Trade, credit and systemic fragility ☆

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Abstract

This paper treats an idealized monetary framework in which merchant banks finance trade; trade which is induced by decentralized production. Indeed, merchant bank credit instruments, coupled with local bank deposits, facilitate decentralization of both production and trade. At the same time, decentralized production, exhibiting technological complementarity, induces systemic monetary fragility. However, with the decentralization of trade, the indemnification of either merchant bank credit instruments or of local bank deposits eliminates fragility. In particular, deposit insurance also stabilizes credit. The result is a stable cashless economy, a replacement of trade in specie. © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction

Recently McAndrews and Roberds (1999) suggest an idealized monetary framework. Local deposit banks provide payment services. Trade is financed by merchant bankers, who do not provide payment services. Thus these two functions are institutionally separated. In discussing Bryant's (1997) model of

banking and trade, McAndrews and Roberds (1999) assert that their idealized monetary framework provides further insight into banking and the monetary system. However, McAndrews and Roberds emphasize, and examine in some detail, the payments role of local deposit banking. This paper complements theirs by focusing on the financing of trade by merchant bankers, and on merchant bank interaction with local deposit banks. [1] Here, the payments role of local deposit banking, itself, is simply imposed. Hopefully, the resulting simple, idealized, framework lays bare an aspect of the essential functioning of the monetary system.

Decentralized production induces trade, and a lack of a double coincidence of wants. Merchant bankers' credit instruments, together with local deposit banking, solve the lack of a double coincidence of wants in trade. In doing so, this monetary system facilitates the decentralization of both production and trade. One aspect of the functioning of this monetary system is of particular interest. As a by-product of the decentralized production, the credit instruments and deposits are rendered systemically fragile. Taken as an integral whole, the monetary system is fragile. However, with decentralized trade, the indemnification of either merchant bankers' credit instruments or of local bank deposits eliminates this fragility. Indemnification of both is redundant. In particular, deposit insurance of local banks also stabilizes merchant bank credit.

2. Decentralized production: Fragility and trade

Decentralized production induces fragility. There is a basic parable of decentralized production. In this parable, there are $N > 1$ individuals whose inputs e_i, "effort," jointly determine output. In particular, the payoff to effort for each individual i is $a[\min(e_1, \ldots, e_N)] - be_i$, where $a > b > 0$ and $e_i \in [0, 1]$. $a[\min(e_1, \ldots, e_N)]$ is the utility gained by the individual from the joint output, and $-be_i$ is the utility cost to the individual of her (own) effort. With decentralization, the individuals choose their effort levels independently. This game has a continuum of Pareto ranked Nash equilibria, where e_i are equal for all i. [2] A fortiori, such multiple equilibria are a concern in the, slightly more complicated, version of this parable developed in this paper. One approach game theory takes to multiple equilibria is to select particularly salient equilibria. Specifically, where they exist, Pareto optimal and secure equilibria are selected

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[1] While stressing its relevance for modern banking, McAndrews and Roberds motivate their idealized framework historically as well, citing De Roover (1948) (see also De Roover, 1953). The latter emphasizes the role of merchant bank credit in trade.

[2] See, e.g., Cooper (1999, pp. X–XIII, 2–4, 41–45).

(Cooper, 1999). The above basic parable of decentralized production has both. Namely, $e_i = 1$, for all i, is Pareto optimal. On the other hand, $e_i = 0$, for all i, is the secure equilibrium. That is, $e_i = 0$ maximizes the player's payoff, given that she believes that the others will choose the strategy that minimizes her payoff. "Fragile" is taken to mean that the economy has both Pareto optimal and secure equilibria, like the basic parable of decentralized production. The, slightly more complicated, version of the basic parable, developed in this paper, is fragile, as well.

