Industrial Structure and Corporate Finance*

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Abstract

Instead of focusing on a single firm as the unit of analysis in corporate finance, we look to the relationships *between* firms in determining corporate financial decisions. Our focus is the management of working capital, especially for the financing of growth when firms are credit-constrained. We highlight the way in which industrial structure and corporate financial decisions are interrelated, and how one influences the other. We also highlight the role played by specific financial instruments, such as the system of transferable promissory notes found in some Asian countries, as a way to ease the bottlenecks in financing expansions.

*First Version. Comments are welcome.

1 Introduction

The conventional approach to corporate finance based on the principal-agent model takes the single firm as its unit of analysis. We take a different tack in this paper. We will address the issue of how corporate financial decisions are arrived at as the result of the *interaction* among firms, and thus how corporate financial decisions and industrial structure are determined together, and how one affects the other.

When considering the composition of corporate balance sheets, our focus on the interactions among firms would be more than justified. In cross-country empirical studies of corporate balance sheets[1], the assets and liabilities that reflect the interactions among firms (as suppliers and customers) constitute a very significant portion of a company's balance sheet. Short maturity assets and liabilities, also known as current assets and liabilities, include accounts receivable (the money owed to the firm by others), inventories of raw materials and finished goods and cash. Rajan and Zingales (1995, p. 1428) find that the average ratio of current assets to total assets is 48% for the United States. Figures for accounts receivable are equally noteworthy. Accounts receivable constitute 18% of total assets for U.S. firms, and the figures are higher for Germany (27%), France (29%), Japan (23%), and the United Kingdom (22%).

Current assets reflect the nature of the firm's business activity but also its interactions with other firms in the production process. The exact composition will reflect the type of business and the stage of the production cycle that the firm finds itself in. However, unlike fixed assets such as property, plant and machinery, current assets are not always easily used as collateral for raising external finance. Inventories of raw materials or finished goods

[1] See, for instance, Rajan and Zingales (1995).

could be used as collateral for borrowing provided that the inventory could be properly warehoused and monitored by an independent warehouse company who will provide the bank with proper documentation, such as receipts and valuations. However, such a scheme would be disruptive to production and would not be practical for most companies.[2]

Accounts receivable can also sometimes be used as collateral for bank lending in special cases, or be sold to (discounted by) specialist financial firms known as *factoring firms* that purchase the unpaid invoices, and take on the rights to the future cash flows. However, the cash that can be obtained through either means is limited by considerations of the creditworthiness of the firm's customers, as well as the legal framework that underpins the transfer of claims.[3]

The logistics of production will be one element in determining the size of accounts receivable on a firm's balance sheet. However, there may also be a rationale from a corporate finance perspective for the special status of accounts receivable as an asset class, and why firms may end up holding such large amounts of this asset class on their balance sheets. These considerations are additional to those concerns that have been examined in the trade credit literature.[4]

A firm's accounts receivable is a claim against customer firms in the production chain - the downstream firms, so to speak. The flip-side of this relationship is that the downstream firm's *accounts payable* can be seen as

[2]See Brealey, Myers and Allen (2005, chapter 30), or other texts on working capital management such as Gallinger and Healey (1991), Nill and Sartoris (1995), Vander Weide and Maier (1985), and Scherr (1989).

[3] A recent study on factoring commissioned by the European Union can be found at http://ec.europa.eu/enterprise/entrepreneurship/financing/docs/factoring_en.pdf

[4]The trade credit literature has focused on the trade credit decisions of individual firms, and on the empirical determinants of the size of accounts receivable (see, for instance, Petersen and Rajan (1997)). A recent theoretical analysis is Cuñat (2006).

a liability of that firm backed by its own assets, including its own accounts receivable against customer firms yet further down the production chain. Drawing on the insights of Merton (1974), we may think of a firm's accounts payable as taking on some of the features of defaultable debt issued by that firm backed by its assets. The value of accounts receivable along the production chain depends, ultimately, on the cashflows collected by the final product firm, and which is distributed back along the production chain.

Accounts receivable and accounts payable generate a chain of interlocking claims and obligations that bind the firms within the production chain into a common destiny. To the extent that the final product generates healthy cashflows, the value of accounts receivable as an asset class will be kept high, to the benefit of all the firms in the production chain. Thus, when a firm contemplates a course of action that undermines the cashflow, it will need to take into account the negative repercussions of its actions on the value of its claims against firms further down the production chain.

In effect, it is as if each subcontracting firm is a stake-holder in the project that results in the sale of the final good. Hence, holding accounts receivable as an asset on one's balance sheet tends to mitigate the incentives to indulge in private benefit or other forms of moral hazard. The mitigation is largest when the effective stakes held by the upstream firms are largest. In this respect we can see this implication in the same light as the conclusions of simpler corporate finance models for a single firm where moral hazard necessitates the entrepreneur holding a sufficiently large stake in the outcome of the project.

Cross-holding of equity stakes may have similar incentive properties in bringing about the "common destiny" of the firms. However, accounts receivable present two differences as compared to equity stakes. First, the

firms become *creditors* to each other. Second, accounts receivable fluctuate with the ebb and flow of production, and hence change one-for-one with the underlying production relationships. In contrast, the more formal process of effecting transfers of ownership may lag the underlying production relationships, or be contingent on the legal underpinnings of ownership. In any event, the interlocking chain of claims and obligations generated by accounts receivable will reinforce the common destiny already implied by the cross-holding of shares.

The upshot of our analysis is that firms that diversify across many customers may end up loosening the common destiny, and diluting the incentive effects. For similar reasons, accounts receivable have greatest value when held by a firm *within* the production chain, than by an outside owner - such as a bank or a factoring firm that purchases the accounts receivable. Such differential value of accounts receivable puts strict limits on the extent to which firms can free up working capital by selling their accounts receivable. All these considerations have important implications for the relationship between industrial structure and the composition of balance sheets.

The Japanese *keiretsu* mode of industrial structure has been the topic of a large literature in management and industrial organization, and can further be distinguished between the *horizontal keiretsu*, where a group of loosely affiliated firms across diverse industries are arranged around the group's "main bank" at the center, and the *vertical keiretsu* where firms are tied tightly together into the production process into a multi-layered set of sub-contracting relationships[5].

An example made famous from business school case studies is the contrast between the so-called "Toyota model" of production, where a multi-layered

[5] See Aoki (1988), Hoshi, Kashyap and Scharfstein (1991), Gilson and Roe (1993), Miwa and Ramseyer (2002), among others.

set of sub-contracting firms contribute over 70% of the value-added of the finished automobile produced by Toyota, to the case of General Motors, where the proportions are reversed, and the value-added of subcontractors is less than 30%. Industrial structure depends on more than mere considerations of corporate finance. However, it is valid to ask to what extent corporate finance can shed light on the viability of alternative industrial structures. To the extent that industrial structures differ across countries in the *same* industry, the reasons for the differences should be of interest. Our claim is that the diversity of balance sheets and industrial structures reflect the different ways of meeting the challenge of organizing the production of complex, "round-about" goods.

