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Integration of Lending and Underwriting: Implications of Scope Economies

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Abstract

Informational scope economies provide a cost advantage to universal banks offering "one-stop shopping" for lending and underwriting that enables them to "lock in" their clients' subsequent business. This market power reduces universal banks' incentive, relative to that of specialized investment banks, to apply costly underwriting efforts; consequently, universal banks are less successful in selling their clients' securities. Our results suggest that an integrated financial services market is less innovative than one with specialized intermediaries. Our analysis also identifies economy, intermediary, and firm characteristics that motivate either the integration or segmentation of bank lending and underwriting.

THE GLASS–STEAGALL ACT of 1933, which had long segmented the financial services industry in the United States, was eliminated on November 12, 1999, when then President Clinton signed into law the Gramm–Leach–Bliley Act, otherwise known as the Banking Modernization Bill. The motivation for the banking industry's support for the regulatory change is readily understood; according to a Wells Fargo executive, "This enables the bank to do what we really want to be able to do and that's to provide the full range of services to our customers under one roof."[1] Therefore, the new law brings to the United States what has long been available in much of the rest of the world—"one-stop shopping" for financial services. However, the regulatory change has not been without controversy. Critics emphasize that the new law is likely to increase industry concentration to a relatively few "financial supermarkets"—that is, universal banks—that will dominate the capital market with negative consequences for their customers. In response, industry leaders express the view that allowing the integration of financial services will actually improve the welfare of bank customers. The vice chairman of J.P. Morgan testified before Congress that "... fundamental reform

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[1] Remarks of Pamela Chavez, quoted in Shepherd (2000).

of America's financial laws is necessary to allow U.S. financial services firms to provide their customers with a full range of products, ... more innovation, and lower costs, and to enable U.S. firms to compete on fair and equal terms in domestic and international markets" (see Patterson (1999)).

Our study is motivated by this controversy regarding the likely effects of enabling "one-stop shopping" for financial services. We focus on lending and underwriting of securities by universal banks and relate the benefits of the scope economies that are expected to result from such integration to the intermediaries' efforts at underwriting their clients' securities. The lower information costs and consequent efficiency gains possible from combining related activities are generally believed to be one of the important motivators for the integration of financial services. Referring to such benefits, the vice chairman of J.P. Morgan said "...financial services providers are better able to access information about a customer's total account relationship in order to offer products best suited to the customer's needs" (Patterson (1999), op. cit.). The savings from scope economies arise in our model when information costs incurred by universal banks in learning about their clients in the process of underwriting their securities need not be fully incurred again when making them a bank loan.[2] This information cost can be viewed as a fixed cost of establishing a "relationship," possibly associated with an initial evaluation of the firm's creditworthiness. Once a firm has had its securities sold by a universal bank, or has borrowed from it, the universal bank will not again incur this information or relationship cost in subsequent dealings with this firm. In contrast, having its securities underwritten by a specialized underwriter—that is, an investment bank—commits the firm to a new relationship cost if it later seeks a bank loan.

Underwriters undertake a variety of activities aimed at helping sell to capital market investors the securities of their client firms. The extent of these activities affects the likelihood of a successful placement, and a creditworthy firm's security issue may or may not be successful despite the efforts of its underwriter. If the firm is unable to have its securities underwritten, it may seek a bank loan to meet its credit needs.[3] Unlike the activities of underwriters that may or may not be successful in selling the securities of the creditworthy firms, bank lenders undertake costly and unobservable monitoring of credit applicants that enables them to distinguish the ones that are creditworthy. If a universal bank has been the firm's unsuccessful underwriter, it can then provide a bank loan to the firm that is determined to be of acceptable quality, without again incurring the relationship cost. The universal bank will be able to profit from retaining the firm as a borrower because it can offer loan terms that match what the firm would be offered by a new lender that would have to incur a new relationship cost (see also

[2] Our model captures the idea of financial services being bought by firms over time. The essential feature is that the different financial services provide scope economies, but the sequence in which they are undertaken is unimportant for our basic results.

[3] For distinction between bank and capital market financing, see Diamond (1991), Allen (1993), Besanko and Kanatas (1993), Chemmanur and Fulghieri (1994), Qi (1994), Allen and Gale (1995, 1997), Bhattacharya and Chiesa (1995), Dewatripont and Maskin (1995), Von Thadden (1995), Yosha (1995), and Boot and Thakor (1997a).

Sharpe (1990) and Rajan (1992)). In contrast to the universal bank, a (specialized) investment bank loses the firm's business entirely and is left with the cost of its efforts if the securities' offering is not successful. Therefore, the investment bank has more to lose from a failed security offering than does the universal bank that has captured its client's business. This gives the investment bank a stronger incentive to work for its customer, thereby providing the firm with a greater likelihood of successfully selling its securities.[4]

Since we take financial intermediaries to be competitive ex ante, the scope economies that are expected to be enjoyed by a universal bank when it underwrites a firm's securities and later possibly lends to it are passed on to the firm—competition reduces the universal bank's underwriting fee below that offered by an investment bank. In contrast, the greater likelihood of successful capital market financing in using an investment bank reduces the need for the firm to rely on costly bank credit. Therefore, the firm's choice of underwriter type is based on a comparison of the benefit of the universal bank's scope economies embodied in the lower underwriting fee and the greater likelihood of successful capital market financing with the investment bank that avoids costly bank monitoring. In particular, the economies of scope that help motivate the formation of such integrated intermediaries in the first instance may, by themselves, result in a cost to firms having their securities underwritten by these intermediaries. Therefore, investment and universal banks are likely to coexist even if the latter institutions enjoy some scope economies (which ostensibly provide them with a cost advantage), and there is a meaningful trade-off to scope economies, even ignoring, as we do here, the potential conflict of interest inherent in combining lending and underwriting within one intermediary.[5]

Although our specific analysis describes as information production an underwriter's efforts at selling a firm's securities, we mean for such efforts to proxy for all activities of an underwriter aimed at helping its client raise capital. With such a broad interpretation, our analysis provides insight into an important issue regarding the integration of financial services—its effect on financial innovation. If we focus on the type of financial innovation undertaken by underwriters that has the aim of helping clients raise funds, then such innovation is within the scope of underwriter efforts in our model. With this interpretation, our analysis suggests that an integrated financial services industry will undertake less underwriting efforts along all dimensions—in particular, it will be less innovative—than one that is segmented along functional lines. Of special interest here is that it is the scope economies that motivate not only the integration of lending and underwriting but also the reduction of innovation in such an integrated financial services industry.

[4] This is a critical difference between our model and that of Boot and Thakor (1997b) in which their assumption that lending is more profitable than underwriting provides the universal bank with the incentive to lend rather than underwrite. Here, it is the scope economies that are generally believed to motivate the formation of a universal bank that diminish its incentive, relative to an investment bank, to undertake costly efforts in underwriting.

[5] This issue is analyzed by Benston (1990), Kroszner and Rajan (1994, 1997), Puri (1994, 1999), and Rajan (1994), Berlin, John, and Saunders (1996), Kanatas and Qi (1998).

The model is set up in Section I. In Section II, we examine the firm's choice of intermediary type for its funding needs. In Section III, we discuss the empirical implications of our model. Section IV concludes. All mathematical proofs are contained in the Appendix.

I. The Model

We consider a risk-neutral economy where firms are each endowed with a project but without resources to finance it. Firms seek external financing which is either bank loans or capital market debt. The economy has two dates, $t=0$ for the funding and initiation of the project and $t=1$ for its payoff. There are two types of firms, "good" (type g) and "bad" (type b). The proportion of type g firms is $\phi \in (0,1)$ and that of type b is $1-\phi$. A firm's type is unknown a priori to anyone, including itself. The project of a firm of either type requires the same investment of $I>0$ dollars at $t=0$. At $t=1$, the project of a type g firm will pay off $y>0$ dollars with probability $p \in (0,1)$ and zero with probability $1-p$, while that of a type b will pay off zero for sure. We assume $\phi py < I < py$, so that uninformed financing is socially undesirable.