Decentralized production induces trade. To treat long distance trade explicitly, the basic parable is extended slightly. Production is decentralized geographically. Thus, there are $N > 1$ discrete and separate islands. On each island there is a single merchant banker and a set of intermediate good producers. On a given island, only one of N intermediate goods can be produced, a different one on each island, intermediate good i on island i, say. That is, there is specialization. These intermediate goods are costlessly transportable. Each intermediate good producer is identical, except for island location, as are merchant bankers. Intermediate good producers are endowed with the same amount of leisure, which is their only endowment. They can convert their leisure into the respective intermediate good, on any scale, at the fixed rate of return of one to one. Merchant bankers are without endowment. For simplicity of exposition, merchant bankers double as consumption good fabricators. They can convert $(I_1, \ldots, I_N)$ units of the N intermediate goods into $xN \min(I_1, \ldots, I_N)$ units of a single consumption good, at their own island, costlessly. $x > 1$. The role of x appears later. The pre-multiplication by N is just a matter of units, insuring that one unit of each input, when combined, yield x units of output, for each individual unit of input. Intermediate good producers consume leisure and consumption good, and their identical utility functions are strictly increasing, with strictly convex upper contours. Merchant bankers-fabricators (MB-Fs) consume only the consumption good, also having identical utility functions with strictly positive marginal utility.

This decentralized production is the simple, basic form of technological complementarity described in Cooper (1999, pp. 41–45). Its use highlights the possibility of technological interdependence generating systemic monetary fragility. As illustrated above, this simple Leontief production technology can be treated as component parts assembly, using traded component parts. Here the component parts come in infinitesimal increments. [3] For further discussion of technological complementarity see Cooper (1999); also Evans et al. (1998), Cooper and John (1988) and Bryant (1983).

The geographically decentralized production and trade is fragile, as well. Further technological assumptions facilitate the specification of the Pareto

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[3] Note that this technology is constant returns to scale.

optimal and secure equilibria which characterize the fragility. In addition to advanced production, intermediate good producers have a second, primitive, Robinson Crusoe, production technology available to them. On their own, (potential) intermediate good producers can produce consumption good, on their own island. This consumption good is identical to the consumption good produced by the MB-F on her own island. Specifically, intermediate good producers can convert leisure directly into the consumption good, on any scale, at the fixed rate of return of one to one. Recall, however, that the rate of return achieved by production with intermediate goods is $x > 1$. The ''advanced'' decentralized production, described earlier, is more productive than this primitive direct production. A (potential) intermediate good producer can produce only all intermediate good, or all consumption good, but not both. With these assumptions, there is a unique optimal amount of direct, primitive, production of consumption good, by a (potential) intermediate good producer who chooses not to produce intermediate good. Call this optimal amount of production, when using primitive production, I^*. This is also, by construction, the optimal amount of leisure input, when using primitive production.

Capacity constraints in advanced production also facilitate the characterization of the fragility, through the specification of the Pareto optimal and secure equilibria. Each MB-F has, then, a maximal scale of production, and it is the same, xNK, in terms of output. That is, the maximal capacity is K in terms of each intermediate good, and K in terms of the leisure input required to produce each intermediate good. As integer problems are not of interest here, K is a positive integer multiple of I^*, $K = JI^*$, $J > 0$. There also are a surplus number of (potential) intermediate good producers on each island, that is the number exceeds NJ, N being the number of fabricators (and islands and intermediate goods).

With these technological assumptions, fragility is clearly characterized. The Pareto optimal and secure equilibria arise naturally. As the intermediate good producers are in surplus, and the fabricators are scarce, it is natural that, in the Pareto optimal equilibrium, the intermediate good producers are paid their opportunity cost. That is, intermediate goods producers' leisure trades one for one with commodity, when using advanced production, as it does when they use the primitive, Robinson Crusoe, production on their own. As a consequence, in the Pareto optimal equilibrium, the rents from advanced production, $x - 1$ per unit, go to the MB-Fs, and they produce at capacity. Moreover, by symmetry, commodity on different islands trades one for one.

Moreover, now, the secure, but inefficient, equilibrium involves all intermediate good producers using primitive production only. That is, here, with primitive production, leisure also exchanges one for one with commodity; but, with primitive production, this occurs no matter what the other intermediate good producers do. Security is now found in foregoing efficient, advanced,

specialized, but decentralized, joint production and trade, in favor of an in-efficient, but secure (from coordination failure) self-sufficiency. Thus, the ad-dition of primitive production, to the parable of decentralized production, yields a more natural, appealing version of a secure equilibrium.

