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Loan-Monitoring and Deposit-Servincing by Commercial Banks in a Stationary Environment

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1-1999

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January 27, 1999

Abstract

We take up the hypothesis that risk premiums on equities are embodying the costs incurred by equity holders in monitoring the firms which they have invested in. This idea is a key ingredient in our construction of a two sector neoclassical model with widget producing firms and commercial banks. So-called user costs or interest rate spreads are key prices of commercial bank services in the model. Commercial banks produce deposit services (check-writing services or transactions services) and lending services to widget producers.

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1. Introduction

We explore the hypothesis that risk premiums in equities "capitalize" monitoring costs incurred by the owner of the equities. Clearly, the direct owner of the

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[*] I have benefitted greatly from the comments of Geir Asheim in my seminar presentation of Hartwick [1997]. One of his key remarks is noted below.

equity can be expected to monitor the firm invested in until the marginal cost of monitoring equals the marginal value of such activity and presumably value here corresponds to risk reduction or consumption smoothing. Hence the idea that a risk premium "capitalizes" some monitoring cost seems obvious. The open question is how much. Here we explore the polar case involving all of the premium representing monitoring costs. We come at this issue from an accouting perspective, from a framework set out in Hartwick [1997], essentially a two sector, stationary, general equilibrium system with generic banks, widget producers, and households. We make much of valuing the outputs of banks with interest rate wedges, so-called "user costs". These generic flow prices for financial assets were developed by Donovan [1978], Barnett [1980], and Hancock [1985] and were made use of in national accounting by Fixler and Zieschang [1991] and have, in fact, been incorporated in national accounting practice (SNA93[1] [1993, pp. 565-66]). In general equilibrium, the products of banks (lending serrvices and deposit services) are the inputs of widget firms and households and thus the user costs appear in the accounts of all three "agents" and, in a final accounting, most of the bank services end up as intermediate goods. The cost of bank services end up in the price of final goods, for the most part. The same can be said for legal services. They get produced over the accounting period in question, get consumed by households, banks and widget producers, and appear largely embodied in the prices of final goods.

Equity held by households in banks and widget firms was incorporated in the capital accounts of banks and widget firms in Hartwick's model and associated

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[1]SNA93 (Sytem of National Accounts, 1993) is the familiar name given to the United Nations manual setting out current national accounting practice or methodology. See reference Intersecretariat Working Group on National Accounts [1993].

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risk premiums were conspicuous in the final flow accounts for the economy. Our task here is to attempt to explain what these premiums are in fact representing in those final accounts.[2]

In a stationary environment there is no savings to allocate to new projects and thus, our commercial banks, as our principal lenders, have no new loans to place. They simply monitor and turn over existing loans and provide generic deposit services (check-writing in our phrase) to the owners of the deposits. In such a simple world sorting out the flow and capital accounts of commercial banks is quite straight-forward.[3] But interesting valuation questions emerge, particularly with regard to resources used up in loan-monitoring by banks and in borrower-monitoring by equity holders (households here). To keep matters simple, we appeal to constant returns to scale and other neo-classical properties of the technology made use of by banks and by widget producers. Attention is paid to reconciling the value of inputs with the value of output in the economy. Besides shedding light on procedures for valuing the banking sector in the national accounts, we arrive at the notion of so-called risk premia in equity rates representing or "capitalizing" costs incurred in monitoring equity placements.

Our approach is to set out the zero profit flow conditions for banks and widget firms and the capital "constraints" for banks and widget firms and to integrate these accounts into a reduced-form zero profit condition for each type of firm. One then has to make economic sense of the value of outputs relative to the

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[2]The idea of linking these premiums to some real resource flow was raised by Geir Asheim in a seminar presentation of the model in Hartwick [1997].

[3]Our assumption of stationarity means also that the portfolios of banks are not being adjusted. Levels of loans are not changing nor is the level of equity a household has in a firm. With regard to deposits, we assume perfect periodicity. Initial holdings are run down over a period and are restored to the initial value at the end of the period.

value of inputs. Since our economy is a mini general equilibrium system, the accounts of banks and widget firms are connected because banks lend to widget firms and hold deposits from these firms. Banks require some labor and K-capital (machines and structures) in order to service loans and deposits. A straightforward monitoring cost, incurred by the bank with regard to lending, emerges. In addition, banks provide deposit services (generic transactions or check-writing services) at a positive resource cost as well. Households write checks in order to acquire the widgets produced and firms write checks to pay workers and lenders.

