THE FRACTIONAL RESERVE BANKING DIAGRAM

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Resumen: El sistema bancario de reserva fraccionaria es inherentemente inestable. Los bancos de reserva fraccionaria crean tres tipos de riesgos cuando conceden préstamos: riesgo de liquidez, riesgo de tipo de interés y riesgo de impago. Estos riesgos interactúan para hacer de la banca de reserva fraccionaria inestable y propensa a la quiebra. Este trabajo deriva el Diagrama de Banca de Reserva Fracciona. Este diagrama se utiliza para ilustrar el riesgo de liquidez, el riesgo de tipo de interés y riesgo de impago. Finalmente, se utiliza para comparar la banca central, el sistema de banca libre y la banca con coeficiente de reserva del 100%.

Palabras clave: Banca de reserva fraccionaria, Banca Central, banca libre, banca con coeficiente de reserva del 100%, pánicos bancarios.

Clasificación JEL: E32, E43, E50, E52, E58, G21

Abstract: Fractional reserve banking systems are inherently unstable. Fractional reserve banks create three types of risks when they make loans: liquidity risk, interest rate risk, and default risk. These risks interact to make fractional reserve banking systems unstable and prone to failure. This paper derives the Fractional Reserve Banking Diagram. The diagram is used to illustrate liquidity risk, interest rate risk, and default risk. Finally, the diagram is used to compare central banking, free banking, and 100 percent reserve banking.

Keywords: Fractional Reserve Banking, Central Banking, Free Banking, 100% Reserve Banking, Banking Panics

JEL Codes: E32, E43, E50, E52, E58, G21

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I
INTRODUCTION

It is widely recognized that fractional reserve banking systems are inherently unstable. Ludwig von Mises showed in 1912 that «it is theoretically impossible to maintain the credit bank system in a state of liquidity» (1912, 370). During the 1930s Irving Fisher argued that fractional reserve banking systems «cannot but be unstable» (1936, 10). In the 1950s, Milton Friedman wrote about «the 'inherent instability' of a fractional reserve system» (1960, 66). Throughout his career Murray N. Rothbard emphasized «the essential and inherent unsoundness of fractional reserve banking» (1983, 98). It is also widely recognized that fractional reserve banking systems are vulnerable to collapse: «An important factor that helps make banking panics possible is the existence of fractional-reserve banking» (Frank and Bernanke, 659)[1].

Fractional reserve banks create three types of risks when they make loans: liquidity risk, interest rate risk, and default risk. These risks interact to make fractional reserve banks unstable and prone to failure. Interest rate risk and default risk are acknowledged, but economists tend to emphasize liquidity risk. For example, Stephen G. Cecchetti says that «Banks' fragility arises from the fact that they provide liquidity to depositors» (2008, 331). According to N. Gregory Mankiw, «Bank runs are a problem for banks under fractional-reserve banking. Because a bank holds only a fraction of its deposits in reserve, it cannot satisfy withdrawal requests from all depositors» (2004, 641). Liquidity risk is fundamental, but for a fractional reserve bank interest rate risk and default risk are inevitably intertwined with liquidity risk. The purpose of this paper is to show how liquidity risk, interest rate risk, and default risk interact to make fractional reserve banking systems inherently unstable.

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[1] Free bankers hold the minority view that «fractional-reserve banking systems are *not* inherently weak or unstable» (Selgin 1996, 207). Still, free bankers recognize that «Practically everyone believes that they [banking crises] are an inherent part of fractional-reserve banking» (Selgin 1996, 193). See Selgin (1988, 1996) for more on fractional reserve free banking.

II
LIQUIDITY RISK

Asset transformation occurs when fractional reserve banks transform reserves into loans. The bank balance sheet, or T-account, is the easiest way to illustrate the process of asset transformation. Imagine that Star Bank is established with $10 of capital invested in the new bank. Star Bank's accountant debits the reserves (cash) account for $10 and credits the equity account for $10. T-Account 1 is Star Bank's balance sheet.

STAR BANK

Assets		*Liabilities & Equity*	
Reserves	10		
		Equity	10
Total	10	Total	10

T-account 1: Open Star Bank.

Now Star Bank is ready to begin operations. Imagine that depositors deposit $100 with Star Bank for safekeeping. Star Bank's accountant debits the reserves account for $100 and credits the deposits account for $100. The left-hand side of the balance sheet shows that Star Bank has $110 of cash reserves. The right-hand side of the balance sheet shows that Star Bank has $100 of deposits and $10 of equity.

STAR BANK

Assets		*Liabilities & Equity*	
Reserves	110	Deposits	100
		Equity	10
Total	110	Total	110

T-account 2: New Deposits.

At this point Star Bank is a 100 percent reserve bank. All deposits are covered by reserves, so «Under 100% reserve banking, banks are nothing more than a safekeeping service» (Abel and Bernanke 2005, 524). Star Bank can meet all of its depositors' demands for cash. There is no risk of deposit outflows exhausting the bank's cash reserves.