Not only does decentralized production induce fragility, it also induces trade; and thereby encourages monetary development. Indeed, decentralized production and trade can induce a lack of a double coincidence of wants. In particular, traded inputs, but local final goods, bring this feature of trade into sharp relief. [4] Importantly, then, assume that intermediate good producers can only consume the consumption good produced *on their own island*. This is the local final goods aspect. There now is a lack of a double coincidence of wants. Between the MB-F of a given island and an intermediate good producer of that same island, there is a double coincidence of wants. Otherwise, there is a lack of a double coincidence of wants. Each MB-F wants the intermediate goods from each of the other islands, to produce consumption good on her own island. At the same time, each intermediate good producer wants the consumption good on her own island only. MB-Fs need a way to have each other pay intermediate good producers on their own islands, with consumption good produced on their own islands, for intermediate goods used by the MB-Fs on the other is-lands. This need is met by the monetary system.

3. Credit instruments and local deposit banking

Merchant bank credit instruments and local deposit banking solve this lack of a double coincidence of wants in trade. However, further assumptions on the physical environment are necessary for this. Specifically, there is a clearing of credit instruments used in trade. The particular credit instruments treated are bills of exchange issued by merchant bankers. To allow for the clearing of bills of exchange, between merchant bankers, there is an "Exchange." Imagine that the islands are arranged around the circumference of a circle, and that there is a central location, the "Exchange." After input producers have consumed the consumption good, MB-Fs can go to the Exchange. The MB-Fs can consume their own product on their own island, or they can costlessly take it to the Exchange. At the Exchange, they can consume their own product, or the consumption good brought by other MB-Fs to the Exchange. The MB-Fs are indifferent to consuming their own product, on their own island, and con-suming their own product, or other MB-Fs' product, at the Exchange. Im-portantly, at the Exchange, MB-Fs can also, instead, simply cancel out their

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[4] This structure of traded inputs and local final goods has uses in other contexts as well, as (independently developed) in Bogdanova's (1999) international real business cycles model.

offsetting bills of exchange, issued by each other. This physical structure is illustrated in the top section of Fig. 1 (where "MB-F" is merchant banker-fabricator, and "*I*'s" are intermediate good producers).

Some further elaboration is necessary to treat trade, credit instruments and local deposit banking. To arrange for trade and credit, MB-Fs have branches
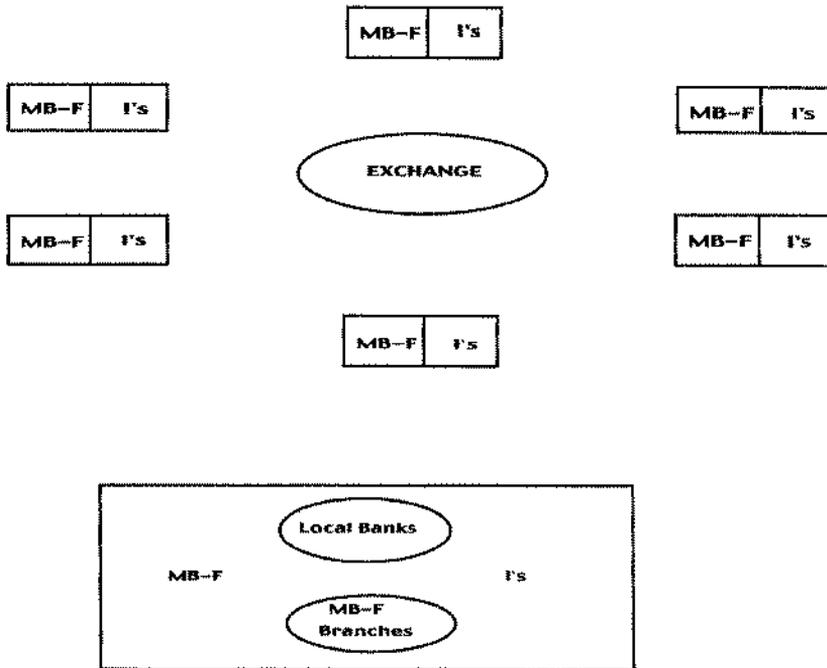
1. MB-Fs instruct their branches to sell bills of exchange to the other MB-Fs.
2. Branches are paid with deposits in a local bank. (The local bank issues over-drafts to the (bill buying) MB-F, who transfers the deposits to the branches of the other (bill selling) MB-Fs.) After this step, each MB-F is holding bills of exchange of the other MB-Fs, and each branch has an on-island deposit.
3. Branches buy intermediate good with the deposits, and ship it to their "home office" MB-F.
4. MB-Fs produce consumption good, intermediate good producers (*I*'s) buy it with deposits (MB-Fs overdrafts with local deposit banks are cancelled), and consume it. MB-Fs consume the remaining consumption good as profit.
5. MB-Fs send the bills of exchange to the Exchange, where they are cancelled.