At the opposite end of the spectrum from the Toyota model in terms of the value-added of subcontracting firms is the dominant position of the *Chaebol* firms in Korea, and the comparatively much weaker small firm sector there. The term *Chaebol* refers to the large conglomerate firms in Korea where a tightly-knit group of family members related to the original founder of the firm still exercise considerable influence, or outright control. These firms have generated much debate on the political economy of development. *Chaebol* firms have been accused of stifling the growth of the small and medium sized enterprise (SME) sector in Korea, and perpetuating the lopsided industrial structure to the detriment of long-run economic success. The contrast between the "Toyota model" and the *Chaebol* model can hardly be more stark.

Ideas from corporate finance (especially the financing of working capital) may shed some light in understanding the origins and persistence of the lopsided industrial structure with its disparities in size and financial strength between the *Chaebol* firms and the small firm sector. At the beginning of

its period of rapid economic growth in the 1960s, Korea ranked among the poorest of developing countries, with a rudimentary manufacturing sector. In making the transition from basic manufactured goods into increasingly sophisticated manufactured goods - migrating up from shoes to computer chips - the demands on working capital and funds for fixed investment would have been very considerable. How was the Korean financial system able to fund the expansion of its companies?

A firm's ability to find ready cash to meet its short-term obligations will be an important determinant of the scale of the firm's operations, and especially important in financing expansions of its activity given the time lags between incurred costs and future cash flows. Some recurring obligations (most notably the wage bill) cannot be deferred, and must draw on the firm's cash holdings. Thus, irrespective of the long-run solvency of the firm, its ability to raise funds to meet its short-term obligations may act as a brake on the expansion of a firm's activities. In other words, the firm's liquidity position matters, as well as its long-term solvency, in financing expansions.

There is much evidence - both systematic and anecdotal - that small and medium sized firms experience difficulties in raising finance from outside sources. Some evidence for developed countries is provided by Berger and Udell (1995) for the United States, Voordeckers and Steijvers (2005) for Belgium and Poutziouris et al. (2005) for the United Kingdom. However, the constraint on raising outside finance is especially important in emerging market countries, where the factors that limit financing of firms in advanced countries can be expected to bite much harder. From their survey of firms in India, Allen et al. (2005) note the overwhelming importance of funding from family and close friends for firms that are in their expansion stages.

More to the point, the constraints on raising outside finance can be ex-

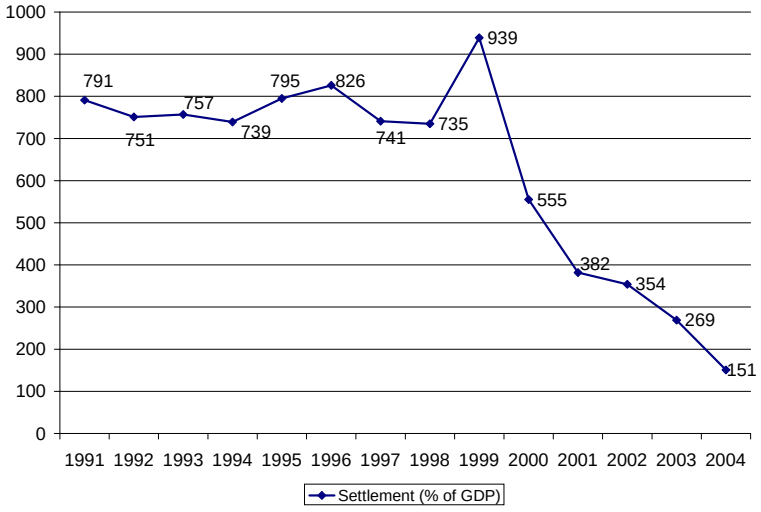


Figure 1: Total annual settlement of promissory notes as % of GDP (source, Bank of Korea (2005))

pected to bind particularly hard for the purpose of raising working capital, given the imperfect pledgability of accounts receivable and inventories as collateral against loans.

In this paper we will argue that, in the case of Korea, financial innovation contributed to overcoming the bottlenecks in financing working capital. In particular, we will highlight the role played by financial instruments known as *transferable promissory notes*.[6]

Transferable promissory notes have a venerable history in Korea stretching back several hundred years, comparable to the origin of bills of exchange in Europe. However, the modern version of these notes saw their heyday in the period of rapid industrialization in Korea, backed by laws amended or

[6]Known as *Uh-um* (어음) in Korean, and in particular the subclass of uh-um known as *promissory uh-um*. We describe the legal provisions governing these instruments in the main body of the paper.

newly promulgated in the 1960s. These notes are corporate liabilities that promise payment at some date in the future, but they have the key legal provisions of endorsement, transferability and the possibility of discount (much like a bill of exchange)[7]. Their use in Korea has been very substantial, with the settlement amounts ranging between seven and ten times GDP as recently as the 1990s, before falling precipitously in last few years (see figure above).

To put these numbers into context, the total market capitalization of the Korean stock market stood at just 57% of GDP at the end of 2004.[8] Of course, settlement amounts exaggerate the total pool of outstanding notes given the short-term nature of the these notes (on which more below). However, there can be little doubt that these notes have played a key role in corporate finance in Korea. Equally remarkable is the rapid drop in their use since 1999. Both their significant past use and the rapid drop in recent use cry out for further explanation. We attempt to address both issues.

As we explain in the main body of the paper, the system of transferable promissory notes is a vehicle for creditworthy firms to make their creditworthiness available to other firms in the production process. Rather than promising to pay cash at some date in the future, a creditworthy firm issues promissory notes against a credit line granted by a bank, and pays its suppliers in notes today. In effect, the accounts receivable of the supplier firm is held in the form of promissory notes, rather than in unpaid invoices. However, since notes are transferable and discountable, the accounts receivable that would normally sit idly on a firm's balance sheet can be liquified

[7]However, unlike a bill of exchange (which is an *order to pay*), a promissory note is a *promise to pay*. This legal difference plays an important role, as described below.

[8]The total market capitalization of the Korea Stock Exchange (KSE) was 52.9% of GDP at the end of 2004 (Korea National Statistical Office (2005)). The 57% figure is arrived at by adding the market cap of the Kosdaq market.

immediately, either by transferring it to other firms, or by discounting the note to obtain cash. In either case, subcontracting firms that would not receive a loan in its own name can utilize indirectly the credit line that has been granted to the issuer of the note. In turn, the supplier firm can pay its own upstream supplier firms in the notes. In this way, the *velocity* of circulating funds can be increased by means of the promissory notes.

However, as discussed in the context of the *keiretsu* in Japan, weak balance sheets of sub-contracting firms is a disadvantage in terms of fostering commitment to the common project and promoting "common destiny", and act as a limit to the length of production chains. We will show that the system of promissory notes can be seen as a substitute (albeit a very imperfect one) for large balance sheets and the attendant incentive effects. Promissory notes, unlike cash, have limited liquidity outside the immediate production relationships, and (paradoxically) it is precisely their *illiquidity* that make them effective as a substitute for large, inter-locking balance sheets.