Standard prices emerge for deposit services and bank lending services (monitoring activity here) and these prices turn out to have a representation as interest rate spreads, "mark-ups", or wedges between (a) the certain rate and the deposit rate and (b) the loan rate and the certain rate. It is certainly an old idea that the difference between the lending rate and the deposit rate is serving as a "price" for the output of banks, generically conceived. However there are many details to be filled in, in order for this intuition to rise to the level of serious economic analysis. Some of these suble details are woven together below. The SNA93 leaves open the question of whether banking services should be considered to be completely intermediate in nature in the national accounts or whether part of banking services should be viewed as part of final or net national product. We clarify this matter. Our approach can be summarized as follows. Take the (textbook) capital accounts of banks[4] and incorporate them in zero current profit conditions, and take the (textbook) zero current profit conditions of widget firms and incorporate the appropriate capital accounts. Firms in our two sectors end up with a similar

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[4]Tobin [1982; 1998, Chapt. 7], Kashyap and Stein [1994; pp. 236-238], and Dewatripont and Tirole [1994; Chapt. 7].

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treatment and this leads to an easy working out of the accounts for the economy as a whole. This is all in a sense prior to the traditional and complicated matter of commercial banks taking the savings of households and allocating them to new projects, as in Stiglitz and Weiss [1983] and de Meza and Webb [1987] for example. We have no net savings in our stationary economy and no need for someone to allocate financial capital to new projects. We abstract from explicit stochasticity associated with deposit drawdown and with loan risk, and from the explicit formulation of information asymmetries associated with say poorly informed depositors, poorly informed holders of equity in banks,[5] and poorly informed holders of equity in widget firms.

The price of K-capital changes with the level of equity in the economy and this price is linked to the market rate of interest, r. Hence the real and financial or monetary sides of the economy are linked. Given an exogenous savings rate, it is quite straightforward to define a balanced growth path for our economy. We comment on this at the end.

2. No Equity, Just Deposits

We consider **widget producers** first. There are many identical competitive producers and we can aggregate up via a constant returns to scale, neoclassical production function, $F(K^x, N^x)$ $(= Q)$, where K^x is a stock of machine or K-capital with flow of services, K^x, and N^x is a flow of labor services. Hence

$$
\begin{aligned}
p^x Q &= p^x F_{K^x} K^x + p^x F_{N^x} N^x \\
&= rq K^x + w N^x
\end{aligned}
\tag{2.1}
$$

[5]See for example Dewatripont and Laffont [1995].

for net price p^x, and rental rate, rq $(= p^x F_{K^x})$, and wage, w $(= p^x F_{N^x})$. r is the certain rate of return and q is the price of a unit of K-capital. Now current zero profit for widget firms is represented in

$$pQ = -r^D D^x + r^L L + w N^x, \qquad (2.2)$$

where r^D and r^L are the deposit and loan rates respectively, and D^x are deposits placed by the widget firms in the banks, and L are the loans placed by the banks in the widget firms.[6] The capital constraint for widget firms takes the form

$$L = qK^x + D^x. \qquad (2.3)$$

Now, when (2.3) is multiplied by r and the result in combined with (2.2), we obtain the basic relation

$$
\begin{aligned}
pQ &= [r^L - r]L + [r - r^D]D^x + w N^x + rq K^x \\
   &= [r^L - r]L + [r - r^D]D^x + p^x Q. \qquad (2.4)
\end{aligned}
$$

With regard to **commercial banks**, we postulate the joint production of loan-services, $\widehat{L}$, and deposit-services, $\widehat{D}$, in $M(\widehat{L}, \widehat{D}) = G(K^b, N^b)$. The hats indicate physical volumes of loans and deposits as distinct from dollar values. We assume that there are standardized units of measurement so that $D = \$1 \times \widehat{D}$ and $L = \$1 \times \widehat{L}$. Associated with loan-services $\widehat{L}$ is a dollar stock L. And associated with deposit-services $\widehat{D}$ is dollar stock D. More on this below. We assume constant