The purpose of a bank is to earn a profit. Reserves pay no interest, but a bank can earn interest by making loans: «Fractional reserve banking is profitable for banks because, instead of sitting in the vault earning no interest for the bank, a portion of the funds received from depositors can be used to make interest-earning loans» (Abel and Bernanke 2005, 524). To demonstrate, imagine that the legal reserve requirement is 10% so banks only hold 10% of their deposits in reserve. T-account 3 separates required reserves and excess reserves. The left-hand side of T-account 3 shows that Star Bank has $10 of required reserves and $100 of excess reserves.

STAR BANK

Assets		*Liabilities & Equity*	
Required Reserves	10	Deposits	100
Excess Reserves	100		
		Equity	10
Total	110	Total	110

T-account 3: Excess Reserves.

To earn interest and make a profit, Star Bank makes loans equal to its excess reserves. The bank has $100 of excess reserves, so it makes loans of $100. Star Bank's accountant debits the loan account for $100 and credits the reserves account for $100.

STAR BANK

Assets		*Liabilities & Equity*	
Reserves	10	Deposits	100
Loans	100		
		Equity	10
Total	110	Total	110

T-account 4: Asset Transformation.

T-account 4 shows that Star Bank has transformed its excess reserves into loans. This process is called asset transformation. T-account 4 also shows that Star Bank has become a fractional reserve bank. Star Bank has $100 of deposits, but only $10 of reserves. Only a percentage, or fraction, of the bank's deposits are covered by reserves.

Fractional reserve banking exposes shareholders and depositors to certain risks[2]. Fractional reserve banking creates liquidity risk. Liquidity risk is «the risk that a bank will have trouble meeting demands for withdrawals» (Ball 2009, 284). Fractional reserve banks never keep enough cash in their vaults to cover all of their deposits, so fractional reserve banks are always at risk of being unable to meet demands for cash:

> Fractional reserve banking works on the assumption that outflows and inflows of reserves will roughly balance, and in particular that a large fraction of a bank's depositors will never want to withdraw their funds at the same time. If a large number of depositors attempt to withdraw currency simultaneously, the bank will run out of reserves and be unable to meet all its depositors' demands for cash (Abel and Bernanke 2005, 526-527).

[2] Advocates of the subjective theory of probability do not distinguish between risk and uncertainty. Advocates of objective theories of probability argue that fractional reserve banking creates uncertainty, not risk. Most banking books do not distinguish between Knightian risk and Knightian uncertainty. The term risk is used here to facilitate the discussion. See Huerta de Soto for more on the distinction between risk and uncertainty in connection with banking (1998, 385-395).

To demonstrate, consider Star Bank's balance sheet as shown in T-account 4. The left-hand side of the balance sheet shows that Star Bank has $10 of reserves. The right-hand side of the balance sheet shows that Star Bank's deposits are $100. Now imagine that a depositor withdraws $10 from Star Bank. When a customer withdraws money, the bank's reserves fall by the amount of the withdrawal. In this case the depositor withdraws $10 from the bank, so the bank's reserves fall by $10. T-account 5 shows Star Bank's balance sheet after the $10 deposit outflow.

STAR BANK

Assets		*Liabilities & Equity*	
Reserves	0	Deposits	90
Loans	100		
		Equity	10
Total	100	Total	100

T-account 5: Deposit Outflow.

T-account 5 shows that Star Bank has no cash reserves after the deposit outflow. Since Star Bank has no cash, so it cannot meet anymore demands for cash.

Now imagine that a different depositor attempts to pull another $10 out of Star Bank. Star Bank must tell this depositor that it cannot give the depositor their money. In short, the bank must suspend payments. Star Bank must scramble to sell its loans on the market, but bank loans are illiquid assets. Other banks may not know the borrower's credit quality, and to find a borrower quickly, Star Bank may have to sell its loans at a discount. Imagine that Star Bank can only sell its loans for $80.

STAR BANK

Assets		*Liabilities & Equity*	
Reserves	80	Deposits	90
		Equity	-10
Total	80	Total	80

T-account 6: Fire-Sale.

Star Bank reserves are only $80, but the bank's deposits are $90. Star Bank owes its depositors $90, but Star Bank only has total assets of $80. Thus, the bank's equity account is -$10. Since Star Bank's liabilities exceed its assets, Star Bank is insolvent.

When news spreads that Star Bank has suspended payments, depositors panic and rush to the bank to withdraw their money. A bank run is an event in which many depositors simultaneously 'run' to the bank to withdraw their money. As shown above, however, Star Bank does not have enough cash reserves to pay all of their depositors. Since the bank is insolvent, some depositors lose their money. This example illustrates that the liquidity risk created by fractional reserve banking creates the possibility that depositors will lose some or all of their money.