Fig. 1. Cycle of decentrailized production and trade.

at each of the islands. [5] Also at each of the islands are competitive and cost-lessly operating local deposit bankers, who maintain accounts on their own islands only. This structure is illustrated in the center section of Fig. 1.

The simple idealized monetary framework suggested by McAndrews and Roberds (1999) is now in place. The functions of credit instruments, and local deposit banking, in supporting trade, in the Pareto optimal equilibrium, are clearly delineated. The basic working of credit instruments, and local deposit banking, is straightforward. MB-Fs instruct their branches to issue bills of exchange, to the other MB-Fs. The bills of exchange are promises to the consumption good produced by the issuing MB-F, which is what she has to offer. These bills specify delivery either at the island of the issuing MB-F, or at the Exchange. The branch is paid, for the bill of exchange, with a deposit at the local deposit bank used by the MB-F buying the bill of exchange. To create this deposit, the bank issues an overdraft to that MB-F. [6] The deposit is denominated in units of consumption good of the MB-F buying the bill of exchange. That is, after every branch, of every MB-F, takes this step, every MB-F is holding bills of exchange. The bills of exchange promise the delivery of the consumption goods of the other MB-Fs, at the other islands, or at the Exchange.

Crucially, each branch of a MB-F now has something that the intermediate good producers at that island want. Each branch has a claim to the consumption good on the intermediate good producer's own island, in the form of a deposit at a local deposit bank, on that island.

Thus, with this trade between bills of exchange and deposits, the lack of a double coincidence of wants has been solved. The branch next goes to the intermediate good producers on the island, and buys intermediate good with the deposit. The branches ship the intermediate good back to their "home office" MB-F. Then the MB-Fs fabricate the consumption good with the intermediate goods. Intermediate good producers purchase the consumption good with their deposits, which are denominated in units of the consumption good of their own island. These deposits cancel out the overdrafts. The MB-Fs now have on hand any consumption good not bought by the intermediate good producers. They also hold each other's bills of exchange. Indeed, by symmetry, the bills of exchange are for equal amounts of consumption good. Consequently, the MB-Fs can just consume any remaining consumption good, as profit. The MB-Fs then remain holding each other's bills of exchange, but no consumption good. They then can take the bills of exchange to the Exchange,

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[5] There is a very long history of merchant bank branches, see, e.g., Braudel (1979), De Roover (1948, 1953), Origo (1957), and Van Der Wee (1977).

[6] For discussion of such overdrafts see McAndrews and Roberds (1999), De Roover (1948) and Van Der Wee (1977).

and cancel them out, completely offset them, as by symmetry they are equal. That is, the Exchange can be a purely financial Exchange, a clearinghouse for bills of exchange, despite being able to handle consumption good. [7] The cycle of decentralized production and trade is complete. This is outlined in the bottom section of Fig. 1.

Other than the vestigial multi-lateral meeting at the Exchange for the off-setting of bills, [8] exchanges are bilateral, and decentralized. Not only is the production decentralized, trade in goods and in financial instruments is decentralized as well.