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[6]Over the period of producing a batch of widgets, firms will in fact be running down their initial holding of deposits as they write checks. At the end of the period the widgets are bought by households and the widget firms get their holding of deposits restored to its initial value. We are glossing over this "non-stationarity" in the level of deposits. Another consequence of the assumption of stationarity is that the value of loans, L, does not change. Stationarity should not be associated only with a positive increment in savings and investment.

returns to scale[7] so that

$$M_{\widehat{L}}\widehat{L} + M_{\widehat{D}}\widehat{D} = G_{K^b}K^b + G_{N^b}N^b. \tag{2.5}$$

Hence

$$
\begin{aligned}
p^L\widehat{L} &= \{p^L G_{K^b}K^b + p^L G_{N^b}N^b - p^L M_{\widehat{D}}\widehat{D}\}/M_{\widehat{L}} \\
&= rqK^b + wN^b - p^D\widehat{D} \tag{2.6}
\end{aligned}
$$

where and $p^L G_{K^b}/M_{\widehat{L}}$, $p^L G_{N^b}/M_{\widehat{L}}$, and $p^L M_{\widehat{D}}/M_{\widehat{L}} = p^L$. We also have

$$
\begin{aligned}
p^D\widehat{D} &= \{p^L G_{K^b}K^b + p^L G_{N^b}N^b - p^D M_{\widehat{L}}\widehat{L}\}/M_{\widehat{D}} \\
&= rqK^b + wN^b - p^L\widehat{L}. \tag{2.7}
\end{aligned}
$$

Now the banks' current zero profit condition is[8]

$$r^L L = r^D D + wN^b \tag{2.8}$$

and its current capital "constraint" is

$$D = qK^b + L \tag{2.9}$$

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[7]In fact, there seems little doubt that there should be scale economies in monitoring. For example, one could for the same cost monitor a firm borrowing $500 as one borrowing 5 million dollars. And on the deposit side, it costs the same to process a $500 check as a 5 million dollar check. So one should think about economies of scale on this side of the bank also. These points have been well set out in the literature. We are of course taking an "opposite" tack and are investigating a stylized constant returns to scale world of banks and widget firms.

[8]Fixler and Zieschang [1991; p. 57] refer to this as "a fundamental accounting identity for banks". We refer to it as the zero current or flow profit condition. There is merit in Fixler and Zieschang drawing attention to this condition since it does not figure in most models of a commercial bank. Typically, a model is built around the capital accounts of a commercial bank. See for example Kashyap and Stein [1994], Dewatripont and Tirole [1994; Chapt. 7], and Tobin [1998; Chapt. 7]. We would be inclined to label our equation (3.3) below as "the fundamental equation of bank analysis" in stationary environments. A version of it appears in Fixler and Zieschang but they do not appear to draw much from it. In fact they seem to take it from Hancock [1985].

where $D = D^h + D^x$, where D^h are deposits of households. We are abstracting from bank reserves held to service customers requiring currency. When (2.9) is multiplied by r and combined with (2.8), we obtain

$$[r^L - r]L + [r - r^D]D = wN^b + rqK^b. \tag{2.10}$$

This zero profit condition[9] is linked to (2.6) and (2.7) above because $p^L \widehat{L}$ is the same as $[r^L - r]L$ and $p^D \widehat{D}$ is the same as $[r - r^D]D$. The latter are deposit services produced by the banks and the former are lending services produced by the banks. We will associate deposit services with flows of checks moving through the banks and lending services with costs of continually monitoring loans, L. Since our framework is stationary, there is no placing of savings in new projects by the banks. More on this below.