III
INTEREST RATE RISK

A fractional reserve bank cannot create liquidity risk without simultaneously creating interest rate risk. Interest rate risk is the risk associated with changes in the interest rate. «a bank's liabilities tend to be short term, while its assets tend to be long term. This mismatch between the maturities of the two sides of the balance sheet creates interest-rate risk» (Cecchetti 2008, 288). According to Rothbard,

> *the time structure of the firm's assets should be no longer than the time structure of its liabilities*…. But deposit banks do not and *cannot* ob-

> serve this rule. On the contrary, its liabilities—its warehouse receipts—are due instantly, on demand, while its outstanding loans to debtors are inevitably available only after some time period, short or long as the case may be. A bank's assets are always «longer» than its liabilities, which are instantaneous (1983, 98-99)[3].

Fractional reserve banks transform zero maturity assets (reserves) into assets with longer maturities (loans). Fractional reserve banking increases the maturity of the bank's assets, but it does not affect the maturity of the bank's liabilities. In short, fractional reserve banking increases the maturity mismatch between the bank's assets and liabilities. Therefore, fractional reserve banking creates interest rate risk[4].

The present value of a loan depends on the interest rate. In other words, the present value of a loan is interest rate sensitive. All else equal, the present value of a loan falls when the interest rate rises; the present value of a loan rises when the interest rate falls. In contrast to loans, bank deposits are due on demand and do not pay interest. Therefore, bank deposits are not interest rate sensitive. The present value of a bank's loans can change suddenly, but the present value of its deposits cannot. This means fractional reserve banks have interest rate risk.

To demonstrate, consider the details of Star Bank's loans. According to the loan contracts, $127.63 will be received in 5 years and the interest rate is 5%. In this case, the present value of the loan is $100. The present value of the bank's loans is reflected on the bank's balance sheet in T-account 7.

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[3] Ludwig von Mises stressed this point:

Since ancient times commercial law has imposed on everybody the obligation to have regard to liquidity throughout the whole conduct of his business…. steps must be taken to permit the full and punctual settlement of every claim as it falls due…. For credit-issuing banks, regard to this fundamental rule of prudent conduct is an impossibility…. They are bound to collapse as soon as confidence in their conduct is destroyed. (1912, 369).

[4] Duration gap analysis is used to measure a bank's interest rate risk. All else equal, a fractional reserve bank's duration gap increases when it makes loans. See Mishkin (2004, 221) for more on duration gap analysis. Some might object that fractional reserve banks can hedge against the risks they create with derivatives. This is true, but it does not mean that risks are not created by fractional reserve banking. Derivatives can transfer risk, but derivatives can never destroy risk.

STAR BANK

Assets		*Liabilities & Equity*	
Reserves	10	Deposits	100
Loans	100		
		Equity	10
Total	110	Total	110

T-account 7: Present Value of a Loan.

The loan account is negatively related to the interest rate. Imagine that the interest rate rises from 5% to 10%. All else equal, the present value of Star Bank's loans drops from $100 to $79.25. T-account 8 shows Star Bank's balance sheet after the interest rate rises.

STAR BANK

Assets		*Liabilities & Equity*	
Reserves	10	Deposits	100
Loans	79.25		
		Equity	-10.75
Total	89.25	Total	89.25

T-account 8: Higher Interest Rate.

A bank's reserves and deposits are not interest rate sensitive. A higher interest rate does not affect a bank's reserves account or deposits account. Star Bank still has $10 of reserves and $100 of deposits, but Star Bank can only sell its loans for $79.25 if it needs to raise cash quickly. The bank only has total assets of $89.25 but it still has liabilities of $100. Star Bank's liabilities exceed its assets so that its equity is -$10.75. The higher interest rate makes Star Bank insolvent.

It is possible to create a schedule to show Star Bank's balance sheet at different interest rates. Table 1 shows the amount of Star Bank's total assets and total liabilities (deposits) at different interest rates.

TABLE 1
BANK BALANCE SHEET SCHEDULE

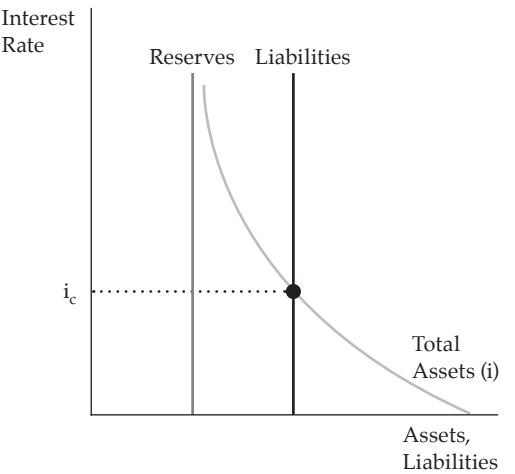
Interest Rate	*Reserves*	*Loans*	*Total Assets*	*Total Liabilities*	*Equity*
1%	10	121.43	131.43	100	31.43
2%	10	115.60	125.60	100	25.60
3%	10	110.09	120.09	100	20.09
4%	10	104.90	114.90	100	14.90
5%	10	100.00	110.00	100	10.00
6%	10	95.37	105.37	100	5.37
7%	10	91.00	101.00	100	1.00
8%	10	86.86	96.86	100	-3.14
9%	10	82.95	92.95	100	-7.05
10%	10	79.25	89.25	100	-10.75