Nevertheless, promissory notes can be seen as a transitional stage of financial development due to their many shortcomings. The flip-side of making creditworthiness available to others is that one's own leverage must increase. In effect, the creditworthy firm must borrow on behalf of the whole production chain, rather than just for its own purposes. In the run-up to the 1997 financial crisis in Korea, *Chaebol* firms had debt to equity ratios of 300% or more - many times the OECD average. The ensuing financial crisis exposed the fragility of the financial system built on promissory notes. The element of "common destiny" that was instrumental in ensuring the good incentive properties of promissory notes in good times was also responsible for the contagious failures during the crisis. This "dark side" of promissory notes has led to concerted efforts by the authorities to reduce their use following

the 1997 financial crisis.

However, to the extent that the economic success of Korea can be attributed in part to the financial innovations that arose to overcome the financing constraints of growing firms, the Korean experience has many important lessons for other developing countries in their policies toward their own financial development. We begin the main body of the paper by examining the corporate finance of alternative industrial structures, and developing the arguments on the endogenous formation of relationships between firms.

2 Model of Recursive Moral Hazard

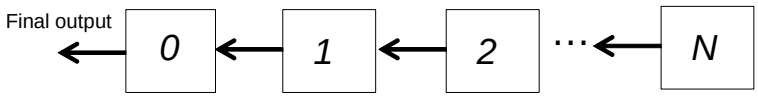
One of our goals in this paper is to examine the optimality properties of alternative industrial structures from the viewpoint of corporate finance. The development of our argument will be in two steps. As a first step, we present an analysis of a simple linear, hierarchical industrial structure where firms are arranged into a single chain. The purpose of this analysis is to introduce the main building blocks for the general analysis. We then proceed to examine the efficiency properties as we vary the industrial structure.

2.1 Single Chain

Suppose there is a new opportunity for a group of firms to produce a final good for sale. In order to abstract away from agency problems within each firm, we assume that all firms are fully equity financed, and managed by their respective owners. Our focus will be on the incentive problems that arise from the *interaction* among firms.

There is one firm, labelled as firm 0, that sells the final output. The other firms produce intermediate inputs that are necessary in the production of the final good. Firm $i+1$ supplies its output to firm i. In addition to

firm 0, there are N upstream firms.



There is a "time to build" element in the production. Each step of the production process takes precisely one period of time, where time is indexed by $\{0, 1, 2, \cdots\}$. Also, each firm incurs a wage cost of w, which must draw on the firm's cash holdings, and cannot be deferred.

One unit of the final good can be sold every period indefinitely into the future for the price $q > 0$, but there is a probability that the product becomes obsolete by being overtaken by a competing product. When the product becomes obsolete, the price of the good drops to zero.

The probability of obsolescence depends on the quality of the good, and this quality depends on the efforts exerted by all firms in the production chain. If all exert high effort, then the probability of obsolescence is π^H, but if one or more firms exert low effort, the probability increases to π^L. Conditional on the product not being obsolete, the cashflows of the firms (before any transfers take place) can be depicted as follows.

		Firms				
		0	1	$\cdots$	$N-1$	N
date t	0					$-w$
	1				$-w$	$-w$
	$\vdots$			$\cdots$	$-w$	$-w$
	$N-1$		$-w$	$\cdots$	$-w$	$-w$
	N	$-w$	$-w$	$\cdots$	$-w$	$-w$
	$N+1$	$q-w$	$-w$	$\cdots$	$-w$	$-w$
	$N+2$	$q-w$	$-w$	$\cdots$	$-w$	$-w$
	$\vdots$	$\vdots$	$\vdots$		$\vdots$	$\vdots$

Firms' Cashflows Before Transfers

In order to make the problem non-trivial, we assume that the expected revenue is large enough that there is a positive surplus in the production relationship when taking total production costs into account. We examine two related issues.

- The first is the financing of the initial "triangle" of costs from date 0 to date N.
- The second is the *sustainability* of the production chain in steady state once the final product begins earning cashflow from date $N+1$ onwards.

The initial "triangle of costs", refers to triangle-shaped region in the table above when the wage cost w must be incurred by the firms in the production chain before the final product begins to generate revenue. The total required working capital before any cashflow from the final product is realized is given by:

$$\frac{(N+1)(N+2)}{2}w$$

If the firms are well capitalized, the initial working capital can obtained from the firm's own equity. However, when the firms are not well capitalized, the initial working capital will have to come from outside sources. The longer is the production chain, the greater will be the demands of the initial working capital. We will leave the discussion of the financing the initial "triangle of costs" until section 3. Before we do so, we first examine the steady-state problem - of sustaining the production chain.

2.2 Steady State Analysis

Once the product begins to generate a cashflow, this cashflow cascades back along the production chain. The focus of our model will be on the potential

for moral hazard that this cashflow generates. A firm has the choice of two actions - high effort or low effort. The low effort decision of the firm can be interpreted as the decision to divert cashflows to alternative uses that result in private benefit, but is detrimental to the success of the final output. Tirole's (2005) recent textbook discusses the rationale for such an approach. Suppose there is a constant b with $0 < b < 1$, so that if a firm diverts cashflow C for its private benefit, it derives payoff bC.

In steady state, there is a cashflow of q to firm 0, provided that the product is not obsolete. Let us denote by p_i the steady-state cash flow received by firm i. Then, the expected discounted net cash flow to firm i conditional on high effort by all firms is

$$\sum\nolimits_{s=0}^{\infty} \left(1 - \pi^H\right)^s \left(p_i - p_{i+1} - w\right) \tag{1}$$

As noted above, for the group of firms to enjoy the cashflow from the sale of the final product, it must first finance the initial "triangle" of costs of production before the first unit of the good can be sold. In reaching the steady state, the firms along the production chain must finance the early production costs by drawing on alternative sources of finance. If the firm has positive equity, it can draw on its equity in funding the production, and in return will acquire claims - accounts receivable - against its customer firm, and may also incur accounts payable against its supplier firm.

Denote by R_i^H the value of *net accounts receivable* (accounts receivable minus accounts payable) of firm i in steady-state when all firms exert high effort at every date. We denote by R_i^L the value of i's net accounts receivable when firm i exerts low effort, and assume that $R_i^L \leq R_i^H$. Define the difference between the two as

$$R_i \equiv R_i^H - R_i^L \tag{2}$$

R_i is the change in the value of i's net accounts receivable when i deviates to low effort. This term will play a critical role in our model, and so it is worth pausing to examine this term more closely and consider its economic meaning.

The accounts receivable of firm i is an asset on the balance sheet of firm i, and is a claim against its customer in the production chain, namely firm $i-1$. The value of this asset depends on the creditworthiness of firm $i-1$. In turn, the creditworthiness of firm $i-1$ depends on the strength of $i-1$'s balance sheet, and so depends on the value of $i-1$'s claim on firm $i-2$, and so on. Ultimately, the cashflow generated by the sale of the final product by firm 0 will influence the value of accounts receivable all the way along the production chain.