Three types of financial intermediaries can facilitate the financing of projects: (1) commercial banks that only lend, (2) investment banks that only underwrite securities, and (3) universal banks that both lend and underwrite. All intermediaries are perfectly competitive, a priori, and so are capital market investors. There is no intertemporal discounting. The role of a bank lender is to undertake costly "monitoring" of its credit applicants that correctly identifies each one's type. Such monitoring is not observable and not contractible, but the bank has sufficient funds to finance projects that it deems creditworthy, that is, those identified as type g. In contrast, underwriters undertake a variety of activities that aid the selling of their clients' securities. The level of such activities, which we refer to as information production and is denoted by $\alpha \geq 0$, is assumed to be unobservable, but the essential aspect is that it is not contractible. These activities of the underwriter, however, generate an observable and verifiable signal, $\theta \in \{0,1\}$, about the issuer type, g or b, and greater underwriter effort results in a better signal. Therefore, the underwriter's role is to facilitate the security issues of its client firms through the production and dissemination of information about them. Underwriters differ from bank lenders in that while banks learn firms' types without error, underwriters (and consequently capital market investors) may be incorrect in their inferences.[6]

As mentioned, the informativeness of signal $\theta \in \{0,1\}$ about firm type depends on the level α of underwriter information production. With no information production, that is, $\alpha=0$, there is no content to this signal which is identically $\theta=0$ for both types of firms. With a positive level, $\alpha>0$, however, signal θ relates

[6] This somewhat extreme distinction between commercial and investment banks in what they learn about their clients captures the idea of the "specialness" of banks that is in, for example, Fama (1985).

to firm type as follows:

$$\Pr(\theta = 0|\text{type } b) = 1 \text{ and} \tag{1a}$$

$$\Pr(\theta = 1|\text{type } g) = q(\alpha) \in (0,1). \tag{1b}$$

The function $q(\alpha)$ satisfies regularity conditions: $q(0)=0$, $q'(\alpha)>0$, and $q''(\alpha)<0$ for $\alpha>0$, $q'(0)=\infty$, and $q'(\infty)=0$, implying that greater information production by underwriters makes it more likely that type g firms will be correctly identified with the signal $\theta=1$.

We now specify the costs each type of intermediary incurs in serving a client firm. We assume that the first time a firm transacts with an intermediary, the intermediary incurs a cost, $c>0$, to establish a customer relationship. No additional relationship cost is incurred if the firm uses the same intermediary for a subsequent transaction. As will be clear, parameter c is a measure of the scope economies enjoyed by a universal bank that provides a firm with both underwriting and lending services. In addition to this relationship cost c, a bank lender incurs a monitoring cost, $m>0$, to learn the true type of a firm applying for a loan, while an underwriter incurs an information cost to unearth signal θ that is a function of its information production level α, given by $n\alpha+k$, with n, $k>0$. Because we do not want either a bank loan or security underwriting to be the dominant choice for a firm, we assume $k<m$, a plausible assumption that banks' (total) monitoring cost—which for simplicity is a constant—exceeds the fixed portion of underwriters' information costs (but not necessarily their total costs). With the opposite relation, that is, $m<k$, firms would always choose a bank loan over security underwriting in our model because of the lower cost of bank credit.

Thus, a firm will initially approach either a lender or an underwriter, depending on the expected costs of bank monitoring relative to that of underwriter information production. In particular, the firm can initially apply for a loan from a commercial or a universal bank, or use an underwriter that is either an investment or a universal bank to access the capital market. While the firm's initial choice can generally be changed subsequent to it being identified as type g by the original intermediary, we will show that this will not happen with proper contracting between the firm and the intermediary prior to the incurrence of intermediary costs. Given imperfect underwriter information production, however, the firm may subsequently seek bank financing if its underwriter identifies the firm as type b and thereby fails to sell its securities.

A. Commercial Bank Lending

We consider first a firm's decision to initially apply for a loan from a commercial bank. There are several incentive problems in this credit application. If loan applications are unobservable, the firm can submit identical applications to multiple banks and force them to compete on the loan terms after they have incurred both relationship and monitoring costs and have identified the firm as type g. Furthermore, after being formally approved for credit by a bank, the firm can seek to borrow from a new bank, thereby hoping to avoid paying for the original

bank's monitoring cost. The firm can also seek capital market financing at this stage, possibly at a lower cost as well. Such incentive problems suggest that if the firm's loan application is approved, the firm should be liable for a fee to compensate for the bank's relationship and monitoring costs. This fee obligation, however, provides the bank with an interim cost advantage over its rivals, which may enable the bank to extract an interim rent from lending to the firm. The bank's moral hazard, in turn, suggests that it should make a credible commitment to lend to the firm at competitively prespecified loan terms, conditioned on credit approval. Finally, the bank must have the incentive to actually monitor its loan applicants.

In light of the above discussion, we establish that upon a firm's application for bank credit, an incentive-compatible contract between the firm and the bank provides that: (a) the bank shall formally approve or deny the firm's loan application at $t=0$; (b) if the firm's loan application is approved, the firm shall be able to borrow at $t=0$ from the bank an amount $x_b \geq 0$ at a loan interest factor (one plus the loan rate) of $\gamma_b \geq 0$; and (c) the firm is obligated to pay the bank at $t=0$ a fee of $f_b \geq 0$ only if the bank approves its credit application at the terms specified in item (b). In particular, if the bank's fee f_b and interest factor γ_b are set competitively at $f_b=(c+m)/\phi$—compensating fully for its relationship and monitoring costs—and $\gamma_b=1/p$, then it is optimal for the firm to apply for this bank's credit and, if approved, to borrow only from this bank an amount $x_b=I+f_b$ to finance the project and pay the fee. Under these terms, the bank expects to break even in its transaction with a loan applicant, that is,

$$\phi(f_b+p\gamma_b x_b-x_b)-c-m=0, \tag{2}$$

and with the fee obligation, the firm, once identified as type g and approved for credit by the bank, cannot be better off switching to a new bank lender or to a security underwriter, as the firm would have to compensate the new intermediary for an additional relationship cost. Furthermore, since the firm's fee obligation is contingent on the approval of bank credit at the prespecified terms, it is clear that given monitoring (to be confirmed), the bank will truthfully identify type g firms to secure the fee and type b ones to prevent a loan loss. And firms identified as type b by the bank will not seek an alternative source of funding for their zero-payoff projects.[7]

With these contractual provisions, the firm's expected payoff from initially seeking a commercial bank loan is

$$B^*=\phi p(y-\gamma_b x_b)=\phi(py-I)-c-m. \tag{3}$$

We need $B^*>0$ to make bank lending a viable option; this condition is implied by two parametric restrictions that we will introduce. Finally, the bank will

[7] While we provide intuitive explanations for the above contractual provisions, a formal verification of these claims, as well as of similar ones in Sections I.B, I.C, and I.D, is lengthy and hence omitted. However, it is contained in a working paper version of this article and available from the authors upon request.

monitor its credit applicants if it is better off lending with, rather than without, monitoring—that is, if

$$\phi(f_b + p\gamma_b x_b - x_b) - c - m > f_b + \phi p\gamma_b x_b - x_b - c \Rightarrow I > \frac{m}{1-\phi}. \tag{4}$$

Condition (4) will be shown to be implied by the same parametric restrictions.