Table 1 shows that Star Bank's reserves and deposits do not depend on the interest rate. In this example, Star Bank's total liabilities equals its deposits, so the bank's total liabilities are not interest rate sensitive. In contrast, table 1 shows that the bank's loan account is interest rate sensitive. As the interest rate rises, the present value of its loans falls. Total assets equals reserves plus loans, so the bank's total assets are interest rate sensitive. All else equal, the amount of total assets falls as the interest rate rises.

The balance sheet schedule can be represented graphically. Figure 1 is the Fractional Reserve Banking (FRB) Diagram. The FRB Diagram shows the amount of a fractional reserve bank's assets and liabilities at different interest rates.

The FRB Diagram has five properties. First, the Reserves Curve and the Liabilities Curve are vertical. This means that reserves and deposits are not interest rate sensitive. Second, the Liabilities Curve is located to the right of the Reserves Curve. The distance between the Reserves Curve and Liabilities Curve represents liquidity risk. Third, the Total Assets Curve slopes downward from left to right. This indicates that the amount of total assets depends on the interest rate: as the interest rate falls, the amount of total assets rises. Fourth, the Total Assets Curve becomes flatter as the interest rate

FIGURE 1
FRACTIONAL RESERVE BANKING (FRB) DIAGRAM

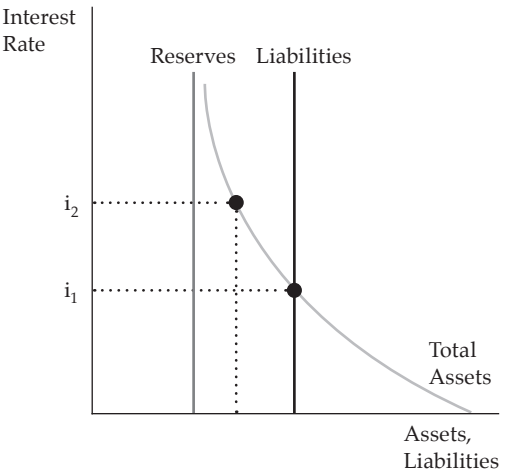


falls. Fifth, the point where the Total Assets Curve intersects the Total Liabilities Curve is the crossover rate. The crossover rate is the interest rate at which the amount of total assets equals the amount of total liabilities. In figure 1, iC is the crossover rate. The equity account is positive when the interest rate is below the crossover rate. The equity account is negative when the interest rate is above the crossover rate. In other words, the bank is insolvent if the interest rate exceeds the crossover rate.

Imagine that the interest rate rises. In figure 2 the interest rate rises from i1 to i2. There is a movement up along the Total Assets Curve. The amount of total assets falls when the interest rate rises, but the higher interest rate does not affect the bank's liabilities. The interest rate is above the crossover rate. This means that total liabilities are greater than the amount of total assets, so Star Bank is insolvent.

Now imagine that depositors learn that Star bank is insolvent. Depositors panic and run to Star Bank to withdraw their money. However, the bank's total assets are only $89.25. Star Bank cannot pay back all of their depositors, so some depositors lose their money. The interest rate risk created by fractional reserve banking creates the possibility that depositors will lose their money.

FIGURE 2
INTEREST RATE RISK



IV
DEFAULT RISK

Fractional reserve banks create default risk when they make loans. Default risk is «the risk that borrowers won't repay their loans» (Ball 2009, 269). Fractional reserve banks transform reserves into loans, and when a bank makes a loan there is always the possibility that the borrower might not repay the loan. Therefore, fractional reserve banks expose their shareholders and depositors to default risk.

For example, imagine that one of Star Bank's borrowers defaults. The borrower cannot return principal and interest to Star Bank. If the interest rate is still 5%, Star Bank must write down the value of its loans to $70.

STAR BANK

Assets		*Liabilities & Equity*	
Reserves	10	Deposits	100
Loans	70		
		Equity	-20
Total	80	Total	80

T-Account 9: Loan Default.

Table 2 shows the amount of Star Bank's total assets, total liabilities, and equity (before and after the default) at different interest rates.