On the liabilities side of firm i's balance sheet is its *accounts payable* to its supplier firm, namely firm $i+1$. Drawing on the insights of Merton (1974), we may think of firm i's accounts payable as akin to defaultable debt whose economic value derives from the assets of firm i that back that obligation. The difference between the value of accounts receivable and the value of accounts payable is akin to the equity value of a firm who has issued defaultable debt backed by its assets. Since the value of equity is the value of a call option with strike price equal to the face value of its liabilities, the sensitivity of the equity value with respect to the asset value of the firm is given by the delta of the call option multiplied by the total size of the balance sheet. The term R_i measures this sensitivity. R_i will depend on three factors, as explained below.

- ratio of accounts receivable to accounts payable
- absolute size of the balance sheet

- sensitivity of accounts receivable to moral hazard

Take each in turn. The ratio of accounts receivable to accounts payable determines the implied leverage of the firm, and hence the delta of the implied call option. If the ratio is high enough, the call option is deep in the money and its delta approaches its maximum value of 1.

For any given *ratio* of accounts receivable to accounts payable, the absolute size of the balance sheet measures the number of units of the call option effectively held by the firm. Hence, the larger is the balance sheet of firm i, the greater is the gain to any proportional change in the value of its assets.

Finally, the sensitivity of the value of accounts receivable to moral hazard will affect the size of R_i. If the financial health of the firms in the production chain is unrelated to the moral hazard in the chain, then the accounts receivable will be insensitive to moral hazard. However, if the firms share a "common destiny" and have pooled their joint survival on the success of their joint project, then the sensitivity will be high.

In order to discourage firm i from taking private benefit, the present value of cashflows arising from the per period payment p_i received by firm i must be sufficiently large relative to the payment p_{i+1} that it makes to firm $i+1$ so that the payoff from exerting high effort is no lower than the payoff from low effort. Thus, in the steady-state, the incentive compatibility constraint is

$$\frac{1}{\pi^H}\left(p_i - p_{i+1} - w\right) + R_i^H \geq bp_i + \frac{1}{\pi^L}\left(p_i - p_{i+1} - w\right) + R_i^L \tag{3}$$

We can re-write this condition by using the definition of R_i from (2) and the shorthand:

$$\pi \equiv \frac{1}{\frac{1}{\pi_H} - \frac{1}{\pi_L}} \geq 0 \tag{4}$$

so that π is an approximation of the increased probability of obsolescence that comes from one firm deviating to low effort. The incentive compatibility constraint (3) for firm i can be written as

$$p_i \geq \frac{1}{1-\pi b}\left(p_{i+1} + w - \pi R_i\right) \tag{5}$$

This inequality capture *recursive moral hazard* inherent in our model. The moral hazard is recursive in the sense that the payment to firm i must be sufficiently large so as to induce it not to take the private benefit, but the payment to firm i also includes the inefficiency rent that is due to its supplier firm, $i+1$. In turn, the payment p_{i+1} includes inefficiency rents that accrue to suppliers further up the chain. Thus, with each step in the production chain, the moral hazard rents are magnified. The recursive nature of the moral hazard generates inefficiencies akin to the "double marginalization" discussed in the literature on vertically integrated monopolies.

Firm 0 is at the apex of the recursive relationships, and plays the role of the principal in the design of the optimal contract. We solve for the steady state payments $\{p_i\}$. The objective is to maximize the discounted expected profit for firm 0 subject to the incentive constraints of all firms further up the production chain, and subject to the participation constraints of all firms. Conditional on high effort by all firms, the expected profit to firm 0 depends only on the difference $q - p_1$, and hence the optimal contract minimizes p_1.

On the assumption that all firms wish to participate in the production chain, minimizing the hurdle price p_1 implies that the incentive compatiblity constraint binds for all firms. Hence, (5) defines a first-order difference equation for the profile of payments $\{p_i\}$. In the special case where $R_i = R$

for all i, we can write

$$\begin{aligned} p_i &= \frac{1}{1-\pi b}\left(p_{i+1} + w - \pi R\right) \\ &= \frac{w-\pi R}{1-\pi b}\left(1 + \tfrac{1}{1-\pi b} + \left(\tfrac{1}{1-\pi b}\right)^2 + \cdots + \left(\tfrac{1}{1-\pi b}\right)^{N-i}\right) \end{aligned} \tag{6}$$

The production of the final good is feasible only when

$$q \geq p_1 \tag{7}$$

Thus, for the special case when $R_i = R$ for all i, the minimum hurdle price p_1 is given by

$$p_1 = \frac{w-\pi R}{\pi b}\left(\left(\frac{1}{1-\pi b}\right)^N - 1\right) \tag{8}$$

Notice that (8) is a convex function of the length N of the production chain. Thus, even if the value-added of having another stage to the production process is increasing in the length of the chain, there may be a natural limit to the size of the production chain given by moral hazard. Value-added must not only increase as the production chain becomes longer, but it must increase *sufficiently*, so as to overcome the threshold value p_1.

Take a simple example. Suppose that the revenue from the final good sale, q, is an increasing, concave function of the length N of the production chain, capturing the idea that the marginal technological gain from having another layer of production declines with the number of layers, and excessively many layers might even reduce the output. If the final product firm is free to act as the principal in choosing the length of the proudction chain, it will choose N so as to maximize:

$$q(N) - p_1(N) \tag{9}$$

Since the hurdle price p_1 is an increasing convex function of N, the optimal length of the production chain can be approximated by the first order condition

$$q'(N) = p_1'(N) \tag{10}$$

giving us the optimal industrial structure N^*. The important point for us is that industrial structure depends both on technological or logistical concerns, but also the composition of the balance sheets of the firms in the chain. A technological advance, which can be depicted by the upward shift of $q(N)$ curve, would raise the length of the hierarchy. A financial innovation of reducing working capital requirement, expressed by a downward shift of $p_1(N)$ curve, would also lengthen the optimal production chain.

We will return to consider the empirical implications of the hurdle price (8), and the crucial role played by R and π. Before we do so, we depart from the naive single chain arrangement of firms to consider more general relationships among firms as customers and suppliers.

2.3 General Industrial Structure

Let us now consider sub-contracting relationships that are no longer a single chain, but a general ordering with firm 0 at the apex. The relationships are defined in terms of the matrix Σ, whose (i, j)th entry is given by

$$\sigma(i,j) = \begin{cases} 1 & \text{if } j \text{ is a subcontractor of } i \\ 0 & \text{otherwise} \end{cases}$$

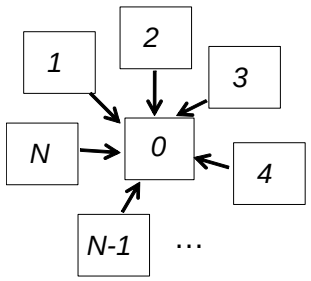
We continue to label the firms with the set $\{0, 1, 2, \cdots, N\}$ and impose the condition that if j is a subcontractor for i, then $i < j$. Hence, the matrix Σ is upper triangular. Since no firm is a subcontractor to itself, the diagonal entries of Σ are zero.

By using the matrix Σ we can express a variety of subcontracting relationships among firms. The single chain we have examined already is the

special case where

$$\Sigma = \begin{bmatrix} 0 & 1 & & \\ & 0 & \ddots & \\ & & \ddots & 1 \\ & & & 0 \end{bmatrix}$$

and all other entries are zero. At the other extreme, we can have the completely "flat" structure where firm 0 is at the center of a circular structure in which all other firms are subcontractors to firm 0.