B. Universal Bank Lending

We now consider a firm's initial choice of a universal bank lender for monitoring and possible credit. For a firm, the difference between seeking a loan from a universal rather than a commercial bank is that if it is identified as type g by the former intermediary, the firm will have the additional choice of seeking security underwriting by this intermediary. However, the same contractual provisions described in Section I.A also make unattractive this additional choice of the firm. Once the universal bank has incurred the monitoring cost and the type g firm is obligated to pay for it, there is no benefit for the firm to substitute the competitively prepriced loan with capital market financing. Therefore, an incentive-compatible contract between the firm and the universal bank lender has exactly the same provisions as those in Section I.A. That is, if a firm seeks a bank loan in the first place, it makes no difference whether it chooses a commercial or a universal bank—it will borrow at identical terms if approved—and we simply assume that it chooses a commercial bank.

C. Investment Bank Underwriting

Instead of applying for bank credit, a firm can initially approach an investment bank for capital market financing. The investment bank produces information to generate an observable and contractible signal $\theta \in \{0,1\}$ about the issuer type. We assume that a firm's contracting with an underwriter is publicly observable, and therefore, once this is observed, no other underwriter wants the firm's business because competition after both intermediaries incurred the relationship and information costs would ensure a loss for both. We also assume that firms cannot make a second attempt at capital market financing if the first attempt fails—that is, after they have been identified with the signal $\theta = 0$ by an initial underwriter. This captures the view that if a firm is unable to sell its securities in a public offering, it has to wait before making a second attempt and, in the meantime, it may have to rely on bank financing. As before, there are incentive problems between an investment bank and a firm contracting with it. After the investment bank has incurred the costs to unearth the signal $\theta = 1$, the firm can switch to another underwriter or seek to borrow from a bank lender. This incentive problem suggests that the firm should be liable for an underwriting fee, $\mu > 0$, to the investment bank that unearthed the signal $\theta = 1$ so long as the intermediary commits to sell the firm's securities at this fee. The latter provision is needed to prevent the investment bank from using its interim cost advantage to extract an interim rent. In contrast, if the signal unearthed is $\theta = 0$, the firm should not be liable for the fee because the underwriter can generate this signal without

producing any information—that is, by simply choosing $\alpha = 0$. Thus, a state-contingent fee provides the investment bank with the incentive to produce the necessary information. In summary, we establish that an incentive-compatible contract between the firm and the investment bank underwriter provides that: (a) the underwriter shall unearth signal $\theta \in \{0,1\}$ about the firm at $t = 0$; (b) if the signal unearthed is $\theta = 1$, the underwriter agrees to sell the firm's securities for a fee of $\mu \geq 0$; and (c) the firm is obligated to pay the underwriting fee μ only if the underwriter unearths the signal $\theta = 1$ and does not renege on its earlier agreed term in (b) to sell the firm's securities. In fact, we need, and will have, $\mu > c$, to ensure that the investment bank will indeed not renege on the earlier commitment. Recall that greater underwriter information production improves the accuracy of signal θ. In particular, given a level α of information production, a type g firm is identified with the signal $\theta = 1$ with probability $q(\alpha)$, while a type b firm is identified with $\theta = 0$ with probability one. Thus, firms identified with $\theta = 1$ are necessarily type g and are able to sell their securities at a competitive return to investors of $r = 1/p$. The funding such a firm needs from its security issue is $x = I + \mu$, which finances the project and pays the fee, and the firm's expected payoff from the investment bank's underwriting is

$$S_u = p(y - rx) = py - I - \mu. \tag{5}$$

Our subsequent parametric assumptions will ensure $S_u > 0$.

Given the underwriter's information level α, firms identified with the signal $\theta = 0$ are unable to sell their securities because the expected payoff of their projects is

$$\frac{\phi[1 - q(\alpha)]}{1 - \phi q(\alpha)} py < \phi py < I. \tag{6}$$

The above follows because out of the proportion $1 - \phi\, q(\alpha)$ of firms identified with $\theta = 0$, only the fraction $\phi[1 - q(\alpha)]$ is type g. Their choice is either to abandon financing attempts altogether or to seek a bank loan. These firms do not know their types and their updated probability of being type g is $\phi[1 - q(\alpha)]/[1 - \phi q(\alpha)] > 0$. Thus, it may be beneficial for a firm with a failed security offering to seek bank financing at this stage (our parametric assumptions will ensure this). Analogous to our analysis in Section I.A of initial bank lending, it is now optimal for a bank to agree to lend competitively to the firm, if identified as type g and approved for credit, the necessary funds at a loan interest factor of $\gamma_a = 1/p$ and a fee of f_a that compensates fully for the bank's relationship and monitoring costs at this stage—that is, given a conjectured equilibrium α,

$$f_a = \frac{1 - \phi q(\alpha)}{\phi[1 - q(\alpha)]}(c + m). \tag{7}$$

This fee f_a differs from the earlier f_b of initial bank lending precisely because only the proportion $1 - \phi q(\alpha)$ of firms are left to subsequently seek bank credit and then only the remaining type g—the fraction $\phi[1 - q(\alpha)]$—will receive it. The amount the type g firm will now borrow from the bank is similarly $x_a = I + f_a$.

While the bank expects to break even on this loan, based on the updated likelihood that the firm is type g, that is,

$$\phi[1-q(\alpha)](f_a+p\gamma_a x_a-x_a)-[1-\phi q(\alpha)](c+m)=0, \tag{8}$$

the firm's expected payoff from obtaining bank credit after failing the security issue is

$$S_b=p(y-\gamma_a x_a)=py-I-\frac{1-\phi q(\alpha)}{\phi[1-q(\alpha)]}(c+m). \tag{9}$$

We need $S_b>0$ for the equilibrium α to ensure that bank financing at this stage is socially viable. Combining this condition with the earlier assumption $\phi py<I<py$, we require that parameter y satisfy

$$\frac{I}{\phi p}>y>\frac{I}{p}+\frac{[1-\phi q(\alpha)](c+m)}{p\phi[1-q(\alpha)]}. \tag{10}$$

The above range of y is not a null set if

$$I>\frac{[1-\phi q(\alpha)](c+m)}{(1-\phi)[1-q(\alpha)]}, \tag{11}$$

that is, if the firm's funding needs, I, are large enough relative to the relationship and monitoring costs, $c+m$. Throughout our analysis, we assume that conditions (10) and (11) are satisfied for the equilibrium values of α. These two conditions imply $B^*>S_b>0$, and $S_u>0$ whenever investment bank underwriting is preferred to bank credit. Condition (11) also implies (4), ensuring bank monitoring in Sections I.A and I.B. Furthermore, the bank will monitor firms that failed their security issues and turned to it for credit in order to identify remaining type g firms, rather than extending credit to such applicants without first monitoring them, if

$$\begin{aligned}&\phi[1-q(\alpha)](f_a+p\gamma_a x_a-x_a)-[1-\phi q(\alpha)](c+m)\\&>\phi[1-q(\alpha)]p\gamma_a x_a-[1-\phi q(\alpha)](x_a-f_a+c),\end{aligned} \tag{12}$$

that is, if $I>[1-\phi q(\alpha)]m/(1-\phi)$, which is implied by condition (11) as well.

By combining the probability $\phi q(\alpha)$ of successful capital market underwriting and the resulting firm payoff, S_u, with its probability $\phi[1-q(\alpha)]$ and payoff S_b of bank financing if capital market financing should fail, the firm's expected payoff from initially choosing investment bank underwriting is

$$S(\alpha,\mu)=\phi q(\alpha)S_u+\phi[1-q(\alpha)]S_b=\phi(py-I)-c-m+\phi q(\alpha)(c+m-\mu). \tag{13}$$

Comparing $S(\alpha,\mu)$ above with B^* given in (3), we see that the last term in (13) represents the relative cost of bank lending over investment bank underwriting. If $c+m-\mu>0$—that is, if the bank's relationship and monitoring costs exceed the underwriting fee μ—then the relatively more costly bank credit favors the choice of investment bank underwriting.