We now integrate the accounts of widget firms and banks by combining (2.4) and (2.10). This leads to the **basic accounting result**

$$pQ + [r - r^D]D^h = wN^b + rqK^b + wN^x + rqK^x. \tag{2.11}$$

We observe that total value-added in the economy, the RHS of (2.11), equals the "gross" value of widgets produced plus some transacting services, associated with households acquiring the widgets from the producers of the widgets. The activity of banks is almost totally intermediate except for the transacting services, $[r - r^D]D^h$. However from an economics perspective, these transacting services should really be incorporated in the costs to the households of acquiring the final goods.[10] It as if in acquiring widgets, households must pay a delivery charge.

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[9] $-[r^L - r]$ and $-[r - r^D]$ are referred to as "user costs" of a \$1 loan and of a \$1 deposit respectively. See Fixler and Zieschang [1991]. The user cost approach here originates with Donovan [1978] and Barnett [1980] and is exploited effectively in Hancock [1985].

[10] I am indebted to Geir Asheim for alerting me to this point.

From this perspective **all banking services are intermediate.**[11]

The above accounting relations are essentially equilibrium conditions. To obtain equilibrium values we need to specify some additional "behavioral" relations. We need, first, to link the production of banking services associated with loans and deposits to the real transactions in the economy. A straightforward approach is to say that widget production requires check-writing services from banks (transacting services) in proportion to the amount of widgets produced. These costs then resemble transportation costs in the sense that a physical flow of goods produced is linked to a physical flow of checks moving through the bank and this flow has real processing costs associated with it. In addition there must be a stock of deposits placed by the check-writer on hand in order for check-writing to be permitted. We have in mind a perpetual cycle in which deposit stocks are topped up at the end of period t and are run down over period $t+1$ by check-writing. A period is defined by the time it takes to produce a new batch of widgets. And we can link check-writing by households to the volume of widgets acquired, again in a linear fashion. Hence physical widget volume is linked linearly to two flows of check-writing or to two volumes of deposits.[12] We posit for firms, $\delta Q = \widehat{D}^x$ and for households, $\alpha Q = \widehat{D}^h$, where δ and α are parameters. Check-writing becomes an intermediate "good", with some linked to the households consumption

[11]The current UN guidelines for doing national accounting in SNA93 [1993, pp. ////] are unclear as to whether all banking services should be condsidered intermediate or whether some should be considered as final. Eisner [1989; p. 12] reports that there is an imputation of about 1.7 % in the US national accounts for financial services. This figure presumably covers the total value-added of "banks", broadly defined, and not just the "residual", $[r - r^D]D^h$ in equation (2.11).

[12]At the opening of a period, households and firms will have "full" stocks of deposits in their accounts and check-writing will draw these accounts to zero at the end of the period. Then the process is repeated. A period can be defined by the length of time it takes to produce a batch of widgets.

of "final" widgets in equation (2.11).

With regard to L we will make it a parameter for the moment. Roughly speaking, we are saying that there are "projects" that households cannot invest in directly. The banks become specialized investors. (Diamond and 'Dybvig [1981] proceed in this way.) And our choice of L is such that (2.3) solves as an equality.

We assume that total labor N $(= N^b + N^x)$ and K-capital, K $(= K^b + K^x)$ are given. Hence the allocation between banking activity and widget production needs to be solved for. Note that (2.3) and (2.9) imply that

$$D^h = qK. \tag{2.12}$$

This implies that households own the K-capital via their deposits. (When equity is present, things are different.) Equation (2.12) also defines price q. r will get solved for when the rental price of a unit of K gets solved for. It is straightforward to solve for an interior solution such that all K and N are used currently. One ends up with solution values for q, r, w, D^x, D^h, $\widehat{D}^x$, $\widehat{D}^h$, r^L, r^D, K^x, K^b, N^x, and N^b. See the Appendix.

3. Equity in Banks

A deficiency of the above model[13] is that depositors have no hold on the bank managers. Households put their deposits into the banks and hope that the bank managers will be prudent in lending the funds. A simple way to give depositors some hold on bank managers is to have households "require" that bank managers have a substantial personal equity stake in the bank that they are managing. One thinks of those ancient gold keepers who presumably lived among their depositors.

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[13]In addition to the arbitrariness of setting L exogenously.