The Σ matrix corresponding to this type of relationship is given by

$$\Sigma = \begin{bmatrix} 0 & 1 & \cdots & 1 \\ & 0 & & \\ & & \ddots & \\ & & & 0 \end{bmatrix}$$

and all other entries zero.

More generally, denote by $S(i)$ the set of immediate sub-contractors of i. The steady-state incentive compatibility constraint for firm i is a generalized version of (3), and can be written as

$$\frac{1}{\pi}\left(p_i - \sum_{j \in S(i)} p_j - w\right) + \pi R_i \geq b p_i \tag{11}$$

Hence,

$$(1 - \pi b)\, p_i \geq \sum_{j \in S(i)} p_j + w - \pi R_i \tag{12}$$

We arrange the differences $w - \pi R_i$ in column vector form, and denote it as z. Thus, in matrix form, (12) can be written as

$$(1-\pi b)\overbrace{\begin{bmatrix} p_1 \\ \vdots \\ p_N \end{bmatrix}}^{p} \geq \begin{bmatrix} \quad \Sigma \quad \end{bmatrix} \begin{bmatrix} p_1 \\ \vdots \\ p_N \end{bmatrix} + \overbrace{\begin{bmatrix} w - \pi R_1 \\ \vdots \\ w - \pi R_N \end{bmatrix}}^{z}$$

More concisely,

$$\left((1-\pi b)\, I - \Sigma\right) p \geq z \tag{13}$$

Since Σ is upper-triangular, the matrix $\left((1-\pi b)\, I - \Sigma\right)$ is also upper-triangular, with positive diagonal entries. Hence, it is non-singular. Thus, from (13),

$$\begin{aligned} p &\geq \tfrac{1}{1-\pi b}\left(I - \tfrac{1}{1-\pi b}\Sigma\right)^{-1} z \\ &= \tfrac{1}{1-\pi b}\left(I + \tfrac{1}{1-\pi b}\Sigma + \left(\tfrac{1}{1-\pi b}\right)^2 \Sigma^2 + \cdots\right) z \end{aligned} \tag{14}$$

Here, Σ^k is the matrix whose (i,j)th entry is 1 if and only if there is a path from firm i to firm j following the subcontracting relationship of length exactly k. Since Σ is upper triangular with zeros along the diagonal, there is some n such that $\Sigma^k = 0$ if $k > n$, but $\Sigma^n \neq 0$. The number n has the interpretation of the longest subcontracting chain among the firms. Thus, the incentive compatibility constraint for the recursive moral hazard problem can be written as

$$p \geq \tfrac{1}{1-\pi b}\left(I + \tfrac{1}{1-\pi b}\Sigma + \cdots + \left(\tfrac{1}{1-\pi b}\right)^n \Sigma^n\right) z \tag{15}$$

The recursive nature of moral hazard comes out clearly from (15), and the main lessons from the single chain industrial structure carry over to more general industrial structures. The inefficiency associated with moral hazard is magnified when the production hierarchy has many layers. The powered

matrix Σ^k represents chains in the industrial structure of length exactly k, and each such chain is associated with a recursive monopoly rent given by the factor $\left(\frac{1}{1-\pi b}\right)^k$. Hence, taller production hierarchies are associated with larger moral hazard rents, and hence are more demanding to sustain.

In order to organize the discussion more systematically, let us introduce some terminology to talk about how "flat" or "tall" a production hierarchy is. Attach a label to each firm in the production chain according to the distance between that firm and the final product firm (firm 0), where distance is measured in terms of the length of the shortest path from firm 0 along the production chain. Formally, say that firm i has distance d to the final product firm if the jth entry of the top row of Σ^d is 1, but the jth entry of the top row of $\Sigma^{d'}$ is zero for every $d' < d$.

A summary measure of the "height" of any given production hierarchy can be obtained from the distribution $(f_1, f_2, \cdots, f_n)$, where f_k is the proportion of the firms that have distance k to the final product firm. In comparing two production hierarchies with associated height distributions f and f', let us say that the hierarchy associated with f is *flatter* than the hierarchy associated with f' if f' dominates f in the sense of first-degree stochastic dominance. In other words, when

$$\sum_{j=1}^{k} f_k \geq \sum_{j=1}^{k} f'_k \tag{16}$$

for every k. Then (15) implies that moral hazard rents are lower for flatter hierarchies. Hence, incentive considerations favor flatter hierarchies, other things being equal. The fact that we observe a diversity of production hierachies across industries, and across countries within the same industry suggests that other things are not equal. In particular, there are two ways in which others things may not be equal.

- The revenue of the final product may be much higher when produc-

tion is organized as a many-layered hierarchy of firms, than when it is organized as a flat hierarchy.

- The forcing vector z is small enough so that moral hazard rents are small. Hence, the hurdle prices $\{p_i\}_{i \in S(0)}$ of the firms that are the immediate sub-contractors of firm 0 are low enough so that production is feasible for the final goods producer.

The first bullet point is primarily a technological or logistical matter that has to do with the *desirability* of having a multi-layered hierarchy of firms in the production relationship. If a multi-layered industrial structure leads to large gains in the value-added of the final product - due to the greater "roundaboutness" of production, then it would be desirable to organize production in such a way.

The second bullet point concerns the *feasibility* of having a multi-layered production hierarchy, irrespective of its desirability from a technological point of view. Even if the multi-layered hierarchy would result in greater potential revenues, the recursive moral hazard rents may be too large, and may exceed the potential gains in revenue. The fact that we observe different industrial structures in the *same* industry across different countries suggests that concerns about technology may not be the only determinant of industrial structure. We must also look to the feasibility of achieving a particular industrial structure arising from corporate finance considerations.

2.4 Empirical Implications

Our results have potential to address several empirical issues. First, we can address the degree to which multi-layered production hierarchies differs across countries and across industries, and the potential reasons for such differences. The "Toyota model" of production that involves many layers of

subcontracting relationships suggests something both about the technological nature of automobile manufacture, but also about the financial strength and degree of diversification of the subcontracting firms in Japan. To the extent that different degrees of production hierarchies are observed across countries in the *same* industry, this suggests that the observed differences may be attributable to the differences in the balance sheet composition of the subcontracting firms, and hence on the forcing vector z.

Our model suggests that the forcing vector z in (15) is small when two conditions are met.

- subcontracting firms have large accounts receivable relative to total assets,
- subcontracting firms do not diversify by supplying many different customer firms.

The desirable incentive properties associated with the absence of diversification arises from the fact that the accounts receivable of a subcontracting firm falls in value when held by someone outside the production process. The sensitivity of the fall in value to the effort decision of the subcontracting firm results in the mitigation of the moral hazard. If a firm exerts low effort and takes private benefit, the cashflow generated within the production chain will diminish. It is as if each subcontracting firm is a stake-holder in the project that results in the sale of the final good. Hence, the incentives to indulge in private benefit is mitigated. The mitigation is largest when the effective stakes held by the subcontracting firms are largest. Since the accounts receivable are assets that are ultimately backed by the success of the project as a whole, large accounts receivable have desirable incentive effects. In this respect we can see this implication in the same light as the

conclusions of simpler corporate finance models for a single firm where moral hazard necessitates the entrepreneur holding a sufficiently large stake in the value of the firm.