We now characterize the equilibrium information level α and underwriting fee μ. In our model, the information level α chosen by the investment bank is not contractible and is made after the underwriting fee μ has been set. Therefore, for any fee μ that has been determined, the investment bank chooses α to maximize its own expected profit at this point:

$$\phi q(\alpha)\mu - n\alpha - k - c. \tag{14}$$

The investment bank's choice of the information level, denoted by α^s, is characterized by the first-order condition as a function of the fee μ:

$$\phi q'(\alpha^s)\mu - n = 0. \tag{15}$$

The second-order condition implies that α^s is increasing in μ, a larger fee motivates greater information production.

The underwriting fee μ is determined by initial competition among investment banks. Such competition ensures that μ is chosen to maximize the firm's expected payoff $S(\alpha,\mu)$ given in (13), subject to the information level α being determined by (15), that is, $\alpha = \alpha^s$, and the investment bank's expected profit being nonnegative, that is,

$$\phi q(\alpha^s)\mu - n\alpha^s - k - c \geq 0. \tag{16}$$

Let μ^s denote the optimal fee; condition (16) implies that $\mu^s > c$, as we have assumed. Condition (15) implies $\mu^s = n/[\phi q'(\alpha^s)]$, and by substituting this into (13), the firm's optimal payoff if it initially chooses investment bank underwriting is

$$S^* \equiv S(\alpha^s, \mu^s) = \phi(py - I) - c - m + \phi q(\alpha^s)\left(c + m - \frac{n}{\phi q'(\alpha^s)}\right). \tag{17}$$

In general, the investment bank's underwriting profit constraint (16) may or may not be binding. Since the intermediary's choice of information level α is itself a function of the underwriting fee μ, the firm may agree to a fee that provides a positive profit to the investment bank, thereby subsequently motivating a greater level of information production. However, we have no reason to expect our qualitative results to be affected by whether underwriting profits are positive or zero. In the much simpler case where constraint (16) is binding, the optimal fee μ^s and information level α^s are jointly determined by condition (15) and the equality (zero-profit condition) of (16). Thus, α^s is determined by

$$\frac{n}{q'(\alpha^s)} = \frac{n\alpha^s + k + c}{q(\alpha^s)} \tag{18}$$

and is independent of parameter ϕ, the proportion of type g firms. In contrast, the investment bank's underwriting fee $\mu^s = n/[\phi q'(\alpha^s)]$ is decreasing in ϕ because a smaller ϕ implies a lower likelihood of successful security underwriting, and therefore a higher fee is needed to compensate the underwriter for its information cost. As will be shown in the proof of our first proposition, there is a critical value $z^s > 0$, such that constraint (16) is binding for all $\phi < z^s$. Intuitively, by lowering the likelihood that the firm's securities will be sold, a smaller ϕ makes it less

likely that the firm can benefit by offering an underwriting fee higher than the zero-profit amount. In general, the critical value z^s can be greater than one, in which case constraint (16) is binding for all feasible $\phi \in (0,1)$. This is the case for a numerical example that is presented at the end of the Appendix to illustrate our analysis.

D. Universal Bank Underwriting

We now examine the alternative of a firm initially approaching a universal bank to underwrite its securities. By choosing a universal bank for underwriting, the firm wants this intermediary to unearth an (imperfect) signal $\theta \in \{0,1\}$ about its type, rather than to undertake more costly monitoring to identify its type in the first place. Analogous to the analysis in Section I.C, letting $\mu > 0$ denote now the universal bank's underwriting fee, we have that an underwriting contract between the firm and the universal bank should obligate the firm to pay the fee $\mu > c$ to the universal bank if the intermediary unearths the signal $\theta = 1$ and also commits to sell the firm's securities at this fee. Likewise, the firm should not be liable for the fee if the signal unearthed is $\theta = 0$ because the intermediary can generate this signal without producing any information. Given the information level α produced by the universal bank underwriter, a proportion $\phi q(\alpha)$ of firms will be identified with the signal $\theta = 1$ and recognized as type g. These firms now have the additional choice of borrowing from this universal bank, rather than only having it sell their securities. But, as before, with the same contractual provisions given in Section I.C, these firms cannot be better off making this interim switch because there is no cost advantage for the firms to borrow rather than to sell securities at this stage. Therefore, once a firm contracts with a universal bank for security underwriting, the firm, if identified with the signal $\theta = 1$, will use this intermediary to raise the necessary funds, $x = I + \mu$, from the capital market. Given this success, the firm's expected payoff is

$$U_u = p(y - rx) = py - I - \mu. \tag{19}$$

Here, $U_u > 0$ is also implied by conditions (10) and (11) whenever universal bank underwriting is preferred to bank credit.

Given the universal bank's information level α, the proportion $1 - \phi q(\alpha)$ of firms identified with the signal $\theta = 0$ are unable to sell their securities and have to turn to bank credit. In addition to approaching a different bank lender, these firms can now seek a loan from the same universal bank that attempted but failed to sell their securities. Since we want to capture the universal bank's scope economies solely by the relationship cost c, we assume that the information production by a universal bank underwriter does not reduce the cost of its subsequent monitoring of the firm. Allowing for such a reduction in the monitoring cost would only strengthen the scope economies enjoyed by a universal bank but not change our basic results. While both the original universal bank and any new bank lender incur the monitoring cost m at this stage, the new bank incurs the additional relationship cost c. As in Section I.C, the new bank has to break even on the loan,

and given a conjectured equilibrium α, a best offer by this bank involves charging the firm a fee of

$$f_a = \frac{1 - \phi q(\alpha)}{\phi[1 - q(\alpha)]}(c + m) \tag{20}$$

and a loan interest factor of $\gamma_a = 1/p$. Thus, if identified as type g, the firm will choose to borrow from the universal bank that earlier attempted to sell its securities if this intermediary's fee and loan interest factor are competitive with those offered by rival lenders. The universal bank is opportunistic and uses its (limited) cost advantage to maximize its interim profit by only matching its rivals' best offer—that is, by choosing the same f_a and γ_a as above—thereby still ensuring that the firm will remain with it for the project loan.[8] The amount the firm will borrow from the universal bank is $x_a = I + f_a$. By not having to incur again the relationship cost, the universal bank is able to "lock in" its customer at an interim profit, and the firm's expected payoff if it secures a loan from this universal bank is

$$U_b = p(y - \gamma_a x_a) = py - I - \frac{1 - \phi q(\alpha)}{\phi[1 - q(\alpha)]}(c + m). \tag{21}$$

Conditions (10) and (11) also ensure $U_b > 0$, so that subsequent lending by the universal bank is viable. By initially approaching a universal bank for security underwriting, and if this fails, for subsequent lending, the firm's expected payoff is

$$\begin{aligned} U(\alpha, \mu) &= \phi q(\alpha) U_u + \phi[1 - q(\alpha)] U_b \\ &= \phi(py - I) - c - m + \phi q(\alpha)(c + m - \mu). \end{aligned} \tag{22}$$

The universal bank's choice of underwriting information level α is also made after the underwriting fee μ has been determined. For any predetermined fee μ, the universal bank chooses α to maximize the sum of its expected profits from initial underwriting,

$$\phi q(\alpha)\mu - n\alpha - k - c, \tag{23}$$

and if this fails, from subsequent lending,

$$\phi[1 - q(\alpha)](f_a + p\gamma_a x_a - x_a) - [1 - \phi q(\alpha)]m. \tag{24}$$

That is, the universal bank chooses α to maximize

$$\phi q(\alpha)(\mu - c) - n\alpha - k. \tag{25}$$

The above differs from the profit function of the investment bank precisely because the universal bank expects to benefit from extending a loan to the type g firm if its security issue fails. The universal bank's choice of information level, denoted by α^u, is determined by the first-order condition,

$$\phi q'(\alpha^u)(\mu - c) - n = 0. \tag{26}$$

[8] Our basic results would be unchanged if the universal bank were to extract some but not all of the interim rent.