However, the description of the cycle of decentralized production and trade, in the Pareto optimal equilibrium, is not quite complete. Rates of exchange remain to be determined. With decentralized trade, determination of rates of exchange is decentralized, as well. As noted above, the intermediate good producers are in surplus, and it is natural that they be paid their opportunity cost. That is, intermediate goods producers' leisure naturally trades one for one with commodity, as it does in primitive production. Hence, the rents from advanced production, $x - 1$ per unit, naturally go to the MB-Fs. Moreover, by symmetry, commodity on different islands naturally trades one for one. However, a decentralized mechanism generating these natural results is yet to be specified.

Two rates of exchange are decentrally determined. Branches (of the other MB-Fs) decentrally exchange bills of exchange for deposits, with MB-Fs. The bills of exchange and deposits are denominated in the consumption goods of different islands. Then the branches decentrally exchange deposits for intermediate goods, with intermediate good producers. These are denominated in consumption good and intermediate good of the same island. The two decentrally determined rates of exchange, between bills and deposits, and between deposits and intermediate goods, in turn, determine the profits of the MB-Fs.

The natural rates of exchange can be decentrally determined through "final offer." Indeed, suppose the branches of MB-Fs make "take it or leave it" offers to intermediate good producers, and to other MB-Fs. [9] Then the "natural" rates of exchange are an immediate result. Firstly, a branch cannot offer intermediate good producers less than their opportunity cost, and, as the latter

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[7] Historically, the great fairs of Europe, in part, functioned as a traveling clearinghouse for bills of exchange used in trade. Massive volumes of transactions were supported, with only trivial quantities of gold present; gold used just to "make change," that is, to settle small net balances. The fairs functioning as clearing houses for bills of exchange is reported in, for example, Braudel (1979), and succinctly in Lopez (1976, esp. p. 90) and Van Der Wee (1977, esp. pp. 315–322).

[8] Moreover, historically often actually done "at arms length" through brokers.

[9] Perhaps branches do not have the authority to bargain.

are in excess supply, has no reason to offer more. Consequently, one for one is the rate of exchange between deposits and intermediate goods.

Consider now the rate of exchange between bills of exchange and deposits. The branch of a MB-F is selling a bill of exchange that promises consumption good, at that issuing MB-Fs island, or, alternatively, at the Exchange. As there is costless shipping to the Exchange, the branch can offer no less than a one for one rate of exchange. The bill buying MB-F could simply take her own product to the Exchange, instead of buying the bill of exchange. At the same time, the branch has no reason to offer better than one for one. At a one for one rate of exchange, the branch's own MB-F makes a profit of $x - 1$ units of consumption good, per unit of intermediate good purchased. Hence, the branch should buy deposits just sufficient for her MB-F's full capacity. If all branches do this, MB-Fs produce at capacity, generating consumption good exceeding the branches' demands for deposits by this same factor of $x - 1$. That is, at the one for one rate of exchange, MB-Fs are just indifferent to selling deposits to the branches (of the other MB-Fs) of up to x times the total demanded by those branches, $x > 1$. Consequently, one for one is the rate of exchange.

The description of the cycle of decentralized production and trade, in the Pareto optimal equilibrium, is complete. Rates of exchange are determined in a decentralized manner. Both rates of exchange, between bills and deposits, and between deposits and intermediate goods, are at their natural rates of one for one. The MB-F ultimately makes a profit of $x - 1$ units of (own island) consumption good, per unit of intermediate good. The branch, at each island, buys I^* units of intermediate good from each of J intermediate good producers. The MB-Fs produce at capacity, maximizing profits, thereby generating Pareto optimality.

Hopefully this simple, idealized, framework, of merchant bank credit and local deposit banking, lays bare an aspect of the essential functioning of the monetary system. Credit instruments, and local deposit banking, solve the lack of a double coincidence of wants in trade. This simple framework also exhibits systemic monetary fragility.

4. Monetary fragility

A sustained theme in monetary economics is fragility. Moreover, that there is a systemic component to monetary fragility is also a sustained theme. It is not (just) that individual banks are fragile, rather the entire system is, taken together, fragile. Bhattacharya and Thakor (1993) review the systemic component of monetary fragility. This systemic component of monetary fragility is of particular interest as a prominent model of monetary fragility, Diamond and Dybvig (1983) (see also Bryant, 1980), treats individual bank fragility. The fragility identified in this paper is of a very different sort.