The Japanese *keiretsu* industrial structure (more specifically, the *vertical keiretsu*) where affiliated firms interact closely with one another could be seen as one possible device for achieving the *lack* of diversification that results in greater sensitivities of accounts receivable to moral hazard. The greater fragility that results from lack of diversification is compensated for by the greater value that is produced through higher effort. This idea of the improved incentives due to greater fragility is reminiscent of the literature on the role of the fragility generated by the demand deposit contract for banks in disciplining the bank's managers (Diamond and Rajan (2000)). Figure 2 is an illustration of the well-known fact that Japanese firms tend to have larger current assets as a proportion of fixed assets. Our model suggests that such a feature of corporate balance sheets should be considered together with the depth and strength of the SME sector in Japan.

Our perspective is also useful in thinking about relative size of cash holdings. Rajan and Zingales (1995, p. 1428) note that the average accounts payable of Japanese firms is 16.4% of the value of total assets, while at the same time the average cash holding is 18.4%[9]. In other words, Japanese firms could (if they chose) pay off their accounts payable with their cash holdings. Our model suggests that even if firms can pay off their accounts payable, there are desirable incentive properties of large, inter-locking balance sheets.

[9]The cash holding of U.S. firms have also increased in recent years. Bates, Kable and Stulz (2006) note that U.S. firms could also repay their accounts payable with cash holdings. Our model suggests one reason why accounts payables may persist even with large cash holdings.

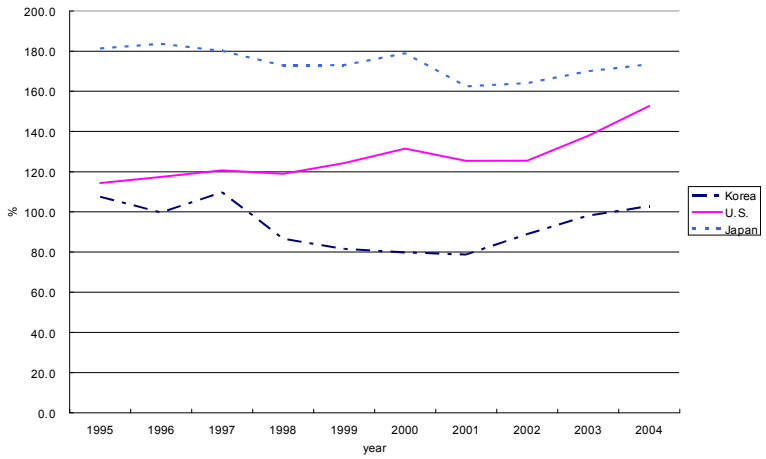


Figure 2: Ratio of Current Assets to Fixed Assets (in %) for Manufacturing Firms in Japan, United States and Korea

Another aspect of the importance of holding accounts receivable is that firms face limits on the extent to which they can free up working capital by selling their accounts receivable to factoring firms who discount the unpaid invoices and pays cash. Factoring is common in the United States and is especially prevalent in some European countries. However, one of the puzzles has been why the discount rates offered by the factoring firms has been so high[10]. Also, the availability of factoring is limited to a narrow group of well-known, creditworthy firms. Our framework suggests one possible answer. Factoring transfers assets that are claims on the whole production chain to holders outside the chain. However, holders outside the production hierarchy value these assets less. The greater the difference in value, the less likely is factoring to be observed.

[10]See the study commissioned by the European Union on factoring, available from http://ec.europa.eu/enterprise/entrepreneurship/financing/docs/factoring_en.pdf

The difference between accounts receivable and accounts payable on a firm's balance sheet can be seen as the equity stake of the firm in the production process. Thus, mitigating moral hazard through large accounts receivable necessitates subcontracting firms investing large amounts of resources in building up such an equity stake. In this sense, having a financially sound small and medium sized enterprise(SME) sector can be expected to be most conducive to minimizing the moral hazard inefficiencies in production.

For countries such as Japan and many European countries such as Germany and Italy, the financial strength of the SME sector is reflected in the significant role they play in their respective national economies. However, for developing countries with a weak SME sector, the pre-conditions are much less favorable for mitigating moral hazard through stronger balance sheets. Financial strength of the SME sector cannot be achieved overnight, and their large equity stake is often the result of many years (indeed, decades) of accumulation of profits. Thus, for developing countries, the prescription suggested by the Toyota model may not be appropriate for their circumstances. We will now examine one possible way in which the lack of equity capital may be partially overcome in mitigating moral hazard, and sustaining high value-added production chains.

3 Financing the Triangle of Costs

Our discussion so far has focused on the steady state of the production process, taking it for granted that the firms in the production chain can find enough working capital to finance the initial costs of production (the "triangle" of costs) further up the chain before the cashflow materializes from the sale of the final product. When the subcontracting firms are financially strong, and well capitalized, the initial start-up costs can be borne by firms

within the chain. However, for many developing countries with financially weak small firm sectors, the lack of working capital will be a constraint on setting up multi-layered production hierarchies, even if such a production hierarchy has positive net present value in steady state.

Nor can outside financial sources easily fill the gap. The possibility of outside funding will be severely limited by the limited collateral value of accounts receivable, as already discussed. For many developing countries, contractual incompleteness entailed by financial underdevelopment will exacerbate the barrier to outside funding.

3.1 Transferable Promissory Notes

Korea's experience suggests that financial innovation may contribute toward overcoming the hurdles against outside funding of long production chains. In Korea, *transferable promissory notes* have played a prominent role in corporate finance. Transferable promissory notes are short-term corporate liabilities that have the legal provisions of endorsement, transferability, and the possibility of discount[11]. They are similar to bills of exchange in terms of their legal provisions, but differ from them in that promissory notes are *promises to pay*, rather than an *order to pay* that has been formally accepted by a bank. This legal difference, although seemingly minor, turns out to be important when considering the incentive effects within the production chain.

In essence, transferable promissory notes act as a device in which a creditworthy firm can make its creditworthiness available to other firms in the production chain. The mechanics of the funding arrangement involving

[11] The text (in Korean only) of the relevant laws on promissory notes can be found at http://lawpia.com/html7/bill.htm. We are not aware of any English text of the laws, but we welcome suggestions from readers for possible sources.

promissory notes is best explained through a concrete example.

Consider a simplified version of the linear production chain that has three firms - firms $0, 1$ and 2. Suppose that only firm 0 has sufficient collateral assets to be creditworthy. Firms 1 and 2 cannot borrow from outside sources, and neither do they have enough equity to finance an expansion in production. For the sake of argument, suppose firms 1 and 2 have zero equity to draw on. Each firm must incur wage cost of $w > 0$, and each step in the production chain takes one time period. The final product can be sold for $q > 3w$, so that there is positive surplus in the project in steady state. Suppose for simplicity that the surplus is shared equally among the firms so that the steady-state payment received by all three firms is $p = q/3 > w$.