Although the universal bank possesses market power once it has established a business relationship with the firm, the intermediary faces competition when it initially acquires the firm's business. Such competition ensures that the universal bank's underwriting fee μ is chosen to maximize the firm's expected payoff $U(\alpha,\mu)$ given in (22), subject to the information level α being determined by (26), that is, $\alpha=\alpha^u$, and the intermediary's profit from expected dealings with the firm being nonnegative, that is,

$$\phi q(\alpha^u)(\mu - c) - n\alpha^u - k \geq 0. \tag{27}$$

Let μ^u denote the optimal underwriting fee for the universal bank; condition (26) implies $\mu^u = n/[\phi q'(\alpha^u)] + c > c$. By substituting this into (22), the firm's optimal payoff if it initially seeks universal bank underwriting is

$$U^* \equiv U(\alpha^u, \mu^u) = \phi(py - I) - c - m + \phi q(\alpha^u)\left(m - \frac{n}{\phi q'(\alpha^u)}\right). \tag{28}$$

As before, constraint (27) on the universal bank's profit in general may or may not be binding. In the much simpler binding (zero-profit) case, the optimal μ^u and α^u are jointly determined by (26) and the equality of (27). Thus, α^u is determined by

$$\frac{n}{q'(\alpha^u)} = \frac{n\alpha^u + k}{q(\alpha^u)} \tag{29}$$

and is independent of parameter ϕ. In the proof of Proposition 1, we also show that there is a critical value $z^u > 0$, such that constraint (27) is binding for all $\phi < z^u$. If the critical value z^u is greater than one—as is the case in the same numerical example in the Appendix—then constraint (27) is binding for all feasible $\phi \in (0,1)$. Utilizing both critical values z^s and z^u, we have our key result.

PROPOSITION 1: If $\phi < \min\{z^s, z^u\}$, *then zero-profit constraints* (16) *and* (27) *are binding for both forms of underwriters. In this case, as well as in the alternative of both constraints being nonbinding, the investment bank produces a greater level of information than does the universal bank underwriter, that is,* $\alpha^s > \alpha^u$.

PROPOSITION 1 is intuitive once we recognize the difference in incentives between the two forms of underwriters. Unlike a universal bank that will be able to capture an interim rent from lending to the type g firm if it fails to sell the firm's securities, an investment bank will be unable to recoup its underwriting costs if the firm's security issue is unsuccessful. Therefore, the investment bank has the stronger incentive for information production in order to improve the likelihood of successfully underwriting the securities.

II. The Choice of Intermediary

We now turn to the firm's initial choice of bank or capital market financing, and in the latter case, its choice of an investment or a universal bank underwriter. While our basic result—Proposition 1—holds when both or neither of the zero-profit constraints (16) and (27) are binding, our subsequent analysis considers for tractability only the binding case. Given the result of Proposition 1, we expect similar results for the nonbinding case.

A. *Bank versus Capital Market Financing*

We first compare bank lending to capital market financing. From equations (3), (17), and (28), the incremental benefit of choosing an investment bank or a universal bank underwriter over a bank lender is, respectively,

$$S^* - B^* = \phi\, q(\alpha^s)\,(c + m - \mu^s) = q(\alpha^s)(c + m)(\phi - z^{sb}) \text{ and} \tag{30a}$$

$$U^* - B^* = \phi\, q(\alpha^u)\,(c + m - \mu^u) = q(\alpha^u)\, m\,(\phi - z^{ub}) \tag{30b}$$

where the two new critical values are

$$z^{sb} \equiv \frac{\phi\mu^s}{c + m} = \frac{n}{q'(\alpha^s)(c + m)} < z^s \quad \text{and} \tag{31a}$$

$$z^{ub} \equiv \frac{\phi(\mu^u - c)}{m} = \frac{n}{q'(\alpha^u)m} < z^u. \tag{31b}$$

The above inequalities are shown in the proof of Proposition 2, and if constraints (16) and (27) are binding, both z^{sb} and z^{ub} are independent of ϕ. Letting $z^* = \min\{z^{sb}, z^{ub}\}$ and $z^{**} = \min\{z^s, z^u\}$, we have $0 < z^* < z^{**}$, and for m sufficiently large, $z^* < 1$.

PROPOSITION 2: *Consider $\phi < z^{**}$ so that zero-profit constraints (16) and (27) are binding for both forms of underwriters. Then, if $\phi < z^*$, the firm prefers bank lending to underwriting by either an investment bank or a universal bank underwriter; but if $z^* < \phi < z^{**}$, underwriting by one or both forms of intermediaries is preferred to bank lending.*

Intuitively, since both underwriting fees, μ^s and μ^u, are decreasing in the proportion ϕ of type g firms, a smaller ϕ results in a higher underwriting fee relative to the bank's relationship and monitoring costs. Therefore, firms prefer bank to capital market financing if (and only if) ϕ is smaller than the critical value z^*.

B. *The Choice of Underwriter Type*

To examine the firm's choice of underwriter type, we assume that the proportion of type g firms is $\phi \in (z^*, z^{**})$; that is, we are in the situation where the zero-profit constraints are binding for both forms of underwriters and capital market financing by one or both forms of underwriters is preferred to bank credit. Since the

investment bank undertakes greater information production than does the universal bank underwriter, the likelihood that the firm will have its securities successfully sold, thereby avoiding the need for bank credit, is greater if the investment bank is the underwriter. However, while the universal bank underwriter produces less information and thereby makes the sale of the firm's securities less likely, it does economize on information costs to the benefit of its client firm. Thus, denoting by $\Delta = S^* - U^*$ the incremental benefit to the firm of choosing an investment over a universal bank underwriter, and using equations (17), (18), (28), and (29), we have

$$\Delta = \phi[q(\alpha^s) - q(\alpha^u)]m - n(\alpha^s - \alpha^u) - [1 - \phi q(\alpha^s)]c. \tag{32}$$

Define one more critical value,

$$z^{su} \equiv \frac{n(\alpha^s - \alpha^u) + c}{[q(\alpha^s) - q(\alpha^u)]m + q(\alpha^s)c} > 0, \tag{33}$$

and for m sufficiently large, $z^{su} < 1$.

PROPOSITION 3: *Consider $\phi \in (z^*, z^{**})$ so that the zero-profit constraints are binding for both forms of underwriters and capital market financing is preferred to bank credit. If, in addition, $\phi < z^{su}$, a universal bank underwriter is chosen over an investment bank; but, if $\phi > z^{su}$, an investment bank is preferred.*

Here, the smaller the proportion ϕ of type g firms, the less likely are underwriting attempts to be successful, for any given level of underwriter information. This lower likelihood of underwriting success associated with a smaller ϕ makes the direct cost savings that the universal bank enjoys and that are passed on to the firm relatively more valuable than the benefit of the greater information production by the investment bank. Thus, the universal bank underwriter is preferred if (and only if) ϕ is smaller than the critical value z^{su}. Summarizing the results of Propositions 2 and 3, we have the following.