The depositors could verify the equity stake these gold keepers had in their "bank". Similarly for small town banks, one presumes. It is straightforward to add an equity term E^b, exogenously set, to the above model. We assume that this equity is held by managers of the bank. The banks' flow accounts become

$$Lr^L = Dr^D + wN^b + [r + \gamma^b]E^b \tag{3.1}$$

where γ^b is a "risk premium", exogenously set here. The banks' capital accounts become

$$E^b + D = qK^b + L. \tag{3.2}$$

When (3.2) is multiplied by r and inserted in (3.1) we obtain

$$[r^L - r]L + [r - r^D]D = rqK^b + wN^b + \gamma^b E^b. \tag{3.3}$$

The meaning of (3.3) is obvious except for $\gamma^b E^b$. It is really capturing a cost to the managers which they incur in order to gain the confidence of their depositors. If they did not have to signal a commitment to prudence in this way, they could put their funds, E^b, in some other investment vehicle. $\gamma^b E^b$ is the flow cost of demonstrating prudence and should be subtracted from the final consumption goods, accruing to the households who are bank managers. In addition to advertising a commitment of bank managers to depositors, $\gamma^b E^b$ also represents the cost to managers of monitoring the lending officers at work in the bank. Given their commitment of E^b, the managers will strive to protect its value and the best method here is to monitor the lending activity closely. We are of course side-stepping the setting out of a detailed micro-structure for this $\gamma^b E^b$. Certainly a higher level of prudence is signalled by a larger holding of equity by the managers of a bank in the bank in question. We are agnostic on the precise nature of the equilibrium

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level of equity in this competition among banks for market share in the market for deposits. They also have rate r^D available as an instrument to compete with but, given perfect competition among banks, one presumes that banks are price takers here.

To round things out, we will introduce equity, E^x, held by households in widget firms. The central point here is that households are willing to incur some "own" costs of monitoring the widget firms once they commit to holding equity in these firms. One has the option of putting funds in banks and letting the bankers do the monitoring of loans channeled out the bank, or of lending funds directly to the widget firms and incurring the monitoring costs oneself. In a fully worked out model, there will be a relationship between the levels of monitoring costs and the volume of funds going to borrowers through the two channels.[14] An equity holder's risk can generally be reduced by her doing more monitoring of the firm which she has invested in. We will in fact identify $\gamma^x E^x$ in return $[r + \gamma^x]E^x$ with monitoring costs incurred by the equity holders.[15] We acknowledge that $\gamma^x E^x$ is generally identified as a reward for risk-bearing. Our investors can be thought of as having eliminated risk to themselves by pursuing an aggresive program of monitoring. $\gamma^x E^x$ will have to be subtracted from the equity holders gross flow of widgets, *qua* consumption, in order for the accounts to indicate that $\gamma^x E^x$ is a cost to these equity holders. We could contemplate equalizing the net consumption of our two types of households: those represented by a bank manager and those represented by a holder of equity in the widget firms.

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[14]The Modigliani-Miller Theorem indicates that the value of the firm is prior to and independent of the split between debt and equity in the firm but this is not to say that the riskiness of equity in a firm is independent of leverage.

[15]There is a difference between the marginal cost and average cost of monitoring in general. We treat them as the same here.

The flow accounts for widget firms are now

$$pQ = r^L L - r^D D^x + w N^x + [r + \gamma^x] E^x \qquad (3.4)$$

and the capital "constraint" is

$$L + E^x = q K^x + D^x. \qquad (3.5)$$

When (3.5) is multiplied by r and combined with (3.4) we obtain

$$pQ = [r^L - r]L + [r - r^D]D^x + w N^x + r q K^x + \gamma^x E^x. \qquad (3.6)$$

The interpretation of this in straightforward. Recall that we are identifying $\gamma^x E^x$ with monitoring costs shouldered by equity holders. This is relevant for the placing of $\gamma^x E^x$ in the final reckoning in the accounts. This reckoning is done by combining (3.6) and (3.3) to obtain

$$pQ + [r - r^D]D^h - \gamma^b E^b - \gamma^x E^x = w N^b + w N^x + r q K^b + r q K^x.$$