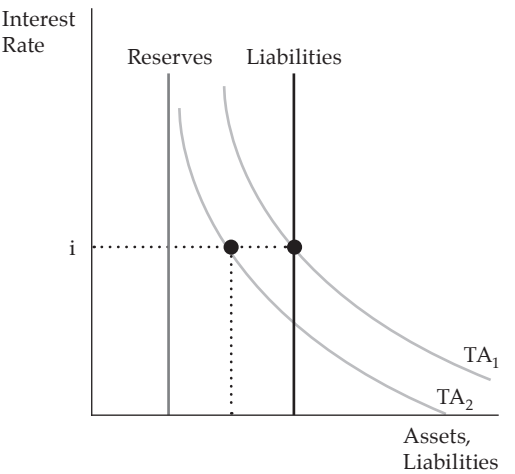
TABLE 2
BANK BALANCE SHEET SCHEDULE

Interest Rate	*Reserves*	*Loans 1*	*Total Assets 1*	*Loans 2*	*Total Assets 2*	*Total Liabilities*	*Equity 1*	*Equity 2*
1%	10	121.43	131.43	85	95	100	31.43	-5
2%	10	115.6	125.6	80.92	90.92	100	25.6	-9.08
3%	10	110.09	120.09	77.07	87.07	100	20.09	-12.93
4%	10	104.9	114.9	73.43	83.43	100	14.9	-16.57
5%	10	100	110	70	80	100	10	-20
6%	10	95.37	105.37	66.76	76.76	100	5.37	-23.24
7%	10	91	101	63.7	73.7	100	1	-26.3
8%	10	86.86	96.86	60.8	70.8	100	-3.14	-29.2
9%	10	82.95	92.95	58.06	68.06	100	-7.05	-31.94
10%	10	79.25	89.25	55.47	65.47	100	-10.75	-34.53

In figure 3, the default shifts the Total Assets Curve to the left. The default reduces the bank's crossover rate. The interest rate is above the crossover rate, so the bank is insolvent.

Now depositors find out that Star bank is insolvent. Depositors rush to Star Bank to pull out their money. The bank only has $80 of total assets, but they have $100 of total liabilities (deposits). Star Bank cannot pay off all of their depositors and some depositors suffer losses. The default risk created by fractional reserve banking exposes shareholders and depositors to potential losses.

FIGURE 3
DEFAULT RISK



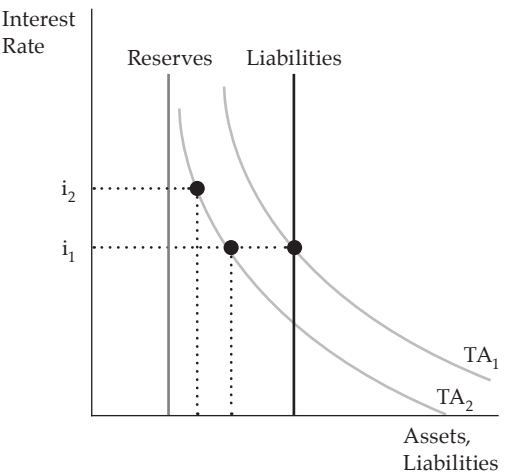
V
BANKING PANICS

Liquidity risk, interest rate risk, and default risk make fractional reserve banking systems unstable. A banking panic is an event in which many individual banks fail at the same time. Banking panics involve the interplay of liquidity risk, interest rate risk, and default risk. It is impossible to know what will start a banking panic *a priori*. A wave of defaults can start a banking panic; a rising interest rate can start a banking panic; a surge in withdrawals can start a banking panic. Regardless of what starts a banking panic, liquidity risk, interest rate risk, and default risk interact and aggravate each other during banking panics.

The FRB Diagram can be used to illustrate a banking panic. It is possible to aggregate all individual bank balance sheets to create a Fractional Reserve Banking System Diagram. Figure 4 shows the banking system when all individual bank balance sheets have

been aggregated[5]. First, imagine that there is a sudden wave of loan defaults[6]. The Total Assets Curve shifts left, from TA1 to TA2. The banking system's crossover rate falls. The banking system is now insolvent at the prevailing interest rate (i1).

FIGURE 4
BANKING PANIC



The deterioration of bank balance sheets impacts the fractional reserve banking system's ability to make loans. The supply of loans drops and the interest rate rises:

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[5] For simplicity, it is assumed that all liabilities in the banking system are demand deposits. This means that the Total Liabilities Curve is vertical in figure 4. In reality, the Total Liabilities Curve will not be vertical. Instead, the Total Liabilities Curve will have a negative decreasing slope. However, the Total Liabilities Curve will be steeper than the Total Assets Curve because a fractional reserve bank's total assets are more interest rate sensitive than total liabilities.