1. If $\phi < z^*$, bank credit is chosen.
2. If $\phi \in (z^*, z^{**})$, capital market financing is preferred, in which case the choice of underwriting intermediary depends on the relative value of z^{su}:
   a. if $z^{su} < z^*$, the investment bank is chosen over the universal bank underwriter;
   b. if $z^{su} > z^{**}$, the universal bank is the preferred underwriter; and
   c. if $z^* < z^{su} < z^{**}$, the universal bank underwriter is chosen for $\phi \in (z^*, z^{su})$ while the investment bank is chosen for $\phi \in (z^{su}, z^{**})$.

Although we are generally unable to guarantee $z^* < z^{su} < z^{**}$, our numerical example in the Appendix satisfies this condition. Below, we study how particular model parameters affect the choice of underwriter. In this regard, we again consider $\phi \in (z^*, z^{**})$, and we assume $z^* < z^{su} < z^{**}$ so that either form of underwriter may be preferred.

C. Comparative Statics

We first examine the importance of the size of the scope economies, c. The direct effect of the scope economies makes integrating financial services beneficial because competition forces the universal bank to pass on to the firm the anticipated cost savings. The indirect effect, however, is that in selling the firm's securities, the universal bank produces less information because it knows that it will retain the type g firm for lending (and make an interim profit from this) if its underwriting effort fails. While the net effect is generally indeterminate, we show in the next proposition that the direct cost savings dominate the indirect effect of lower information production if parameter ϕ is sufficiently "small"—not too much greater than z^* (but greater than z^* to rule out bank lending). Intuitively, a smaller ϕ implies a lower likelihood of the firm being able to issue its securities, for any given information level α produced by the underwriter. In this situation, the marginal benefit of the investment bank's greater information production is not large enough to outweigh the direct benefit of the universal bank's scope economies.

PROPOSITION 4: *If $\phi > z^*$ but ϕ is sufficiently close to z^*, then the incremental benefit, Δ, to the firm from choosing an investment bank over a universal bank underwriter is decreasing in the size of the scope economies, c; that is, $d\Delta/dc < 0$.*

We have thus far taken the size of the scope economies, c, as independent of any firm characteristic; we now relate it to the firm's funding needs, I. Note that α^s and α^u, as determined by (18) and (29), are not affected directly by parameter I, nor is the incremental benefit Δ. If larger funding needs entail a greater relationship cost—that is, if the scope economies are increasing in I—then any effect of I on Δ enters indirectly through a function $c(I)$, with $c'(I) > 0$. With this extension, the qualitative result derived above for the scope economies, c, is applicable to the funding needs, I.

PROPOSITION 5: *If $\phi > z^*$ but ϕ is sufficiently close to z^*, then the incremental benefit, Δ, to the firm from choosing an investment bank over a universal bank underwriter is decreasing in the size of the firm's funding needs, I; that is, $d\Delta/dI < 0$.*

The bank lender's monitoring cost, m, affects the firm's choice of underwriter as well. Certainly, a larger monitoring cost motivates the choice of underwriting over bank lending. Since the investment bank's security underwriting is more likely (than that by a universal bank) to be successful, it follows that an increase in m raises the expected benefit of seeking capital market funding with the investment bank as underwriter.

PROPOSITION 6: *The firm's incremental benefit, Δ, from choosing an investment bank over a universal bank underwriter is increasing in the bank lender's monitoring cost m; that is, $d\Delta/dm > 0$.*

The relative attractiveness of capital market financing also depends on how likely the security issue is to be successful—the usefulness of underwriter infor-

mation in identifying type g firms. To examine this aspect, we specify, $q(\alpha) = \beta\hat{q}(\alpha)$ with $\beta \in (0,1]$, and assume that the regularity conditions of $\hat{q}(.)$ are the same as those of $q(.)$. While parameter β formally measures the accuracy of signal θ in identifying type g firms, for any given level of information, it can be interpreted as a measure of the usefulness of such information in helping firms secure capital market financing. Clearly, if underwriter information becomes more useful—that is, β is greater—then the underwriter that produces more of such information—that is, the investment bank—is preferred, all else the same.

PROPOSITION 7: *The firm's incremental benefit, Δ, from choosing an investment bank over a universal bank underwriter is increasing in the usefulness of underwriter information, β; that is, $d\Delta/d\beta > 0$.*

III. Empirical Implications

In this section, we examine empirical implications of our model. We first summarize direct testable implications.

1. All else the same, universal banks are more likely to be the underwriters if the average quality of issuing firms (i.e., parameter ϕ) is relatively low, while investment banks are more likely if it is relatively high (Proposition 3).
2. Universal banks are more likely to be the preferred form of underwriter, the greater are the potential information cost savings from scope economies (Proposition 4).
3. Firms that have obtained underwriting services from universal banks are likely to retain the same intermediaries for bank credit (Proposition 4).
4. Firms that generally have greater financing needs or larger issue sizes are more likely to choose universal bank underwriters over investment banks (Proposition 5).
5. Firms that expect greater bank monitoring costs are more likely to choose investment banks over universal banks for their underwriting needs (Proposition 6).
6. Firms that are less likely to be successful in selling their securities because of the limited usefulness of underwriter efforts are more likely to choose universal bank underwriters rather than investment banks (Proposition 7).

We now discuss possible ways to empirically examine some of these implications. Concerning item 2 above, since the cost advantage of the universal bank from its integration of lending and underwriting requires that information be durable, it is clear that the potential for scope economies diminishes as the environment becomes more volatile. For example, in economies having relatively high and variable rates of inflation and possibly significant political and economic uncertainties, the value of information on a particular firm (or even on a particular industry) may decline significantly over time. Thus, with scope economies being smaller and less important, the universal bank form becomes relatively less attractive, suggesting that in such economies investment banks are likely to coexist and compete strongly with universal banks for firms' underwriting business.

Turning to the importance of individual firm characteristics, since the economies of scope result from the universal bank's combining of underwriting and lending services, all else the same, it is those firms that expect to later use bank financing that will choose a universal bank for underwriting, thereby trading off this intermediary's lower underwriting efforts with the cost savings. In contrast, firms that are less likely to also seek bank credit are more likely to buy underwriting services from investment banks. In this context, it is the firms for which underwriters' information production is expected to be relatively ineffective, resulting in a low probability of success in selling their securities, that are likely to later apply for a bank loan. Therefore, as indicated in item 6 above, such firms are more likely to use a universal bank underwriter. What characterizes such firms? We know from the literature that a long history of profitability and of successfully repaying debt has generally been thought to be necessary for a firm to be able to borrow from the capital market. Thus, if we interpret younger, smaller, and less profitable firms as being less likely to have an acceptable track record for capital market financing, thereby making underwriting efforts less effective, then our analysis suggests that such firms are more likely to choose a universal bank underwriter. Interestingly, a deterioration of the economic environment is likely to make any firm's security issue more doubtful, but especially that of the younger, less profitable, and less well-known firms. Again, this reduced likelihood of successful underwriting motivates a concern for follow-up bank lending and hence the choice of a universal bank underwriter. However, this prediction is in contrast to the earlier one of a more volatile economic environment reducing the value of informational scope economies and motivating the use of investment banks. Thus, an economy that deteriorates, and becomes more volatile, may lead to either universal bank underwriters or investment banks being preferred.