The RHS is value-added in the economy and the LHS is net consumption of widgets by households. Recall that $[r - r^D]D^h$ should be interpreted as the trans-actions cost of households acquiring widgets and is thus part of the final price of widgets consumed. To acquire a widget, a household pays p and a "tax" or delivery charge. Moreover, before any consumption occurs, costs $\gamma^b E^b$ and $\gamma^x E^x$ must be netted out of pQ. These are monitoring costs incurred by households who own equity in widget firms and monitoring costs that bank owners incur in monitoring their lending officers. The accounts for our economy are summarized in a national accounting matrix. The rules of construction are (a) a column sum equals its corresponding row sum and (b) receipts are in rows and expenditures

are in columns.[16]

Table 1

National Accounting Matrix

$\backslash^{receipts\rightarrow}_{\exp end\downarrow}$	widgets	dep & lendg	lab^x	K-cap^x	lab^b	K-cap^b	Hhlds
widgets							pQ-γ^xE^x
dep-ser	[r^L−r]L						-γ^bE^b
lend-ser	[r-r^D]D^x						[r-r^D]D^h
labor^x	wN^x						
K-cap^x	rqK^x						
labor^b		wN^b					
K-cap^b		rqK^b					
Hholds			wN^x	rqK^x	wN^b	rqK^b	

Observe in Table 1 that the households column sum is net national product and the row sum is net national income or value-added. To turn these accounts into a model to solve, we need some "behavioral" relations. We can make use of our transactions "technology" which we set out in the previous section. With regard to solving for L, it seems appropriate to link monitoring costs by households holding equity in widget firms to monitoring costs incurred by banks of loans to the widget firms. One approach is to require that the model solve with $[r^L - r] = \beta\gamma^x$ where β is between 0 and unity. This approach to solving the model effectively fixes the equilibrium price of loans, since this latter is $1 \times [r^L - r]$. Banks in this view, are specialist-monitors whereas households are amateur monitors. Banks here are more efficient at monitoring, in some sense, than are households. Finally we have E^b, E^x, and γ^b as parametric. In our model these items can be thought of as being determined by past history and we are cutting into this stationary historical

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[16]This accounting matrix is a variant of Richard Stone's social accounting matrix. We have adapted the matrix to have net national product appear in the Households column and net national income appear in the Households row.

"evolution". In a more complicated framework, equity would get allocated to equalize a risk-adjusted return for each placement of funds. We do not pursue this point here.

Our model solves with $D^h + E^x + E^b = qK^b + qK^x$. Households own the real capital in the economy. Of interest, it that, with E^b and E^x given, capital goods price, q solves for differently than when there is no equity. Hence interest rate r also solves differently. Hence the existence of equity has impacts on the organization of the real, not just financial, side of the economy. In the previous model we solved under the assumption that L was a parameter. Now, by our linking of monitoring costs by banks to those of households, we effectively solve under the assumption that the **price** of L is a parameter. See the Appendix.

4. Discussion

An obvious shortcoming of our final model above is the exogeneity of E^b, E^x, γ^b, and γ^x. We have no specification of risk facing the households and banks, their "agents", and no specification of the response to risk by the households and by bankers. We cannot answer the question: "why do banks exist in our world?" and "why do banks do the particular amount of lending which they do?" Diamond and Dybvig [1983], for example, argue that (a) banks have special expertise or access to investing in long term projects, relative to households and (b) households cannot insure themselves in insurance markets against certain private consumption shocks.[17] Banks then become indirect insurers (smoothers of consumption for

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[17]An emphasis in Diamond and Dybvig is on the possibility of an "equilibrium" bank run or meltdown of their banking system when an excess of depositors show up to withdraw. This important analysis is not a concern of ours. On Diamond and Dybvig as a model of a banking industry, see Bernanke and Gertler [1987].

households), and can attract customers as depositors because they have their specialized skill at placing investment in projects, relative to households. Roughly speaking, Diamond and Dybvig, would have our loans from banks to firms as exogenous and households would "invest" in banks via depositing in order to access the high return banks obtain on their loans. In the process households would smooth their consumption across periods. We, in contrast, have no explicit shocks facing out households and hence no reason for them to seek out a consumption-smoothing "mechanism" or channel. Diamond and Dybvig do not allow households to enter into an equity contract with the firms with the lucrative long-term project in their model and have been criticized for this approach. (See Goodhart [1989; pp. 114-115] for comments and references.) We of course do have households holding equity in our widget firms but are agnostic as to how households select the particular level of investment which we observe.