Decentralized production is one possible source of systemic monetary fragility. While credit instruments and local deposit banking facilitate the decentralization of production and trade, they are, as a result, an integral part of a decentralized joint production system; and the decentralized joint production system, itself, is fragile.

The source of fragility, with both advanced decentralized production and primitive production available, is a simple one. Advanced production of consumption good requires intermediate goods from all the islands. Suppose the intermediate good producers, on any island, believe that the intermediate good producers on another island will not produce any intermediate good. Then they, too, should not produce any intermediate good. Their own intermediate good is useless without the other. Instead, they should use the primitive production technology, to make consumption good directly themselves. No matter what the others do, primitive production yields consumption good, one for one with leisure. That is, primitive production is secure.

The fragility of decentralized production, in turn, renders credit instruments, and local deposit banking, systemically fragile. Indeed, the monetary structure, of merchant bank credit and local deposit banking, delineates three forms of induced monetary fragility. There is fragility in the merchant bank credit instruments themselves, but also in local deposit bank credit (that is, the overdrafts), and in their deposits, as well. Consider first fragility in local bank deposits. If intermediate good producers believe that deposits will prove worthless, they do not accept deposits from branches, and do not produce intermediate goods. As there are no intermediate goods produced, there is no production by MB-Fs. The deposits are, then, in fact, worthless. The belief that deposits will prove worthless is self-fulfilling. Notice that the source of the problem, for an intermediate good producer, is not the unwillingness of the other intermediate good producers, on her own island, to accept deposits. Rather, it is the failure of deposit banking on the other islands which is the source of the problem. That is, the fragility is a systemic fragility, not an individual local bank fragility.

Similar reasoning explains fragility in local deposit bank credit and in bills of exchange. Consider local deposit bank credit. In the Pareto optimal equilibrium, the local deposit banks provide the MB-Fs overdrafts, so the latter can purchase bills of exchange, from the other MB-Fs' branches, with deposits. However, if the local deposit banks believe that the MB-Fs will not be able to make good on the overdrafts, then they do not issue them. If all local deposit banks have this belief, then MB-Fs' branches do not receive deposits, and are unable to purchase intermediate goods. MB-Fs are unable to produce, and are, then, in fact, unable to make good on overdrafts. The belief that MB-Fs will not make good on overdrafts is self-fulfilling. Finally, consider the merchant bank credit instruments themselves, the bills of exchange. A MB-F is supposed to buy bills of exchange from the branches of the other MB-Fs. If MB-Fs

believe that the bills of exchange, issued by the others, will prove worthless, they do not buy them, however. If all MB-Fs have this belief, they are all unable to purchase intermediate goods, are unable to produce, and the belief is self-fulfilling. [10]

This simple idealized monetary framework, suggested by McAndrews and Roberds (1999), also enables one to confront an important issue raised by this monetary fragility, namely, indemnification.

5. Indemnification

Fortunately, monetary fragility, in a system of decentralized production and trade, is not insoluble. Indeed, indemnification eliminates the systemic fragility. This is not merely of theoretical interest. Historically, private indemnification of bills of exchange, and of local bank deposits, is observed. There is also, of course, a long history of public indemnification of local bank deposits, in the form of government deposit insurance. Interestingly, indemnification of either bills of exchange or of local bank deposits suffices to eliminate the systemic fragility. Indemnification of both is redundant.

To treat indemnification in a simple manner, "gold" is introduced to the model. An outside entity is endowed with gold, before production and trade begin. Gold can be consumed at any island, as a perfect substitute for consumption good at that island. Gold also can be consumed at the Exchange, as a perfect substitute for consumption good. Indemnification of a claim means that the outside entity stands ready, if necessary, to exchange gold for that claim.