Item 2 above also implies that firms that do not require much prior credit evaluation will be more likely to choose investment banks. Therefore, larger, older, better-known firms that can expect only small economies of scope are more likely to use an investment bank for underwriting. In contrast, firms that expect to require greater credit analysis, resulting in larger relationship costs, will more likely choose universal banks for their underwriting and lending needs, thereby economizing on such costs. In this interpretation, if the smaller, younger, less well-known firms are able and willing to use capital market financing, they are more likely to choose universal banks in order to realize the potentially large scope economies. These implications are in accord with those above from the consideration of the effectiveness of underwriter efforts. However, these implications are opposite to a consideration of the effect of monitoring costs. If the smaller, younger, less well-known firms also expect greater monitoring costs when using bank loans, then item 5 suggests that they are more likely to prefer investment bank underwriting.[9] Thus, the predicted relation in our model

[9] This latter implication is in accord with what we would expect from a consideration of the potential conflict of interest problem of universal banks. Although we do not consider this issue here, the latter problem is clearly more notable the less well known is the firm, thereby providing the incentive for such firms to prefer investment banks.

between how well known a firm is and its choice of underwriter appears to be ambiguous.

Turning to the effect of the size of firms' funding needs, item 4 indicates that firms are more likely to use universal bank underwriters the greater is the size of their funding needs. Since larger firms are more likely to have greater financing requirements and therefore to give rise to a larger value of total scope economies, our model predicts that these firms will more likely utilize universal bank underwriters, all else the same.

Finally, the central feature of our analysis is the ability of universal banks to "lock in" their customers' future business. Therefore, the primary implication of our model—item 3—is that once firms use a universal bank intermediary, they have the incentive to retain this bank for future financial services, whether these are underwriting or lending.

Some of these empirical implications can be compared to available evidence. A notable study in this area is Kroszner and Rajan (1994), whose two key results relate to some of our model's implications.[10]

1. Universal banks are more likely than investment banks to underwrite larger issues of securities.
2. Universal banks are more likely than investment banks to underwrite securities of better-known firms.

The implication of our item 4 is consistent with the first finding above. Concerning the second finding, our analysis suggests that the implication for intermediary choice of how well known is a firm is generally ambiguous. In our analysis, the better known a firm is, the smaller are the potential scope economies, motivating the choice of an investment bank. But, if the better-known firms are also the larger firms or can expect lower monitoring costs by bank lenders, then the motivation is for the choice of a universal bank.

IV. Conclusion

We examine certain implications of allowing the integration of lending and underwriting as complementary activities that exhibit economies of scope in the credit evaluation of firms. Universal banks offer both financial services, thereby economizing on such costs to the benefit of their customers. However, these cost savings also have a downside by enabling universal banks to capture their customers' future business. Knowing that they will still be able to profit from their clients' credit needs even if their underwriting efforts are unsuccessful, universal banks have less incentive to provide the costly efforts that will aid the successful marketing of their clients' securities. Therefore, our basic result is quite

[10] The other findings in this study relate to the default experience of securities underwritten by universal versus investment banks. Unfortunately, these results cannot readily be compared to our predictions since our model does not consider default, nor does it have any feature that can provide for such an interpretation.

broad: Relative to investment banks, universal banks will expend fewer resources of all types—and therefore be less successful—in helping their clients raise capital.

One interpretation of underwriter efforts is as financial innovation aimed at obtaining capital for its client at the best terms possible. With this interpretation, our key result suggests that an integrated financial services industry will be less innovative than one that is segmented along functional lines. This implication appears contrary to the claim made by industry leaders that innovation shall be enhanced by financial services integration.

Our results are also contrary to the predictions of the critics of the integration of financial services; our analysis indicates that universal banks are unlikely to dominate the security market. While the informational cost savings are a powerful incentive for firms to work with a universal bank, we emphasize that such firms also face the downside of a diminished expected benefit from capital market financing. However, our analysis also disputes the claims of the advocates of financial services integration that it shall motivate greater capital market development. Our finding that the integration of financial services may result in generally diminished underwriter efforts suggests that the further development of the capital market after such integration is likely to slow rather than accelerate.

Our implications appear to be consistent with generally accepted differences between European and U.S. capital markets. Relative to those in the United States, European markets have been characterized by less disclosure on firm activities and less standardization of the type of information made available, thereby making scope economies more important and the benefits of capital market financing less significant. Likewise, the general "thinness" of the capital markets in Europe makes the success of any security issue more uncertain. These features would promote the relatively greater use in Europe of universal intermediaries, as has been the case, and that as a consequence, European capital markets would experience less financial innovation. Indeed, our analysis suggests that the relatively greater pace of capital market development and financial innovation in the United States may have resulted at least in part from the segmentation of its financial services industry.

Appendix

Proof of Proposition 1: We first show that there are $z^s > 0$ and $z^u > 0$, such that if $\phi < \min\{z^s, z^u\}$, then constraints (16) and (27) are both binding. In the investment bank case, the Lagrangian of the firm's maximization problem is

$$L^s = \phi(py - I) - c - m + \phi q(\alpha^s)(c + m - \mu) + \lambda^s[\phi q(\alpha^s)\mu - n\alpha^s - k - c], \quad \text{(A1)}$$

where λ^s is the multiplier. The first-order condition implies that the optimal μ^s satisfies

$$q'(\alpha^s)(c + m - \mu^s)\frac{d\alpha^s}{d\mu^s} + (\lambda^s - 1)q(\alpha^s) = 0. \quad \text{(A2)}$$

Then condition (15) implies $d\alpha^s/d\mu^s = -q'(\alpha^s)/[q''(\alpha^s)\mu^s] > 0$. By substituting this, constraint (16) is binding if

$$\lambda^s = 1 + \frac{[q'(\alpha^s)]^2(c+m-\mu^s)}{q(\alpha^s)q''(\alpha^s)\mu^s} > 0, \tag{A3}$$

and with $\mu^s = n/[\phi q'(\alpha^s)]$ given by (15), that is, if

$$\phi < \frac{n}{q'(\alpha^s)(c+m)} - \frac{nq(\alpha^s)q''(\alpha^s)}{[q'(\alpha^s)]^3(c+m)} \equiv z^s > 0. \tag{A4}$$

In the universal bank case, the Lagrangian of the firm's maximization problem is

$$L^u = \phi(py - I) - c - m + \phi q(\alpha^u)(c+m-\mu) + \lambda^u[\phi q(\alpha^u)(\mu - c) - n\alpha^u - k], \tag{A5}$$

where λ^u is the multiplier. The first-order condition implies that the optimal μ^u satisfies

$$q'(\alpha^u)(c+m-\mu^u)\frac{d\alpha^u}{d\mu^u} + (\lambda^u - 1)q(\alpha^u) = 0. \tag{A6}$$

Now, condition (26) implies $d\alpha^u/d\mu^u = -q'(\alpha^u)/[q''(\alpha^u)(\mu^u - c)] > 0$. By substituting this, constraint (27) is binding if

$$\lambda^u = 1 + \frac{[q'(\alpha^u)]^2(c+m-\mu^u)}{q(\alpha^u)q''(\alpha^u)(\mu^u - c)} > 0, \tag{A7}$$

and with $\mu^u = n/[\phi\, q'(\alpha^u)] + c$ given by (26), that is, if

$$\phi < \frac{n}{q'(\alpha^u)m} - \frac{nq(\alpha^u)q''(\alpha^u)}{[q'(\alpha^u)]^3 m} \equiv z^u > 0. \tag{A8}$$

Thus, for $\phi < \min\{z^s, z^u\}$, both constraints (16) and (27) are binding. To see $\alpha^s > \alpha^u$, first note that if $\mu^u \leq c$, $\alpha^s > \alpha^u = 0$. If $\mu^u > c$, conditions (18) and (29) imply

$$q(\alpha^s)n - q'(\alpha^s)(n\alpha^s + k) = q'(\alpha^s)c > q(\alpha^u)n - q'(\alpha^u)(n\alpha^u + k) = 0. \tag{A9}$$