How can the three firms find a way to overcome the lack of equity capital to expand production? Transferable promissory notes issued by firm 0 is one way to achieve this. The table below illustrates the cashflows.

		Firms			
		0	1	2	Bank
date	t			$p - w$	$-p$
	$t+1$		$p - w$		$-p$
	$t+2$	$-w$			
	$t+3$	$3p - 2p$			$2p$
working capital		$w + 2p$	0	0	

Mechanics of Transferable Promissory Notes

At date $t - 1$ (before any costs are incurred), firm 0 secures a credit line at its main clearing bank for the amount $2p$. Then, firm 0 issues transferable promissory notes with face value $2p$, and pays firm 1 this amount in return for the promise to deliver the intermediate output. Firm 1, in turn, pays

face value p of the promissory notes to firm 2, in return for the promise of firm 2 to supply its intermediate good to firm 1.

At date t, firm 2 discounts the promissory note. The discount can take place at any bank, but let us suppose that the discount takes place at the main transactions bank that has supplied the credit line to firm 0. Neglecting credit risk for the moment, and assuming that the risk free interest rate is zero, suppose firm 2 obtains cash of p from the discounting bank. With this cash, firm 2 pays its wage bill of w, and produces its intermediate good.

At the beginning of date $t+1$, firm 2 delivers its intermediate good to firm 1, who then discounts its holding of promissory notes at the bank, obtaining cash of p. This cash is used to pay its wage bill of w, and firm 1 is able to produce its intermediate good. This intermediate good is delivered to firm 0 at the beginning of date $t+2$.

At date $t+2$, firm 0 incurs cost of w to produce the final good. This final good yields revenue of $3p$ at date $t+3$. At this date, firm 0 redeems the promissory notes discounted by firms 1 and 2, and repays the bank the amount $2p$.

The example above is extreme in that the two subcontracting firms have no resources to pay for the initial set-up costs of the production chain. In practice, subcontracting firms will have some equity capital of its own that it can use to meet the initial costs. Indeed, much of the criticism of the promissory note system in Korea has centered on the fact that promissory notes have been used as a way to defer the payment of cash to the supplier firms. However, the noteworthy feature of the arrangement using transferrable promissory notes is that the two subcontracting firms can (in principle) economize considerably on their working capital. By being able to obtain cash by relying on the creditworthiness of firm 0 that has issued the

promissory notes, the subcontracting firms can overcome the initial hurdle of finding resources to start the production chain.

The flip-side of the coin is the necessity of the credit line obtained by firm 0. The buren of obtaining working capital for the whole production process is borne by firm 0. However, firm 0 may be better placed to obtain credit if it has large fixed asset holdings that may serve as suitable collateral. In effect, the whole funding arrangement relies on firm 0 making its creditworthiness available to its subcontactors through the institution of promissory notes.

3.2 Moral Hazard with Promissory Notes

Given our focus on the role of moral hazard in the production chain, the financing of the "triangle of costs" does not address the central question of the incentive properties in the production chain, when the subcontracting firms do not hold a large stake in the outcome of the project by having large accounts receivable. To restate the question, consider the incentive compatibility constraint (3), which was

$$\frac{1}{\pi^H}\left(p_i - p_{i+1} - w\right) + R_i^H \geq bp_i + \frac{1}{\pi^L}\left(p_i - p_{i+1} - w\right) + R_i^L \qquad (17)$$

When sub-contracting firms are poorly capitalized, they cannot build up the large holdings of accounts receivable that makes both R_i^H and the ratio R_i^H/R_i^L large. How, then, can the incentive constraint be satisfied? Transferable promissory notes have features that mitigate the constraint.

First, their *illiquidity* distinguishes them from cash, where their illiquidity is manifested in the limited amounts of discount offered by the banks, coupled with steep discount rates for unusually large transactions. Both effects operate through the moral hazard coefficient b in (17), pushing down its value and hence mitigating the incentive constraint. Because discounting

of notes is discretionary (legally, the obligations apply to the issuer only at maturity) banks apply strict criteria for the amount of discounting that they will allow per period, and can refuse to discount unusually large sums. The clearing system for promissory notes means that information is shared among banks. Notes can be discounted by private money lenders in the grey market (on which more below), but there are severe adverse selection discounts for such transactions.

Second, there is the institution of *endorsement*, formalized in the laws governing promissory notes. Before the note can be transferred to another firm, it must be endorsed by the transferring firm. By endorsing the note, the transferring firm guarantees to take on the obligation of redeeming the note in case the original issuer defaults. When the issuer of the note defaults, *all* of the endorsing firms become liable at the same time, and the holder of the note can demand payment from any of the endorsers. The order in which the note was endorsed has no bearing on the sequence in which firms are liable.

The economic rationale for the making the endorsers jointly liable is clear. By imposing joint liability, the endorser cannot refuse payment by citing some other firm as being "more liable" for the payment of the note, and exploiting the uncertainties surrounding the true ability to pay of those further up the liability chain. Thus, the claim embodied in promissory notes become less informationally sensitive. The institution of endorsement is essentially identical to those governing the circulation and settlement of bills of exchange in Europe and the United States. Although bills of exchange are not widely used today in countries with developed financial systems, they had an important role in the development of the financial system in the past.[12]

[12] See Schnabel and Shin (2004) for a discussion of the legal underpinnings of bills of exchange in Europe in the 18th century.

The institution of endorsement achieves through legal liability the same element of "common destiny" that was achieved by holding large values of accounts receivable. For firms that are poorly capitalized, achieving large balance sheets is not feasible due to the lack of equity capital they can invest in the production chain. Nevertheless, by endorsing and passing on the promissory notes of downstream firms in the production chain, each firm becomes a stakeholder in the success of the production chain itself. In terms of the condition (17) above, whereas R_i^H is small, the ratio R_i^H/R_i^L can be kept high. In short, whereas accounts receivable are small, its sensitivity to effort can be kept high.

There is one additional effect. The sensitivity of accounts receivable to effort is enhanced due to the fact that all subcontracting firms end up holding claims directly on the final product firm, rather than indirectly through the balance sheets of the firms along the production chain. When a claim is held directly on the final product firm, the impact of success or failure of the product affects the interests of all firms along the production chain through the value of the accounts receivable. However, without promissory notes, there is a cushion of equity at each firm along the chain that serves to dampen the impact of moral hazard on the value of the accounts receivable.

To summarize, promissory notes have three crucial advantages over cash transactions that reduces the moral hazard rents, and hence makes production chains feasible.

- Monitoring and restricting the amounts of discount provides a partial check against moral hazard.

- The institution of endorsement binds the firms into their "common destiny".

- By holding accounts receivable directly in the obligations of the final goods producer, payoffs are more sensitive to effort.

However, common destiny also has its dark side, as seen during the financial crisis of 1997. When the financial health of the issuing firm deteriorates, all the holders of notes in the chain suffer together. The greater fragility that sharpens incentives also creates the potential for common shocks that cause widespread distress.