[6] In this example a wave of loan defaults sets off the panic, but a rising interest rate can also set off a banking panic. A wave of loan defaults and/or a rising interest rate both cause a deterioration in banks' balance sheets: «most financial crises in the United States have begun with a deterioration in banks' balance sheets» (Mishkin, 2004, 192). Moreover, «The history of banking in the United States shows clear evidence that downturns in the business cycle put pressure on banks, substantially increasing the risk of panics» (Cecchetti 2008, 332).

> The state of banks' balance sheets has an important effect on bank lending. If banks suffer a deterioration in their balance sheets and so have a substantial contraction in their capital [equity], they will have fewer resources to lend, and bank lending will decline…. A financial crisis also decreases the supply of funds to borrowers, which leads to higher interest rates. (Mishkin 2004, 191).

In figure 4, the interest rate rises from i1to i2. As the interest rate rises, there is a movement up along the TA2 Curve. The present value of performing loans falls, so the amount of total assets is even lower at the higher interest rate (i2). The rising interest rate aggravates the banking crisis; the interest rate is higher, but the crossover rate is lower. The crossover rate and interest rate diverge. Banks start closing down because they are insolvent. As more and more banks close because of pre-run insolvency, bank runs begin at the banks that are still open. These banks are overwhelmed by withdrawals. There are not enough reserves in the system to pay back all depositors, and some depositors lose their money.

VI
CENTRAL BANKING

Fractional reserve banking systems are fragile and prone to collapse. Many economists believe that governments must try to stabilize fractional reserve banking systems. A central bank is the main way that governments try to stabilize banking systems. The purpose of a central bank is to stabilize the inherently unstable fractional reserve banking system:

> The primary function of a central bank has been to stand ready to supply funds — promptly and in abundance … The central bank is the ultimate source of liquidity in the economy … it is the central bank that must be responsible for supplying funds promptly on those rare but crucial occasions when liquidity shortages threaten economic stability … because of this responsibility, the

> central bank has traditionally been called the lender of last resort (Ritter, Silber and Udell 2004, 377-378)[7].

A central bank tries to stabilize the fractional reserve system by intervening in the banking system. The main way a central bank intervenes is by changing the amount of reserves in the banking system and the most important way that a central bank changes the amount of reserve is by buying assets from banks. In short, central banks stabilize fractional reserve banking systems by buying assets from banks[8].

The FRB Diagram can be used to show how central banks attempt to stabilize fractional reserve banking systems. Imagine that the banking system is insolvent. Now imagine that the central bank conducts expansionary open market operations. Simply put, the central bank intervenes by buying assets from the banks.

The central bank's intervention shifts the Reserves Curve to the right, from R_1 to R_2. The Total Assets Curve shifts right, from TA1 to TA2. After the intervention, the amount of total assets exceeds total liabilities. The central bank has restored solvency. Figure 5 shows that a central bank tries to stabilize the banking system during a banking panic by buying assets from banks.

Figure 5 shows that the central bank intervention affects the banking system in three other important ways. First, the intervention reduces liquidity risk in the banking system. The intervention shifts the Reserves Curve to the right, from R_1 to R_2. This reduces

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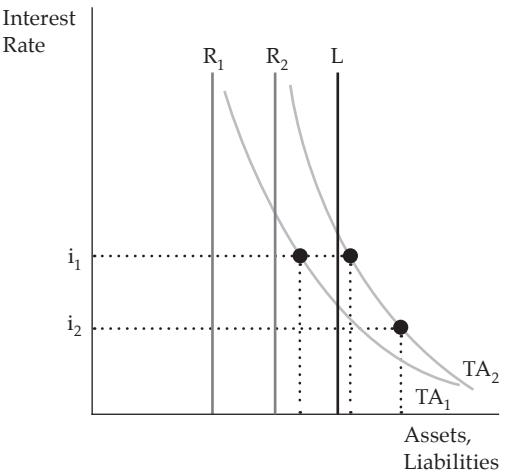
[7] Central bankers emphasize other central bank goals, including price stability, high employment, stable interest rates, and stable exchange rates. However, central bankers acknowledge that these «policy goals often conflict» and «There is simply no way that policy makers can meet all their objectives at the same time» (Cecchetti 2008, 366). The primary objective of a central bank is stabilizing the fractional reserve banking system. Other objectives are afterthoughts: «When the Federal Reserve System was created, its most important role was intended to be as the lender of last resort; to prevent bank failures from spinning out of control, it was to provide reserves to banks when no one else would, thereby preventing bank and financial panics» (Mishkin 2004, 402).

[8] According to Ritter, Silber and Udell (2004, 380), «open market operations are the mainstay of Federal Reserve policy», but Cecchetti admits that «In practice, the Fed virtually never sells securities. It always buys, the only question is how much» (2008, 407 n. 5).

FIGURE 5
CENTRAL BANK STABILIZATION



the distance between the Reserves Curve and Liabilities Curve. In short, the intervention raises the reserve ratio. This means that there is less risk of deposit outflows exhausting the banking system's reserves.