Consider, first, the indemnification of merchant bank credit instruments, bills of exchange. Suppose that the outside entity indemnifies all bills of exchange. Then no MB-F has reason to refuse a bill of exchange, from another MB-F's branch. A bill of exchange is a safe guarantee to consumption good, in the form of gold. The MB-Fs can, in turn, offer the bills of exchange as collateral for their local deposit banks' overdrafts. Hence, the local deposit banks can safely issue the overdrafts. Finally, the intermediate good producers can safely accept the deposits in payment, as they, too, are now effectively backed by the gold, as collateral. That is, the deposits pay off even if the MB-Fs are unable to produce. As long as all parties understand and believe the indemnification, the decentralized production and trade occurs. Hence the indemnification is not invoked, and the indemnifying gold stays with the indemnifier. All three forms of fragility, in merchant bank credit instruments, in local deposit bank credit, and in deposits, are eliminated.

Naturally, this indemnification of bills of exchange only eliminates the fragility involving trade, facilitated by bills of exchange, as isolated in this

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[10] Braudel (1979) prominently chronicles historical failures in bills of exchange markets.

paper. If there is another source of bank fragility, as in the Diamond and Dybvig (1983) model, the indemnification of bills of exchange alone does not stabilize bank deposits. This observation suggests that indemnification of local bank deposits may be the more interesting subject. The prevalence of indemnification of deposits, in the form of government deposit insurance particularly, also suggests this conclusion.

Consider, then, indemnification of local bank deposits; without indemnification of merchant bankers' bills of exchange. Suppose, then, that a local deposit bank can commit to a line of credit to a MB-F, and the resulting deposits are indemnified. The MB-Fs branches then issue bills of exchange to the other MB-Fs, backed by that line of credit. That is, when MB-Fs instruct their branches to issue a bill of exchange to a particular other MB-F, they open an account, in their own books, crediting that MB-F. That account is backed by a like amount of the line of credit. The account is subsequently written down, when the other MB-Fs' branches, in turn, offer bills of exchange, in return for indemnified deposits. No MB-F has any reason to refuse such a bill of exchange, offered by a branch, as it also is effectively indemnified. Of course, intermediate good producers have no reason to refuse an indemnified deposit. The only question remaining is whether the other local deposit banks are issuing overdrafts. If they have not already committed to do so, then the other local deposit banks are, indeed, willing to issue an overdraft, with the indemnified bills of exchange as collateral. Consider, once again, the original local deposit banker committing to the line of credit. She realizes that her MB-F will be able to buy intermediate good, and therefore she bears no risk in committing to the line of credit. Hence, indeed, all local deposit banks commit to a line of credit. Once again, all three forms of fragility, in merchant bank credit instruments, in local deposit bank credit, and in deposits, are eliminated.

It is not really surprising that indemnification of either bills of exchange, or of deposits, suffices to eliminate fragility; that it is not necessary to indemnify both. Indemnification, of either, is really a substitute for the MB-Fs paying directly in gold. If MB-Fs pay directly in gold, there is no fragility. The intermediate good producers, paid in gold, cash on the barrelhead, consume, whether or not the MB-Fs are able to produce. They simply consume the gold.

The analogy of indemnification to direct payment in gold is straightforward. Consider indemnification of bills of exchange. Imagine, for example, that MB-Fs are endowed with gold. Indeed, they have enough gold on deposit with their local deposit banks to cover their expenditures for intermediate goods. Redundancy of indemnification of deposits is now immediate. When MB-Fs instruct their branches to issue a bill of exchange, to a particular other MB-F, they open an account, in their own books, crediting that MB-F. That account is backed by a like amount of gold on deposit with the local deposit bank. The gold on deposit is effectively indemnifying the bill of exchange. As above, when they accept a bill of exchange from the other MB-F's branch, the MB-Fs write

down that account, and instruct their local deposit bank to transfer that amount of gold, as a gold deposit, to the branch. In this scheme, the intermediate good producers bear no risk, they are accepting gold deposits. The local deposit banker also bears no risk, she is merely transferring gold deposits, as instructed. Finally, the other MB-F has no reason to refuse the bill of exchange, of the MB-F in question, as she is credited with an account at that issuing MB-F, backed by the gold deposit. The analogy of indemnification of deposits to direct payment in gold is similar. Indemnification of local bank deposits is as if it is the local deposit banker who has the gold endowment, on deposit with herself. She lends the gold deposit to the MB-F, and so on.