3.3 The Case of Korea

Promissory notes have been used in Korea for hundreds of years, but their heyday was during the recent decades of the country's high growth, but before the crisis of 1997. During the 1990s, the total amount of promissory notes settled varied between 7 and 10 times GDP before falling sharply after 1999, as shown in the chart in the introduction. Promissory notes have been an important (indeed primary) means of payments between firms in Korea. According to a survey of small and medium sized firms in Korea, promissory notes accounted for almost 60% of all payments made to Korean SME firms until the crisis of 1997 (see table below).

Share of total payments received by SMEs (%)			
Year	Cash*	Prom. Notes	Trade Credit**
1992	34.0	59.2	6.8
1993	29.4	56.2	14.4
1994	28.2	56.6	15.2
1995	30.3	57.5	12.2
1996	29.4	55.7	14.9
1997	28.2	59.5	12.3
1998	32.0	53.6	14.4
1999	34.4	49.8	15.8
2000	38.9	43.1	18.0

Source: Korea Federation of Small and Medium Business, Survey of Small and Medium Firms, (1992 - 2000)

* Cash refers to cash and checks received within 30 days of sales of goods.

** Trade credit refers to cash and checks received after 30 days of sales of goods.

Another notable feature of the use of promissory notes in Korea is the small proportion of notes that are held to maturity. One implication of our theory is the high velocity of the notes as measured by the number of times the notes are transferred before redemption. One crude measure of velocity is the proportion that are either transferred or discounted. According to a survey in 1998, only 26 percent of promissory notes were held by the original promisees until its maturity. 17 percent were handed over to other firms, and 57 percent were sold at discount to financial institutions or private money lenders.

Use of Promissory Notes in 1998 (in %)		
Hold to maturity	Transfer as means of payment	Discount for cash
25.6	17.0	57.4

Source: Korea Federation of Small and Medium Business, Survey of Small and Medium Firms' Financial Standing 1998.

Promissory notes are discounted primarily by banks, accounting for close to 90% of all notes discounted in 1998. However, other non-bank financial institutions or lenders in the unregulated private curb markets are also potential discounters of the notes. In 1998, non-bank financial institutions discounted 3.8% of the total discount amount, and the private curb market accounted for 5%. Although we do not have a detailed breakdown of the discount rates across different types of financial entities, aggregate discount

rates for the period 1995 to 1999 suggest that overall discount rates high (see table below).

Distribution of annualized discount rates (% of total)								
	$< 12\%$	12− 18%	18− 24%	24− 30%	30− 36%	36− 42%	$> 42\%$	average annualized discount rate (%)
1995	4.0	13.1	46.6	30.3	5.5	0.5	0	24.3
1996	0.4	17.5	42.5	32.8	6.1	0.3	0.4	25.3
1997	5.1	3.5	16.4	26.4	25.8	7.9	14.9	34.5
1998	10.7	26.7	18.0	20.9	21.1	1.4	1.2	24.5
1999	20.9	3.7	33.0	24.0	17.6	0.8	0	23.3

Source: Kookmin Bank, Survey of SMEs' Financial Standing, 1995 -1999.

Annualized discount rates are high, with the median being in the range of 18 - 30%. The crisis year of 1997 stands out particularly starkly. Such high discount rates are consistent with the illiquidity of promissory notes, already alluded to. The high discount rate discourages discounting of notes in favor of passing the notes within the production chain. However, the discount rate must not be too high, since firms must be able to obtain cash when all other sources of funds have been exhausted. The market discount rate reflects the delicate equilibrium arising from the adverse selection discount. If the discount rate is too low, notes play the same role as cash, and the incentive effect is lost. If the discount rate is too high, they lose their effectiveness in channeling funds to working capital-constrained firms.

Before the 1997 Asian financial crisis, the leverage ratio of Korean *Chaebol* firms was very high, with the debt to equity ratio being in excess of 300%. One of the policy prescriptions that was adopted after 1997 crisis was that Korean firms should reduce their leverage ratios. Also, having identified promissory notes as one the main culprits in the propagation of the crisis, official policy was directed toward curbing their use.

However, such policy recommendations may neglect the particular role played by the promissory note system in providing working capital to subcontracting firms. By putting an arbitrary upper bound on corporate leverage ratios, the constraint will bind on the working capital requirements of the subcontracting firms, who may have difficulty in playing their respective parts in the production process. Projects that have positive net present value may not be undertaken due to the constraint on working capital. The fact that many small and medium sized enterprises in Korea still complain of being credit-constrained in spite of a strongly capitalized banking sector suggests that the limits placed on the availability of credit to small firms is still binding.

3.4 Comparative Industrial Structure

One of the key lessons of our approach is to point to the interactions between the corporate financial decisions and the industrial structure of the production process.

A more direct way to overcome the lack of working capital suffered by subcontracting firms would be through vertical integration of the production process, in which the intermediate inputs are produced in-house by the producer of the final good. In this way, financial considerations may play a central role in determining the concentration and degree of vertical interation of a particular industry.

One symptom of the greater vertical integration of the production process would be the small current asset/fixed assets ratio in aggregate corporate balance sheets, since *inter-firm* transactions would become *intra-firm* transactions after vertical integration.

In an economy where the SME sector is well capitalized, and financially

sound, our model predicts that there are beneficial incentive effects of the SMEs supporting large balance sheets themselves. As well as Japan, some of the European countries (notably Germany and Italy) are examples where the SME sector is large, and influential. In contrast, the U.S. is known to be more vertically integrated than Japan or some of the European countries. In this context, Korea may be an even more glaring example of an economy that has extensive vertical integration. Of the forces that drive the push toward greater vertical integration, the incentive to overcome the shortage of working capital may be one of them.

4 Concluding Remarks

Our paper represents only a small step in the study of the interactions between industrial structure and corporate finance. The next steps are to use the insights we can gain in order to address the the diversity seen in cross-country studies of corporate balance sheets. These studies (such as Rajan and Zingales (1995)) raise important questions on the reasons for such diversity. No doubt, the reasons for the diversity will have sources that are outside the realms of traditional corporate finance. However, in broad terms, the main explanatory factors will be underlying differences in the industrial structure of the different countries, as well as the differing ways in which those economies have adapted to overcome any financing difficulties that arise. From our theory, we may expect certain empirical features to go together.

- High leverage ratios, lower accounts receivable and greater levels of vertical integration may be expected to occur together. Korea would be a prime example of such a case.

- Also, economies that have more "round-about" products that involve many stages of production would be more vulnerable to the shortage of working capital, and hence would give rise to the economic forces that push the economy toward greater vertical differentiation.

- A financially strong SME sector and high levels of accounts receivable and low vertical integration would be expected to occur together. Japan and Germany would be examples.

One very interesting comparison is between Korea and Taiwan. In both cases, the degree of round-aboutness of the manufacturing sector are similar. However, the SME sector in Taiwan is well-known to be much more robust as compared to the sector in Korea. One typical response to this observation is to view the weakness of the SME sector as the *consequence* of the dominance of the *Chaebol* in Korea.

However, our approach also suggests that the inference could be reversed. The weakness of the SME sector also exerts a strong economic force that favors the greater vertical integration and greater use of promissory notes in the manufacturing stage. In other words, the weakness of the SME sector in Korea may be a contributory cause of the persistent dominance of *Chaebol* firms in Korea.

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