Second, the intervention reduces interest rate risk in the banking system. When the central bank buys assets from the banks, the central bank exchanges zero maturity assets (reserves) for assets with longer maturities (loans). This reduces the amount of maturity mismatching in the banking system. The intervention makes the Total Assets Curve steeper. In figure 5, TA2 is steeper than TA1. This means that there is less interest rate risk in the banking system. The intervention raises the banking system's crossover rate and this improves the banking system's ability to withstand the higher interest rate.

Third, the intervention restores the banking system's ability to make loans. In figure 5 renewed lending by the banking system reduces the interest rate, from i1 to i2. There is a movement down along the TA2 Curve. The interest rate and crossover rate converge. The lower interest rate helps to restore solvency in the banking system by increasing the present value of existing loans. In sum-

mary, central bank intervention during a banking panic can temporarily restore solvency, reduce liquidity risk, and reduce interest rate risk[9].

VII
FREE BANKING AND 100 PERCENT RESERVE BANKING

A central bank's purpose is to stabilize the fractional reserve banking system. However, a central bank cannot totally stabilize a fractional reserve banking system or totally prevent banking crises: «The mere existence of a lender of last resort, then, will not keep the financial system from collapsing» (Cecchetti 2008, 334). Central banks do not eliminate the fundamental sources of instability: liquidity risk, interest rate risk, and default risk. The central bank tries to manage these risks, not abolish them. A fractional reserve banking system with a central bank is still inherently unstable.

Advocates of free banking argue that a fractional reserve banking system with a central bank is more unstable than a fractional reserve banking system with no central bank. Free market forces limit fractional reserve banks, but central banks attempt to remove these limits: «The institution of Central Banking eased the free-market restrictions on fractional-reserve banking» (Rothbard 1994, 62). The threat of bank runs encourages banks to operate prudently.

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[9] Depositors still suffer losses when a central bank buys assets to stabilize the banking system. Central bank asset purchases are inflationary: «a purchase of assets by the central bank is called an open-market purchase. It increases the monetary base and thus the money supply» (Abel and Bernanke 2005, 530). Central banks try to stabilize the banking system by imposing an inflation tax: «The government collects the inflation tax by printing money (or by having the central bank issue new money) and using the newly created money to purchase goods and services. The inflation tax is paid by any member of the public who holds money» (Abel and Bernanke 2005, 592). Bank failures impose direct losses on certain depositors, but central banking imposes indirect losses on all depositors: «Among all forms of extracting resources however, inflation is perhaps the most indirect, and it is the one that requires the highest degree of sophisticated understanding on the part of the individual…. Something a bit closer to reality is approximated by the popular references to inflation as the 'hidden tax'» (Buchanan and Wagner 1977, 114).

Bank runs discourage bank managers from taking on excessive liquidity risk, interest rate risk, and default risk: «bank runs … also have a positive effect: they discourage banks from misusing deposits. If a bank takes excessive risks or money disappears mysteriously, depositors are likely to notice and withdraw their funds…. This threat gives banks a reason to keep deposits safe» (Ball 2009, 294). According to free bankers, a central bank allows fractional reserve banks to take excessive risks. «the very presence of even a well-behaved central bank is itself a fundamental cause of financial fragility» (Selgin 1996, 220). Government intervention in the fractional reserve banking system results in more liquidity risk, interest rate risk, and default risk: «Governmental intervention in monetary matters, far from providing the stable monetary framework for a free market that is its ultimate justification, has proved a potent source of instability» (Friedman 1960, 23).

The FRB Diagram can be used to illustrate the arguments made by advocates of free banking. In figure 6, TAFB is the Total Assets Curve in a system of free banking. TACB is the Total Assets Curve in a fractional reserve system with a central bank.