Two virtures of our approach are (a) we have a closed general equilibrium system and so we are able to see key links between banks, widget firms and households and (b) we have neo-classical production functions "defining" banks. A seeming by-product of (a) and (b) is the "shadow pricing" of bank outputs, namely $[r^L - r]$ for loans and $[r - r^D]$ for deposit services. This links our approach to Hancock [1985] and to Fixler and Zieschang [1991], but in new ways. They focused on interest rate spreads as prices of bank products but did not tie the banks to the lenders in a general equilibrium system. The other novelty of our approach seems to be the interpreting of mark-ups associated with returns on equities (so-called risk premiums) as pure monitoring costs. Our approach involves associating the full value of the markups with monitoring costs. We assume that average equals marginal monitoring costs. This is somewhat special but

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has the virture of giving us a full capitalization of monitoring costs in mark-ups. If marginal monitoring costs were upward sloping, we would end up with mark-ups representing monitoring costs in part and some other cost such as "risk-bearing". This may be empirically relevant but obscures the point that so-called risk premiums may in fact be capitalizing a large volume of resources involved explicitly in monitoring borrowers by lenders. Though we have assumed constant returns in bank monitoring activity, it is easy to argue that monitoring a large loan costs the same as a small loan. Still our formulation seems to sit more comfortably with banks than with non-institutional equity holders. No doubt households do incur monitoring costs when they hold equity. The open question is how much of the mark-ups comprise monitoring costs and how much represents other costs, such as "risk-bearing". A reason to invest in a mutual fund is not only for diversification but also to buy into the monitoring activity that you assume the mutual fund personnel are doing of the firms which they invest in on your behalf.

5. Balanced Growth

If some of current widget production is saved by households, this will translate in to increases in equity and deposit holdings, i.e. ΔEs and ΔDs. The widgets foregone will correspond with increases in K-capital or into ΔK, part of which will be for the expansion in the widget sector and part in the banking sector. It is not difficult to expand our capital and flow accounts to reflect these dynamic or non-stationary[18] elements. Postulating a constant savings rate is a reasonable

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[18]A repeating, non-growing economy might be a more accurate term for our "stationary economy".

first pass. The rate of growth in the E^b and E^x would be such as to preserve the relative prices unchanged, including of course r and q. The way we have structured our model with equity, lends itself to the possibility of a balanced growth path. Along such a path relative prices would not change. Such a path could serve as a benchmark solution. Clearly it is the transient solutions that would be of interest, paths with relative prices changing, and we have not attempted to analyze one at this point. Changing the savings decision into an optimization problem is clearly the place to begin an analysis of transient paths.

6. Concluding Remarks

We have turned the general equilibrium system of accounts in Hartwick [1997] into a solvable economic model. The three key assumptions we introduced were (a) proportionality between deposit services supplied by commercial banks and deposit services demanded by agents doing transacting, namely widget producers and households, as consumers of the final product, (b) proportionality between the loan servicing costs of commercial banks and the borrower-monitoring costs of equity holders, and (c) complete "capitalization" of borrower-monitoring costs of equity holders in equity mark-ups or "risk premiums". Assumption (c) raises new questions about the place of risk premiums in a complete accounting system and about the nature of a risk premium itself. Our solving of the model underlying the accounts has forced us to confront new economics, namely the nature of risk premiums and the place of monitoring activity in a complete economic system. Also of interest in our solution was the link between the paper claims of households on capital (equity holdings and deposits with commercial banks) and the volume of physical K-capital in the model. This link "determined" the price of K-capital

goods in the economy. And in the end, we noted that the model extends quite readily to a balanced growth representation, given an exgenous savings rate.