Therefore, $\alpha^s > \alpha^u$ since the function, $q(\alpha)n - q'(\alpha)\ (n\alpha + k)$, is increasing in α, that is,

$$\frac{d}{d\alpha}[q(\alpha)n - q'(\alpha)(n\alpha + k)] = -q''(\alpha)(n\alpha + k) > 0. \tag{A10}$$

If constraints (16) and (27) are not binding, $\lambda^s = \lambda^u = 0$. The first-order conditions are

$$\phi q'(\alpha^s)(c+m) - n + \frac{nq(\alpha^s)q''(\alpha^s)}{[q'(\alpha^s)]^2} = 0 \quad \text{and} \tag{A11a}$$

$$\phi q'(\alpha^u)m - n + \frac{nq(\alpha^u)q''(\alpha^u)}{[q'(\alpha^u)]^2} = 0. \tag{A11b}$$

The second-order conditions imply that the left-hand sides of both equations above are decreasing in α^s and α^u. By replacing α^s in the first equation above with α^u, and then substituting this into the second equation,

$$\phi q'(\alpha^u)(c+m) - n + \frac{nq(\alpha^u)q''(\alpha^u)}{[q'(\alpha^u)]^2} = \phi q'(\alpha^u)c > 0. \tag{A12}$$

Therefore, for this nonbinding case, $\alpha^s > \alpha^u$ is implied by the second-order condition for the optimal α^s. Q.E.D.

Proof of Proposition 2: From the proof of Proposition 1, $0 < z^{sb} < z^s$ $(0 < z^{ub} < z^u)$ because z^{sb} (z^{ub}) is the first term of z^s (z^u). Thus, $0 < z^* = \min\{z^{sb}, z^{ub}\} < z^{**} = \min = \min\{z^s, z^u\}$. If $\phi < z^*$, $S^* - B^* < 0$ and $U^* - B^* < 0$. Then bank financing is preferred to either form of security underwriting. If $z^* < \phi < z^{**}$, however, $S^* - B^* > 0$ or $U^* - B^* > 0$, or both hold. Now, at least one form of security underwriting is preferred to bank financing. Q.E.D.

Proof of Proposition 3: If $\phi < z^{su}$, $\Delta < 0$ and universal bank underwriters are preferred to investment banks. But, if $\phi > z^{su}$, $\Delta > 0$ and investment banks are preferred. Q.E.D.

Proof of Proposition 4: By taking the derivatives of equation (15) and the equality of (16),

$$q'(\alpha^s)\mu^s \frac{d\alpha^s}{dc} + q'(\alpha^s)\frac{d\mu^s}{dc} = 0 \quad \text{and} \quad \phi q(\alpha^s)\frac{d\mu^s}{dc} = 1. \tag{A13}$$

Then $d\mu^s/dc = [\phi q(\alpha^s)]^{-1}$ and $d\alpha^s/dc = -q'(\alpha^s)/[\phi q(\alpha^s)q''(\alpha^s)\mu^s] > 0$. Likewise, by taking the derivatives of equation (26) and the equality of (27),

$$\begin{aligned} q^u(\alpha^u)(\mu^u - c)\frac{d\alpha^u}{dc} + q'(\alpha^u)\left(\frac{d\mu^u}{dc} - 1\right) = 0 \quad \text{and} \\ \phi q(\alpha^u)\left(\frac{d\mu^u}{dc} - 1\right) = 0. \end{aligned} \tag{A14}$$

Now, $d\mu^u/dc = 1$ and $d\alpha^u/dc = 0$. By applying these results,

$$\frac{d\Delta}{dc} = [\phi q'(\alpha^s)(c+m) - n]\frac{d\alpha^s}{dc} - [1 - \phi q(\alpha^s)]. \tag{A15}$$

Since α^s is independent of ϕ, so is μ^s. Then, for ϕ not too much greater than z^{sb}, $d\alpha^s/dc$ is finitely positive, but $\phi q'(\alpha^s)(c+m) - n$ is either negative or approaching zero; therefore, $d\Delta/dc < 0$. If $z^{sb} < z^{ub}$, $z^* = z^{sb}$; the same result holds for ϕ not too much greater than z^*. Similarly, if $z^{sb} > z^{ub}$, $z^* = z^{ub} < z^{sb}$; thus, for ϕ not too much greater than z^*, $\phi q'(\alpha^s)(c+m) - n < 0$ and $d\Delta/dc < 0$. Q.E.D.

Proof of Proposition 5: Note that the proof of Proposition 4 does not directly involve parameter I. Thus, any effect parameter I has on the incremental benefit Δ is indirectly through function $c(I)$. With $c'(I) > 0$, the result derived for c applies for I. Therefore, $d\Delta/dI < 0$ for ϕ not too much greater than z^*. Q.E.D.

Proof of Proposition 6: Since conditions (15), (16), (26), and (27) involve no parameter m, thus, α^s, μ^s, α^u, and μ^u do not vary with it. Therefore,

$$\frac{d\Delta}{dm} = \phi[q(\alpha^s) - q(\alpha^u)] > 0. \tag{A16}$$

Q.E.D.

Proof of Proposition 7: By substituting $q(\alpha) = \beta\hat{q}(\alpha)$ into (15) and the equality of (16), and taking the derivatives of both,

$$\beta\hat{q}''(\alpha^s)\mu^s\frac{d\alpha^s}{d\beta} + \hat{q}'(\alpha^s)\left(\mu^s + \beta\frac{d\mu^s}{d\beta}\right) = 0 \quad \text{and} \quad \mu^s + \beta\frac{d\mu^s}{d\beta} = 0. \tag{A17}$$

Then $d\mu^s/d\beta = -\mu^s/\beta$ and $d\alpha^s/d\beta = 0$. Likewise, by substituting $q(\alpha) = \beta\hat{q}(\alpha)$ into (26) and the equality of (27), and taking the derivatives of both,

$$\begin{aligned} &\beta\hat{q}''(\alpha^u)(\mu^u - c)\frac{d\alpha}{d\beta} + \hat{q}'(\alpha^u)\left(\mu^u - c + \beta\frac{d\mu^u}{d\beta}\right) = 0 \quad \text{and} \\ &\mu^u - c + \beta\frac{d\mu^u}{d\beta} = 0. \end{aligned} \tag{A18}$$

Now, $d\mu^u/d\beta = -(\mu^u - c)/\beta$ and $d\alpha^u/d\beta = 0$. By applying these results,

$$\frac{d\Delta}{d\beta} = \phi\{[\hat{q}(\alpha^s) - \hat{q}(\alpha^u)]m + \hat{q}(\alpha^s)c\} > 0. \tag{A19}$$

Q.E.D.

Numerical Example: We consider $q(\alpha) = \alpha^{.25}/(\alpha^{.25} + 0.25)$, which satisfies all regularity conditions. We also specify $c = .25$, $m = 4$, $n = 1$, and $k = .25$. If constraints (16)

and (27) are binding, the optimal information levels, α^s and α^u, solve equations (18) and (29), and have $\alpha^s = 0.0477$ and $\alpha^u = 0.0264$. Then, $z^s = 2.640$, $z^u = 1.351$, $z^{sb} = 0.198$, $z^{ub} = 0.112$, and $z^{su} = 0.905$. And $z^* = \min\{z^{sb}, z^{su}\} = 0.112$ and $z^{**} = \min\{z^s, z^u\} > 1$. Thus, we have $z^* < z^{su} < 1 < z^{**}$ and that constraints (16) and (27) are binding for all feasible $\phi \in (0,1)$. By applying Propositions 2 and 3, it follows that: (a) bank credit is most preferred if $\phi \in (0,0.112)$, (b) universal bank underwriting is chosen if $\phi \in (0.112,0.905)$, and (c) investment bank underwriting is most desirable if $\phi \in (0.905,1)$.

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