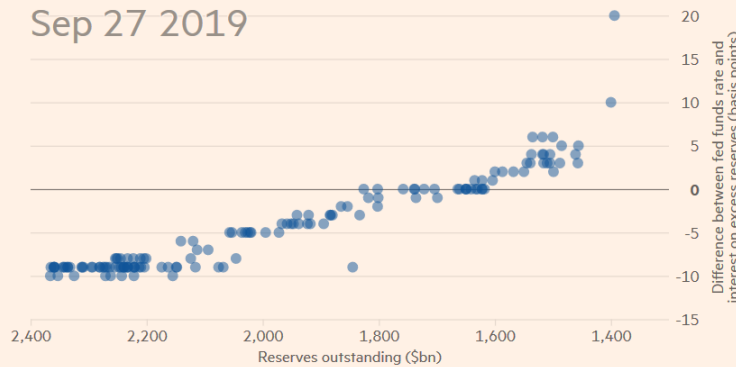
Sources: Bank of America; Bloomberg
© FT

Overnight repo trading volume ($bn)   June 2018: 784

Tax reform increases pressure

US budget balance ($tn)   Tax reform takes effect

Outstanding Treasury Securities ($tn)

*Preliminary numbers as of September 2019
Source: CBO, Sifma
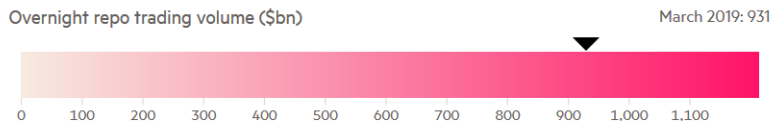© FT

Overnight repo trading volume ($bn)   December 2018: 919

Hedging costs rise and foreign investors sell Treasuries

Net yield on a 10-year Treasury hedged in Yen or Euros (%)

Yen

Euros

Cumulative net foreign purchases of Treasuries ($bn)

Fed raises interest rates and foreign investors retreat from the market

Source: BMO Capital Markets, US Treasury, Bloomberg
© FT

Panel 1 (top left)

Overnight repo trading volume ($bn)
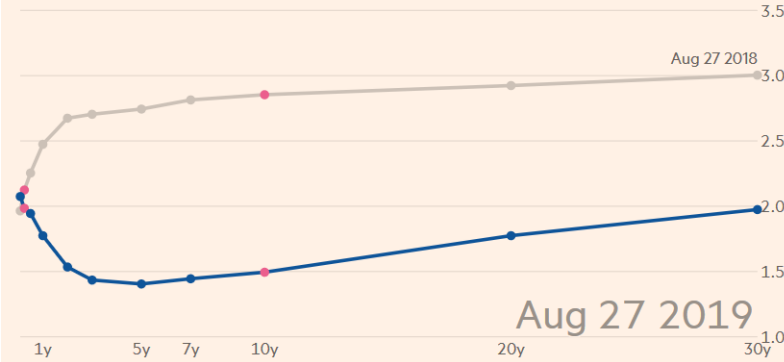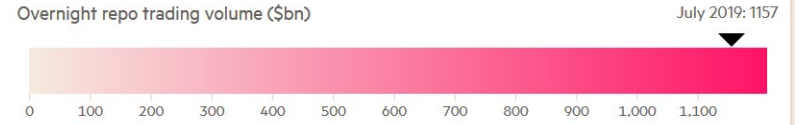
March 2019: 931

0 100 200 300 400 500 600 700 800 900 1,000 1,100

How the yield curve inverted

Replay ↻

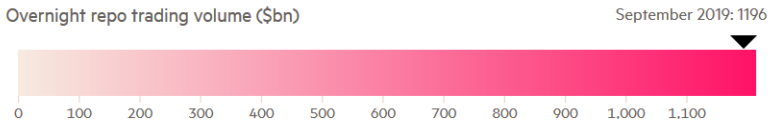Daily US Treasury yields with 3 month and 10 year yields highlighted (%)

Aug 27 2018

Aug 27 2019

1y 5y 7y 10y 20y 30y

3.5
3.0
2.5
2.0
1.5
1.0

Panel 2 (top right)

Overnight repo trading volume ($bn)

July 2019: 1157

0 100 200 300 400 500 600 700 800 900 1,000 1,100

Cash held by the US Treasury begins to increase

Treasury cash balance ($bn)

Oct 18 Nov Dec Jan 19 Feb Mar Apr May Jun Jul Aug Sep

400
300
200
100
0

Panel 3 (bottom left)

Overnight repo trading volume ($bn)

September 2019: 1196

0 100 200 300 400 500 600 700 800 900 1,000 1,100

How the reserves of the four largest US banks differ

Total weighted high-quality liquid assets ($bn)
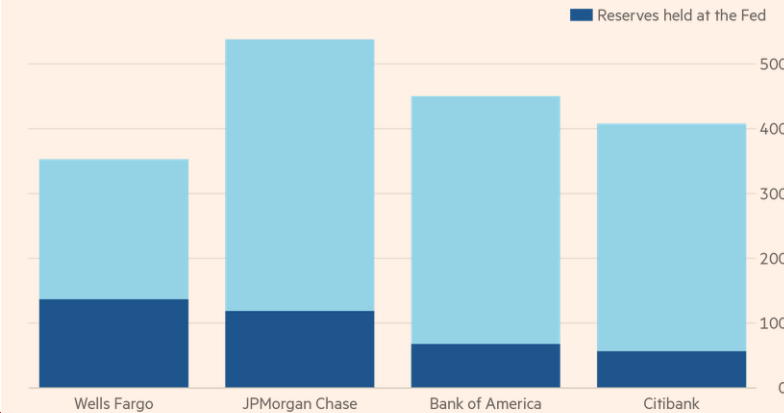
■ Reserves held at the Fed

Wells Fargo JPMorgan Chase Bank of America Citibank

500
400
300
200
100
0

Panel 4 (bottom right)

Overnight repo trading volume ($bn)

October 2019: 1093

0 100 200 300 400 500 600 700 800 900 1,000 1,100
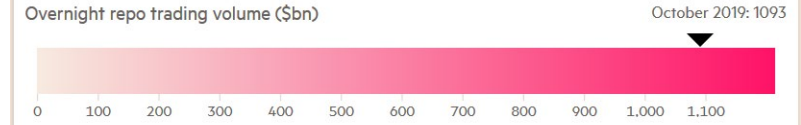
The Fed injects billions to soothe repo markets

$bn

■ Overnight repo   ■ Other short-term repo

Sep 2019 Oct Nov

220
200
180
160
140
120
100
80
60
40
20
0