Appendix 1: Solving the Model

Case 1: (no lending by banks or equity held by households)

A simple case to serve as a benchmark has the banking sector producing only deposit services in

$$\widehat{D^x} = G(K^b, N^b)$$

under constant returns to scale and only for the widget firms. Households are assumed to require no deposit services for the moment. Then we have widgets produced under constant returns to scale in

$$Q = F(K^x, N^x)$$

and the economy has a fixed endowment of

$$K = K^x + K^b$$

and

$$N = N^x + N^b.$$

Now we close the model with a "behavioral" relation,

$$\widehat{D^x} = \delta Q$$

for δ a positive parameter, relating check-writing (deposit services demanded by widget producers) to the volume of widgets currently produced. Inputs will be priced according to the value of marginal products and the value of inputs equals the value of product under competitive conditions. Hence the model solves in a transparent way.

We can only obtain a solution for rq and not for r and q separately. Hence we cannot solve for $[r - r^D]$ at this point, though we will obtain a price for banking "product", $\widehat{D}^x$. Note that we cannot satisfy the widget firms' capital constraint, (2.3) in the text because there is no lending. The financial link from households to widget firms is open at this point. Our simplified model, here, is then complete from a real standpoint but incomplete from financial standpoint.

Case 2: (households "consume" deposit services)

We now add the demand relation, households require check-writing services

$$\widehat{D}^h = \alpha Q,$$

and the supply, from banks relation,

$$\widehat{D}^x + \widehat{D}^h = G(K^b, N^b). \tag{6.1}$$

There is little change from our previous case. We are still dealing with two neoclassical sectors linked linearly in

$$G(K^b, N^b) = \{\frac{1}{\alpha + \delta}\}F(K^x, N^x).$$

Households end up consuming less widgets because there is the new transactions "tax", $\widehat{D}^h$, on their consumption. Alternatively they are now locked into joint consumption of widgets and check-writing services and the new check-writing services consume some of the primary inputs, thus lowering net consumption of widgets.

We still can only solve for rq and not r and q separately. And we still cannot obtain a value for r^D in $[r - r^D]$. We do however obtain a price of the output of banks, or a price for $\widehat{D}^x + \widehat{D}^h$.

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These first two cases are simple variants of the two sector neoclassical model. There is a linear relationship on the demand side and banking activity is essentially intermediate.

Case 3: (positive loans, L)

With an ownership link from households to widget firms, matters become more complicated. (a) Suppose that households own widget firms via loans from banks, and "own" banks via their (households) deposits. This is our first model above in the text. We need a positive value for loans L or equation (2.3) in the text becomes becomes relevant. (b) Given a positive L we need joint production from banks or a more complicated joint production relation than that in (6.1). The constant returns to scale relation $M(\widehat{L}, \widehat{D}) = G(K^b, N^b)$ in the text does the job but we need a demand function for $\widehat{L}$. The simplest approach is to fix demand exogenously. Then the real model solves much like it did in our two previous cases.

But now we can solve for q in

$$D^h = qK$$

which is derived in the text early on. (Recall that $\$1 \times \widehat{D^h} = D^h$, $\$1 \times \widehat{D^x} = D^x$, and $\$1 \times \widehat{L} = L$.)[19] Then we can solve for r. Then r^L and r^D can be obtained from the relation $[r^L - r] \times \$1$ equalling the price of $\widehat{L}$, and $[r - r^D] \times \$1$ equalling the price of $\widehat{D^x} + \widehat{D^h}$. We have then explained the solving of our first model in

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[19]The assumption of each unit of $\widehat{D}$ and $\widehat{L}$ being associated with $\$1$ is crucial to obtaining the value of q. And once we have a value of q the value of the certain rate, r, emerges. (rq is the rental rate on a unit of K and rq emerges in the solution of the real part of the model.) Hence a theory of the determination of the certain rate is bound up in these relations.

the text. We have not dealt with delicate issues in the existence of non-negative quantitites and prices, but an "appropriate" choice of $\widehat{L}$ will result in positive quantities and prices, including values for the $r's$, to emerge.

Case 4: (positive equity levels)

$\widehat{L}$ is now endogenous. But its price gets set by the relation $\beta\gamma^x = [r^L - r]$.

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