In short, either one, believable indemnification of merchant bank bills of exchange, or, more importantly, local bank deposit insurance, eliminate systemic fragility; and hence, moreover, the indemnification, or insurance, is not called upon.

6. Concluding comments

There is a feature, built into the above monetary model, that may be worth stressing. The monetary system facilitates trade, and trade enables specialization. This specialization, in turn, yields the higher productivity of advanced production. Hence, failure of the monetary system imposes real opportunity costs, the costs of foregone specialization. In this aspect, as well, the above model may be a useful parable. [11]

Decentralized trade is not, of course, the only trading structure possible in the physical environment of this model. Consider, for example, an alternative market organization of centralized trade. Indeed, suppose MB-Fs buy all the intermediate good at their own island. That is, they take on the role of specialized wholesaler. They pay the intermediate good producers with promises to consumption good, at their own island. The MB-Fs then move to the Exchange. In a multi-lateral bartering at the Exchange, they exchange the intermediate goods. With this alternative centralized monetary and trading structure, intermediate good producers now have exactly the same problem as in the above decentralized monetary structure of merchant bank credit and local deposit banks. That is, if they all believe that the MB-Fs' promises to consumption goods will prove worthless, and consequently do not produce intermediate good, this is self-fulfilling. Once again, indemnification eliminates this source of fragility. However, in this market organization of centralized trade, there is another source of fragility, which indemnification does not eliminate. Namely, even if their promises to consumption goods are

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[11] The author is indebted to Peter Hartley for stressing this point.

indemnified, MB-Fs have to worry about whether other MB-Fs are purchasing intermediate good. If not, the MB-F is unable to barter for other intermediate goods, and is unable to produce. The indemnification is called upon, and the MB-F is bankrupt. Thus, the belief that MB-Fs will not purchase intermediate goods is self-fulfilling. As in Bryant's (1997), specialized wholesalers are themselves subject to risk; indeed, even if they pay in gold. Consequently, in indemnification and stability, the above decentralized trade, using merchant bank credit instruments and local deposit banking, has an advantage over this centralized trade. [12]

With its focus on the merchant bank, this paper simply imposes the payments role of local deposit banking. Fortunately, McAndrews and Roberds (1999) examine, in some detail, this payments role of local deposit banking. It may be worth noting that Van Der Wee (1977) provides a simpler, historical, explanation. For further simplicity, this paper has assumed that gold is costlessly transportable. In reality, of course, gold is heavy, but, nonetheless, valuable enough that it is, inadequately guarded, subject to theft. Hence there emerged specialist "cash keepers," who rented out strong and secure boxes for storing gold. Naturally, even taking gold out only for transactions was still costly. Hence, for transactions between those who had gold in storage, they started just transferring the right to the gold, while leaving the gold secure with the "cash keepers." On a local scale, they were replicating Fort Knox of modern times, where title to gold was transferred, rather than transporting gold internationally. Thus was local deposit banking born, in the low countries at least (and, indeed, until this day, commercial banks provide safety deposit boxes as well as deposit accounts). [13] With the emergence of more organized long distance trade, and merchant bankers, rather than having merchant bankers set up whole new, and redundant, sets of accounts, merchant bankers' bills of exchange were just "fed into" the pre-existing system of "cash keeper," local deposit bank, accounts; as described in the model above.

The monetary framework of merchant bank credit, and local deposit banks, suggested by McAndrews and Roberds (1999), completely avoids trade in specie. It is a cashless economy, at least for these transactions. That is, there is a replacement of specie by contracts and institutions. This observation, itself, supports McAndrews' and Roberds' assertion that their framework provides valuable insight into banking and the monetary system. Evolution to a cashless economy is a fundamental issue for monetary economics.

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[12] Notice also that, in the model, decentralized trade has no explicit real cost advantage. However, in reality, practical difficulties of centralized, multi-lateral contracting and trade may provide further advantage to the decentralized trade using merchant bank credit and local deposit banks.

[13] See also De Roover (1948, 1953).

Acknowledgements

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