FIGURE 6
FREE BANKING VERSUS CENTRAL BANKING

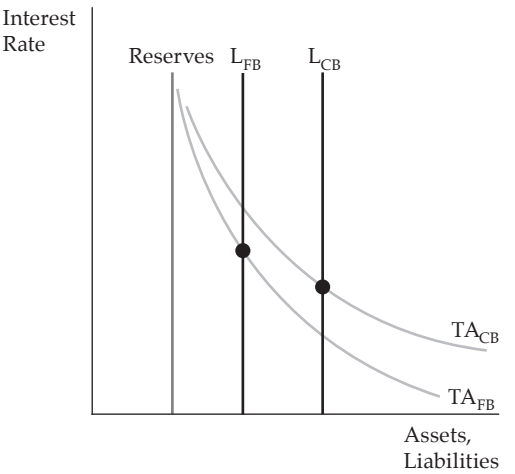

Figure 6 shows that there is more liquidity risk and more interest rate risk in a fractional reserve banking system with a central bank. First, LCB is to the right of LFB. This means that the system with the central bank has a lower reserve ratio and thereby has more liquidity risk. Second, TACB is flatter than TAFB. This means that the system with the central bank has more interest rate risk. Furthermore, a banking system with a central bank has a lower crossover rate. A banking system with a central bank has a lower tolerance for a high interest rate. The interest rate is always artificially low in an economy with a fractional reserve banking system, but the interest rate will tend to be even lower if there is a central bank[10]. Finally, a system with a central bank will have more default risk. A central bank creates moral hazard: «the moral hazard associated with a government safety net encourages too much risk taking on the part of banks» (Mishkin 2004, 264)[11]. The moral hazard created by a central bank increases default risk in the fractional reserve banking system. According to free bankers, a central bank fosters liquidity risk, interest rate risk, and default risk. Therefore, a central bank makes the fractional reserve banking system even more unstable and leads to even more severe banking panics.

Free banking imposes limits on fractional reserve banks, but a free banking system with fractional reserves is still unstable. Banks still have liquidity risk, interest rate risk, and default risk in a fractional reserve free banking system. Free market forces limit these risks, but these risks still exist. Therefore, free banking cannot totally eliminate banking panics: «a free banking system would not necessarily be panic proof. As long as banks continue to have liabilities unconditionally redeemable on demand, while holding only fractional reserves, the possibility of a systemic collapse would still exist» (Selgin 1996, 229). Free banking cannot totally stabilize a fractional reserve banking system or eliminate banking panics.

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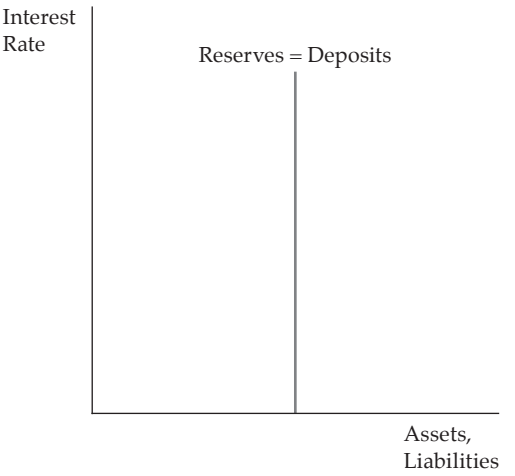
[10] On the economic effects of an artificially low interest rate, see Mises (1949, 547-563), Hayek (1931, 197-329), Garrison (2001, 57-83), Huerta de Soto (1998, 265-395), and Fuller (2013).

[11] Like deposit insurance, central banking creates moral hazard: «Although the Fed's role as the lender of last resort has the benefit of preventing bank and financial panics, it does have a cost…. The Fed's lender-of-last-resort role has thus created a moral hazard problem similar to the one created by deposit insurance» (Mishkin 2004, 403).

Advocates of 100 percent reserve banking argue that 100 percent reserve banks are totally stable[12]. According to Henry C. Simons, «deposit banks, which, maintaining 100 percent reserves, simply could not fail» (1933, 34). Irving Fisher argued that «With 100% reserves, however, the money would be there; and honestly run banks could never go bankrupt» (1939, 22). Since 100 percent reserve banks are totally stable, advocates point out that 100 percent banking makes banking panics impossible: «the establishment of a 100-percent reserve requirement would put an end to bank crises» (Huerta de Soto 1998, 745).

The Bank Diagram can be used to illustrate the arguments made by advocates of 100 percent banking. Figure 7 shows a 100 percent reserve banking system.

FIGURE 7
100 PERCENT RESERVE BANKING SYSTEM



[12] Advocates of 100 percent reserve banking include David Hume, Thomas Jefferson, Jean-Baptiste Say, David Ricardo, Irving Fisher, Frederick Soddy, Ludwig von Mises, Frank Knight, Benjamin Graham, Henry C. Simons, Friedrich Hayek, Maurice Allais, Milton Friedman, James Tobin, and Murray N. Rothbard. See Allen (1993), Dimand (1993), Huerta de Soto (1998, 716-735), and Simons (1933, 23-29).

First, the Reserves Curve and Deposits Curve overlap. Both curves shift right when there is a deposit inflow, and both curves shift left when there is a deposit outflow. Still, both curves always overlap. This means that 100 percent banks have no liquidity risk. Bank runs cannot make a 100 percent reserve banking system insolvent. Second, the Reserves Curve and the Deposits Curve are vertical. This means that 100 percent banks have no interest rate risk. A rising interest rate cannot make a 100 percent reserve banking system insolvent. Third, 100 percent reserve banks have no default risk. Since 100 percent reserve banks do not make loans, it is impossible for a sudden wave of loan defaults to bankrupt a 100 percent reserve banking system. 100 percent reserve banks do not have any liquidity risk, interest rate risk, or default risk, so «A 100 per cent reserve banking crisis is an impossibility» (Selgin 1996, 193).

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